SEVENTH FRAMEWORK PROGRAMME
THEME 6
Environment (including Climate Change)

Grant agreement for: Small or medium-scale focused research project

Annex I - "Description of Work"

Project acronym: CITYZEN
Project full title: megaCITY - Zoom for the ENvironment

Grant agreement no.: 212095

Date of preparation of Annex I (latest version): 13 August 2008
Date of approval of Annex I by Commission: *(to be completed by Commission)*

List of Beneficiaries

Beneficiary Number	Beneficiary name	Beneficiary short name	Country	Date enter project	Date exit project
1 (coord)	Meteorologisk institutt	metno	Norway	month 1	month 36
2	Peking University	PKU	China	month 1	month 36
3	Centre National de la Recherche Scientifique	CNRS	France	month 1	month 36
4	Institut National de l'Environnement Industriel et des Risques	INERIS	France	month 1	month 36
5	Universität Bremen	IUP-UB	Germany	month 1	month 36
6	Rhenish Institute for Environmental Research at the University of Cologne	FRIUUK	Germany	month 1	month 36
7	Forschungszentrum Jülich GmbH	FZJ	Germany	month 1	month 36
8	University of Crete	ECPL	Greece	month 1	month 36
9	Consiglio Nazionale Delle Ricerche	CNR	Italy	month 1	month 36
10	Norsk Institutt for Luftforskning	NILU	Norway	month 1	month 36
11	Universitetet i Oslo	UiO	Norway	month 1	month 36
12	Institute of Marine Sciences-Middle East Technical University	METU	Turkey	month 1	month 36
13	University of Leicester	ULeic	United Kingdom	month 1	month 36
14	International Institute for Applied Systems Analysis	IIASA	Austria	month 1	month 36
15	National Observatory of Athens	NOA	Greece	month 1	month 36
16	Cairo University Center for Environmental Hazard Mitigation	CEHM	Egypt	month 1	month 36

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PART A

A 1 Overall budget breakdown for the project

Participant number in this project	Participant short name	Estimated eligible costs (whole duration of the project)					Total receipts	Requested EC
		RTD / Innovation contribution (A)	Demon-stration (B)	Manage-ment (C)	Other (D)	Total (A+B+C+D)		
1	metno	446 667	0	0	0	516 667	0	400 000
2	PKU	244 400	0	0	0	244 400	0	120 000
3	CNRS	233 333	0	0	0	233 333	0	175 000
4	INERIS	333 333	0	0	0	333 333	0	250 000
5	IUP-UB	466 667	0	0	0	466 667	0	350 000
6	FRIUUK	200 000	0	0	0	200 000	0	150 000
7	FZJ	400 000	0	0	0	400 000	0	300 000
8	ECPL-UoC	266 667	0	0	0	266 667	0	200 000
9	CNR	300 000	0	0	0	300 000	0	225 000
10	NILU	138 205	0	0	0	138 205	0	100 000
11	UiO	200 000	0	0	0	200 000	0	150 000
12	METU	160 000	0	0	0	160 000	0	120 000
13	ULEIC	233 334	0	0	0	233 334	0	175 000
14	IIASA	133 333	0	0	0	133 333	0	100 000
15	NOA	100 000	0	0	0	100 000	0	75 000
16	CEHM	33 333	0	0	0	33 333	0	25 000
Total		**3 909 272**	**0**	**0**	**0**	**3 959 272**	**0**	**2 915 000**

A 2 Project summary

We will determine the air pollution distribution and change in and around hotspots over the last decade from extensive satellite and in-situ observations and we will employ a series of different scale models in order to analyze the impacts of air pollution hot spots on regional and global air quality including potential future changes for various climate scenarios. Focus is on ozone and particulate matter with chemical and physical characterization, and their precursors. The Eastern Mediterranean (Istanbul, Athens, Cairo), the Po Valley, the BeNeLux region, the Pearl River Delta in China (with megacities Guangzhou and Hong Kong) and the hot and polluted European summer 2003 are chosen for intensive case studies. The consortium includes groups from China, Turkey, Greece and Italy, in addition to France, Germany, UK and Norway, with experts on the observations, emission data and models. A set of chemical transport models which connect all the most important spatial and temporal scales will be developed and used to quantify how the observed air pollution arises. The models and emission inventories will be evaluated, errors identified and improved on the urban, regional and global spatial scales. Climate change may cause changes in air pollution in and around hotspots, and hotspot pollution can change precipitation and temperature/albedo. These feedbacks will be studied in scale-bridging model systems based on global climate model scenarios, and in a coupled high resolution chemistry-climate model. The model systems evaluated in the project will be applied to analyse mitigation options in and around hotpots, also taking into account climate change. Best available technologies and sectoral changes will be studied. Several partners have key roles in the technical underpinning of policy. They will ensure that the improved emission inventories, scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact.

A 3 List of beneficiaries

Beneficiary no.	Beneficiary name	Country
1 (Coordinator)	Meteorologisk institutt	Norway
2	Peking University	China
3	Centre National de la Recherche Scientifique	France
4	Institut National de l'Environnement Industriel et des Risques	France
5	Universität Bremen	Germany
6	Rhenish Institute for Environmental Research at the University of Cologne	Germany
7	Forschungszentrum Jülich GmbH	Germany
8	University of Crete	Greece
9	Consiglio Nazionale Delle Ricerche	Italy
10	Norsk Institutt for Luftforskning	Norway
11	Universitetet i Oslo	Norway
12	Institute of Marine Sciences-Middle East Technical University	Turkey
13	University of Leicester	United Kingdom
14	International Institute for Applied Systems Analysis	Austria
15	National Observatory of Athens	Greece
16	Cairo University Center for Environmental Hazard Mitigation	Egypt

PART B

B 1 Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B 1.1 Concept and project objective(s)

B 1.1.1 Science and technology objectives for the project

The global urban population has risen from about 3% of the world's total population in the year 1800 (Brunn and Williams, 1983) to about 47% by 2000 (UN, 2004). In 2007, for the first time in history, more than half of the world's population will be living in cities, and the trend is expected to continue (according to United Nations Population Fund UNFPA). As a consequence megacities and regional hot spots have developed with anthropogenic emissions and changes in land usage that are likely to have large environmental implications both in the regional hot spots themselves and on a larger scale. The pattern in emissions is likely to change with urbanization as a result of changes in lifestyle and economic growth. Rapid economic growth in megacities is often not followed by an equally rapid growth in infrastructure such as road construction or public transportation systems, leading to inefficient traffic flow and enhanced air pollution. For instance, Gurjar and Lelieveld (2005) point out that the per capita CO emissions in megacities tend to be higher than in densely populated countries.

The increasing emissions from the emerging and evolving megacities as well as changes in the emission patterns increase the severity of several environmental problems, in particular in relation to air pollution, climate change, water and soil resources. It has become urgent to deal with this broad problem in a policy context as they affect a large part of the population.

The main objectives of the proposal are:

- Quantify and understand current air pollution distribution and development in and around selected megacities/hot spot regions, including the interaction across the different spatial scales
- Estimate the future impact from emission changes with a focus on the effect of rapid growth in the population of megacities/hot spots and the increasing background of pollutants (concentrate on ozone O_3, particulate matter PM, and their precursors)
- Estimate how megacities/hot spots influence climate change
- Estimate how megacities are responding to climate forcing which can influence transport patterns, chemical oxidation and biogenic emissions (especially biogenic volatile organic compounds BVOC)
- Study mitigation options, e.g. by introducing biofuel, to keep the air pollution load in and around megacities/hot spots within sustainable limits in terms of human health effects and climate impact.
- Develop tools to estimate interactions between different spatial scales (megacities to global)
- Bring the scientific results and methods developed and applied during the course of the project to semi-operational use with those consortium partners that on a more permanent basis provide technical underpinning of policy work, that is, ensure an excellent return on the investment in the project both during and after the project has ended.

Relationship to the topics in the call

This proposal addresses "Impacts of air pollution from megacities and large air-pollution "hotspots" in Europe and elsewhere." We propose "Integrated research on emissions, their local impacts with special emphasis on air quality and associated risks, and their regional to global impacts". We propose to do "Assessment of mitigation options and quantification of impacts from polluted air masses on larger scale atmospheric dynamics (physics, chemistry, hydrological processes, long-range/hemispheric transport etc.) as other important feedbacks between air quality, climate and climate change". We have responded positively to the encouragement to include International Cooperation Partner Countries (China). We expect that the project will fulfil the expectations in the call (see Section 3) with "A better quantification of air quality, mitigation options and availability of more reliable tools for prediction of air quality in cities." Our proposal does not emphasise the demonstration of daily forecast systems of urban air pollution, our focus is on reliable tools for predicting air pollution in cities as a function of changing emissions and climate, in a policy underpinning context. We expect to contribute significantly "to EC Thematic Strategy on Air Pollution and Air Quality regulation. Better quantification on regional and global links between air pollution, climate and climate change necessary to underpin mitigation and other policy initiatives."

B 1.1.2 What are the environmental issues and policy frameworks?

The environmental issues that motivate this proposal are linked to air pollution in megacities/hot spots and their impact on the earth system locally and on larger regional and global scales.

The environmental issues in the project are:

- The reduced air quality and health effects from concentrations of particulate matter (PM), ozone (O_3) and nitrogen dioxide (NO_2)
- Ecosystem damage by emissions of sulphur and nitrogen oxides, ammonia (NH_3) and volatile organic compounds (VOC).
- The transport of the increasing amount of air pollution from megacities to the regional and global scales.
- The influence of air pollution on weather and climate, resulting in changes in precipitation, the hydrological cycle, temperature, sunshine and weather element distribution.
- Possible impact and non-linear feedbacks of climate change on the emissions and air quality in megacities and their surroundings in the future.

Important policy frameworks in the context of the proposal are:

- UNFCC (United Nations Framework Convention on Climate Change) with Intergovernmental Panel on Climate Change (IPCC) and the Kyoto process,
- CLRTAP (Convention on Long Range Transboundary Air Pollution), with its technical underpinning activities in EMEP (European Monitoring and Evaluation Programme) and its Task Forces on Measurements and Modelling (TFMM) and Intercontinental Transport of Air Pollution (TFHTAP),
- BDC (Biodiversity convention),
- MC (Marine Conventions like OSPAR),
- EU Clean Air for Europe thematic strategy for Air Quality, the National Emissions Ceilings Directive; the Framework Directive on Air Quality, through DG Environment and through European Environment Agency and its Topic Centre for Air Quality and Climate Change,
- GMES (Global Environmental Monitoring Strategy),

- GEOSS (Global Earth Observation System of Systems),
- The Chinese Ministry of Science and Technology initiative "Synthesized Techniques for Pollution Complex (Multi Air Pollutants) Prevention in City-Cluster and Integrated Demonstration (STPPC)" to build up the capacity of regional air pollution control and related coordination mechanism.

CITYZEN is designed to contribute to national authorities (ministries of environment and national environmental agencies), intergovernmental structures, the EU and in China (listed above). In Section 3 of the proposal it is outlined in more detail how the project will ensure its impact on the user/policy community.

B 1.1.3 Hypotheses and approach to be taken in the project

In CITYZEN, a number of hypotheses will be tested. These include:
1) Megacities and hot spots have changed the regional and global distribution of ozone, particulate matter, and their precursors including carbon monoxide CO and other pollutants significantly compared to what would be the case with more evenly distributed emissions.
2) Megacities affect the radiative budget and aerosol microphysics such that precipitation and the number of sunlit hours and thus temperature and photochemistry change significantly both locally and over larger regions. This may become more significant in the future as megacities and their emissions grow.
3) Climate change will change weather patterns (winds, temperature, stability, precipitation) and surface properties, which affect air quality in megacities and regional hot spots. If more frequent high pressure situations occur, episodes with reduced air quality will become more frequent.
4) Climate change will induce episodic and permanent changes in the natural and anthropogenic cycles of atmospheric trace chemicals.
5) Changes in frequency and intensity of forest fires and other biomass burning will at times contribute significantly to air pollution in megacities and hot spots.
6) Measures can be defined that reduce the adverse effects of megacity/hot spot emissions. The adverse effects relate both to air quality (human health) and climate change/weather modification.
7) The effect on air quality in some megacities following the replacement of gasoline in parts by biofuel is to reduce the formation of secondary pollutants: aerosols and ozone.

The air pollution distribution and development in and around hotspots over the last decade will be determined from extensive satellite and in-situ observations. Focus is on particulate matter with chemical and physical characterization, ozone and their precursors.
Hotspot is throughout this proposal taken to denote an extended large city (megacity) or even a region which is densely populated and which can have several large cities or even megacities (more than 10 million inhabitants).

We will focus most of the work in this project on four hotspot regions. Although megacities first developed in Europe, they have been studied most intensely outside Europe, in particular in India, the Far East, and the Americas, where populations of megacities have been expanding rapidly in the last century. We focus on emission hot spots of particular interest in and around Europe - the Po Valley in Italy, the Eastern-Mediterranean including Athens, Istanbul and Cairo, and the BeNeLux region including the Ruhr area. We contrast the European situation with the Pearl River Delta in China (with megacities Guangzhou and Hong Kong) as one example for an area with rapid development outside Europe (map in Figure 3). Extensive observational data exists for these megacities/hot spots, which (in combination with analysis of satellite and emission data) can provide necessary information for testing and further development of model tools. The special study hotspots are chosen also to allow the investigation of the air pollution impact of hotspots at different latitudes and exposed to different large scale flow regimes (e.g. the role of deep convection at low latitudes).

In addition, we choose the exceptionally hot, polluted European summer 2003 as a study case. Recent predictions of the future climate in Europe suggest that the weather conditions that prevailed for several weeks may become more frequent in the future. This extraordinary event is selected as a model case for the study of hotspot emissions - climate interactions. It will also serve as a test case for inter-comparing the numerical models involved in this project.

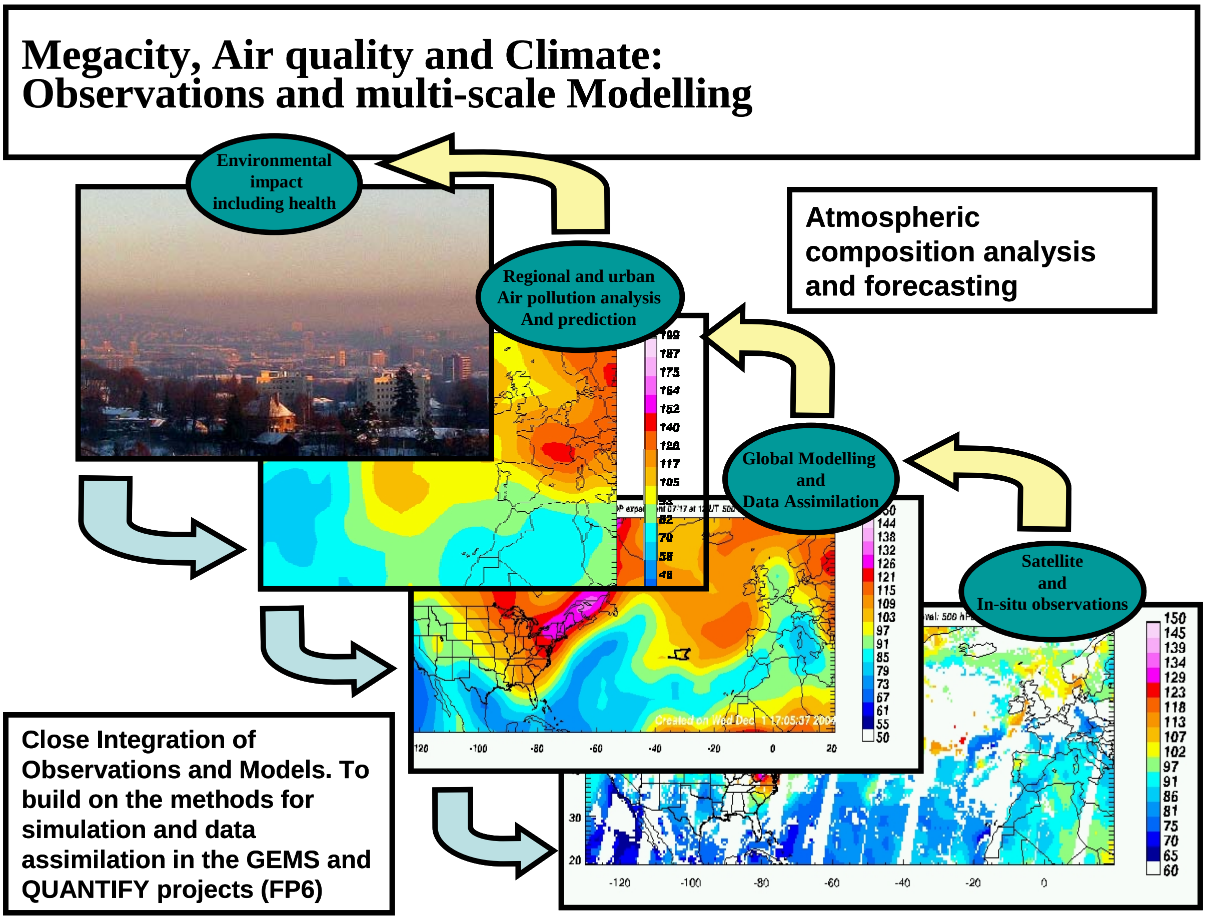

Figure 1: In this project we will develop further and apply model systems that bridge together the processes occurring on the spatial scales spanning from the urban to the global: "An integrated zooming system to analyse air pollution impacts and climate effects from hotspots/megacities." Air pollution flows between megacities/hotspots, the surrounding regions and globally. The analysis and forecasting of air pollution in hotspots require observations and modelling effort that take into account the interactions of transport processes and air pollution loads on this range of spatial scales and cover the range of temporal scales determined by the atmospheric life times of the essential pollutants involved.

An important idea in the project is to use these four hotspot regions to further develop and apply model systems that bridge together the processes occurring on the spatial scales spanning from the urban to the global: "An integrated zooming system to analyse air pollution impacts and climate effects from hotspots/megacities." This concept is illustrated in Figure 1. The integrated system proposed here is a combination of models in different scales, earth observation and in-situ data. The modelling system is an ensemble of models zooming from global to regional and urban scales and capable to link to climate models. The scale bridging capability of this integrated system is necessary to characterise adequately the exchange of pollution from hotspots/megacities and the impact in affected areas/regions. The project will provide a lasting semi-operational structure of nested models and methods applicable for the underpinning of policy development for hotspots/megacities and extending to the regional and global spatial scales.

The consortium includes groups from China, Turkey, Greece, Egypt, and Italy, in addition to France, Germany, United Kingdom, Austria, and Norway, with first-hand experts on the observations, emission data and model experience.

The semi-operational capability of this project is guaranteed by the experience of the participants. Some of the organisations involved in the consortium are actively working in technical working groups supporting the European Commission and the Convention on Long Range Transboundary Air Pollution. For these reasons they have developed their tools (models, observation devices) under quality control procedures (validation, version-handling, user orientation), to ensure operationality and reliability. Several teams are also involved in consortia participating to the elaboration of future GMES atmospheric service. More precisely they currently contribute to the GEMS[1] project (FP6), coordinated by ECMWF, and to the PROMOTE GMES[2] Service element funded by ESA and coordinated by the DLR (German Aerospace Center). Both projects should prefigure the future pre-operational services for chemical atmospheric composition monitoring.

B 1.2 Progress beyond the state of the art

Baseline

Megacities affect air quality and climate through the emission of direct and indirect gaseous pollutants, and through particles that are either emitted directly or formed through chemical processes within the megacity environment and its plume beyond. Greenhouse gases and particles affect climate. Particles also act indirectly through precipitation changes and changes in surface-atmosphere fluxes of sensible and latent heat. At the same time climate change affects air quality in megacities not only through physical and chemical processing (e.g. changes in the hydrological cycle, surface properties, biogenic and anthropogenic emissions, photochemistry in haze conditions), but also through climate-enforced population changes and migration towards expanding cities. The processes involved occur on very different temporal and spatial scales.

The effect of megacities on the global environment and vice versa is not yet well quantified. The main problems are the lack of high resolution emission data and of model systems that feature adequate resolution within the emission hot spots and, at the same time, global coverage to address global effects. Analyses of available observations in the past, while focusing mostly on health effects and changes in atmospheric composition and climate, have not been thoroughly analysed with regard to megacities as modifiers of air quality and climate in a world characterized by increasing urbanization.

[1] Global and regional Earth-system (Atmosphere) Monitoring using Satellite and in-situ data

[2] PROtocol MOniToring for the GMES Service Element : Atmosphere

Although efforts are being made to integrate modellers of different spatial scales (e.g. in the Network of Excellence ACCENT), scale-bridging methods combining local, regional, and global state-of-the art models is today still in there infancy.

The impact of aerosol emissions on local climate is still poorly understood. Outflows of precursors and processes in the plume need to be further investigated as well as the aerosol impact on cloud formation and precipitation.

The combined use of observations, emission data, and models of different scales will enable CityZen to go forward in these special fields of science, focused particularly on megacities and emission hot spots. Through the inclusion of forefront experts in the fields of observations, emission estimates, and modelling, CityZen will start from the current state-of-the-art, exploiting available data and modelling tools.

Recently developed capabilities that will be exploited in CITYZEN include:

1) The scientific inversion of nadir observations that has been demonstrated to result in tropospheric columns and amounts of a number of tropospheric trace species, which allow the study of transport events, emission quantification and source attribution.

2) The simultaneous observation of HCHO and CHO.CHO and the comparison with models recently published, which have extended significantly the ability to measure critical O3 precursors from space (Wittrock et al, 2006). The retrievals of the total column of CO columns have been demonstrated from SCIAMACHY (Buchwitz et al, 2000; Buchwitz and Burrows, 2004; Buchwitz et al, 2004 a/b; Buchwitz et al 2006). Similarly it has been shown that the precision of the measurements of the greenhouse gases, CO2 and CH4, is suitable for studies of large conurbations, and regions (Buchwitz et al 2000, de Beek et al 2004, Buchwitz and Burrows 2004, Buchwitz et al 2005, 2006).

3) Important advancements in satellite remote sensing these last years that have opened up challenging perspectives in tropospheric chemistry and air quality monitoring (Borrell et al., 2003, Clerbaux et al., 2004). The operation of nadir-viewing space-borne passive remote sensors using either the absorption, refraction or reflection properties of the atmosphere to probe the lower layers has provided satellite-derived global views of trace gases (GOME, IMG, MOPITT, SCIAMACHY) and aerosols (TOMS, POLDER, MODIS), on a long-term basis.

4) Improved model capacities for simulating complex atmospheric chemistry processes, especially in the field of aerosol chemistry. Recent developments allow to simulate particulate matter mass concentrations in an acceptable way, though uncertainties are still high when considering some particulate compounds (organic and natural species for instance).

5) Improved coupling of observation and modelling, especially through implementation of data assimilation for chemistry applications. Atmospheric models are now used to interpret the dynamical and chemical processes that are revealed by satellite monitoring, to estimate the source emissions of pollutants, and to provide chemical forecasts.

Advances beyond state-of-the-art

The contribution of the changing emissions from large agglomerations to air quality, atmospheric nutrient deposition and climate in the area and the impact of climate change to the emissions from these pollution hot spots and their consequences will be described and quantified within CITYZEN beyond what has been done previously.

Advances beyond the state of the art will be made within this project on the following scientific topics and methods:

- Pollution export and chemical reactivity of hot spot outflow
- Composition and chemical fate of aerosols originating from hot spot regions
- Feedbacks between climate change and air quality in and around hot spots in Europe and China
- Combined use of satellite and in-situ observations for characterizing and assessing air pollution in and around megacities
- Coupling of models focusing on different scales, nesting techniques
- Integration of observations and models on different scales
- Contribution to semi-operational services which endeavour to monitor the chemical and physical state of the Earth's atmosphere

CITYZEN is innovative in applying models of different scales to the same experiments and in combining them through nesting techniques and common analyses routines. The model output will be evaluated by comparison to the large amount of measurement data that is available or being retrieved within the consortium.

In the following the state of the art and the expected advance beyond is summarised for the main topics of the proposal.

Air pollution development during the last decade in the four hotspot regions chosen for special studies (Eastern-Mediterranean, BeNeLux/Ruhr, Po-Valley, and Pearl River Delta):

1) The detailed analysis of satellite and in-situ observations together with model results, will quantify air pollution in and around megacities and detect trends for the last 10 years. This has not been done before with such a large data set. (*Task 1.1*)

2) The combined effort of models focusing on different scales and the development and use of a new scale-bridging model system will allow for a more accurate description and quantification of outflow than with specialized global/regional/urban models. The modelling chain will allow to downscale from the global to the urban scale through appropriate boundary conditions feeding the highest resolution scales. Conversely, the project will give the opportunity to combine the results issued from a set of global and regional models for assessing the impact of hot spot regions on regional and global air quality. Comparisons of the different scale results will bring indicators of the variability and accuracy of the model results. (*Tasks 1.2 and 1.3*)

3) Pollution levels will be quantified in more detail, looking at past trends, through the combined use of observations and models on different scales. (*Tasks 1.1-1.2*)

4) The CITYDELTA project defined for supporting the implementation of the Air Pollution Thematic Strategy of the European Commission also demonstrated the high quality level of current regional and urban scales models and provided ranges of uncertainties thanks to the implementation of an ensemble approach (Cuvelier et al, 2006; Vautard et al, 2006; Thunis et al, 2007). CITYZEN will contribute significantly to the model evaluation work at different scales and the result will be a set of models which are well characterized in terms of accuracy and shortcomings. (*Tasks 1.1 and 1.2*)

5) The ability to measure the aerosol optical thickness over land and in particular over cities and urban areas has only recently been demonstrated for the first time using the BAER algorithm, and the algorithm has been successfully applied to SeaWiFS, MODIS and MERIS data (von

Hoyningen-Huene et al 2003, 2004, 2006, Lee et al 2004, Kohanovsky et al 2005). CITYZEN will apply the BAER algorithm to provide a climatology of AOT over the selected megacities and urban regions. (*Tasks 1.1, 1.4, 1.7*)

6) Recent studies (Kouvarakis et al., 2001; Krom et al., 2006) have shown the importance of atmospheric nitrogen deposition for the seawater productivity in the oligotrophic East Mediterranean sea. CITYZEN is going to quantify nitrogen deposition in this area. (*Task 1.4*)

7) For South-eastern Europe, this study will provide the first analysis of trends of trace gases tropospheric columns and aerosol optical thicknesses over the large urban agglomerations of the area (Istanbul, Cairo and Athens extended areas) and will assess the combined impacts on the East-Mediterranean environment. Such analyses have not been performed until now for the East-Mediterranean hot spot region, and the fact that simultaneous observations from the three main urban agglomerations will be made available within this project adds to the knowledge about the mechanisms of pollution build-up and exchange. Istanbul, Athens and Cairo form an imaginary triangle in the middle of which a remote, coastal station is situated, providing a first class opportunity to determine the downwind impact of these megacities. It is also the first time that an air pollution/regional climate study of the outflow and environmental impacts of Istanbul/Cairo and Athens is performed. The study will largely benefit from the synergistic use of ground based systematic observations, satellite data and chemistry/transport modelling results that will allow to constraint emission inventories from growing European large agglomerations and megacities in the vicinity of Europe from where few observational data are available at present. Interactions between natural and anthropogenic emissions downwind highly polluted areas like megacities or large agglomerations will be investigated in terms of their global importance for atmospheric chemistry and climate. (*Task 1.4*)

8) The flux of pollutants into and out of megacities and hotspots will be quantified in detail in order to study the impact of megacities and hotspots on the global spatial scale and vice versa. (*Tasks 1.1-1.7*)

9) Combining remote sensing, in-situ measurements, and inverse modelling, emissions from megacities and their trends will be derived. (*Task 2.1*)

Focus on megacity and its climate impact, and how climate change affects megacities. We focus on the 4 hot spot regions and the summer 2003:

10) A review of chemistry-transport models is provided in table form in section 1.3. The EMEP-Task Force on Hemispheric Transport of Air Pollutants model intercomparison, where several of the consortia members have leading roles (FZJ, UiO, metno/EMEP), is designed to eliminate several key uncertainties that hinder efforts to draw consistent conclusions from the existing literature on transport of ozone and aerosols over long distances, specifically regarding the divergent assessment methods, spatial extent of source and receptor regions, and reported metrics resulting from the various objectives addressed by individual studies. The inter-model diversity within the Task Force gives some indication of the real uncertainty associated with model calculation of hemispheric transport http://aqm.jrc.it/HTAP/. Experiment Set 1 (2006-2007) evaluates source-receptor (S/R) relationships among 4 world regions. Experiment Set 2 consists of artificial tracer experiments that will help to understand the model diversity found in experiment 1 (2007). Experiment Set 3 will focus on dedicated experiments for mercury, ozone, aerosol, and POPs and link closely to measurements. Finally in 2008-2009 a revised set of S/R-simulations will inform the TF HTAP's 2009 assessment report. CITYZEN will contribute significantly to this work and the result will be a set of scale bridging models which are well characterized in terms of accuracy and shortcomings. For more information about TFHTAP see TFHTAP (2007). (*Tasks 1.2 and 1.3*)

11) Rosenfeld [2000], using satellite observations, reported that downwind aerosol concentrations from high emission areas influence the radius of cloud droplets. In particular, aerosol particles lead to clouds with a higher number of small radius droplets thus prohibiting precipitation on the one hand and screening incoming solar radiation by altering cloud albedo on the other hand. Radiative forcing due to carbonaceous particulates and sulphate is supposed to range between –0.3 à –1.8 Wm^{-2}. Nevertheless the large uncertainty associated with such figures is well known (Jacobson et al., 2001; Tegen et al., 2000). CITYZEN will reduce these uncertainties for the selected emission hot spots in order to better quantify the human influence on weather. The use of state-of-the-art aerosol models coupled to chemistry and climate will allow to quantify the climate impact from hot spot emissions beyond what has been done earlier. (*Tasks 2.1, 2.4, and 2.5*)

12) The effect of climate on air chemistry and pollution will be investigated in larger detail than previously for selected hot spots, applying models of different scales. (*Tasks 2.2 and 2.3*)

13) Coupled climate-chemistry model results for the 2050-decade for Europe and beyond will be analysed in order to provide, for the first time, a high resolution coupled calculation over a sufficiently long time period to provide a statistically significant evaluation of how climate change signals by then can modify the air pollution improvement from emission reductions alone. (*Task 2.3*)

14) The effect of atmospheric chemistry on climate will be investigated in larger detail than previously for selected hot spots, applying models of different scales. (*Task 2.5*)

Mitigation. Focus on trends in emissions in urban, regional, global scales. Quantify future climate-impact:

15) The health and climate effects of aerosols call for mitigation strategies. CITYZEN will predict in detail what specific measures will bring about in terms of aerosol levels, radiative forcing and regional climate change. Aerosol optical properties will be calculated. (*Tasks 1.7, 2.4, and 2.5*)

16) With respect to emission inventories, the EMEP database is the main European dataset (www.emep.int) for past, present and future years for the pollutants relevant for this project. The resolution is $50x50km^2$ and the data are distributed by source category. These data reside with the coordinator of this project (metno). The RAINS model has independently developed emission numbers for Europe (Amann et al., 2004; Kupiainen and Klimont, 2006) and Asia (Cofala et al., 2004; Klimont et al., 2001). Global emission inventories draw heavily on the regional ones, and are available through EDGAR, GEIA, and the RETRO project (coordinated by Martin Schultz who is a member of the project consortium). See TFHTAP (2007). CITYZEN will exploit these emission inventories beyond what has been done earlier, with focus on local emissions and a harmonization of emissions on different scales for the selected hotspots. (*Tasks 3.1 and 3.2*)

17) Consistent emission numbers across spatial scales will be made available for present and for future emission scenarios. Changes in population patterns, transport infrastructure and possibly alternative fuels will be further looked into (*Task 3.3*)

18) Pollution levels will be quantified in more detail in terms of spatial resolution through the spatial scale-bridging model calculations, looking at future scenarios. The research and model methodology developed applied beyond the four hotspot regions selected for special studies by doing calculations of future air quality (2030, 2050, 2070) for Europe and making results available to science and policy. (*Task 3.4*)

19) Several countries have begun to identify the most efficient compromises between environmental impact and economical aspects for their areas. A 2007 report, written by the air quality expert group under the supervision of DEFRA (UK) (http://www.defra.gov.uk/environment/airquality/publications/airqual-climatechange/), must be considered as an example of what can be done. Starting from the DEFRA report, mitigation measures able to deal with both air quality and climate

change will be defined within CITYZEN (*task 3.3*). In particular the innovative combination of climate and regional air quality models will be used along with new analyses of multi-year measurements. (*task 3.4*)

20) The importance of climate change on mitigation strategies will be assessed through a focused case study on the 2003 summer and similar calculations. The results will help to define emission reduction strategies for the future. (*Tasks 2.2 and 3.5*)

Performance indicators

1) Development and demonstration of improved model systems, including scale-bridging methods. Improvement model results of outflow from megacities, their impact on the global environment and vice versa.

2) Analyses and availability of extensive measurement data for the present and the last two decades. Accessible databases will ensure the available of the new analysis and measurement data.

3) Improved emission data for the present and emission scenarios for the 21st century allowing for improved model studies. Both input data to models and model results will be proof of the progress and improvements made.

4) Reports made available to policy makers. Increase information flow between science and policy (conferences, conventions, in-person meetings) and between science and the public (reports, webpages)

B 1.3 S/T Methodology and associated work plan

B 1.3.1 Overall strategy and general description

Overall strategy:

Four work packages are established to organise the work in the project:

- WP1 Megacities and Air Quality, led by Laurence Rouil, INERIS
- WP2 Megacity Air Quality and Climate Change, led by Martin Schultz, FZJ
- WP3 Megacity in the Future – Mitigation options for a sustainable Atmosphere, led by Paul Monks, ULeic
- WP4 Integration of tools and support to policy, led by Leonor Tarrason, metno

These work packages are interconnected in that methodology built up in WP1 (hotspot air quality observations and modelling) and WP2 (climate observations and modelling related to hotspot pollution) is applied for mitigation studies of future climate and air quality interactions in WP3 where also emission inventories are established. WP1, WP2, and WP3 deliver research results and methodology for further application in current and future policy contexts through WP4. The structure of the links between the WPs is shown in Figure 2.

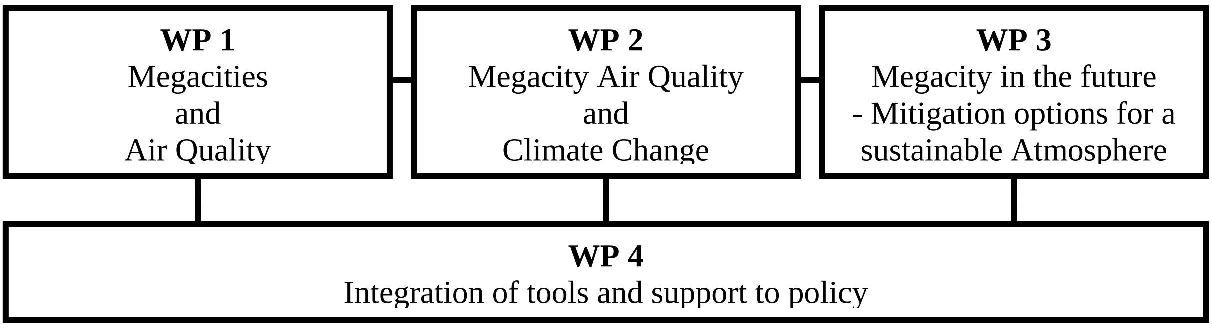

Figure 2: The organisation of the work in CITYZEN in work packages

We focus on four hotspot regions, and an exceptional meteorological situation with an extensive observational basis available to us in addition to data on emissions and meteorology. For these test cases it is considered that the consortium is particularly well positioned to extract further information on the particular hypotheses in this proposal from existing evidence:

- The BeNeLux hotspot region including the Ruhr area
- Northern Italy: The Po Valley
- The wider East-Mediterranean hotspot region including Athens, Istanbul and Cairo
- Pearl River Delta in China (see map in section 1.3.3)
- the hot and polluted summer 2003 in Central and West Europe

Hotspot is throughout this proposal taken to denote an extended large city (megacity) or even a region which is densely populated and which can have several large cities or even megacities (more than 10 million inhabitants).

Tools to be used in the project:

Observations

IUP-UB: GOME-1 (on ERS) and **SCIAMACHY** (on ENVISAT) are two UV/vis satellite instruments that provide measurements of radiance and irradiance at a spectral resolution sufficient to derive atmospheric abundances of a number of species (O3, NO2, SO2, HCHO, CHOCHO) using absorption spectroscopy. The data are complemented by using data from **OMI** (on AURA) and the new operational instrument **GOME-2** (on Metop-A), which was launched in November 2006. GOME measures the up-welling radiation leaving the atmosphere from 240 to 790 nm. SCIAMACHY has extended wavelength coverage, enabling it to make measurements from 214 to 2380 nm and alternately observes in nadir and limb viewing geometry. GOME-1, SCIAMACHY and GOME-2 achieve global coverage at the equator in 3 days, 6 days and ~1day respectively. The spatial resolution of GOME-1 is 40x320 km2 (limited data set 40x80 km2), that of SCIAMACHY is 30x60 km2 and that of GOME-2 is 80x40 km2. SCIAMACHY is currently planned to make measurements beyond 2010. The existing time series can be used to constrain and validate model simulations of tropospheric composition on a regional and larger scale, can serve as a starting point for inverse modelling of emissions and provides insights into the patterns and amounts of export from pollution hot spots and mega cities.

CNRS: IASI (on Metop) **-** IASI, the Infrared Atmospheric Sounding Interferometer, is a new tropospheric remote sensor to be carried for a period of 14 years on the Metop-A, B, and C weather satellites deployed as part of the EUMETSAT Polar System. The first Metop was successfully launched in October 2006. The IASI instrument consists of a Fourier transform spectrometer associated with an imaging system, designed to measure the infrared spectrum emitted by the Earth in the thermal infrared using a nadir geometry. The IASI mission will provide improved infrared soundings of the temperature profiles in the troposphere and lower stratosphere, moisture profiles in the troposphere, as well as some of the chemical components playing a key role in the climate monitoring, global change and atmospheric chemistry (CO_2, CH_4, N_2O, CO, O_3, HNO_3). It has an excellent spatial resolution as it perform measurement at any place of the globe 2 times per day.

CNRS: ACE (on SCISAT) **-** The Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS) was launched onboard SCISAT-1 by NASA in 12 August 2003. The ACE-FTS is a high resolution (0.02 cm^{-1}) infrared Fourier transform spectrometer (FTS) operating from 2 to 13 microns (750-4400 cm^{-1}) is measuring the vertical distribution of trace gases, particles and temperature by solar occultation. The vertical resolution is about 3 - 4 km from about 5 km up to about 100 km. The ACE mission aims, among other, to explore the relationship between atmospheric chemistry and climate change, and is delivering profile measurements of H_2O, O_3, N_2O, CO, CH_4, NO, NO_2, HNO_3, HF, HCl, N_2O_5, $ClONO_2$, CCl_2F_2, CCl_3F, COF_2, ClO, CHF_2Cl, HDO, SF_6, HCN, CH_3Cl, CF_4, C_2H_2, and C_2H_6.

CNRS: CALIPSO - The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) was launched in April 2006 for a planned 3-year mission. CALIPSO is flying in formation with the Aqua, Aura, CloudSat, and Parasol satellites as part of the Afternoon Constellation or A-train. The constellation flies in a sun-synchronous orbit with an orbit inclination of 98o. CALIPSO flies about 2 minutes behind the Aqua satellite, with an equator crossing time of about 1:30 PM. CALIPSO provides vertically-resolved information on aerosols and clouds, and will be used among other to study the pathways for intercontinental transport of air pollution.

In situ surface or airborne observations – The air pollution concentration distribution in time and space is fairly or very well mapped in all the hotspot regions selected as special study cases, and these observations are either monitoring system based or collected during research campaigns like the Regional Integrated Experiments on Air Quality over Pearl River Delta in China (PRIDE-PID) in October-November 2004 or the TORCH campaign over SE England (surface and airborne) during August 2003. Other datasets include the MOZAIC data which are aircraft based, and the EMEP database which is European in scope and covers several decades with daily or hourly observations of ozone and PM and their precursors outside of urban areas (hosted at NILU). The partners in the project have direct or indirect access to all relevant in-situ observations related to the hotspot study regions, and one of the tasks preparing for model development and validation is to make these datasets available.

Emissions

The project builds on data and expertise in available emission inventories for the four selected hotspot regions, and for the larger regional and global spatial scales. This is elaborated in the first three tasks in WP3 (“Megacity in the Future – Mitigation options for a sustainable Atmosphere”).

Models

The model systems that form the basis for the development of the spatial-scale bridging ensemble of models in this project, are listed in the model table including technical details for domain/resolution, underlying meteorology, convection scheme, emissions, tropospheric chemistry for gases and aerosols, stratospheric chemistry/boundary condition, coupling between chemistry and dynamics (yes or no), and the main references. It is particularly important here to note the domain and resolution of each of these models as some of them specialise on the global domain, others on the regional or urban/local. The model development and application proposed here build on the experience from CityDelta and EuroDelta where several of the partners (INERIS, metno and others) contributed (Cuvelier et al., 2007, Thunis et al., 2007, van Loon et al., 2007, Vautard et al., 2007, Vautard et al., 2006).

Risk assessment and contingency plans:

In designing the CityZen project, special care has been taken to reduce the risks of failure to a minimum. For every objective, more than one partner or instrument are chosen to fulfil the corresponding tasks. Satellite observations will be analysed by IUP-UB and CNRS, emissions will be compiled by IIASA, CNRS and the partners responsible for the special case studies in their respective regions. There is more than one model available for each of the spatial scales (local, regional, global).
Thus, the objectives of CityZen do not depend on one single source, and if one instrument or model should fail this should not compromise the success of the project in terms of achieving its objectives.
It is, in general, very difficult to schedule new scientific findings. However, in the case of CityZen we are starting from a solid baseline, with some of the investigations already having started and with state-of-the-art tools of investigation (models instruments) already being at our disposal. Their further development is dependent only on the availability of manpower, which is certain to be available.
The members of the consortium are well acquainted with each other and have collaborated earlier. A smooth and efficient collaboration is thus very likely.

Model	Institute	Contact, e-mail addresses	Domain / resolution	Underlying GCM/ Meteorology	Advection scheme	Convection scheme
TM4-ECPL	ECPL	Maria Kanakidou: mariak@chemistry.uoc.gr	Global, 3°x2°, 31 hybrid levels up to 10hPa	ECMWF reanalysis project data http://www.ecmwf.int/research/era/	*Prather*, [1986]	*Tiedke (1989)*
CHIMERE	INERIS	Laurence Rouil: Laurence.rouil@ineris.fr Bertrand Bessagnet : bertrand.bessagnet@ineris.fr	Europe : 0.5°*0.5° with 8 hybrid levels up to 500 hPa City scale : 5km*5km	ECMWF reanalysis refined by MM5 high resolution runs	PPM, [Corella, 1984]	Vertical diffusion is implemented using the diffusivity profile proposed by (Troen and Mahrt, 1986), with a special treatment of unstable situations.
EMEP	metno	Leonor Tarrason Leonor.Tarrason@met.no Michael Gauss Michael.Gauss@met.no Øystein.Hov Oystein.Hov@met.no	Global: 1°x1°, Europe: 0.5°*0.5°, City scale: 5km*5km Al with 20 hybrid levels up to 100hPa	ECMWF reanalysis and IFS HIRLAM high resolution runs	Bott (1989)	Eddy diffusion coefficient based on scaling approach for different stability regimes, modified O'Brien for unstable conditions, (see refs)
BOLCHEM	CNR	Alberto Maurizi: a.maurizi@isac.cnr.it Mihaela Mircea: m.mircea@isac.cnr.it Massimo D'Isidoro: m.disidoro@isac.cnr.it	Continental/regional 50 x 50 km/7 x 7 km; 33 levels	on line meteorology (BOLAM, Buzzi et al, 1994)	Weighted Average Flux (Hubbard and Nikiforakis, 2003)	Kain and Frisch, 1990
EURAD	FRIUUK	Michael Memmesheimer: mm@eurad.uni-koeln.de Hermann Jakobs: hj@eurad.uni-koeln.de Elmar Friese: ef@eurad.uni-koeln.de	Hemispheric, Europe, urban 125-250 km, 15-125 km, 1 – 5 k m upper boundary 10 – 100 hPa, 23–30 layers	NCEP, ECMWF MM5, hydrostatic, Non-hydrostatic, Nesting options	*Bott* (1989) *Smolarkiewicz* (1983)	Eddy diffusion coefficient based on scaling approach for different stability regimes (Holtslag and Nieuwstadt, 1986)
ECHAM5-HAMMOZ	FZJ	Martin Schultz: m.schultz@fz-juelich.de	Global, standard res. 2.8° x 2.8°, will run 1° x 1°; 31 hybrid levels up to 10 hPa	ECHAM5 GCM or relaxation to ECMWF meteorology	Lin&Rood (2003)	Modified Tiedtke & Nordeng
OsloCTM2	UiO	Ivar S.A. Isaksen: ivar.s.a.isaksen@geo.uio.no Michael Gauss: michael.gauss@geo.uio.no	global, sfc – 10 hPa 2.8°x2.8° or 1°x1° 40 levels	ECMWF-IFS forecast data	Second Order Moments [*Prather*, 1986]	mass flux scheme of *Tiedke* [1989]
Models-3/CMAQ	PKU	Yuanhang Zhang: yhzhang@pku.edu.cn Xuesong Wang: xswang@pku.edu.cn	East Asia, China, urban: 36km-12km-4km, 13 levels up to 50hPa	NCEP reanalysis data to MM5,non-hydrostatic, nesting options	PPM (Corella,1984), Bott (1989), YAM (Yamartina,1993)	PPM (Corella,1984), YAM (Yamartina,1993)
MOZART	CNRS	Claire Granier: claire.granier@aero.jussieu.fr	Global, variable spatial resolution. standard : 2.8° x 2.8°, will run 1° x 1°; Vertical resolution variable; standard: 31 hybrid levels up to 2 hPa	Various GCMs, or ECMWF or NCAP analyses/reanalyses	Lin and Rood (2003)	Zhang and McFarlane (1995)

Table continues on next page.

Model	Emissions	Tropospheric chemistry gas and aerosols, indirect cloud effects?	Stratospheric chemistry / boundary condition	Coupling chemistry -dynamics	References
TM4-ECPL	*GEIA (Guenther et al., 1995)* and *EDGARv2.0* (*Olivier et al., 1996*) Cooke et al., 1999 AEROCOM (Ginoux et al., 2001)	sulphur and ammonia chemistry, C1-C5 Volatile Organic Compounds (*VOC*) (update of Poisson et al., 2000) including isoprene and highly simplified terpenes and aromatic chemistry. On-line gas-phase chemistry and secondary aerosol formation, all major aerosol components including SOA (Tsigaridis et al., 2006) EBI solver	nudge to methane mixing ratio above 50 hPa with CLAES/UARS data, HNO3 is prescribed at 10hPa using UARS HNO3:03 ratios, O3 and O3s are relaxed to climatology	no	Van Noije et al. [2004], Myriokefalitaki s S. [2006], Wittrock et al. [2006]
CHIMERE	EMEP emissions	Chemistry model : MELCHIOR [Lattuati 1997] Pandis &Seinfeldt (1998) dry deposition scheme is used. Wet deposition parameters proposed by EMEP are applied, including distinction between in-cloud and sub-cloud scavenging coefficients. More details http://euler.lmd.polytechnique.fr/chimere.	Boundary conditions : Climatologies issued from global models : LMDZ-INCA[5] for gas and GOCART[6] for particulate compounds	no	[Schmidt et al, 2001], [Bessagnet et al, 2004] and see below
EMEP	Global : Muller, Edgar_v3.2 (refs) Europe: EMEP emissions (Vestreng et al., 2006)	Gas phase chemisry EMEP (Simpson et al., 1993) Aerosol phase chemistry: EQUSAM (Metzger et al., 2002)	No stratospheric chem. BC: Climatological values (Logan, 1998); correlation with potential vorticity	no	Simpson et al., 2003 Tarrason et al., 2006
BOLCHEM	EMEP, regional and national inventories. Dust and sea salt process emissions.	Gas phase chemistry: CBIV (Gery et al., 1989), SAPRC90 (Carter, 1990) Aerosol: M7 (Vignati, 2004), Secondary Organic Aerosol production.	no stratospheric chem. / ECMWF or GFS (meteorology), EMEP or Mozart (chemistry).	yes	COST 728/732 model inventory, Mircea et al., 2007. Atmos. Env., *in press.*
EURAD	EDGAR V3.2 for hemisph. applications EMEP, TNO for Europe (with downscaling scheme) Local high resolution data from North-Rhine-Westphalia (1 km resolution)	Gas-phase chemistry: RADM2, RACM-MIM (Stockwell, 1997; Geiger, 2003, Karl et al, 2006); Rosenbrock two-step solver (Sandu, 2001; Sandu and Sander, 2005) Dry deposition (Resistance model Wesley, 1989) Aerosols: MADE/SORGAM (Ackermann et al., 1998; Schell et al., 2001): ASOA, BSOA, NH4-NO3-SO4-Water eq. system Aqueous phase, clouds (Walcek, 1986; Chang et al., 1987)	Climatological values; correlation with potential vorticity	no	Jakobs et al., 2002 Memmesheimer et al., 1997 Memmesheimer et al., 2004
ECHAM5-HAMMOZ	RETRO V2, fires either from RETRO or GFEDv2; aerosol emissions from AEROCOM	MOZART2 chemistry (Horowitz et al., 2003) with modifications (O3+NO); aerosol processes according to Stier et al., 2005	Zonal mean climatology of ozone and HNO3 prescribed at 10 and 30 hPa and relaxation to climatology above tropopause	Not yet for gas-phase, but easy to implement. Available for aerosols	Rast et al., in prep.; Stier et al., 2005; Pozzoli et al., in press; Aghedo et al., 2007
OsloCTM2	Muller, Edgar_v3.2 (refs)	detailed ozone/NOx/ hydrocarbon scheme including 58 species, QSSA solver	Ozone influx prescribed at 10 hPa (450 Tg/year)		*Sundet* [1997]
Models-3/CMAQ	TRACE-P (Streets,2003)	Gas phase chemistry: CBIV (Gery et al., 1989), SAPRC (Carter, 1990), SMVGEAR and QSSA solver Aqueous phase : RADM Aerosols: ISORROPIA for thermodynamics	no stratospheric chem. Time invariant boundary concentration profiles or coarse domain modeling results for nested fine domains		Byun, 1999
MOZART	POET database RETRO database Available from www.accent-network.org	Chemical scheme developed for MOZART-4, including a detailed ozone/HOx/NOx/VOCs/SO2 scheme. BC, OC, SOA calculationb included (4 bins)	Zonal mean climatology of ozone and HNO3 prescribed at the top of the model and relaxation to climatology above tropopause	No	*Horowitz et al., 2003, Granier et al., 2006.*

B 1.3.2 Timing of work packages and their components

Task	Description	Lead	2008				2009												2010												2011							
			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	WP 1: Megacities and Air Quality																																					
1.1	Concentrations and deposition of air pollutants in megacities over the last decade	iup-ub																																				
	D1.1.1	iup-ub												x																								
	D1.1.2	iup-ub												x																								
	D1.1.3	iup-ub																								x												
	D1.1.4	iup-ub																								x												
	D1.1.5	iup-ub																																		x		
	D1.1.6	iup-ub																																		x		
	D1.1.7	iup-ub																																				x
1.2	Export fluxes from megacities: modelling different scales	ineris																																				
	D1.2.1	ineris																		x																		
	D1.2.2	ineris																					x															
	D1.2.3	ineris																							x													
	D1.2.4	ineris																																				x
1.3	Documentation of new model tools	metno																																				
	D1.3.1	metno																x																				
	D1.3.2	metno																														x						
1.4	Case study: The Eastern Mediterranean including Athens, Istanbul and Cairo	ecpl																																				
	D1.4.1	ecpl										x																										
	D1.4.2	ecpl																								x												
	D1.4.3	ecpl																												x								
	D1.4.4	ecpl																																				x
1.5	Case study: Benelux including Ruhr area	friuuk																																				
	D1.5.1	friuuk																x																				
	D1.5.2	friuuk																						x														
	D1.5.3	friuuk																								x												
1.6	Case study: The Po Valley	isac																																				
	D1.6.1	isac																x																				
	D1.6.2	isac																						x														
	D1.6.3	isac																								x												
	D1.6.4	isac																																				x
1.7	Case study: The Pearl River delta	pku																																				
	D1.7.1	pku												x																								
	D1.7.2	pku																						x														
	D1.7.3	pku																								x												
	D1.7.4	pku																																				x
	WP 2: Megacity Air Quality and Climate Change																																					
2.1	Quantify greenhouse gas and aerosol emissions from megacities/urban areas over the last two decades	iup																																				
	D2.1.1	iup																		x																		
	D2.1.2	iup																										x										
2.2	Case study: European summer 2003 heat wave	fzj																																				
	D2.2.1	fzj												x																								
	D2.2.2	fzj																														x						
2.3	Quantify impacts of climate change on Megacity air quality and regional air pollution	uio																																				
	D2.3.1	uio																																		x		
2.4	Contribution of air pollution from megacities to climate change	nilu																																				
	D2.4.1	nilu																		x																		
	D2.4.2	cnr																						x														
	D2.4.3	pku																								x												
	D2.4.4	pku																																				x
2.5	Chemistry-climate modeling: aerosol and ozone impact	metno																																				
	D2.5.1	metno																														x						
	WP 3: Megacity Mitigation – a Sustainable Atmosphere																																					
3.1	Comparison and evaluation of existing emission inventories	cnrs																																				
	D3.1.1	cnrs												x																								
	D3.1.2	cnrs												x																								
	D3.1.3	cnrs																								x												
3.2	Evaluate emissions from megacities with focus on hydrocarbons	cnrs																																				
	D3.2.1	cnrs																		x																		
	D3.2.2	cnrs																								x												

Task	Description	Lead	2008				2009												2010												2011							
			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
3.3	Future emission scenarios	iiasa																																				
	D3.3.1	iiasa															x																					
	D3.3.2	iiasa																								x												
	D3.3.3	iiasa																																				x
	D3.3.4	iiasa																																				x
3.4	The impact of future emissions on air quality and climate	ineris																																				
	D3.4.1	ineris																								x												
3.5	Quantify impacts of climate change on hotspot air quality and regional air pollution	uio																																				
	D3.5.1	uio																								x												
	WP 4: Integration and technical support to policy																																					
4.1	Demonstrate applicability of methodology developed in WP1-3 beyond the selected hotspots	uio																																				
	D4.1.1	uio																														x						
	D4.1.2	uio																														x						
4.2	Effects of megacity emissions on climate in megacities and their surroundings in 2030, 2050 and 2070	fzj																																				
	D4.2.1	fzj																																				x
4.3	Establish and document the generic aspects of the model tools developed in WP1-3 for mitigation options	ineris																																				
	D4.3.1	ineris																																		x		
	D4.3.2	ineris																																				x
4.4	Work with national authorities, intergovernmental organizations and EU-institutions	metno																																				
	D4.4.1	metno																																		x		
4.5	Ensure significant, broad and lasting impact of results and tools developed in this project	metno																																				
	D4.5.1	metno																																		x		
4.6	Collaboration with sister project MEGAPOLI	metno																																				
	D4.6.1	metno																										x										
4.7	Dissemination to public	metno																																				
	D4.7.1	metno		x																																		
	D4.7.2	metno																																				x

dark red: high activity, light red: medium activity, white: low or now activity, x: deliverable date

B 1.3.3 Work package list / overview

Work package list

Work package No	Work package title	Type of activity	Lead beneficiary No	Person-months	Start month	End month
1	Megacities and Air Quality	RTD	4	213.2	1	36
2	Megacity Air Quality and Climate Change	RTD	7	83.8	1	36
3	Megacity mitigation – a Sustainable Atmosphere	RTD	13	94.9	1	36
4	Integration and support to policy	RTD	1	61.4	1	36
	TOTAL			453.3		

B 1.3.4 Deliverables list

List of Deliverables – to be submitted for review to EC

Del. no.	Deliverable name	WP no.	Lead bene-ficiary	*Estimated indicative person-months*	Nature[3]	Dissemi-nation level[4]	Delivery date (proj. month)
D1.1.1	Data set of tropospheric columns of NO2, SO2, HCHO, and CHOCHO over selected areas from GOME and SCIAMACHY (1995 – 2006)	1.1	5 IUP-UB	17.2	O (data base)	RE, free to registered users	12
D1.1.2	Data set of aerosol optical depth over selected areas from SeaWiFS data	1.1	5 IUP-UB	4	O (data base)	RE, free to registered user	12
D1.1.3	Data set of aerosol optical depth over selected areas from MERIS data	1.1	5 IUP-UB	4	O (data base)	RE, free to registered users	24
D1.1.4	Analysis of the evolution of air pollution in the studied high emissions areas over the 10 past years	1.1	5 IUP-UB	12	R	PU	24
D1.1.5	Data set of tropospheric columns of NO2, SO2, HCHO, and CHOCHO over selected areas from GOME, SCIAMACHY and GOME-2 (1995 – 2009)	1.1	5 IUP-UB	7	O (data base)	RE, free to registered users	34
D1.1.6	Final project assessment of changes in air pollution in hotspot areas for the last decade derived from nested modelling, remote sensing and in-situ measurements	1.1	5 IUP-UB	8	R	PU	34
D1.1.7	Publication on air pollution in hotspot areas	1.1	5 IUP-UB	6	O (article)	PU	36
D1.2.1	Report on evaluation of transport pathways based on model results and analysis of satellite data	1.2	4 INERIS	8	R	PU	18
D1.2.2	Assessment of the impact of pollutant height release on its vertical distribution and its transport downwind of urban areas	1.2	4 INERIS	9	R	PU	21
D1.2.3	Publication on scale errors in global model simulations based on comparison with regional/Lagrangian model results and also observations	1.2	4 INERIS	6	O (article)	PU	23
D1.2.4	Report on evaluation of the seasonal import/export budgets of targeted hotspots to regional and global air quality (mainly for ozone and PM)	1.2	4 INERIS	6	R	PU	36
D1.3.1	First report on model tools and the implementation of a common approach to bridge scales in a dynamic fashion in models.	1.3	1 metno	8	R	PU	16
D1.3.2	Second report on model tools and the	1.3	1	8	R	PU	30

3 Nature of the deliverable: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other
4 Dissemination level: **PU** = Public, **PP** = Restricted to other programme participants (including the Commission Services), **RE** = Restricted to a group specified by the consortium (including the Commission Services), **CO** = Confidential, only for members of the consortium (including the Commission Services)

	implementation of a common approach to bridge scales in a dynamic fashion in models.		metno				
D1.4.1	First observational data compilation for the East-Mediterranean area	1.4	8 ECPL	10	O (data base)	RE, free to registered users	10
D1.4.2	New targeted observations in the East-Mediterranean area	1.4	8 ECPL	8	O (data base)	RE, free to registered users	24
D1.4.3	Model evaluated trends of ozone, PM and deposition patterns over the recent 10 to 20 years, discrimination between anthropogenic and natural contributions	1.4	8 ECPL	14	R	PU	28
D1.4.4	Report on import/export budgets from the East-Mediterranean area at the regional and global scales	1.4	8 ECPL	10	R	PU	36
D1.5.1	Data compilation for the Benelux/Ruhr area	1.5	6 FRIUUK	4	O (data base)	RE, free to registered users	16
D1.5.2	Evaluation of current state of modelled ozone, PM and deposition fields	1.5	6 FRIUUK	4	R	PU	22
D1.5.3	Report on import/export budgets from the Benelux at the regional and global scales	1.5	6 FRIUUK	6	R	PU	24
D1.6.1	Data compilation for the Po Valley	1.6	9 CNR	3	O (data base)	RE, free to registered users	16
D1.6.2	Evaluation of current state of modelled ozone, PM and deposition fields	1.6	9 CNR	3	R	PU	22
D1.6.3	Report on import/export budgets from the Po-Valley area at the regional and global scales	1.6	9 CNR	4	R	PU	24
D1.6.4	Publication on the contribution to and from the surrounding region to the air pollution in the Po Valley	1.6	9 CNR	4	O (article)	PU	36
D1.7.1	Data compilation for the Pearl River Delta (PRD)	1.7	2 PKU	10	O (data base)	RE, free to registered users	12
D1.7.2	Evaluation of current state of modelled ozone, PM and deposition fields	1.7	2 PKU	10	R	PU	22
D1.7.3	Report on import/export budgets from the PRD area at the regional and global scales	1.7	2 PKU	10	R	PU	24
D1.7.4	Peer-reviewed publication on the outflow of pollutants from the PRD and their impact on the regional to global scales.	1.7	2 PKU	10	O (article)	PU	36
D2.1.1	Data set of dry mixing columns of CO2 and CH4 over selected areas from SCIAMACHY (2003 – 2006)	2.1	5 IUP-UB	10	O (data base)	RE, free to registered users	18
D2.1.2	Report on greenhouse gas and aerosol emissions from megacities derived from observations and inverse modelling.	2.1	5 IUP-UB	5	R	PU	26
D2.2.1	Report on high-temperature impact on BVOC emissions and air quality for the summer 2003 case.	2.2	10 NILU	8	R	PU	12
D2.2.2	Database of air quality changes (e.g. surface ozone) in NW Europe during the summer 2003 heat wave, including observational and model data.	2.2	10 NILU	12	O (data base)	RE, free to registered users	30
D2.3.1	Report on climate induced changes in air quality and chemical composition on different scales	2.3	11 UiO	10.8	R	PU	34
D2.4.1	Report on changes in meteorology due to megacity emissions based on an analysis of	2.4	7 FZJ	8	R	PU	18

	the RETRO data base.						
D2.4.2	Identification of OM sources (primary and secondary components) by NMR	2.4	9 CNR	6	R	PU	22
D2.4.3	Report on reductions of the uncertainties in estimates for direct aerosol forcing and heating by black carbon.	2.4	2 PKU	6	R	PU	24
D2.4.4	Publication on aerosol impact	2.4	2 PKU	8	O (article)	PU	36
D2.5.1	Report on megacity impact on the distribution of climate parameters and weather elements, regionally and globally	2.5	1 metno	10	R	PU	30
D3.1.1	Report on the assessment of the consistency of the emissions inventories used in the CITYZEN models.	3.1	3 CNRS	12	R	PU	12
D3.1.2	Database for the participants to the project, including preliminary emissions inventories of chemical compounds at the global and regional scales.	3.1	3 CNRS	8	O (data base)	RE, free to registered users	12
D3.1.3	Harmonization of the inventories available in the database developed within Task 3.2	3.1	3 CNRS	14.9	O (data base)	RE, free to registered users	24
D3.2.1	Database for the participants to the project, considering more specifically hydrocarbons for several megacities and extension at the regional/global scale.	3.2	3 CNRS	8	O (data base)	RE, free to registered users	18
D3.2.2	Report and documentation for the emissions database (based on final emission data).	3.2	3 CNRS	8	R	PU	24
D3.3.1	Data base of preliminary future emissions for the different scenarios.	3.3	14 IIASA	14	O (data base)	RE, free to registered users	15
D3.3.2	Data base of final future emissions for the different scenarios.	3.3	14 IIASA	4	O (data base)	RE, free to registered users	24
D3.3.3	Report on evaluation of the impact of a partial replacement of fossil fuel by biofuels for transportation and energy generation, on emissions from megacities and larger scales (based on final emission data).	3.3	14 IIASA	2	R	PU	36
D3.3.4	Report on the definition of mitigation scenarios which could be proposed to deal both with air quality in megacities and climate change.	3.3	14 IIASA	2	R	PU	36
D3.4.1	Report on future air quality changes on different scales based on the adopted emission scenarios from task 3.3	3.4	4 INERIS	10	R	PU	24
D3.5.1	Report on implications for mitigation strategies on air pollution under climate change	3.5	11 UiO	12	R	PU	24
D4.1.1	The regional and global impact of selected megacity areas due to future changes of traffic infrastructure	4.1	11 UiO	5	R	PU	30
D4.1.2	The regional and global impact of selected megacity areas due to changes in population distribution	4.1	11 UiO	5.4	R	PU	30
D4.2.1	Publication on megacities impact on climate change by 2050	4.2	7 FZJ	6	O (article)	PU	36
D4.3.1	Evaluation of ensemble approach and validity of the results	4.3	4 INERIS	12	R	PU	34
D4.3.2	Interactive tool kit for presentation of results	4.3	4 INERIS	8	O (Tool	PU	36

					system)		
D4.4.1	Web access to project results tailored for use by authorities and intergovernmental organisations	4.4	1 metno	8	O (web pages)	PU	34
D4.5.1	Report on improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence	4.5	1 metno	9	R	PU	34
D4.6.1	Collaborative dissemination with MEGAPOLI on website after joint session at EGU general assembly	4.6	1 metno	4	O (web pages, EGU sess.)	PU	26
D4.7.1	Establish a project webpage, to be continuously updated throughout the project	4.7	1 metno	2	O (web pages)	PU	2
D4.7.2	Documentation of (or links to) most relevant project results on project webpage	4.7	1 metno	2	O (web pages)	PU	36
			Total	453.3			

List of compulsory Deliverables – to be submitted for review to EC

D.c1	Mid-term project report	all	1 metno	1	R	PU	18
D.c2	Final project report	all	1 metno	1	R	PU	36
D.c3	Report on awareness and wider societal implications	all	1 metno	1	R	PU	36

B 1.3.5 Work package descriptions

Work Package 1 Megacities and Air Quality:
led by Laurence Rouil, INERIS

Summary Here we will determine the air pollution distribution and change in and around hotspots over the last decade from extensive satellite and in-situ observations and we will employ a series of different scale models in order to analyze the impacts of air pollution hot spots on regional and global air quality including potential future changes for various climate scenarios. Focus is on ozone and particulate matter with chemical and physical characterization, and their precursors. The Eastern Mediterranean (Istanbul, Athens, Cairo), the Po Valley, the BeNeLux region (including the Ruhr area), the Pearl River Delta in China (with megacities Guangzhou and Hong Kong) are chosen for intensive case studies. A set of chemical transport models which connect all the most important spatial and temporal scales will be developed and used to quantify how the observed air pollution arises. The models and emission inventories will be evaluated, errors identified and improved on the urban, regional and global spatial scales. In this way the models nest together the global, regional and urban spatial scales so that uncertainties that arise from differences in process parameterizations as well as numerical methods are minimised. With these nested model systems the fluxes of pollutants from the selected hotspots to the surrounding region for parts of the past decade will be calculated.

Objectives The objectives in WP1 are through combined use of observations and modelling on different scales, with focus on the megacities and hotspots selected for this project, to:

- quantify the present levels and long-term changes of concentrations of pollutants (trace gases and aerosols) in hotspots and at rural sites and the contribution of pollutants from hotspots to transport and transformation of pollutants
- quantify the impact of hotspots on air quality and pollution on regional and global scales
- quantify the global contribution (including fires and biomass burning) to hotspots
- develop and apply models that bridge scales in a dynamic fashion
- integrate the updated general emission inventory from WP3 (Tasks 3.1 and 3.2) with specific local data in the selected megacity/hotspot regions.

Tasks There are seven tasks in WP1, as outlined in detail in the WP-table. The tasks 1.1 to 1.3 are devoted to:

1) The assessment of trends of air pollutants concentrations in the urban areas that have been chosen as test cases thanks to available measurements and modelling results.
2) The assessment of import/export budgets between the hot spot areas and the rest of the domain (global, European, Chinese).
3) The elaboration of a bridging-scale approach that will allow to compute these budgets with an enhanced control of uncertainties, taking benefit from the availability of several regional and global models.

The tasks 1.4 to 1.7 are the application cases that will be studied in detail during the project. In each case, a qualification of the hot spot domain considering the emission, terrain and meteorology points of view will be performed. Specific studies that will help to better understand air quality behaviour in these areas are also proposed by "local team". We will focus below in particular point to Tasks 1.4 and 1.7 which detail the Eastern Mediterranean and Pearl River Delta case studies, respectively. These are particularly important to the proposal because of intensity of emissions, the meteorological regime and the impact of air pollution and climate variability and trends on a large population.

The Eastern Mediterranean hotspot region includes Istanbul as a megacity Istanbul (largest urban center in Northwestern Turkey, with more than 12 million inhabitants in the metropolitan area) and the Athens extended area (of about 5.5 million people), and the Cairo metropolitan area which is a megacity with more than 16 million inhabitants. The Eastern Mediterranean is the cross road of air masses where man-made pollution meets with natural emissions. These emissions include nitrogen oxides, carbon monoxide, volatile organic compounds, as well as particulate matter. The main pollution sources include the industrial sector, transportation, and domestic heating from the continental part of Europe, Balkans and the Black Sea. Forest fires and agricultural/biomass burning emissions are also affecting the area during the dry season. Spots of intense burning activity are found north of the Black Sea and combined with the dominance of the northerly winds over the Aegean Sea, contribute significantly to pollution build up during summer. Natural emissions from semi-arid North African regions (e.g. Sahara desert), from the vegetation that surrounds the Mediterranean Sea and from the Mediterranean Sea itself also affect the area. Southerly winds from Africa mobilises the transport of air masses with high loads of dust and low levels of NOx and O3 over the Eastern Mediterranean. This air flow pattern is most frequent during the transition periods (spring and autumn). Air masses transported from the Atlantic Ocean atmosphere and within the upper troposphere from Asia can also reach the area under certain air flow conditions. Due to the favourable climate several large, continuously growing, agglomerations are located inside the Eastern Mediterranean hotspot region or close to it, and Athens, Istanbul and Cairo have grown dramatically over the past 10 years. Also the Po Valley hotspot region affects the East

Mediterranean basin at times.

Pearl River Delta (PRD) is an area with one of the fastest economic development in China. Urbanization in PRD is characterized by city clusters with two mega-cities (Guangzhou and Hong Kong) and many medium-small cities linked by dense highways. The expansion of the economy in this region causes ever higher demands for energy, mobility and communications. As a consequence, coal smog and traffic exhaust together cause serious photochemical smog and particulate pollution problems from urban to regional scale. Atmospheric visibility has been deteriorated with less blue sky year by years with high concentration of O_3 and fine particles. Transformation and transport of air pollutants show rather unique characteristics under such conditions of high concentrations of primary and secondary pollutants. Its possible impact on regional air quality and climate change is a major concern of national government as well as the global community. "Program of Regional Integrated Experiments of Air Quality over Pear River Delta (PRIDE-PRD)" conducted intensive campaigns PRIDE-PRD2004 in October 1- November 5, 2004 and PRIDE-PRD2006 in July 4-31, 2006 by an international science team from China (various institutes from Mainland, Taiwan, and Hong Kong), Germany (ZFJ, IFT and MPIC), Japan (UT and NIES), and Korea (GIST), chaired by Peking University. PRIDE-PRD2004 and PRIDE-PRD2006 are aimed to characterized temporal and spatial changes of aerosol, oxidant and its precursors, to understand chemical composition, size distribution, hygroscopic properties, and optical properties of aerosols, to quantify ozone formation by measurements and modeling, and to explore the relationship of species between aerosol and gaseous phase. The successful accomplishment of the campaigns has deepened the understanding on regional air pollution in the PRD and what controls are needed. Starting from beginning of 2007, the Ministry of Science and Technology will launch a major project "Synthesized Techniques for Pollution Complex (Multi Air Pollutants) Prevention in City-Cluster and Integrated Demonstration (STPPC)" to build up the capacity of regional air pollution control and related coordination mechanism. The STPPC will select PRD as a core area to have technical demonstration, and thus provide opportunities as well as challenges for PRD to improve its regional air quality.

Figure 3: Map of the Pearl River Delta (from http://en.wikipedia.org/wiki/Pearl_River_Delta)

The PRD has become one of the leading economic regions and a massive manufacturing centre of mainland China. The region covers eight prefectures of the Guangdong Province, namely Guangzhou, Shenzhen, Zhuhai, Dongguan, Zhongshan, Foshan, Huizhou (only includes Huizhou City, Huiyang, Huidong, Boluo), Jiangmen and Zhaoqing (only includes Zhaoqing City, Gaoyao and Sihui), and the Special Administrative Regions of Hong Kong and Macau. Until around 1985, the PRD had been mainly dominated by farms and small rural villages, but after the economy was reformed and opened, the Pearl River Delta has become the most economically dynamic region of China with an average real rate of GDP growth exceeding 16% annually during the period 1980-2000. PRD suffers from serious photochemical smog and particulate pollution problems from urban to regional scales. Especially under stagnant conditions the levels of PM-2.5 and ozone represent a serious impact on human health. The radiative forcing by aerosols and black carbon attain high levels and serious impact on climate is to be expected. Atmospheric chemistry is complicated due to interactions between primary emissions and photochemical processes, between gaseous and aerosol phase, and between local and regional air pollution.

Much of the area is frequently covered with brown smog. This has a strong effect on the pollution levels in Hong Kong. Long-term records of space observations have shown that the increases in pollutant amounts over China have been much larger than what was originally expected from emission estimates (Richter et al. 2005).

Work Package 2 Megacity Air Quality and Climate Change:
led by Martin Schultz, FZJ

Summary Climate change may cause changes in air pollution in and around hotspots, and hotspot pollution can change precipitation, temperature/albedo and other climate parameters both in the surrounding region and on an even larger spatial scale. These feedbacks will be studied in scale-bridging model systems based on global climate model scenarios, and in a coupled high resolution chemistry-climate model. We focus on the four hotspots selected as special cases and will investigate their past and potential future climate impact as well as how climate change affects the air quality in the hotspot regions. Recent predictions of the future climate in Europe suggest that the weather conditions during the exceptionally hot summer 2003 may become more frequent. Because of the availability of observations for this period and ongoing efforts to analyze its impacts on air pollution levels, the summer 2003 is selected as a model case for the study of hotspot emissions - climate interactions. It will also serve as a test case for inter-comparing the numerical models involved in this project.

Objectives
- Derive greenhouse gas emissions from megacities and hotspots during the past and the present through combined use of emission data with remote sensing, in-situ measurements, and inverse modelling.
- Quantify the impact of extreme weather conditions on natural emissions and air pollution levels in European hot spots based on the analysis of observational data and model results for the summer 2003 heat wave.
- Establish a common reference database for intercomparison of the models participating in CITYZEN based on year 2003 simulations and link the results from this study to results obtained in the EU projects QUANTIFY and GEMS.
- Explore the potential impacts of future climate change on megacity emissions and air pollution levels by analyzing IPCC climate scenario experiments and using a coupled chemistry climate model and chemistry transport models for selected scenarios.
- Assess the impact of megacity greenhouse gas and air pollutant emissions on weather and climate using ground-based and satellite observations and numerical models on various scales.
- Perform coupled chemistry climate simulations in high resolution to explore feedback effects between air pollution emission changes, chemical processes and changing weather patterns.

There are five tasks in WP2, outlined in detail in the WP-table. These tasks are
1) Quantify greenhouse gas emissions from megacities/urban areas over the last decade
2) Quantify impacts of climate change on Megacity air quality and regional air pollution I: Case study: the European summer 2003 heat wave
3) Quantify impacts of climate change on Megacity air quality and regional air pollution II: Future climate and emission scenarios
4) Contribution of air pollution from megacities to climate change
5) Chemistry-climate modelling: aerosol and ozone impact

Work Package 3 Megacity in the Future – Mitigation options for a sustainable Atmosphere
led by Paul Monks, ULeic

Summary The capability of the ensemble of two global models, three regional models and four urban scale models to forecast future climate and emission situations will be evaluated on the basis of the validation of the performance as judged from observations for the past decade. The spread among the models and variability in the results of each model in the ensemble will be quantified. It will be analysed how the spread and variability change across different regions and for the different scenarios. Conclusions will be drawn on the capability of the ensemble approach and the added value of considering different models for the analysis of variability and trends in air quality and climate. In this way a set of spatial-scale bridging models are established and evaluated. This set of models can serve the purpose of providing technical analysis of the value of mitigation options for air pollution in hotspots. These model systems will be brought in to analyse mitigation options inside and around the hotpots selected for special study, also taking into account climate change. Focus is on the inventories for the emissions in the urban, regional, and global scales, and to ensure consistency in emission inventories across scales. Work will be done to establish emission scenarios on the basis of ongoing regional work in Europe and elsewhere, including IPCC.

Objectives

- Establish future scenarios of population development and needs for energy and how these reflect on emissions of the four hotspot cases (E Mediterranean, Po Valley, BeNeLux, Pearl River Delta) and the associated national, regional and global total emissions.
- On the basis of the emissions scenarios developed in this task and the nested model systems evolving from WP1 and WP2 calculate the changes in air quality in the four hotspot cases and the associated changes in pollutant fluxes between the hotspots and the surrounding regions for future time intervals (preliminary planned for 2030 and the 2050s).
- On the basis of emission scenarios calculate the coupled climate change - hotspot air quality impact for the 2050s for the four hotspots.
- Identify options to mitigate future environmental impacts on air quality and climate from the four hotspots. Make suggestions for a sustainable development.

There are five research tasks in WP3, outlined in detail in the WP-table:

1) Comparison and evaluation of existing emission inventories
2) Evaluate emissions from megacities with focus on hydrocarbons
3) Future emission scenarios
4) The impact of future emissions on air quality and climate
5) Quantify impacts of climate change on hotspot air quality and regional air pollution

Work Package 4 Integration of tools and support to policy:
led by Leonor Tarrason, metno

Summary Here we will demonstrate how the research results and the model methodology developed in WP1-3 is applicable beyond the four hotspot cases by doing calculations of future air quality (preliminary planned for 2030 and 2050s) for Europe. We will analyse the coupled climate - atmospheric chemistry model results for the 2050-decade for Europe and beyond, in order for the first time to provide a high resolution coupled calculation over a sufficiently long time period to provide a statistically significant evaluation of how climate change signals by then can modify the air pollution improvement from emission reductions alone. This will for the first time provide a sufficiently large sample of pollution events under climate change to allow us to make a rigorous statement about the likelihood that the concentration and deposition reductions in response to sectoral emission controls for instance in the transportation or energy generation sectors, at certain times or even averaged over longer time periods like a season, can be significantly modified by the climate change conditions. We will also establish and document the generic aspects of the model tools developed in WP1-3 for the analysis of mitigation options for air pollution in hotspots. In this

way the project will provide generic information and methods of relevance to policy. Several of project partners have key roles in the technical underpinning of policy and they will ensure that the improved emission inventories, scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact. The transfer and application of research results and policy underpinning methods will be done in this work package.

Objectives

- Demonstrate how the research results and the model methodology developed in WP1, WP2 and WP3 is applicable beyond the four hotspot cases by doing calculations of future air quality (preliminary planned for 2030 and 2050s) for Europe
- Analyse the coupled climate -atmospheric chemistry model results for the 2050-decade for Europe and beyond, in order for the first time to provide a high resolution coupled calculation over a sufficiently long time period to provide a statistically significant evaluation of how climate change signals by then can modify the air pollution improvement from emission reductions alone.
- Establish and document the generic aspects of the model tools developed in WPs 1 to 3 for the analysis of mitigation options for air pollution in hotspots. (A nested set of mature models that bridge spatial scales, zooming from global to regional and urban scales that calculate the combined effect of air pollution and climate variability and trends)
- Ensure the integration of results from the other 3 work packages
- Work with national authorities, intergovernmental organisations and EU-institutions to prepare for and whenever possible provide technical underpinning of policy
- Ensure that the improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact.

There are seven tasks in WP4, outlined in detail in the WP-table:

1) Demonstrate how the research results and the model methodology developed in WP1-3 are applicable beyond the four hotspot cases by doing calculations of future air quality (preliminary planned for (parts of) 2030 and 2050s) for Europe.
2) Analyse the coupled climate-atmospheric chemistry model results for the 2050-decade for Europe and beyond, in order for the first time to provide a high resolution coupled calculation over a sufficiently long time period to provide a statistically significant evaluation of how climate change signals by then can modify the air pollution improvement from emission reductions alone.
3) Establish and document the generic aspects of the model tools developed in WP1-3 for the analysis of mitigation options for air pollution in hotspots. Ensure the integration of results from the other 3 work packages.
4) Work with national authorities, intergovernmental organisations and EU-institutions to prepare for and whenever possible provide technical underpinning of policy.
5) Ensure that the improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact.
6) Collaboration with sister project MEGAPOLI
7) Dissemination to public, setting up and maintenance of webpage

The interactions and flow of results in between these four work packages are shown in Figure 4 below. The work packages, including all tasks within, are described in section 1.3.4.

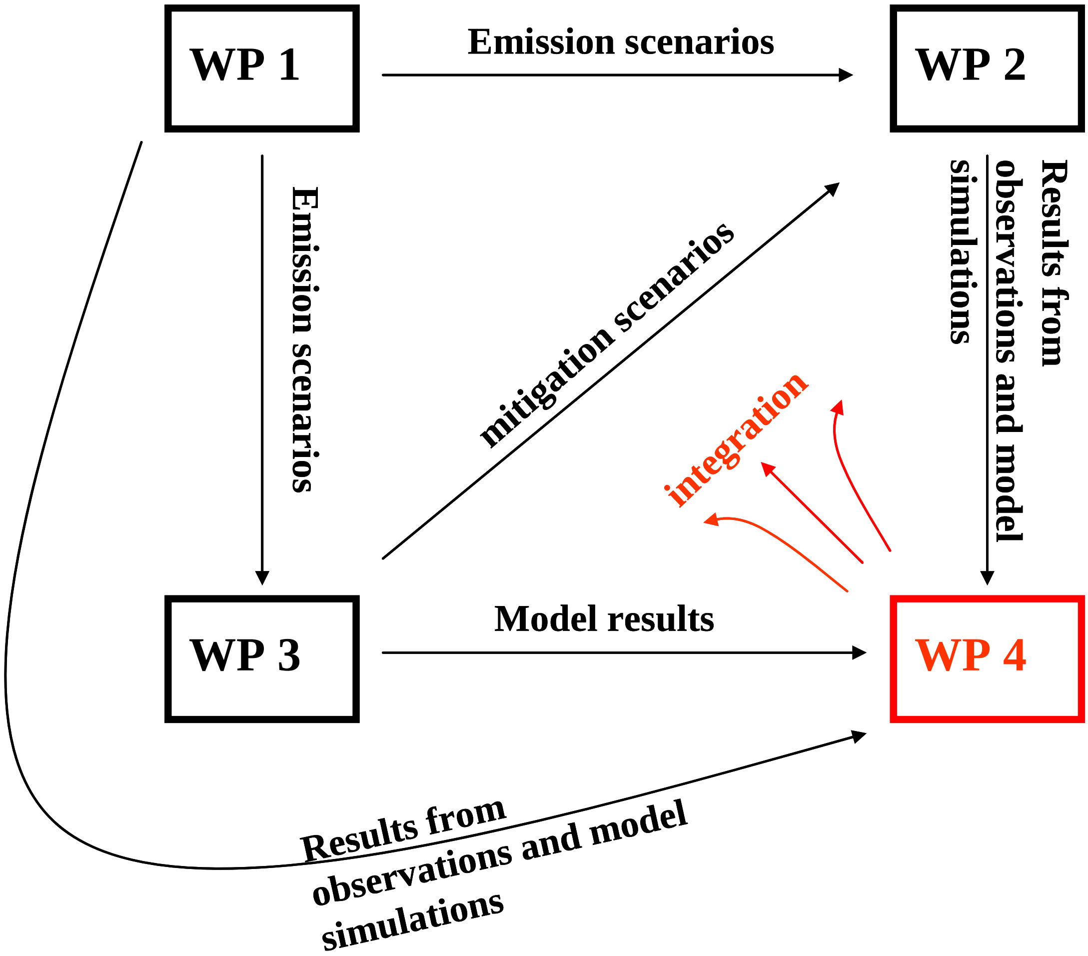

Figure 4: Interactions and interdependencies between the four work packages of CITYZEN.

Work package number	1			Start date:	Month 1			
Work package title	Megacities and Air Quality. WP leader Laurence Rouil, INERIS							
Activity Type	RTD							
Participant id	1 metno	2 PKU	3 CNRS	**4 INERIS**	5 IUP-UB	6 FRIUUK	7 FZJ	8 ECPL	9 CNR
Person-months	*8*	*40*	*9.4*	***13.3***	*35*	*8*	*4*	*10*	*15*
	10 NILU	11 UiO	12 METU	13 ULeic	15 NOA	16 CEHM			
	1.5	*6*	*11*	*8*	*20*	*24*			

Objectives

Through combined use of observations and modelling on different scales, with focus on the megacities and hotspots selected for this project, the objectives of this work package are to:
Hotspot is throughout this proposal taken to denote an extended large city (megacity) or even a region which is densely populated (like the BeNeLux region).

- quantify the present levels and long-term changes of concentrations of pollutants (trace gases and aerosols) in hotspots and at rural sites and the contribution of pollutants from hotspots to transport and transformation of pollutants
- quantify the impact of hotspots on air quality and pollution on regional and global scales
- quantify the global contribution (including fires and biomass burning) to hotspots
- develop and apply models that bridge scales in a dynamic fashion
- integrate/update the general emission inventory with specific local data in the selected megacity/hotspot regions

Description of work (for each task)

1.1: Concentrations and deposition of air pollutants in megacities over the last decade (metno, CNRS, INERIS, IUP-UB, FRIUUK, ECPL, CNR, NILU, UiO)

The purpose is to establish an observational basis through the analysis of the satellite information and in-situ data with an emphasis on the four hotspot cases. This observational basis will be used to evaluate the models. Based on these evaluations, the emission inventories, the model results, the errors identified, and improvements made to the model systems, a set of models will be established that nest together the global, regional and urban spatial scales so that uncertainties that arise from differences in process parameterizations, input data resolution and accuracy, as well as numerical methods, are minimised. Model calculations (global, regional and urban scales) and satellite/ground-based measurements will be used to quantify the concentrations of pollutants in megacities (trace gases and aerosols) and their contribution to transport and transformation of pollutants. Focus will be put on ozone and particulate matter (including aerosol speciation and size distribution). The work will be concentrated on the hotspots chosen for case studies: BeNeLux, Po Valley, E. Mediterranean area, and the Pearl River Delta in China.

IUP-UB: Satellite observations will be used to establish the development of the concentrations of species since end of 1995. Measurements from i) GOME, SCIA and GOME-2 and ii) various aerosol instruments will be used:
- GOME-1, SCIAMACHY and GOME-2 (UV and visible spectral range): tropospheric columns of NO2, HCHO, CHOCHO, O_3 (for tropics and sub tropics and special cases) and SO_2.
- SCIAMACHY (NIR and SWIR spectral ranges): the total columns of CO, total dry column mole fractions of CO_2 and CH_4. MODIS observations will be retrieved to identify biomass and forest fires and to estimate the emissions of CO, PM and other precursors from such fires.
The IUP-UB team will provide a consistent and consolidated set of data form the three instruments measuring the trace gases between 9:30h and 10:30h. Statistically significant monthly mean values

for the data products will be used for the determination of change and trends at the monthly, seasonal, yearly and decadal scales and trends over the period of measurements.

CNRS: global and temporal distributions of the main pollutants will be derived from satellite data (METOP: IASI/GOME-2, AURA: OMI, SCISAT: ACE, and CALIPSO). The measurements of EMEP and others will be used to validate and compare but also to undertake a stand-alone analyses. ACE and CALIPSO's ability to derive vertical information will be used to investigate the altitude at which pollutants are predominantly transported. Long-term changes in CO (IASI/MOPITT and NO_2 (GOME/GOME-2, and get information on what is responsible for the changes. MODIS observations will be retrieved to identify biomass and forest fires and to estimate the emissions of CO, PM and other precursors from such fires.

NILU: will make EMEP and AIRBASE in situ ground level data base available to be used for satellite data validation purposes by IUP-UB and CNRS.

metno, CNRS, INERIS, FRIUUK, ECPL, CNR, UiO: Development and application of chemical transport models. At the global scale the models TM4-ECPL, EMEP, MOZART, and OsloCTM2 are run for nearly a decade with a resolution of about 1°x1° and provide boundary conditions to the regional scales models: CHIMERE, EMEP, EURAD, used to simulate air quality at the regional/megacity scales, with a resolution of about 50km for Europe and China. The regional models provide boundary conditions for the urban scale simulations with CHIMERE, EMEP, EURAD and BOLCHEM for the selected hotspot cases, with a resolution of 5-10 km. The application of several models to the same cases provides us with a quantification of the uncertainty due to model variability (see City-Delta or Eurodelta experiences). The necessary emission input data for the hotspot scale and its surrounding regions, as well as data for land use is provided through the Tasks 1.4, 1.5, 1.6 and 1.7. For the regional and global scales the emission inventories come from Tasks 3.1 and 3.2. Meteorological fields are based on data from ECMWF (including ERA-40) or on reanalysis carried out using limited area models with global model boundary conditions from e.g. ECMWF (at metno the meteorological fields for the Unified EMEP model are generated using the HIRLAM model).

At the global and regional scales the databases for emissions and land use developed in the framework of international cooperative programs will be used: EDGAR and RETRO at the global scale, EMEP at the European scale. Running several models on the test cases allows to evaluate the model variability. Quality checking of the results will be based on comparison with in-situ and satellite data. Computation of health and ecosystem impact indicators.

1.2: Export fluxes from megacities: modelling spatial scales from the urban/hotspot scale to the global scale (metno, CNRS, INERIS, FRIUUK, FZJ, ECPL, CNR, UiO, ULeic)

The purpose is to quantify the pollutant fluxes between the 4 hotspots selected for case study and the surrounding regions and further to the global spatial domain (net fluxes can be both in and out of hotspot regions depending on the species and the atmospheric flow and emission distribution in a given event). The methodology will be elaborated in task 1.3.

metno, CNRS, ECPL, CNR, UiO: MOZART, EMEP, OsloCTM2, and TM4-ECPL will be run switching off the emissions in the hotspot areas to evaluate their impact on the regional and global spatial scales.

metno, INERIS, FRIUUK: CHIMERE, EMEP, EURAD will participate in the sensitivity analysis (with or without hot spot emissions) to assess the impact of urban areas at the regional scale. Each model will use the boundary condition that is the most appropriate for ensuring its correct performance.

Removing emissions in hot spot areas will help to assess their contribution, depending on their location, the period of the year, etc. on the rest of the world. Availability of several models will help estimating the uncertainties considering the range of variability of the model responses. Moreover, comparison between global and regional scale results will be performed for overlapped domains allowing a better understanding of model characteristics. Emission data will be adopted from international programs like EDGAR and EMEP.

It should be noted that some of the involved models will run in a self-nested model system to compute the import/export budgets in Europe and China from the hotspot areas with an expected improved accuracy, using methodologies developed in task 1.3.

CNRS: do a model calculation that complements those described above by running a Lagrangian model (CiTTyCAT) with single or multiple parcels to examine processing in plumes (trace gases and possibly aerosols), mixing between plumes and wet/dry deposition during export. The results will be compared with the resulting concentration and flux fields from global/regional models (e.g. CHIMERE, MOZART) to examine errors in Eulerian transport and chemical processing. Cases will be examined from the data-rich hotspot regions selected for study in this project. The MOZART model will be used to quantify the transport of chemical species emitted from the considered hotspots, for different years corresponding to the satellite observations analyzed in task 1.1. Inter-annual changes in long-range transport will be evaluated.

FZJ: A regional and a global chemistry climate model will be used with different resolutions to study vertical concentration profiles and horizontal and vertical export fluxes of an extended set of pollutants under different meteorological conditions and for various urban agglomerations (in the BeNeLux region and even extending to the Ruhr area, London and Paris). FZJ, together with FRIUUK, will assess the importance of different processes such as frontal lifting, convection, and turbulence on the export fluxes from hotspots, contributing in a significant way to the overall evaluation of hotspot pollutant fluxes in this task.

CNR: The BOLCHEM model will be used to study parameterization of vertical transport with specific reference to deep convection and the parameterization of the initial stage of transport from small scale sources (point sources) using Eulerian and Lagrangian approaches.

FRIUUK: Boundary conditions from the ECHAM5-HAMMOZ model of FZJ will be used together with the nesting option of EURAD to perform multi-scale simulations down to a horizontal grid size of 1 km. Highly resolved emission data are already available and in use for the Ruhr area (1 km, hourly resolution, VOC-speciation, point sources). The other hotspots selected for case studies inside and outside of Europe will be the subject of such model simulations as well, including process analysis for different climate and emission scenarios. Research carried out in this project will help to understand processes in different hotspots in a better way, contributing to increased forecasting reliability. As EURAD includes state-of-the-art 4D-VAR data assimilation, a study will be made of when reanalysis using 4D-VAR is particularly beneficial, and the consequences for calculated hotspot flux estimates over extended time periods will be discussed.

ULeic: Satellite data on multiple tracers will be used to quantify the exports of megacities and large urban conglomerations via long-range transport of CO and CO2. Multi-spectral satellites will be used to assess the role of uplifting and the role of transport. OCO/GOSAT will be used for emission estimates.

1.3: Documentation of new model tools (metno, PKU, CNRS, INERIS, FRIUUK, ECPL, FZJ, CNR, UiO)

One of the main challenges of the project is the model scale-bridging approach that will allow to assess the impact of hot spot areas on regional and global air quality, and conversely. It will be tackled by implementing a nested approach. More dynamic processes will be implemented with a two-way nested approach where the coarser resolution models implemented in the widest domains feed the highest resolution models through their boundary conditions. For the purpose of our applications, ozone and particulate matter as well as their precursors should be concerned by these processes. Results obtained in the fine-resolution domains can also be used for updating the information in the coarser grid. These methods could help improving model accuracy for a better understanding of the effect of focused emission areas on the rest of the domain. This is particularly relevant for the hot spot areas analysed in this project, impact of which is expected really significant.

metno, PKU, CNRS, INERIS, FRIUUK, ECPL, FZJ, CNR, UiO: Technical difficulties that must be overcome include the resolution of the chemistry, the mass conservation, and the management of the time step constraints in the different domains. An appropriate definition of the methodology will be established in this task for some of the involved models. The choice of relevant species to be transported will be the first priority. Sensitivity studies and considerations related to the chemistry of secondary pollutant precursors and intermediate products will be investigated. Priority will be put on gaseous compounds. Constraints related to computational power will also be documented.
CHIMERE, EMEP, BOLCHEM, Models-3/CMAQ and EURAD are the candidates for dealing from the regional to the urban scale. All these models have demonstrated their capacities to have good performances at both scales (see CITYDELTA, GEMS and PROMOTE projects). The EMEP model is also designed for running at the global scale, i.e. a fully nested chain can be developed at least for this model. The global scale models TM4-ECPL, ECHAM5-HAMMOZ, OsloCTM2 and MOZART will benefit from refined emissions and output from the regional scale models and will, in turn, provide improved boundary conditions.
The coupled opportunities brought by the availability of regional and global models in the same project will be studied and a fully nested approach will be promoted when the models characteristics have been studied thoroughly. Benefits taken from the dynamic nested approach will be compiled in a reference document, delivered by the work package.

1.4: Case study: The Eastern Mediterranean including hotspots the greater Athens, Istanbul and Cairo regions (ECPL, METU, NOA, and CEHM)
Note that Tasks 1.1/1.2 also address the East-Mediterranean hotspot and thus complement Task 1.4. The term 'Hotspot' is throughout this proposal taken to denote an extended large city (megacity) or even a region which is densely populated (like the BeNeLux or the East-Mediterranean region).

The study of the air pollution budgets, as well as their implications for the climate in the region and on a global scale, in the Eastern Mediterranean is a particularly important part of this proposal. Maria Kanakidou (ECPL) leads this activity which includes Task 1.4 with close links to Task 1.5.

ECPL, METU, NOA: Compile, evaluate and refine when possible in terms of spatial and temporal resolution, data for emissions and land use in the Eastern Mediterranean. ECPL and METU also compile and evaluate all available in-situ observations of air pollutants to the extent that the measurements are relevant for the subjects of study in this project. The partners will contribute to the basic data required to establish emission of the past decade, and for future scenarios, in cooperation with other emission experts (Task 3.1, 3.2).
ECPL: In addition to the TM4-ECPL applications in Tasks 1.1 and 1.2, the coupled aerosol gas phase chemistry model will also allow the evaluation of the interactions between pollution sources and natural emissions (terrestrial vegetation but also marine emissions since many megacities and large agglomerations are located near the coast) with regard to ozone, acids and to particulate matter formations. There is increasing evidence of build up of O3 and PM including SOA downwind of pollution sources that can be due to such interactions.
The geographical extent of the downwind impact of the pollution hot spots depends on air flow patterns and will be determined based on health- and ecosystem-indices, like the number of O3 and PM exceedences of a certain threshold, and change in the deposition of oxidised or reduced nitrogen to ecosystems. The ECPL contribution will particularly evaluate the impact of pollution hot spots affecting the Mediterranean basin, including Po Valley, Istanbul, Cairo and the extended Athens area. The ageing of VOC and OA composition and the changes in the hygroscopicity of aerosols as well as their transformation rate in polluted air masses exported from hotspot areas will be evaluated based on model calculations. The impact of the transformation and decomposition

products of the pollutant emissions from the Athens extended area, Istanbul and Cairo on the air quality in the East Mediterranean and the Black Sea will be evaluated based on the model calculations.

METU: will contribute observations for Istanbul and Erdemli, participate in the case study based on the in-situ measurements as well as aerosol observations derived from satellite. Their contribution to this task includes collection of data, modelling particularly long-range transports to (and from) Istanbul and vicinity and compilation of traffic emission of Istanbul.

CEHM: will contribute measurement data and analyses for the Cairo Area.

NOA: will provide data on multi-decadal meteorological/climatological records of precipitation, temperature, pressure etc, available gaseous tracer measurements, aerosol optical/physical properties and chemical composition. NOA will perform the basic statistical analyses of the available air quality measurements from the three megacities in the Eastern Mediterranean hotspot, to the extent that the measurements are relevant for the subjects of study in this project, and investigate relationships between pollution loads and climate parameters.

1.5: Case study: BeNeLux hotspot region (FRIUUK, FZJ, ULeic)

Note that Tasks 1.1/1.2 also address the BeNeLux hotspot region and thus complement Task 1.5. The term 'Hotspot' is throughout this proposal taken to denote an extended large city (megacity) or even a region which is densely populated (like the BeNeLux or East-Mediterranean region).

The purpose is to study the air pollution budgets, as well as their implications for the climate in the region and on a global scale of the BeNeLux hotspot region, including the Ruhr area.

FZJ, ULeic: Compile, evaluate and refine when possible in terms of spatial and temporal resolution, data for emissions and land use in the BeNeLux hotspot region. FZJ and ULeic also compile and evaluate the available in-situ observations of air pollutants to the extent that the measurements are relevant for the subjects of study in this project. These partners also contribute to the basic data required to establish emission of the past decade, and for future scenarios, in cooperation with other emission experts (Task 3.1, 3.2).

ULeic: Using a combination of ground-based networks and aircraft campaign data from around the London metropolitan, an assessment will be made of the scale, magnitude and variability of oxidant and particle production in the region. The observations will be used to assess the impact of a megacity on the regional atmosphere, on the ozone and oxidant budgets.

FRIUUK: Based on simulations carried out in WP1.2, episodes/events of specific interest for O3 and PM will be selected in the Ruhr area, where additional high-resolution model calculations with EURAD will be performed. Focus is on the importance of different processes (chemical transformation, deposition, turbulent transport, large scale transport) controlling the concentration of photo-oxidants (O3) and atmospheric particles. Budget analysis will be undertaken to investigate the impact of different meteorological/climate situations. Model results will be evaluated and interpreted using available data.

FZJ: will use coupled chemistry climate model to simulate selected episodes of interest for the BeNeLux/Northwest European hot spot region. Results shall be evaluated by comparison with observations and other models participating in this task.

1.6: Case study: The Po Valley (CNR, NILU)

Note that Tasks 1.1/1.2 also address the Po Valley hotspot region and thus complement Task 1.6. The term 'Hotspot' is throughout this proposal taken to denote an extended large city (megacity) or even a region which is densely populated (like the BeNeLux or Eastern Mediterranean region).

The purpose is to study the air pollution budgets, as well as their implications for the climate in the region and on a global scale of the Po Valley hotspot region.

CNR: collect the accessible in-situ observations of air pollutants to the extent that the measurements are relevant for the subjects of study in this project and will make available to the project. The partner contributes to a critical discussion of available emission inventories of the past decade, and for future scenarios, in cooperation with other emission experts (Task 3.1, 3.2).

CNR: numerical experiments will be carried out with BOLCHEM. Comparison will be performed using lidar measurements available from the national project AEROCLOUDS and from the network EARLINET ASOS. Specific measurements carried out during campaign will characterize the ozone and aerosol load. The integration of observations and model calculations is crucial for a careful assessment of the exchanges between the PoValley and the Mediterranean region and between the Po Valley and the rest of continental Europe.

NILU: Will use the EMEP Unified model to study photochemical processes and in particular reactions between anthropogenic NOx from megacities and biogenic VOC (isoprene/terpenes) from surrounding vegetation areas that are likely to occur on a fine temporal and spatial scale. The mixing zone between the megacity plume and nearby vegetation will be studied in a nested EMEP model (i.e. a model covering different grid scales) for the formation of ozone and secondary organic aerosols (SOA). Observations from the FORMAT project (FP5, coordinated by NILU) of formaldehyde (an isoprene degradation product) will be used, in addition to isoprene data. A national research project for the development of SOA modelling will also support this task. Various chemical mechanisms for use on local scale vs on regional scale will be evaluated. Sensitivity studies, quantifying the importance of feedback mechanisms, such as increased temperatures and radiation on the photochemistry, will be carried out.

1.7: Case study: The Pearl River Delta (PKU, FZJ)

Note that Tasks 1.1/1.2 also address the Pearl River Delta issues and thus complement Task 1.7. Hotspot is throughout this proposal taken to denote an extended large city (megacity) or even a region which is densely populated (like the Pearl River Delta or Eastern Mediterranean regions).

The purpose is to study the air pollution budgets, as well as their implications for the climate in the region and on a global scale of the Pearl River Delta hotspot region.

The objective of the Pearl River Delta case study is to characterize temporal and spatial changes of aerosol, oxidant and their precursor concentrations, to understand chemical composition, size distribution, hygroscopic properties, and optical properties of aerosols, to quantify ozone formation by measurements and modelling, and to explore the relationship of species between aerosol and gas phase.

PKU: Compiles, evaluates and refines when possible in terms of spatial and temporal resolution, data for emissions and land use in the PRD hotspot region. PKU also compiles and evaluates the available in-situ observations of air pollutants to the extent that the measurements are relevant for the subjects of study in this project. The partner also contributes to the basic data required to establish emission of the past decade, and for future scenarios, in cooperation with other emission experts (Task 3.1, 3.2).

PKU: Data analysis of Pearl River Delta intensive campaigns in 2004 and 2006 will be made by observational-based model and regional model. An additional intensive campaign can be arranged in 2008 if necessary. Using a combination of ground-based networks and campaign data, an assessment will be made of the scale, magnitude and variability of oxidant and particle production in PRD. CMAQ and its inverse model will be used to assess the impact of a megacity on the regional atmosphere and to evaluate regional emission inventory. Aerosol optical properties and its climate effects will be evaluated by numerical closure experiments. Control strategy will be recommended as one of outputs in the project.

An integrated set of models is needed, going from urban to regional scales. This set of models is developed in close collaboration with the other partners and parameterized to fit the Chinese

circumstances.
FZJ: perform additional analysis of the field campaign data of summer 2006 in the Pearl River Delta and Beijing regions.

Deliverables
D1.1.1: Data set of tropospheric columns of NO2, SO2, HCHO, and CHOCHO over selected areas from GOME and SCIAMACHY (1995 – 2006) (month 12)
D1.1.2: Data set of aerosol optical depth over selected areas from SeaWiFS data (month 12)
D1.1.3: Data set of aerosol optical depth over selected areas from MERIS data (month 24)
D1.1.4: Analysis of the evolution of air quality in the studied high emissions areas over the 10 past years (month 24)
D1.1.5: Data set of tropospheric columns of NO2, SO2, HCHO, and CHOCHO over selected areas from GOME, SCIAMACHY and GOME-2 (1995 – 2009) (month 34)
D1.1.6: Final project assessment of air quality in hotspots areas for the last decade derived from nested modelling, remote sensing and in-situ measurements (month 34)
D1.1.7: Publication on air quality in hotspot areas (month 36)
D1.2.1: Report on evaluation of transport pathways based on model results and analysis of satellite data (month 18)
D1.2.2: Assessment of the impact of pollutant height release on its vertical distribution and its transport downwind of urban areas (month 21)
D1.2.3: Publication on scale errors in global model simulations based on comparison with regional/Lagrangian model results and also observations (month 23)
D1.2.4: Report on evaluation of the seasonal import/export budgets of targeted hotspots to regional and global air quality (mainly for ozone and PM) (month 36)
D1.3.1: First report on model tools and the implementation of a common approach to bridge scales in a dynamic fashion in models (month 16)
D1.3.2: Second report on model tools and the implementation of a common approach to bridge scales in a dynamic fashion in models (month 30)
D1.4.1: First observational data compilation for the Eastern-Mediterranean area (month 10)
D1.4.2: New targeted observations in the area (month 24)
D1.4.3: Model evaluated trends of ozone, PM and deposition patterns over the recent 10-20 years, discrimination between anthropogenic and natural contributions (month 28)
D1.4.4: Report on import/export budgets from the East-Mediterranean area at the regional and global scales (month 36)
D1.5.1: Data compilation for the Benelux/Ruhr area (month 16)
D1.5.2: Evaluation of current state of modelled ozone, PM and deposition fields (month 22)
D1.5.3: Report on import/export budgets from the Benelux to regional and global scales (month 24)
D1.6.1: Data compilation for the Po Valley (month 16)
D1.6.2: Evaluation of current state of modelled ozone, PM and deposition fields (month 22)
D1.6.3: Report on import/export budgets from the Po Valley area at the regional and global scales (month 24)
D1.6.4: Publication on the contribution to and from the surrounding region to the air pollution in the Po Valley (month 36)
D1.7.1: Data compilation for the Pearl River Delta (PRD) (month 12)
D1.7.2: Evaluation of current state of modelled ozone, PM and deposition fields (month 22)
D1.7.3: Report on import/export budgets from the PRD area at the regional and global scales (month 24)
D1.7.4: Peer-reviewed publication on the outflow of pollutants from the PRD and their impact on the regional to global scales (month 36)

Work package number	2			**Start date**	Month 1		
Work package title	Megacity Air Quality and Climate Change. WP leader Martin Schultz, FZJ						
Activity Type	RTD						
Participant number	1 metno	2 PKU	3 CNRS	4 INERIS	5 IUP-UB	6 FRIUUK	**7 FZJ**	8 ECPL
Person-months	*7*	*5*	*4.8*	*3*	*12*	*8*	***15***	*5.5*
	9 CNR	10 NILU	11 UiO	12 METU	13 ULeic			
	5	*5.5*	*5*	*5*	*3*			

Objectives

- Derive greenhouse gas emissions from megacities and hotspots during the past and the present through combined use of emission data with remote sensing, in-situ measurements, and inverse modelling.
- Quantify the impact of extreme weather conditions on natural emissions and air pollution levels in European hot spots based on the analysis of observational data and model results for the summer 2003 heat wave.
- Establish a common reference database for intercomparison of the models participating in CITYZEN based on year 2003 simulations and link the results from this study to results obtained in the EU projects QUANTIFY and GEMS.
- Explore the potential impacts of future climate change on megacity emissions and air pollution levels by analyzing IPCC climate scenario experiments and using a coupled chemistry climate model and chemistry transport models for selected scenarios.
- Assess the impact of megacity greenhouse gas and air pollutant emissions on weather and climate using ground-based and satellite observations and numerical models on various scales.
- Perform coupled chemistry climate simulations in high resolution to explore feedback effects between air pollution emission changes, chemical processes and changing weather patterns.

Description of work (for each task)

2.1: Quantify past and present greenhouse gas and aerosol emissions from urban agglomeration areas over the last two decades (CNRS, IUP-UB)

The purpose is to quantify past and present greenhouse gas and aerosol emissions from urban agglomeration areas over the last two decades.

CNRS: Present-day emissions from megacities will be quantified through inverse modelling of recent satellite observations (METOP IASI, METOP GOME2, AURA/OMI, CALIPSO) and the inter-annual, seasonal, weekly and daily patterns will be characterized. Specific retrievals of satellite data will be performed at the city scale. The results will be compared with bottom-up emission estimates.

IUP-UB: SCIAMACHY retrievals of CO_2 and CH_4 dry mixing columns will be performed in order to establish the data record for SCIAMACHY greenhouse data from 2002 to 2009 and to provide a consistent time series on the global scale. CO_2 and CH_4 retrievals over land will be compared to assimilation models of CO_2 (e.g. Carbon Tracker) based on ground based data. The temporal changes in greenhouse gas column densities will be compared with trends in bottom-up emission data.

2.2: Case study: the European summer 2003 heat wave (metno, CNRS, INERIS, IUP-UB, FRIUUK, FZJ, CNR, NILU, UiO, METU, ULeic)

The purpose is to evaluate how the hot, polluted event which peaked in the first half of August 2003 over Central- and West Europe modified the efficiency of deposition, of anthropogenic and biogenic emissions, of convective activity and other parts of the hydrological cycle, of air parcel residence times in the atmospheric boundary layer, of boundary layer mixing properties, and of the temperature dependent chemical fluxes through the chemical processing mechanisms.

metno, CNRS, INERIS, IUP-UB, FRIUUK, CNR, NILU, METU, ULeic: Work together to establish the best possible datasets for anthropogenic emissions, observations (in-situ from the surface and aircraft, remote sensing from satellite and the ground), surface-atmosphere fluxes including land use types and its state, biogenic emissions, meteorological data and process descriptions relevant for model calculations of the particular physical, chemical and dynamical conditions prevailing in the hot and polluted conditions in particular in August 2003 in central- and west Europe).

ULeic: Using a combination of ground-based networks and aircraft campaign data from around the London metropolitan, an assessment will be made of the scale, magnitude and variability of oxidant and particle production in the London region contrasting the summer 2003 situation with normal conditions. In particular the data will be analysed to assess role of in-situ chemistry in evolution and production of SOA by assessing the role of BVOCs in the acceleration of the formation of oxidant from megacities. Data for soil moisture and land/atmosphere water vapour fluxes will be applied to evaluate how surface changes could have contributed to the elevated ozone and PM levels. The available CO measurements will be used to find out how boreal forest fires in Siberia (and on the Iberian peninsula) could have contributed to the increases in pollutants.

UiO: Numerical simulations of the summer 2003 heat wave will be performed with a high resolution (1x1 degree) global model using assimilated meteorological data. Sensitivity studies to assess the impacts of different meteorological, chemical and biological processes on the ozone levels will be performed and the simulated air pollution levels over European and other hot spot regions will be compared with regional and local scale models and ground based and satellite observations. The global-scale results from these studies will be linked to modelling efforts in the European QUANTIFY project.

metno, NILU: Use the EMEP Unified Model to study photochemical processes and in particular reactions between anthropogenic NOx from megacities and oxidation products from biogenic VOC (isoprene/terpenes) emitted from surrounding vegetation areas on a fine temporal and spatial scale. Observations of formaldehyde (an isoprene degradation product) from the FORMAT project will be used, in addition to isoprene data, to evaluate the model simulations. The mixing zone between the megacity plume and nearby vegetation will be studied in detail with a nested EMEP model (i.e. a model covering different grid scales) for the formation of ozone and secondary organic aerosols (SOA). The scale-dependency of the model results will be assessed and various chemical mechanisms for use on the local to regional scale will be evaluated. Sensitivity studies, quantifying the importance of feedback mechanisms, such as increased temperatures and radiation on the photochemistry, will be carried out. Evaluate how the hot event in the summer 2003 modified the efficiency of deposition, of biogenic emissions, of convective activity, of air parcel residence times in the atmospheric boundary layer, of boundary layer mixing properties, and of the temperature dependent chemical fluxes through the chemical processing mechanisms.

FRIUUK: Numerical simulations will be undertaken for the European and local scale with horizontal grid resolution down to 1 – 5 km. The focus will be placed on the densely populated Ruhr area for which an emission data set with a 1 km resolution is already available. The impact of changes in meteorological conditions and the impact of emission reductions will be analysed through sensitivity simulations. Different chemical mechanisms (RACM, RACM-MIM) will be applied and intercompared. The model results will be compared with larger scale model results from partner FZJ and field measurements during the ECHO campaign performed in North-Rhine Westphalia during the summer of 2003.

CNR: The BOLCHEM model with EMEP emissions and chemical nesting capabilities will be used

to simulate ozone levels over Europe during the summer 2003 heat wave. Special attention will be given to the Po Valley region, where a strong inhomogeneous surface pattern of urban and rural terrain is present.
FZJ: The coupled chemistry climate model ECHAM5-HAMMOZ will be used in 1x1 degree resolution to simulate the European heat wave in the summer of 2003 and to investigate the relative role of gas-phase and aerosol compounds for air pollution levels during this period. The model will be initialized with assimilated meteorological data and short simulations without meteorological constrains will be made to assess the radiative forcing impacts of specific greenhouse gases and aerosol components. The results from these studies will be linked to analyses from the European GEMS project and the modelling results from the other project partners.

2.3: Quantify impacts of climate change on Megacity air quality and regional air pollution (metno, PKU, FZJ, ECPL, UiO, METU)
The purpose is to quantify impacts of climate change on hotspot air quality and regional air pollution for the four hotspot regions selected for special study.

PKU, FZJ, ECPL, METU: Results from IPCC climate scenario simulations performed at the Max Planck Institute in Hamburg will be analysed for the selected megacity regions in order to assess potential climate change in these areas. The coupled chemistry climate model ECHAM5-HAMMOZ will be used to simulate the decade of the 2050s. At least 10 years of results are needed to obtain a reliable statistics. A minimum of 4 runs will be performed on the global scale: 1) present climate - present emissions, 2) future climate - present emissions, 3) future climate - future emissions, and 4) present climate - future emissions. The results will be compared with other studies in the literature and the impact of climate change on air pollution levels will be assessed.
UiO: Perform model runs with the OsloCTM2 driven by met data from a climate model for 2050. Quantify the change in air quality and the chemical active compounds through comparisons with model runs using current day meteorology. Meteorological input data will be provided by *FZJ*. Comparisons with model runs where no meteorological change is assumed, but emission changes over the same time period are used.
metno: Carry out EMEP Unified Model calculations nesting down to the urban scale for the 4 hotspots that are selected cases for time slices (parts 2030s and 2050s sufficient to get a statistically valid distribution of possible pollution events under climate change, based on FZJ-high resolution climate data and a selection of the emission scenarios from WP3.

2.4: Contribution of air pollution from megacities to climate change (PKU, INERIS, IUP-UB, FZJ, ECPL, CNR, ULeic)
The purpose is to calculate the contribution of air pollution from hotspot regions to climate with focus on the four hotspot regions selected for special study.

CNR: Detailed measurements of size segregated chemical composition of aerosol, together with background measurements and main gaseous components will allow detailed investigation of the basic processes that occur in the megacity plume leaving the Po Valley. The simultaneous measurements in two sites in the Valley (Milan, in the centre of one of the major urbanizations, and San Pietro Capofiume, in a rural area) and in a high level station (Monte Cimone, monitoring the troposphere just higher of the valley boundary layer) gives the possibility to perform detailed comparisons between two main types of air masses and of the impact of the high polluted atmosphere on the regional radiative forcing.
ULeic: Application of satellite and ground-based observations to determine the impact of megacities on downwind cloudiness thereby implying a regional climate forcing. SEVERI measurements from MSG (over Europe) will be used to seek evidence for downwind change in

cloud optical properties. On a test case basis the cloud properties will be measured using radar data available from the UK cloud radar, in coordination with Aerosol Optical Depth analyses that have been retrieved from MERIS and other high resolution instruments by IUP-UB. Testing will precede the detailed analysis.
IUP-UB: The optical properties of aerosol over Europe and the Atlantic will be retrieved and analysed. Their impact of the radiation balance and thereby climate will be studied.
INERIS: In a first step, averaged monthly radiative forcings will be calculated on a 5 years period by a regional CTM (1995-2000) using a climate simulation without radiative forcings. In a next step, these radiative forcings will be injected in a regional climate model (RegCM or MM5) to compute the next period (2000-2004), a new set of monthly average radiative forcings will be calculated by the CTM and injected in the next climate calculations, and so on until 2070. This work will allow assessing the impact of the evolution of air quality on climate.
FZJ: Results from the European RETRO project will be evaluated to detect possible past changes in meteorology originating from changing megacity emissions. A perturbation run using the RETRO setup will be performed with no or reduced megacity emissions and spanning at least one decade. Furthermore, the impact of regional chemical emission patterns (NOx-CO-NMVOC ratios) in megacities will be analysed. These results will be contrasted with a future scenario run. The radiative forcing of greenhouse gases and aerosols from these simulations will be evaluated.
ECPL: The CTM TM4-ECPL, coupled with an aerosol radiative (direct) forcing module, will be applied to evaluate the radiative forcing by pollution emissions from hot spot regions. Recent changes in the atmosphere and its aerosol radiative forcing due to population and pollution growth will be evaluated.
Meteorological observations during the recent decades will be analyzed in conjunction with air quality observations selected to detect interactions between climate and air quality with focus on the pollution hot spot areas over the studied area. Chemical and hygroscopic changes of aerosol and the aerosol turnover time in polluted air masses exported from the East Mediterranean hot spot areas will be assessed. The impacts on air quality, on pollutant deposition and on climate forcing of the export of pollution plumes from the studied area versus that from other polluted areas like China (trans-boundary pollution) will be evaluated.
PKU: Data obtained in closure experiments of aerosol optical properties in PRD will be used to evaluate aerosol radiative forcing. The large and partially compensating effects of direct cooling and heating by black carbon will be studied. The very important role of particulate organic carbon in aerosol direct effect will be elucidated. The impact of the changing emissions from the PRD mega-city cluster on aerosols, including their mixing state, will be analysed. The very strong interactions between ozone and secondary aerosol formation will be evaluated including the changes in these interactions due to future developments in emissions.
CNRS: Use MOZART to evaluate the fluxes from the four hotspot cases selected for special study, to the global/regional burden of BC, OC and SOA.

2.5: Chemistry-climate modelling: aerosol and ozone impact (metno, FZJ)
The purpose is to calculate how the concentration and distribution of ozone, with focus on the four hotspot regions selected for special study, impact on the distribution of climate parameters regionally and globally.

FZJ: The coupled chemistry climate model ECHAM5-HAMMOZ will be spun up with prescribed sea surface temperatures (or full meteorology) from recent IPCC simulations and then run in an unconstrained climate mode to test the "divergence" of 1-2 months climate simulations under various ozone precursor and/or aerosol source scenarios. A set of realisations (ensemble) will be run to ensure statistical reliability. Runs will be made in T106 resolution (roughly 1 degree) or better and they will be analysed with a special attention given to the selected hot spot regions.

metno: Global runs with the NCAR CAM3 model including the aerosol direct and indirect feedback will be performed with T42 or T106 resolution as part of a Norwegian national climate project. The results from these simulations will be analysed to detect bidirectional feedbacks between climate change and air pollution emissions in the selected hot spot regions.

Deliverables

D2.1.1: Data set of dry mixing columns of CO2 and CH4 over selected areas from SCIAMACHY (2002 – 2006) (month 18)
D2.1.2: Report on greenhouse gas and aerosol emissions from megacities derived from observations and inverse modelling (month 26)
D2.2.1: Report on high-temperature impact on BVOC emissions and air quality for the summer 2003 case (month 12)
D2.2.2: A database presenting air quality changes (e.g. surface ozone) in NW Europe during the summer 2003 heat wave, including observational and model data (month 30)
D2.3.1: Report on climate induced changes in air quality and chemical composition on different scales (month 34)
D2.4.1: Report on changes in meteorology due to megacity emissions based on an analysis of the RETRO data base (month 18)
D2.4.2: Identification of OM sources (primary and secondary components) by NMR (month 22)
D2.4.3: Report on reductions of the uncertainties in estimates for direct aerosol forcing and heating by black carbon (month 24)
D2.4.4: Publication on aerosol impact (month 36)
D2.5.1: Report on megacity impact on the distribution of climate parameters regionally and globally (month 30)

Work package number	3			**Start date**	Month 1			
Work package title	Megacity in the Future – Mitigation options for a sustainable Atmosphere. WP leader Paul Monks, ULeic							
Activity Type	RTD							
Participant number	1 metno	2 PKU	3 CNRS	4 INERIS	6 FRIUUK	7 FZJ	8 ECPL	9 CNR
Person-months	*6*	*22*	*9.4*	*3*	*7*	*6*	*10*	*3.5*
	10 NILU	11 UiO	**13 ULeic**	14 IIASA				
	1	*5*	***6***	*16*				

Objectives

- Establish future scenarios of population development and needs for energy and how these reflect on emissions of the four hotspot cases (E Mediterranean, Po Valley, BeNeLux, Pearl River Delta) and the associated national, regional and global total emissions
- On the basis of the emissions scenarios and the nested model systems evolving from WP1 and WP2 calculate the changes in air quality in the four hotspot cases and the associated changes in pollutant fluxes between the hotspots and the surrounding regions for future time intervals (preliminary planned for 2030 and the 2050s).
- On the basis of emission scenarios calculate the coupled climate change - hotspot air quality impact for the 2050s for the four hotspots.
- Identify options to mitigate future environmental impacts on air quality and climate from the four hotspots. Make suggestions for a sustainable development

Description of work (for each task)

3.1: Comparison and evaluation of available emission inventories (metno, PKU, CNRS, FZJ, ECPL, CNR, ULeic, IIASA)

The purpose is to compare and evaluate existing emission inventories to recommend “best available” high resolution emission inventories for use in hotspot air pollution models for the last decade.

metno, PKU, FZJ, ECPL, CNR, ULeic, IIASA: Evaluate available emission inventories for the four hotspots selected as special cases. Compare their consistency with the national and regional emission inventories. Recommend “best available” high resolution emission inventories for use in hotspot air pollution models for the last decade.
CNRS: In a first step, assess the consistency of the surface emissions inventories used in the global and regional models for past, current and future emission conditions. If necessary, in a second step, the emissions inventories used in the CITYZEN simulations will be harmonized.
FZJ: Evaluation of emission inventories on the basis of detailed emissions data from the RETRO project and contribute to the analysis of regional-scale differences.
metno: EMEP emissions for regional, global and local emission inventories including sector allocation of emissions; establishment of the mechanisms that generate emission estimates (sector activities; economical/technological scenarios); compare existing global emission inventories and data from national inventories in US, Canada and China.
PKU: The data obtained by emission inventories and inverse modelling will be compared, and EMEP’s intercomparison are supported.
IIASA: Establish consistency between the urban emission inventories with inventories available in the GAINS model for the national or state level (in China).

3.2: Evaluate emissions from megacities with focus on hydrocarbons (PKU, CNRS, NILU,

ULeic)
The purpose is to evaluate emissions from megacities with focus on hydrocarbons.

CNRS: Harmonize currently available global and regional emissions inventories (RETRO for emissions since 1960, GICC since 1900, EDGAR for 2000, and EMEP for regional EU emissions) in collaboration within the GEIA network and the Chinese partners in Beijing and Shanghai. Information on hydrocarbon speciation in RETRO and EMEP will be used, and a methodology for providing emissions of a larger number of species will be developed. This activity will complement the work done in Task 3.1.
PKU: use CMAQ inverse modelling and footprint method to evaluate emission inventory of hydrocarbons, NOx and other pollutants. Hydrocarbons speciation of main anthropogenic origin can be evaluated by source testing data and regional modelling.
NILU: Evaluation of EMEP VOC emission estimates by using the EMEP Unified model to study photochemical processes and in particular reactions between anthropogenic NOx from hotspots and biogenic VOC (isoprene/terpenes) from surrounding vegetation areas that occur on a fine temporal and spatial scale. The mixing zone between the megacity plume and nearby vegetation will be studied in a nested EMEP model for the Po Valley and using observations from the FORMAT project (coordinated by NILU in FP5) of formaldehyde (an isoprene degradation product) and other species, in addition to a few data sets of isoprene, and the implications for the VOC emission inventories will be assessed.
ULeic: Evaluate VOC emission speciation on the basis of existing ambient VOC observations.

3.3: Future emission scenarios (metno, PKU, CNRS, INERIS, FRIUUK, FZJ, ECPL, CNR, UiO, ULeic, IIASA)
The purpose is to evaluate existing emission scenarios with a particular emphasis on the hotspot regions selected for special study, to establish the emissions to be used in the mitigation analysis in the project.

IIASA: Several emission scenarios will be developed and used as input to the future and mitigation studies of Task 3.4 and WP4. Among the specifications for the emission scenarios to be developed are the following mitigation options:

- Structural changes in transport: changes in the hotspot transport infrastructure for supplies and personal communication
- Technical changes in transport by generalized use of biofuels and alternative fuels
- Structural changes in population distribution in the hotspots and associated emission changes

Emission scenarios will be developed with focus on the four selected hotspots (Po Valley, Eastern Mediterranean, BeNeLux, and Perl River Data)

metno, PKU, CNRS, INERIS, FRIUUK, FZJ, ECPL, CNR, UiO, ULeic, IIASA: Existing emission scenarios (EU baseline scenario, IPCC scenarios including those that will be established for the Fifth assessment report, bottom-up scenarios calculated on the basis of sectoral activity models for the four selected hotspots, the surrounding regions/countries and globally) will be evaluated and compared.

3.4: The impact of future emissions on air quality and climate (metno, PKU, CNRS, INERIS, FZJ, ECPL)
The purpose is to analyse how future emissions give rise to changes in air quality and climate in particular related to the four hotspot regions selected for special study, and to discuss implications for mitigation strategies for air quality and climate combined.

INERIS: *A* regional climate model RegCM will be used to make meteorological simulations for five years and a regional CTM to calculate radiative forcings which in turn are introduced in the climate model to compute the next five year period, and so on until 2070. This will allow the assessment of changing air quality on climate and likely contribute to the IGAC-IGBP / SPARC-WCRP initiative on Atmospheric Chemistry and Climate.
INERIS: Using emission scenarios from Task 3.3 for some of the hotspots selected as special cases, CHIMERE will be run to evaluate the impact of the mitigation scenarios. Impact in the city itself and also at the regional level will be considered for the different cities. Metrics related to ozone and PM concentrations will be defined so that population exposure can be estimated.
ECPL: TM4-ECPL, coupled with an aerosol radiative (direct) forcing module, will be applied to evaluate the consequences on radiative forcing of the case-study hot spot pollution emissions. Future changes in the atmosphere and its aerosol radiative forcing due to population and pollution growth will be evaluated. The impacts on air quality, on pollutant deposition and on climate forcing of the export of pollution plumes from European large agglomerations versus that from other polluted areas like China (trans-boundary pollution) will be evaluated.
CNRS: Sensitivity studies: Assess air quality/regional air pollution from hotspots if gasoline is replaced by biofuel: Use the MOZART global model to test a few scenarios of replacement of fossil fuel by biofuels.
PKU: Mitigation scenarios in PRD will be made in very close communication with government and collaborators in the project (see Tasks above). Then the scenarios will be evaluated by CMAQ under consideration of regional and local impacts.
FZJ: Spin up ECHAM5-HAMMOZ simulation with prescribed sea-surface-temperature SST (or full meteorology) and test the "divergence" of 1-2 months climate simulations under various ozone precursor and/or aerosol source scenarios. A set of realisations (ensemble) will be run to ensure statistical reliability. Runs will be made in T106 resolution (roughly 1 degree) or better.
metno: Perform global runs with NCAR CAM3 with aerosol direct and indirect feedback on-line in the calculations with T42 or T106 resolution for emission scenarios that will be in line with the recommendations for the IPCC 5th assessment report (Part of a Norwegian national climate project).

3.5: Quantify impacts of climate change on hotspot air quality and regional air pollution (metno, FZJ, UiO)
The purpose is to quantify impacts of climate change on in particular the air quality in the four hotspot regions selected for special study, and to discuss implications for mitigation strategies for air quality and climate combined.

metno, FZJ, UiO: The results of the calculations done in Task 2.4 will be analysed for the four hotspot regions selected for special study, with the particular purpose to identify events in the calculated pollution climatology where the magnitude of the “climate change signal” in the distribution and variability of air pollution is comparable to or larger than the impact that reductions in anthropogenic emissions have on the concentration and distribution of ozone and PM. Such “events” (which for instance can be of the hot, polluted European summer 2003-type) will be studied and additional calculations carried out to investigate the driving mechanisms behind particularly significant results. The implications for any mitigation strategy of air pollution under climate change, will be investigated in particular.

Deliverables
D3.1.1: Report on the assessment of the consistency of the emissions inventories used in the CITYZEN models (month 12)
D3.1.2: Database for the participants to the project, including preliminary emissions inventories of

chemical compounds at the global and regional scale (month 12)
D3.1.3: Harmonization of the inventories available in the database developed within Task 3.2 (month 24)
D3.2.1: Database for the participants to the project, including emissions inventories of chemical compounds at the global and regional scale, considering more specifically hydrocarbons for several megacities and extension at the regional/global scale (month 18)
D3.2.2: Report and documentation for the emissions database (based on final emission data) (month 24)
D3.3.1: Data base of preliminary future emissions for the different scenarios (month 15)
D3.3.2: Data base of final future emissions for the different scenarios (month 24)
D3.3.3: Report on evaluation of the impact of a partial replacement of fossil fuel by biofuels for transportation and energy generation, on air quality in megacities and at larger scales (based on final emission data) (month 36)
D3.3.4: Report on the definition of mitigation scenarios which could be proposed to deal both with air quality in megacities and climate change (month 36)
D3.4.1: Report on future air quality changes on different scales based on the adopted scenarios (month 24)
D3.5.1: Report on implications of mitigation strategies for air pollution under climate change (month 24)

Work package number	4			**Start date**	Month 1			
Work package title	Integration of tools and support to policy. WP leader Leonor Tarrason, metno							
Activity Type	RTD							
Participant number	**1 metno**	2 PKU	3 CNRS	4 INERIS	5 IUP-UB	6 FRIUUK	7 FZJ	8 ECPL
Person-months	***12***	*10*	*9.4*	*2*	*1*	*1*	*6*	*1*
	9 CNR	10 NILU	11 UiO	12 METU	13 ULeic	14 IIASA		
	7	*1*	*2*	*2*	*4*	*3*		

Objectives

- Demonstrate how the research results and the model methodology developed in WPs 1 to 3 is applicable beyond the four hotspot cases by doing calculations of future air quality (preliminary planned for 2030 and 2050s) for Europe
- Analyse the coupled climate -atmospheric chemistry model results for the 2050-decade for Europe and beyond, in order for the first time to provide a high resolution coupled calculation over a sufficiently long time period to provide a statistically significant evaluation of how climate change signals by then can modify the air pollution improvement from emission reductions alone.
- Establish and document the generic aspects of the model tools developed in WPs 1 to 3 for the analysis of mitigation options for air pollution in hotspots. Ensure the integration of results from the other 3 work packages
- Work with national authorities, intergovernmental organisations and EU-institutions to prepare for and whenever possible provide technical underpinning of policy
- Ensure that the improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact

Description of work (for each task)

4.1 Demonstrate how the research results and the model methodology developed in WP1-3 are applicable beyond the four hotspot cases by doing calculations of future air quality (preliminary planned for (parts of) 2030 and 2050s) for Europe (metno, UiO)

The purpose is to demonstrate how the research results and the model methodology developed in WP1-3 are applicable beyond the four hotspot cases by doing calculations of future air quality (preliminary planned for (parts of) 2030 and 2050s) for Europe.

UiO: Extend the Task 2.3, where model runs are performed with the OsloCTM2 driven by met data from climate model for the 2050s (and perhaps the 2030s). Quantify the change in air quality and the chemical active compounds through comparisons with model runs using current day meteorology. Meteorological input data provided from GCM scenario runs (either internal from the project partner FZJ or external runs available through the IPCC-process from one of the international climate model groups). Comparisons with model runs where no meteorological changes is assumed, but emission changes over the same time period is used.
metno: Extend the Task 2.3 where EMEP Unified Model calculations are carried out nesting down to the urban scale for the 4 selected hotspots for time periods (parts 2030s and 2050s) sufficient to get a statistically valid distribution of possible pollution events under climate change, based on FZJ-high resolution climate data and a selection of the emission scenarios from WP3. The analysis will focus on Europe including its hotspots. Meteorological input data provided from GCM scenario runs (either internal from the project partner FZJ or external runs available through the

IPCC-process from one of the international climate model groups). Emission scenarios compatible with those driving the GCM calculations for the meteorology will be applied. The analysis will focus on Europe including its hotspots.

4.2 Analyse the coupled climate-atmospheric chemistry model results for the 2050-decade for Europe and beyond, in order for the first time to provide a high resolution coupled calculation over a sufficiently long time period to provide a statistically significant evaluation of how climate change signals by then can modify the air pollution improvement from emission reductions alone (FZJ).

The purpose is to analyse the coupled climate-atmospheric chemistry model results for the 2050-decade for Europe and beyond, in order for the first time to provide a high resolution coupled calculation over a sufficiently long time period to provide a statistically significant evaluation of how climate change signals by then can modify the air pollution improvement from emission reductions alone**.**

FZJ: Extend Task 3.4 where a ECHAM5-HAMMOZ simulation is spun up with prescribed sea-surface-temperature SST (or full meteorology) and test the "divergence" of 1-2 months climate simulations under various ozone precursor and/or aerosol source scenarios. A set of realisations (ensemble) will be run to ensure statistical reliability. Runs will be made in T106 resolution (roughly 1 degree) or better. The results will be analysed in particular for Europe to derive a climatology of pollution events over a sufficiently long time period to be able to estimate the magnitude of the "climate change signal" in the distribution and variability of air pollution over Europe. This will for the first time provide a sufficiently large sample of pollution events under climate change to allow us to make a rigorous statement about the likelihood that the concentration and deposition reductions in response to sectoral emission controls e.g. of traffic or power generation, at certain times or even averaged over longer time periods like a season, can be significantly modified by the climate change conditions.

4.3 Establish and document the generic aspects of the model tools developed in WP1-3 for the analysis of mitigation options for air pollution in hotspots. Ensure the integration of results from the other 3 work packages (metno, CNRS, INERIS, FRIUUK, ECPL, CNR, UiO, ULeic)

The purpose is to establish and document the generic aspects of the model tools developed in WP1-3 for the analysis of mitigation options for air pollution in hotspots. Ensure the integration of results from the other 3 work packages.

***metno, CNRS, INERIS, FRIUUK, ECPL, CNR, UiO, ULeic*:** In WP1, task 1.1, the models TM4-ECPL, EMEP, MOZART, OsloCTM2 are run at a global scale, the models CHIMERE, EMEP, EURAD at regional/megacity scales, and CHIMERE, EMEP, EURAD, BOLCHEM at urban scales for the selected hotspot cases. Based on the evaluation of the models, the emission inventories, the model results, the errors identified and improvements made to the model systems, the fluxes of pollutants from the selected hotspots to the surrounding region have been calculated in WP1 and WP3 both for the past decade and for future years. In this way the models nest together the global, regional and urban spatial scales in so that uncertainties that arise from differences in process parameterizations as well as numerical methods, are minimised.

The formulation, results and evaluation of these models will be documented. Evaluation of the ability of the ensemble of 2 global models, 3 regional models and 4 urban scale models to forecast future climate and emission situations will be carried out. The variability in the responses from the ensemble of models will be quantified. It will be analysed how this variability changes across different regions and for the different scenarios. Conclusions will be drawn on the capability of the ensemble approach and the added value of considering different models for the analysis of impacts.

In this way a set of spatial-scale bridging models are established and evaluated. This set of models can serve the purpose of providing technical analysis of the value of mitigation options for air pollution in hotspots.

4.4 Work with national authorities, intergovernmental organisations and EU-institutions to prepare for and whenever possible provide technical underpinning of policy (metno, PKU, INERIS, IUP-UB, FRIUUK, NILU, IIASA)

The purpose is to work with national authorities, intergovernmental organisations and EU-institutions to prepare for and whenever possible provide technical underpinning of policy. This Task is further elaborated in Section 3.1.2 of the proposal, and contributes to the implementation of "The expected Impact" as specified in the call text and detailed in Section 3.1.2.

metno, PKU, INERIS, FRIUUK, NILU, IUP-UB (and other partners) will advise their European and national environmental agencies and ministries of environment on matters related to air pollution in hotspots and their broader implications for climate. Special care will be taken for BeNeLux (including the Ruhr area), which is covered only by FRIUUK, while no partners from Belgium, the Netherlands or Luxemburg are included. The contact to these agencies is guaranteed throught he involvement of metno (EMEP), INERIS, and NILU in CLEANAIR, TFMM, TFHTAP.

metno, NILU: will provide advise through their operational roles in providing technical support in EMEP to CLRTAP and indirectly to EU Thematic Strategy e.g. through its cooperation with IIASA. NILU and metno will also through their involvement in the European Topic Centre for Air and Climate Change under European Environment Agency contribute to the assessment of the state and evolvement of all atmospheric pollution related environmental problems in the countries of the EU. metno also brings the project results and methods into WMO through Global Atmosphere Watch (GAW) which is also in charge of implementing the IGOS-IGACO strategy.

IIASA: implement the findings of CITYZEN into the GAINS-Europe and China models, so that the interactions between air quality and climate can be more comprehensively assessed for policy development with GAINS.

4.5 Ensure that the improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact (metno, NILU, ULeic, IIASA)

The purpose is to ensure that the improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact. This Task is further elaborated in Section 3.1.2 of the proposal, and contributes to the implementation of "The expected Impact" as specified in the call text and detailed in Section 3.1.2.

metno, NILU, ULeic, IIASA: will ensure that the documentation of the improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence will be reported into the permanent technical policy underpinning activities under CLRTAP (TFMM, TFHTAP), WMO and the EU, and published in an appropriate way in their www-pages to ensure easy access to data, models and documentation. Institutions like metno and NILU with a long-term mission to support applications of science will adopt key methodological and data advances achieved in the project, into their (semi)operational routines.

4.6 Collaboration with sister project MEGAPOLI (metno, CNRS, IUP-UB, ECPL, in collaboration with MEGAPOLI)

The purpose of this task to exploit possibilities of mutual benefit between CityZen and its sister projects MEGAPOLI. Coordinator meetings will identify tasks where the two projects can collaborate efficiently to facilitate scientific progress, e.g. by exchange of data and methods, and to check consistency of the results obtained in the two projects prior to publication.

metno, and selected members of the MEGAPOLI consortium: establish and maintain joint webpages, or mutual links between CityZen and MEGAPOLI webpages, links to the sister project's databases and publications (where reasonable and allowed by copyright regulations).

Coordinators of CityZen (metno) and MEGAPOLI: Coordinators meeting (4 to 6 months after start of the project period) to identify links between the consortium members and implement efficient collaboration. Organize one common project meeting of CITYZEN and MEGAPOLI (about halfway through the project period), and co-convene a session on megacities at an EGU meeting (towards the end of the project period), where results from CITYZEN and MEGAPOLI are presented, alongside with research from outside the two consortia.

metno, CNRS, IUP-UB, ECPL, selected members of the MEGAPOLI consortium: Establish the link between CityZen, MEGAPOLI, and IGAC. Involve the two projects in the upcoming IGAC assessment on megacities.

4.7 Dissemination to public, setting up and maintenance of webpage (metno)

metno: Will establish and maintain a project web page, to be updated continuously during the project. Special attention will be paid to making project information and results available to the public. To this end the coordinator will make sure that the members of the consortium follow the dissemination plan, including

- peer-reviewed publications
- presentations in international conferences
- reports, brochures, made available as printed matter and on project webpage
- networking with the ACCENT project

This task complements Task 4.4 which is directed towards policy.

Deliverables
D4.1.1: The regional and global impact of selected megacity areas due to future changes of traffic infrastructure (month 30)
D4.1.2: The regional and global impact of selected megacity areas due to changes in population distribution (month 30)
D4.2.1: Publication on megacities impact in climate change by 2050 (month 36)
D4.3.1: Evaluation of ensemble approach and validity of the results (month 34)
D4.3.2: Interactive tool kit for presentation of results (month 36)
D4.4.1: Web access to project results tailored for use by authorities and intergovernmental organisations (month 34)
D4.5.1: Report on improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence (month 34)
D4.6.1: Collaborative dissemination with MEGAPOLI on website after joint session at EGU general assembly (month 26)
D4.7.1: Establish a project webpage, to be continuously updated throughout the project (month 2)
D4.7.2: Documentation of (or links to) most relevant project results on project webpage (month 36)

B 1.3.6 Efforts for the full duration of the project

Project number (acronym) : 212095 (CITYZEN)

Workpackage[5]	WP1	WP2	WP3	WP4	TOTAL per Beneficiary
1 metno	8	7	6	12	**33**
2 PKU	40	5	22	10	**77**
3 CNRS	9.4	4.8	9.4	9.4	**33**
4 INERIS	13.3	3	3	2	**21.3**
5 IUP-UB	35	12	0	1	**48**
6 FRIUUK	8	8	7	1	**24**
7 FZJ	4	15	6	6	**31**
8 ECPL	10	5.5	10	1	**26.5**
9 CNR	15	5	3.5	7	**30.5**
10 NILU	1.5	5.5	1	1	**9**
11 UiO	6	5	5	2	**18**
12 METU	11	5	0	2	**18**
13 ULeic	8	3	6	4	**21**
14 IIASA	0	0	16	3	**19**
15 NOA	20	0	0	0	**20**
16 CEHM	24	0	0	0	**24**
TOTAL	**213.2**	**83.8**	**94.9**	**61.4**	**453.3**

[5] Please indicate in the table the number of person months over the whole duration for the planned work , for each work package by each beneficiary

Project number (acronym): 212095 (CITYZEN)

Activity Type	metno	PKU	CNRS	INERIS	IUP-UB	FRIUUK	FZJ	ECPL	CNR	NILU	UiO	METU	ULeic	IIASA	NOA	CEHM	TOTAL ACTIVITIES
RTD/Innovation activities																	
WP 1	8	40	9.4	13.3	35	8	4	10	15	1.5	6	11	8	0	20	24	213.2
WP 2	7	5	4.8	3	12	8	15	5.5	5	5.5	5	5	3	0	0	0	83.8
WP 3	6	22	9.4	3	0	7	6	10	3.5	1	5	0	6	16	0	0	94.9
WP 4	12	10	9.4	2	1	1	6	1	7	1	2	2	4	3	0	0	61.4
Total 'research'	33	77	33	21.3	48	24	31	26.5	30.5	9	18	18	21	19	20	24	453.3
Demonstration activities																	
???																	
Total 'demonstration'																	
Consortium management activities																	
Coordination (admin)	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5
Total ' management'	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5
TOTAL BENEFICIARIES	38.5	77	33	21.3	48	24	31	26.5	30.5	9	18	18	21	19	20	24	458.8

B 1.3.7 List of milestones and planning of reviews

The main milestones can be divided roughly into the following categories:

- availability of improved model tools
- availability of improved emission data
- availability of measurement data and analyses
- availability of reports and data bases to the consortium and the scientific community

In some cases, to allow for a smooth work flow also in the earlier stages of the project, the availability of these prerequisites is defined stepwise, usually as one 'preliminary' set of data/models, and one 'final' set. The 'preliminary' set should be elaborated enough to allow testing, modelling and analyses to a reasonable degree of accuracy. Also, it should enable identifying inconsistencies and making corrections before the project period is progressed too far. Towards the end of the project, the 'final' sets of data/models will be available. These will represent the state-of-the-art and will be the basis for publications and further research after the end of the project.
Milestones concerning emissions are set as early as possible to allow modellers finish their simulations well before the end of the project.

List and schedule of milestones

Milestone no.	Milestone name	WPs no's.	Lead beneficiary	Delivery date from Annex I	*Comments*
M1.1.1	Satellite data available for the period 1995-2006.	1.1	5 IUP-UB	12	accessible data base
M1.1.2	Aerosol data available over selected areas.	1.1	5 IUP-UB	24	accessible data base
M1.2.1	Common scale-bridging approach implemented in a dynamic fashion in models, simulations done.	1.1, 1.2	4 INERIS	30	Comparison against measurements
M1.3.1	Scale-bridging approach involving CityZen models, preliminary versions available.	1.3	4 ineris	12	nesting techniques, exchange of boundary conditions, working versions
M1.3.2	Scale-bridging approach involving CityZen models, final versions.	1.3	1 metno	24	nesting techniques, exchange of boundary conditions, fully elaborated.
M1.4.1	Integrated/updated local emissions for the East-Mediterranean hotspot.	1.4	8 ECPL	12	data base accessible to consortium
M1.5.1	Integrated/updated local emissions for the BeNeLux hotspot.	1.5	6 FRIUUK	12	accessible data base
M1.6.1	Integrated/updated local emissions for the Po Valley hotspot.	1.6	9 CNR	18	accessible data base
M1.7.1	Integrated/updated local emissions for the PRD hotspot, preliminary.	1.7	2 PKU	12	accessible data base

M1.7.2	Integrated/updated local emissions for the PRD hotspot, final data set.	1.7	2 PKU	24	accessible data base
M2.1.1	Satellite (SCIAMACHY) data of CO2 and CH4 available for the period 2002-2006.	2.1	5 IUP-UB	12	accessible data base
M2.2.1	Common reference database for inter-comparison of the models participating in CityZen based on year 2003.	2.2	10 NILU	18	report
M2.3.1	First estimates of climate-induced changes in air quality available to policy support tasks in WP4.	2.3	11 UiO	24	report
M2.4.1	Estimates of changes in weather elements available to policy support tasks in WP4.	2.4	7 FZJ	24	report
M2.4.2	Estimates on aerosol impact available to policy support tasks in WP4.	2.5	9 CNR	24	report
M2.5.1	Nested model systems with climate-chemistry coupling available.	2.5	7 FZJ	12	comparison against measurements
M3.1.1	Updated regional and global scale emission, preliminary version.	3.1, 3.2	3 CNRS	12	accessible data base
M3.1.2	Updated regional and global scale emission, final version.	3.1, 3.2	3 CNRS	24	accessible data base
M3.3.1	Future emission scenarios available for model calculations in WPs 2 and 3, preliminary version.	3.3	14 IIASA	15	accessible data base
M3.3.2	Future emission scenarios available for model calculations in WPs 2 and 3, final version.	3.3	14 IIASA	24	accessible data base
M3.4.1	Results of future air quality changes available to WP4.	3.4	3 CNRS	24	report
M3.5.1	Suggestions made for mitigation options in the four selected hotspot regions.	3.5	11 UiO	24	report
M4.1.1	Estimate of the impact of future traffic changes on megacities available.	4.1	11 UiO	24	accessible website
M4.2.1	Knowledge on climate change impact for different time slices available.	4.2	7 FZJ	30	accessible website
M4.3.1	Evaluation of model tools done, estimates on uncertainties available.	4.3	3 CNRS	30	accessible website

M4.4.1	Inform policymakers in the EU and CLRTAP about the project and its plans for policy support	4.4, 4.5	1 metno	3	meeting
M4.4.2	Attend regular inter-national techn. meetings of EMEP (TFMM, TFHTAP) and the revision of EU Thematic strategy for air pollution, in order to communicate opportunities provided by CITYZEN for improved emission inventories including scenarios, spatial scale-bridging model systems and new systematic observational evidence.	4.4, 4.5	1 metno	6 and subsequent meetings	meeting
M4.4.3	Organize a special meeting between project scientists and policy makers (use the Swedish "Saltsjøbaden-workshop"-series as a model).	4.4, 4.5	1 metno	30	meeting
M4.6.1	Potentials for collaboration with MEGAPOLI identified.	4.6	1 metno	7	web page
M4.6.2	joint EGU session with MEGAPOLI.	4.6	1 metno	24	meeting
M4.7.1	CityZen web page available (will be updated continuously throughout the project).	4.7	1 metno	2	web page

Tentative schedule of project reviews

Review no.	Tentative timing, i.e. after month X = end of a Ring period	*planned venue of review*	*Comments , if any*
1	After project month: 18	Oslo	Check if the project is on track and identify changes that can be made to improve the work, if necessary.

B 2 Implementation

B 2.1 Management structure and procedures

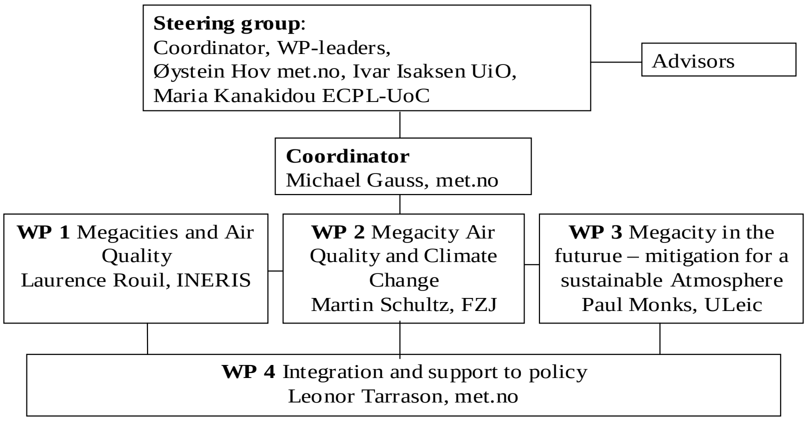

Figure 5: The Management structure of CITYZEN

Objectives of the project management are:
- to ensure a smooth running of the CITYZEN activities
- to develop and apply sound quality management procedures at CITYZEN level
- to develop and apply sound financial management procedures for CITYZEN
- to develop and maintain all contractual documents for CITYZEN
- to install and maintain an online collaboration tool supporting all Activities within CITYZEN
- to ensure appropriate co-operation among the Activities and with related projects
- to apply a sound information management

The following sections describe the principles for the management of CITYZEN. The details will be fixed in the Consortium Agreement (CA).

Management Structure

The operational management structure mirrors the structure of the implementation plan where the main aspects are given in the Tables with the WP-descriptions (Tasks, description of work, deliverables, in addition to the milestone table for the project). There is 3-level hierarchy: the coordinator, the WP leaders and the task leaders. At all hierarchy levels, decisions will be made by consensus, whenever possible. The WP-level is particularly important as the WPs are the major sub-divisions of the project and each WP has verifiable end-points and deliverables.

The Steering Committee

The steering committee for the project will consist of the WP-leaders and the coordinator. In addition the project PIs Maria Kanakidou, ECPL, Øystein Hov, metno and Ivar Isaksen, UiO will be in the steering committee with a particular responsibility to ensure the realisation of the expected impact of the project as specified in the call. At a later stage the steering committee will establish a set of advisors chosen to ensure the exchange of information with other relevant national and international research activities (including ongoing EU-projects) and to maximise the impact of the project.

The terms of reference for the steering committee would include responsibility for important decisions concerning the progress of CITYZEN, like:

- preparation and final approval of the annual Implementation Plan prior to the submission to the European Commission,
- all budget-related matters,
- structure and restructuring of the Work Packages,
- acceptance of new participants as well as the exclusion of Participants,
- alteration of the Consortium Agreement,
- premature completion / termination of the Project, and
- selection of advisors from outside the project
- formalise delivery mechanisms to users of the project results (see Table in Section 3)

Advisors

Advisors will be selected in the start-up phase of the project after discussion of their mandate and candidates at the kickoff meeting of the project. It is seen as particularly important to attract as advisors a few policy people with a technical (scientific) interest and who are affiliated with national environment ministries/agencies, the European Commission, CLRTAP, IPCC and WMO.
In addition we have established working relationships with a number of ongoing FP6 EU-projects that are relevant to CityZen, notably those that are related to GMES (GEMS, GEOMON and the follow-up of GEMS MACC), NitroEurope, EUCAARI and EUSAAR. These working relationships are already ongoing at the coordinator's institution and/or other CityZen partners also take part in these other projects, thus ensuring sufficient transparency, and information flow across project boundaries. Formalisation of these links will be made when need arises.

The coordinator

The coordinator is the intermediary to the European Commission and is authorised to execute the project management. He shall report and be accountable to the project Steering Committee. He works under instructions of the Steering Committee and has the following responsibilities:

- work together with the Steering Committee in their duties to perform CITYZEN;
- provide and control financial procedures for CITYZEN and its activities;
- ensure uniform quality control procedures within CITYZEN;
- conduct the daily management of CITYZEN;
- fulfil the management responsibilities under the contract with the EU Commission;
- submit deliverables to the European Commission;
- receive, compile, and distribute to the partners and other relevant recipients documents, reports, statements of expenditure, minutes of meetings of the Steering Committee, and other information from the partners.

Quality Management (QM)

CITYZEN will establish quality control of its work process and the deliverables. For instance, important reports from one WP will be reviewed by a representative from another WP. Documentation and transparency of work processes and data will be the subject of reporting and discussion in the all-staff meetings and in the steering committee, and important QM-principles will be established in writing. An important aspect of the quality management is to ensure the best possible use of project resources among the partners to reduce double work and foster synergy. The project management will take a process oriented and result-based approach to QM. This will be done by monitoring of the performance in the project, evaluating the capability to change approach and procedure when required, and by interacting with the users of the expected impact of the project to ensure that their interests are served. The steering committee will approach QM in the project in a systematic fashion because of the gains possible by a concrete and practical approach:

- improved cost-efficiency in the project
- improved balance between project resources and providing the expected impact from the project
- excellence in performance and results
- improvement of user community satisfaction
- improvement of internal work distribution and flow, satisfaction among PIs and partners
- improvement of competitiveness, competence and visibility of the project

Finance Management

The coordinator organisation Norwegian Meteorological Institute, metno, organises the finance management of the CITYZEN project, i.e. transferring advance payments and final payments to the individual participants, after receiving payments from the EC. All individual cost statements will be collected and submitted to the EC. Financial audits will be organised according to the EC rules.

Information Management

Two aspects of the monitoring of progress and the information management are of special importance. The first aspect is related to progress monitoring, where regular progress reports will be used to monitor progress of CITYZEN against the work plan. If necessary, corrective measures can be agreed by the Steering Committee and implemented by the CITYZEN Coordinator. If issues of a strategic or political nature need to be addressed, or changes to the work plan need to be made, problems can be forwarded to the Steering Committee. The second aspect involves the management of deliverables. Deliverables are first handled (until approval stage which involves internal peer review) at WP level, and then at Consortium level. Only Consortium level deliverables are submitted to the EC.

Meetings

The Steering Committee (SC) will meet regularly during the course of the three-year project period (twice a year as a minimum). Additional meetings may be called by the CITYZEN coordinator, or at the request of participants. When delegates cannot attend a meeting, they may give power to another delegate to represent them. Such power shall be confirmed in writing to the respective chairperson prior to the start of the meeting. The operation of the Steering Committee will be by reference to a written agenda distributed in advance of the meeting. Additional issues may be raised only by unanimous agreement.

Workshops

There will be annual “all-staff” meetings where all active researchers in the project in addition to the steering committee and advisors are invited to come to present finished, ongoing and planned work and to review project plans, co-operation with other projects, and the interaction with national, international, intergovernmental and EU-level research, policy and technical organisations related to the theme of the project.

Reporting

A firm reporting structure will be implemented. Regular reports will be provided, and consolidated versions of these reports will be forwarded to the respective next higher level. These reports will establish the basis for various management processes, such as, for example, risk management and progress monitoring.

Internal communication

Most of the information will be distributed electronically: by exchange of email (address to be defined) and by internet (the coordinator will establish a website, one option is to use www.nilu.no/pip which is much used as a "host" for project coordination). The latter will be used for exchange and storage of documents (reports, minutes, workshop presentations), including those received from third parties (e.g., other projects or EC).

Conflict resolution

The project management will endeavour to resolve any conflicts at the lowest possible level. That means, the conflict resolution process will start at task level. Here, and in general, it will first be attempted to reach a consensus, to be mediated by the respective task leader. Only if this fails will the conflict be discussed at Work Package level. Initially, this will be done through electronic negotiation and mediation. The management procedures of the respective WP will apply. If no consensus can be reached at this level, either the WP leader will decide or, if the problem is of relevance beyond the WP, further mediation at a meeting of the Steering Committee will follow. An extraordinary meeting may be convened to resolve extremely urgent and/or serious cases. Ultimately, the CITYZEN coordinator will decide at either an ordinary or at this extraordinary meeting.

Risk Management

As a collaborative effort of the consortium a large but solid framework has been developed to bring together the know-how. With the realisation of a framework, consisting of many partners, contributing to different activities, over several years, some expected and unexpected situations may occur, that may have major influence on the successful outcome. First of all, to decrease the risks and its consequences, a strong management organisation has been established. A number of risks have been identified, for which the suggested coordination actions will prevent strong influence on the outcome of CITYZEN. The risk associated with interdependencies between WPs, e.g., inputs can arrive late, exchanged deliverables do not meet the needed level of quality, or activities fail: CITYZEN has organised its WPs in a way that the most critical components from activities are managed within each WP to minimise this risk. Furthermore the management structure ensures that such a risk will be spotted very early and dealt with. CITYZEN participants may decide to leave the consortium or withdraw from a subproject because of lack of budget, priority change or any other reason. The CITYZEN management will provide services in mediation and re-allocation of budgets to new or existing partners. A WP leader may decide to leave the institution he/she is currently working for. The consequences of this risk have been reduced, as a lot of focus has been put on this during the CITYZEN preparation. The current consortium is strong enough to replace any WP leaders by one of the experienced scientists in the consortium.

The risk of CITYZEN management failure. Firstly, the CITYZEN management is performed by an organisation (metno), having long lasting experience in managing scientific projects. The metno management will provide a section in the regular reports on its progress. Any partner having complaints to the CITYZEN management or coordinator can bring this to the attention of the Steering Committee. The Management Commission and the coordinator assume responsibility for monitoring the quality of the CITYZEN management.

Expertise risks (e.g. a key person with a specific expertise is leaving the project). The consortium is strong enough to handle such cases. Management will be in a position to assign an adequate replacement.

Project execution risks (e.g. key milestones or critical deliverables are delayed). The strict monitoring and the reporting structure will enable project management to become aware of potential such risks at an early stage. Management will then act to prevent any far-reaching problems. If need be, additional resources may be allocated in such cases.

We are aware that some of the Work Packages have a higher risk than others, e.g., related to the choices made for future emission scenarios and mitigation options in WP3. We see this as an inherent uncertainty that cannot be eliminated. A further difficulty lies in the interdisciplinary consortium.

The CITYZEN coordinator will continuously control the overall project plan, its milestones and critical paths. Moreover, the project's reporting structure will ensure that the management is aware of potential problems well in time. Thus, it will be possible to initiate counter measures before a problem will become critical. Such tight control will apply and all levels and will make sure that solutions will be available in time.

Management of Intellectual Property Rights (IPR), see also section 3.2:
This will be addressed in the Consortium Agreement (CA).

B 2.2 Beneficiaries

Participant 1: metno
The Norwegian Meteorological Institute (metno) is the national meteorological service in Norway. In addition to national weather forecasting, aviation weather forecasting and climate monitoring for Norway and adjacent sea areas, metno is involved in extensive research activities. metno represents Norway in ECMWF, EUMETSAT, EUMETNET, WMO and other international fora, and metno takes part in international projects funded by EU and other bodies on climate, atmospheric and marine research, and air pollution research.
metno employs around 400 persons, among them 70 scientists doing research within numerical weather prediction, ocean modelling, remote sensing, air pollution, product development, instrumentation, climatology and climate research. metno has extensive experience in developing methods and operational applications that have led to innovation and value addition in both the private and public sector.
In air pollution research the institute is the western center for modelling within the EMEP project (European Monitoring and Evaluation Programme) under the Convention for Long Range Transmission of Air Pollutants (CLRTAP) under UNECE. EMEP provides the technical underpinning for air pollution policies within the CLRTAP and the European Commission (Clean Air for Europe). The air pollution research at metno has a strong operational component where the results of research are turned into products that are generated on demand by policy makers, public authorities nationally or internationally or the research community. Through EMEP and its support of the EU Thematic Strategy on air pollution metno has the capability and mission to provide services in air pollution abatement and in the understanding of the coupling of climate/weather variability and air pollution, beyond the duration of single projects.
Dr. Michael Gauss received his PhD in atmospheric chemistry in 2003 at the University of Oslo. He has been working for the University of Oslo since 1998 and for metno since 2006. He has co-authored 21 peer-reviewed publications, 5 of which as first author and has contributed to international assessments for the IPCC. He has gained international experience through his participation in 10 EU-funded projects focusing on atmospheric chemistry and climate change. Recently, he has coordinated a multi-model study within the ACCENT network of excellence, results from which have been used in the IPCC-TAR report.
Prof. Øystein Hov is the Director of Research at metno and has published 80(1) papers and 170 reports in the field of modelling and interpretation of observations of atmospheric chemical composition from the urban to the global scales, and on the interface between science and policy. He has participated in 7 EU projects and overseen 46, and has managed budgets to the order of 15m per annum (PGDs-20). He is Chair of the WMO Commission on Atmospheric Sciences' Open Area Group on Environmental Pollution, Atmospheric Chemistry & Urban Pollution and Member of

Editorial Board of Tellus B. He s a member of the Norwegian Academy of Science and Letters. He was the director of NILU (1996-2003) and professor in meteorology at University of Bergen (1989-1996).

Dr. Leonor Tarrasón has authored more than 70 reports and articles on transboundary air pollution and its implications for policy development. She is head of the air pollution section at the Norwegian Meteorological Institute and project leader of EMEP/MSC-W since 1998. She is been member of the Technical Analysis Group under the CAFÉ programme and is presently member of the Steering Committee of the CITY DELTA programme, where the links between regional and urban air pollution with relevance for policy are investigated. She has participated in 5 EU projects in the last four years, mainly to support the design of control strategies under the CAFÉ programme (MERLIN, CAFÉ-BASELINE, NEC review) and presently coordinates the development of Eulerian EMEP chemical dispersion model to link hemispheric, regional and local air pollution problems.

Participant 2: PKU

Peking University is a comprehensive and National key university. The University consists of 30 colleges and 12 departments, with 93 specialties for undergraduates, 2 specialties for the second Bachelor's degree, 199 specialties for Master candidates and 173 specialties for Doctoral candidates.

The state key lab of atmospheric environmental simulation, part of The College of Environmental Sciences and Engineering, is active in integrated field measurements of atmospheric chemistry, lab simulation of photochemical processes and numerical modelling. In past ten years, the key lab carried out fundamental research and applied projects with focus on urban and regional air pollution in Pearl River Delta and Beijing areas to support its policy.

Prof. Yuanhang Zhang is the principal investigator of “Program of Regional Integrated Experiments of Air Quality over Pear River Delta (PRIDE-PRD)” starting from 2002. He organized PRIDE-PRD2004 and PRIDE-PRD2006 international campaigns. The Ministry of Science and Technology of China appointed him as chair of the science team of a major project “Synthesized Prevention Techniques for Air Pollution Complex (3C-STAR)” for regional air pollution control. He has published around 100 papers in the field of modelling and interpretation of observations of atmospheric chemistry and pollution control.

Professor Min Hu is the principal investigator of Major International (Regional) Joint Research Program of NSFC (20420130348) with Prof Dr. Alfred Wiedensohler, The Leibniz Institute for Tropospheric Research (IFT), Characterization of the Number and Chemical Size Distribution as well as Hygroscopicity of Fine and Ultrafine Particles in Beijing, China. She is also as PIs for one of five sub-projects, “study on removal mechanism of PM10 from combustion sources in the ambient air”, the National Basic Research Program (2002CB211605) from the Ministry of Science and Technology, China “Research on the formation and control technology of PM10 from combustion sources”, Program for New Century Excellent Talents in University, (NCET-04-0008), from Ministry of Education, China..

Professor Min Shao is the principal investigator of the major 11th 5-years-plan project “Integrated technology and demonstration for complex air pollution control in Pearl River Delta region” (under 3C-STAR) by Ministry of Science and Technology starting from 2006. His main research interest are analysis and sources of volatile organic compounds (VOCs) and particulate organic matters (POMs), he involved in the key project of China National natural science foundation on ground-level ozone abatement for 2008 Olympics, and National high-tech project (863) on source apportionment of atmospheric organics. He was also the scientist responsible for work package of Air chemistry and Deposition in Sino-Norwegian cooperation project of Integrated Monitoring Program on Acidification of Chinese Terrestrial Systems (IMPACTS). Min Shao was supported by Trans-century Scholar program of China Ministry of Education.

Professor J. (Sjaak) Slanina held a position at the Netherlands Energy Research Foundation as senior research scientist in atmospheric chemistry and air pollution. Has over 30 years of experience in atmospheric science with emphasis on deposition and aerosol research with emphasis on instrument development and analytical techniques. He retired in 2005 as part-time full professor at the Department of Environmental Sciences of Wageningen University, The Netherlands and is currently Professor at Peking University, P.R China

Participant 3: CNRS

The Service d'Aéronomie has a long experience in the study of dynamical, radiative and chemical processes in the Earth and planetary atmospheres using combined experimental and theoretical approaches, including various observation systems. The laboratory is also part of the Institute Pierre Simon Laplace (IPSL) which plays a leading role in chemistry-climate research at national and international level. The Service d'Aeronomie has considerable expertise in the field of atmospheric chemistry and aerosol research, ranging from development and application of trajectory, regional and global chemistry models, assimilation, analysis of airborne and satellite data, and study of chemistry-climate interactions. The Service d'Aéronomie is one of the laboratories of the National Center for Scientific Research (CNRS). It is supported by the Centre National d'Etudes Spatiales (CNES) as one of the leading laboratory for the development and exploitation of satellite-borne atmospheric remote sensors.

Dr. Cathy Clerbaux obtained her PhD in Physics from the Université Libre de Bruxelles in 1993. She became a CNRS Research scientist in 1995 and her main affiliation is at Service d'Aéronomie/IPSL in Paris. Her research activities span high resolution Fourier transform spectroscopy (HITRAN and GEISA databases) and atmospheric research using satellite. She has an internationally recognized expertise in thermal infrared remote sensing, including development of trace gases retrieval algorithms, validation experiment, and analysis of the observations using chemistry-transport atmospheric models and data assimilation tools. She has been involved in the analysis of satellite data for several missions (MOPITT/TERRA, IMG/ADEOS, ACE-FTS, TES/AURA). As a PI of the IASI Science Team, she is in charge of the development of the operational retrieval algorithm for the trace gases inversion from the IASI data. She was a lead author for the IPCC-TEAP 2005 and the WMO ozone 2007 reports. She is also a remote sensing expert for CNES, ESA (TRAQ mission) and Eumetsat (Meteosat Third Generation).

Dr. Kathy Law is a CNRS " Directeur de Recherche". She has been the Programme Manager of UK NERC Upper Troposphere/Lower Stratosphere Ozone between 1998-2002, and she then joined the Service d'Aeronomie/IPSL in 2003. She is the co-chair of the International Global Atmospheric Chemistry (IGAC/IGBP) project, and a member of the Commission for Atmospheric Chemistry and Global Pollution (CACGP), She has been PI/co-I on many current and past EU/nationally funded projects (e.g. SCOUT-FP6, ITOP, MOZAIC, TACIA, MAXOX, POET, EXPORT,…); she has been co-author, contributor and reviewer of numerous international assessments organised by WMO/UNEP, IPCC, IGAC and of more than 50 peer-reviewed scientific papers.

Dr. Claire Granier is a "Directeur de Recherche" at the Service d'Aéronomie/IPSL in Paris. She has over 25 years research experience in atmospheric sciences. For the past 20 years, she has worked on the development of three-dimensional global chemistry-transport models which have been used for the study of the composition of the lower atmosphere and its evolution. She is coordinating the activities on emissions within the ACCENT European Network of Excellence. Since 2005, she is the Deputy Coodinator of the GEMS (Global and regional Earth-system Monitoring using Satellite and in-situ data) FP6 Integrated Project. She is the co-coordinator of the GEIA (Global Emissions Inventory Activity) project of the AIMES/IBGP program. She is a member of the steering committee of the AIMES/IGBP Project. She is author or co-author of more than 60 peer-reviewed scientific papers.

Participant 4: INERIS

INERIS places its wealth of experience and its scientific and technical know how at the service of the French government and both the private and public sectors so as to guide them in their actions with regard to safety and the protection of health and the environment. This support results, in particular, in the provision of study and consultancy services, including:

1) Accidental risks: Identification, analysis and prioritisation – Implementation of safety management systems - Regulatory support - Third party expert evaluation – Drafting of emergency plans, etc. 2) Chronic risks: Measurement of pollutants in the air, water and soil – Characterisation of polluting substances, discharges and wastes – Study of the effects linked to industrial activities (apart from ionising radiation) on health and ecosystems – Detailed risk assessments linked to potentially polluted sites and soils - Third party expert evaluation, impact studies. 3) Soil and sub-soil risks: Risk assessments linked to gas emanations from the ground – Assessments of the risks of earth movements – Contributing to drafting PPRN (Natural Risk Prevention Plans) and PPRM (Mining Risk Prevention Plans) – Auscultation and monitoring of soil and sub-soil risks, etc. 4) Certification: Certification of materials and equipment (ATEX Directives, CEM Directives, etc.) – Physical & chemical properties of products, etc.

In the field of air quality INERIS is a major actor in France supporting the implementation of the air quality monitoring strategy, developing and hosting the national air quality forecasting and mapping platform, PREV’AIR (www.prevair.org) and realising technical and research studies to support the French Ministry of Ecology within the European framework.

Dr Laurence Rouïl is the head of the “Modelling and Economical analysis” Unit of the Chronic risks division at INERIS. She received her Ph.D in 1995 in the field of applied mathematics. Her main area of experience is air quality modelling. Since 10 years she has developed skill and competence being the leader of research activities closely linked to operational applications. The PREV’AIR system is one of the example of such projects that she has developed with her team and in cooperation with other research partner, to answer to policy makers expectations taking advantage of the current know-how in the field of air pollution. She is the leader of the “Integrated European air quality” service in the PROMOTE project, funded by the ESA as a GMES service element. She participates to the management board of the GEMS project (FP6). Finally she belongs to the EMEP core Bureau for 2 years, and will be the new chair of the Task Force on measurement and Modelling by Sep 2007.

Dr Bertrand Bessagnet is a R&D engineer who joined INERIS in 2001. He got his Ph.D in the field of atmospheric aerosol modelling in 2000. He is now a project manager in air quality modelling, and the main developer of the aerosol module in the CTM CHIMERE, which is used at INERIS. This competence allows him to contribute to the definition of the PM monitoring startegy in France. He is involved in the PREV’AIR system and in many European model intercomparison exercises in the framework of the Convention on Long-Range Transboundary Air Pollution, as CITYDELTA and EURODELTA. He has also done research works on natural gas and aerosol species contributing to the aerosol load in Europe.

Dr Frédérik Meleux is a R&D engineer who joined INERIS in 2005. He received his Ph.D in 2002 working on the links between local, regional and global air pollution with nested models. At INERIS he participates to modelling activities in the framework of the Prev'Air system developing procedure that could improve the quality and the reliability of the results. He also works on the analysis of the climate change on the future air quality. He participates to the GEMS and PROMOTE projects and develops experience related to data assimilation in Air Quality models, especially for the assimilation of earth observation products. He has contributes to the implementation of such procedures in the CHIMERE model.

Participant 5: IUP-UB

The University of Bremen was founded at the end of the 1960’s, and has a student body of around 20000. It has developed a strong research programme in the natural sciences and in 2006 was selected as one of the top ten Universities in Germany. The Institute of Environmental Physics within the Faculty of Physics of the University of Bremen has more than fifteen years experience in remote sensing of the earths atmosphere, both from ground and from satellites. The institute with currently about 100 members has been successfully involved in a number of EU projects (e.g ESMOS, ESMOS-ARCTIC, SESAME, SCUVS1-3, PRICE, PRIME, THESEOBROMINE, COSE, GODIVA, THESEO-2000-EUROSOLVE, FORMAT, POET, RETRO, QUILT, UFTIR, SOGE, STAR, ACCENT, GEOMON).

Prof. Dr. John Burrows is the head of the Institute of Environmental Physics at the University of Bremen and has been active in research since 1975. He graduated with an M.A. Ph.D, from Trinity College Cambridge University in 1978, working subsequently at the Havard-Smithsonian Center for Astrophysics, A.E.R.E. Harwell, Oxford University and the Max-Planck Institute for Chemistry in Mainz. His specialities are atmospheric physical and chemical processes using laboratory, in situ and remote sensing measurements. Professor Burrows has published approximately 320 scientific papers in peer reviewed on these subjects. He is founder and Principle Investigator/Lead scientist of the Global Ozone Monitoring Experiment (GOME) and SCanning Imaging Absorption spectroMeter for Atmospheric ChartograpHY (SCIAMACHY). GOME has been successfully making measurements since its launch in April 1995 on the ESA ERS-2. SCIAMACHY has begun its mission in spring 2002 as part of the ESA ENVISAT payload. Professor Burrows is a fellow of the AAAS and AGU and in 2006 was awarded the COSPAR William Nordberg Medal for his laboratory and remote sensing research of relevance to advancing atmospheric science.

Dr. Andreas Richter graduated in physics at the Ludwig Maximilians Universität in Munich in 1991. He received his PhD in 1997 at the University of Bremen where he has been working as a research scientist ever since. His research interest is remote sensing of trace gas concentrations in the UV/visible spectral range using ground-based, air-borne and satellite platforms. He is strongly involved in the calibration, validation and retrieval algorithm development for the satellite instruments GOME and SCIAMACHY, and currently leading the DOAS group at the Institute of Environmental Physics, University of Bremen. Dr. Richter has published more than 80 papers in peer-reviewed journals and participated in 8 EU and 1 ESA projects over the last 5 years.

Dr. Michael Buchwitz studied Physics at the University of Bremen and obtaining his Diploma, B.Sc. andM.Sc. in 1992 in solid state physics. Since 1993 he is working at the Institute of Environmental Physics (IUP) of the University of Bremen (UB), Germany (except for one year where he was working as software developer and project manager at the software company Interzart AG). He participated at the specification of the SCIAMACHY instrument and was scientific secretary of the GOME Science Advisory Committee. In 2000 he made his PhD focusing on radiative transfer and retrieval algorithm development for SCIAMACHY. Currently, he is leading a group working on SCIAMACHY near-infrared nadir retrievals (greenhouse gas and carbon monoxide). Dr. Buchwitz is the author of over 30 manuscripts in peer reviewed Journals about his research.

Dr. Wolfgang von Hoyningen Huehne has worked as a research scientist at the Institute of Meteorology (Leipzig University) from 1971 till 1997. He holds a senior research scientist position at University of Bremen since 1998. His main areas of interest include aerosol/cloud remote sensing from orbiting optical instruments, radiative transfer, light scattering and experimental ground-based atmospheric optical measurements. He has developed aerosol retrieval algorithm BAER for multispectral nadir scanning instruments.

Participant 6: FRIUUK

The Rhenish Institute for Environmental Research (RIU) at the University of Cologne has a long-standing experience in atmospheric modelling and has gained considerable expertise in regional simulation of transport, chemical transformation and deposition of atmospheric pollutants and other trace species. The team contributed to the international projects EUROTRAC-1 and EUROTRAC-2 and has been engaged in various national and multilateral projects of climate and air quality research. It has been a partner in different research activities funded by the European Union, e. g. VOTALP, RIFTOZ, ASSET and GEMS. It is partner in the GMES-PROMOTE project. The present activities include forward modelling of atmospheric dispersion and chemistry, short-range forecasting of atmospheric pollution for Europe and subregions of it and research on chemical atmospheric data assimilation using a four-dimensional variational approach. The work is based on the EURAD Model System (European Atmospheric Dispersion Model System) developed by RIU and the University of Cologne in cooperation with the Research Center Jülich. Recently the EURAD model has been extended to hemispheric applications to investigate intercontinental transport. It has been used for the assessment of the future development of air quality in Europe and strongly polluted urban areas. Special area of interest has been the past and future air quality of the Ruhr area. Access to highly resolved emission data for North-Rhine-Westphalia (1 km grid size) as well as observational data is available and is used for model calculations and evaluation.

Dr. Michael Memmesheimer is working in the field of air quality modelling since more than 20 years. Specific fields of research are the interaction of dynamics and chemistry in the atmosphere, aerosols and coupling of emissions to complex CTMs. He participated in numerous national and international projects (e.g. EUROTRAC, VOTALP). At present he is working on user driven research projects for the environmental agencies of North-Rhine-Westphalia (LUA), in particular the Ruhr area and Germany (UBA) with emphasis on EU air quality directive regulations and the development of air pollution control strategies. He published more than 20 peer reviewed articles.

Dr. Hermann Jakobs is working in the field of air quality modelling since more than 20 years. Specific fields of research are the development and application of complex CTMs for the short-term forecast of air pollution and hemispheric applications of the EURAD model. He participated in numerous national and international projects (e.g. EUROTRAC, COST Action 602). At present he is working within GMES-PROMOTE and on several user driven research projects for national and international environmental agencies (e.g. EPA, Ireland). He published more than 20 peer reviewed articles.

Prof. Adolf Ebel has been active in atmospheric research since more than 40 years. His main focus is now modelling of the atmospheric composition employing the EURAD model. He is leading the RIU and teaching at the University of Cologne. He published more than 50 peer-reviewed articles. He has been supervising a larger number of PhD students (11 since 1998) and has been an active member on various scientific commissions and committees (e.g. EUROTRAC-1 SSC, SCOSTEP Bureau, IAMAS/ICMA). Total of competitive funding acquired for FRIUUK over the last five years has been about 5 Mio EURO.

Further scientists involved are ***Dr. Hendrik Elbern*** (data assimilation) and ***Elmar Friese*** (particle modelling).

Participant 7: FZJ

The research center Jülich is one of 15 Helmholtz centers in Germany and has 4400 employees. The institute for chemistry and dynamics of the geosphere (ICG)-2 has a long-standing research record in tropospheric chemistry research with a particular strong focus on the measurements of trace gases and global to regional-scale modelling. It is directed by Prof. Andreas Wahner. The institute is one of the lead coordinators of the MOZAIC/IAGOS programme which acquires routine data of ozone, water vapour, carbon monoxide and nitrogen oxides from passenger aircraft. The modelling group led by Martin Schultz has a co-ordinating role in the European GMES project GEMS (Global and regional Earth-system Monitoring using Satellite and in-situ data), where an operational system for Earth System model forecasts including data assimilation is being developed. They are also leading a sub-task on diagnosing transport processes in an ongoing multi-model assessment study in support of the task force on hemispheric transport of air pollution (TFHTAP) and they host the data base for this international project. The research center Jülich owns some of the fastest supercomputers dedicated to research world wide, and the institute has excellent access to these supercomputing capabilities. Other activities of the ICG-2 involve the utilisation of an outdoor simulation chamber allowing the measurement of atmospheric chemical processes under realistic environmental conditions and the strong involvement in ground-based and airborne field campaigns. For example, ICG-2 was selected as one of the few European partners to participate in two recent field campaigns in Beijing (CAREBEIJING 2006) and the Pearl River Delta (PRIDE-PRD 2006), China, in the summer of 2006 and contribute the first HOx radical measurements in China.

Dr. Martin Schultz will be leading the work package on chemistry climate interactions. He is head of the modelling group at the ICG-2 and has more than 15 years research experience in the field of atmospheric chemistry. Schultz worked at the FZJ while producing his PhD thesis. Afterwards he went to Harvard University to work with Daniel Jacob on the analysis of aircraft field campaign data and the development of global three-dimensional chemistry transport models. In 1999 he returned to Germany and worked at the Max Planck Institute for Meteorology in Hamburg, where he led a research group on Aerosols, chemistry and climate and also led the development of the coupled chemistry general circulation model ECHAM5-HAMMOZ which he proposes to employ in this project. Since summer 2006 he is employed again at the FZJ. Schultz has authored and co-authored more than 35 peer-reviewed articles in scientific journals and more than 20 other publications, and he participated in or co-ordinated several European and international research projects (PRICE, OCTA, NASA GTE PEM-Tropics, NASA GTE TRACE-P, RETRO, GEMS).

Dr. Andreas Hofzumahaus is leading the research group on photochemistry and radicals at the ICG-2. He organized and participated in many national and international field campaigns and was the coordinator of the FZJ involvement in the Beijing and Pearl River Delta studies. He published more than 40 peer reviewed articles in scientific journals.

The institute will hire a postdoctoral researcher to work on the project.

Participant 8: ECPL

The Environmental Chemical processes Laboratory of the University of Crete (ECPL-UoC) belongs to the Department of Chemistry of the University of Crete. Its activities concern teaching and research on various topics of Environmental Sciences. The faculty of the ECPL team has more than 20 years of expertise in environmental science research. Particular focus is given to atmospheric chemistry and physical chemistry relevant to organic volatile and semi-volatile compounds, ozone and aerosols in the troposphere and climate change. The team has expertise both on experimental and chemical /climate modelling studies. ECPL is actually running two Master Programs on environmental sciences. (http://ecpl.chemistry.uoc.gr) ECPL has four faculty members, three scientific collaborators, two technical staff members and forty graduate and Ph.D. students. ECPL has up to date infrastructure to perform high level research relevant to atmospheric sciences: I) a state-of-the art sampling and analytical chemical instrumentation; II) a well-equipped air and aerosol background monitoring station in a central location of Eastern Mediterranean (Finokalia-Crete); III) Several workstations and linux clustered computers. **Assoc. Prof. Maria Kanakidou** (PI for ECPL) has performed both experimental - field - and chemistry/transport modeling studies of Tropospheric Chemistry and O3 budget with focus on the impact of volatile organic compounds on oxidant levels and has valuable expertise on modeling field campaigns. She is President of CACGP and member of the steering Committee of IGAC. She has received the H. Julian Allen Award 1998. She has been the coordinator of the EU financed project PHOENICS. She is serving as reviewer of scientific papers in several scientific journals and of research proposal and several EU countries and US. She has about 50 publications in peer-reviewed scientific journals (2 in Nature), 10 in peer-reviewed books and about 100 presentations at international conferences. **Prof. Nikolaos Mihalopoulos** has more than 60 publications in peer reviewed journals (1 in Nature and 1 in Science) devoted to atmospheric chemistry and physics. His research activities focus on biogeochemical sulfur, nitrogen and phosphorus cycle and aerosol chemistry over marine remote locations and marine regions strongly influenced by human activities. He has performed several studies on long range transport phenomena of aerosols and gases in the East Mediterranean. He is responsible for the monitoring station of the ECPL (http://finokalia.chemistry.uoc.gr) at Finokalia at the NE coast of Crete that has been used as experimental site by several international projects like MEDUSE, ELCID, MINOS, etc.

Participant 9: CNR

The Institute of Atmospheric Sciences and Climate (ISAC) is part of the Italian National Research Council (CNR). Over 200 staff members, postdoctoral researchers, and students conduct pure and applied research on atmospheric sciences and the climate system. The Institute is divided into Dynamic Meteorology, Climate Change, Observations, Atmospheric Processes and a technical service structure: Field Facilities and Instrumentation. CNR is to improve our knowledge of the atmospheric and climate processes of the planet Earth and at the same time to produce results directly transferable to the society also beyond the national borders. A strong commitment concerns the education and training of young scientists as a way to push forward the research frontier and to meet the expectations of young generations. Numerical modelling, laboratory and field experiments, remote sensing and development of novel instrumentation are the natural means to fulfil the institutional commitments.

Rita Cesari is CNR researcher at ISAC. She works in the field of turbulent dispersion and air quality numerical modelling. ***Stefano Decesari*** is CNR researcher at ISAC. His research field is experimental atmospheric chemistry. ***Massimo Disidoro*** is post-doc fellow at ISAC. His main research activity refers to dynamical and chemical modelling of the atmosphere, with special care to data assimilation in the BOLCHEM group. ***Maria Cristina Facchini*** is Senior Researcher at the CNR ISAC where she is in charge of the aerosol research within the Atmospheric Chemistry Program. She published more than 80 articles in the field of aerosols and cloud chemistry. She has participated in 9 EU projects and she has procured more than 1.5 M in research income (PGD-10). ***Federico Fierli*** is researcher at CNR ISAC and associate Professor of Climate Physics, University of Rome "Tor Vergata". His interests range from tropospheric and stratospheric dynamics to chemical data analysis and assimilation. He has a wide experience as PI in several international and national projects. ***Sandro Fuzzi*** is research director at CNR ISAC where leads the group "Atmospheric Chemistry", is director of the project 'Climatic changes' of the CNR Department 'Earth and Environment' and is coordinator of the EU NoE ACCENT . His main research interest is in the physical and chemical processes in multiphase atmospheric systems (aerosols and clouds) and their effects on atmospheric composition change and climate. He has coordinated several international projects and is or has been member of several international committees and Panels. ***Alberto Maurizi*** is CNR researcher at ISAC. He leads the BOLCHEM group and is PI for ISAC in the EU IP GEMS. His scientific interests span from basic turbulence to environmental application of dispersion modelling of passive and reacting species. He published more than 25 papers on peer reviewed journals. ***Mihaela Mircea*** is post doc fellow at ISAC. Her main research interest is the experimental and numerical study of aerosol-climate interactions and the modelling of air quality. **Francesco Tampieri** is research director at CNR ISAC. His main research interests are in turbulence and dispersion processes in geophysical flows, and in atmospheric boundary layer dynamics. He was director of two CNR Institutes. He is Professor at Bologna University where he gives the course on Boundary layer at Bologna University. He published more than 60 papers on peer reviewed journals and is in the editorial board of Boundary Layer Meteorology and Il Nuovo Cimento C. ***Paolo Paradisi*** is CNR researcher at ISAC. His main research interests are: anomalous diffusion processes, turbulent transport of gas and aerosol, wind structure and dispersion in urban environment, time series analysis.

Participant 10: NILU

The Norwegian Institute for Air research is an independent research foundation specializing in air pollution research from global to local problems. NILU is the Chemical Co-ordinating Centre (CCC) for EMEP and a member of the EEA's Topic Centre for Air Quality. The institute has a long experience in measurements of atmospheric trace gases and aerosols and in the development of new measurement methods and instrumentation. The institute also has long experience in handling and analysis of satellite data. NILU is developing and handling a large number of databases for different clients and project. NILU is involved in several EC-research projects, including GEOMON, EARLINET-ASOS, EUSAAR, EUCAARI, ACCENT and SCOUT-O3

Mr. Sverre Solberg is a M.Sc. in meteorology and works as a senior scientist at NILU with 15 years experience in atmospheric chemistry. His major practical experience cover studies of transport and photochemical reactions in the lower troposphere by use of chemical transport models and by data interpretation and statistical tools. Key topics are related to volatile organic compounds (VOC) and ozone formation. He has been a PI in a large number of EU projects (ARCTOC, TACIA, MAXOX, CATOME, SUB-AERO) and is currently involved in the GEOSS-project GEOMON and the EU-initiative EUSAAR. He was a member of the steering committee of the EUROTRAC-II project TOR-2 and has been the project leader of several projects funded by the Research Council of Norway and the Nordic Council of Ministers.

Dr. Kjetil Tørseth is director of the Atmospheric and Climate Change Department and Head of the EMEP Chemical Co-ordinating Centre. He has extensive experience in management and statistical analysis of air pollution data. Tørseth is Member to the General Assembly and to the Managing committees to the EC-FP6 Network of Excellence on Atmospheric Composition Change (ACCENT). He is appointed member of the Commission of Atmospheric Chemistry and Global Pollution (CACGP), he is the permanent representative of Norway for the ”World Meteorological Organisation – Global Atmosphere Watch”-programme. He is vice-chairman of the EUROTRAC2 ”Environmental Assessment Group”, and he editor of the EUROTRAC Synthesis and Integration Report. Tørseth acts as ”National Focal Centre” for the Norwegian participation in the ”International Cooperative Programme on Integrated Monitoring” (ICP-IM), and he participates in the ICP Forests Expert Panel on Deposition. Tørseth is author or co-author of more than 130 scientific reports including about 30 papers in peer reviewed literature.

Ms. Ann M. Fjaeraa is working as a scientist at the Atmospheric and Climate Change Department. Fjaeraa is working with the development of the new database structure at NILU, and has experience in database related work like development of routines and software for end user-tools for a number of EU projects. She has also experience in work with satellite measurements and air quality assessments.

Participant 11: UiO

The Department of Geosciences at the University of Oslo has long experience in studies related to atmospheric pollution, ozone depletion and climate processes. The studies are performed by the atmospheric chemistry group led by professors Ivar S.A. Isaksen and Frode Stordal, and consists of 12 scientists (researchers, post docs, and PhD students). The focus is on modelling of distributions and long-term changes in pollutants and chemically active greenhouse components and their forcing due to human activity. Studies of the atmospheric impact of aircraft emissions and the impact of ship emissions on chemical composition and on climate forcing have been performed. In particular, the modelling includes interactive studies of particles and gaseous compounds (involving sulphate, mineral dust, nitrates, organics and sea salt), climate-chemistry interactions (involving particles, and ozone/methane chemistry). The group is participating in several EU environmental projects on atmospheric chemistry and climate, and has participated actively in international assessments on climate and ozone (IPCC climate assessments, WMO/UNEP ozone assessment, IPCC and EU assessments on atmospheric aircraft emissions), and on long range transport of pollutants. The group has close collaboration with research groups in the US, Europe and in China. UiO will apply their modeling tool (basically the OsloCTM2 model) to investigate the impact of emissions on different scales (from megacities/regional hot spots to global scale), the role of climate-chemistry interaction, and the impact of mitigation on the atmospheric composition..

Prof. Øystein Hov is adjunct professor in meteorology at the Department of Geosciences (UiO) and the Director of Research at metno and has published 80(1) papers and 170 reports in the field of modelling and interpretation of observations of atmospheric chemical composition from the urban to the global scales, and on the interface between science and policy. He has participated in 7 EU projects and overseen 46, and has managed budgets to the order of 15m per annum (PGDs-20). He is Chair of the WMO Commission on Atmospheric Sciences' Open Area Group on Environmental Pollution, Atmospheric Chemistry & Urban Pollution and Member of Editorial Board of Tellus B. He s a member of the Norwegian Academy of Science and Letters. He was the director of NILU (1996-2003) and professor in meteorology at University of Bergen (1989-1996).

Prof. Ivar S.A. Isaksen is professor in Meteorology at the University of Oslo. He has 30 years of experience in research and teaching in atmospheric sciences, and has supervised 16 PhD students during the last 10 years. He has published more than 120 peer reviewed papers, and presented more than 50 invited papers and lectures at international meetings and conferences during the last 6 years. He has coordinated several EU projects and been lead author of IPCC climate and WMO/UNEP ozone assessments. He is president of the International Ozone Commision (IOC). He has obtained the National Oceanographic and Administration (NOAA) Award for outstanding scientific achievement, and the Norwegian Ministry of Environment award for Environmental Research. Research emphasis: Modeling of ozone depletion, changes in greenhouse gases, impact of man made emissions of pollutants on regional and global scales.

Prof. Frode Stordal is a professor in Meteorology at the Department of Geosciences at the University of Oslo. He has 30 years of experience in modelling of the stratosphere and the troposphere, including chemistry, tracer transport and radiative transfer, with a special emphasis on integration with observations. He has been a PI in more than 20 EU projects, and coordinated 2 EU projects. He currently coordinates the project SOGE-A, a SSA in FP6. He has experience in directing research, e.g. as executive secretary for a Nordic climate research program (1992-1998), and as chairman of the climate research program of the Research Council of Norway (2001-2003).

Dr. Michael Gauss works as researcher 50% at the Department of Geosciences (Univ. Oslo) and 50% at metno. He has co-authored 21 peer-reviewed publications, 5 of which as first author and has contributed to international assessments for the IPCC. He has gained international experience through his participation in 10 EU-funded projects focusing on atmospheric chemistry and climate change. Recently, he has coordinated a multi-model study within the ACCENT network of excellence, results from which have been used in the IPCC-TAR report.

Participant 12: METU

The Middle East Technical University (METU) is leading the Turkish contribution to the project. In close collaboration with ECPL is responsible of the coordination of this contribution in the project. The Erdemli team will also contribute to the observational data base with existing and new data with deposition data, aerosol chemical characterisation and AERONET data and aerosol satellite (MODIS) data analysis. Erdemli station will participate to the intensive campaign during the selected for the project summer time period. METU has an active participation to SESAME and several oceanographic cruises will take place in 2008 until 2010. We can use the vessels crossing Aegean and Black sea to perform aerosol and O3 measurements.

Dr. Nilgün Kubilay is Professor of Chemical Oceanography at the Institute of Marine Sciences, Middle East Technical University, interested in chemical and physical characteristics and sources of aerosols over the Eastern Mediterranean and long-range transport of desert dust. Her research interests cover monitoring of chemical and physical characteristics of aerosols, remote sensing of aerosols and surface ocean. Specific areas of research cover; Trace metal and water soluble constituents of aerosols; Sources and long-range transport of aerosols; Optical properties of aerosols; Utilizing remote sensing data to evaluate transport of Saharan dust over the eastern Mediterranean; Atmospheric transport of nutrients to the surface water of the eastern Mediterranean; Microbiological constituent of Sahara dust over the eastern Mediterranean; Ocean color data interpretation in the Black Sea region. She has 22 peer reviewed publications in international scientific journals and about 40 articles in books and proceedings of international conferences.

Participant 13: ULeic

The University of Leicester was formed as a University College in 1919, receiving Royal assent to become a full university in 1957. It is a medium sized university with 8-9,000 full time students spread across six broad-based faculties. The University of Leicester was formed as a University College in 1919, receiving Royal assent to become a full university in 1957. The university houses one of the largest University-based space research groups in Europe. The Space Research Centre has the role of carrying out the space research programme of the University in collaboration with other members of the Physics and Astronomy Department as well as cross-departmental initiatives inside the University. The Space Research Centre has strong links with the international space programmes of ESA, NASA, NASDA and the Russian Space Agency as well as national programmes under the UK Particle Physics and Astronomy Research Council and the UK Natural Environment Research Council.

The Earth Observation Science group at the University of Leicester uses data from space-borne instruments to undertake research into the physical behaviour of our natural environment including climate change mechanisms. The programme involves collaborative links with staff from a range of departments and includes satellite and aircraft programmes. The research focuses on atmospheric composition and the impact of change. The EOS group has relevant experience in the application of observational data to EO problems including a strong observational component with involvement in number of national and international ground-based experiments, aircraft experiments and satellite programmes. The group specialises in the development of the synergy between these different observing techniques and has expertise in experimental design and data exploitation for Earth Observation Science.

Dr. Paul S Monks is a Reader in Atmospheric Chemistry in the Department of Chemistry, University of Leicester with research experience in the broad areas of tropospheric oxidation chemistry, stratospheric chemistry, atmospheric composition and photochemistry (> 70 papers). Dr. Paul Monks graduated from the University of Warwick, UK and gained a D.Phil. from the University of Oxford in 1991 before going to work at the Laboratory for Extraterrestrial Physics at NASA/Goddard in the USA returning to England to work at the University of East Anglia as a senior research associate on the SOAPEX project. In 1996, he was appointed to a University Lectureship in Physical Chemistry and Earth Observation Science at the University of Leicester and 2004 promoted to a readership. He is member of various international and national committees, in particular, the management group for the ACCENT NoE and UK Polluted Troposphere programme. He coordinated the FP5 European project TROTREP and has undertaken a number of EU and ESA studies looking at the synergistic use of satellite and ground-based data.

Dr. John Remedios is a senior lecture in the Physics and Astronomy Department at Leicester received his D.Phil. from Oxford University in 1991 for studies of infra-red spectroscopy and remote sounding for the stratosphere. He is particularly experienced in satellite data for atmospheric composition studies of the troposphere and stratosphere. He is well connected to major infra-red satellite teams, including participation in the ESA Expert Laboratory and cal/val teams for MIPAS on ENVISAT, collaboration with the MOPITT/EOS-TERRA team, and involvement in key ESA studies of future space instruments for both limb and nadir sounding. He co-coordinated the framework 5 project, MAPSCORE, combining satellite data with an integrated modelling approach for ozone and polar stratospheric clouds. He is a member of the GATO and Vintersol liason and planning groups. He is head of the UARS Reference Atmosphere Project and he is also co-chair of COSPAR commission A.1 which focuses on satellite measurements of the troposphere and stratosphere.

Participant 14: IIASA

The International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, is an international, non-governmental research institution with 20 member countries in Europe, North America, Asia and Africa addressing a wide range of aspects of global change and development. IIASA has extensive experience in developing comprehensive interdisciplinary assessment models, inter alia in the fields of air pollution, greenhouse gas emissions and energy systems, and applying them in a practical policy context. In particular, IIASA has developed its Greenhouse gas – Air Pollution Interactions and Synergies (GAINS) model as the central analytical tool for the integrated assessment within the Clean Air For Europe (CAFE) programme of the European Commission for the Thematic Strategy on Air Pollution. GAINS also provided input to the European Climate Change Programme (ECCP) to develop emission projections of non-CO_2 greenhouse gases for the EU Member States as an input to the fourth National Communications to the UNFCCC. Currently, GAINS provides analytical input to the proposal on the forthcoming proposal of the European Commission on the burden sharing of the committed 20 percent reduction of GHG emissions by 2020. The implementation of GAINS for China and India, in close cooperation with local partner institutions, is close to completion. In the 1990s, IIASA has led a consortium of more than 50 Asian institutions that applied the predecessor of the GAINS model, i.e., its RAINS air pollution model, to Asia (RAINS-Asia), addressing the scope and cost-effectiveness of SO_2 reductions in 23 Asian countries. Within the FP6 ACCENT Network on Excellence, IIASA coordinates the subproject on "Atmospheric Sustainability", which aims at aligning European atmospheric research activities to address research questions that are relevant for policies on sustainability.

Dr. **Markus Amann**, leader of IIASA's Atmospheric Pollution and Economic Development Programme that oversees the development and applications of the GAINS model, has served as a lead author for the Fourth Assessment Report of the IPCC, focusing on the interactions between mitigation policies with other policy areas including air pollution. He is member of the Clean Air Commission of the Austrian Academy of Sciences, and the Working Group on Ozone in the 21st Century of the Royal Society (UK). **Dr. Fabian Wagner**, before joining IIASA, has worked at the IPCC Technical Support Unit on Greenhouse Gas Emission Inventories at IGES (Japan).

Participant 15: NOA

The National Observatory of Athens (NOA), the oldest research center in Greece, was founded in 1842 and started operating in 1846 the Institute of Meteorology, when the first meteorological observations began. NOA is today supervised by the General Secretariat for Research & Technology of the Ministry of Development and is operating five Research Institutes. It hosts the UNESCO Chair for Natural Disasters, it is the Greek Focal Point on the Global Earth Observing System of Systems (GEOSS) and operates the National Seismological Network. The Institute for Environmental Research and Sustainable Development (IERSD/NOA) was the first organisation that started a systematic study of the urban pollution in Athens in 1980. IERSD/NOA consists of 20 researchers and 25 scientific technical, technical and support staff. The main, relative to the project, infrastructure includes: two fully operated (A class) meteorological stations, two actinometric stations, a mobile air quality station (NO, NO_2, SO_2, O_3, THC, CH_4, PM_{10}), a DOAS for conventional pollutants but also benzole, toluole and xylole, aerosol monitoring station etc) and a fully equipped Laboratory of Chemistry (GC, IC, HPLCGC-MS etc). NOA has been involved in numerous projects on urban environments e.g. URBAN-AEROSOL, APMoSPHERE, MANTLE, RUPIOH, CIRCE. ***Dr. E. Gerasopoulos*** (PI for NOA) is a Senior Researcher at IERSD/NOA, his scientific interests focus mainly on transport and processes of gaseous pollutants with emphasis on ozone and precursors, and transport and processes of aerosols. He has about 35 publications in peer-reviewed scientific journals and has participated in several projects with focus on Eastern Mediterranean. ***Prof. C. Zerefos*** is the President of the National Observatory of Athens. He has more than 25 years of experience on basic and applied research on atmospheric physics. He is an active member of international and European commissions, including the Stratospheric Research Science Panel of the European Union, International Ozone Commission, WMO Executive Council of Experts, NASA/WMO Trends Panel, on stratospheric research topics, ozone layer and ultraviolet solar radiation. His total published work comprises of about 500 research papers in scientific journals and international scientific proceedings and has coordinated or participated in 45 international competitive research projects. ***Dr. Michael Petrakis*,** Research Director, is the Director of IERSD/NOA. His interests are focused mainly on urban air quality (outdoor, indoor), monitoring of man-made pollution and its impact on the environment, exploitation of satellite data to environmental applications, transport and dispersion of pollutants, alternative energy sources, maintenance of meteorological/climatological records.

Participant 16: CEHM

Cairo University Center for Environmental Hazard Mitigation (CEHM) is being established as one of the premier facilities for environmental monitoring in Egypt. Ten Million Egyptian Pounds (3 Million USD) were provided by the USDA (United States Department of Agriculture) through the Egyptian Ministry of International Co-operation in Egypt to develop CEHM at Cairo University. Additional funds (500000 USD) were allocated by Cairo University to construct 600 m^2 modern facility to house the center. Washington University St. Louis, MO and Argonne National Laboratory, Argonne, IL were supporting CEHM for five years starting from 1995. This collaborative effort aims at developing the expertise and capabilities of Egyptian scientists in the fields of environmental management and hazard assessment to meet the challenges of the coming decade and to protect Egypt's environment and develop its natural resources. CEHM assembled state-of-the-art laboratories, such as 1) Information and data analysis Laboratory for computation, image processing, database and geographical information system (GIS), 2) Environmental Chemistry Laboratory for assessment of the chemical characteristics of water, air, soil and biota that contains GC, IC, HPLC, ICP, and spectrophotometer, 3) Air Quality Monitoring Laboratory for calibration and maintenance of CEHM equipment and Egyptian national air pollution monitoring network equipment 4) Two environmental monitoring mobile laboratories for monitoring ambient air pollutants and stack emissions that contains equipment for monitoring of SO_2, NO, NO_2, NO_x, CO, O_3, CH_4, NMHC, THC, TSP, PM_{10}, $PM_{2.5}$, Soot, Dust fall and metrological conditions; in addition to open path FTIR (with heated Teflon tube and 32m cell for stack emissions measurements) and equipment for iso-kinetic sampling of dust, 4) Environmental Geophysical Laboratory for monitoring seismic activity and construct land use maps for new urban communities. CEHM Egyptian Scientists are trained on the use of the latest equipment and techniques in acquiring and interpreting environmental data sets.

Egyptian and U.S. scientists were engaged in collaborative research efforts to address and resolve environmental problems in Egypt: 1) Monitoring Urbanization and Seashore Line Erosion in the Nile Delta – 2) Seismic Hazard Risk Map of Egypt – 3) Geochemistry and Origin of Ground waters in Wadi El-Tarfa Area and Western Delta – 4) Drinking Water Quality in Cairo, Tanta and Surroundings – 5) Lead Sources in Urban Air Particulates in Cairo – 6) Source Profiles for Non-methane Organic compounds in Cairo.

In addition, CEHM is contracted from Egyptian Environmental Affairs Agency (EEAA) to operate the Egyptian Noise Monitoring Network (30 noise monitoring terminals) and the Egyptian National Air Pollution Monitoring Network that consists of 40 stations. CEHM is also responsible for calibration, routine maintenance, major maintenance, repairs, data collection, chemical analysis and reporting for the whole network.

CEHM is hosting Basel Convention Regional Center for Training and Technology Transfer to Arab Speaking Countries supervised by UNEP and Secretariat of Basel Convention (SBC).

The co-workers will be **Dr. Tarek El-Araby**, Associate Professor of Geophysics in Faculty of Science, Vice-director of CEHM and the manager of the Egyptian National Noise and Air Quality Monitoring Networks funded by DANIDA and the Government of Egypt. He was responsible for the monitoring operation of the Cairo Air Improvement Project (CAIP) funded by USAID and several monitoring and consultancy projects funded by JICA, UNDP and Egyptian private sector. Now he is hired by the World Bank to be the environmental consultant for the Egyptian airports development project. **Dr. Ahmed Fahmy,** Associate Professor of Analytical Chemistry in Faculty of Science, he is specialized in air and water analysis, speciation analysis, explanatory of air and water analysis data, expert in atomic and molecular spectrometric analysis. He has more than 18 publications, supervise 2 Ph. D. and 7 M. Sc. Students.

B 2.3 Consortium as a whole

The nature of the research problems calls for a combined use of observational and modelling capabilities, which has determined the selection of a consortium. The consortium members are experts on the observational and modelling experience in the hotspots selected for study, as well as on the broader implications and on how to bring about the desired impact of the research work. The consortium members are internationally acknowledged research organisations in the relevant research disciplines and have a proven track record of successfully working together in previous collaborative projects. The project will benefit from the expertise of Peking University to bring in the Pearl River Delta experience and to contrast that with the situation in European hotspots including the Eastern Mediterranean.

The main strength of the consortium is the presence of

- advanced observational capability, in particular state-of-the-art observing capability from satellites and access to long term records necessary to detect trends
- atmospheric chemistry modelling capability of both the hotspot, the regional and the global spatial scales and in the bridging of the spatial scales in a unified approach,
- air quality forecasting capability including data assimilation techniques,
- climate modelling with the emphasis on regional scale, high resolution coupled calculations of climate and atmospheric chemistry processes (ozone, aerosols)
- emission inventories and sector allocations for hotspots, regions and globally,
- availability of detailed emission data sets for major European hot spots and, through inclusion of a Chinese partner, access to emission data for hot spots in the Far East and the experience gained there during the last decade regarding outflow of pollutants from rapidly emerging megacities and air pollution problems therein
- mitigation options and the technical underpinning of policy in many contexts on a (semi) operational basis

Several partners included in the consortium have already collaborated in earlier projects and thus know each others capabilities, thus enabling efficient collaboration right from the start of the project.

Leadership: The overall coordination of CITYZEN will be led by a Steering Committee of very high quality and profile scientists who collectively have an extensive record of successful management of national, EU and international projects and programmes, with a substantial track record in publishing, supervision of PhD students, and leadership in national and international work related to environmental research and its applications, including the coordination of international projects. The Steering Committee (Michael Gauss, Laurence Rouil, Martin Schultz, Paul Monks, Leonor Tarrason, Maria Kanakidou, Øystein Hov and Ivar Isaksen) also reflects a selection of experts in the field of the modelling of atmospheric chemistry on all spatial scales, the interaction between atmospheric composition and climate change, satellite and in-situ observations, emissions including biosphere-atmosphere exchange and environmental policy analysis.

Institutes and WP leaders: CITYZEN brings together in one integrated project leading scientific teams in Europe including Turkey, together with teams from China and Egypt. Short Curriculum Vitae (steering committee members, WP leaders and PIs) are provided in Section 2.2 together with Institute descriptions for all partners.

Critical mass: CITYZEN brings together communities on the pan-European scale to create the critical mass required to support European environmental policy development. The project team is strengthened by the inclusion of institutes in China and Egypt.

Senior Scientists: The CITYZEN Project will involve the following senior scientists:
Øystein Hov, Leonor Tarrason, Michael Gauss, Ivar Isaksen, David Simpson, Yuanhang Zhang, Sjaak Slanina, Kathy Law, Claire Granier, Cathy Clerbaux, John Burrows, Andreas Richter, Michael Buchwitz, Wolfgang von Hoyningen, Michael Memmesheimer, Hermann Jakobs, Adolf Ebel, Hendrik Elbern, Martin Schultz, Andreas Hofzumahaus, Maria Kanakidou, Nikolaos Mihalopoulos, Maria Christina Facchini, Federico Fierli, Sandro Fuzzi, Alberto Maurizi, Francesco Tampieri, Kjetil Tørseth. Sverre Solberg, Frode Stordal, Nilgün Kubilay, Mehmet Karaca, Tayfun Kindap, Alper Unal, Paul Monks, John Remedios, Markus Amann, Christos Zerefos, Evangelos Gerasopoulos, Michael Petrakis, Tarek El-Araby.

Scientific disciplines, complementarity: The consortium members were carefully chosen to ensure that the diverse expertise and skills are delivered to the project.

Complementarity of consortium				
Hotspot CTM	**Regional CTM**	**Global CTM**	**CTM across all spatial scales**	**Observations satellite**
Partner #: 1, 2, 3, 4, 6, 8, 9, 12	1, 2, 3, 4, 6, 8, 9, 10	1, 3, 4, 7, 8, 9, 11	1, 3, 4, 6, 8, 9	2, 5, 13
Observations in-situ	**Emissions**	**Air Quality forecasting (incl data assimilation)**	**Climate modelling global**	**Coupled climate atmospheric chemistry model, high res (regional)**
Partner #: 2, 7, 8, 9, 10, 11, 12,	1, 2, 7, 9, 12, 13	1, 2, 4, 6	7, 11	6, 7
Technical support to policy and mitigation				
Partner #: 2, 2, 4, 6, 9, 10, 12, 13, 14				

Partners from non EU-25:
The CITYZEN consortium includes 4 Partners from Associated Countries:
metno, UiO and NILU, Norway
METU, Istanbul, Turkey

1 partner from an International Co-operation Partner Country (ICPC):
PKU, China

1 partner from the Mediterranean Partner Countries (MPC):
CEHM, Egypt
(Egypt is also a part of the **European Neighbourhood Policy (ENP)**)

INCO Partners and *Developing Countries* are indirectly a part of CITYZEN through the contribution of CITYZEN research results and methodology (modelling tools, observations, emission inventorying techniques) to the GAW-GURME part of WMO, see Section 3.1. This activity focuses on capacity building in air quality and climate research in developing countries with emerging economies combined with a serious air quality problem including particulate air pollution. In several such countries the atmospheric pollution and its regional and global impact is much less investigated and understood than in Europe, and urban and rural air quality is often rapidly deteriorating. Especially good quality long-term data sets of physical, chemical, and optical characteristics are rare. These kind of data sets are urgently needed to support policy decisions. The lack of knowledge has only partly been compensated by intensive field studies by the international community. Furthermore, emerging research groups in these countries need the development of technical skills to perform detailed analyses.

Inclusion of SMEs:
The CITYZEN consortium does not include SMEs. The objectives and results of CITYZEN are directed towards scientific questions and policy regulation, which belong to the public domain. The processes to be addressed are of scientific and policy interest only and do not constitute a mature business field.
The only exception where SMEs could be considered lies in the emissions sector. However, it was found that IIASA was by far the most suitable and competent partner to fulfil the tasks relevant to the objectives of this project.

B 2.4 Resources to be committed

All participants opt for 75% contribution from the EU except Peking University which asks for 50%. The project will benefit from the investments in a series of EU project including the Network of Excellence ACCENT. The investment in horizontal activities in ACCENT (model infrastructure, access to field data, access to lab data and quality assurance, web technology) will indirectly provide substantial support to CITYZEN in that the leaders of the horizontal activities in ACCENT are partners in the CITYZEN consortium (UiO for the model activity, NILU for the access to field data and the web technology) and FZJ for the quality management.

The resources going into the project include the following categories: Human resources (scientists and support staff), institutions, computers, observations, numerical models, data for emissions including data for the societal and natural processes that generate emissions.

The human resources have been trained through the national funding of universities and R&D institutions.

The project partners are all backed up by their institutions and a rent of office space, staff support and computers is paid for by the project through the indirect costs.

The project does not have any requirements for investment in capital goods like computers, which means that extensive computer power is made available to the project through institutional or national computing or supercomputing resources. Some of the computing tasks are very extensive (e.g. coupled climate-chemistry model calculations over the best part of a decade with fairly high spatial resolution). It is obvious that the project benefits strongly from institutional and national investments in computing, but it is difficult to put numbers on this.

The observational basis available to the project is very substantial and the costs to generate these observations are very substantial. In particular the satellite based instruments come at a very high investment cost, cfr the budgets of ESA and EUMETSAT in Europe. Also the in-situ surface observations available to us come out of monitoring and research programmes with substantial investments. The monitoring programmes are normally funded nationally, while the research observations can derive from both national and international (like EU) funding. All these data come without a data charge to the project. The project therefore adds value to the return from very significant investments in observations.

The numerical models available to the project for further development and application have all been developed through a combination of institutional funding and external funding from national and international research funding agencies. Each of the models can have a decade of development and investment associated with them, again a substantial investment.

In summary the project ensures that very substantial investments pay off in results that are of potentially very large indirect or direct value to society. A mechanism has been carefully designed (described in WP4 and in sections 3.1.1 and 3.1.2) to ensure a lasting societal use and benefit from the research and methods developed through this project. The investments made already in the basic requirements of this project, as outlined above, ensure a very substantial complement to the financial contribution applied for here from the EU.

The total resources including the direct EU contribution requested, are integrated in a coherent way through the combination of the research goals for the projects, its organisation in work packages, and the work and responsibilities of the coordinator and the steering committee.

In the Table below the distribution of the budget is shown for the project and the part requested from the EU divided among the participants and the work packages. The budget is split as approximately 1670 kEURO for WP1, 871 kEURO for WP2, 799 kEURO for WP3, and 575 kEURO for WP4, in total 3914 kEURO, including scientific and administrative coordination. A careful analysis shows that there is a reasonable balance of funding among the partners when the work load is assessed, in the split between the methodological approaches (observations, chemical modelling, climate modelling, emissions, serving the policy needs) and between the different special cases selected for special study.

Overall budget for the full duration of the project per work package:

Partner		WP 1	WP 2	WP 3	WP 4	Coor-dination	Total
1	metno	117 648	100 192	83 736	165 091	50 000	516 667
2	PKU	126 360	18 440	66 440	33 160		244 400
3	CNRS	100 939	26 928	52 733	52 733		233 333
4	INERIS	211 212	45 795	45 795	30 530		333 333
5	IUP-UB	332 800	125 867	0	8 000		466 667
6	FRIUUK	67 328	66 336	59 544	6 792		200 000
7	FZJ	54 320	191 394	74 218	80 068		400 000
8	ECPL	93 434	38 189	120 101	14 943		266 667
9	CNR	155 629	46 571	32 600	65 200		300 000
10	NILU	21 784	87 375	14 523	14 523		138 205
11	UiO	73 504	51 456	53 600	21 440		200 000
12	METU	96 000	40 000	8 000	16 000		160 000
13	ULeic	103 936	48 524	48 524	32 350		233 334
14	IIASA	0	0	112 483	20 851		133 333
15	NOA	100 000	0	0	0		100 000
16	CEHM	33 333	0	0	0		33 333
	Total	**1 688 227**	**887 068**	**772 297**	**561 680**	**50 000**	**3 959 272**

Personnel, other direct, and indirect costs for the full duration of the project:

Partner		Personnel costs	Other direct costs	Indirect costs	Total
1	metno	288 470	22 619	205 578	516 667
2	PKU	134 000	30 000	80 400	244 400
3	CNRS	129 186	16 647	87 500	233 333
4	INERIS	153 873	10 199	169 261	333 333
5	IUP-UB	240 000	51 667	175 000	466 667
6	FRIUUK	101 880	23 120	75 000	200 000
7	FZJ	196 645	8 483	194 872	400 000
8	ECPL	115 000	51 667	100 000	266 667
9	CNR	151 437	15 916	132 647	300 000
10	NILU	69 156	7 500	61 549	138 205
11	UiO	115 910	9 090	75 000	200 000
12	METU	90 000	10 000	60 000	160 000
13	ULeic	132 990	12 844	87 500	233 334
14	IIASA	81 498	7 011	44 824	133 333
15	NOA	50 820	16 147	33 033	100 000
16	CEHM	18 000	4 533	10 800	33 333
	Total	**2 068 865**	**297 443**	**1 592 964**	**3 959 272**

B 3 Potential impact

B 3.1 Strategic impact

B 3.1.1 How will this project contribute to the expected impacts listed in the work programme?

The call lists the following expected impacts:

a) A better quantification of air quality, mitigation options of air pollution in cities
b) Availability of more reliable tools for prediction of air pollution in cities
c) Support to EC Thematic Strategy on Air Pollution and Air Quality regulation
d) Better quantification on regional and global links between air pollution, climate and climate change necessary to underpin mitigation and other policy initiatives

The project will contribute towards these expected impacts in the following ways:

a) A better quantification of air quality and mitigation options of air pollution in cities.

In the project several hotspots in Europe and outside of Europe will be analysed specifically with the aim to map the load, distribution and change with time of the air pollution as assessed from satellite observations, surface observations and use of scale bridging models to properly account for the interchange of pollution across spatial scales where the urban emissions are resolved, and the regional and the global scales.

Mitigation option studies will have an emphasis on particulate matter (in particular PM2.5 and PM10, PM1 may also be studied) and ozone. The following hotspots will be studied: the BeNeLux region, the Po valley, the eastern Mediterranean with Athens, Istanbul and Cairo, and the Pearl River Delta in China. In addition the hot west- and central European summer 2003 will be studied for its implications for altered and more severe pollution regime under climate change.

Tools will be developed in WP1-3 (combination of observational techniques, emission inventories and modelling) for air quality and mitigation studies. These tools will be available through WP4 on a semi-operational basis on demand for the cities selected and can be extended to other cities when need arises.

b) Availability of more reliable tools for prediction of air pollution in cities.

Bridging of spatial scales in forecasting models for policy purposes: The ambition in the project is to develop and demonstrate the use of air quality forecasting models where the information on the coarser scale surrounding the hotspot impacts both ways (two-way nesting) on the air pollution load on the finer spatial scale used for the hotspot. The air quality analysis and prediction studies for the megacities/hotspots selected as special study cases will provide examples of such air quality forecasting and its usefulness in a mitigation context.

The methodological experience of the pilot studies will be brought into WP4 and made available to interested parties in Europe and elsewhere as demand is expressed during the project. The project will use the mechanisms offered through eg. European Environmental Agency (EEA) with its topic center on air quality and climate change, and WMO through the Global Atmosphere Watch (GAW)-Urban Research Meteorology and Environment (GURME) project which is in operation in particular in Asia, Central and South American hotpots and which was started in response to the requests of National Meteorological and Hydrological Services (NMHSs) for help in air quality forecasting (see also Figure 1 in Section 1).

The lead responsibility for GAW and GURME is with the Open Programme Area Group on Environmental Pollution and Atmospheric Chemistry under Commission of Atmospheric Chemistry in WMO. This group is chaired by professor Øystein Hov at metno, one of the PIs in this project. WMO established GURME to enhance the capabilities of NMHSs to handle meteorological and related aspects of urban pollution. GURME is designed to do this through co-ordination and focussing of present activities, as well as initiation of new ones.

c) Support to EC Thematic Strategy on Air Pollution and Air Quality regulation.

The objectives of the Thematic Strategy ("Thematic Strategy on air pollution", COM(2005)446 final, Brussels 21.9.2005) is to provide a specific contribution towards "levels of air quality that do not give rise to significant impacts on, and risks to human health and the environment". This means no exceedance of critical loads and levels for the natural environment, and a safe level (if one exists) of exposure for pollutants as particulate matter and ground level ozone. The Thematic Strategy aims at reducing the concentration of PM2.5 by 75% and ground level ozone by 60% of what is technically feasible by 2020. The threat to the natural environment from both acidification and eutrophication will be reduced by 55% from what is technically possible.

This project will support the Thematic Strategy specifically in several ways:

- The project will bring in an improved and documented capability to use remote sensing data from satellites in combination with model calculations to assess the atmospheric pollutant regime and emissions associated with hotspots. This will improve the capability to check the implementation of air quality legislation (compliance).

- The scale bridging model development will provide a more accurate method to describe the interaction between hotspot emissions and the larger scale atmospheric concentration and deposition fields. The parameterisation of sub grid hotspot emissions in the model calculations currently underpinning the Thematic Strategy is probably the source of important uncertainty in the emission reductions calculated to be required to meet the goals mentioned above. **(**WP1, WP4).

- The feedback from climate change on air quality and deposition both in the intermediate (2020-2030) and long term (2050-2100) is not properly assessed in the current Thematic Strategy. The coupled climate change-atmospheric chemistry calculations and the climate change – CTM offline calculations to be carried out in this project will give the basis to be used to analyse a potentially major source of uncertainty in how the emission targets given in the Thematic Strategy will reduce both the atmospheric concentrations of PM2.5 and ozone, and the deposition to the natural environment. Climate variability and change will affect natural emissions, transport, transformation and sink processes (WP2). This effect comes in addition to the uncertainty brought into the emission reduction estimates by the future growth in regional and global population and economic wealth.

- The coupled climate-chemistry modelling activity will improve our knowledge about the feedbacks between atmospheric pollution and the weather (precipitation, temperature). In this way there will be better technical links between the Thematic Strategy on air pollution and the management of soil, water quality and biodiversity**.** (WP2).

- The role of emissions and emission changes outside of the EU on the concentration of pollutants and deposition in the EU will be calculated in an integrated and a scale-bridging way.

- Through WP4 it will be ensured that the models and the supporting data (emissions, observations, meteorology) in the project are developed in line with both the research needs in the project and the policy needs. Methods and data developed or refined in the project to a mature stage will be added to the (semi)operational capability of research centres which have as part of their mission to provide technical support to policy development. Institutions like metno, IIASA, NILU and INERIS provide technical support to the EU Thematic Strategy, CLRTAP, IPCC and to other intergovernmental international environmental policy support structures (like WMO), and to EU-institutions (like EEA, in particular through the Topic Centre on Air Quality and Climate Change). All partners advise their national governments through their environmental agencies and ministries of environment. The project partners in this way ensure a lasting pay back of the investment in the project, and current and new technical questions relevant to policy can be investigated within the existing structure that supports policy development, without a need to reassemble methodology or research consortia to carry out the tasks.

This is a cost-efficient, mature, reliable and sustainable mechanism for the transfer of research based information to policy and for the channelling of research and assessment needs to the research community from the users. The mechanism is sustainable because the tasks are lifted from the ad-hoc project level to the level of institutions, and based in their mission statements.

- Through the application and further development of emission inventories and the attribution of emissions to societal sectors, further technical results are expected on how air quality concerns can affect other policy areas linked to energy, transport including ships and aviation, and agriculture.

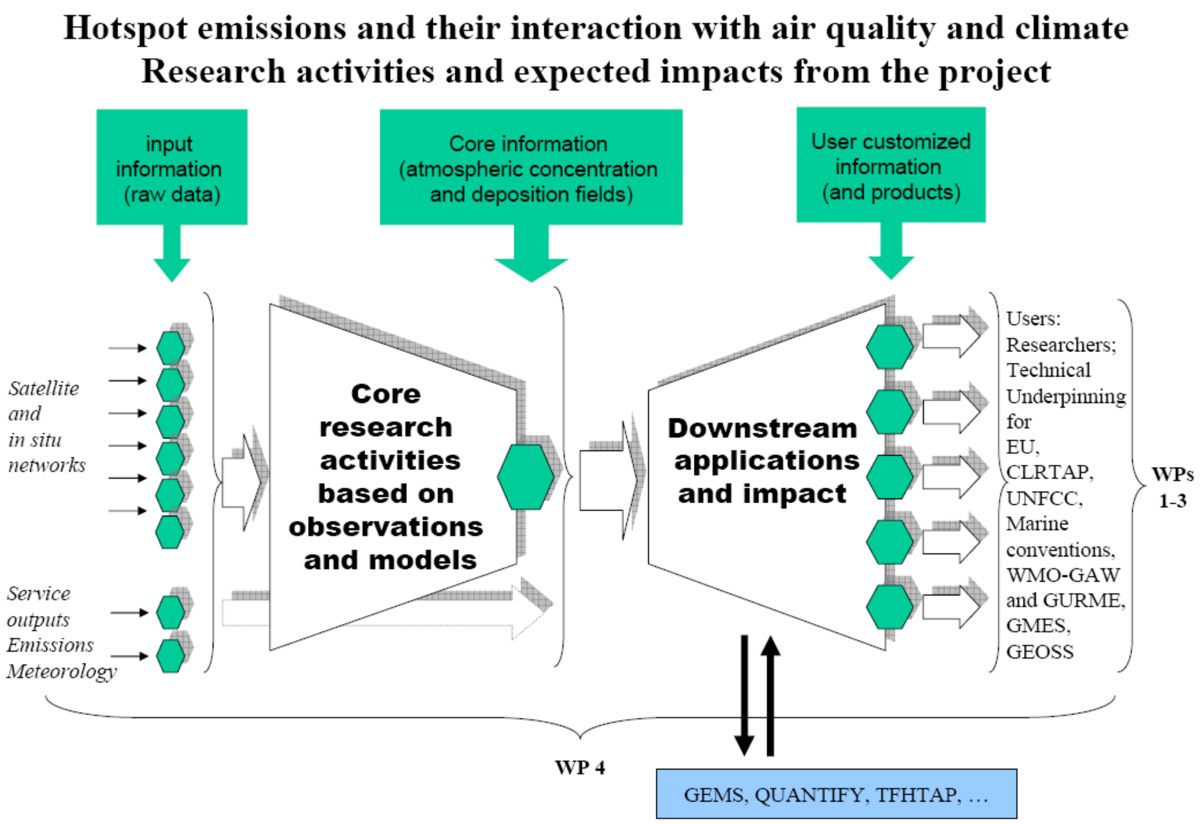

Figure 6: Flow of information from data sources (observations, emissions, meteorology, chemical transformation and sink mechanisms) into the "Core research activities" where all available information and model calculations are blended together into 4-dimensional datasets of a spatial and temporal resolution that is determined by the problem under study. On the basis of these "Core research activities" research is undertaken in WP1-3 by a goal-oriented and specialized analysis of the data fields (observed, calculated; assimilated).

d) Better quantification on regional and global links between air pollution, climate and climate change necessary to underpin mitigation and other policy initiatives.

The special study of the summer 2003 heat wave and pollution episode over central and western Europe is expected to provide combined observational and model-derived evidence on how the physical characteristics of the heat wave (high temperatures, much longer than average residence times for the air in the atmospheric boundary layer, drought and plant stress, forest fires) contributed to an aggrevated air pollution situation (ozone, PM) over extended areas including densely populated regions like the southeast UK, the BeNeLux Countries, the Paris Region etc. Climate change scenarios from Hadley and ECHAM, available to the project through parallel research activities at several of the partners' institutions, will be used to estimate how the frequency of such events may change in the future.

A high resolution climate model with atmospheric chemistry feedbacks included will be used to see how regional weather may respond to the changed atmospheric composition and surface-atmosphere fluxes in the future (year 2050).
Mitigation options will be assessed on the basis of the time slice type calculations where the coupled GCM + atmospheric chemistry model will be run for 1-2 months from different stages in longer GCM scenario runs where the composition of the atmosphere has been calculated off line to save computer time. In GCM calculations with off-line treatment of atmospheric chemistry the feedbacks are missing about how the weather system developments differ due to the spatial gradients in the forcing by radiatively active agents that are inhomogeneously distributed in the atmosphere (notably PM and ozone). Also changes in the size distribution and composition of the aerosol population in the future due to higher emissions of PM or their precursors, is of concern here as the aerosol population determines the rainfall patterns and amounts. The model studies to be carried out will shed light on this, as will the analysis of existing data sets on the relationship between aerosol population and precipitation available in particular in the Po Valley and in the Pearl River Delta.

B 3.1.2 Steps that will be taken to bring about the impacts

The general mechanism to be used to make sure the project research results as well as its methodology development will have the maximum impact on policy both during the project and afterwards, the partners will use their involvement in the on-going technical underpinning mechanisms (listed in the Table below).

Many of the partners, either as institutions or the PIs as individuals, hold key positions in the existing national and international underpinning work, and these positions will be used to convey the value of the project findings in the relevant policy arenas and to bring specific user needs to the attention of the project. In this way the project will strengthen existing mechanisms for policy development and compliance analysis, through its WP4 enable the heritage of methods to be available either on an operational basis in the future, or it can be mobilized when the need arises. The investment in the project will result in both research publications and a stronger underpinning capability in the future during and after the project has ended. Details of knowledge transfer mechanisms are given below.

The Table below is a specification of the right hand side of the diagram above (Figure 6) where the products to users originate from the downstream applications (Output from downstream applications as specified for WP1-4). The project partners have different roles in the relevant policy frameworks and use several different technical underpinning mechanisms. See below for further discussion.

Table of Policy frameworks supported by the project and the technical underpinning mechanisms that the project partners serve

Technical underpinning mechanisms (1), intergovernmental organisations (2), EU institutions (3), national authorities (4):	Policy frameworks
- EMEP including TFMM and TFHTAP (1)	- EU Thematic Strategy on air pollution
- WMO GAW including GURME (2)	- CLRTAP
- IGAC and ILEAPS (IGBP) (1)	- UNFCC
- EANET (1)	- Marine Conventions
- ESA (1)	- National and regional mitigation of air pollution (and climate change)
- IIASA (1)	- GMES
- GMES (1)	
- GEOSS (1)	
- WMO (2)	
- Ministries of Environment (4)	
- National environmental agencies (4)	
- European Environmental Agency and its Topic Centre on Air pollution and climate change (3)	
- The EU Commission (3)	

Abbreviations: EMEP (European Monitoring and Evaluation Programme), TFMM Task Force on Measurements and Modelling, TFHTAP Task Force on Hemispheric Transport of Air Pollution, GAW Global Atmosphere Watch, GURME GAW-Urban Research Meteorology and Environment, IGAC International Global Atmospheric Chemistry project, ILEAPS Integrated Land Ecosystem Atmosphere Processes Study (part of IGBP), IGBP international Geosphere-Biosphere Programme, EANET Acid Deposition Monitoring Network in East Asia, ESA European Space Agency, IIASA International Institute for Systems Analysis Laxenburg Austria, GMES Global Monitoring for Environment and Security, GEOSS Global Earth Observation System of Systems, CLRTAP Convention on Long Range Transmission of Air Pollutants, UNFCC United Nations' Framework Convention on Climate Change

Some of the partners (notably metno, INERIS, IIASA, NILU, PKU, FRIUUK, IUP-UB) advise their European and national environmental agencies and ministries of environment on matters related to air pollution in cities, regions and even continents or globally, and on the technical underpinning of climate change policies. The national authorities in their turn are involved in the international work within structures like CLRTAP, the EU, UNFCC, marine conventions etc. The partners in the project will use the project results and methodologies to strengthen the scientific basis for the advice to their national authorities.

Some partners have as a part of their mission, operational roles in providing technical support to international policy work. This applies in particular to metno and its EMEP involvement under CLRTAP as the Meteorological Synthesizing Centre West (MSCW) where operational calculations of source-receptor relationships for atmospheric trace species like ozone, PM with its chemical composition; NOx and ammonia as well as their transformation products. IIASA is hosting the

EMEP Centre for Integrated Assessment Modelling (CIAM) where the integrated assessment activities for the negotiations under the Convention on Long-range Transboundary Air Pollution are carried out. Furthermore, IIASA is coordinating the activities of the ‘European Consortium for Air Pollution and Climate Modelling’ (EC4MACS) for policy advice to the European Commission.

NILU as the Chemical Coordinating Centre CCC of EMEP has the role to coordinate the surface observations network in EMEP (about 50 countries in Europe and in Eurasia) and NILU through CCC provides on an operational basis, bot a quality assurance system for the observations, and assessments of the continental air pollution situation outside of cities.

NILU and metno through their involvement in the European Topic Centre for Air and Climate Change under European Environment Agency contribute to the assessment of the state and evolvement of all atmospheric pollution related environmental problems in the countries of the EU.

Dr. Cathy Clerbaux is a member of the ESA Advisory Group for the preparation of future satellite mission in the GMES context. She is a remote sensing expert for Eumetsat for the Meteosat Third Generation project.

Dr. Claire Granier is the co-coordinator of the Global Emissions Inventory Activity (GEIA), which is developing a web portal for accessing emissions databases.

Dr. Kathy Law, the project PI at CNRS/SA, is the European chairperson of IGAC, which is the atmospheric programme of IGBP. IGAC organizes international research on atmospheric chemistry and as chairperson Dr Law can bring the project results to use in a direct and decisive manner.

Professor John Burrows is the proposer and principal investigator/lead scientist of GOME and SCIAMACHY projects, which are national and European pioneering space missions observing trace gases form space. He and his team at Bremen are involved in the development of the GMES services at the national and European level, being part of the PROMOTE and GEMS projects. The IUP-UB is a scientific GMES office in Bremen is facilitating the national and regional objectives of GMES as it moves to completion. Professor Burrows is an advisor to the UN through his leadership of Commission A at COSPAR and ESA and EUMETSAT being part of the post EPS team. He has been part of GCOS and CEOS IGOS activities being a co-author of the IGOS-IGACO a strategy for the global observation of chemical composition.

Dr. Laurence Rouil INERIS is the chair person of the Task Force on Measurement and Modelling within EMEP and she is thus in charge of an important element of the international research and assessment work in EMEP for CLRTAP.

Professor Øystein Hov at metno will as the chair person of the Open Programme Area Group on Environmental Pollution and Atmospheric Chemistry under Commission of Atmospheric Chemistry in WMO, bring the project results to the direct use within GAW and GURME. The implementation of the IGACO-strategy under IGOS is now done through GAW, and CITYZEN will provide momentum to this implementation. GAW and GURME are highly relevant for the development of management capabilities of local and regional air pollution problems in Asia, Central and South America and Africa.

Professor Ivar S.A. Isaksen is the coordinator of global modelling activities in the Network of Excellence ACCENT on tropospheric chemistry, and the Integrated project QUANTIFY on the impact fro the transport sector. Through organizing common international activities these activities act to improve modelling capability and they contribute to international assessments.

Dr. Martin Schultz, FZJ, is coordinating the sub project on global reactive gases within the European GMES initiative Global Monitoring of the Earth System (GEMS) which forms an important cornerstone of the foreseen development of operational capacities for integrated Earth System Monitoring in Europe. He is also co-coordinating the ongoing international efforts to conduct a large set of common model experiments in support of the CLRTAP assessments by the task force on hemispheric transport of air pollution (TFHTAP).

Dr. Sandro Fuzzi at CNR is a PI in this project and the coordinator of ACCENT. As this project and ACCENT has overlapping participation to a large extent, cost efficient use of ACCENT resources is ensured and the support for research offered through ACCENT will be brought into concrete action in this project.

Prof. Maria Kanakidou, leader of the East Mediterranean Case study and member of the Steering committee of CityZen, is the president of the international Commission for atmospheric chemistry and global pollution (CACGP). CACGP contributes to the dissemination of science by organizing targeted scientific sessions in international scientific meetings and a quadrennial symposium that is joint with IGAC and WMO. CACGP is strongly supporting scientific interactions between the oceanic and atmospheric scientific communities. The results of CityZen will thus be disseminated and used by both communities.

B 3.1.3 The need for a European approach

Proper investigation of the issues taken up in this proposal requires the polling of knowledge and human resources from the best institutions in Europe and elsewhere. The societal implications of the issues under study are very large. In the EU Thematic Strategy on air pollution it is stated that "Concerning health impacts, currently in the EU there is a loss in statistical life expectancy of over 8 months due to $PM_{2.5}$ in air, equivalent to 3.6 million life years lost annually. Even with effective implementation of current policies this will reduce only to around 5.5 months (equivalent to 2.5 million life years lost or 272,000 premature deaths). For ozone there are estimated to be around 21,000 cases of hastened mortality in 2020. This has severe consequences for quality of life. Children, the elderly as well as citizens suffering from asthma and cardiovascular diseases are particularly vulnerable. In monetary terms, the damage to human health alone is estimated at between €189 - 609 billion per annum in 2020. In view of these costs, taking no further action is not an option."

Twenty of the 30 most polluted cities in the world are in China. According to the book "Dancing with the Giants: China, India and the Global Economy" by the World Bank, air pollution is causing 427 000 extra deaths a year (The Economist, 31March-6 April 2007, p. 11). China is expected to overtake the United States as the world's biggest carbon emitter by 2009. Its current share is 17% of the world's total, against America's 22%. Last year (2006) alone, China added the equivalent of California's entire current generating capacity, nine-tenths of it coal-fired. It is clear that the pollution issues studied in the project have a societal significance that require both urban, regional, national, continental and global approaches for collecting the required underpinning data and knowledge.

B 3.1.4 Account is taken of other national and international research activities

This proposal builds on the investment in past and current infrastructure and projects. Many of the partners have partial public funding for missions that are related to this project (metno, NILU, INERIS, universities). National project based research funds provide a substantial basis on which the work in this project relies. This applies in particular to the observational basis for the case studies in the eastern Mediterranean, the Po Valley, the BeNeLux region, the Pearl River Delta and the hot summer episode in 2003 in Europe. Significant national infrastructure funds go into the establishment, maintenance and quality control of national emission figures and model capabilities. This project will build directly on these investments, which are substantial over many years.

This project also relies heavily on the direct application of the research methods developed and made available through the network of excellence ACCENT, in which many of the consortium members are involved.

Other current and past EU projects with data, results, research methodology which will be brought directly into this project, through the participation (current or past) of some of our consortium members, include

EUCAARI, GEMS, GEOMON, RETRO, AMMA, SCOUT-O3 and EUSAAR.

The links of this project to GEMS take place through the common partners metno, FZJ, CNRS, FRIUUK, IUP-UB, CNR, INERIS, to PROMOTE through INERIS, FRIUUK, CNRS, NILU, to ACCENT through UiO, NILU, CNR, SA/IPSL, IUP-UB, ULeic, FZJ, IIASA, links to EUCAARI through CNR, UiO, metno, NILU, PKU, FZJ, IIASA, to GEOMON through NILU, UiO, ULeic, IUP-UB, to AMMA through CNRS (SA), IUP-UB, to SCOUT-O3 through CNRS (SA), UiO, NILU, and to HYMN through CNRS (SA), UiO.

There is a significant link to the International Polar Year project POLARCAT aimed at the observation and analysis of Arctic “hotspot” pollution through CNRS(SA)/IPSL, NILU and metno.

This project contributes significantly to the EMEP task force TFHTAP through FZJ, UiO, NILU, metno, and IIASA.

There is significant involvement in ESA/EU GMES projects GEMS, PROMOTE and MERSEA through FZJ, FRIUUK, NILU and metno, and to the COST ACTION ES0602 by FRIUUK.
FZJ has an important role in the MOZAIC data base.

B 3.1.5 Assumptions and external factors determining whether the impacts will be achieved

As the impact of the project will be made largely through institutions which already contribute to technical underpinning of environmental policy as a part of their mission statements or long term work plans, the risk for not succeeding in delivering the impact seems low. Also, the individual PIs in the project mentioned to have key roles in international structures for research (like IGAC and ILEAPS) or application of research (like TFMM, EMEP, GAW) have strong mandates given to them byte terms of reference of the structures they are in charge of (eg TFMM has its terms of reference defined by the Steering Body and the Executive Body of EMEP; while GAW and GURME has terms of reference decided by the WMO Commission for Atmospheric Sciences, decided by all the members of WMO.

B 3.2 Plan for the use and dissemination of foreground

The dissemination of results will be performed by

1) The mechanism described in WP4 whereby CITYZEN partners make technical advise and underpinning available to national authorities (environmental agencies, ministries of environment), to intergovernmental organisations like WMO, to international research programmes like IGBP, and to EU institutions. The details of this are described in Section 3.1 (3.1.2).

2) public web pages with communication plans incl. press releases, brochures,

3) peer-reviewed publications,

4) presentations in international conferences

5) networking with the ACCENT project (e.g webportal, use the ACCENT symposia as a means to present CITYZEN results in an organised and integrated manner),

6) in collaboration with the MEGAPOLI project coordinators webpages will be designed and consistency between major findings in CITYZEN and MEGAPOLI will be ensured as far as possible in publications.

The Steering Committee with its advisors will act in a manner that ensures the most urgent knowledge is immediately transferred to relevant users whether they are End Users, Policy Makers or the public in general.

The legal management of Immaterial Property Rights (IPR) will be settled in detail the Consortium Agreement inline with the General Conditions of The Commission Model Contract. The knowledge and innovations created during the project will initially be evaluated by the party owing the knowledge and innovations and by the Steering Committee. The coordinator may organise a further evaluation of the research results e.g. with the aid of Technology Transfer Offices of the contracting parties having the expertise in IPR, market analyses, commercialisation etc.
CITYZEN will follow the general principle that the knowledge will be the property of the parties generating it. The software modelling e.g. CITYZEN All-Scales-Architecture will be agreed the Consortium Agreement (CA). In the CA the IPR owners of source code and data including the access right will be listed and sever as a preliminary input for “Pre-existing Know How” of the CITYZEN Project. Before project start the Consortium will also make sure that questions concerning, confidentiality, and other innovation-related activities are clearly identified and agreed in the CA. The signing of the CA is scheduled after / if having the Commission decision for the proposal. Access Rights for the CITYZEN (semi)operational methods for the technical underpinning of hotspot air pollution/climate change interaction (see WP4) with model source codes and data products will be freely available for the research use. The user community will be controlled via the password procedure.

B 3.2.1 Contributions to standards

This does not appear to be applicable for the nature of this project.

B 3.2.2 Contribution to policy developments

The contribution to policy developments is ensured by WP4, which establishes and documents the generic aspects of the model tools developed in WPs 1 to 3 for the analysis of mitigation options for air pollution in hotspots. Mitigation options will be investigated and results will be conveyed to policy makers. We will work with national authorities, intergovernmental organisations and EU-institutions to prepare for and whenever possible provide technical underpinning of policy. WP4 will insure that the improved emission inventories including scenarios, spatial scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact.
The contact with policy makers is ensured through the participation of several partners in various frameworks and conventions as described in detail in section 3.1.

B 3.2.3 Risk assessment and related communication strategy

There are no risks for society/citizens associated with the project.

B 4 Ethical issues

There are no ethical issues related to human beings, human biological samples personal data (whether identified by name or not), genetic information, or animals regulations associated with the project.

B 5 Gender aspects

Two of the four WP-leaders are women (Laurence Rouil, INERIS for WP1 and Leonor Tarrason, metno for WP4). Maria Kanakidou ECPL will lead an important task in WP1 for the eastern mediterranean. The Steering Committee consists of 3 women (WP1 and WP4 leaders plus Maria Kanakidou, ECPL) and 5 men (the coordinator, the WP2 and WP4 leaders plus Øystein Hov, metno and Ivar Isaksen, UiO).

In the project consortium gender equal opportunities will be encouraged by:

- When vacant positions become available within the project, female scientists will be encouraged to apply.
- Female researchers will also be encouraged to give keynote talks at conferences and workshops organized within the project
- The project web site will have a section dedicated to gender equality themes
- A Gender Awareness Contact Person will be appointed in the project and will make an effort to get the female project participants - PhD students, research scientists, university teachers and senior scientists – actively involved in the project work. The Gender Awareness Contact Person reports to the Steering Committee and will monitor and assess the project actions carried out in this context. Statistics on women’s participation and accomplishments within the project will be produced and updated throughout the project.

In order to facilitate Gender mainstreaming the IUP-UB has participated in a University wide national study aimed at generating measures to ensure equality in the workplace.

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A1:
Our project

Project Number 1	212095	Project Acronym 2	CITYZEN

ONE FORM PER PROJECT

GENERAL INFORMATION			
Project title 3	megaCITY - Zoom for the ENvironment		
Starting date 4	The first day of the month after the signature by the Commission		
Duration in months 5	36		
Call (part) identifier 6	FP7-ENV-2007-1		
Activity code(s) most relevant to your topic 7	ENV.2007.1.1.2.1.: Megacities, air quality and climate		
Free keywords 8		Megacities, Air Quality, Climate change, observations, multi-scale modelling, emission estimates	

Abstract 9 (max. 2000 char.)

We will determine the air pollution distribution and change in and around hotspots over the last decade from extensive satellite and in-situ observations and we will employ a series of different scale models in order to analyze the impacts of air pollution hot spots on regional and global air quality including potential future changes for various climate scenarios. Focus is on ozone and particulate matter with chemical and physical characterization, and their precursors. The Eastern Mediterranean (Istanbul, Athens, Cairo), the Po Valley, the BeNeLux region, the Pearl River Delta in China (with megacities Guangzhou and Hong Kong) and the hot and polluted European summer 2003 are chosen for intensive case studies. The consortium includes groups from China, Turkey, Greece and Italy, in addition to France, Germany, UK and Norway, with experts on the observations, emission data and models. A set of chemical transport models which connect all the most important spatial and temporal scales will be developed and used to quantify how the observed air pollution arises. The models and emission inventories will be evaluated, errors identified and improved on the urban, regional and global spatial scales. Climate change may cause changes in air pollution in and around hotspots, and hotspot pollution can change precipitation and temperature/albedo. These feedbacks will be studied in scale-bridging model systems based on global climate model scenarios, and in a coupled high resolution chemistry-climate model. The model systems evaluated in the project will be applied to analyse mitigation options in and around hotpots, also taking into account climate change. Best available technologies and sectoral changes will be studied. Several partners have key roles in the technical underpinning of policy. They will ensure that the improved emission inventories, scale-bridging model systems and the systematic observational evidence will have a significant, broad and lasting impact.

A3.2:
What it costs

Project Number [1]	212095	Project Acronym [2]	CITYZEN

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Participant number in this project [9]	Participant short name	Estimated eligible costs (whole duration of the project)					Total receipts	Requested EC contribution
		RTD / Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D		
1	met.no	466,667.00	0.00	50,000.00	0.00	516,667.00	0.00	400,000.00
2	PKU	244,400.00	0.00	0.00	0.00	244,400.00	0.00	120,000.00
3	CNRS	233,333.00	0.00	0.00	0.00	233,333.00	0.00	175,000.00
4	INERIS	333,333.00	0.00	0.00	0.00	333,333.00	0.00	250,000.00
5	IUP-UB	466,667.00	0.00	0.00	0.00	466,667.00	0.00	350,000.00
6	FRIUUK	200,000.00	0.00	0.00	0.00	200,000.00	0.00	150,000.00
7	FZJ	400,000.00	0.00	0.00	0.00	400,000.00	0.00	300,000.00
8	ECPL	266,667.00	0.00	0.00	0.00	266,667.00	0.00	200,000.00
9	CNR-ISAC	300,000.00	0.00	0.00	0.00	300,000.00	0.00	225,000.00
10	NILU	138,205.00	0.00	0.00	0.00	138,205.00	0.00	100,000.00
11	UiO	200,000.00	0.00	0.00	0.00	200,000.00	0.00	150,000.00
12	METU	160,000.00	0.00	0.00	0.00	160,000.00	0.00	120,000.00
13	ULEIC	233,334.00	0.00	0.00	0.00	233,334.00	0.00	175,000.00
14	IIASA	133,333.00	0.00	0.00	0.00	133,333.00	0.00	100,000.00
15	NOA	100,000.00	0.00	0.00	0.00	100,000.00	0.00	75,000.00
16	CEHM	33,333.00	0.00	0.00	0.00	33,333.00	0.00	25,000.00
TOTAL		3,909,272.00	0.00	50,000.00	0.00	3,959,272.00	0.00	2,915,000.00