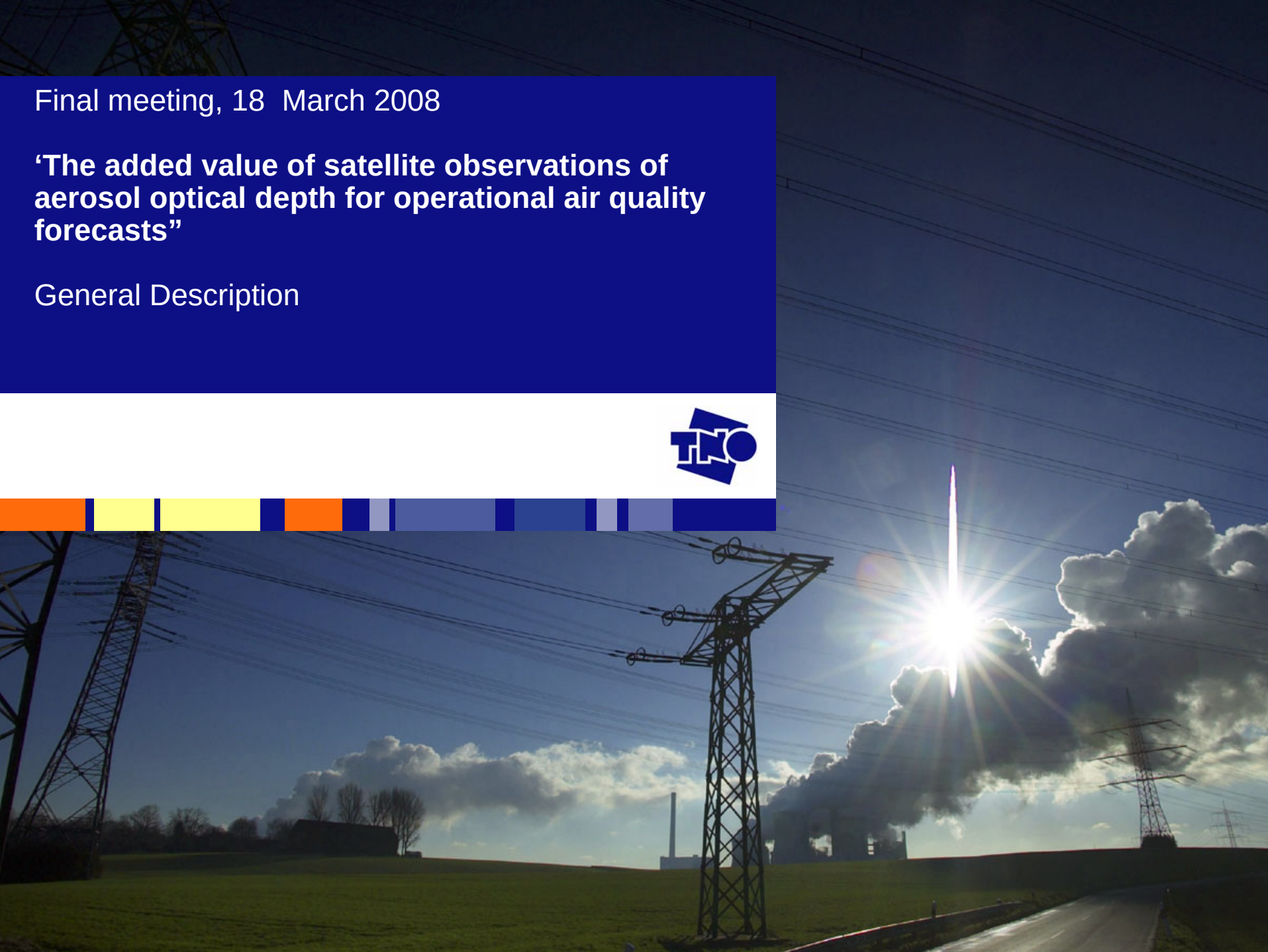
Final meeting, 18 March 2008

‘The added value of satellite observations of aerosol optical depth for operational air quality forecasts”

General Description



Introduction

- Objective
- OSSE for aerosols
- Initial study results and recommendations
- Set-up of follow-up study
  - LOTOS-EUROS model
  - Time periods
  - Domain, resolution
  - Scenarios
  - Unforeseen elevated dust source

Objective

In the context of MTG

Quantify the impact of satellite derived aerosol information as observed by future instruments (Imager and Sounder A-2 band) on the operational forecasting and analysis of groundlevel PM2.5 concentrations over Europe

Objective

Formulated requirements for AOD measurements:

- Time resolution 30 minutes
- Vertical resolution 2km
- Horizontal resolution 10x10 km

Are the available requirements necessary to have a substantial impact relative to the impact of ground level observations of PM2.5?

What is an OSSE?

OSSE = Observing System Simulation Experiment
Assess the impact of future observations

- Production of synthetic observations
- State of the art model (LOTOS-EUROS)
- Active assimilation of observations in the model
- Assessment of added value of assimilation of the observations

What is an OSSE?

Production of synthetic observations:

- Nature run → simulate the 'true' state of the atmosphere
  → Simulation of synthetic groundbased observations at selected locations
  → Simulation of synthetic AOD from aerosol fields

Model (version) different from model used in assimilation

Initial study

Follow-up of:

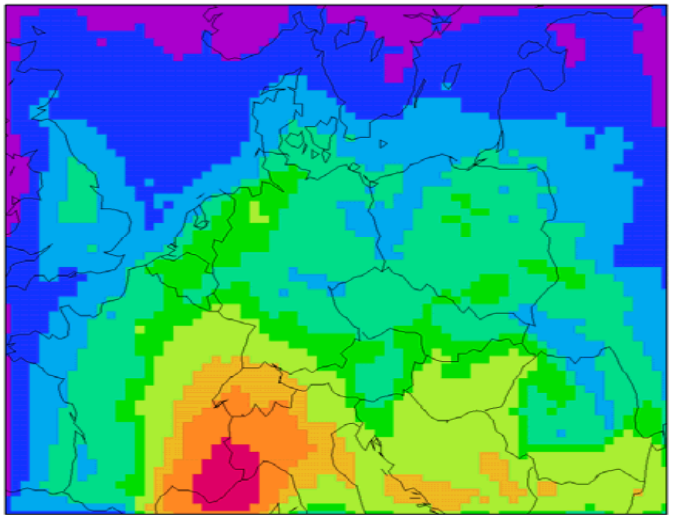
"Operational use of satellite derived aerosol information" (Timmermans et al., 2006)

results were non-conclusive but more indicative

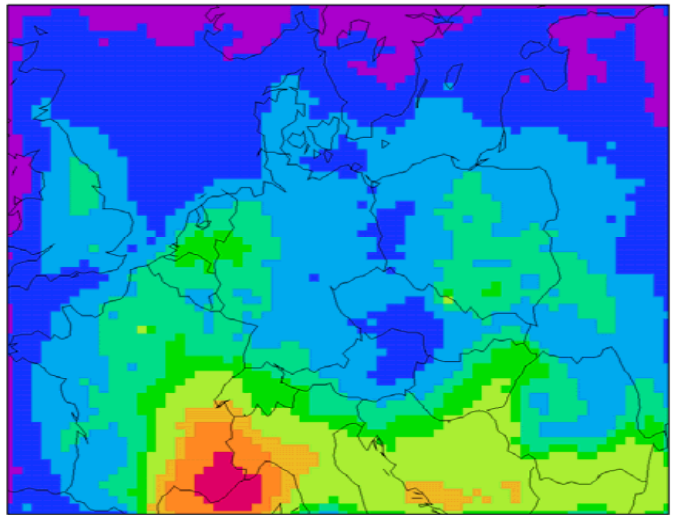
Recommendations → follow-up study

Results initial study

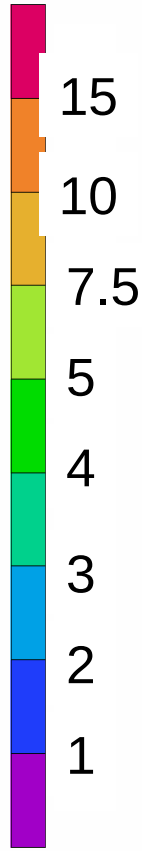
No assimilation



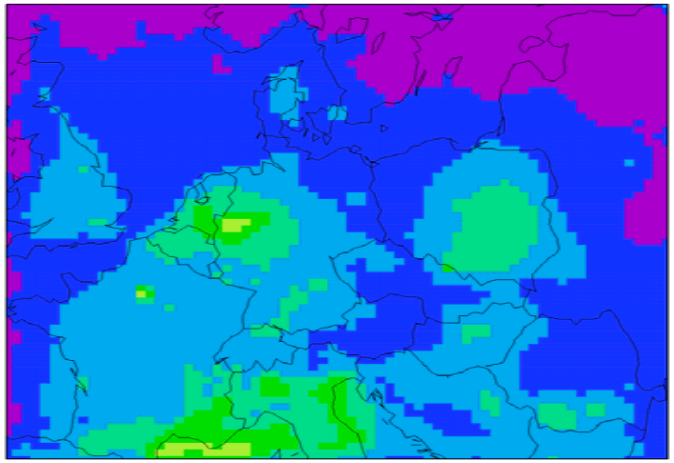
Assimilation of PM2.5



RMSE

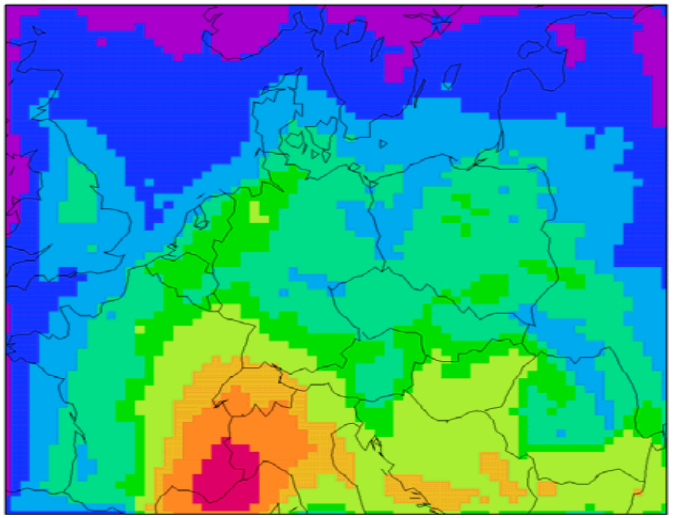


Assimilation of PM2.5 and total AOD Imager

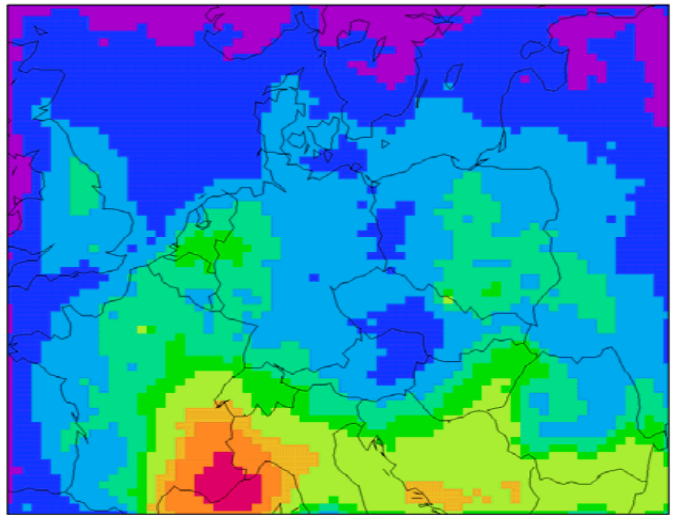


Results initial study

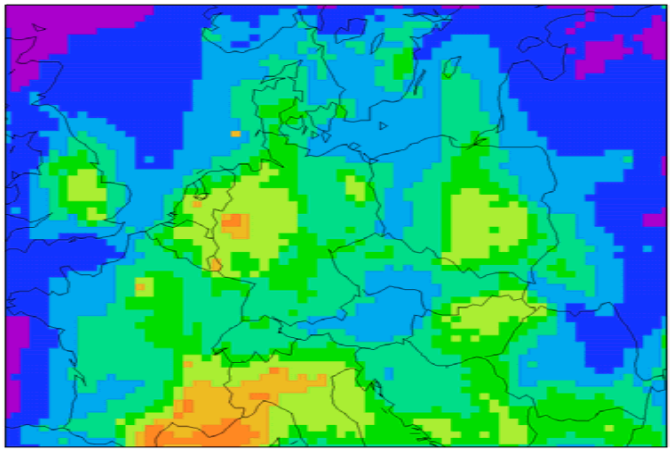
No assimilation



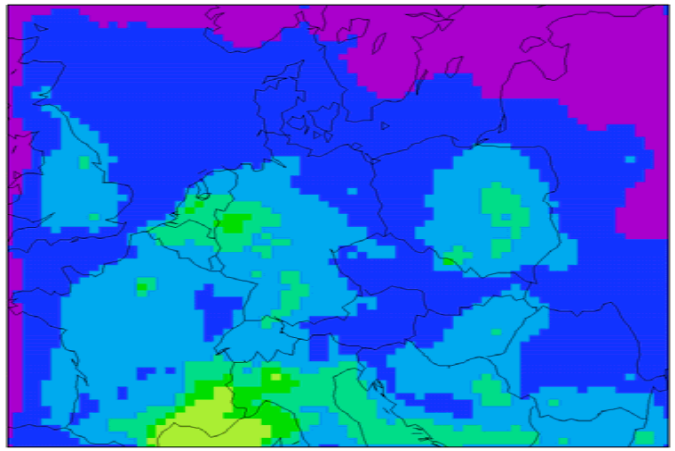
Assimilation of PM2.5



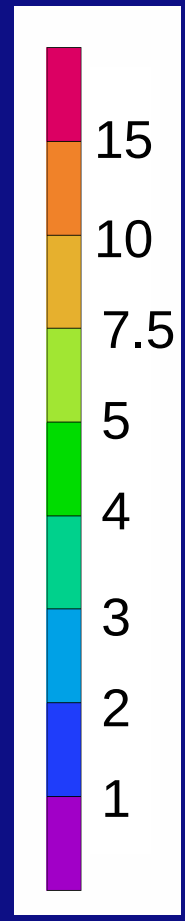
PM2.5 + 3 layers AOD A-band



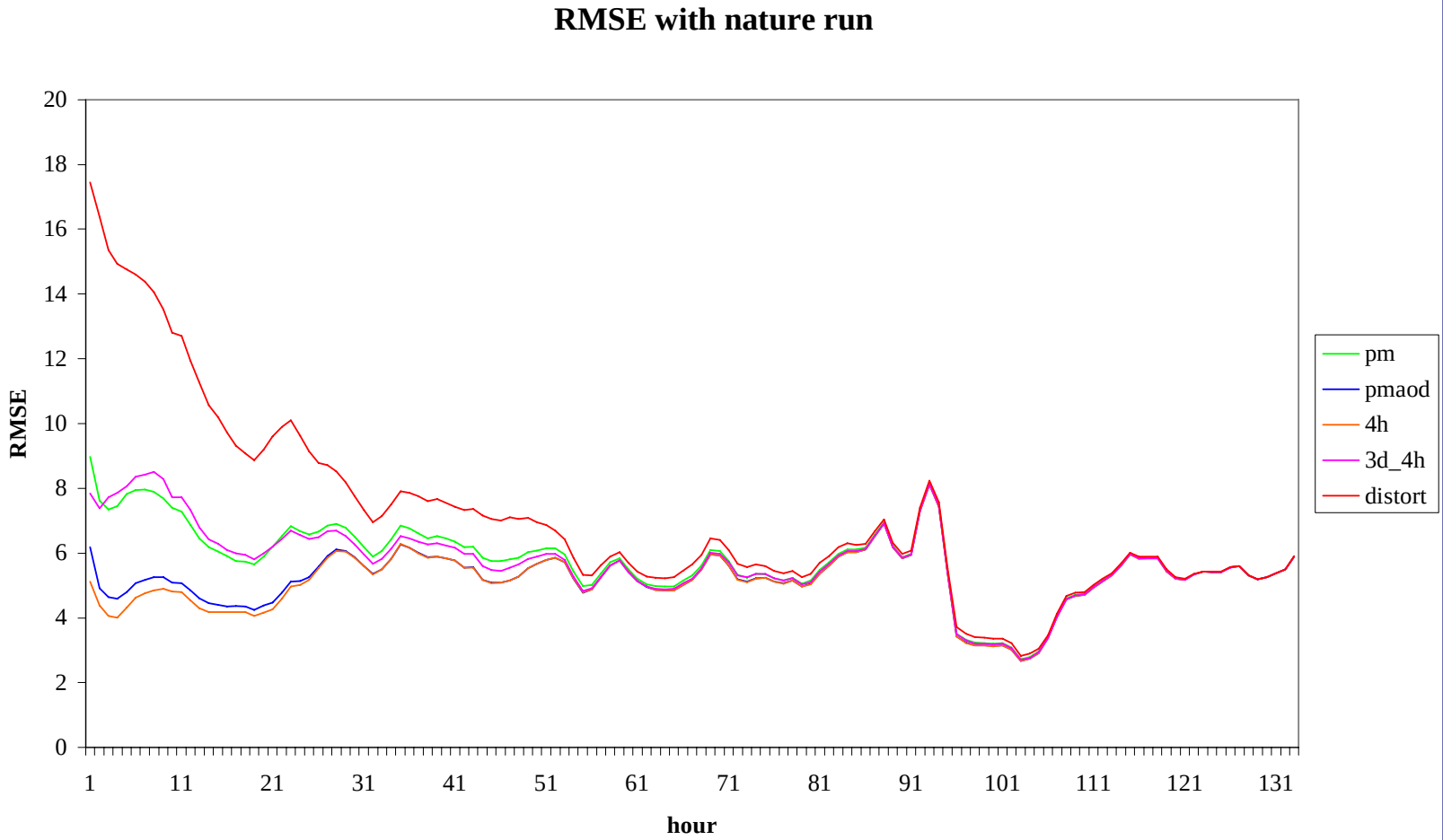
PM 2.5+ 4-hourly total AOD Imager



RMSE



Results initial study: forecast runs



Main recommendations from initial study

- Use a different model for production of synthetic measurements than for assimilation/forecast runs
- Incorporate the error covariance matrix of synthetic AOD measurements in assimilation system
- Use of emissions noise factors in forecast runs
- Higher resolution of model to better match resolution of instruments
- Add cloudy situations → advantage high-res imager
- Better separation of high altitude dust from ground level dust

Set-up of study

Production of synthetic measurements:

- Nature run with CHIMERE model (see presentation of Robert Vautard)
- Production of synthetic satellite measurements (presentation Richard Siddans)

Assimilation and forecast runs with LOTOS-EUROS model

LOTOS-EUROS: Introduction

- 3-D Eulerian chemistry-transport model
- Intermediate complexity to enable long term simulations with modest computing power
- Modelled components:
  - Oxidants (O_3, NO_2, NO, VOC, etc)
  - Particulate matter/aerosol (SO_4, NO_3, NH_4, EC, OC, SS, PMx)
  - Heavy metals (Pb, Cd)
  - Persistant Organic Pollutants (POP's)
- Currently aimed at lower troposphere over Europe

LOTOS-EUROS: Introduction

LOTOS and EUROS have been used in a large number of studies in the past 2 decades

Both models have been compared to other state of the art models on a regular basis:

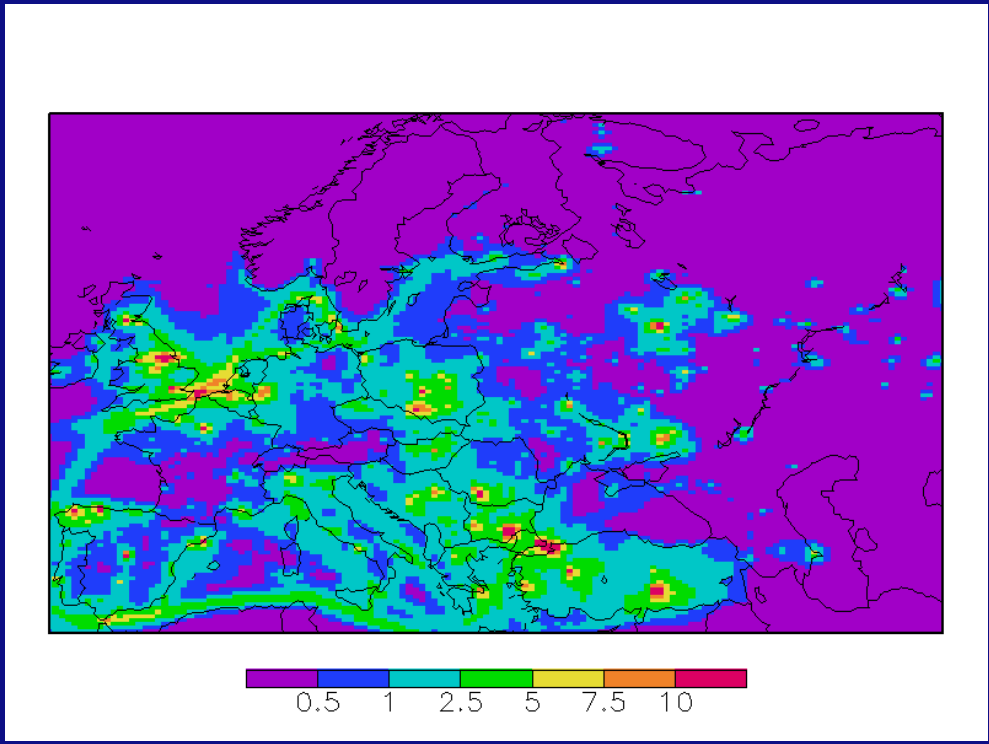
- EUROTRAC-gloream-TOR2 model intercomparisons
- EMEP-review model intercomparison
- City-delta I and II
- EURO-delta I and II (2006)

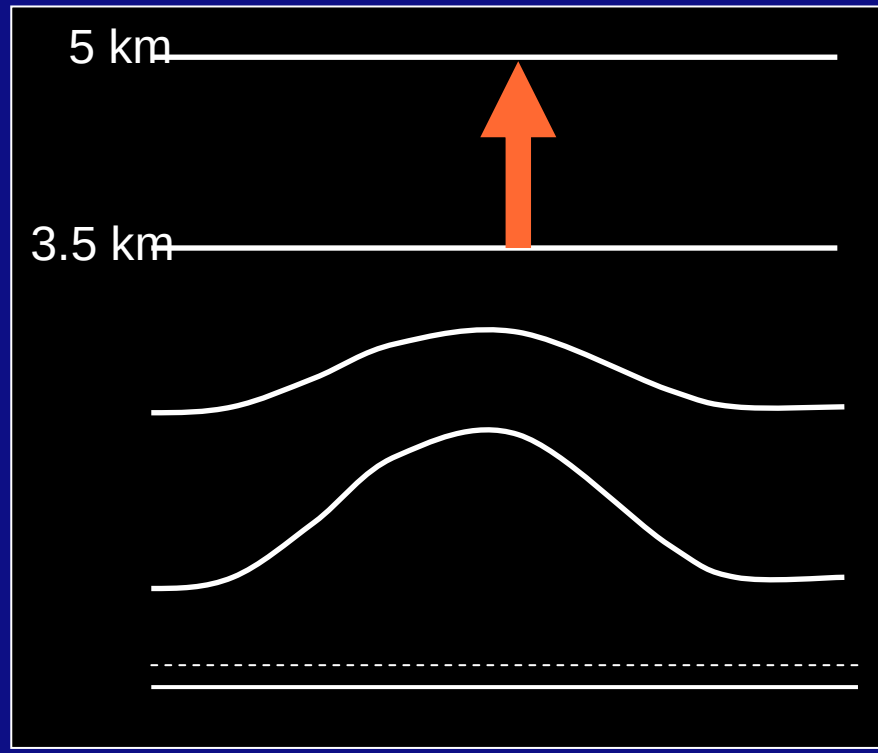
In general the performance of LOTOS-EUROS is comparable to other models

Peer reviewed publications appeared in a number of journals including JGR, ACP and atmospheric environment.

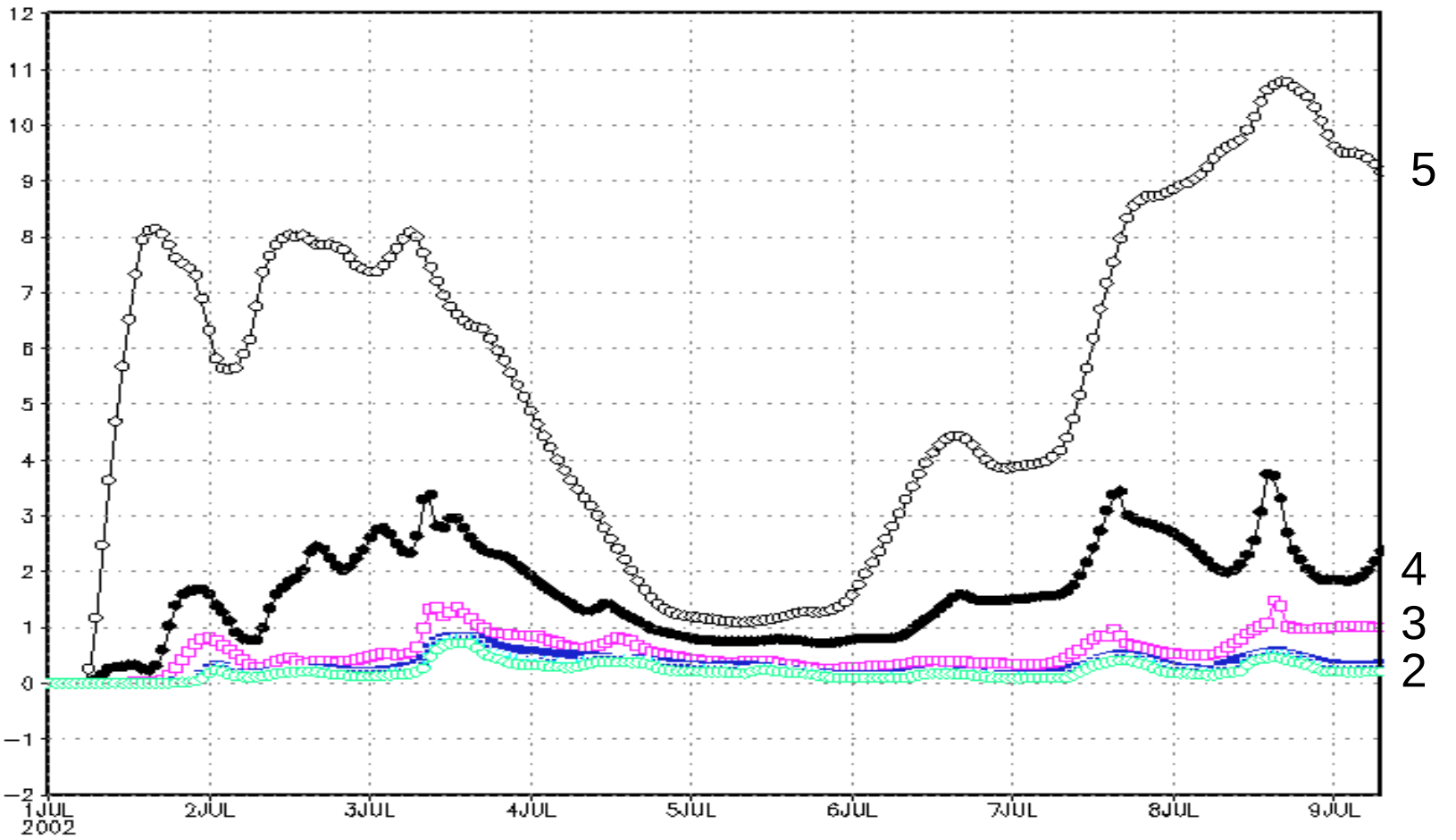
Model Description

- Choice of domain and resolution (standard 0.5x0.25 lon-lat).
- Dynamical vertical structure (depending on mixing layer height)
- Optional surface layer
- Top domain at 5 km for this study (5 layers)





Vertical extent of model



Set-up of study

Time period:

- 15 July – 15 August 2003 (summer period)
  many cloudfree periods/areas
  high AOD episodes
  -- extra cirrus dataset

- 15 February – 15 March 2003 (winter period)
  periods of broken clouds
  AOD episode in Germany, model intercomparison study

Set-up of study

Domain and resolution:

- European domain

  5W to 30E and 42.5N to 60N

  0.25°x0.125° (~12 x 12 km^2)

- Paris Basin area

  400x400 km around Paris

  ~ 3x3 km^2

Set-up of study

Main scenarios:

- European domain, summer
- Paris Basin area, winter

Set-up of study

Elevated unforeseen dust source

Investigate advantage of vertically resolved AOD

investigation of the ability of the assimilation system to improve the model performance in presence of unforeseen emissions.

→ More in presentation Robert Vautard