The JOSEFINA* project: air quality monitoring and simulation over Bavaria and Slovenia

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* Joint Bavarian - Slovenian Endeavor For Innovative Air Quality Analysis

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Context

- Introduction (JOSEFINA project)
- Polyphemus/DLR model
- Comparisons to MODIS AOD and OMI TNO2
- Outlook and Summary

Objectives of JOSEFINA project

Monitoring and forecasting of aerosols in Bavaria and Slovenia based on Copernicus observations

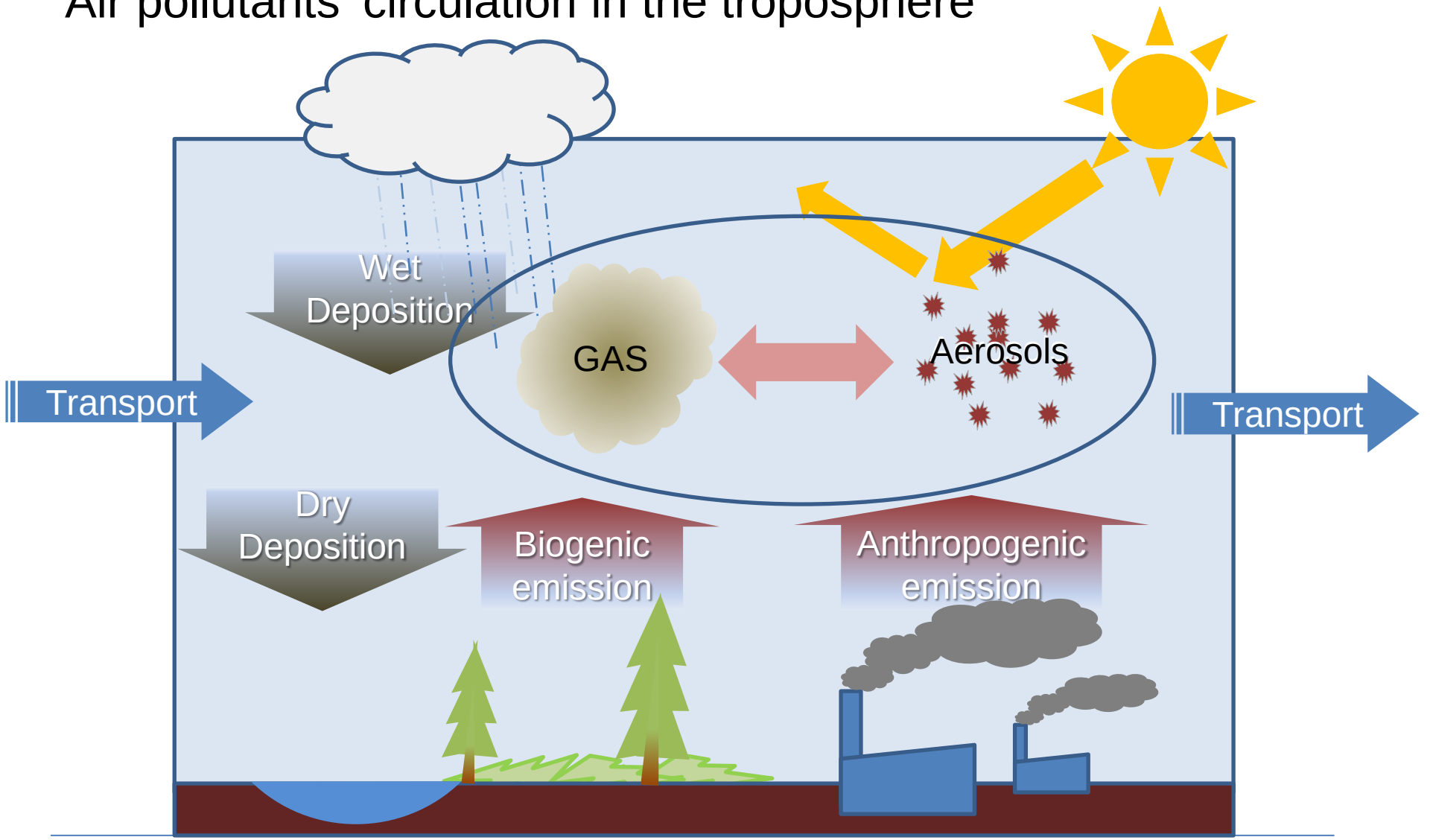
Based on combining:

- in-situ measurements
- satellite-based observations
- numerical modeling

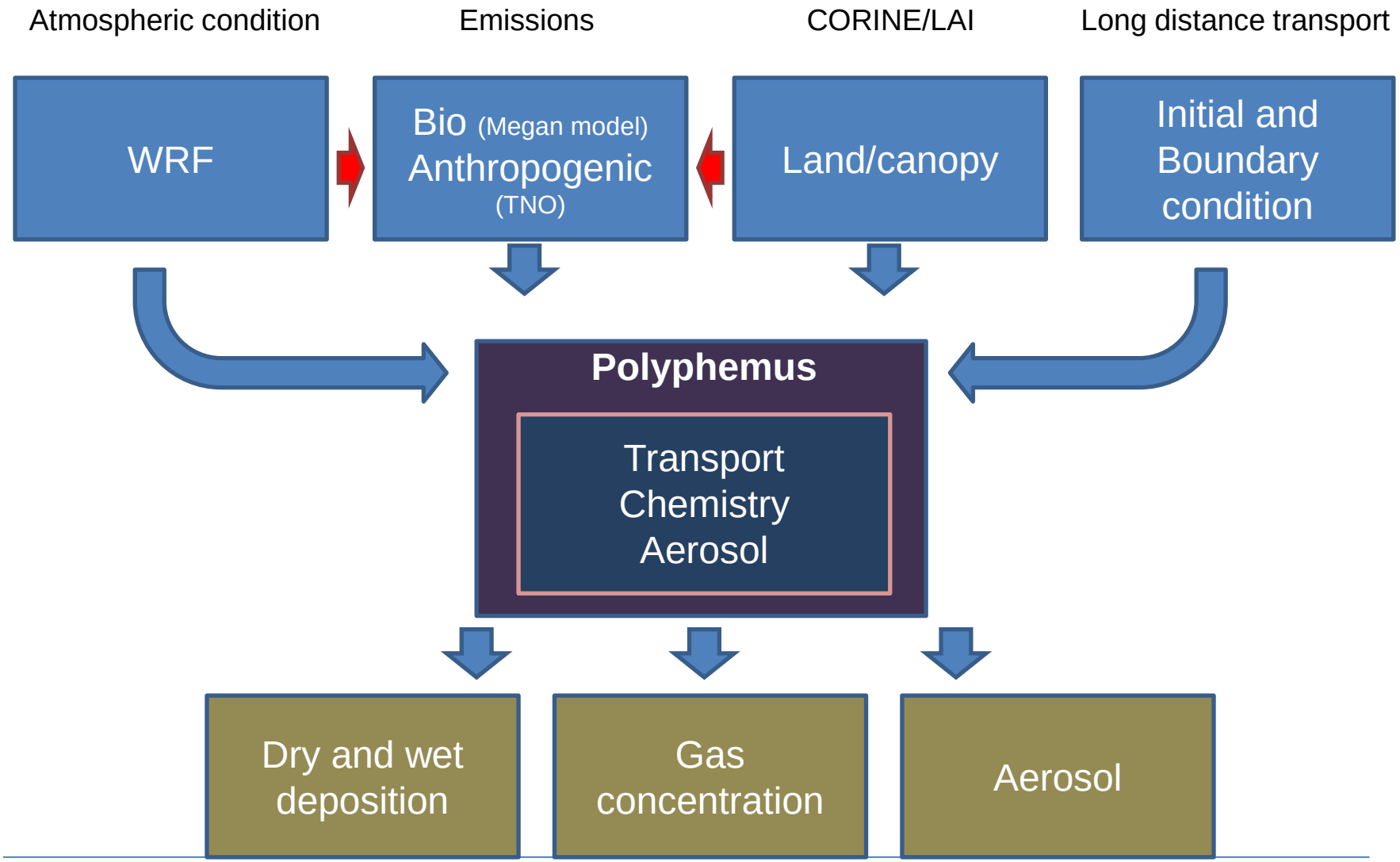
Motivation:

- Provide spatial information on pollution for policy makers and risk groups.
- Strengthening of satellite remote sensing for air quality monitoring in Bavaria.
- Surprisingly weak or missing decrease of monitored pollution at in-situ stations in Bavaria.
- Persistent biases in surface particulate matter in dispersion models.

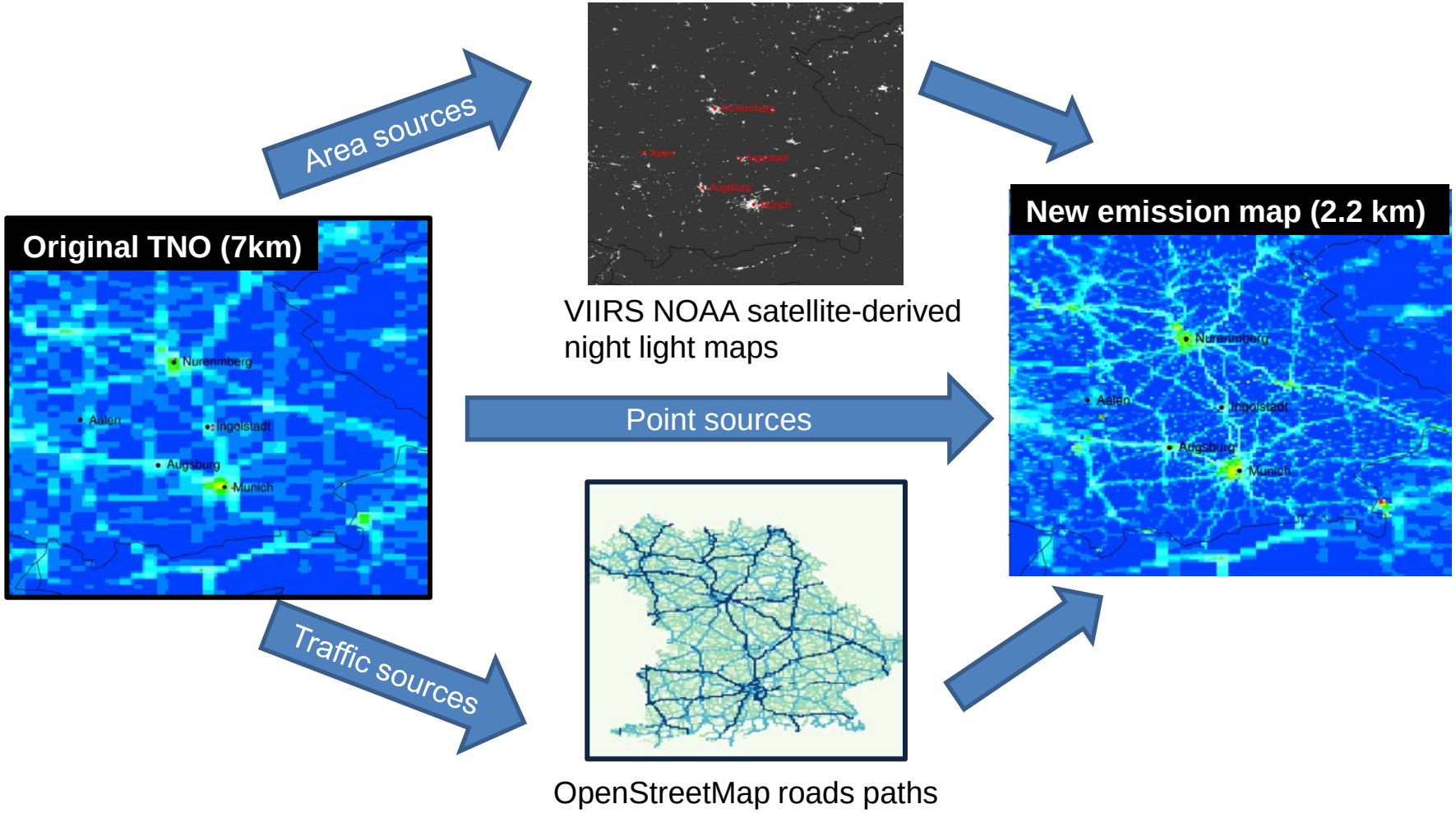
Air pollutants' circulation in the troposphere



...and how it is modelled by Polyphemus/DLR



Downscaling process of TNO EU scale emission data set



Reference run 2011: Polyphemus configuration

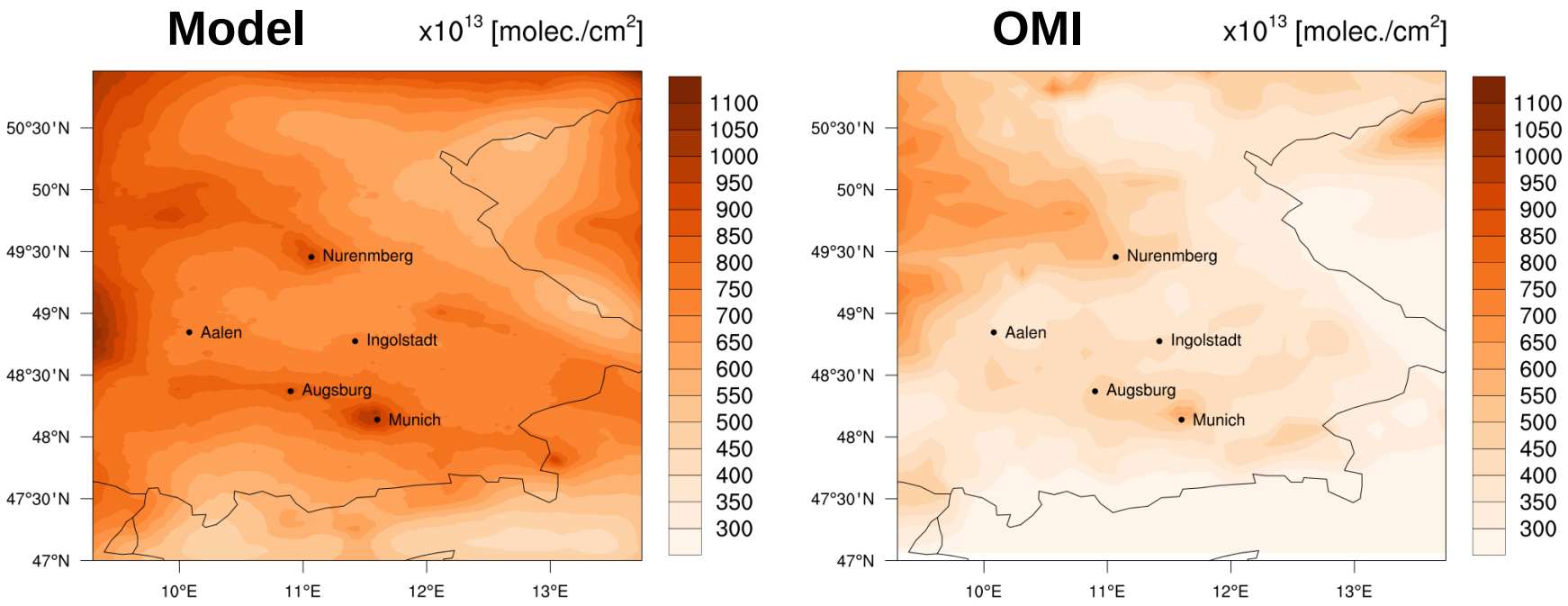
- WRF 3.5 (GSF driven), Skamarock et al., 2008
  - 10 km resolution for Central Europe
- Polyphemus (1.9) /DLR, Mallet et al., 2007; Bergemann CIC 2012
  - Central European mother nest (top at 9 km alt.)
  - two 2 km grid nests = Bavaria / Slowenia (top at 3 km alt.)
- TNO anthropogenic emission data, Kuenen et al., ACP, 2014
  - downscaled to 2.2 km grid
- Megan biogenic emissions, Guenther 2015
- SIREAM-SORGAM (sectoral) aerosol modules, Sportisse et al., 2006

Reference run 2011: observation data used

- Bavaria (LfU) in-situ station data via EEA online archive: NO2, SO2, PM10
- OMI TNO2, Boersma et al., 2007, 2011
  - monthly means, 1/8° gridded KNMI v2.0
- MODIS AOD, Levy et al., 2013
  - 10 x 10 km² DB/DT collection 6 product

Monthly averages!

Average tropospheric NO2 (year 2011)

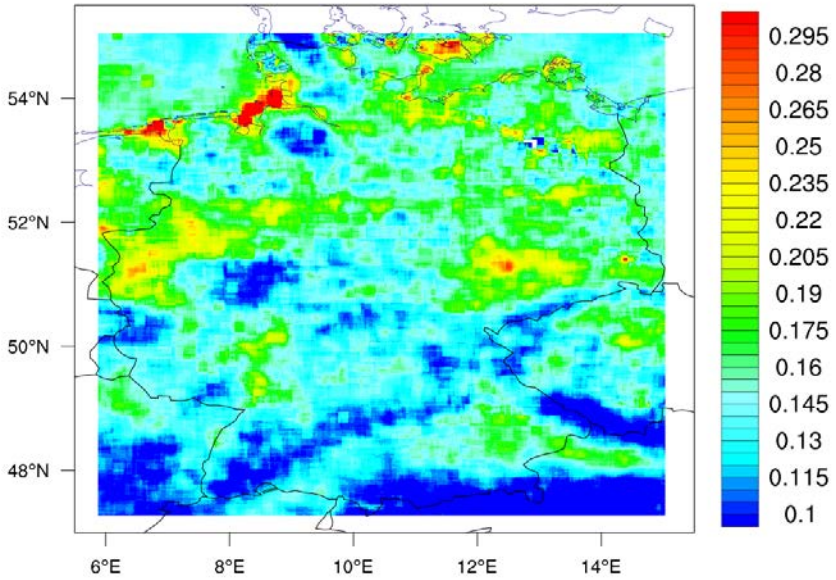


Note: negative NO2 bias d.t. poor satellite coverage during polluted cold seasons?

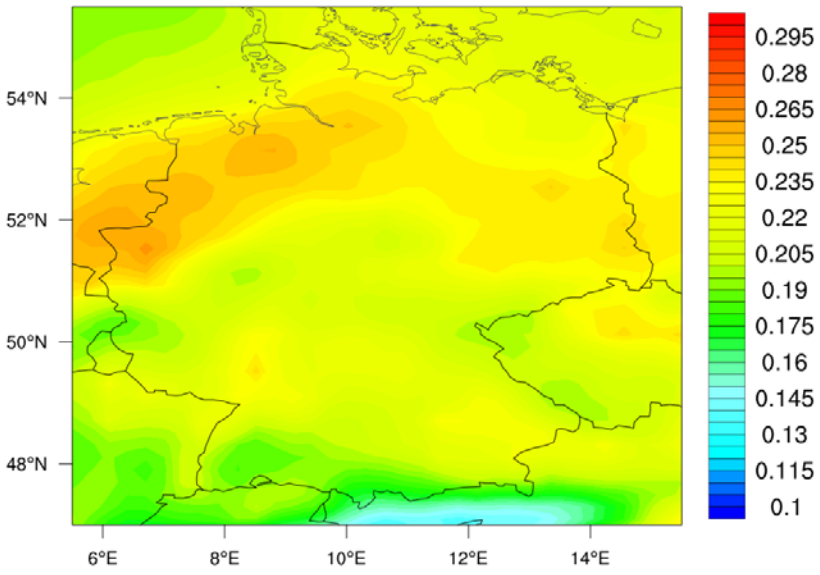
Daily data!

Average AOD for year 2011

MODIS



Model*

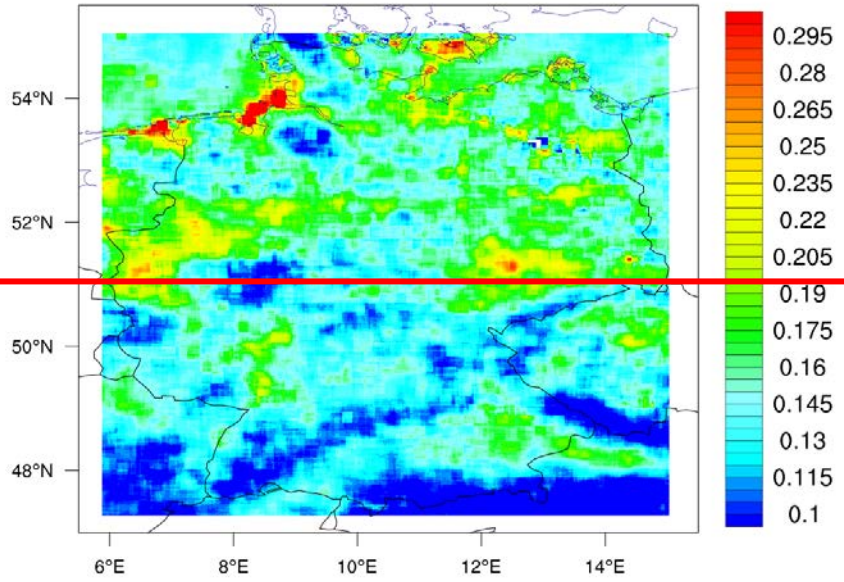


Positive model bias, but polluted areas mainly covered
(* only observation days included)

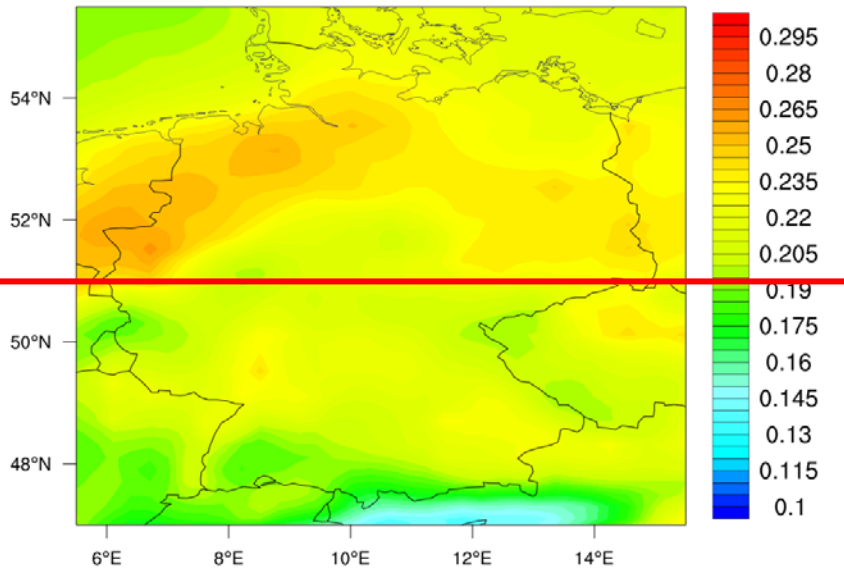
Daily data!

Average AOD for year 2011

MODIS



Model

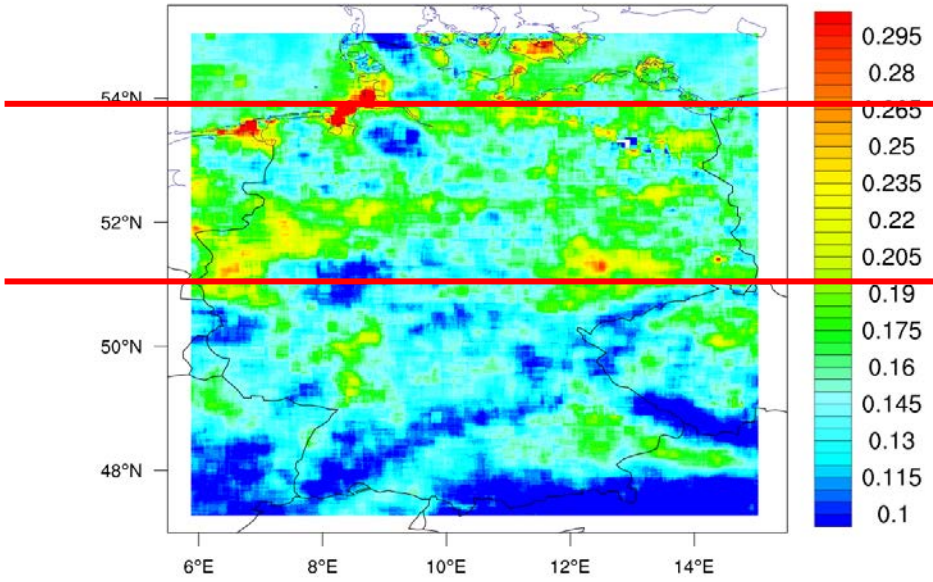


Strong South – North gradient

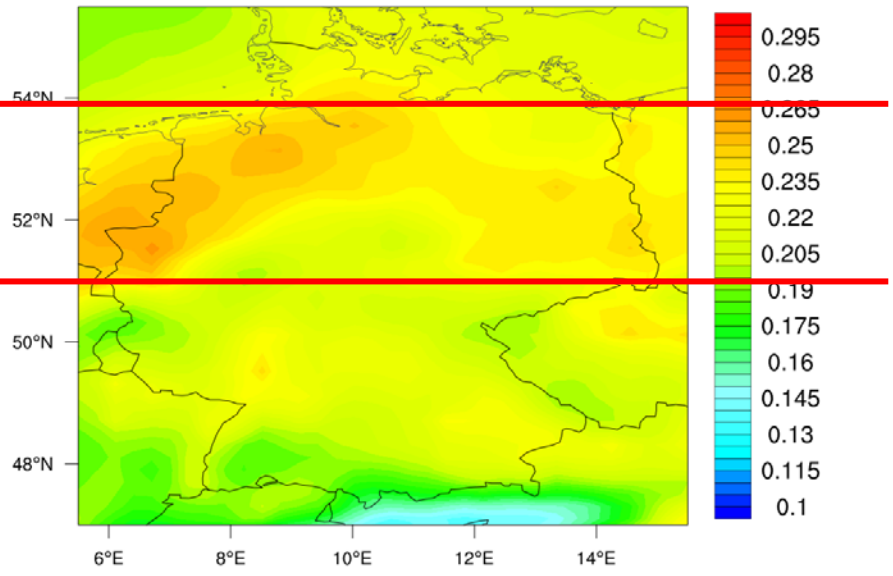
Daily data!

Average AOD for year 2011

MODIS

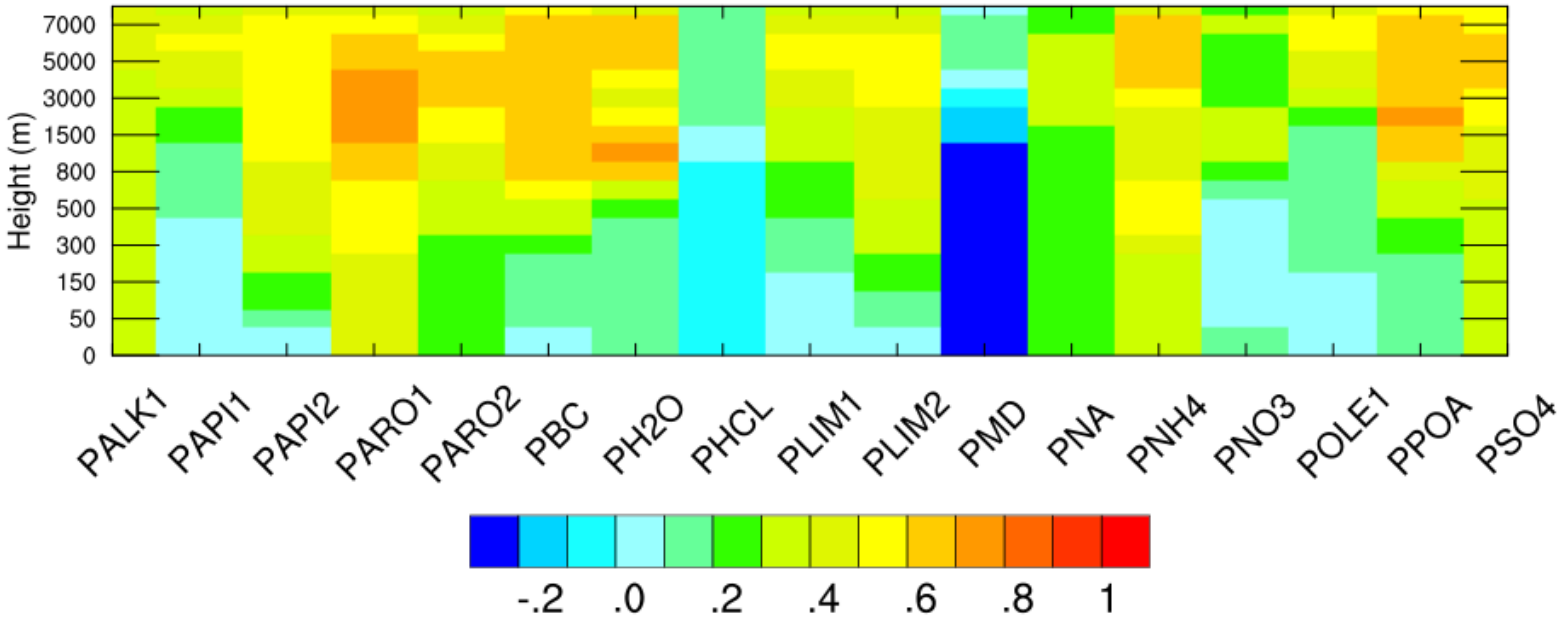


Model

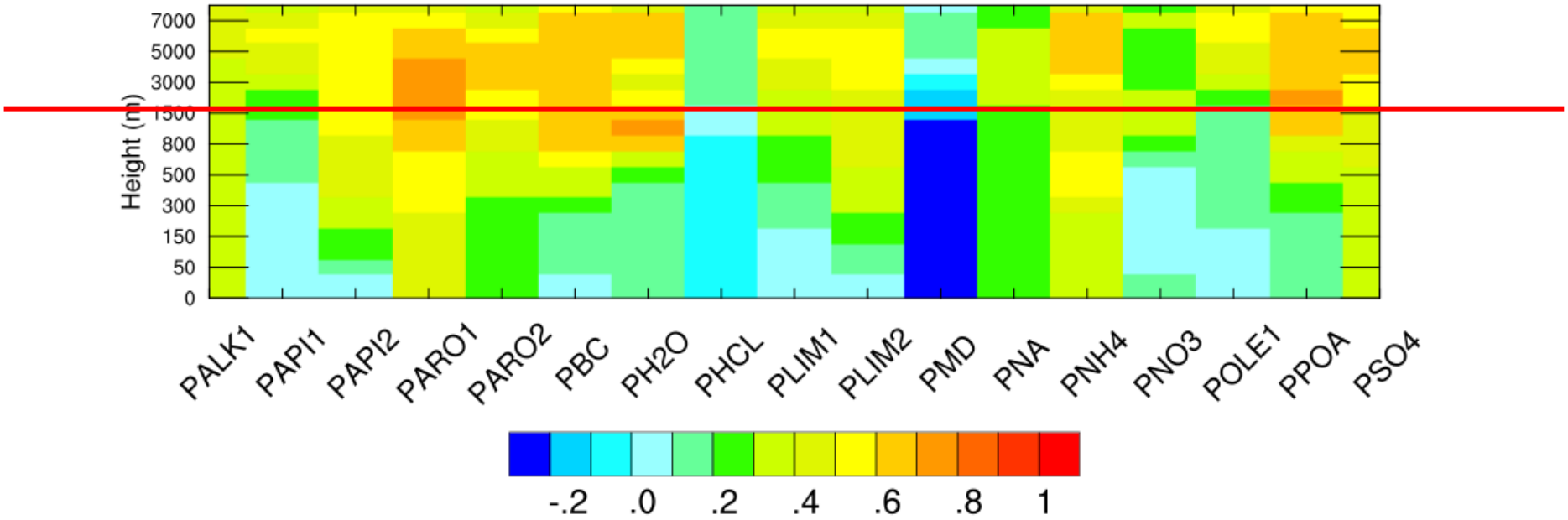


Northern Germany: MODIS highest AOD near the coast areas

Influence of model aerosol type on AOD estimation in different heights



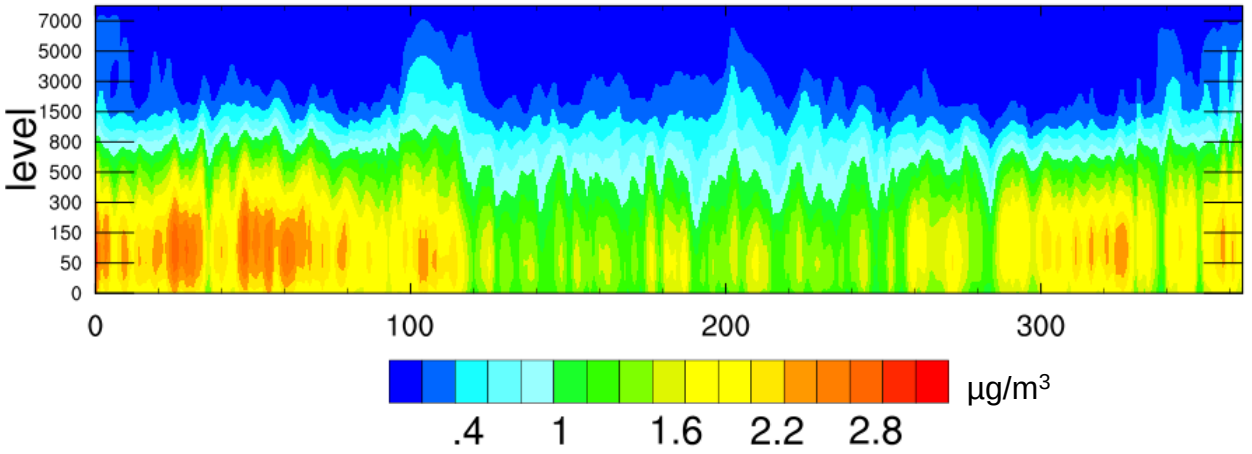
Influence of model aerosol type on AOD estimation in different heights



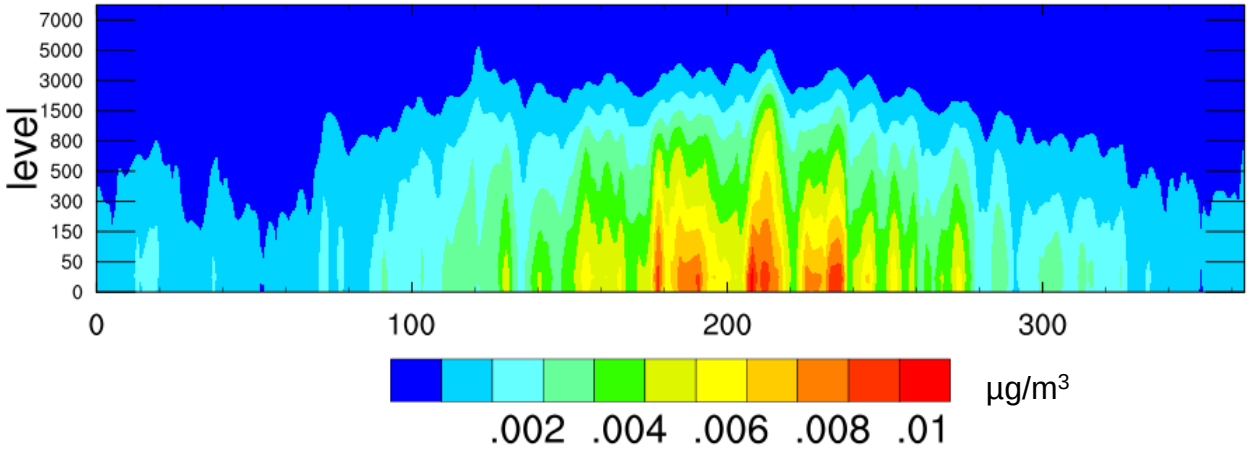
Strongest influence near/above PBL height.

Annual cycle strongly varies among species

PM (NO_3)



PM (API)



Summary

- First steps towards Bavarian-Slovenian spaced-based pollution monitoring
- Model results show that AOD estimation is highly influenced by aerosols in higher altitudes. Thus, vertical resolution is important to get comparisons right.
- Aerosol composition strongly varies during the year. Composition is important to verify and understand aerosol sources.

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Thank You