An updated aerosol climatology over Europe from MODIS/AERONET datasets

The main datasets:

The main purpose for the aerosol maps development is to use them for calculation of UV climatology maps over Europe.

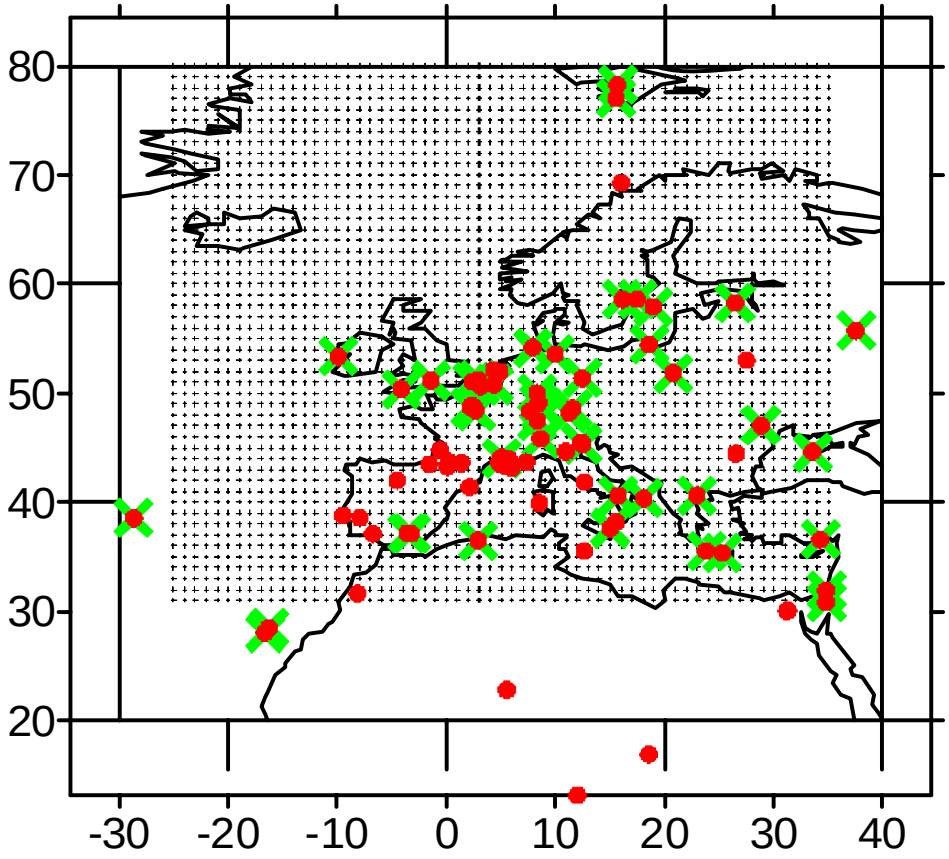
The new MODIS monthly AOT550 climatology v.005 was obtained from both TERRA and AQUA datasets by averaging over the period of Feb 2000-March 2008.

The AERONET dataset was used as well:

1. for the transition from AOT550 to AOT308 which has been fulfilled using a two dimensional field of Angstrom parameter obtained from AERONET dataset and
2. for the validation of MODIS AOT550.

The whole number of the AERONET sites used in the analysis: 82 for the 1994-2006 period. Due to gaps in overcast cloudy conditions especially during winter months real data were obtained from 62 to 73 sites. Data were taken from level 2. (with quality and calibration check) from the latest Version 2, which is characterized by the account of new more sophisticated Rayleigh, O3 and NO2 datasets.

Initial MODIS/AERONET Aerosol Datasets Location



By green crosses the sites are shown where the CIMEL sunphotometers with UV channels (340-1020nm), by red dots – where CIMEL sunphotometers with the only visible and near infrared channels (440-1020nm) are located.

The sequence of data processing:

- NASA MODIS version 5, monthly means AOT at 550nm.
- AERONET data

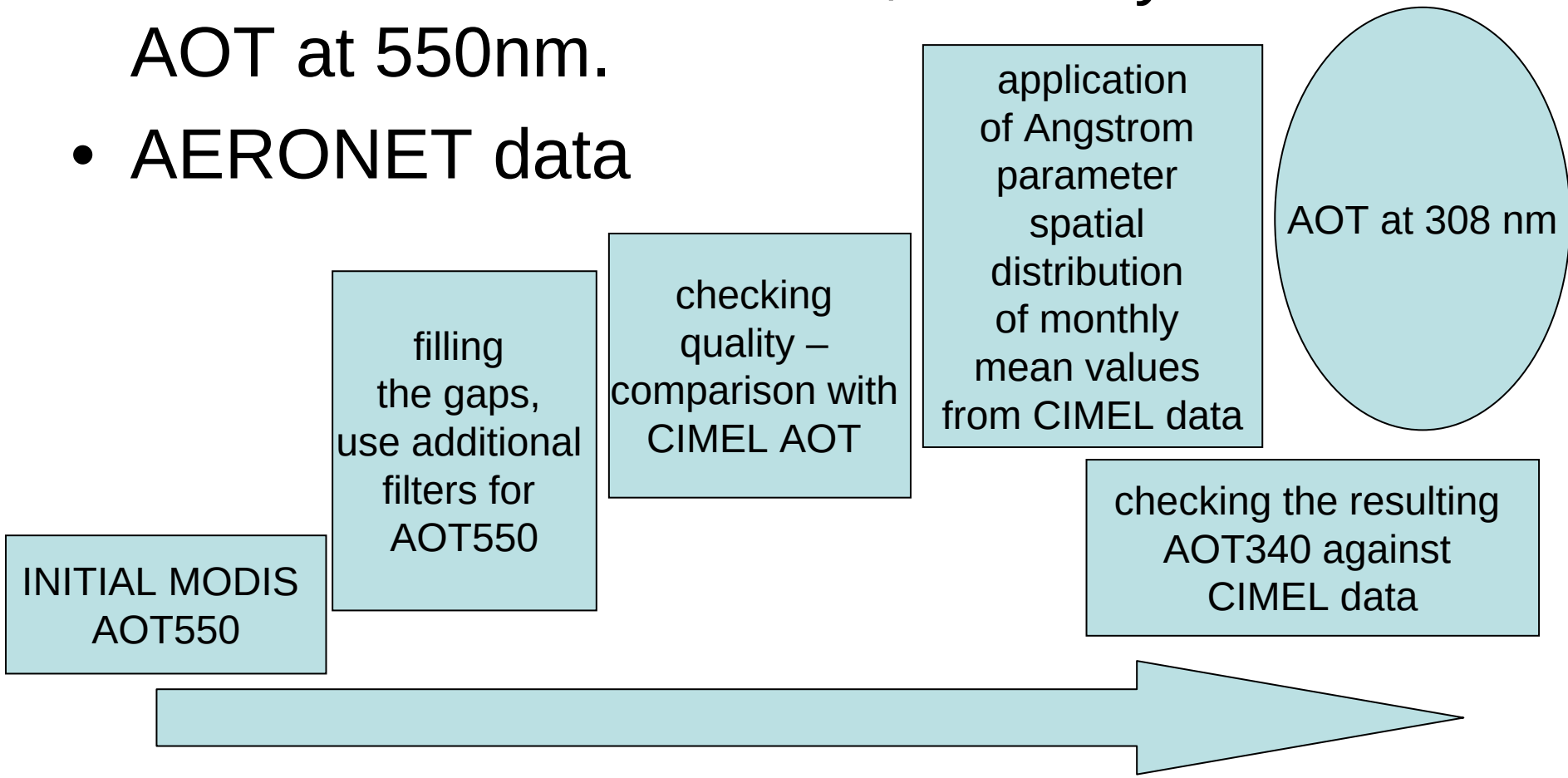
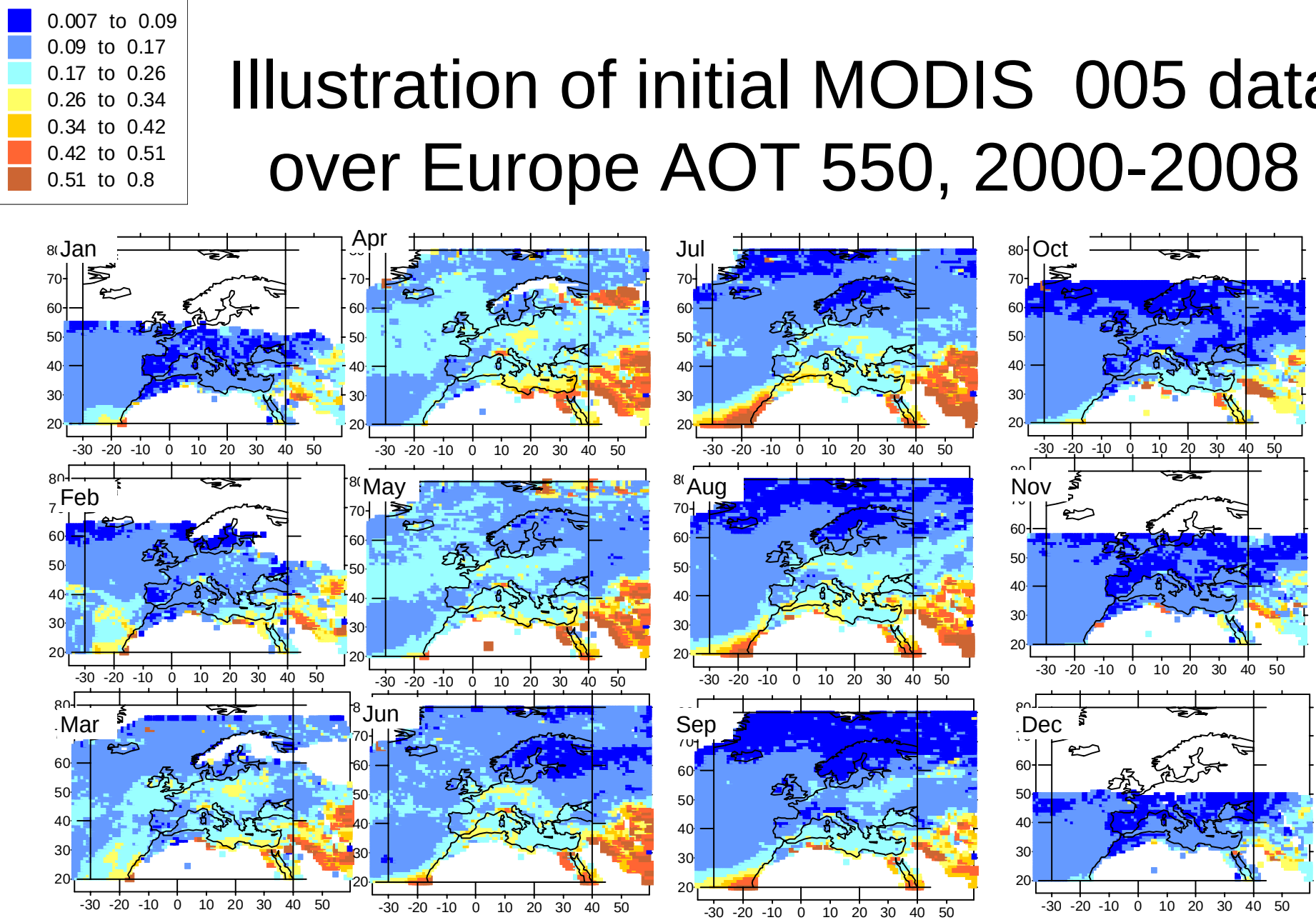


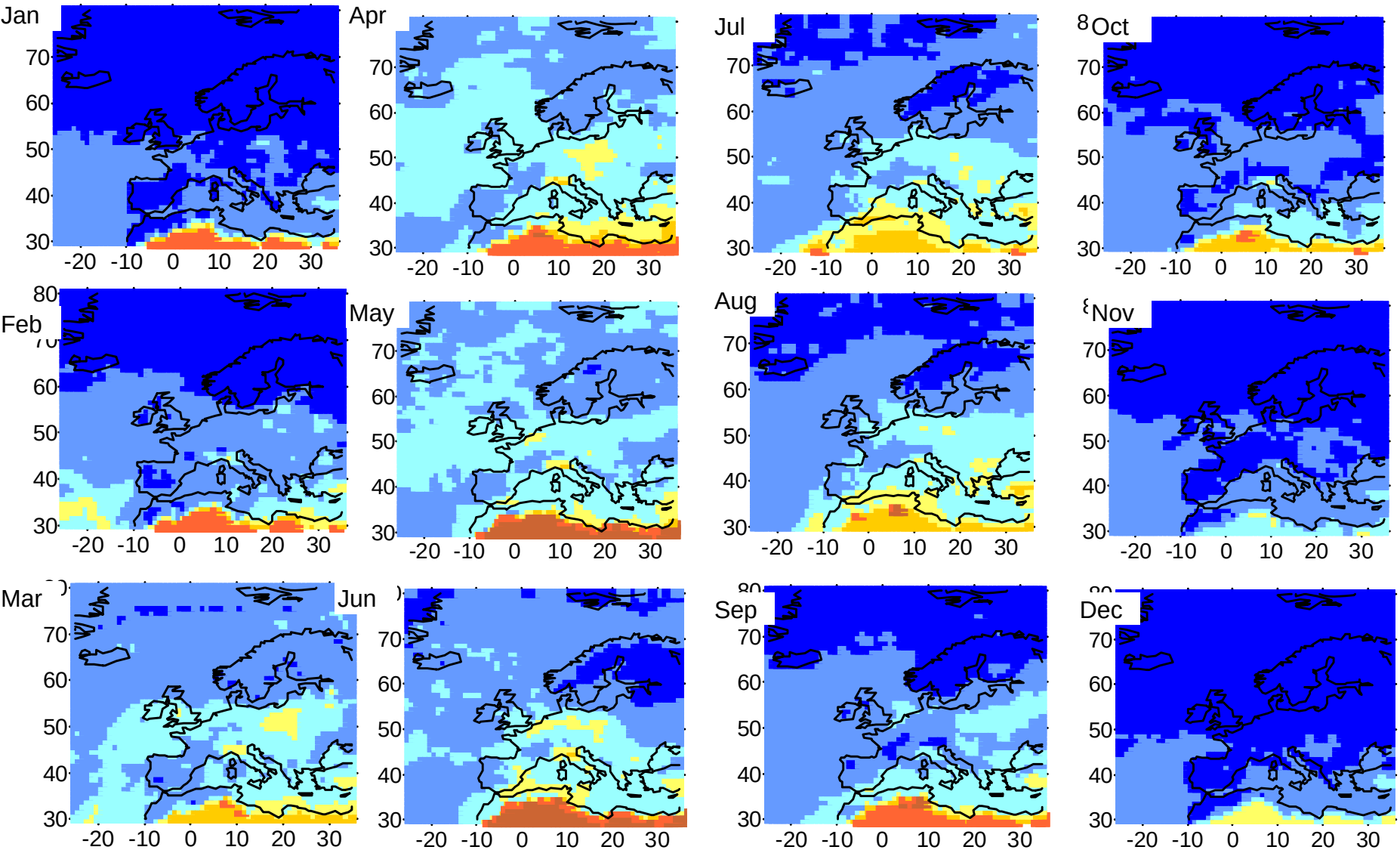
Illustration of initial MODIS 005 data over Europe AOT 550, 2000-2008

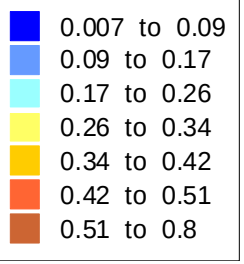


Filters and gaps applied for MODIS dataset

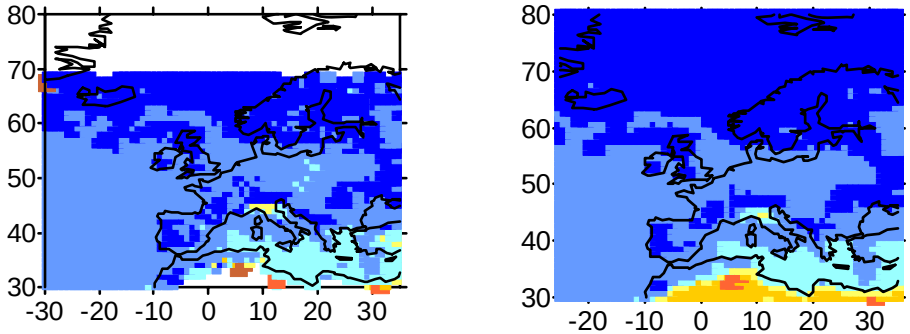
- Additional filter was used for the Arctic data. The data at some pixels over Arctic sometimes are unrealistically high probably due to the effects of high surface (snow) reflectance. For these cases a filter of AOT550= 0.2 was applied according to the highest monthly mean values according to AERONET Arctic data (higher 58N). In addition, in case of the absence of data (mainly winter time snow conditions) – monthly mean values from all available northern Arctic sites were taken to replace the gaps.
- In order to fill the gaps over the African continent the monthly mean AOT550 values recalculated from AERONET sites have been applied.

Modified MODIS AOT550 dataset

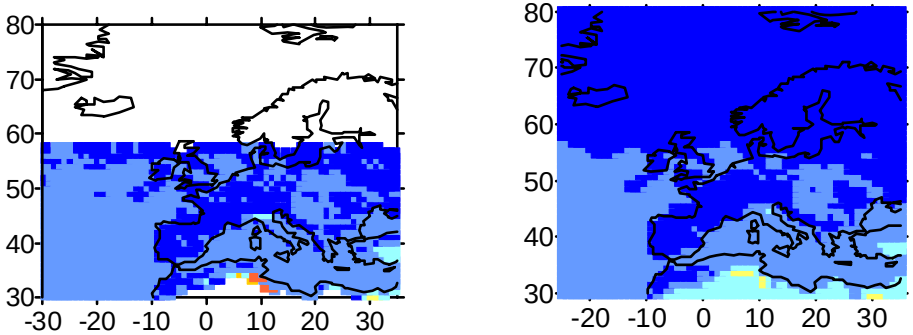




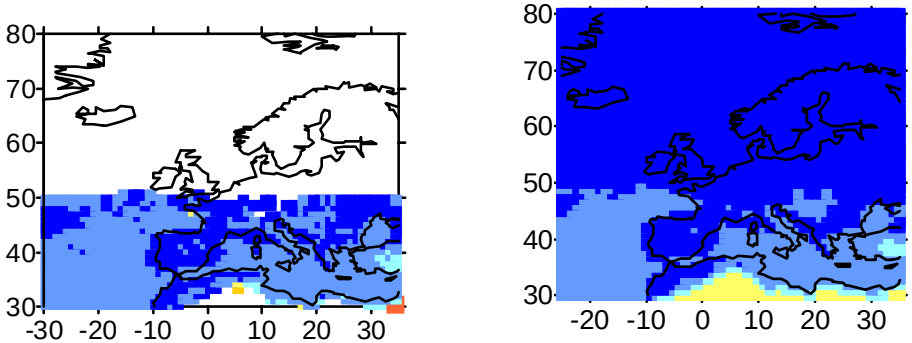
Side by side comparisons:



OCTOBER



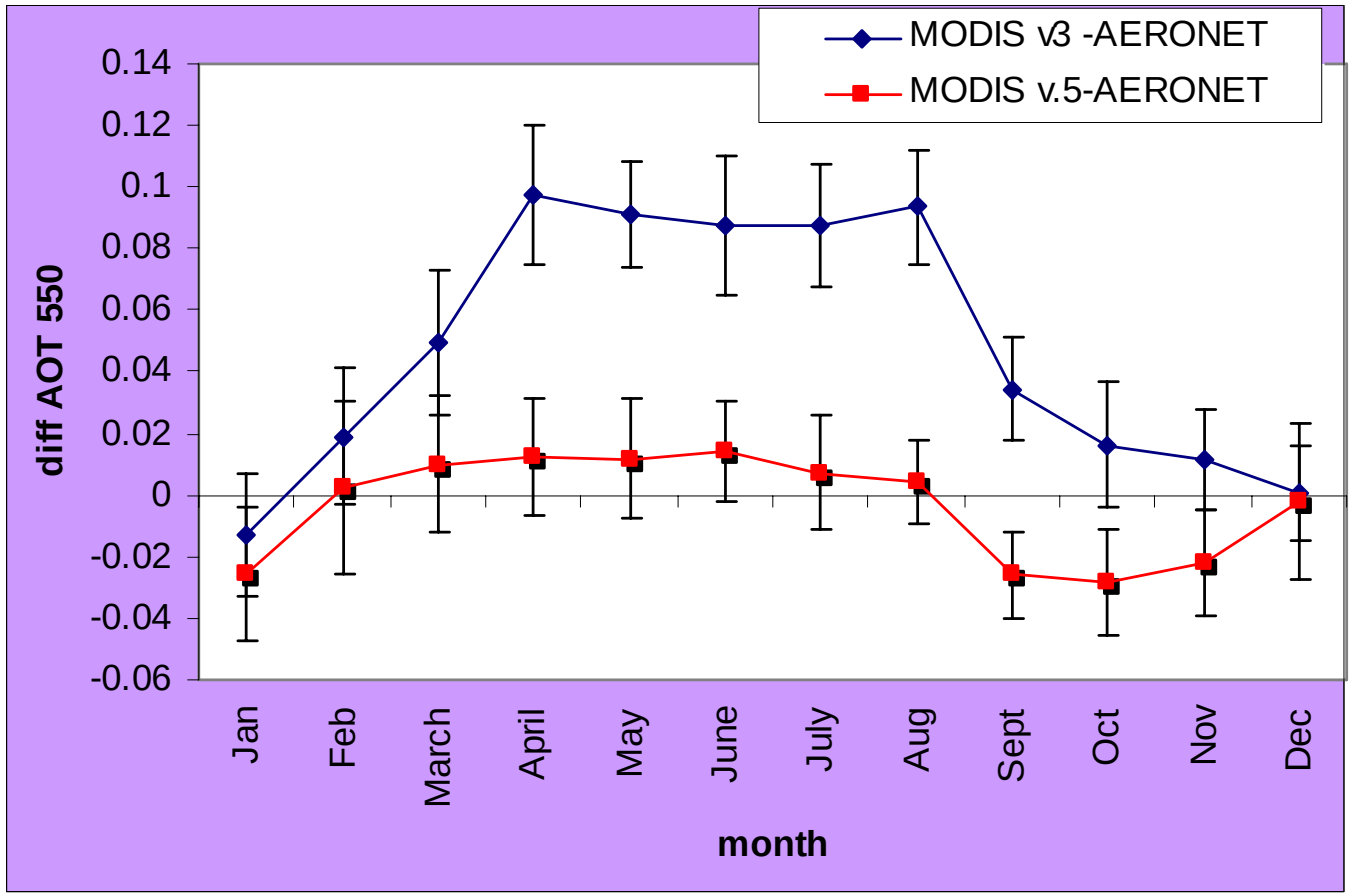
NOVEMBER



DECEMBER

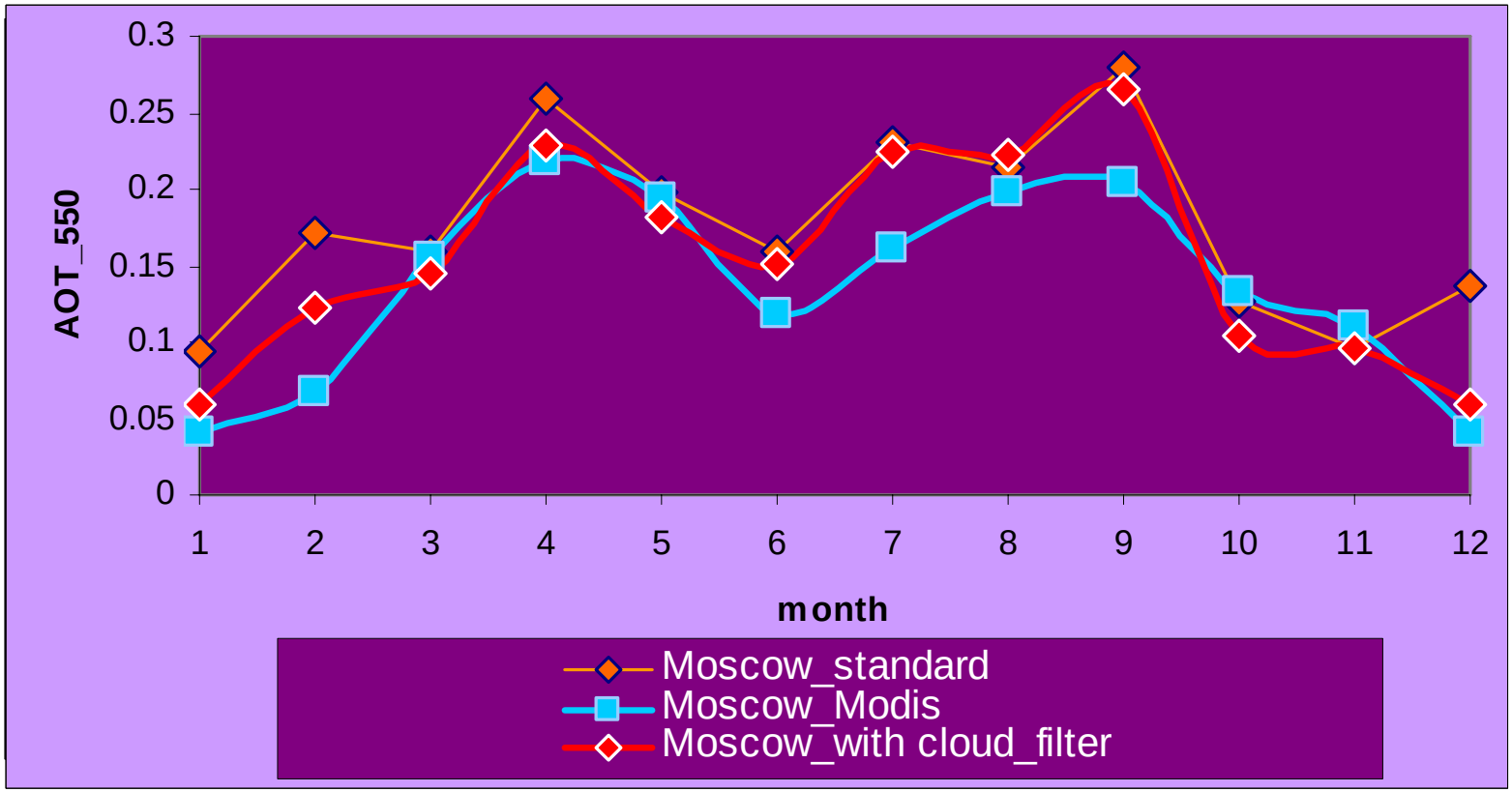
checking MODIS quality – comparison with CIMEL AOT

The comparison between monthly mean values of AOT from different MODIS versions and AERONET recalculated at 550nm

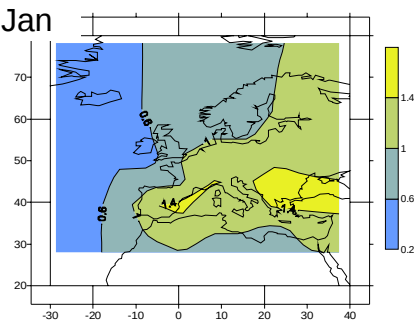


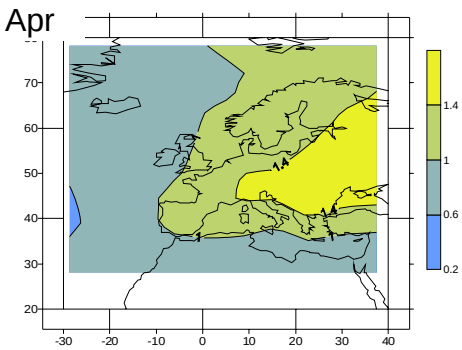
checking MODIS quality – comparison with CIMEL AOT

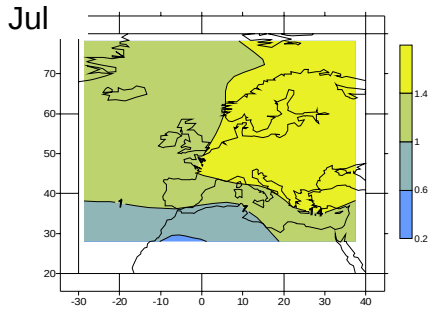
Concerning negative difference in winter months Comparisons with Moscow CIMEL data with an additional cloud filter.

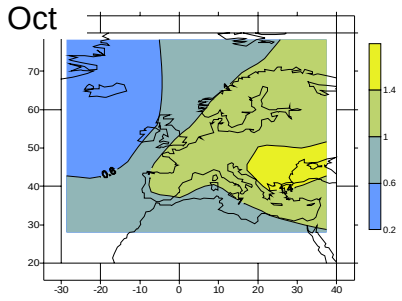


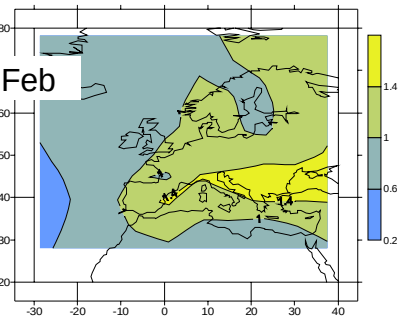
Angstrom parameter (A_440-870) spatial distribution according to AERONET

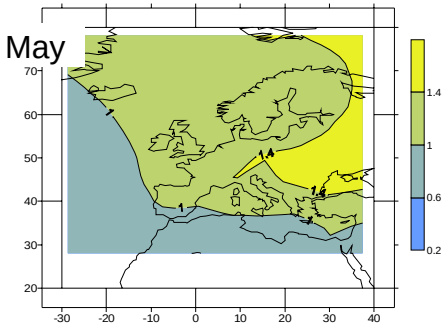


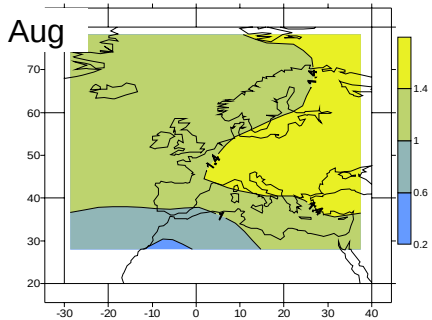


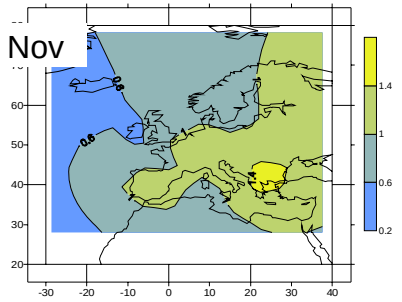


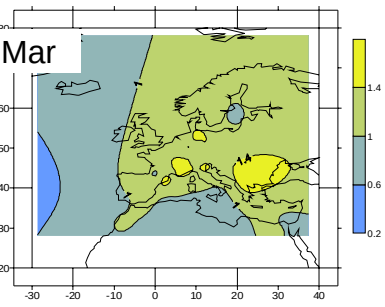


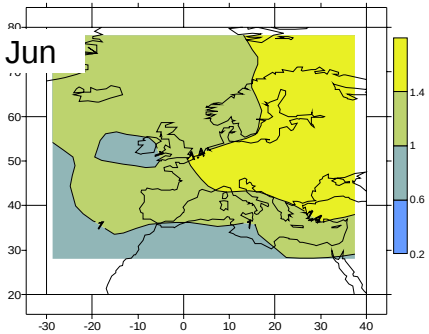


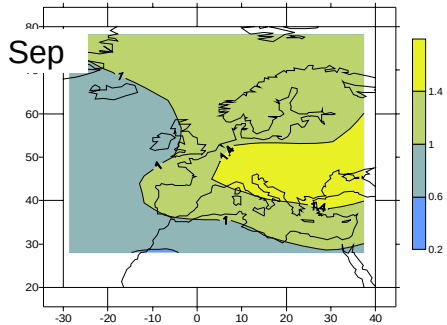


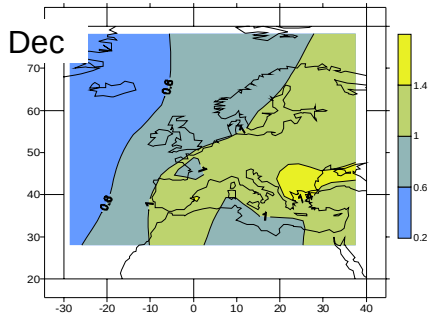






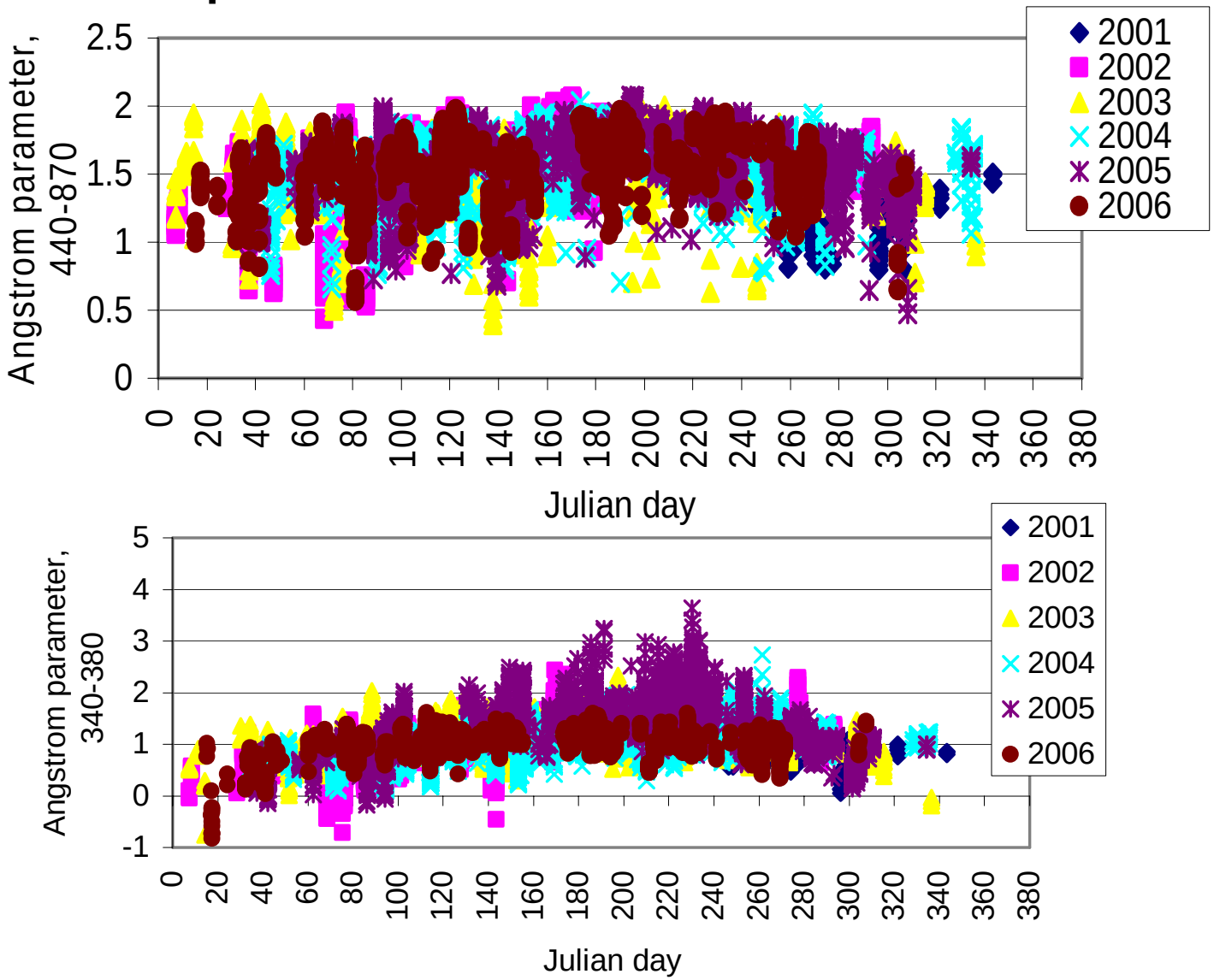




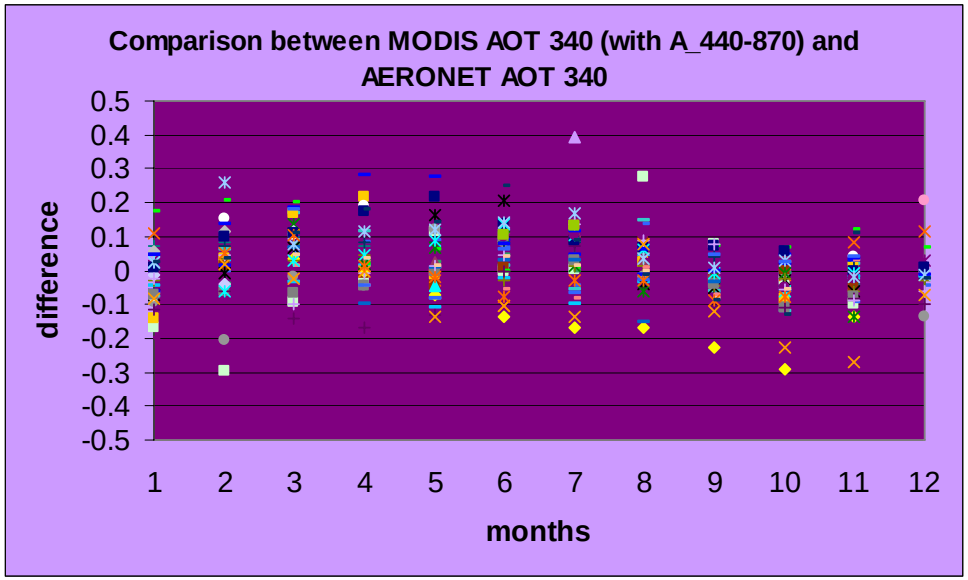


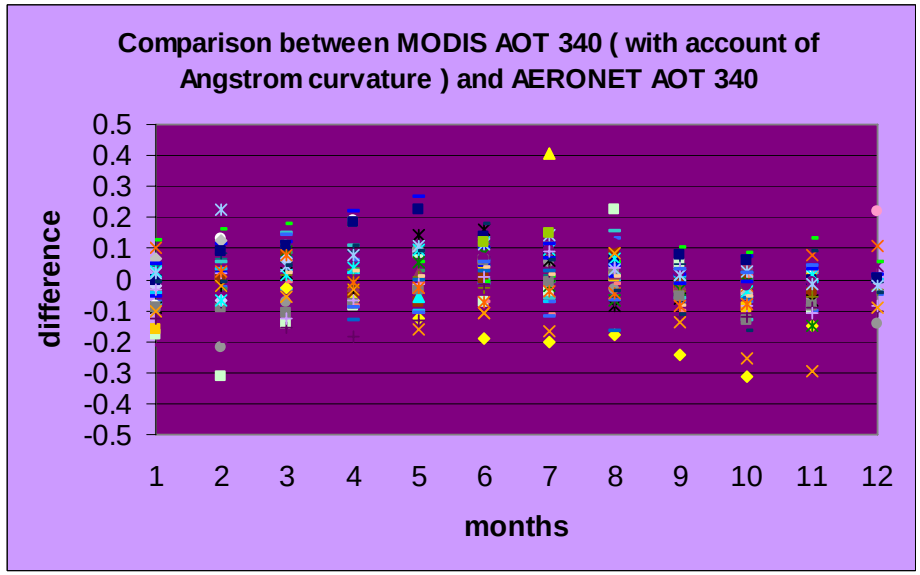
Method of interpolation: Kriging, Ordinary, no drift, small density lines due to small statistics.

Seasonal dependence of Angstrom parameter in Moscow.



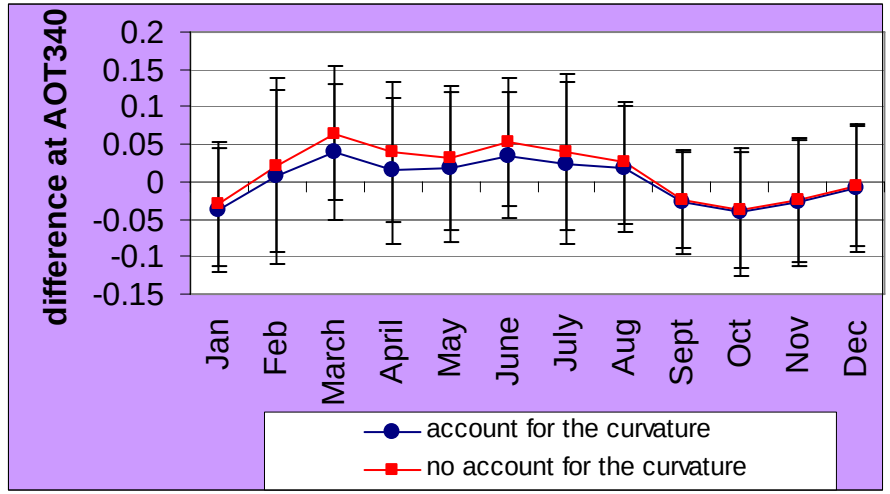
MODIS v.005- AERONET AOT comparisons at 340nm for different European sites using two approaches to account spectral AOT dependence.



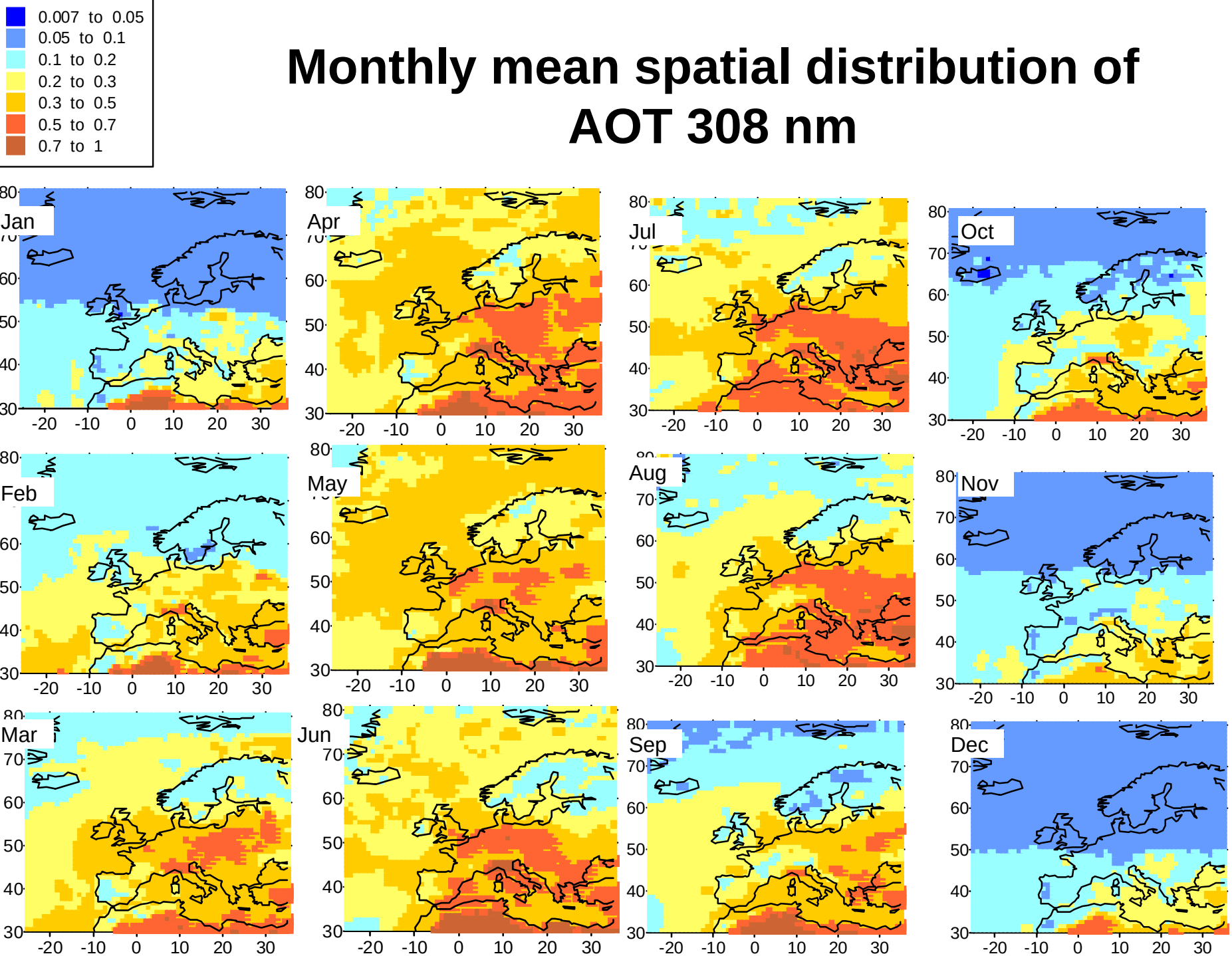


Mean difference in AOT340 between MODIS and AERONET.

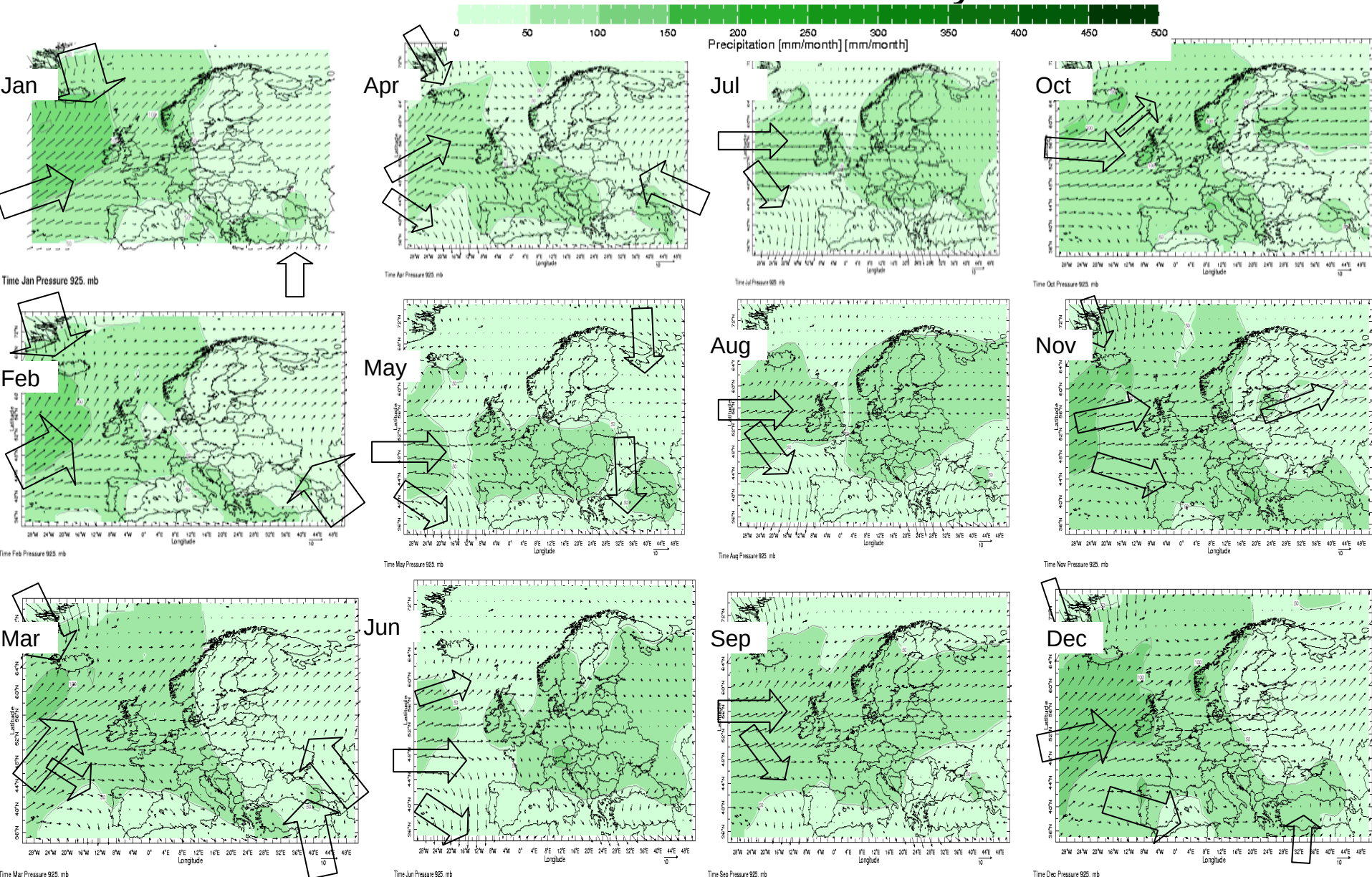
Modis AOT at 340 were calculated with and without account for the curvature of Angstrom parameter.



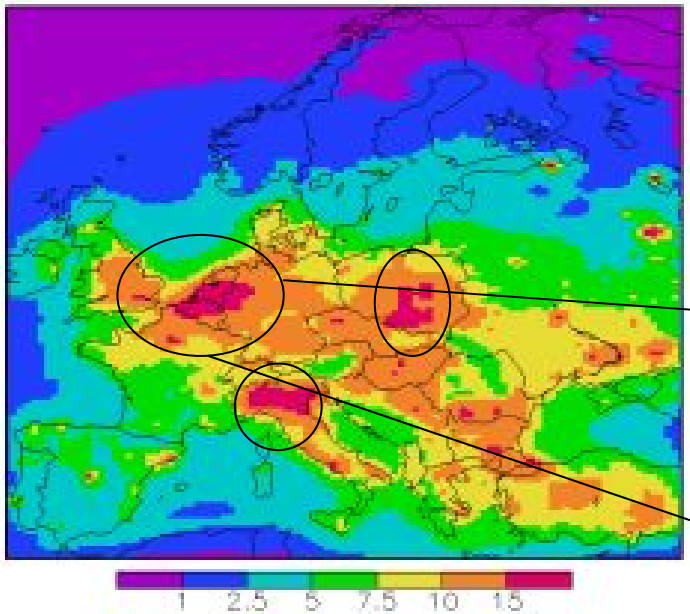
Monthly mean spatial distribution of AOT 308 nm



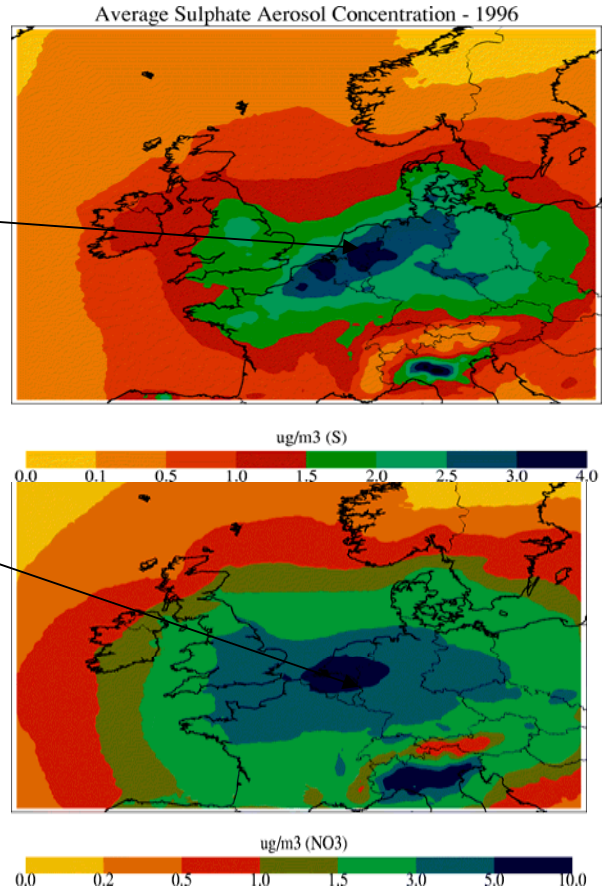
Meteorological fields (wind direction and precipitation) from NOAA (NCEP CPC CAMS_OPI original_version climatology IRI/LDEO Climate Data Library



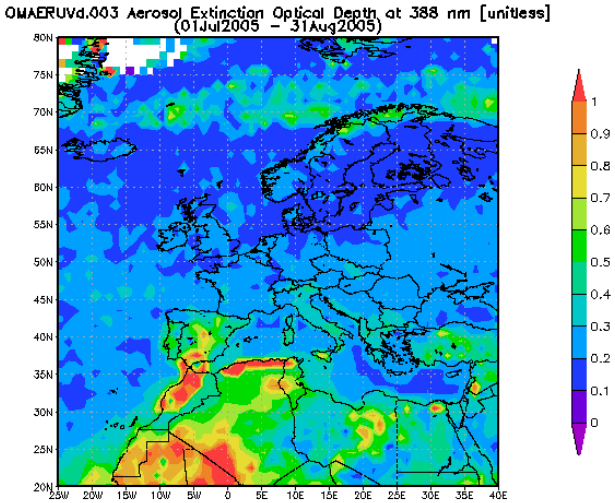
Distribution of PM2.5 aerosols over Europe in 2000, From LOTOS-EUROS aerosol analysis system.

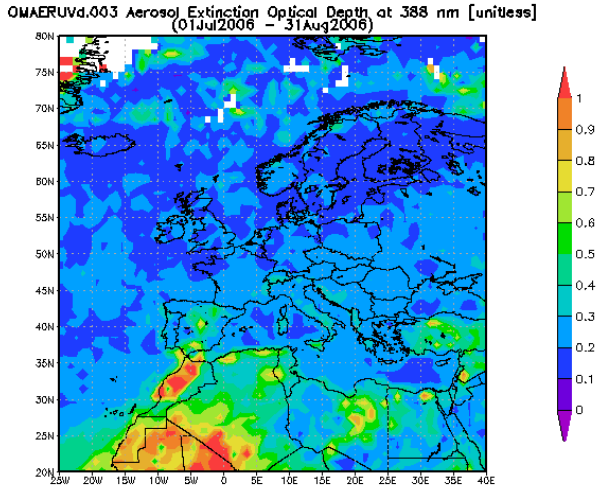


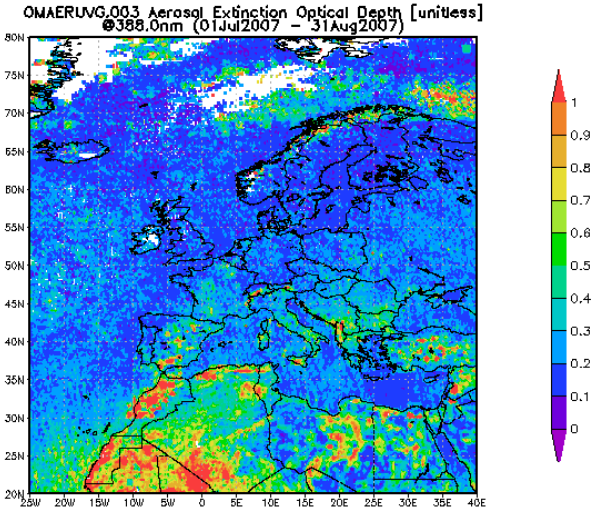
MODELLING PARTICULATE SULPHATE AND NITRATE IN NORTH WEST EUROPE WITH A LAGRANGIAN DISPERSION MODEL (from presentation Redington et al., 2004 EMEP Workshop on PM Measurement and Modelling)

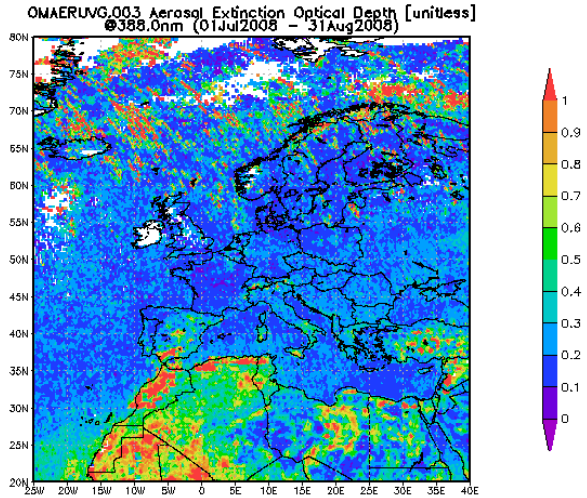


Extinction AOT at 388nm from OMI data . July-August 2005-2008



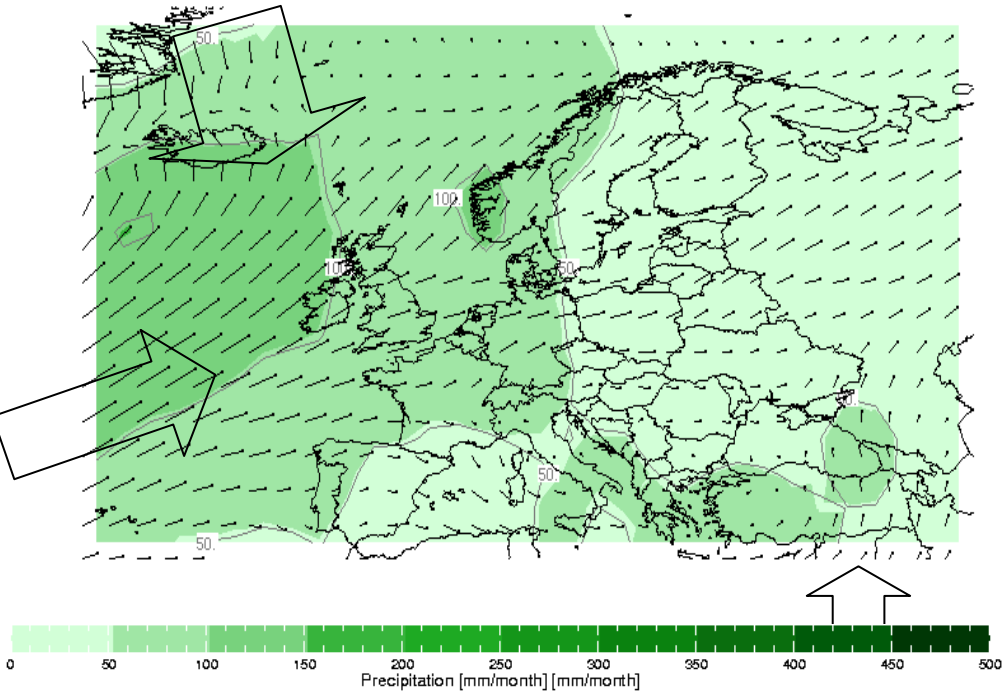




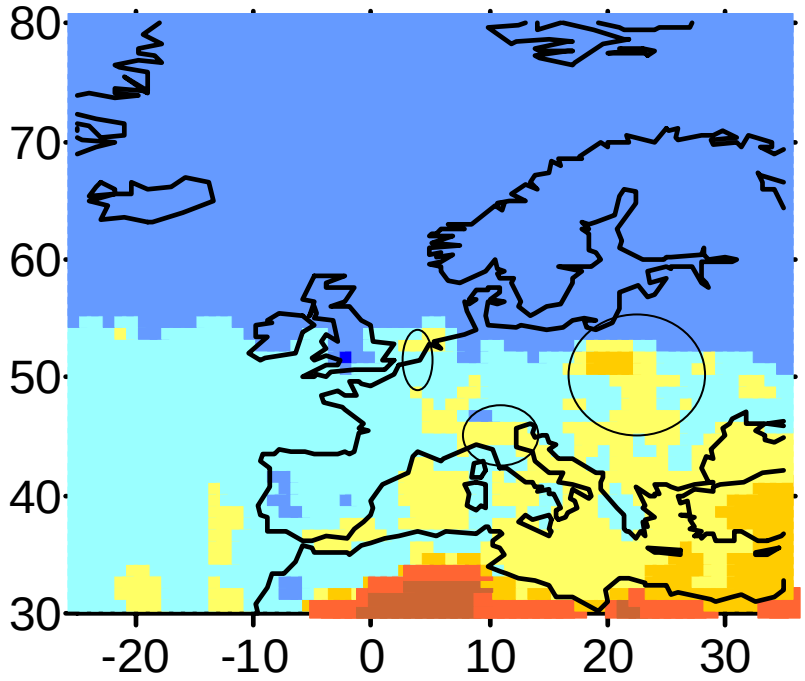


January

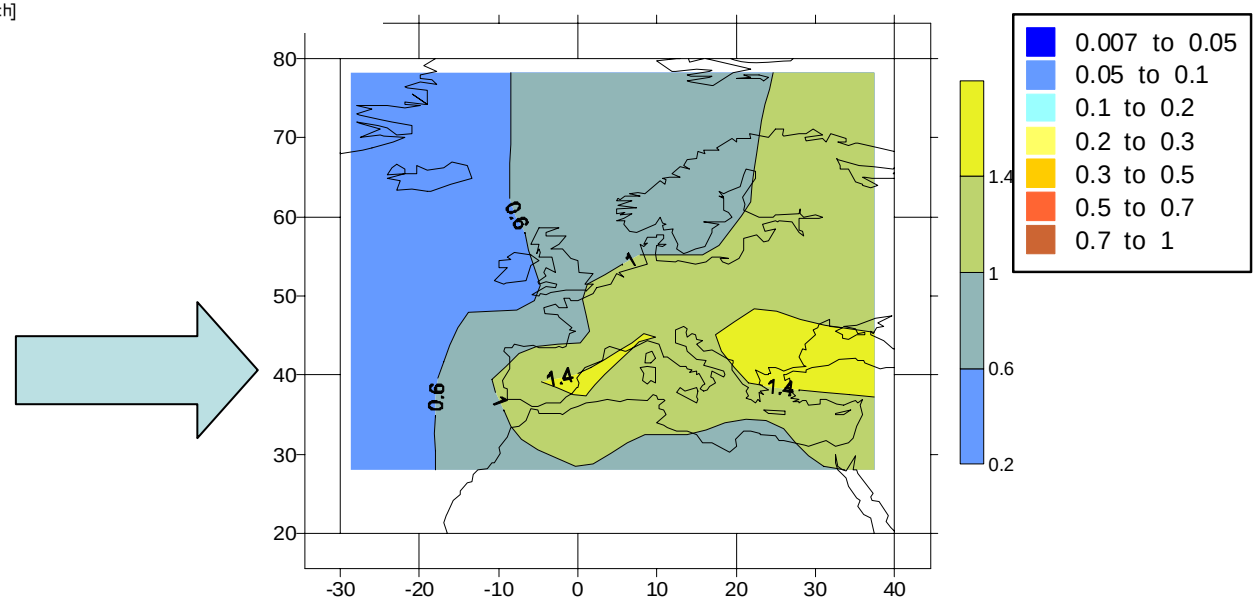
Wind and precipitation



AOT at 308nm

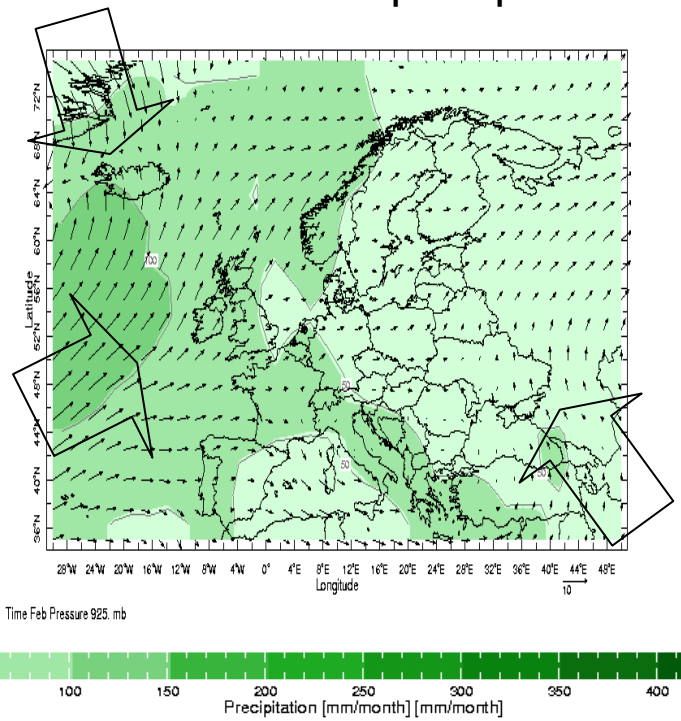


Angstrom Parameter

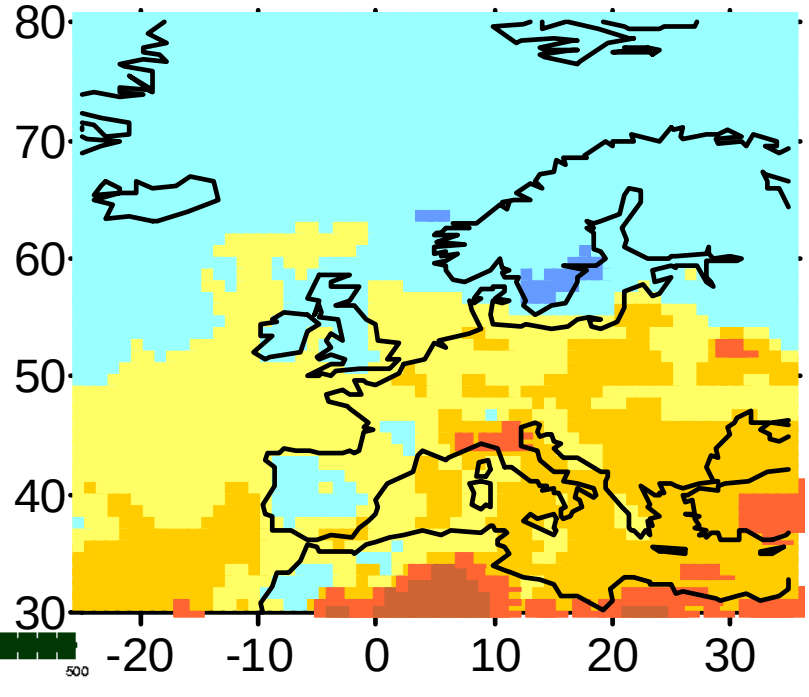


February

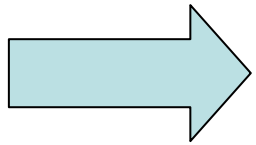
Wind and precipitation

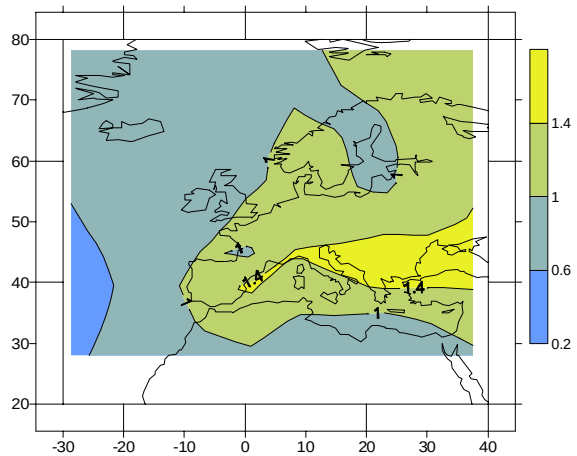


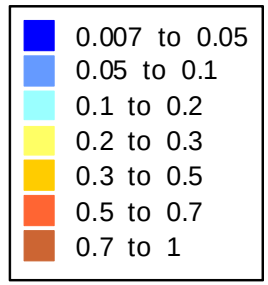
AOT at 308nm



Angstrom Parameter

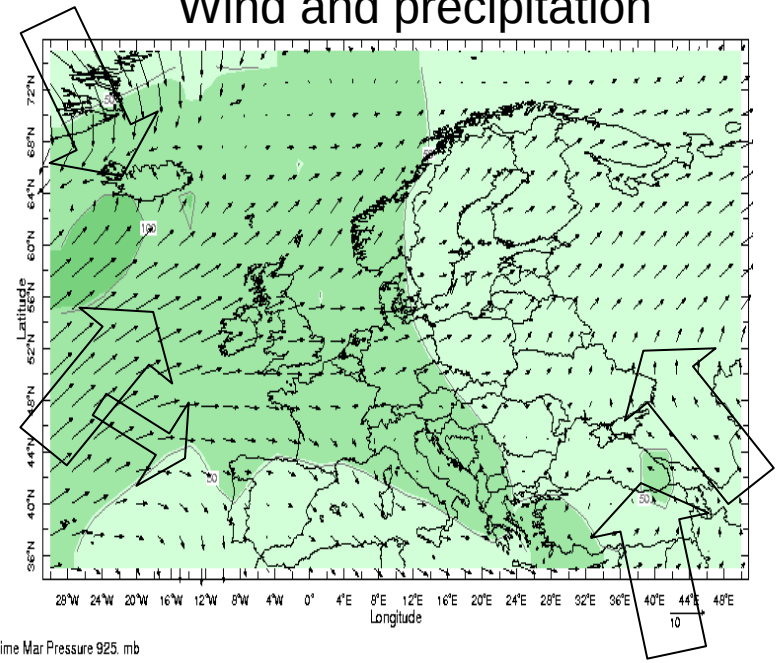




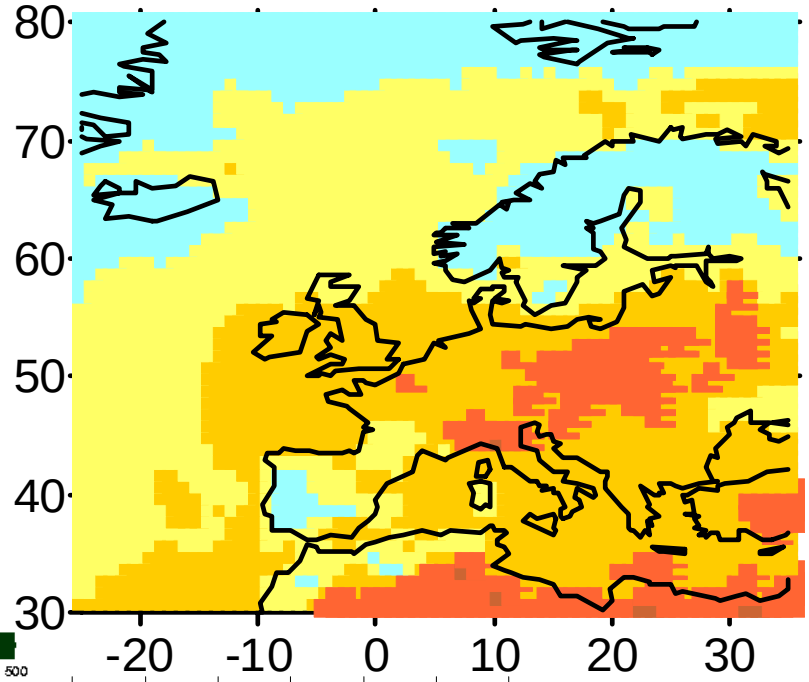


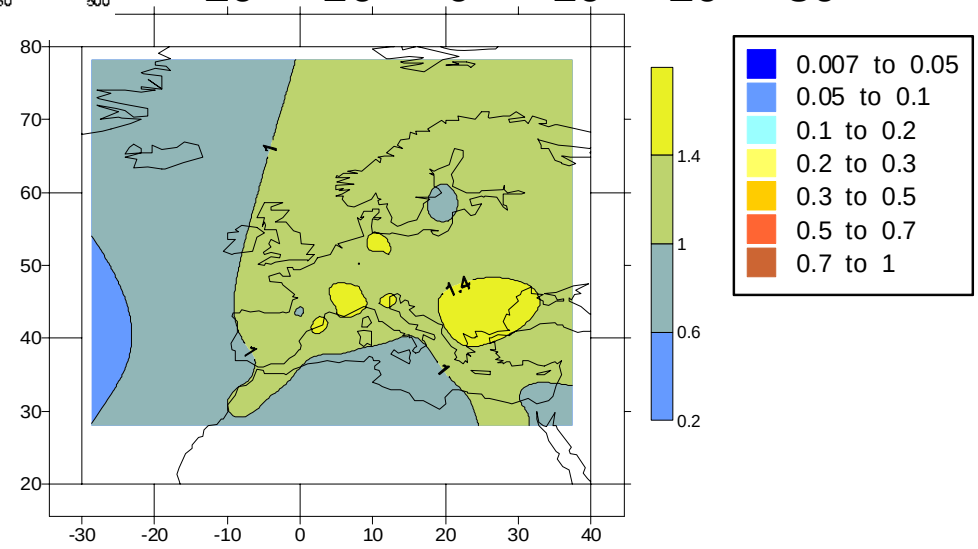
March

Wind and precipitation

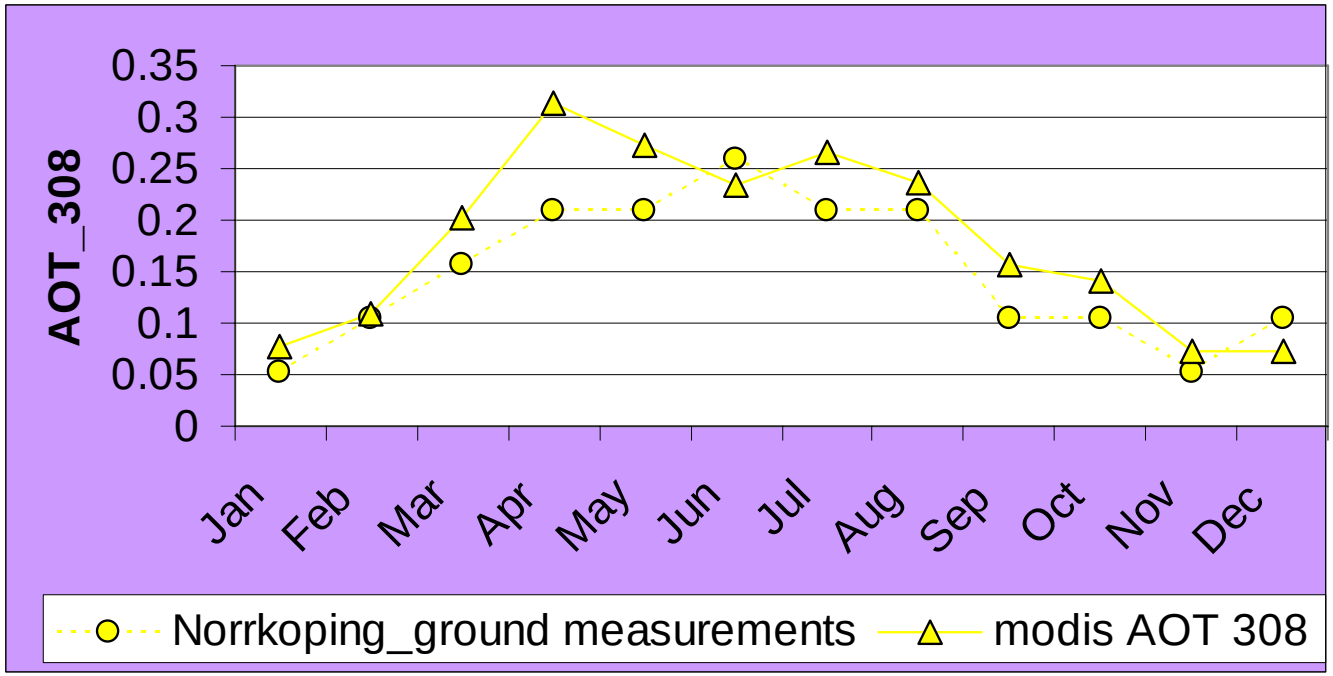


AOT at 308nm





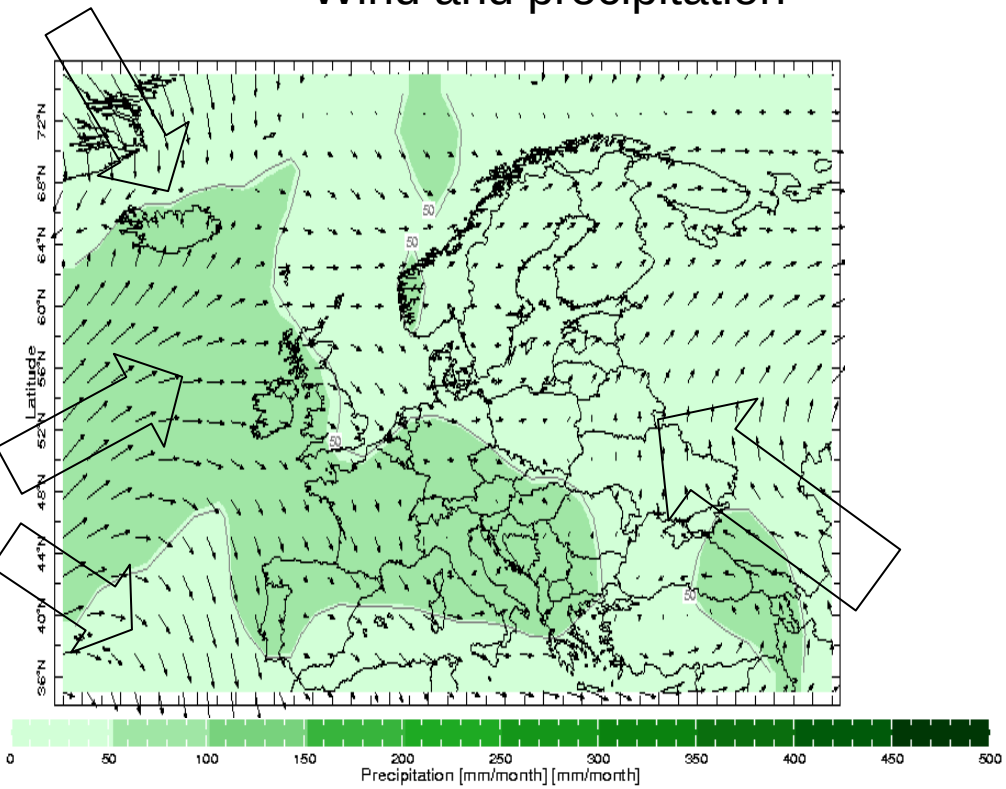
Angstrom Parameter



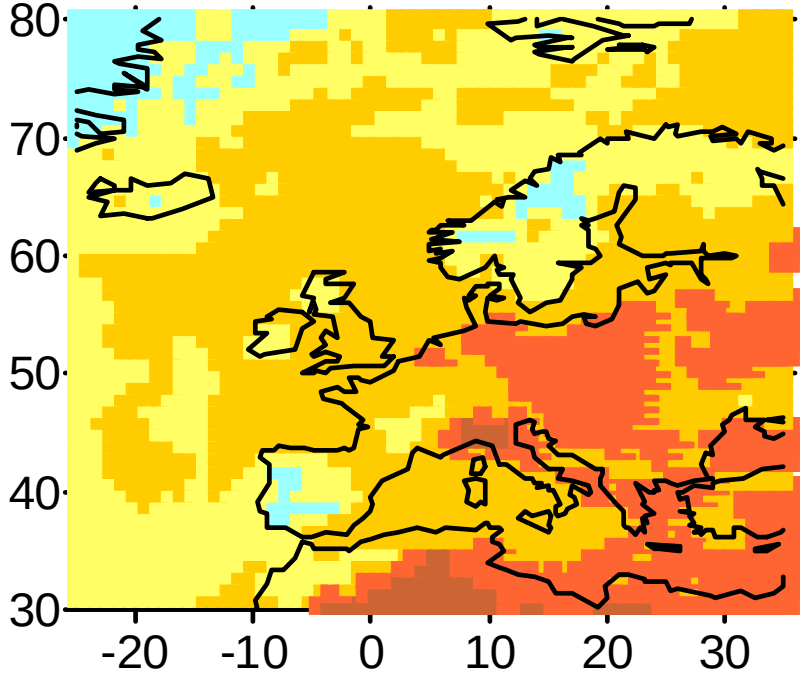
The comparison between AOT 308 over three northern Scandinavian sites from MODIS (Jokioinen, Sodankula, Norkkoping) and SPM2000 Sun photometer measurements for Norkkoping described in Lindfors et al [2007]

April

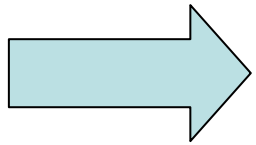
Wind and precipitation

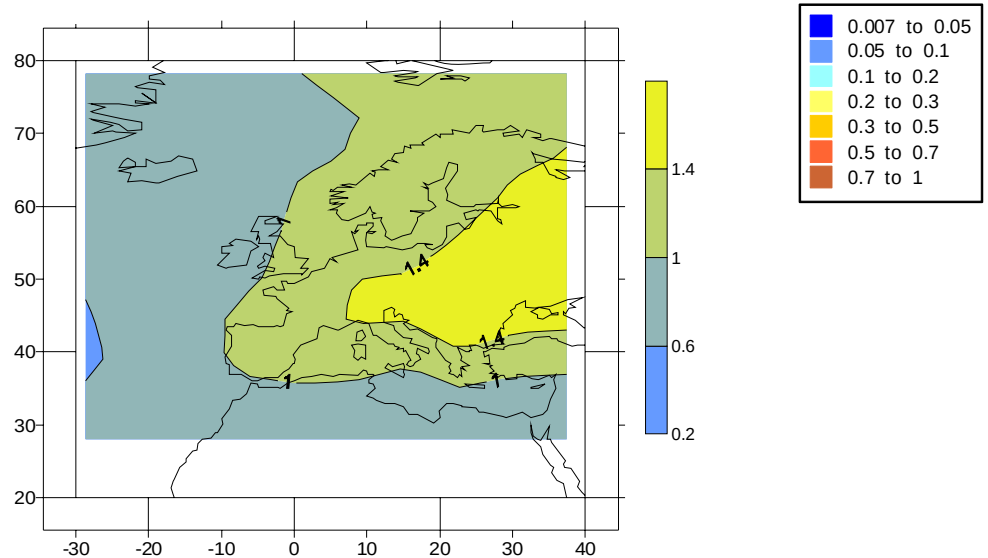


AOT at 308nm



Angstrom Parameter

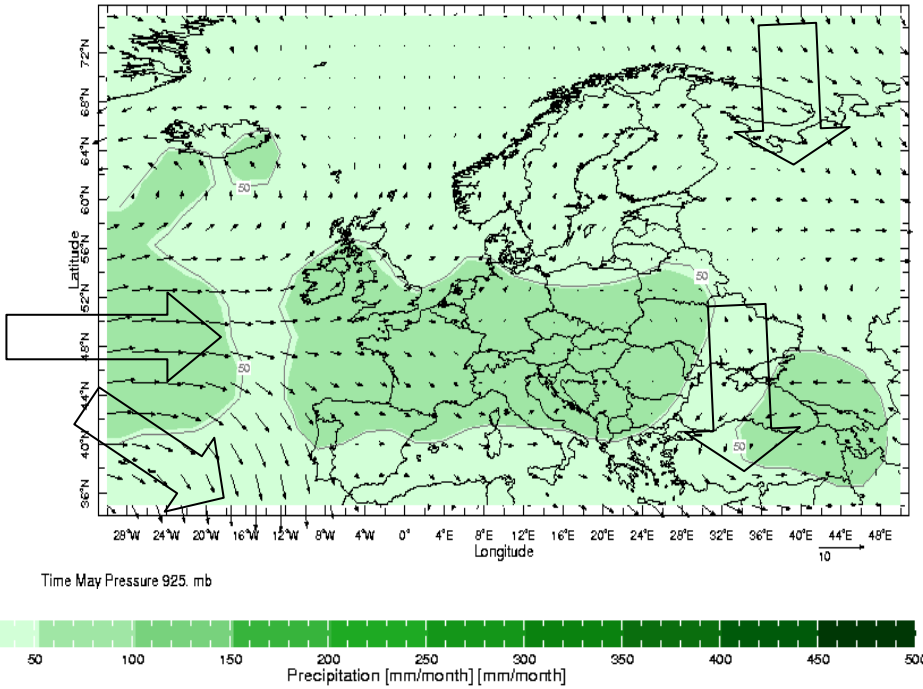




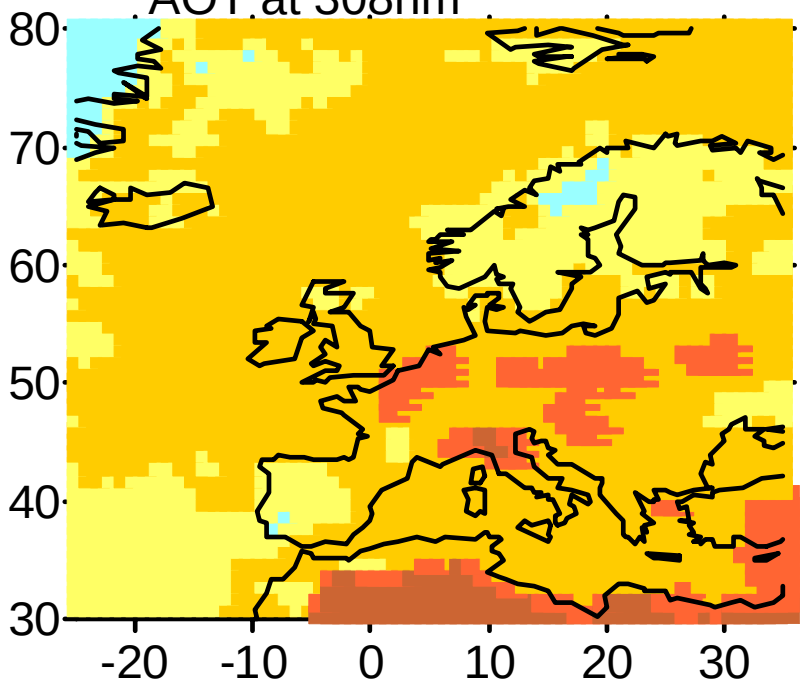
The date of snow off in Eastern Europe (Moscow) – end of March

May

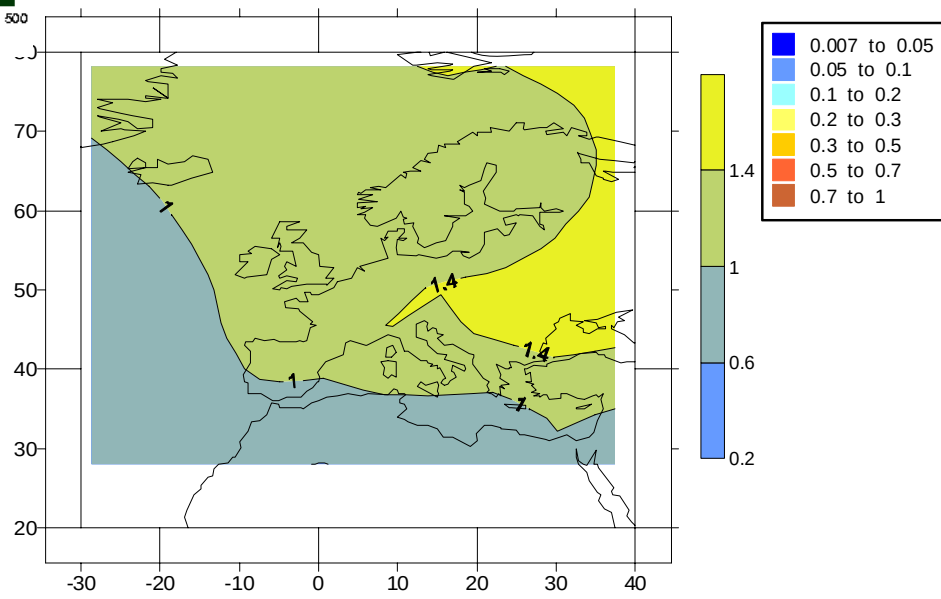
Wind and precipitation



AOT at 308nm

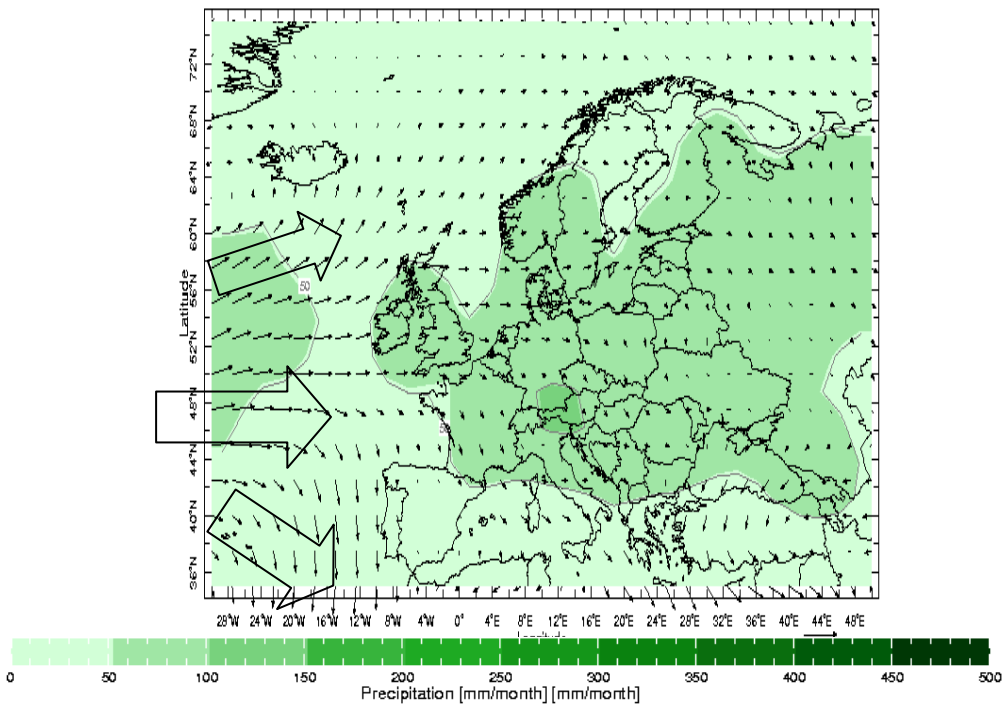


Angstrom Parameter

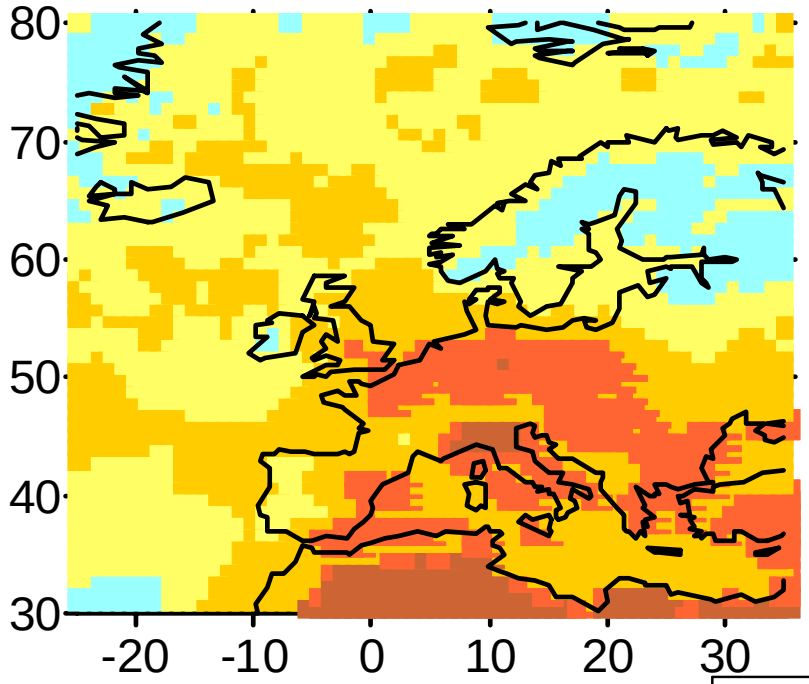


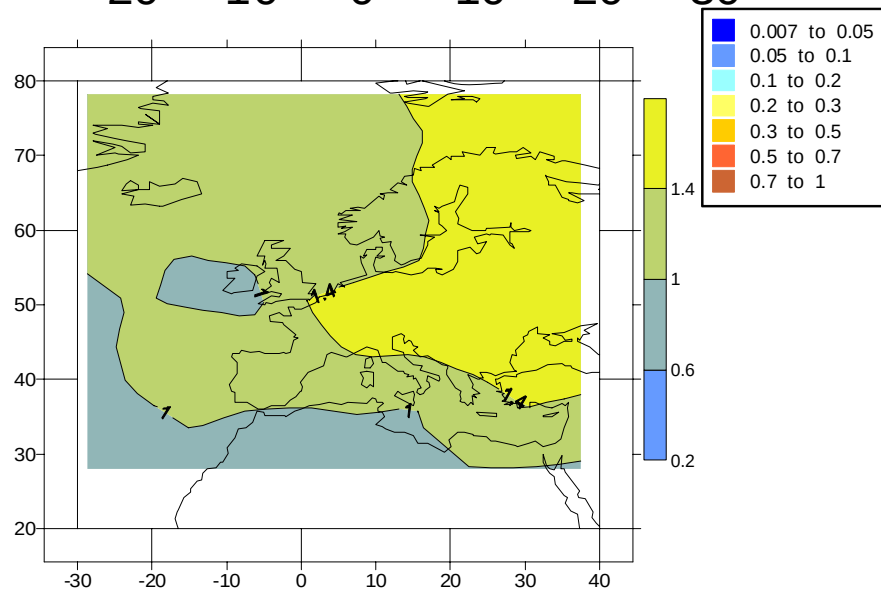
June

Wind and precipitation

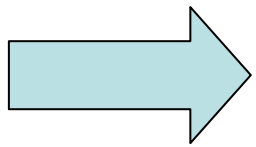


AOT at 308nm



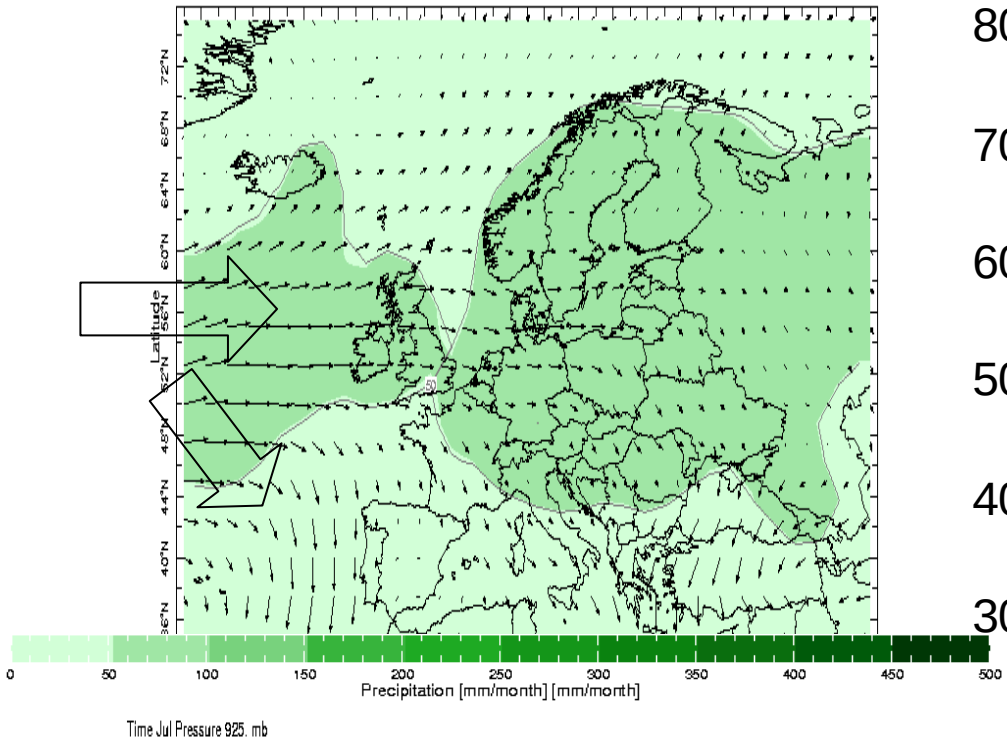


Angstrom Parameter

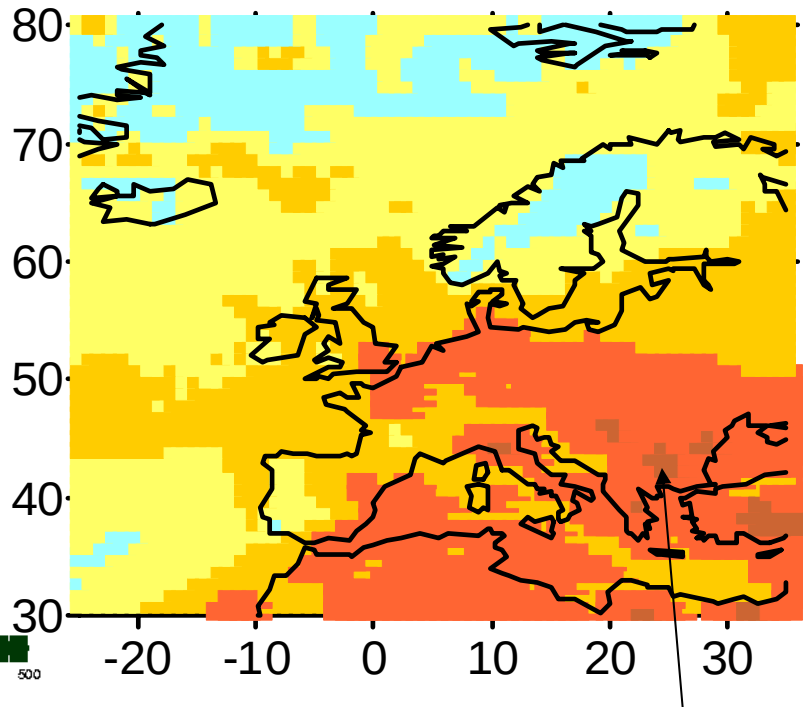


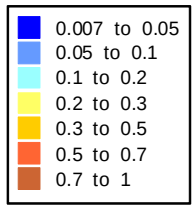
July

Wind and precipitation

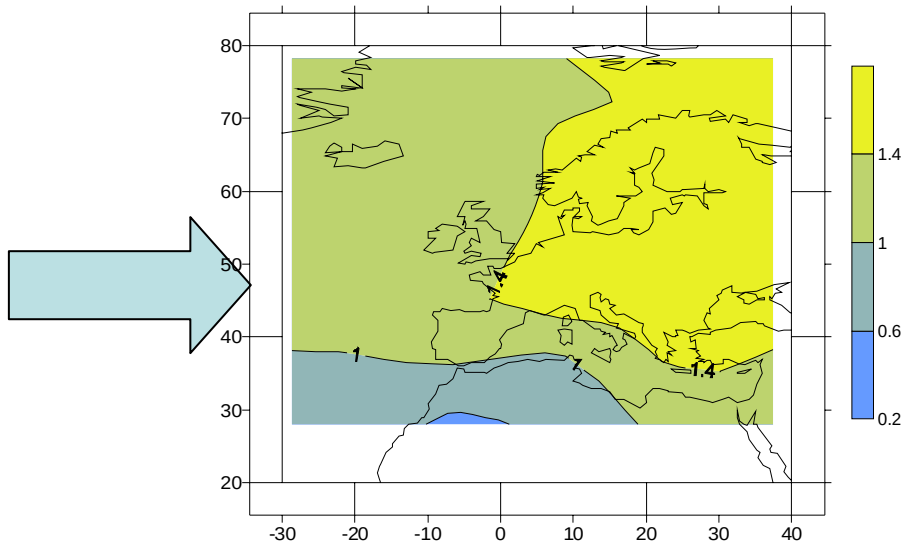


AOT at 308nm





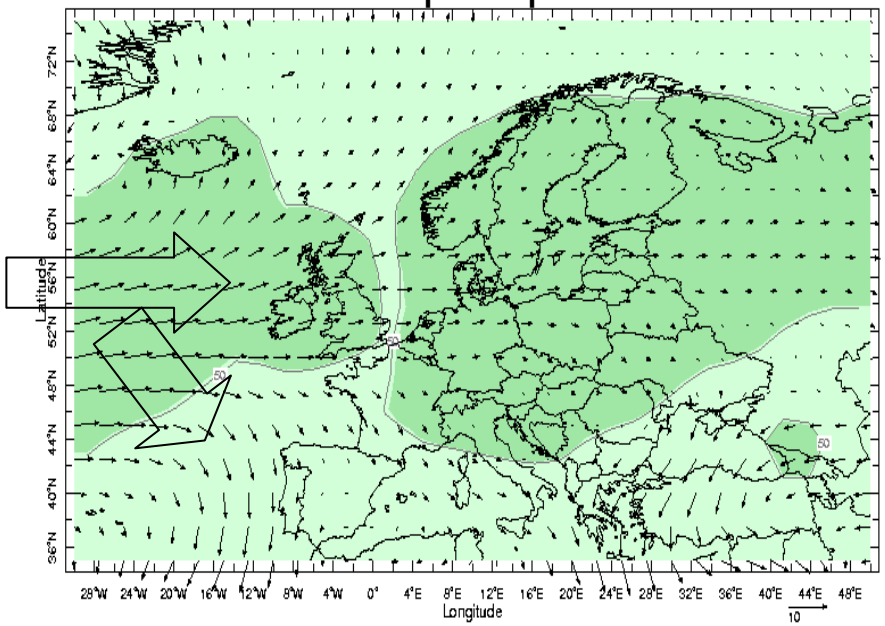
Angstrom Parameter



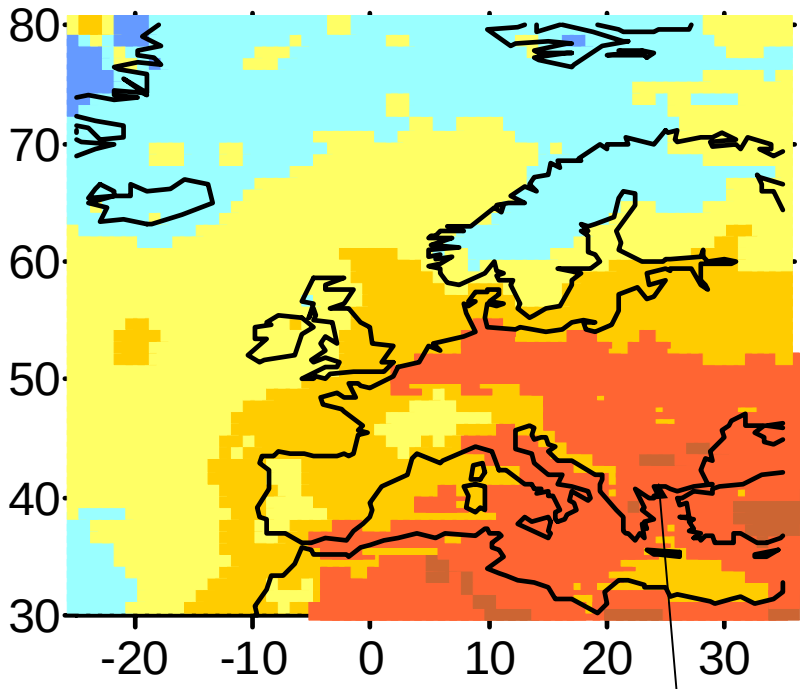
photochemical aerosol origin?

August

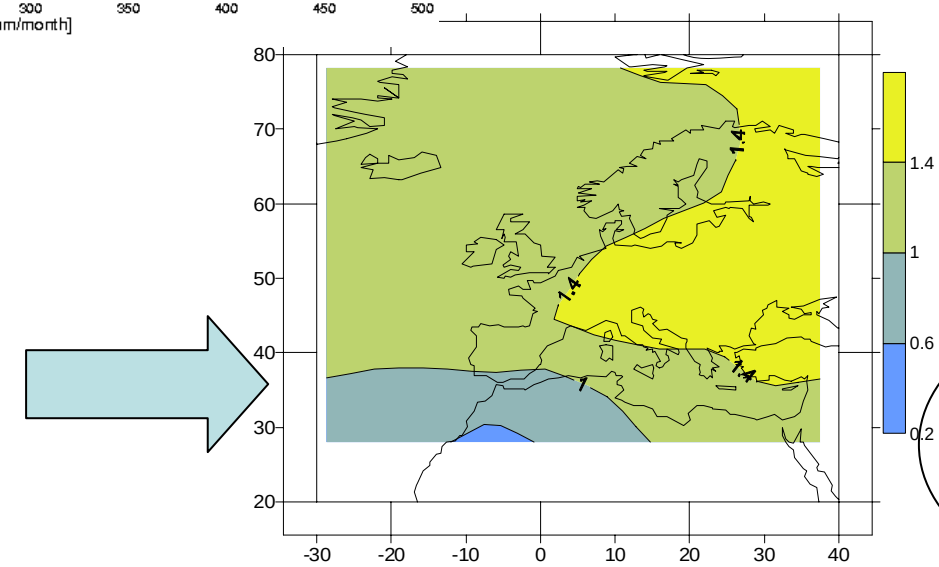
Wind and precipitation



AOT at 308nm



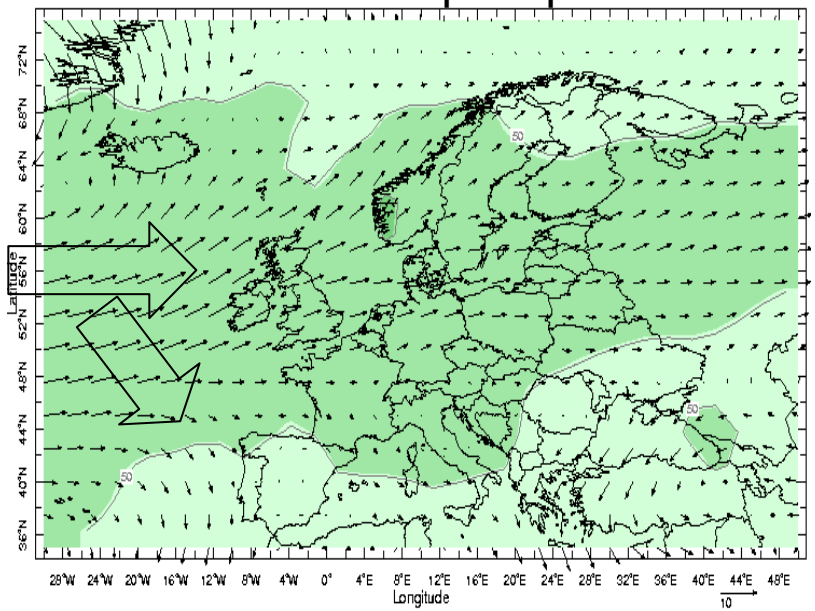
Angstrom Parameter



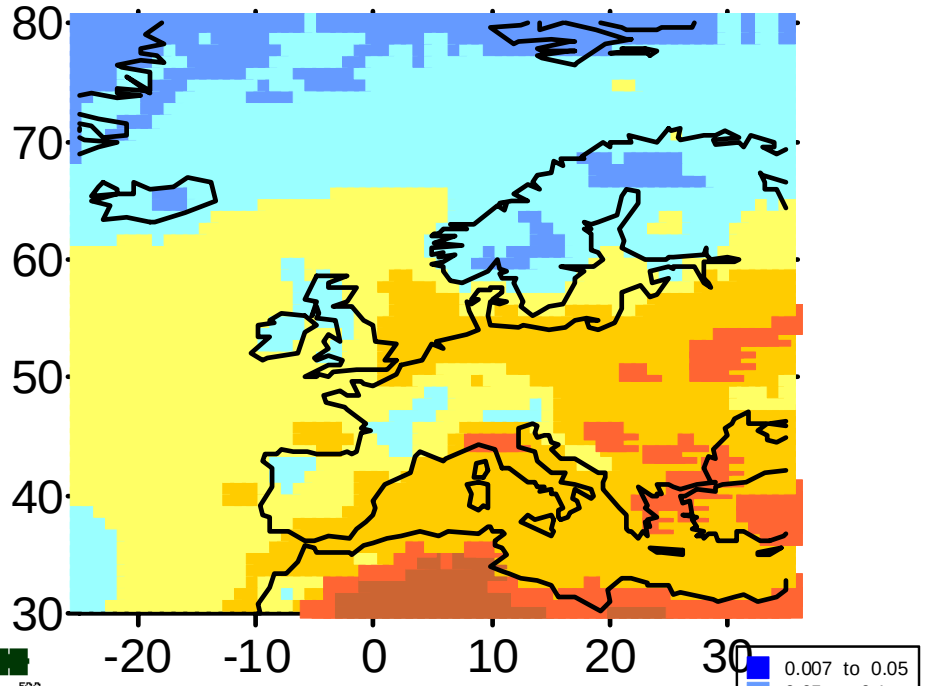
photochemical aerosol origin? plus dust

September

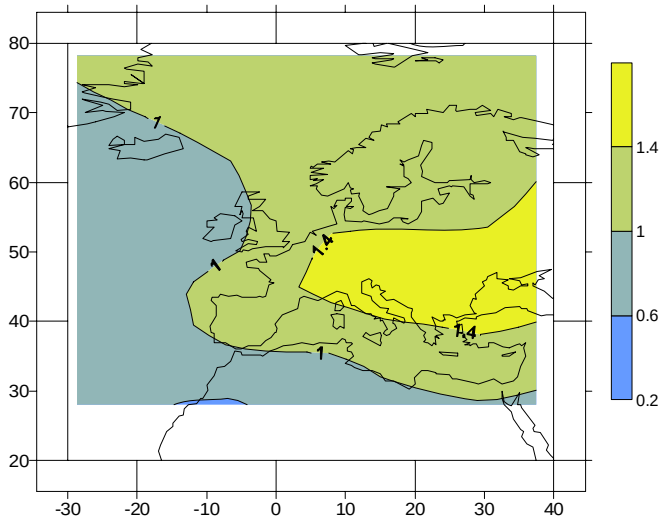
Wind and precipitation



AOT at 308nm

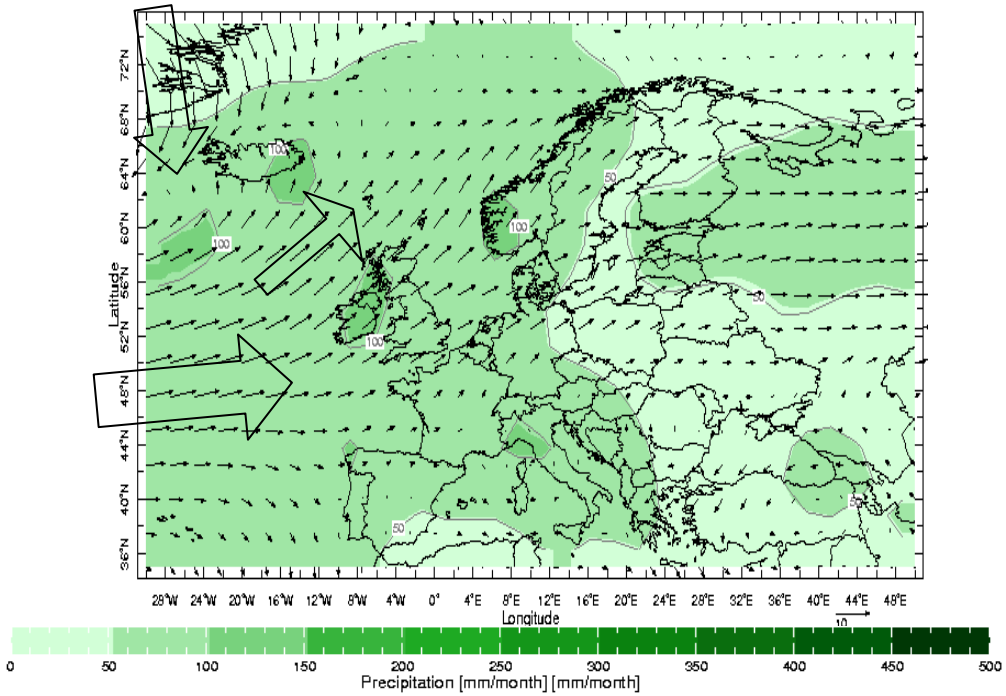


Angstrom Parameter

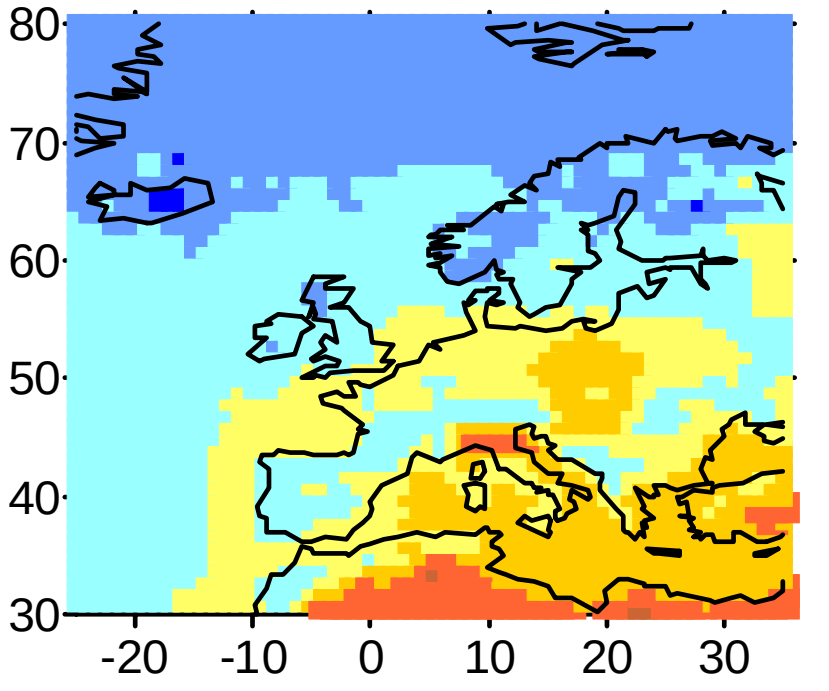


October

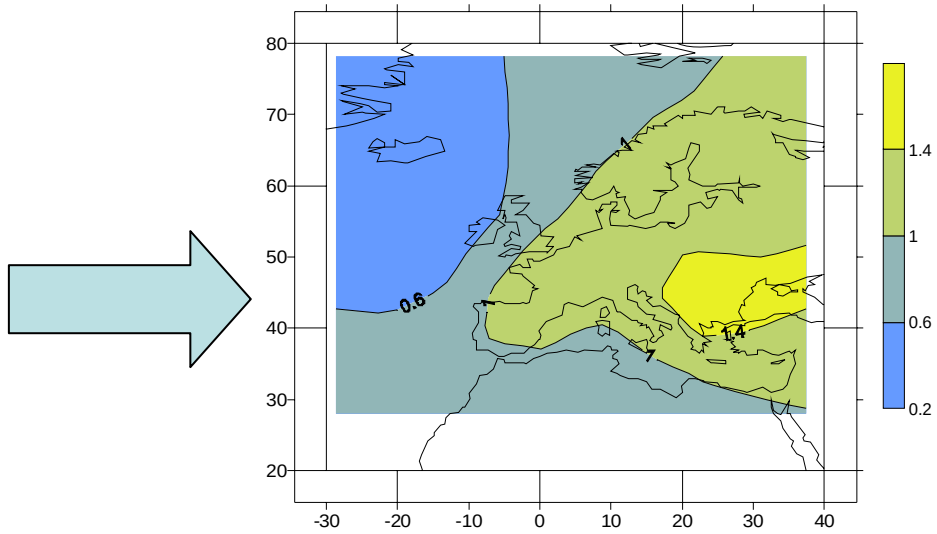
Wind and precipitation



AOT at 308nm

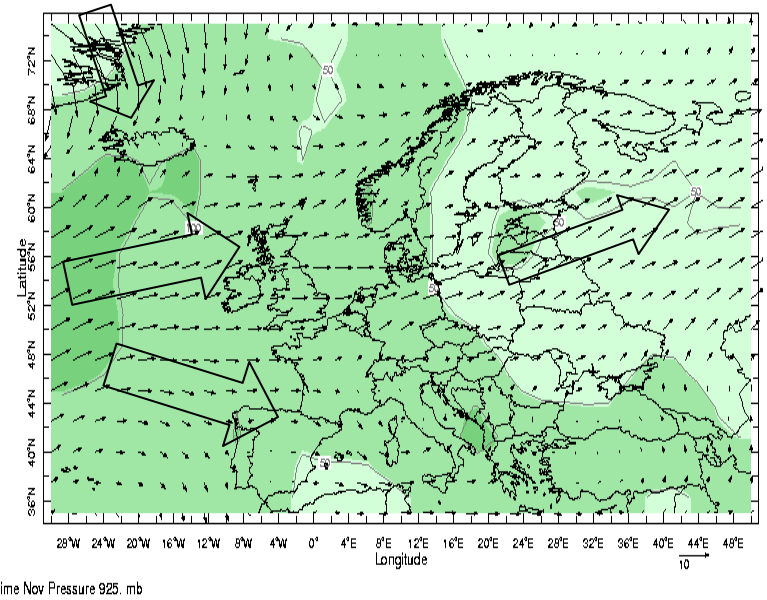


Angstrom Parameter

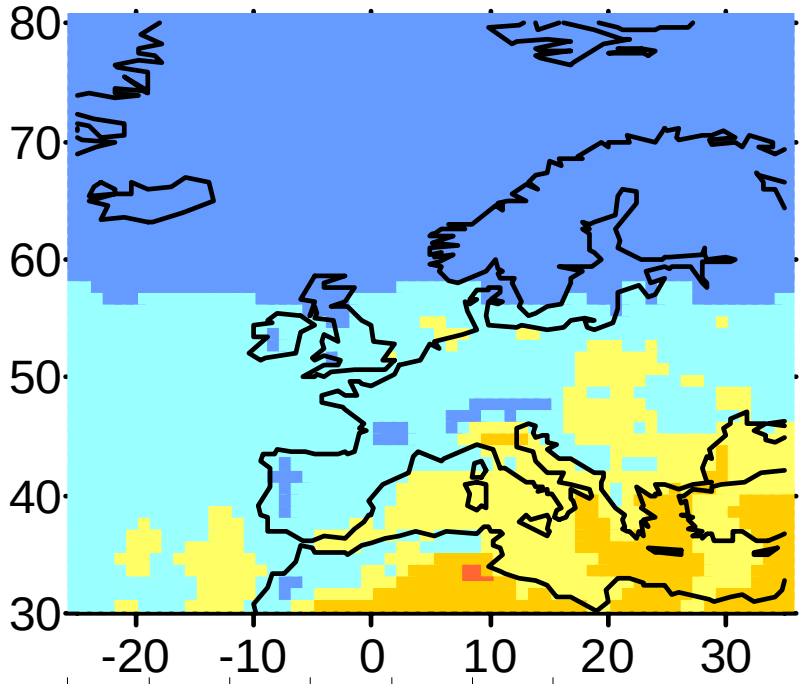


November

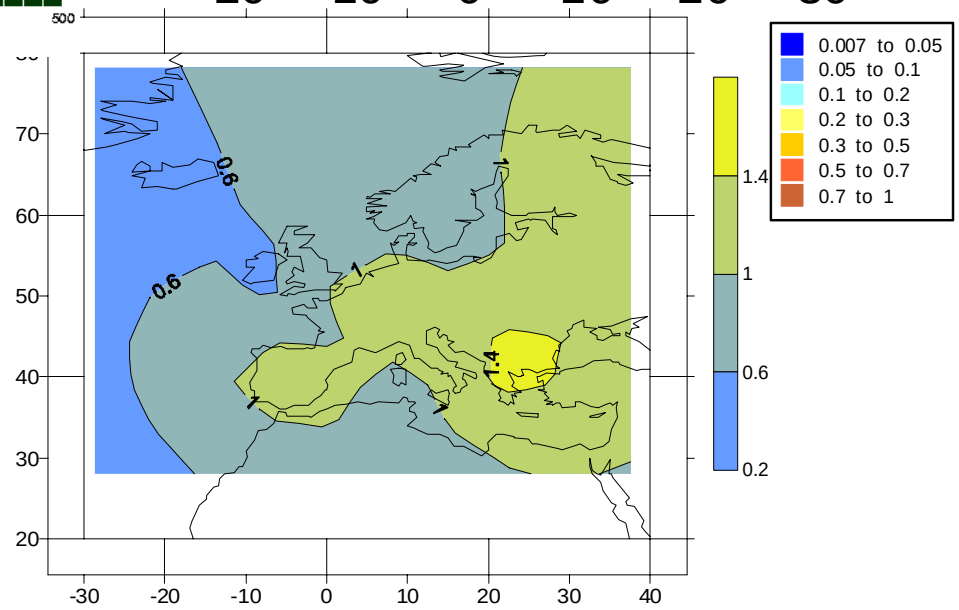
Wind and precipitation



AOT at 308nm

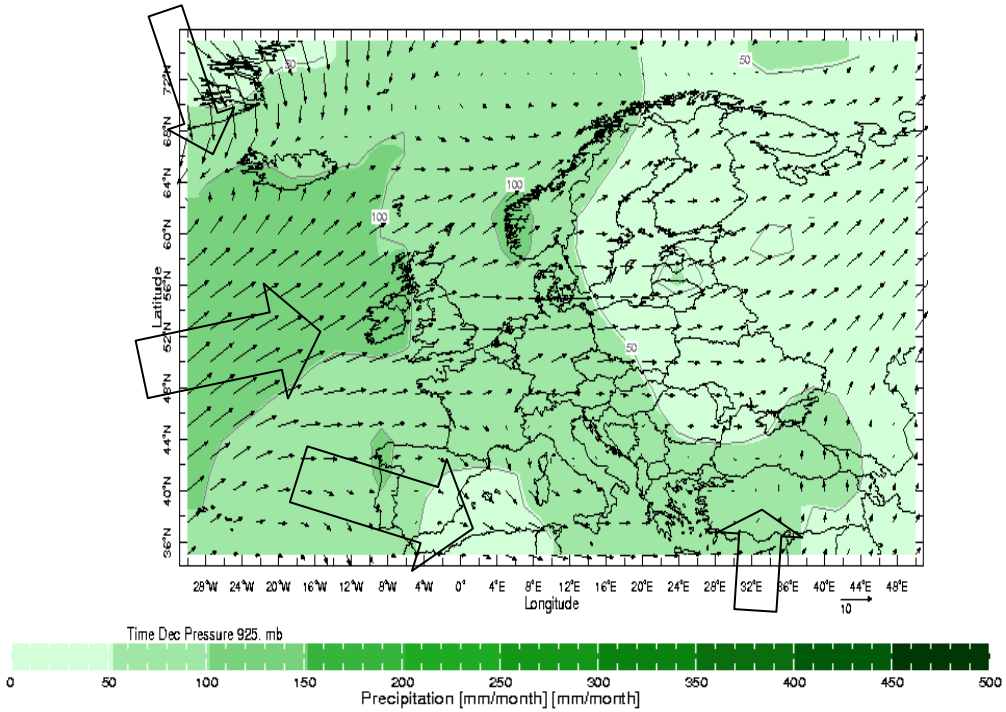


Angstrom Parameter

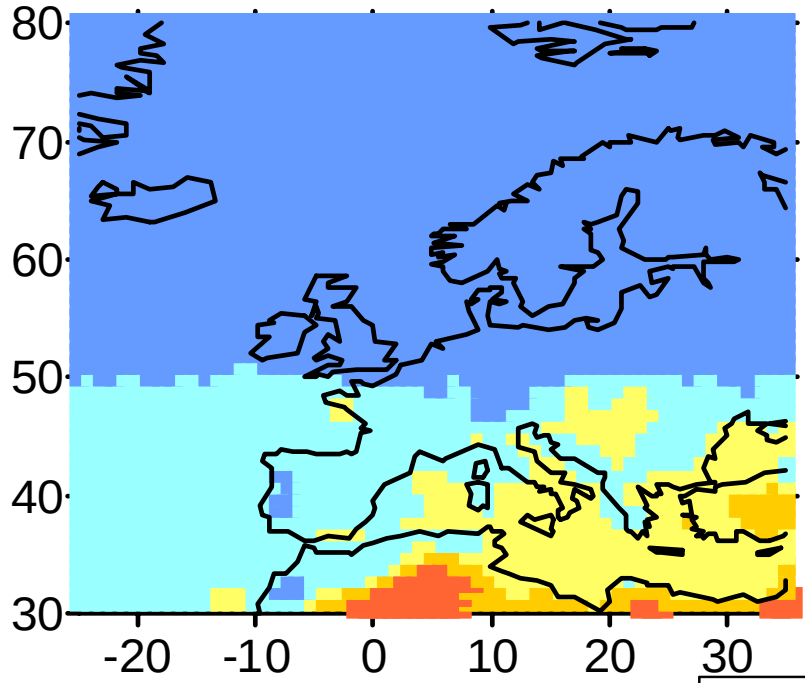


December

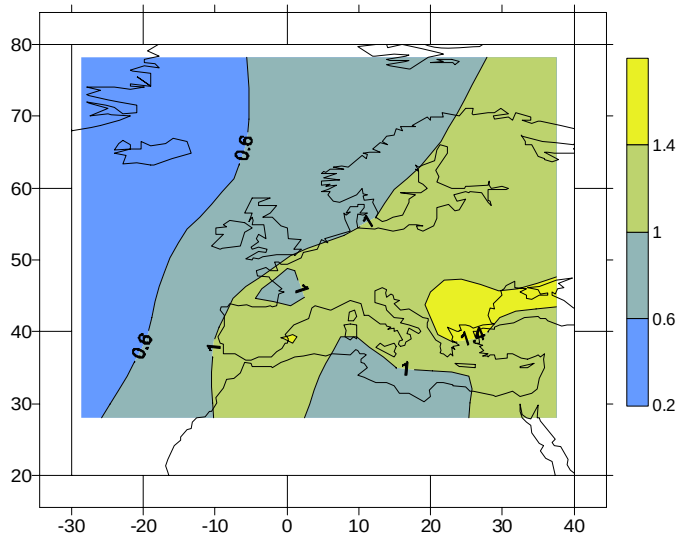
Wind and precipitation



AOT at 308nm

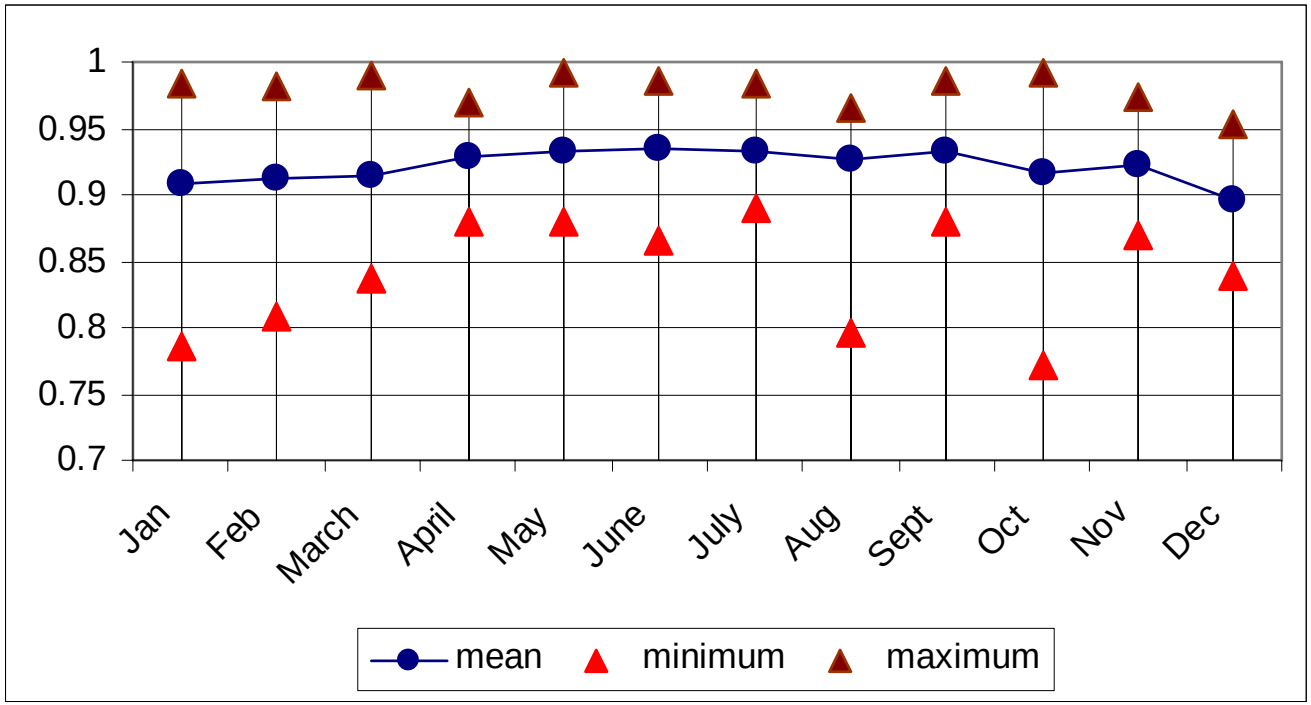


Angstrom Parameter



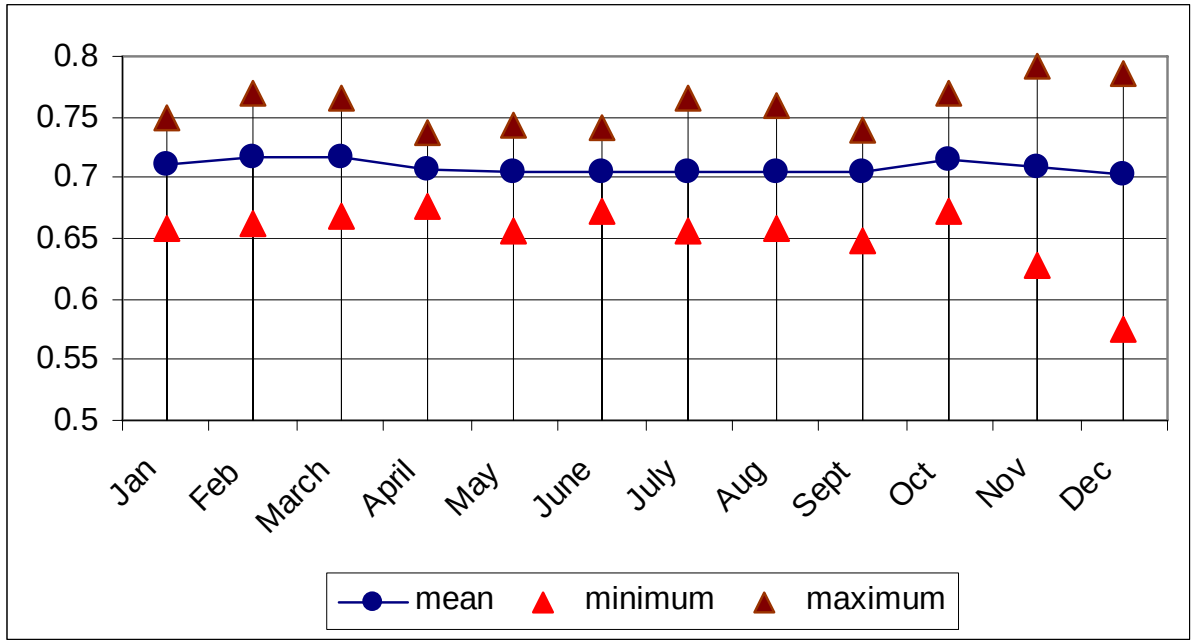
- Due to lack of the information on spatial distribution of SSA as well as large uncertainy of their evaluation it is better to use the average values for the Europe. With small correction to the UV region from 441nm -

Recommended SSA=0.94.



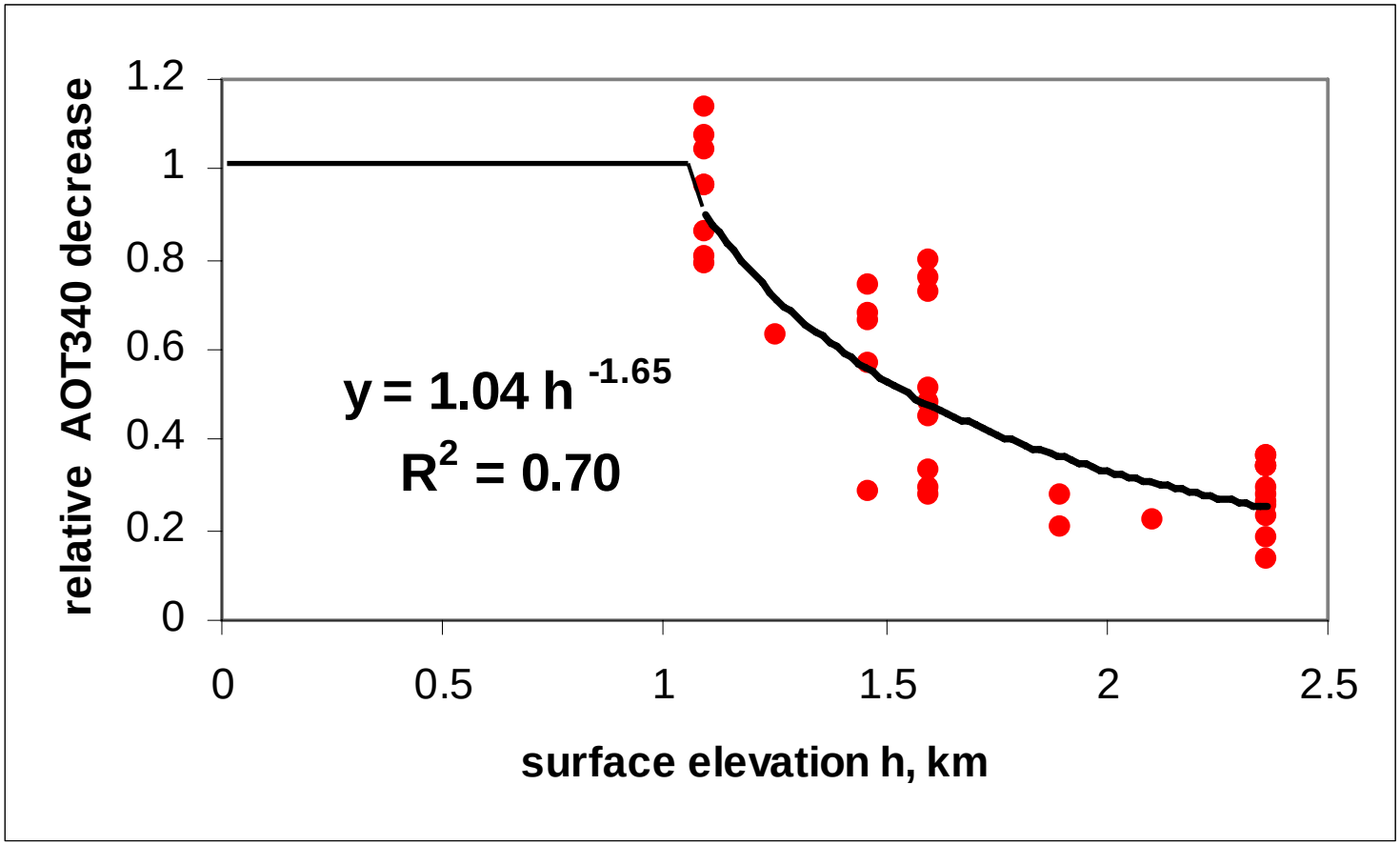
Mean, maximum and minimum single scattering albedo at 441 nm.

- Recommended factor of asymmetry g =0.75 (with accounting of the correction to UV spectral region)



Mean, maximum and minimum factor of asymmetry at 441 nm.

Parameterization of AOT dependence on surface elevation



obtained according to the climatology of lev.2 high elevation AERONET European sites.

Acknowledgements to:

- The AERONET team for providing the data on aerosol datasets over Europe\
- Analyses and visualizations used in this presentation were produced with the Giovanni online data system, developed and maintained by the NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC)." Thanks, Andreas!