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Introduction to the EMEP/MSC-W model

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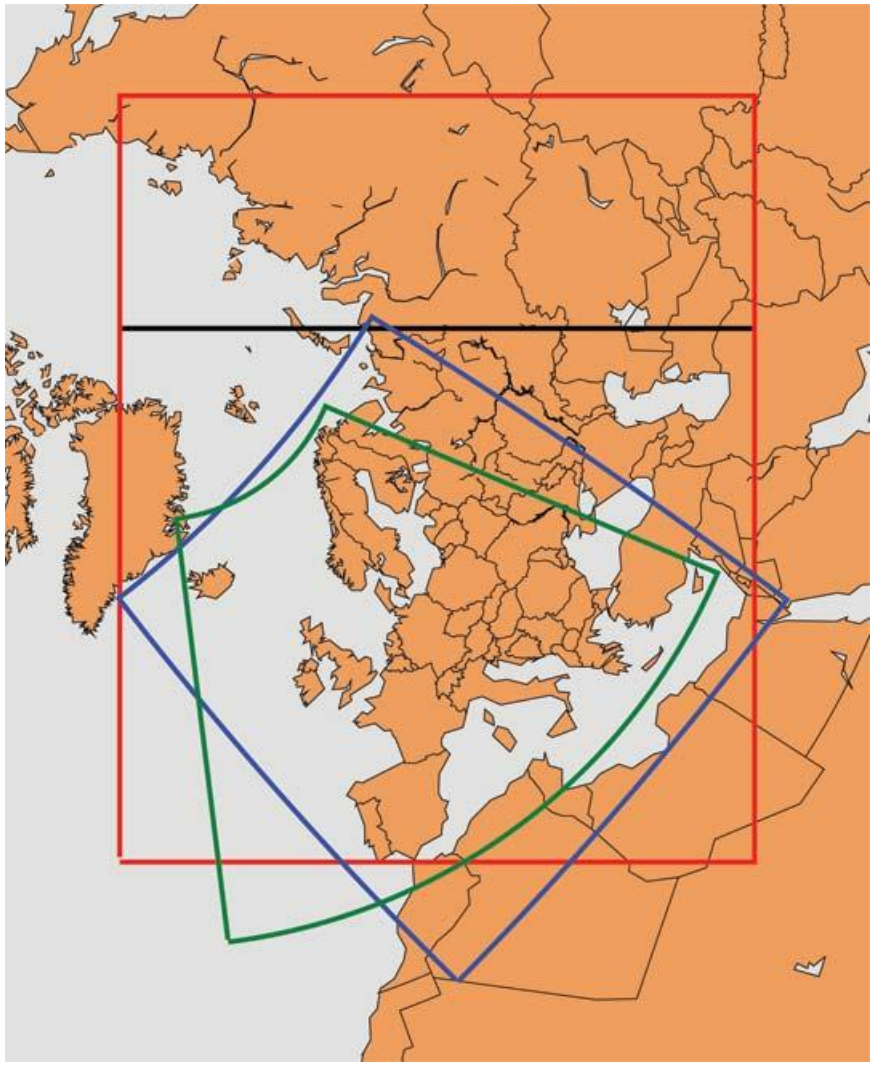
EMEP/MSC-W model training course,

24-26 April 2013

EMEP/MCS-W model

regional/global scale chemical transport model



Calculation domains used for regional runs:

EECCA: PS 50x50 km2

EMEP old: PS 50x50 km2

MACC: lon-lat: 0.25°x0.25°; 0.2°x0.2°; 1x0.5; 0.5x0.25; 0.25x0.125; 0.125x0.0625°

HIRHAM (climate): spherical-rotated 0.2°x0.2°

Other fine-resolution grids for specific applications (e.g. EMEP4UK, EMEP4HR)

Vertical: 20 layers (up to 100 hPa), σ-coordinate

EMEP/MCS-W model

Meteorology (talk by Anna):

Off-line, 3-h EC MWF (standard)

Emissions (talk by Ágnes):

***Anthropogenic* from the EMEP database (CEIP)**

gaseous - SO_x, NO_x, NH_3, NMVOC, CO,

particles - $PM_{2.5}$, PM_{10}

***Biogenic/natural:* DMS, BVOC, NOx (soil, lightning), sea salt, windblown dust, gas/particles from forest fires**

Overall model structure

Unimod.f90

do numt = 2, nterm + nadd (3-h loop “meteorology” time-step)

do nstep = 1, nmax (20-min advection time-step)

dt_chem = 20s x 5, 157s

(chemistry variable time-step)

Overall model structure

Unimod.f90

- **Run configuration & model setup**
- **Initialisations:** grid, species suite & output set, landuse, ecosystems, BVOC...)
- **Emissions:** read and pre-process yearly emissions

do numt = 2, nterm + nadd (3-h loop "meteorology" time-step)

- Boundary & Initial condition
- Some natural emissions
- Meteorology
- **PhyChem:**

do nstep = 1, nmax (20-min advection time-step)

Runchem: chemistry, dry&wet removal

Output: Hourly; sites; zondes... (flight tracks?)

- **Output:** Daily, Monthly, Yearly fields (2D/3D) . . .

Jan Eiof

Some details….

Unimod.f90

- **Run configuration & model setup**

Reads INPUT.PARA
Meteo & trend year, model & chemistry version, run start/end

Created by your modrun.sh:
2010
Base_rv4_3_EmChem09soa_Base_2010_Trend2010
2010 06 01 2010 06 01

Configuration:
parameter selection

ModelConstants_ml.f90 → config_EMEPSTD.nml
My_Aerosols_ml (Equilibrium model – MARS, also EQSAM, EMEP)

- **Initialisations:**

grid: GridRead (GridValues_ml.f90)

grid sizes (IIFULLDOM, JJFULLDOM); projection (lon-lat or Pol-Stereo etc. and Poles), rundomain size (GIMAX, GJMAX, IRUNBEG, JRUNBEG) subdomain partition (NPROCX, NPROCY,)

David

species suite: Chem_ml, CM_ChemSpecs_ml, CM_ChemGroups_ml

output set: My_Derived_ml, Derived_ml, My_Outputs

Jan Eiof

- **Emissions:** Emissions_ml.f90 (EmisDef_ml; EmisGet_ml)

Ágnes

config_EMEPSTD.nml

```
USE_SOILWATER                = T,        ! Uses SMI from meteo data
USE_CONVECTION               = F,
USE_DEGREEDAY_FACTORS        = T,
USE_FOREST_FIRES             = T,
USE_SEASALT                  = T,
USE_EURO_SOILNOX             = T,        ! diff for global + Euro runs
USE_GLOBAL_SOILNOX           = F,        ! diff for global + Euro runs
USE_POLLEN                   = F,        ! EXPERIMENTAL. Only works if start Jan 1
DO_SAHARA                    = T,        ! BCs for dust in regional runs
USE_ROADDUST                 = T,        ! Only EECCA
USE_DUST                     = T,        ! Only EECCA
USE_AOD                      = F,        ! Under development/testing
……..
EMIS_SOURCE                  = "emislist", ! "emislist" or CdfFractions
3DPROFILES  FORECAST         = F,
USE_EMERGENCY                = F,        ! Used for FORECASTs usually, EMEP2010
ANALYSIS                     = F,        ! EXPERIMENTAL: 3DVar data assimilation
```

ModelConstants_ml.f90

```
USE_AIRCRAFT_EMIS        = .true.,      & ! Needs global file, see manual
USE_LIGHTNING_EMIS       = .true.,      & ! ok
NO_CROPNH3DEP            = .true.,      & ! Stop NH3 deposition for growing crops

DEBUG_ii=116,    DEBUG_jj= 63           ! K-Puszta,
DEBUG_pH                 =  .false.
```

My_Aerosols_ml.f90

```
AERO_DYNAMICS     = .false.
EQUILIB_EMEP      = .false.      ! old Ammonium stuff
EQUILIB_MARS      = .true.       ! MARS
EQUILIB_EQSAM     = .false.      ! EQSAM

!.. Number of aerosol sizes

integer, public, parameter :: NSIZE = 5     - For Dry deposition

!   FINE_PM = 1, COAR_NO3 = 2, COAR_SS = 3, COAR DUST = 4,
pollen = 5
```

… some more details

Unimod.f90

- Configurations, Initialisations, Emissions

do numt = 2, nterm + nadd (3-h) **"meteorology" time-step**

- **Boundary & Initial conditions (BCs & ICs)**

  BoundaryConditions_ml (monthly calls)

  - **GlobalBCs_ml.f90 - reads/tabulates BICs**
  - **CM_BoundaryConditions.inc - name mapping**
  - **External_BICs_ml.f90, Nest_ml.f90 – use of external BICs**

- **Natural emissions:**

  DMS, soil NOx, firest fires, BVOC

- **Meteorology**

  Met_ml.f90: reading met. fields, derives Kz, PBL ..

- **PhyChem:**

Anna

… and more details

Unimod.f90

- Configurations, Initialisations, Emissions

do numt = 2, nterm + nadd (3-h "meteorology" loop)

- **PhyChem:**

do nstep = 1, nmax 20-min advection time-step

Advection & diffision

Runchem:

- Setup_1d (k): 1d emissions, species (molec/cm3/s)
- Sea salt, Windblown dust, BVOC
- Chemistry (gas & aqueous): Solver.f90
- Equilibrium chemistry: MARS_ml.f90
- DryDeposion: DryDep_ml.f90
- WetDeposition: Aqueous_n_WetDep_ml.f90

?s to Peter

dt_chem = 20s x5, 157s

CM_Reactions1.inc

CM_Reactions2.inc

MetInt – meteorology interpolation within 3h intervals

Hourly_out; siteswrt_surf; siteswrt_sondes

Modules' overview - I

Main: Unimod.f90

Config: configEMEPSTD.nml ->

ModelConstants_ml.f90 (EMEPDAY = 6am)

Grig: Par_ml.f90, GridValues_ml.f90, GridAllocate_ml.f90

Constants/parameters: PhysicalConstants_ml.f90, ModelConstants_ml.f90

TimeDate_ml.f90

Emissions Anthr

- Emissions_ml.f90
- EmisDef_ml.f90
- EmisGet_ml.f90
- Country_ml.f90
- Timefactors_ml.f90

Emissions Natural

- SeaSalt_ml.f90
- DustProd_ml.f90
- ForestFire_ml.f90
- Volcanoes_ml.f90

Meteo

- Met_ml.f90 (read-in, PBL, kz)
- MetFields_ml.f90 (defs)
- BLPhysics_ml.f90
- CellMet_f90 (sets for grid cells + L, U*)
- SubGrid_ml.f90 (stability, L, U*,
- Micromet_ml.f90 (Ra for landuses)
- SoilWater_ml.f90 (Sets deep soil water)

Landuse

- Landuse_ml.f90
- LandDefs_ml.f90

Modules' overview - II

Atm. Transport

- Advection_ml.f90
- Convection_ml.f90

Dry Deposition

- CM_DryDep.inc
- DryDep_ml.f90 (Micromet_ml)
- Rsurface_ml.f90
- Aero_Vds_ml.f90
- Wesely_ml.f90
- MosaicOutputs_ml.f90
- EcoSystems_ml.f90

Wet Deposition

- Aqueous_n_WetDep_ml.f90
- CM_WetDep.inc

Chemistry

- CM_Chem*.f90
- Solver.f90 (2-step chem. solver)
- CM_Reactions*.inc (gas/aqueuos irrever.)
- My_Aerosols_ml.f90 (equilibrium)
  - --> MARS_ml.f90 (EQSAM_ml)
- My_SOA_ml.f90
- ChemFunctions_ml.f90

Boundary/Initial

- BoundaryConditions_ml.f90
- BoundaryConditions.inc
- GlobalBCs_ml.f90
- ExternalBICs_ml.f90

Other important

- MassBudget_ml.f90
- Timing_ml.f90

INPUT data (Ref: User's Guide)

Table 2.1: List of input data files. Note: YYYY: year, MM: month, DD: day, SS: seasons, POLL: pollutant type (NH_3, CO, NO_x, SO_x, NMVOC, $PM_{2.5}$ and PM_{co}).

Peter – for technical questions, e.g. linking, interpolation, reading

Data		Name		Format
Meteorology data		met/		
Meteorology	*Anna*	meteoYYYYMMDD.nc	(365+1 files)	netCDF
Other Input files		input/		
Global Ozone		GLOBAL_O3.nc		netCDF
BVOC emissions		EMEP_EuroBVOC.nc		netCDF
Landuse	*David*	LanduseGLC.nc and Landuse_PS_5km_LC.nc		netCDF
Degree-day factor		DegreeDayFactors.nc		netCDF
N depositions		annualNdep.nc		netCDF
Road dust	*Robert Bergström*	RoadMap.nc and AVG_SMI_2005_2010.nc		netCDF†
Aircraft emissions	*Michael G*	AircraftEmis_FL.nc		netCDF†
Surface Pressure		SurfacePressure.nc		netCDF†
Forest Fire	*also Jan Eiof, Svetlana*	FINN_ForestFireEmis_YYYY.nc		netCDF†
Natural SO_2		natso2MM.dat	(12 files)	ASCII
Volcanoes	*Álvaro*	VolcanoesLL.dat		ASCII*
		eruptions.csv volcanoes.csv		ASCII

INPUT data (Continuation)

Emissions	*Ágnes (Peter, David)*	emislist.POLL (7 files)	ASCII
Time factors for monthly emissions		MonthlyFac.POLL (7 files)	ASCII
Time factors for daily emissions		DailyFac.POLL (7 files)	ASCII
Time factors for hourly emissions		HOURLY-FACS	ASCII*
Emission heights		EmisHeights.txt	ASCII*
Landuse definitions	*David*	Inputs_LandDefs.csv	ASCII*
Stomatal conductance		Inputs_DO3SE.csv	ASCII*
Lightning emissions	*Jan Eiof*	lightningMM.dat (12 files)	ASCII*
Emissions speciation		emissplit.defaults.POLL	ASCII*
		emissplit.specials.POLL	ASCII*,†
Photo-dissociation rates	*Jan Eiof*	jclearSS.dat (4 files)	ASCII
		jcl1kmSS.dat (4 files) + jcl1.jun	ASCII
		jcl3kmSS.dat (4 files) + jcl3.jun	ASCII
Dust files	*Svetlana Peter*	sand_frac.dat clay_frac.dat	ASCII†
		DUST_f.MM DUST_c.MM	ASCII†
		SoilTypes_IFS.nc	netCDF†
Sites locations for surface output		sites.dat	ASCII*
Sondes locations for vertical output		sondes.dat	ASCII*
Emission factors for scenario runs		femis.dat	ASCII

Notes: † - optional (in most cases); * means ASCII files with header.

…for the rest you can try to ask more or less anybody from the team

…. and this is the end of my talk