Norwegian Meteorological Institute
met.no MSC-W

EMEP/MSC-W model: Grid flexibility, Resolution, Timestep, Advection

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Grid flexibility

- At present we do not officially support the use of non-emep grids (but in practice we will try to help)
- The use of alternative grids is easy… if the required input data is available
- Most input data can be interpolated automatically into proper grid
- Meteorological data is required in the new grid

How does it work?

The grid properties (projection, resolution, size etc.) are read from the file defining the meteorological data. These must be written as attributes in the NetCDF file.

The input data which are not in the right grid are automatically interpolated into the proper grid

Making new meteorological input data for the model from scratch is easy in theory, but not in practice

Grid dependent input data. Emissions

- Gridded input (gridSOx, gridNOx, gridNH3...)
  - Experimental flexibility with 7km resolution in Europe (copyright TNO)
  - global coverage under development
- Forestfire (2002-2011)
- Biogenic VOC
- Soil NOx
- Dust, Sahara: Not flexible yet
- Lightning
- Aircraft
- Volcanoes
- DMS: Not flexible yet
- Roaddust: Europe only

Other grid dependent input data

- Boundary and Initial conditions
- Landuse (based on 5km data in Europe, and 0.1 degree elsewhere (GLC))
- Degree-day factors (metdata, not needed)
- Photodissociation rates (ASCII)
- Sites, sondes (to steer output)

Resolution

- In principle the projection and resolution of the model are not limited
- Many different projection are in use: Polar stereographic, Spherical (lon-lat), Rotated Spherical
- Scales from global (1 degree resolution), to regional at fine scales (1 km) have been used
- Gridsize up to 1440x1440 has been tested
- Vertical resolution: 20 sigma levels

Time steps

- Many different time steps!
- Meteorology: usually 3 hours (+ interpolation)
- Time splitting: 30 minutes to 5 minutes

  sequence: advection (x,y,z)-diffusion-chemistry-deposition
- Advection: largest which satisfies CFL condition (dynamically set)
- Chemistry: 5 to 15 steps, variable length (20 seconds and larger)

Advection

- CFL condition: in one time step pollutants should not be transported over a distance larger than one gridcell.
- The time step is adapted dynamically according to wind speed (in each 1 dimensional column)
- Numerical diffusion reduced by Bott's scheme (4th order horizontally, 2nd order vertically)

Future improvements (grid flexibility)

- Hybrid vertical coordinates $P=A(k)+B(k)*P_{surface}$
- Flexible number of vertical levels
- Thinner lowest level
  - Timesplitting between chemistry and vertical diffusion is one important limitation that must be taken care of
- Grid (and static properties?) defined in separate file
- Longer term: metdata interpolated online?