CAMS and FAIRMODE : a step further ?

Laurence Rouïl (INERIS, FR)

Atmosphere Monitoring

CAMS: COPERNICUS ATMOSPHERE MONITORING SERVICE

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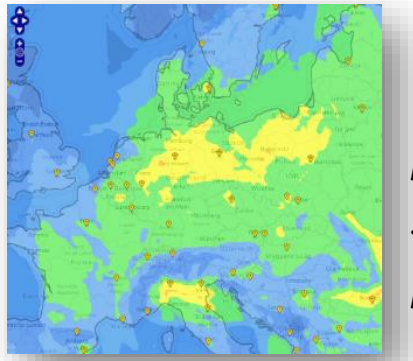
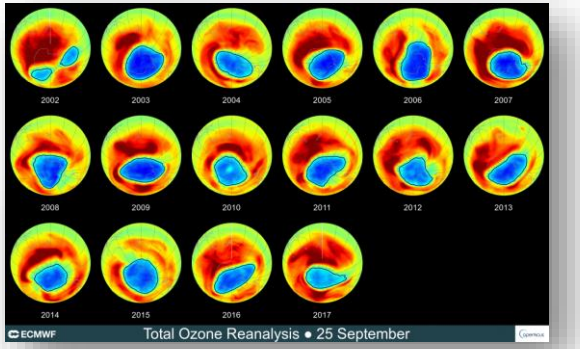
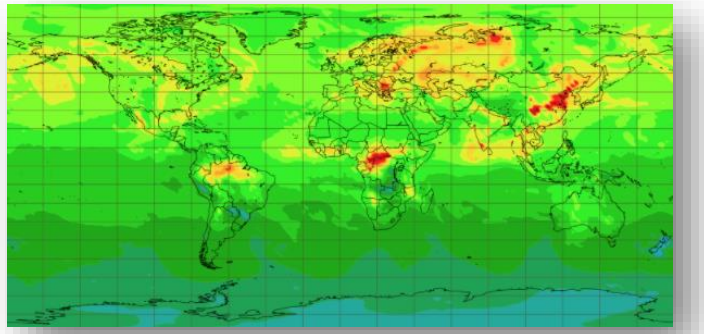


European Air Quality and products in support of policy users

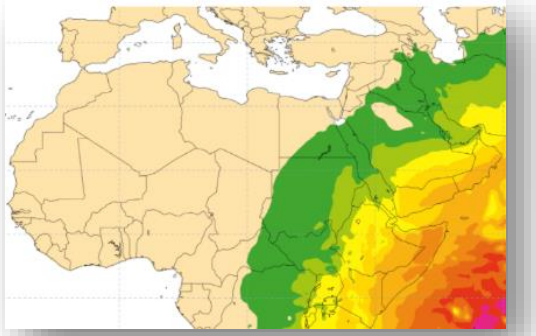


Ozone layer

Emissions and surface fluxes



Global analyses, forecasts and reanalyses



Solar radiation and UV index

Direct access to main daily global products at
http://atmosphere.copernicus.eu/charts/cams

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The Regional CAMS services for Europe

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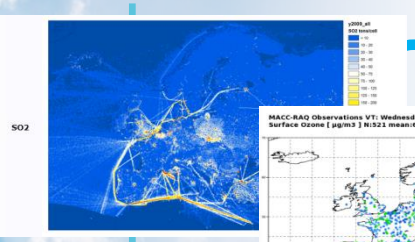
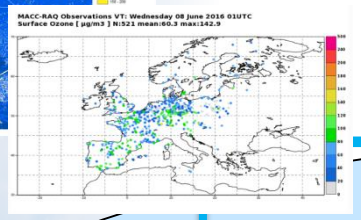
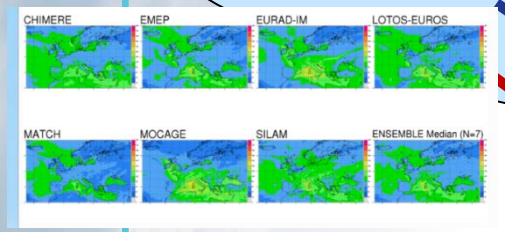


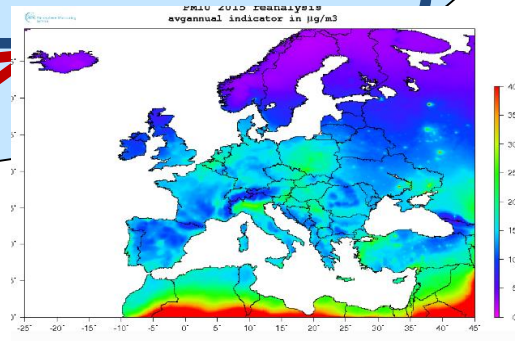


Global model products
Regional emissions
Observations

Daily production of air quality forecasts and Analyses (7 models & Ensemble)

Annual production of air quality reanalyses Interim (YY-1) & Validated (YY-2)





USERS

9 operational models

- CHIMERE (INERIS)
- EMEP (MET Norway)
- EURAD-IM (RIUUK)
- LOTOS-EUROS (KNMI/TNO)
- MATCH (SMHI)
- SILAM (FMI)
- MOCAGE (Meteo-France)
- DEHM (Aarhus Univ.)
- GEM-AQ (Warsaw Univ.)

2 new models under development : MINNI from ENEA (IT), and MONARCH from BSC (SP)

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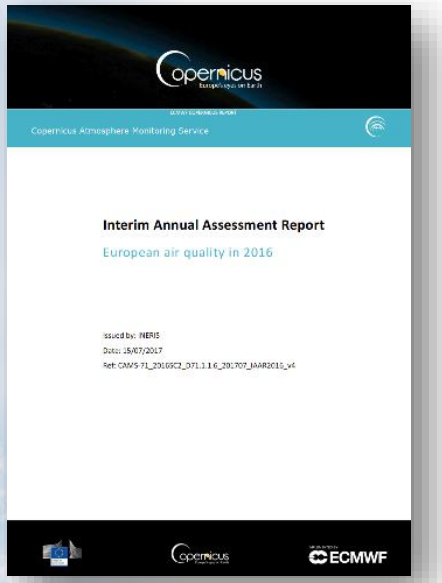
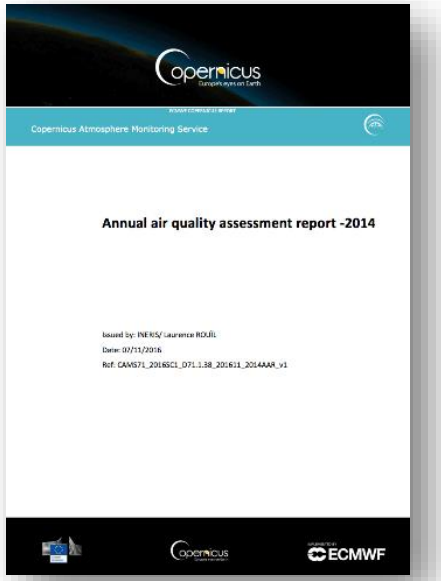
ANNUAL ASSESSMENT REPORTS



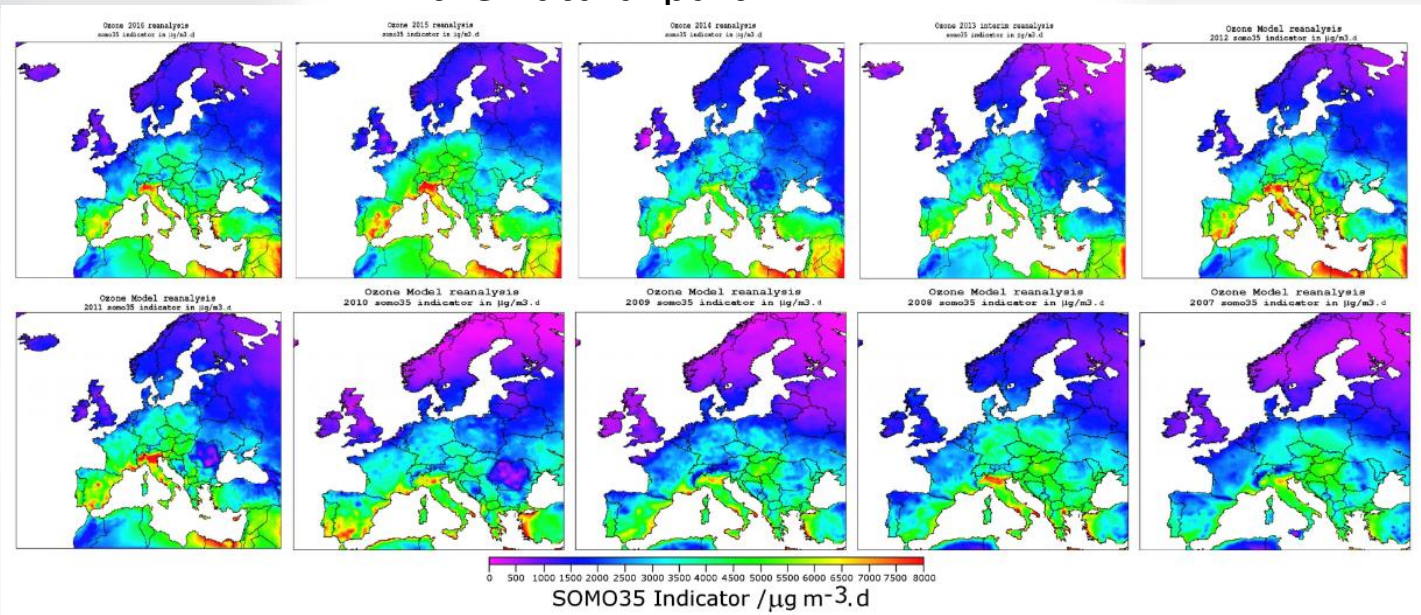
Reports on the European **annual interim reanalysis** (based on observations in an interim stage of validation)

- Focus on episodes for ozone
- Analysis to qualify the relative influence of various sources including the natural part



Reports on the European **annual reanalysis** (based on validated observations)

- Focus on air quality indicators as set in the air quality Directives or relevant for impact studies.
- Consistent with the EEA air quality report



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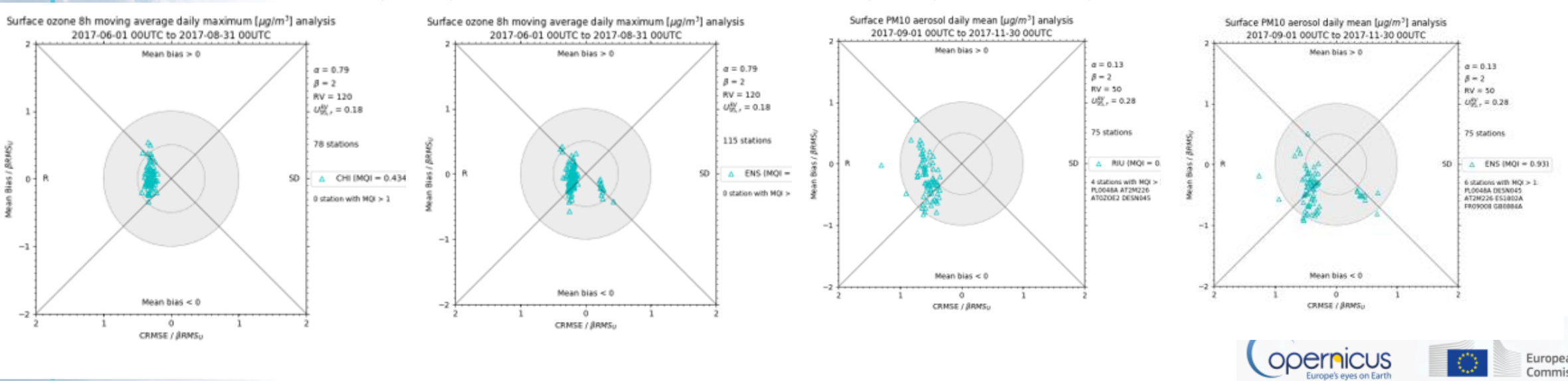
Strengthening the model evaluation process

- CAMS forecasts , analyses and re-analyses are evaluated routinely according to a stringent process that uses UTD and validated air quality observations reported to the EEA
- By the end of 2018, FAIRMODE objectives and metrics have been coded and implemented in the CAMS evaluation process, and a first assessment performed for the 2017 analyses (target plots and summary reports similar to those proposed by the Delta-Tool)



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Strengthening the model evaluation process(ii)

- Evaluation performed for all individual and for the Ensemble (median) for ozone, NO2 and PM10
- The Ensemble results felt into the Fairmode target for ozone and NO2 but for PM10 the objective was not reached for some stations
- Complementarity with the current evaluation process has been demonstrated and Fairmode indicators will be operationally implemented for analyses and re-analyses in 2019
- Interest to extend the approach to forecasts with respect with future Fairmode methodology

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CAMS Policy Support Products

- Delivering fit-for purpose products
  - Support analysis and understanding of air quality trends and episodes
  - Provide illustrative tools to document the multi-factorial and complexity origin of air pollution episodes
  - Focus on PM and ozone for which model capacities are well-suited

- No compliance checking, no planning tools
  - Improving our understanding of air pollution patterns and episodes in Europe : role of local sources versus long range transport, chemical composition, activity sectors, trends…

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Air Pollution Episode analysis tools

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- http://policy.atmosphere.copernicus.eu/index.html

- Understanding air pollution episodes:
  - Chemical composition
  - Activity sectors
  - Geographical origins

- Set of tools based on 3 European CTM : EMEP, CHIMERE and LOTOS-EUROS

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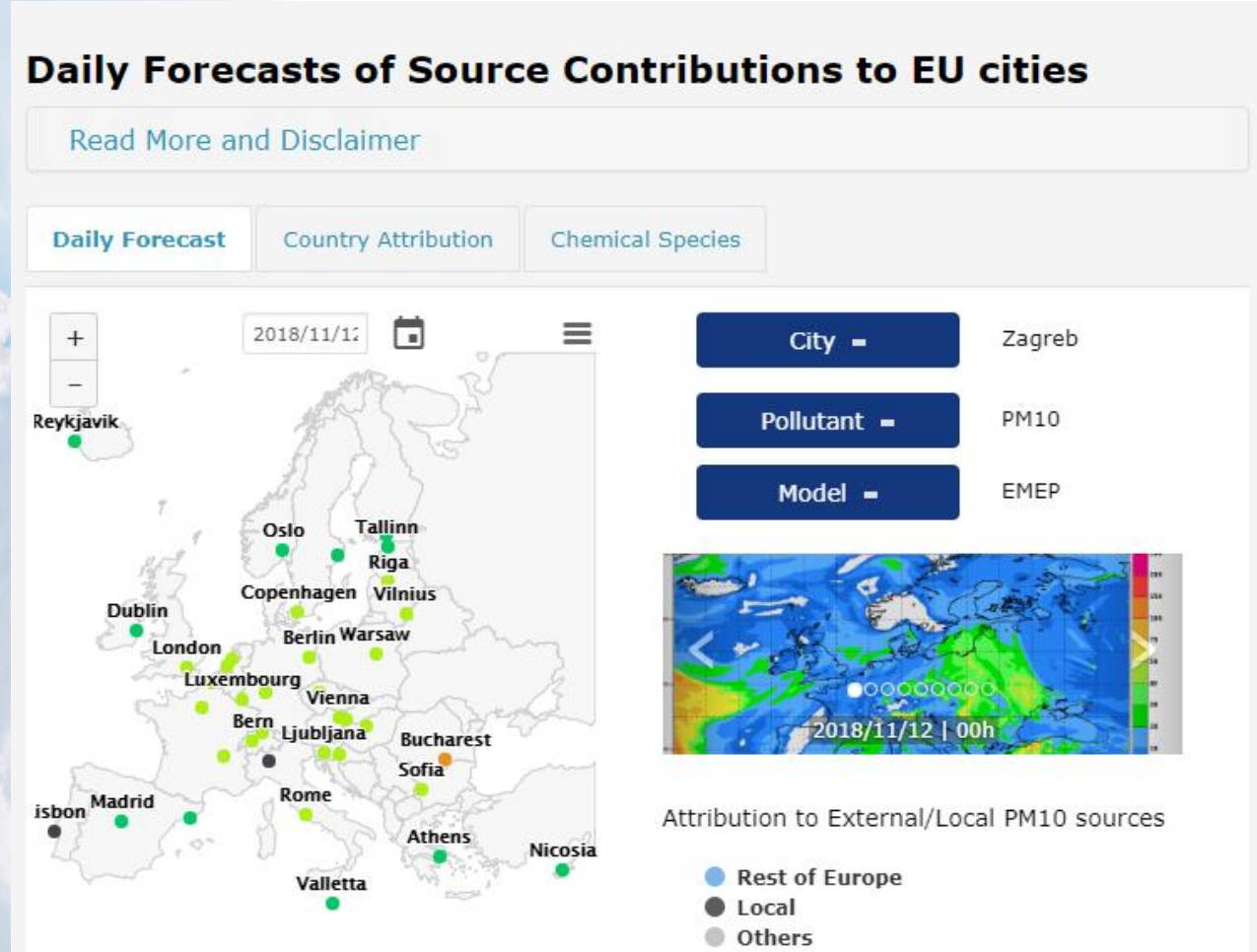
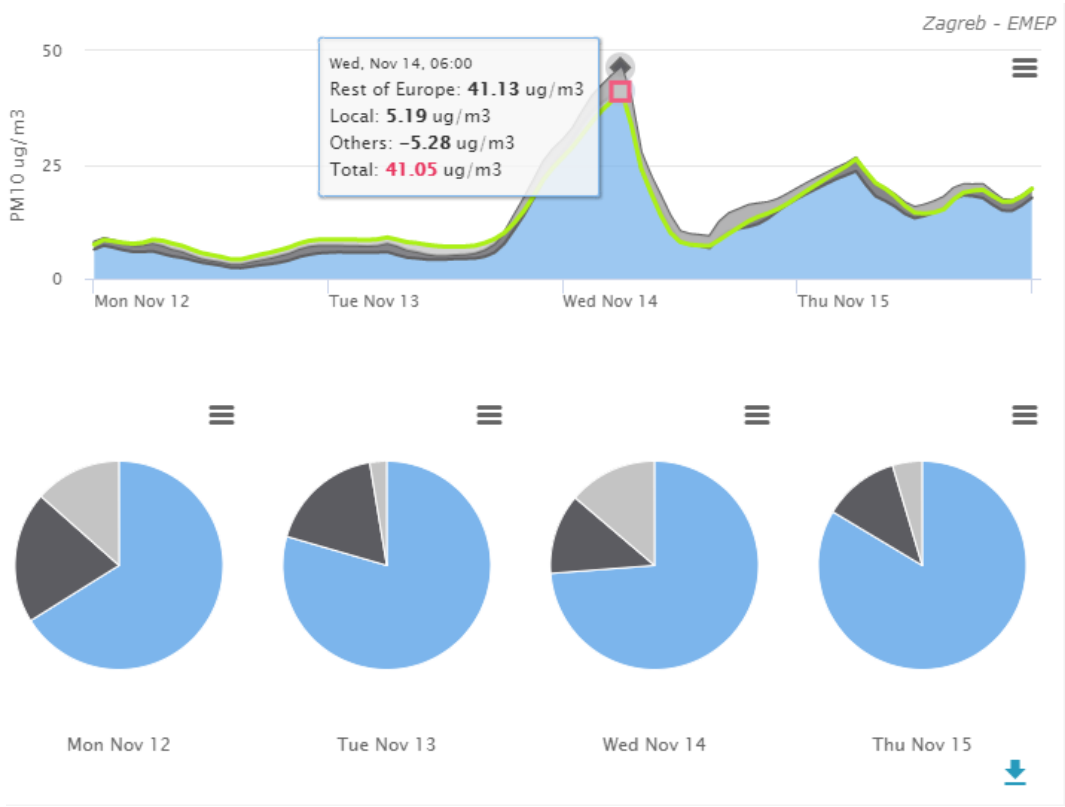
Source-receptor allocation services

Case study for Zagreb: 14.11.2018

Based on Daily EMEP model runs





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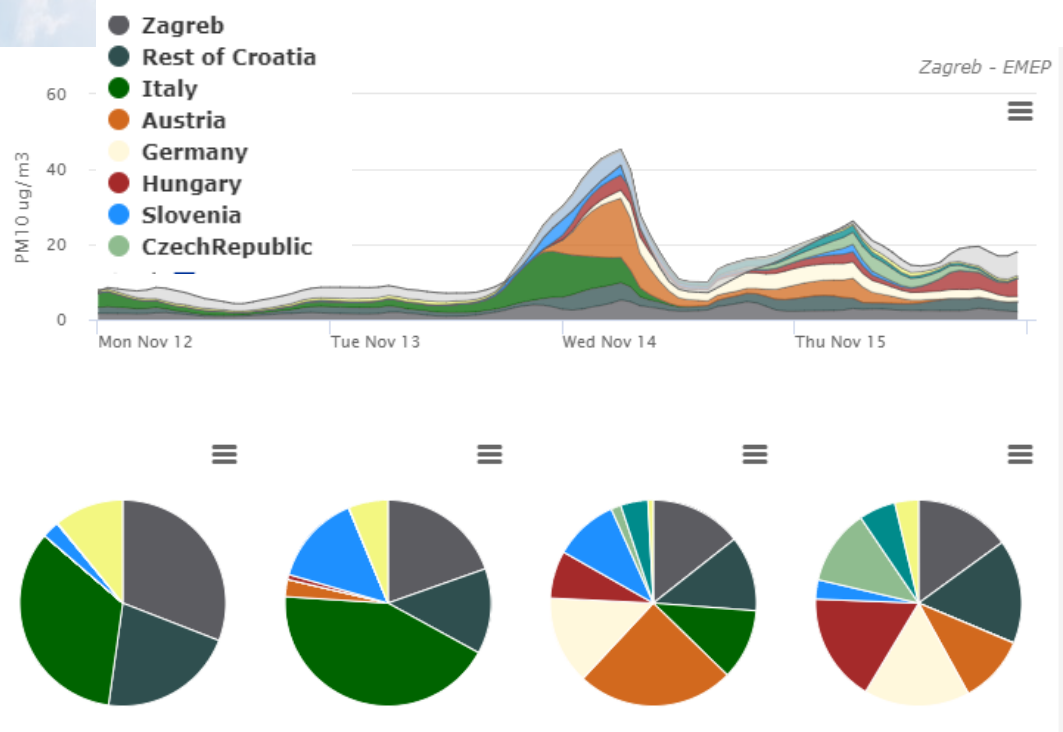
Country allocation & chemical composition

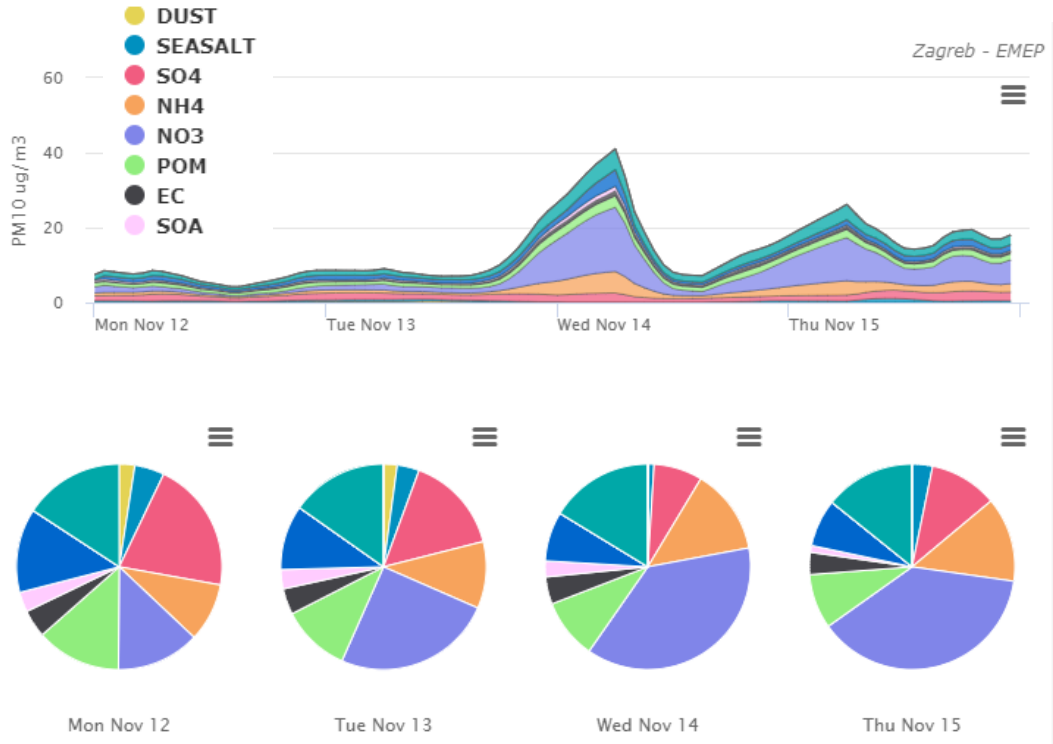
Case study for Zagreb: 14.11.2018

Based on Daily EMEP model runs

Contributing countries



Contributing species



CAMS green scenario toolbox

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- A tool to allow policy users testing the impact of sectoral emission reduction strategies on air pollutant concentrations (Ozone, PM)

- Information is provided in forecasts mode for the next three days and help in highlighting the activity sectors (industry, road traffic, residential heating, agriculture) that influence the most air pollution levels. It depends on the place and time

- The tool is based on the CHIMERE chemistry-transport model run with a 20 km resolution for a limited number of scenarios (about 15) to built up a surrogate simple model that provide quick responses whatever the emission reduction scenario tested

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ACT: Air Control Toolbox

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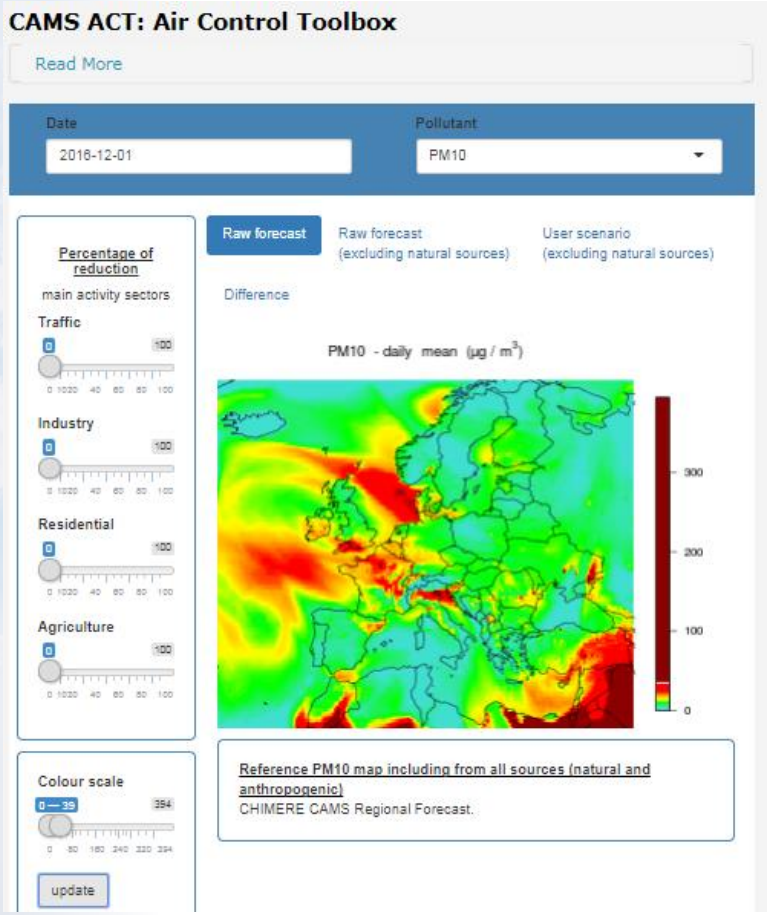
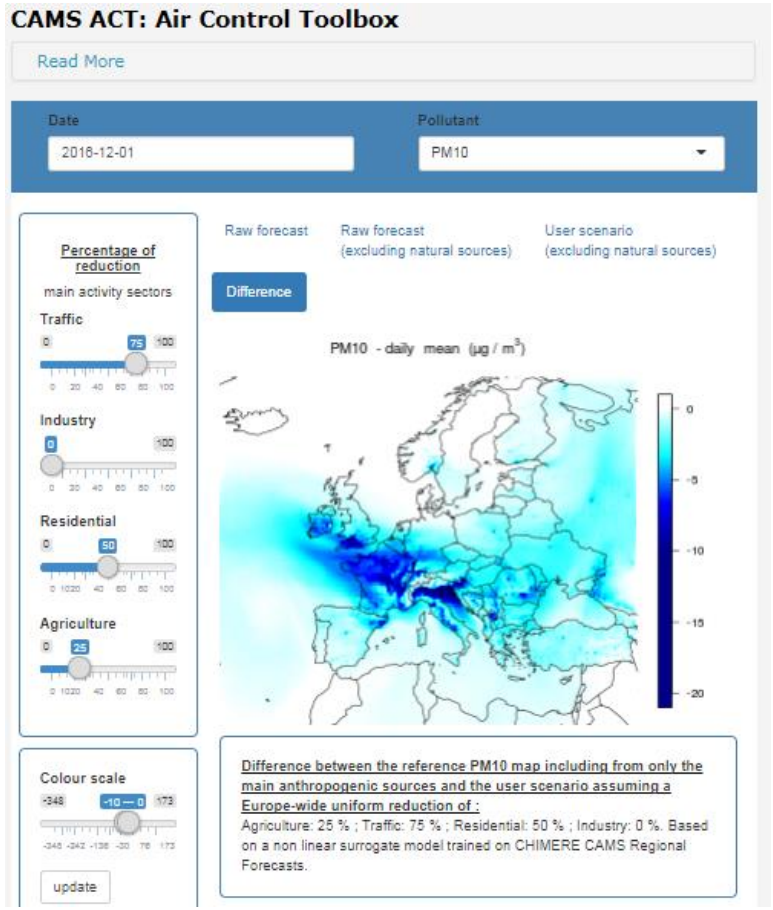
- Web-based fast response episode scenario forecasting
  - Accounting for the complexity of atmospheric chemistry for the current forecasting situation





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Surrogate model methodology

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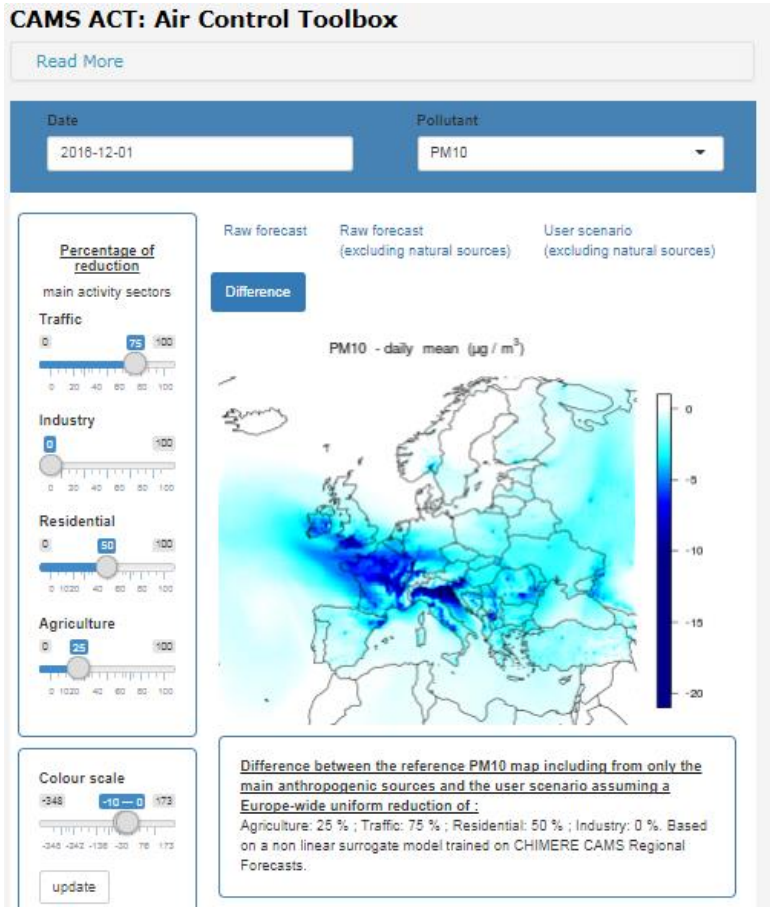
- Surrogate Model
  - Training data set:
    - limited set of Chimere scenarios run on High Performance Computer (15)
  - Fit a regression model (2nd order polynomial)
    - At each grid point
    - For each forecast day (mean for PM10, max for O3)
  - Upload the statistical regression on a fast web-tool

- Development
  - Explore several combinations of emission reductions to account correctly for non-linearities
    - IND, RES, TRA, AGR
    - 10, 30, 60, 90, 100%
    - + Interactions
  - Design the optimal numerical experimental plan for a limited number of episode situations
  - Uncertainty objective : < 2% compared to full model runs



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CAMS Emission inventories

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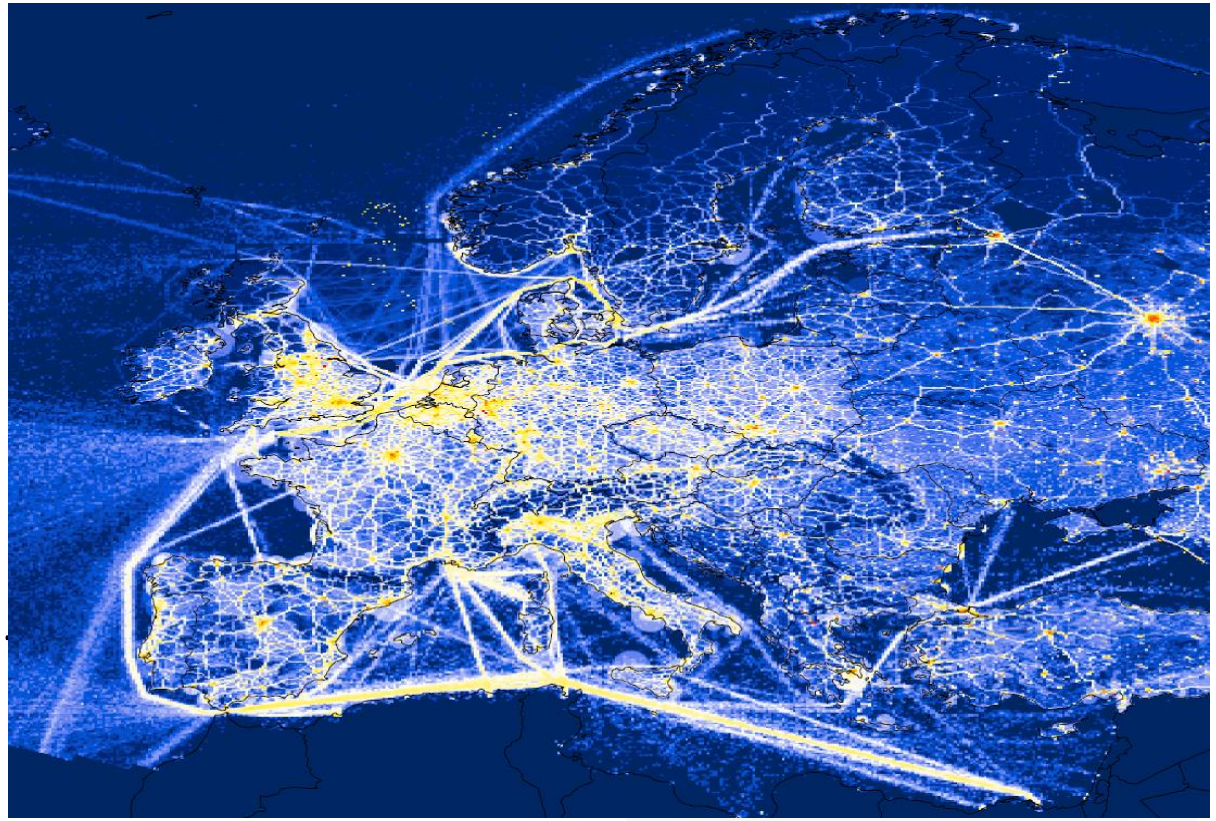
- New release of updated datasets
  - **2015 in September 2018**
  - **2016 in March 2019**
- Input for CAMS AQ forecasts over Europe + reanalyses
- Input for national AQ forecasts and research
- Benchmark with other initiatives and especially within FAIRMODE framework

Example gridded ~ 7 x 7 km TNO-MACC_III emissions data
NOx emissions in 2009 for all sectors



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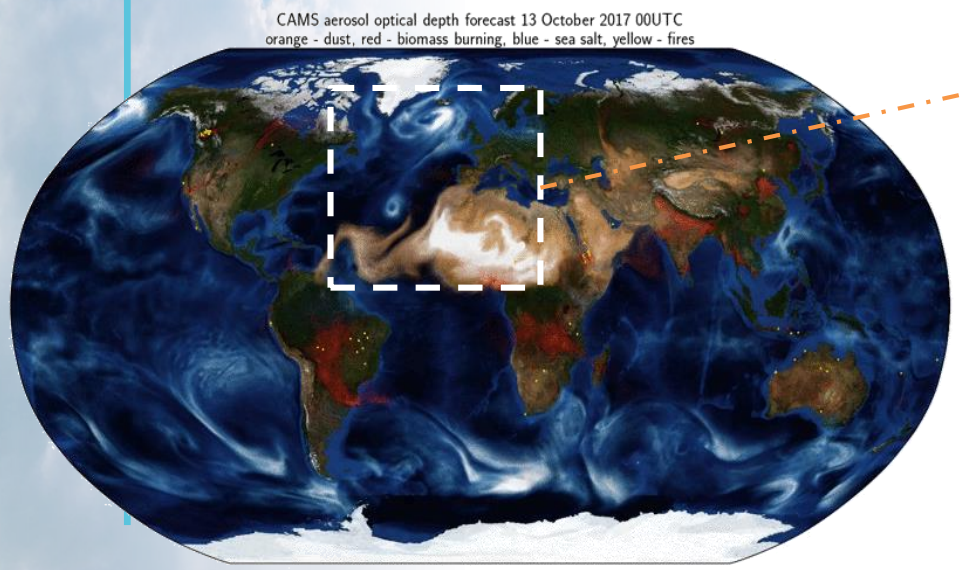
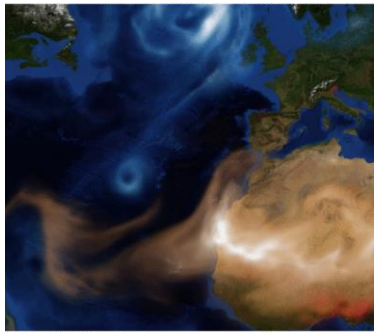
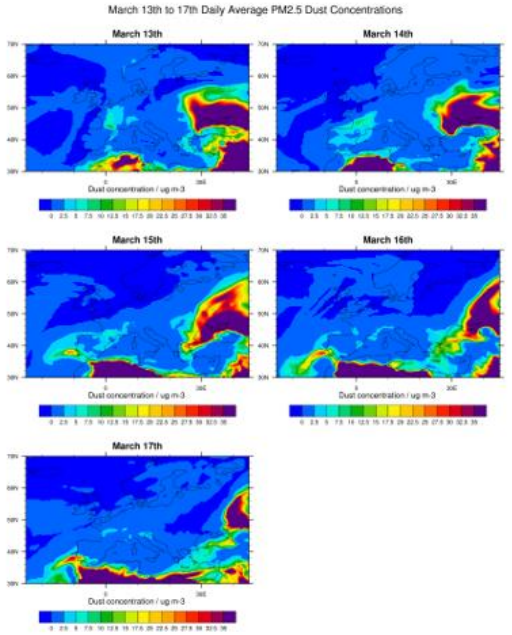
Global products

- Daily forecasts and re-analyses of global aerosols including desert dusts, sea salts and forest fires
- Can be of high interest for reporting on natural contributions in PM
- Used in the 2017 interim report on air quality to analyse several episodes







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THANK YOU FOR YOUR ATTENTION

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