Regional air quality forecasting for the Czech Republic

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ANTHROPOGENIC EMISSIONS

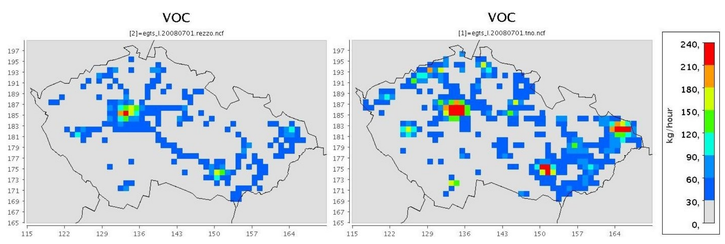
Within the Czech Republic: national inventory of the Czech Republic (REZZO). Elsewhere in Europe: TNO/MEGAPOLI database.

Clear differences between REZZO and TNO/MEGAPOLI emissions (pictured).

Good vertical allocation of emissions was desired: Large and mid-size sources of emissions from combustion processes and technologies were regarded as point sources.

This information is available in the REZZO database, but was required to be estimated for the TNO/MEGAPOLI emissions. Large point sources from the REZZO database were divided into 18 groups. Each group was characterized by both SNAP code and the amount of emissions of dominant pollutants. Emission-weighted averages of stack height and diameter, gas velocity and temperature were then calculated and assigned to the point sources from the corresponding groups in the TNO/MEGAPOLI database.

Pictured: VOC emissions from REZZO (left) and TNO/MEGAPOLI (right).



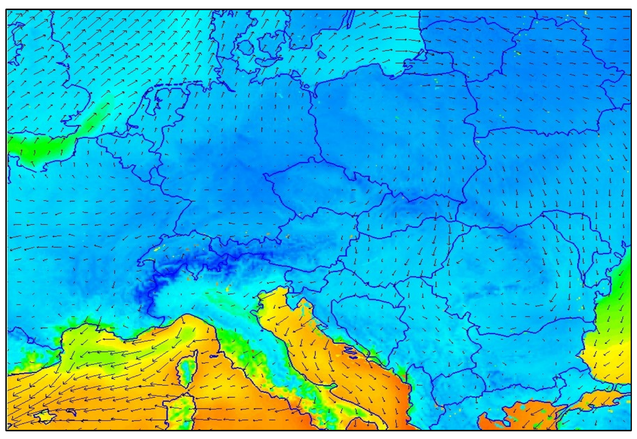
METEOROLOGY

54-hour weather forecasts, starting from 00:00 UTC are ready for processing around 04:00 UTC.

Same horizontal grid as CAMx (although the outer domain is 3 time coarser).

ALADIN's first 68 vertical layers are aggregated to produce CAMx's 20 vertical layers.

Pictured: ALADIN/CE surface temperature and winds pictured at 19:00 on 13/11/2012



ALADIN2CAMX

Processor to create met files for CAMx.

Aggregates vertical levels (and horizontal fields to coarser resolution if required) and produces required files for each CAMx domain.

Computes vertical diffusivity fields.

Exports relevant parameters for biogenic emission estimation, boundary condition extraction.

Vertical diffusivity fields are calculated from the ALADIN meteorological data using the integration methodology employed in CMAQ model. A future task will be to test other formulation methods for this important input field however more work is needed to resolve details in the validation process that will be used.

OPERATIONAL

To generate initial conditions for the next air quality forecast cycle, the other meteorological forecasts (06, 12, 18 UTC) are used to bring the CAMx model state to 00UTC using the most recent, and therefore most accurate, meteorology that is available.

In other words, the 48-hour forecast is run from 00UTC. Separate to that, the 06 UTC forecast meteorology is used to move the predicted CTM state at 06 UTC (initial conditions taken from the main forecast run) to 12 UTC, the 12 UTC forecast is used to move the CTM from 12 to 18 UTC, and the 18 UTC forecast is used to move the CTM to the beginning of the next day. This leaves a more accurate model state (in comparison with using the main forecast's 23h prediction) to begin the next forecast with.

The results of the AQF are expected to be ready for processing and dissemination around 8 UTC. This accommodates delivery of meteorological fields at approximately 04 UTC, processing of CTM inputs (meteorology is used in emission calculations, for example) taking 30 minutes, runtime of the CTM (approximately 3.5 hours). Processing and quality control tasks might also require some time leading to the results eventually becoming publicly available by 9 UTC, 10 CET.

LANDUSE INFORMATION

A number of test landuse files have been prepared for dry deposition. A 26-category and 11-category file were derived from USGS landuse data via a WRF to CAMx processing tool.

The 26-category file will allow the dry deposition model based on the work of Zhang (2001, 2003) to be employed. The 11-category version will enable the older model based on Wesely and Slinn and Slinn to be used (see CAMx user's guide). The third landuse file is also of the 26-category type and was derived using, primarily, CORINE 2006 landcover information.

Global Land Cover (GLC) 2000 landcover information was used to extend the spatial extent of the CORINE database for the entire CAMx domain. This third file includes relative percentages of each landuse category (based on the finer resolution CORINE data (250 m), and GLC data (1000 m)) in the grid cell therefore it better represents the sub-grid cell landuse variability.

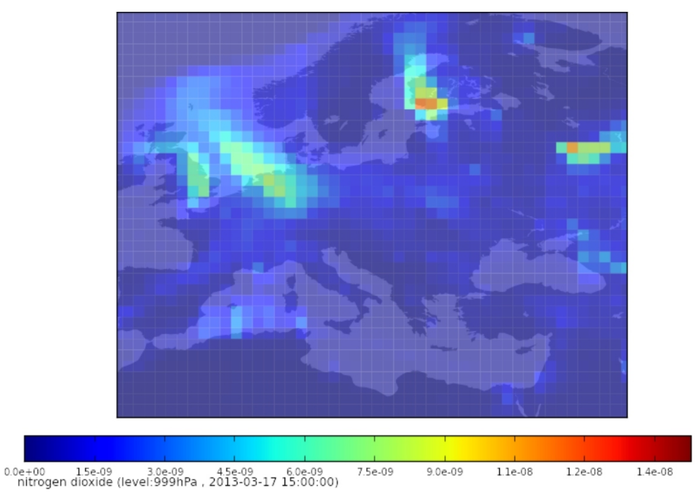
Recently, leaf area index (LAI) values from MODIS products for the year 2009 have been included in the landuse files. The source of this data is the Land-Atmosphere Research Group at Beijing Normal University (Yuan yet al., 2011).

BOUNDARY CONDITIONS

Boundary conditions are gathered from the Monitoring Atmospheric Composition and Climate (MACC) project, made available by the Forschungszentrum Jülich Web Coverage Service (WCS).

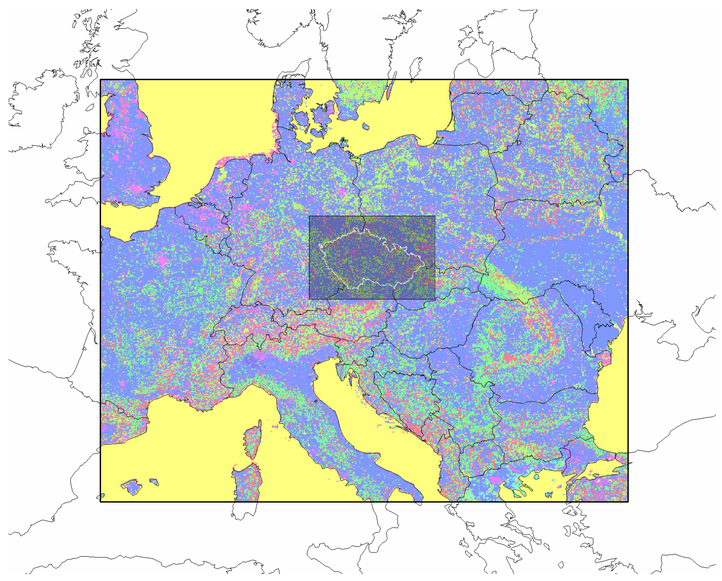
Seasalt and dust concentrations from the MACC dataset are apportioned into the relevant CAMx size bins (coarse/fine) using a log-normal distribution equating cumulative mass with particle diameter.

Pictured: NO2 mixing ratio, 17/3/2013, 15:00.



CAMx

Domains 1 and 2 (shaded).
Colour denotes landuse categories derived from CORINE(2006) and Global Land Cover (2000) datasets.



Domain 1: 171 x 135 cells @ 14.131km
Domain 2: 122 x 80 cells @ 4.711 km

BIOGENIC EMISSIONS

Biogenic emissions were prepared using BEIS model v3.09, part of SMOKE. BEIS requires a special format of input data that consists of: gridded land cover data, emission factors for vegetation types and actual meteorological values.

Land cover data for the domain of interest were prepared from the grid with resolution of 0.01 degree, with the main type of vegetation on each cell of the grid. It was based on the data gathered during AFOLU project. Using a wide range of literature, the emission factors for all of 230 types of vegetation were computed (Zemankova , 2010).

EVALUATION

Performance evaluation of the forecast has not yet been completed and therefore results are not yet available.

References

Yuan, H., Dai, Y., Xiao, Z., Ji, D., Shangguan, W., 2011. Reprocessing the MODIS Leaf Area Index Products for Land Surface and Climate Modelling. Remote Sensing of Environment, 115(5), 1171-1187

Zemánková, K., J. Brechler, 2010. Emissions of biogenic VOC from forest ecosystems in central Europe: Estimation and comparison with anthropogenic emission inventory. Environmental Pollution 158, 462–469

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