



*Meteorologisk  
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# Meteorology

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# Met: Introduction



- The EMEP/MSC-W model uses meteorology off-line as meteorological fields are read from files at 3-hourly intervals
- NWP models: Parlam-PS, Hirlam, Hirham, IFS-ECMWF (current EMEP), WRF, Aladin(EMEP4HR), MM5
- As the EMEP/MSC-W model is reading grid properties from the meteorological input files:
  - preprocessing is necessary (interpolation vert. and hor., mass balance)
  - Large range of areas from local scale (7 km) to global scale (100km) (projection, resolution, size, ...)
- IFS-ECMWF is run as experiment by EMEP/MSC-W in hindcast mode for trend studies (special branch for 3D output)



# Met: Input file example

NetCDF Climate and Forecast (CF) Metadata convention or  
NetCDF CF 1.0 convention (<http://cf-pcmdi.llnl.gov/>)

```
mifaab@stallo-2:/global/work/mifapw/emep/Data/EECCA/metdata_EC/2010
File Edit View Search Terminal Help
netcdf meteo20110101 {
dimensions:
  i = 132 ;
  j = 159 ;
  k = 20 ;
  time = UNLIMITED ; // (8 currently)
variables:
  double i(i) ;
    i:coord_axis = "x" ;
    i:long_name = "EMEP grid x coordinate" ;
    i:units = "km" ;
  double j(j) ;
    j:coord_axis = "y" ;
    j:long_name = "EMEP grid y coordinate" ;
    j:units = "km" ;
  double k(k) ;
    k:coord_alias = "level" ;
    k:long_name = "vertical sigma coordinates" ;
    k:units = "sigma_level" ;
    k:positive = "down" ;
  int time(time) ;
    time:long_name = "time at middle of period" ;
    time:units = "seconds since 1970-1-1 00:00:00.0 +00:00" ;
  double map_factor(j, i) ;
    map_factor:long_name = "mapping factor" ;
    map_factor:units = "" ;
  double lat(j, i) ;
    lat:long_name = "latitude coordinate" ;
    lat:standard_name = "latitude" ;
    lat:units = "degrees_north" ;
  double lon(j, i) ;
    lon:long_name = "longitude coordinate" ;
    lon:standard_name = "longitude" ;
    lon:units = "degrees_east" ;
}
```

```
mifaab@stallo-2:/global/work/mifapw/emep/Data/EECCA/metdata_EC/2010
File Edit View Search Terminal Help
    SMI1:units = "" ;
    SMI1:_FillValue = -32767s ;
    SMI1:scale_factor = 4.05014828359991e-05 ;
    SMI1:add_offset = 0.552709182743798 ;
    SMI1:meteo_date_first = 2011, 1, 1, 3 ;
    SMI1:meteo_date_last = 2011, 1, 1, 24 ;
    SMI1:validity = "instantaneous" ;
  short SMI3(time, j, i) ;
    SMI3:long_name = "SMI3" ;
    SMI3:numberofrecords = 8 ;
    SMI3:units = "" ;
    SMI3:_FillValue = -32767s ;
    SMI3:scale_factor = 4.05014828359991e-05 ;
    SMI3:add_offset = 0.552709182743798 ;
    SMI3:meteo_date_first = 2011, 1, 1, 3 ;
    SMI3:meteo_date_last = 2011, 1, 1, 24 ;
    SMI3:validity = "instantaneous" ;

// global attributes:
  :Conventions = "CF-1.0" ;
  :projection = "Stereographic" ;
  :projection_params = "90.0 -32.0 0.933013" ;
  :vert_coord = "vertical coordinates = (p-p(top))/(p(surf)-p(top))" ;
  ;
  :Grid_resolution = 50000. ;
  :xcoordinate_NorthPole = 8. ;
  :ycoordinate_NorthPole = 110. ;
  :fi = -32. ;
  :ref_latitude = 60. ;
  :created_date = "20110928" ;
  :created_hour = "154531.091" ;
  :lastmodified_date = "20120510" ;
  :lastmodified_hour = "121121.097" ;
}
(END)
```





# Met: 3-D fields - for 20 $\sigma$ levels

Component	- unit	- Type	- main purpose
Horizontal wind vel. comp.	- m/s	- Inst.	- Advection
Specific humidity	- kg/kg	- Inst.	- Chem. reactions, dry deposition
Pot. temperature	- K	- Inst.	- Chem. reactions, eddy diffusion
Precipitation(or 2D+sh/clw)	- mm	- Acc.	- Wet and dry deposition
Cloud cover	- %	- Avg.	- Wet removal, photolysis
Cloud liquid water content	- kg/kg	- Inst.	- Wet removal

Optional (`USE_CONV = «T/F»` in `config_EMEPSTD.nml`):

Vert. wind in $\sigma/\eta$ coor.	- 1/s or Pa/s	- Inst.	- Vertical advection
Convective updraft flux	- kg/m <sup>2</sup> s	- Avg.	- Vertical transport, wet removal
Convective downdraft flux	- kg/m <sup>2</sup> s	- Avg.	- Vertical transport, wet removal

Simpson et al. *The EMEP MSC-W chemical transport model - technical description* acp-12-7825-2012

# Met: 2-D fields - for surface



Component	- unit	- Type	- main purpose
Surface pressure	- hPa	- Inst.	- Air density, def. of vert. levels
Temperature at 2m	- K	- Inst.	- Dry deposition, stability
Surf. flux of sens. heat	- W/m <sup>2</sup>	- Inst.	- Dry deposition, stability
Surf. flux of lat. heat	- W/m <sup>2</sup>	- Inst.	- Dry deposition
Surf. stress or frict. vel.	- N/m <sup>2</sup> or m/s	- Avg./Inst.	- Dry deposition, stability
Snow depth	- m	- Inst.	- Dry deposition
Fraction of ice cover	- %	- Inst.	- Dry deposition
<b>Optional (USE_SEASALT/USE_SOILWATER = «T/F» in <i>config_EMEPSTD.nml</i>):</b>			
Sea surface temp.	- K	- Inst.	- Sea salt
10-m wind-speed	- m/s	- Inst.	- Sea-salt
Soil water, near surface	-	- Inst.	- Dust emissions
Soil water, root zone	-	- Inst.	- Dry deposition

# Met: Domain examples



Area Name	- Resolution	- Projection	- Size	1 day(1 year)
GLOBAL	- 1.0°	- ll	- 290 Mb	(106 Gb)
EECCA	- 50 km	- PS	- 86 Mb	(31 Gb)
EECCA25	- 25 km	- PS	- 345 Mb	(126 Gb)
TNO28	- 28 km	- ll	- 95 Mb	(34 Gb)
TNO14	- 14 km	- ll	- 340 Mb	(124 Gb)
TNO7	- 7 km	- ll	- 1.2 Gb	(438 Gb)

Available with the Open Source code:

[ftp://ftp.met.no/projects/emep/OpenSource/YYYYMM/input/meteo\\*](ftp://ftp.met.no/projects/emep/OpenSource/YYYYMM/input/meteo*)

2005(EMEP - basic met.fields), 2008(EECCA) and 2010(EECCA)

**Modrun.sh**: startdate/enddate (select meteo year) -  
independent of Trendyear (select emission year)



# Met: IFS-ECMWF background

- In 2010 IFS had major resolution upgrade - available to run on T799 and 60 vertical eta levels on a global domain
- EMEP/MSC-W run IFS experiment in hindcast mode (reanalysis) initialised by ERA-Interim data (better use of observations) with a special branch for extra 3D output
- Aim:
  - good description of 3D fields: precipitation and convective parameters
  - same meteorological driver cover global to local domains
  - rerun same model version for trend analysis



# Met: IFS-ECMWF process

- 2 weeks and 400 000 SBUs to run 1 year
- 2 weeks for 4 persons to download from MARS and 1 year global raw NetCDF files on 0.2° need 3.5T
- Preprocessing meteorological input files into model domain and projection ~ 1 week
  
- After 2 years period experiment died with HPC machine and new experiment is under preparation
  - + : improved cloud scheme and better resolution both in space (T799 to T1279) and time (considering hourly)
  - : expensive to reproduce 12 years of meteorology