

Conversion of Czech National Emission Inventory for Input to Air Quality Models

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1 Introduction

SMOKE

Register of Czech Emissions Inventories

Conversion of emissions

Preliminaries

Point sources

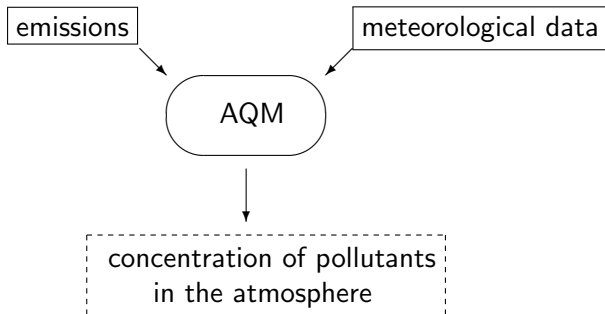
Area sources

Mobile sources

Examples

Air Quality Models (AQMs)

mathematical description of pollution transport, dispersion and related processes in the atmosphere



Large number of AQMs, we have chosen
Models-3/Community Modeling and Analysis System (CMAS)

Eulerian (gridded) atmospheric chemistry and transport modeling
systems

advanced models

- ▶ broad range of scale
- ▶ more emission sources
- ▶ treat multiple pollutants simultaneously (e.g. ozone, toxics, particulate matters)

CAM_x, CMAQ

Emissions

European Emissions Inventories

coordinated by European Environmental Agency (EEA)

data from national emissions inventories are aggregated in CORINAIR/EMEP database

- ▶ grid resolution 50km x 50km
- ▶ divided into sectors according to SNAP nomenclature

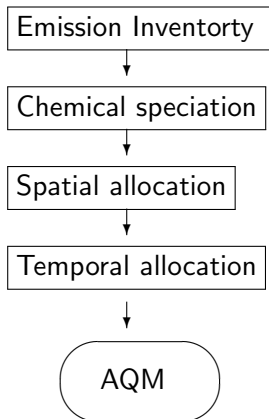
Czech national emission and air pollution sources inventory (REZZO)

large database covering anthropogenic emissions produced in the Czech Republic

administred by the Czech Hydrometeorological Institute

suitable input into advanced AQMs

Emission inventories cover **annual- totals** of **emissions** for every **source** while AQM input is for each **grid cell**, **every hour** and **chemical species**



SMOKE

Sparse Matrix Operator Kernel Emissions (SMOKE)

created by Environmental Modeling Center at the University of North Carolina, Chapel Hill as a part of CMAS

- ▶ allows an extremely detailed emission processing
- ▶ flexible tool for preparation of emission data
- ▶ uses (sparse) matrix vector multiplication \Rightarrow high efficiency on modern computer architectures
- ▶ strongly oriented to applications in the US





REZZO 1,2 very large and mid-sized sources of emissions from combustion processes and technologies



REZZO 3 small sources, in particular emissions from local heating for cadastral units



REZZO 4 transportation, onroad and nonroad mobile sources for cadastral units

Conversion of emissions

SMOKE recognizes four source categories

point sources ↔ REZZO 1, REZZO 2

area sources ↔ REZZO 3

mobile sources ↔ REZZO 4

biogenic emissions

- ▶ models BEIS2, BEIS3
- ▶ biogenic land use data characterize the type of vegetation that exists in either cadastral unit total or grid cell values
- ▶ different approach, subject of our work

SMOKE uses US standards ⇒ it is not straight applicable for Czech emissions some steps must be done for prepare REZZO data as an input into SMOKE

Preliminaries (for all sources)

administrative division codes

- ▶ country/state/county codes ↔ Nomenclature of Units for Territorial Statistics (NUTS)

classification of different anthropogenic activities

- ▶ Source Classification Codes (SCC) ↔ Selected Nomenclature for Air Pollution (SNAP)

associated data were delivered:

- ▶ temporal allocation profiles - based on information about production cycles for particular SNAP categories
- ▶ chemical speciation profiles - defined by the use of chemical mechanism chosen (CBIV, SAPRC)

Point sources

REZZO 1 and REZZO 2 - emissions are apportioned to the grid cell intersecting the point (longitude/latitude)

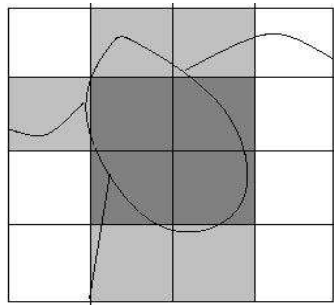
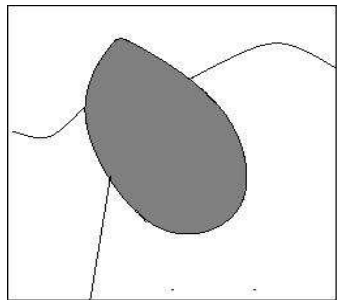
- ▶ stack height and diameter
- ▶ stack gas exit temperature and velocity

Area sources

REZZO 3 cadastral unit-total emissions are spread among the cells intersecting the cadastral unit through the use of gridding surrogates

- ▶ made for a specific horizontal grid
- ▶ created using the information available at a finer resolution than cadastral unit (typically census returns)

The effect of the surrogates application for area sources.



REZZO 3

mainly emissions from local heating \Rightarrow data set on housing from census returns provided by the Czech Statistical Institute used for making surrogates

- ▶ 2.5 millions of buildings
- ▶ exact longitude/latitude position
- ▶ type of building (e.g. block of flats, hospital, school)
 - ★ number of flats
- ▶ type of heating (e.g. local, district)
 - ★ fuel (e.g. coal, gas)

Based on these pieces of information the emission ratios $R(u, i, j)$ were computed

$$E(i, j) = \sum_{u \text{ intersect the cell } (i, j)} E(u) * R(u, i, j)$$

Mobile sources can be processed through
emissions

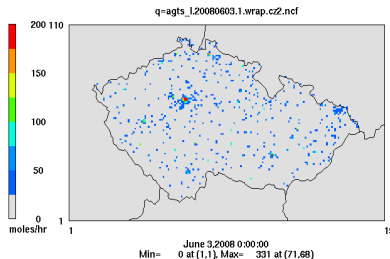
- ▶ REZZO 4 - cadastral unit totals of emissions from mobile sources will be processed using surrogates from public road system

MOBILE6 system

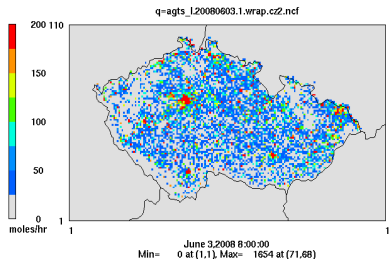
- ▶ special inputs - activity data that consist of vehicle miles traveled and optionally vehicle speed
- ▶ complete activity data for CR are not available at the moment

Example of gridded, speciated, temporal allocated area emissions (REZZO 3)

Layer 1 NO2q

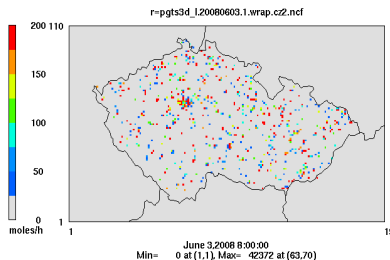


Layer 1 NO2q

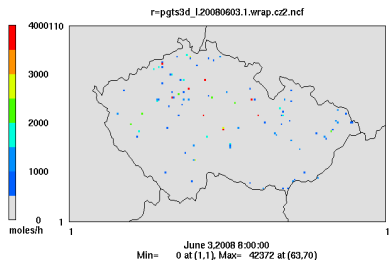


Example of gridded, speciated, temporal allocated point emissions (REZZO 1)

Layer 1 NO₂r



Layer 1 NO₂r



Conclusions

REZZO emissions for point and area sources were converted for grid with 3km horizontal resolution

biogenic and mobile emissions (REZZO 4) are preparing for input into SMOKE

It would be interesting to do similar conversion for larger region (e.g. central Europe)