

WRF-EMEP modelling of pollution from nickel smelters in the Russian-Norwegian border areas

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Foto: Januus Remm,
Univ. Tartu, Estland

Mining in the border areas, Kola MMC

Kola MMC

The key operating assets of Kola MMC



Kola MMC is the largest industrial producer in the Murmansk region and is fully integrated into the transport infrastructure of the North-Western Federal District.

In the Kola MMC, three mines extract disseminated sulfide ores containing nickel, copper and other useful components from the Zhdanovskoye, Zapolyarnoye, Kotselvaara and Semiletka deposits.

Source: www.nornik.ru

<http://www.nornik.ru/en/about-norilsk-nickel/operations/kola-mmc/the-key-operating-assets1>

Nikel smelter and city of Nikel seen from Height 96 19. June 2008



Hourly mean values of SO₂ in city of Nikel:
1470 µg/m³ (kl. 11-12) and 1527 µg/m³ (kl. 12-13).

Stack emissions from Nickel smelter

White, grey, yellow, brown, black...

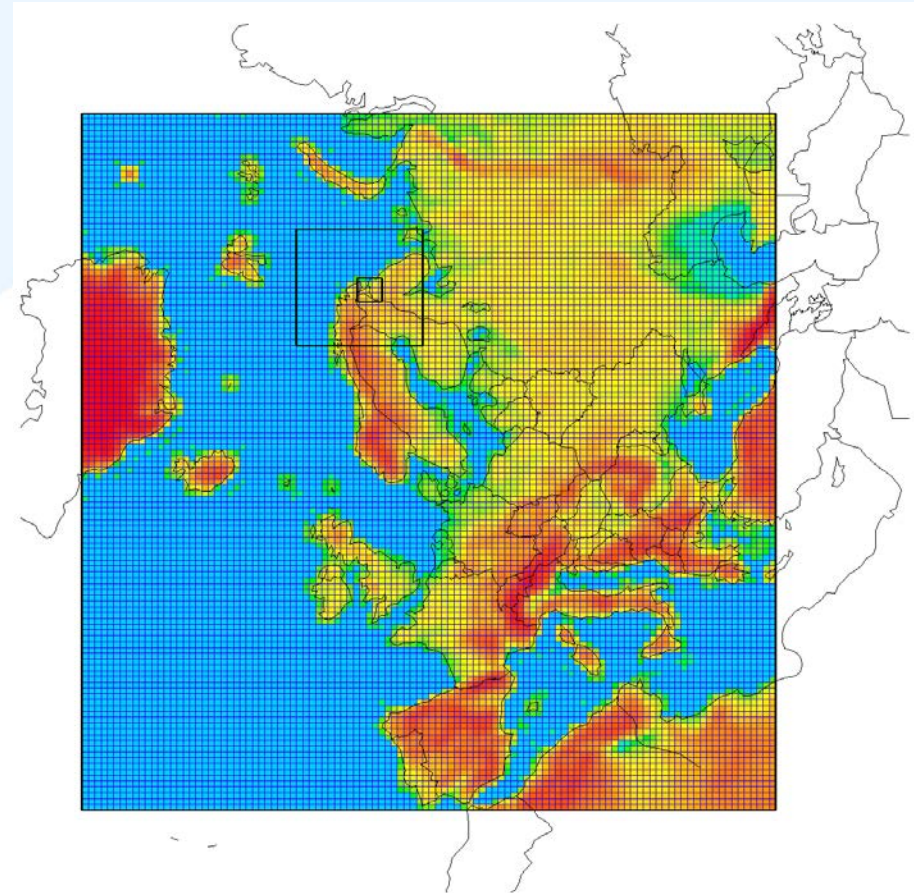


Photos taken Saturday 18. April 2015, just a few minutes between the two pictures.
Photo: Benjamin Flatlandsmo Berglen

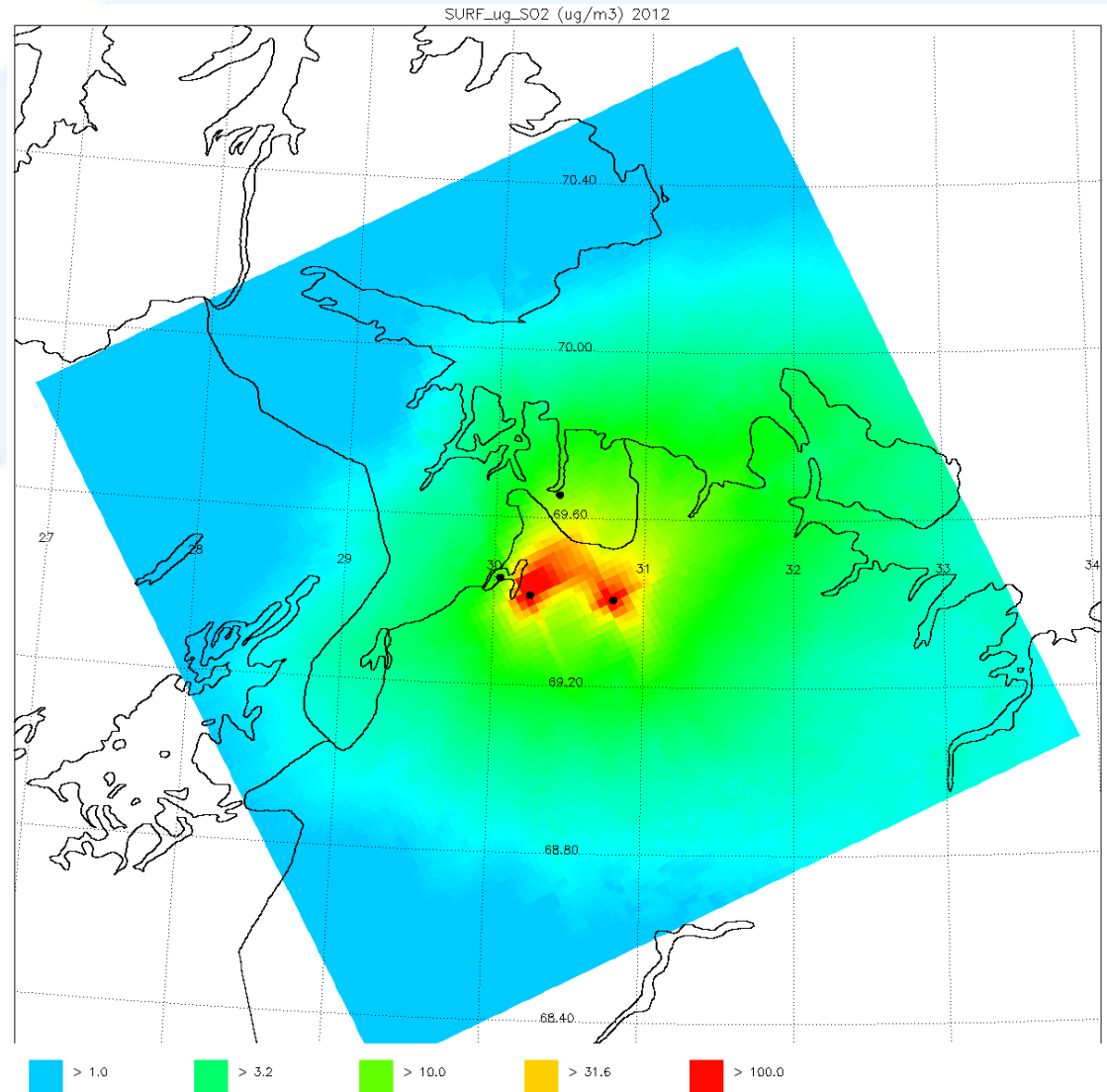


WRF-EMEP model for border areas

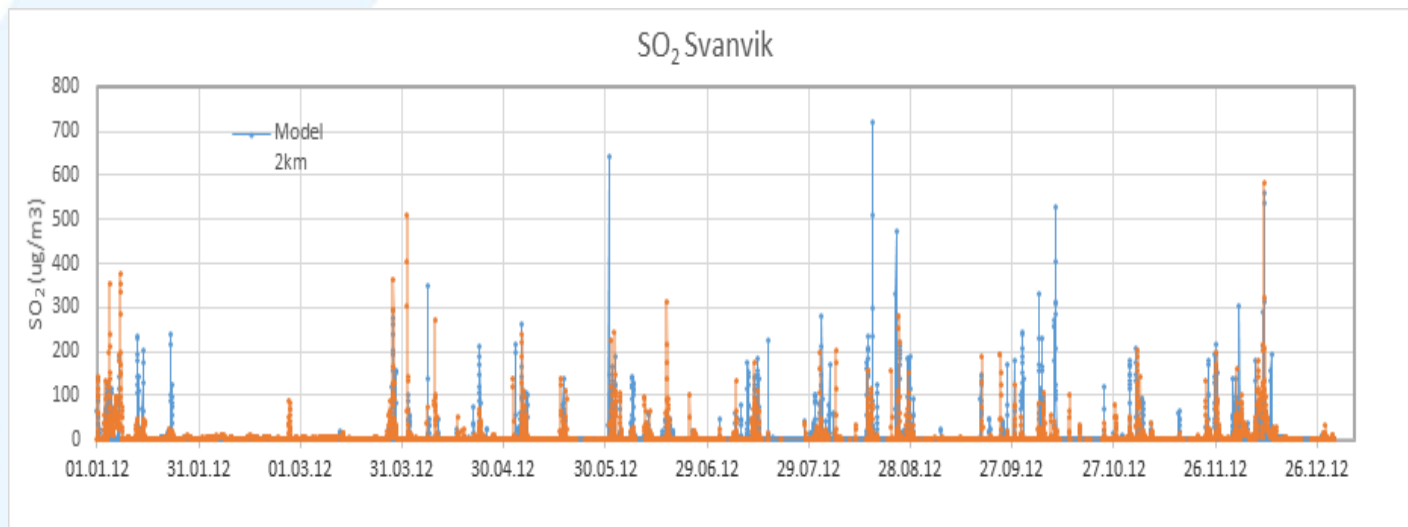
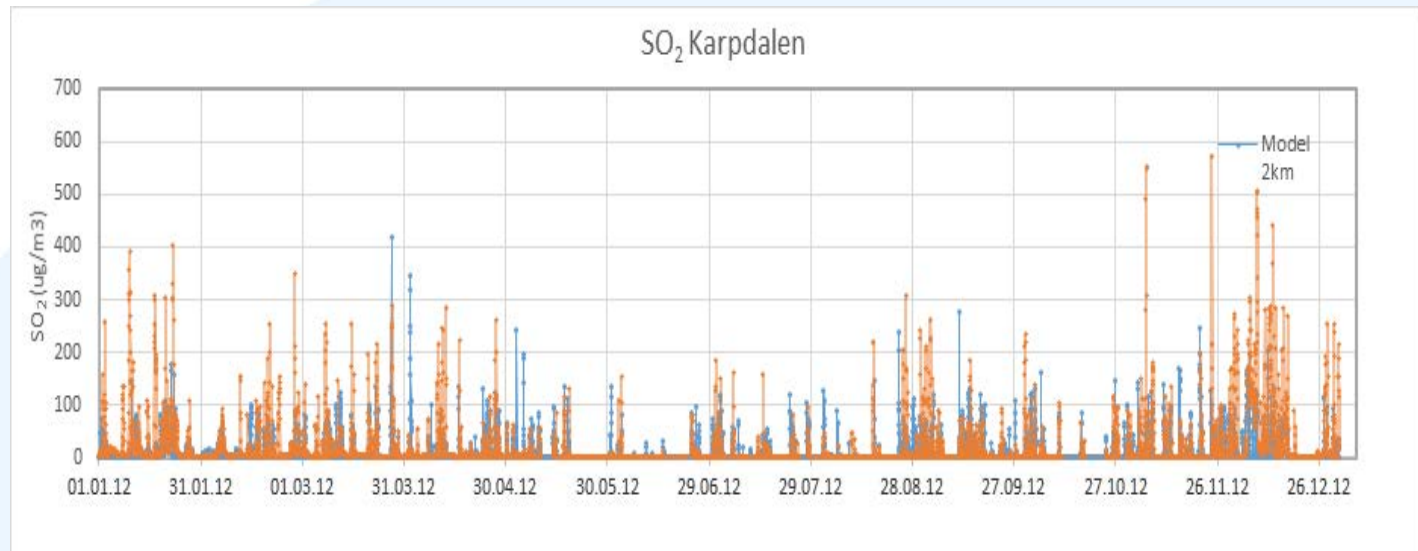
- SO_2
- Nested grid 2, 10 and 50 km grid resolution
- 100'000 tonnes/year, Nikel 60', Zapolyarny 40'
- Nikel 50% diffusive, 50% stack emissions
- Comparison Svanvik, Karpdalen and some data from Nikel and Zapolyarny



Some results: Annual mean concentration SO₂ 2012



Some results: model - observation comparison 2012



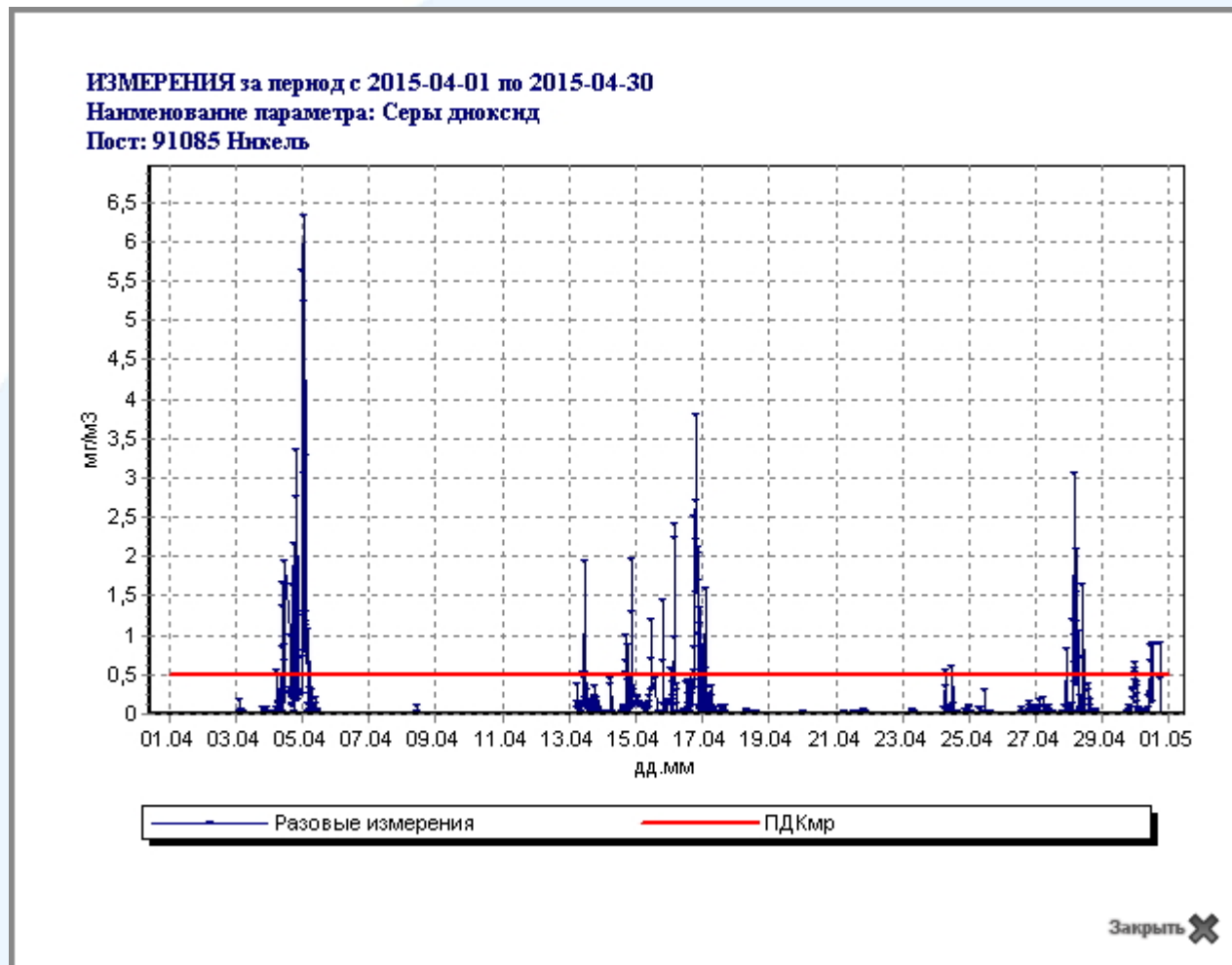
Topics regarding modelling Nickel

- Emissions of SO₂ Zapolyarny and Nickel fairly well known, emissions heavy metal not
- Official EMEP emissions are not correct
- Do not know distribution in time
- Do not know fraction diffusive : stack emissions in Nickel
- Vertical distribution Zapolyarny (all stack) is different from Nickel (assume 50% diffusive, 50% stack)
- Monitoring stations close to smelter (1 km, 8 km)
- Need nested grid

Extra

Russian monitoring SO₂ Nickel

http://www.kolgimet.ru/index.php?option=com_content&view=article&id=54&Itemid=239



Modelling using coarse grid model

Impact assessment of air polluting sources of JSC "Kolskaya MMC" to the Norwegian environment

Also, "SRI Atmosphere" conducted modeling of transfer and dropping of polluting substances on the territory of Norway, produced by "Kolskaya MMC". For the calculation it was used universal model EMEP, officially recognized as a tool of UNECE Convention on long-range transboundary air pollution, whose members are Norway and Russia. These calculations revealed the excess of the critical loads only in one cell of the calculating net not exceeding size of territory 50*50 km around JSC "Kolskaya MMC". This zone of excess indeed capture insignificant part of Norwegian territory, what in any case can't be considered as a fact of prevailing negative impact of Russian Federation towards environment of Norway.

According to the conclusion of "SRI Atmosphere", during the impact assessment of Russian pollution sources towards environment of Norway it is necessary to consider that excess of critical loads is done because of net effects of all sources, located in boarder areas of Russia, Norway and other countries of EU but not only emissions from "Kolskaya MMC".

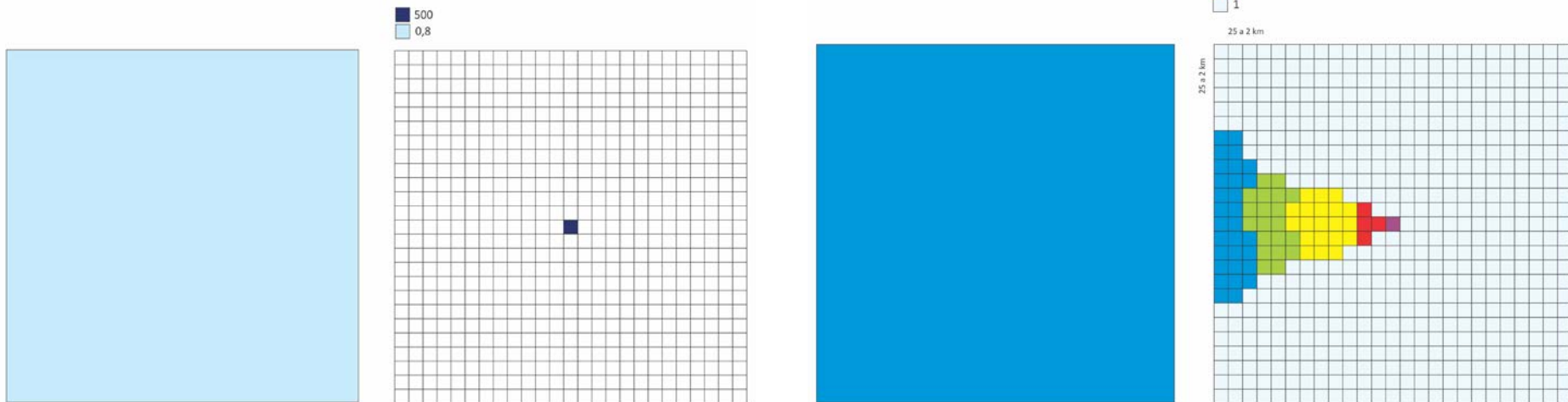
Russian modelling, NILU answer

Tilsvar: 1979 Convention on Long-range Transboundary Air Pollution:

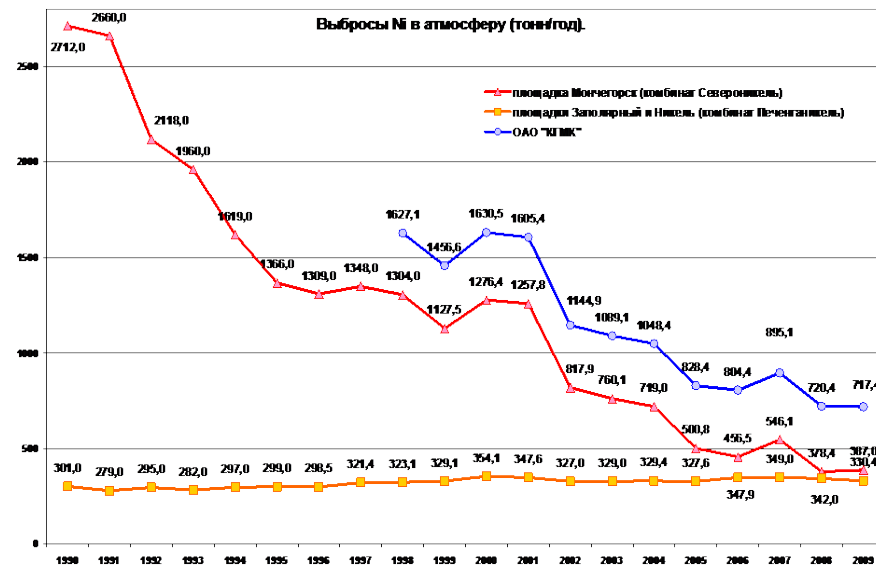
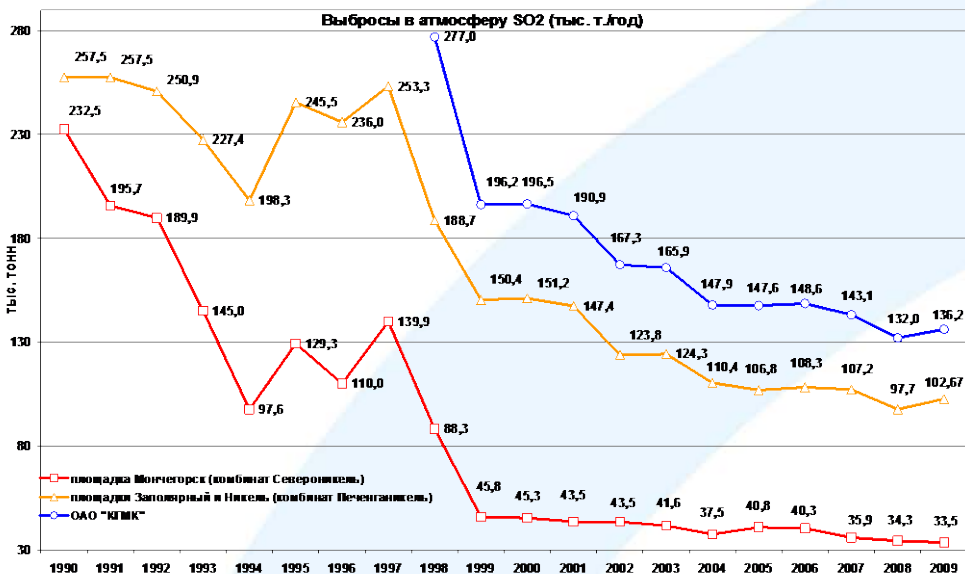
Article 1: DEFINITIONS

(b) "Long-range transboundary air pollution" means air pollution whose physical origin is situated wholly or in part within the area under the national jurisdiction of one State and which has adverse effects in the area under the jurisdiction of another State at such a distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources.

Utslipp (venstre) & konsentrasjon (høyre)



Emissions – official numbers



Source: Kola MMC,
provided by Bellona

Viktige nøkkeltall SO₂ apr '14–mar '15

Rapporteringsperioden 1. april 2014 - 31. mars 2015	Svanvik	Karpdalen
Høyeste 10-minuttersverdi µg/m ³	3541	871
Høyeste timemiddelverdi µg/m ³	1418	616
Antall timemiddel > 350 µg/m ³ sommer	9	0
Antall timemiddel > 350 µg/m ³ vinter	11	27
Høyeste døgnmiddel sommer µg/m ³	160	59
Høyeste døgnmiddel vinter µg/m ³	396	366
Antall døgnmiddel > 125 µg/m ³	2	4
Middelverdi sommer µg/m ³	8,6	6,4
¹⁾ Middelverdi vinter µg/m ³	8,9	18,2
Kalenderåret 2014		
²⁾ Antall timemiddel > 350 µg/m ³	24	15
³⁾ Antall døgnmiddel > 125 µg/m ³	2	3
¹⁾ Årsmiddelverdi µg/m ³	8,8	13,2

1) Norsk grenseverdi for vinterperioden (1. oktober-31. mars) og for et kalenderår er 20 µg/m³, satt for virkning på økosystemer.

2) Norsk grenseverdi for timemiddelverdi av SO₂ er 350 µg/m³ og denne kan overskrides 24 ganger per kalenderår.

3) Norsk grenseverdi for døgnmiddelverdi av SO₂ 125 µg/m³ og denne kan overskrides tre ganger per kalenderår.

Modelling; WRF-Chem

NILU and UiO set up the WRF-Chem atmosphere chemistry model to study emissions, dispersion and deposition of pollution from Nikel and Zapolyarny

http://folk.uio.no/torefl/WRF-Chem/Domene3_SO2-SO4_delay10.gif

http://folk.uio.no/torefl/WRF-Chem/Domene2_SO2-SO4_delay10.gif

http://folk.uio.no/torefl/WRF-Chem/Domene1_SO2-SO4_delay10.gif

Model development; TAPM

TAPM model results;
deposition

