Aerosol over Europe and its impact on UV irradiance

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COST 726 Final Seminar, 13-14 May 2009, Warsaw, PL

Plan:

- Method and data
- Checking against ground-based measurements
- Spatial and seasonal distribution in AOT308. Some features and matching with meteorological and some other sources
- Spatial distribution of relative and absolute aerosol effects on UVI
- The tests of UV loss due to different aerosol in Moscow

The main datasets:

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

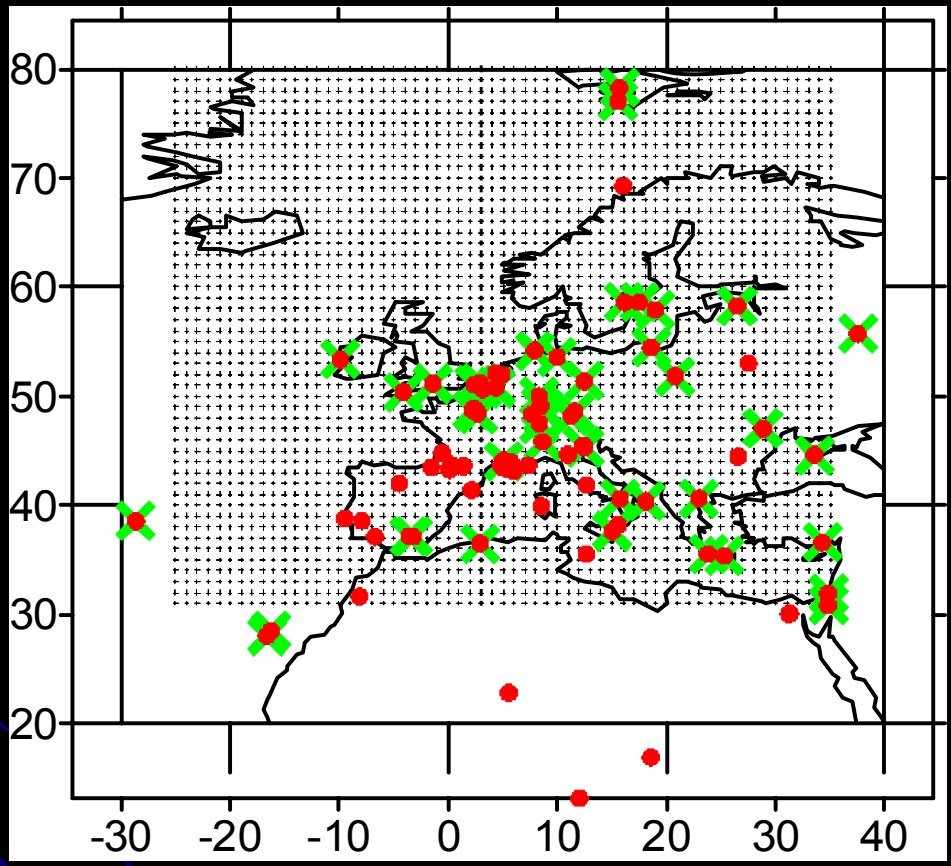
The new MODIS monthly AOT550 climatology v.005 was obtained from both TERRA and AQUA datasets by averaging over the period of Feb 2000-March 2008.

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

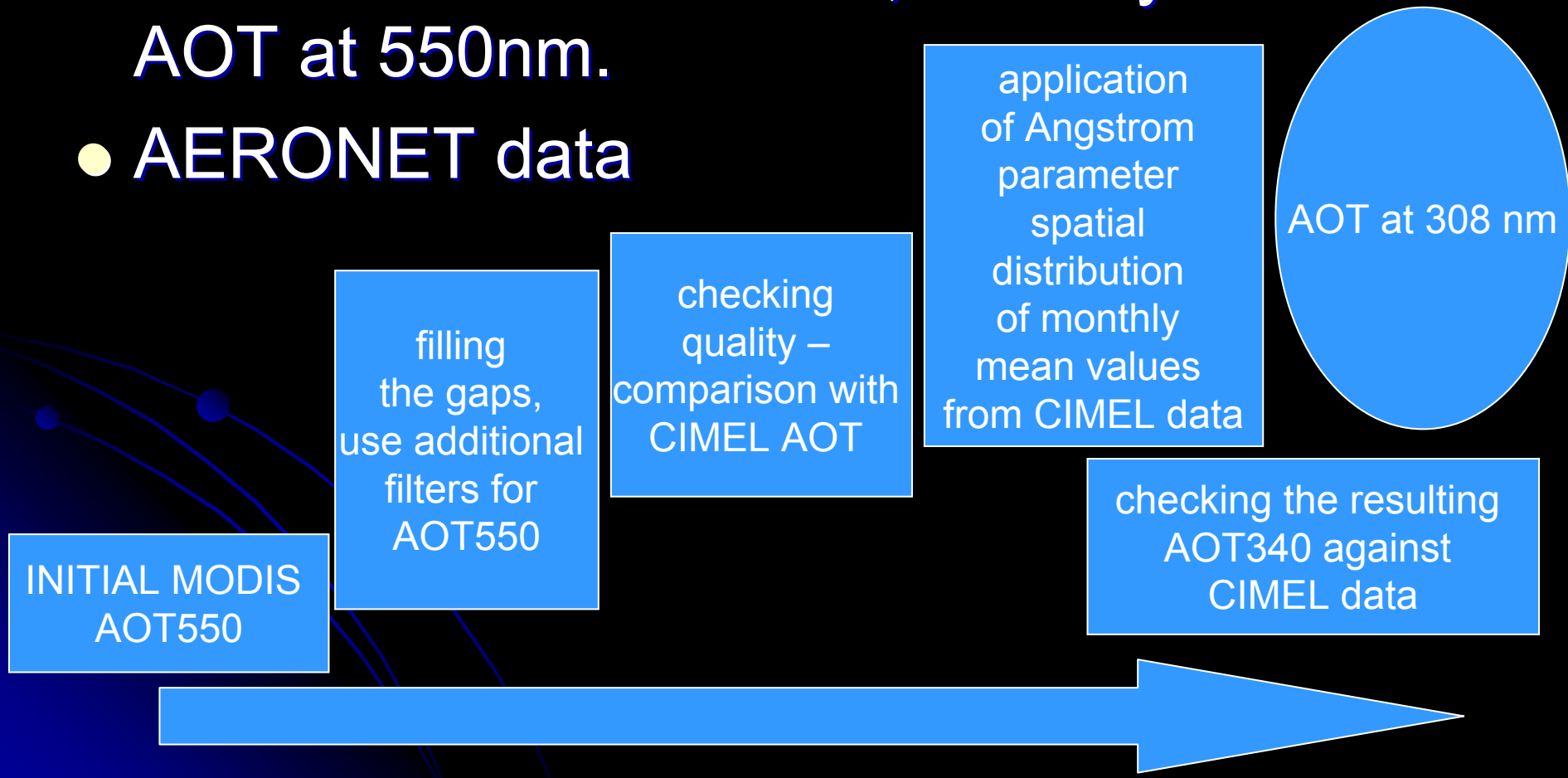
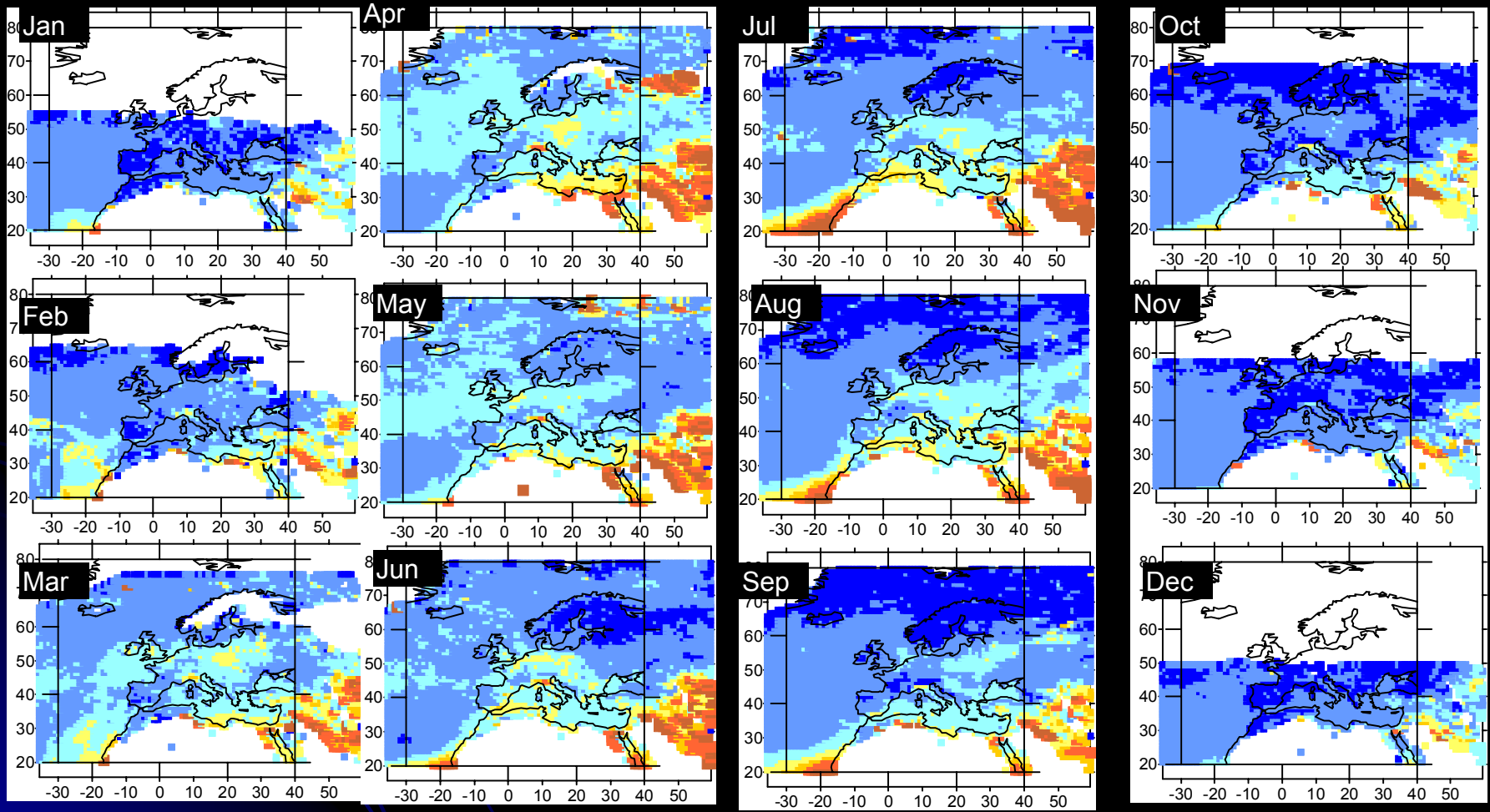


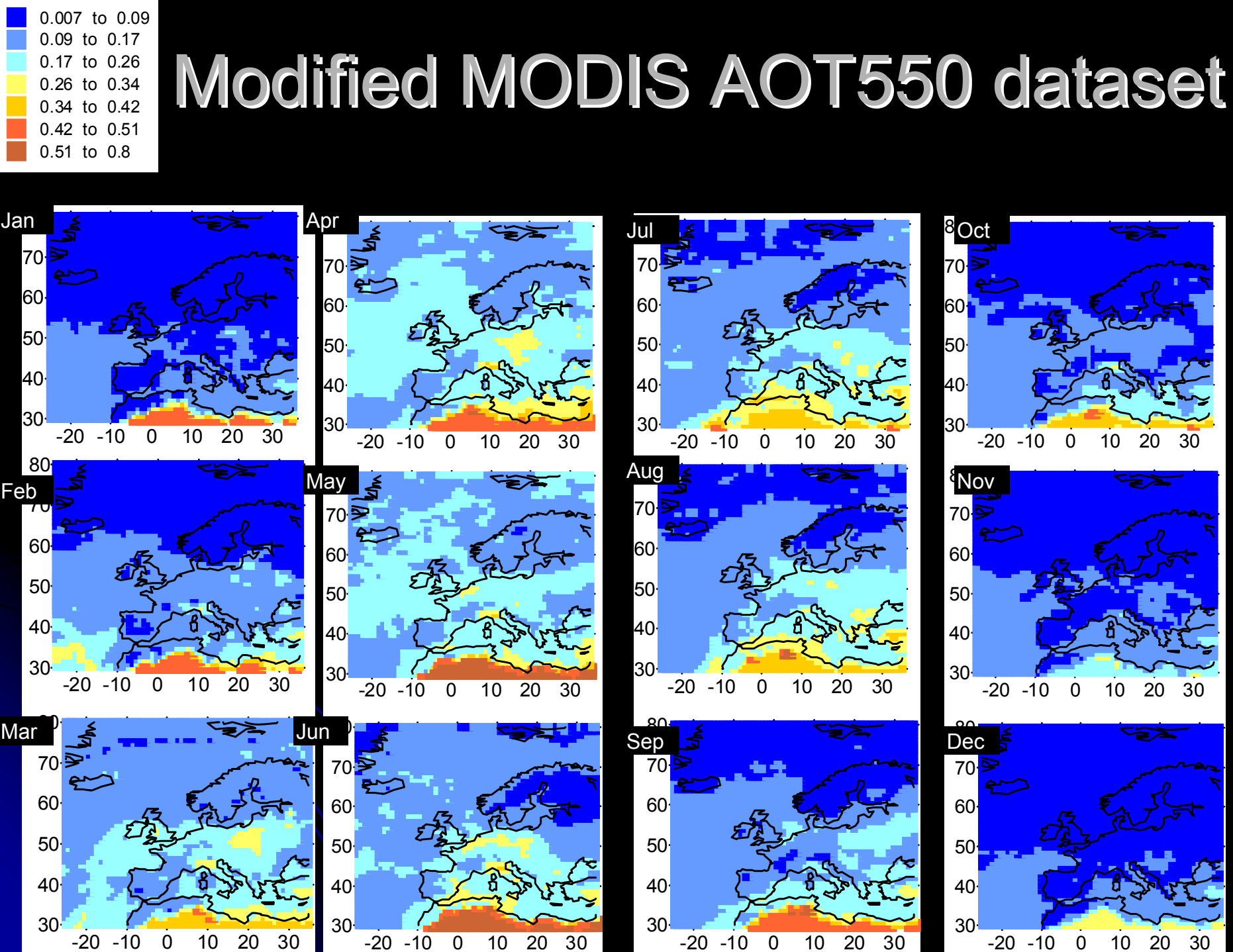
Illustration of initial MODIS 005 data over Europe AOT 550, 2000-2008



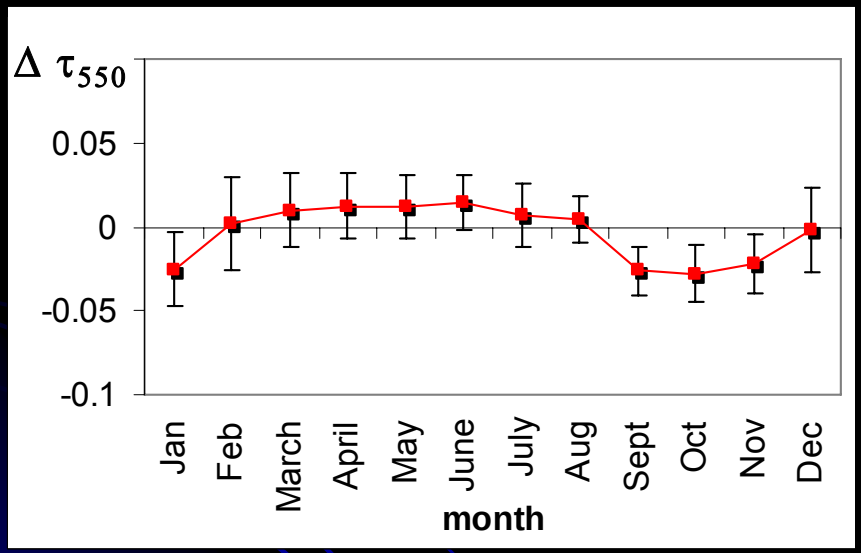
Filters and gaps applied for MODIS dataset

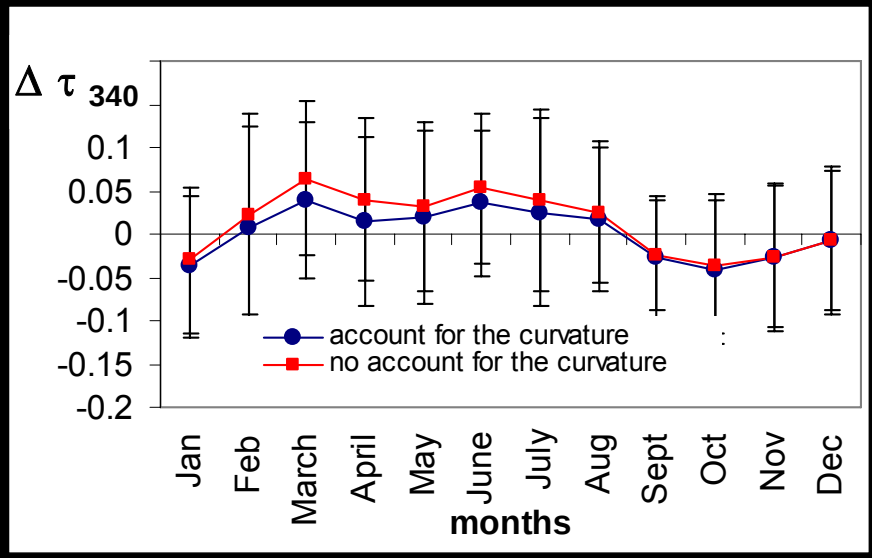
- Additional filter was used for the Arctic data. The data at some pixels over Arctic sometimes are unrealistically high probably due to the effects of high surface (snow) reflectance. For these cases a filter of AOT550= 0.2 was applied according to the highest monthly mean values according to AERONET Arctic data (higher 58N).
- In 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.

Modified MODIS AOT550 dataset

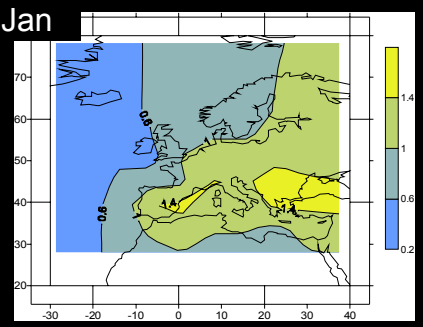


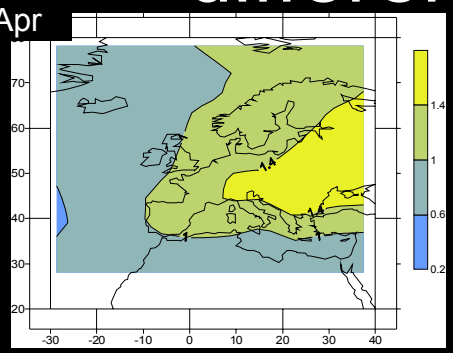
The difference between MODIS and AERONET/PHOTONS aerosol optical thickness over Europe as a function of month at 550nm (a) and at 340 nm (b).

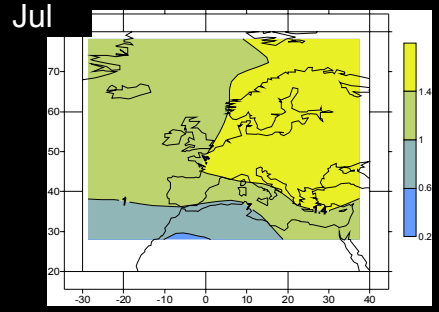


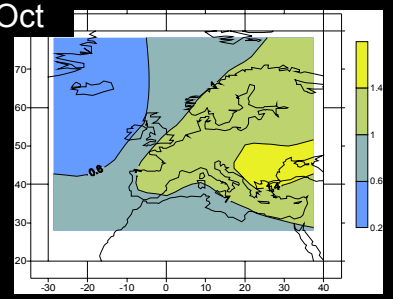


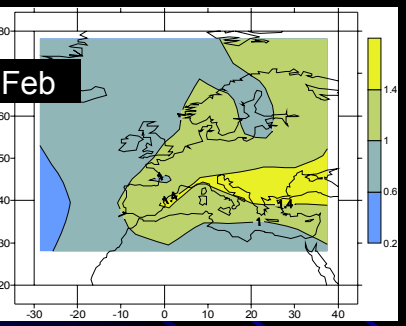
Angstrom parameter ($\alpha_{440\text{-}870}$) spatial distribution according to AERONET for different months

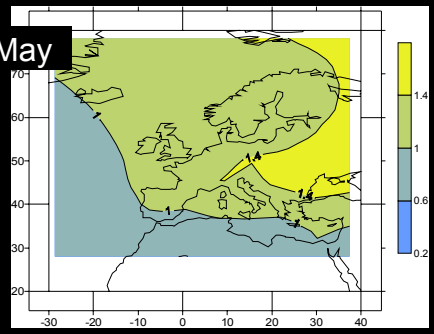


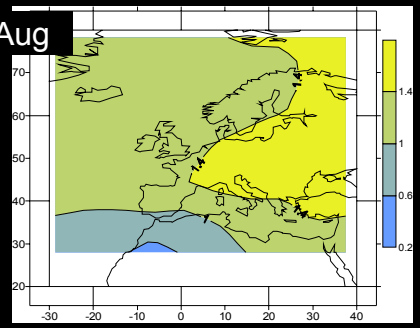


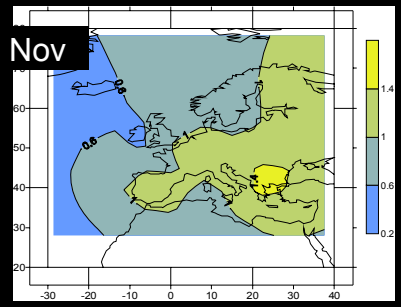


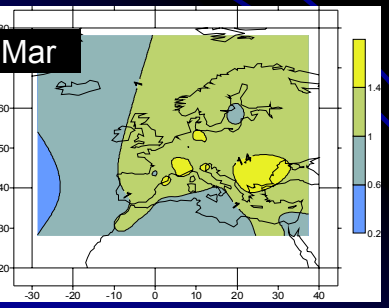


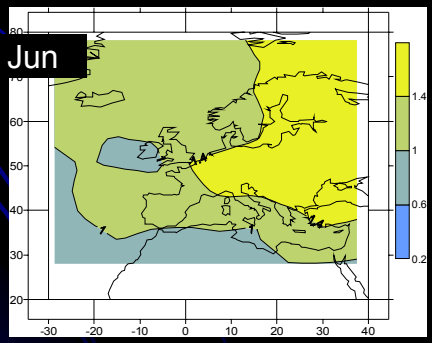


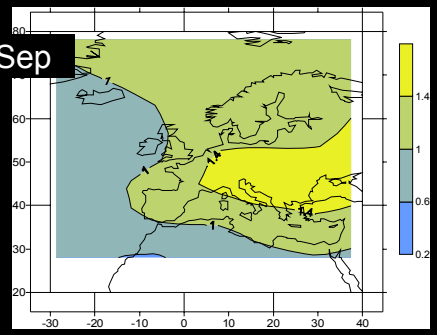


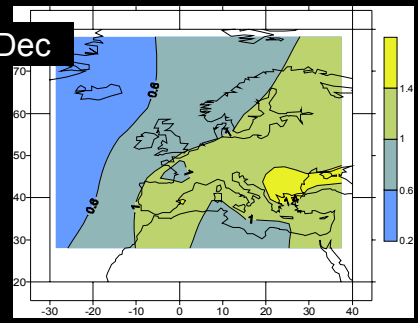






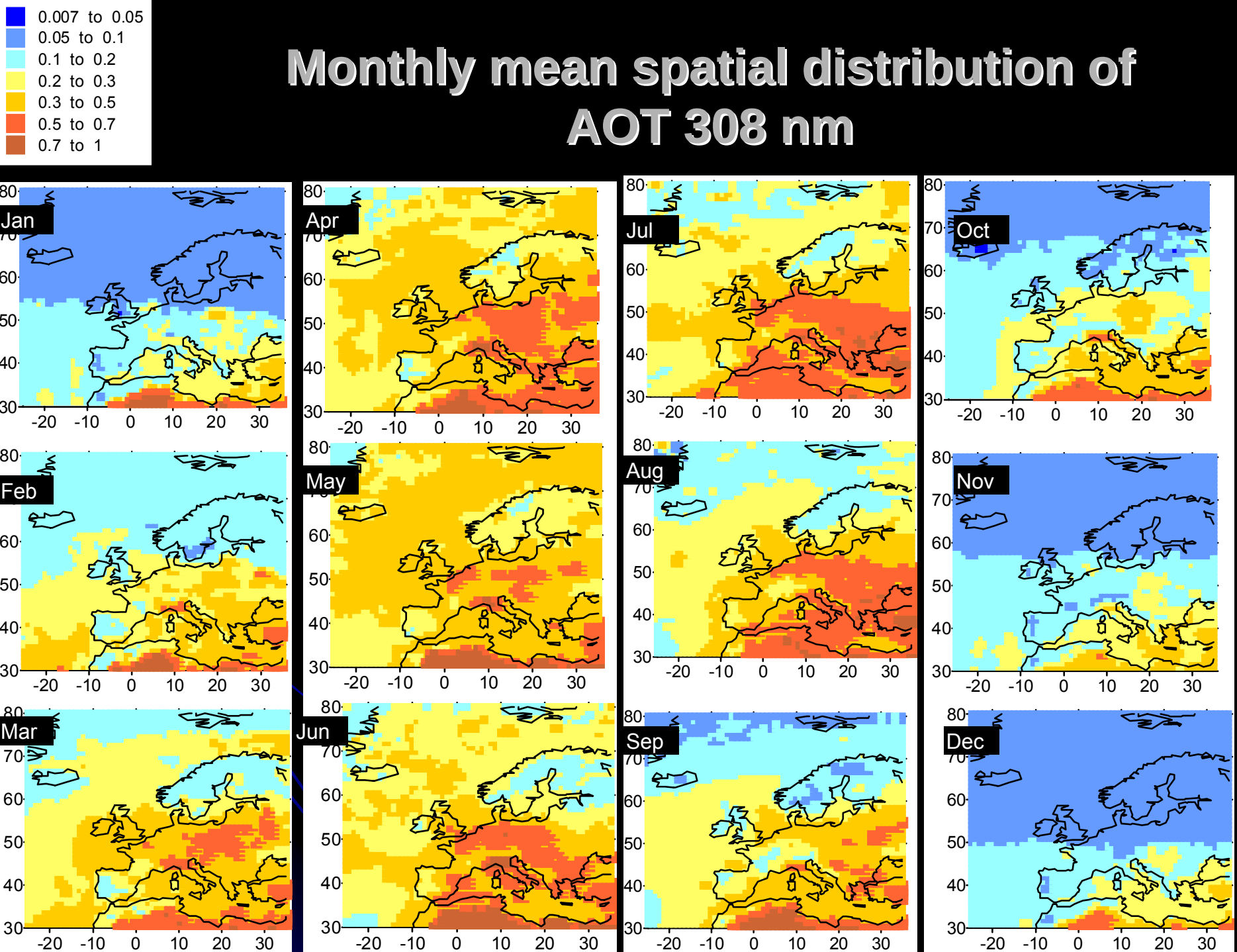






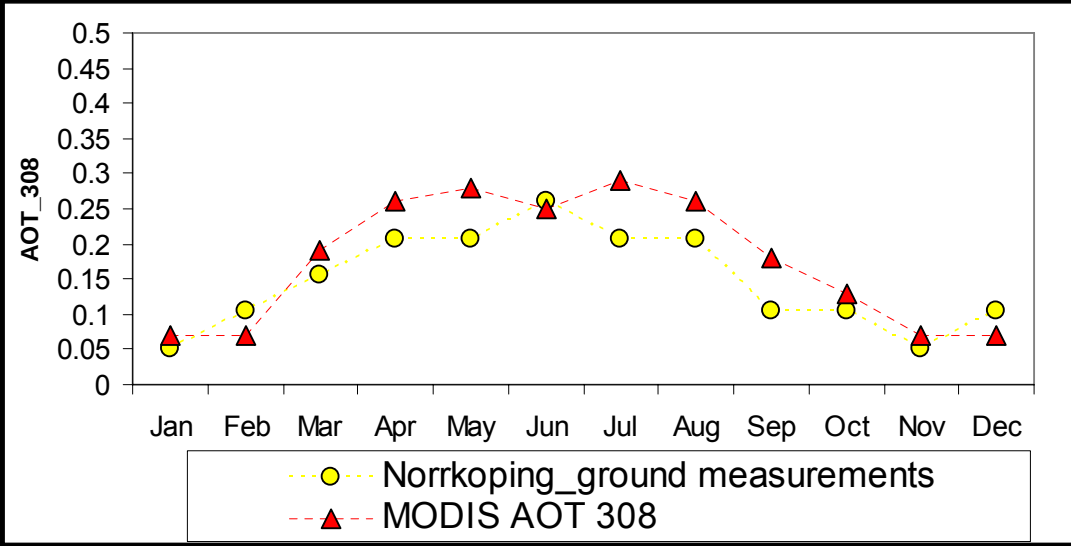
Method of interpolation: Kriging, Ordinary, no drift, small density lines due to small statistics.

Monthly mean spatial distribution of AOT 308 nm



The comparison between monthly mean values of AOT at 308nm and the results of the retrievals:

Northern site

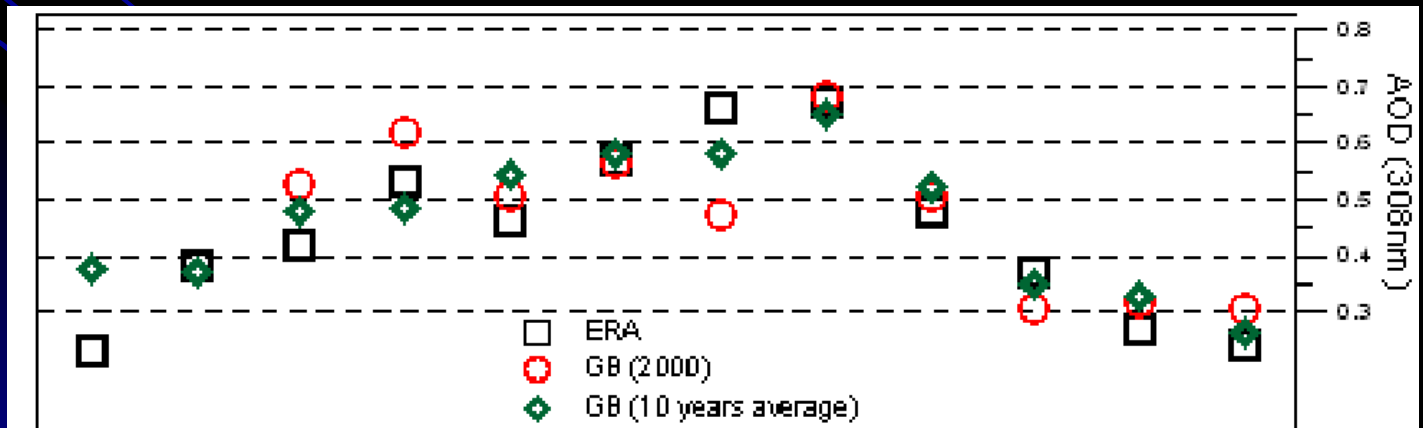


GB data from parameterization in Lindfors et al, , 2007

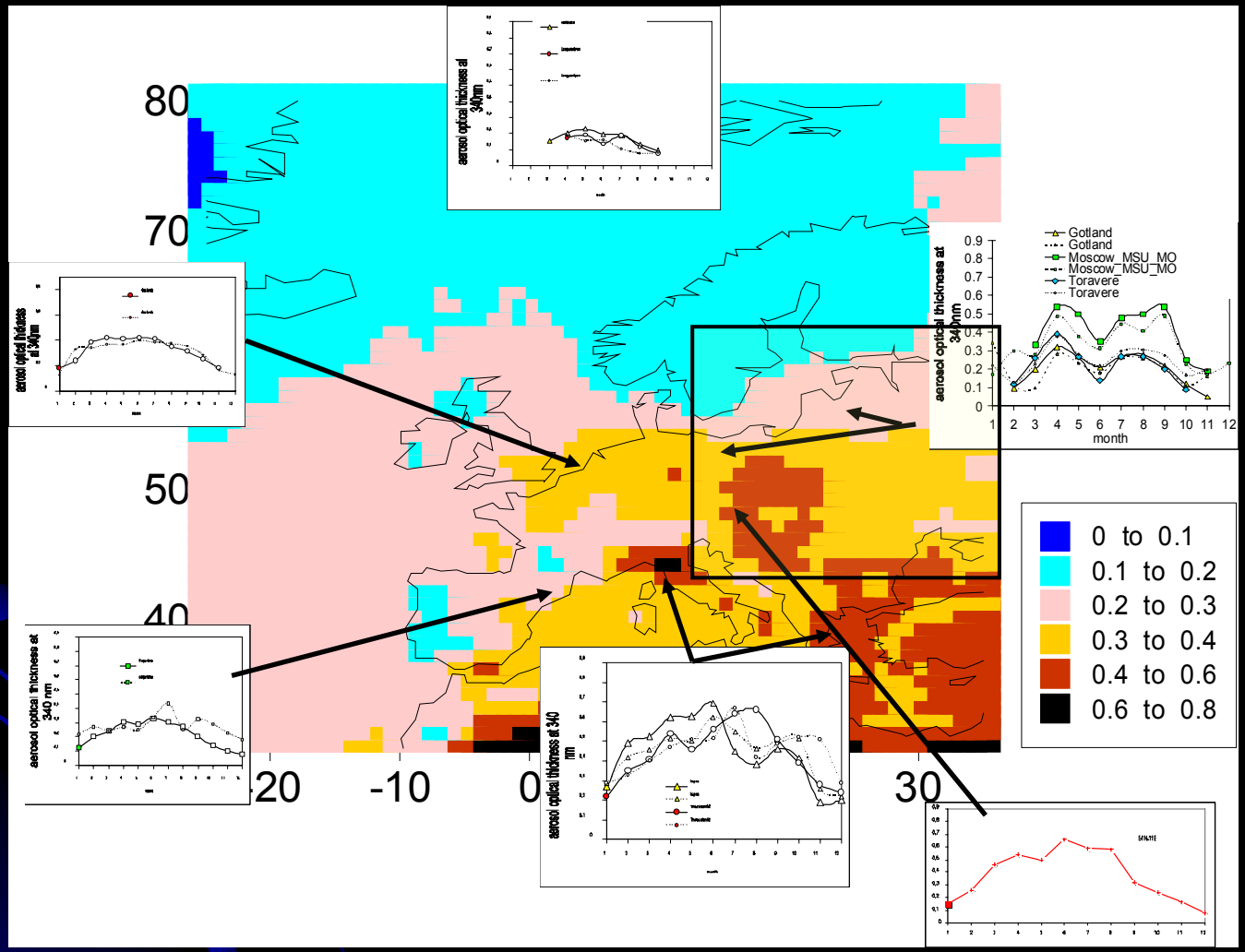
stdev=0.04

courtesy of Andreas Kazantzidis.
Comparisons at Thessaloniki

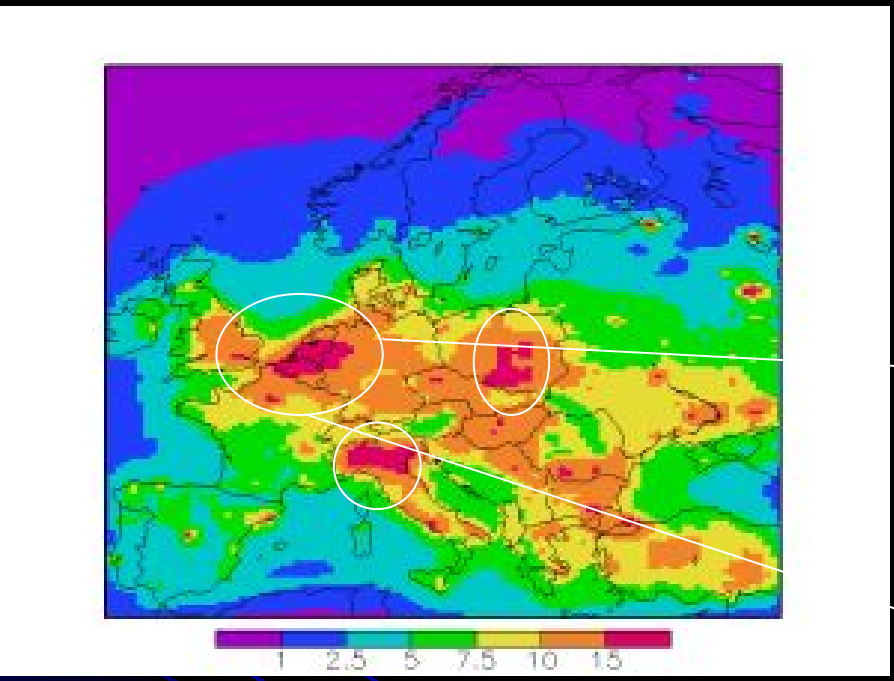
Southern site



AOT 308 yearly mean distribution and distribution of its different seasonal types

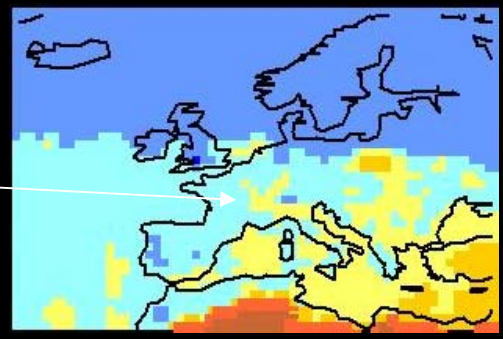


Distribution of PM2.5 aerosols over Europe in 2000, From LOTOS-EUROS aerosol analysis system.

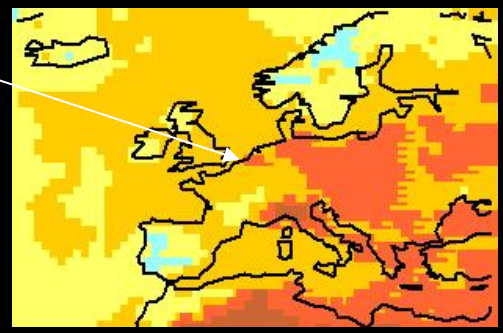


MODIS/AERONET AOT308

Jan



Apr



- Recommended SSA value according to AERONET retrievals is 0.94.
- Recommended value of asymmetry factor g is 0.75.

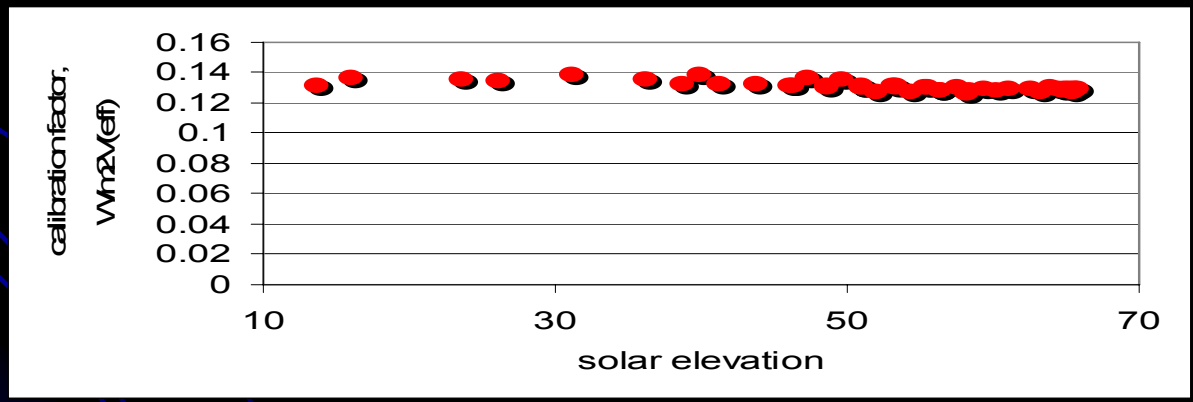
- The dependence on height according to AERONET high elevation site measurements can be approximated in a following way:

$\tau_c = \tau H^{-1.65}$

where H – is the altitude in km.

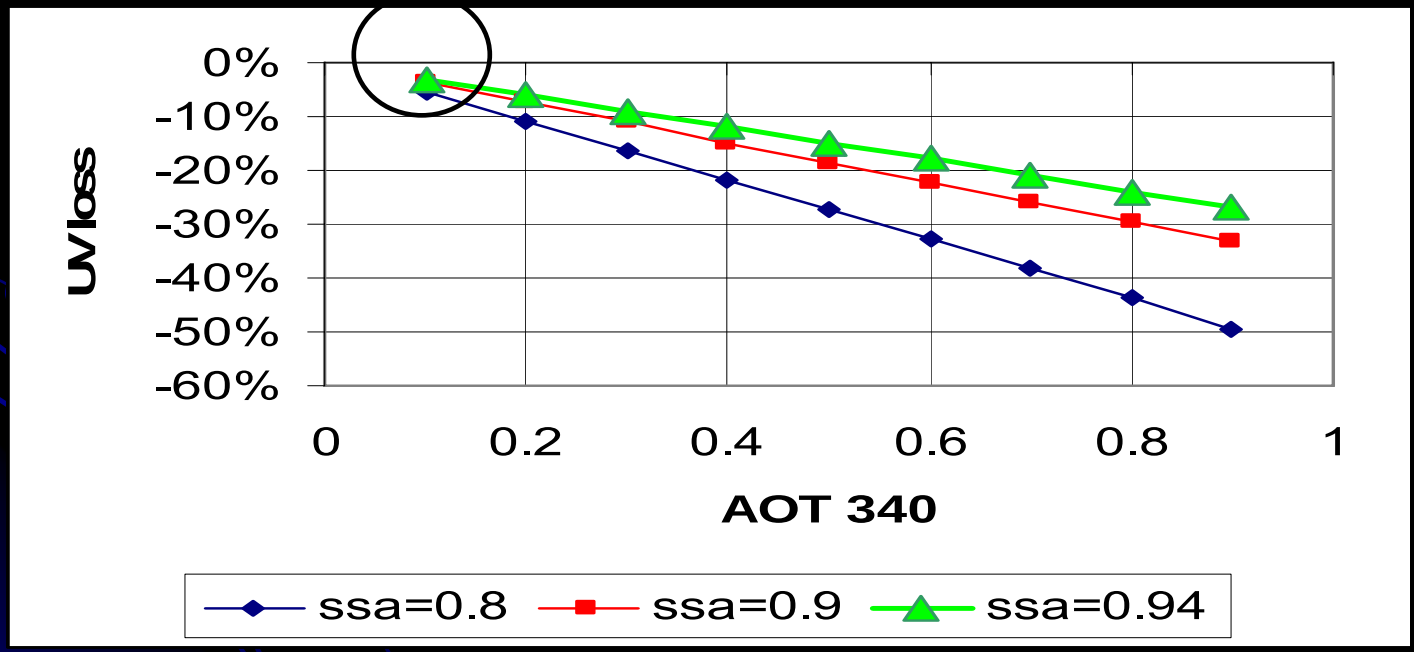
Can this product be verified?

- An attempt based on Moscow quality assured UV data:
- The UVB-1 #060904 has been calibrated against spectroradiometer Bentham DTM-300 in Innsbruck in summer 2008



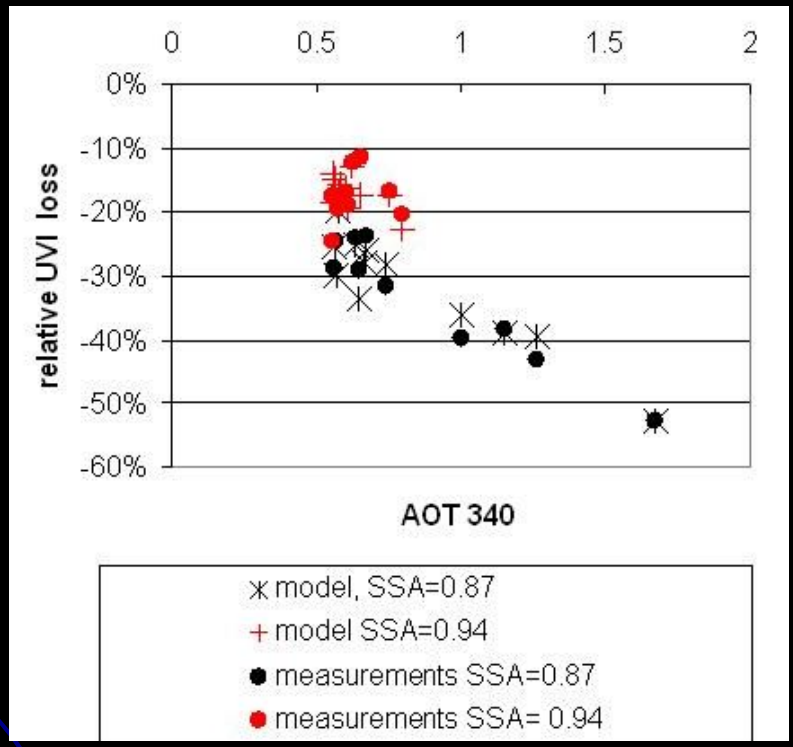
calibration factor 0.131±0.001 at 95%.

The UV loss due to AOT and SSA



The difference should be less than 2% at AOT340 <0.15

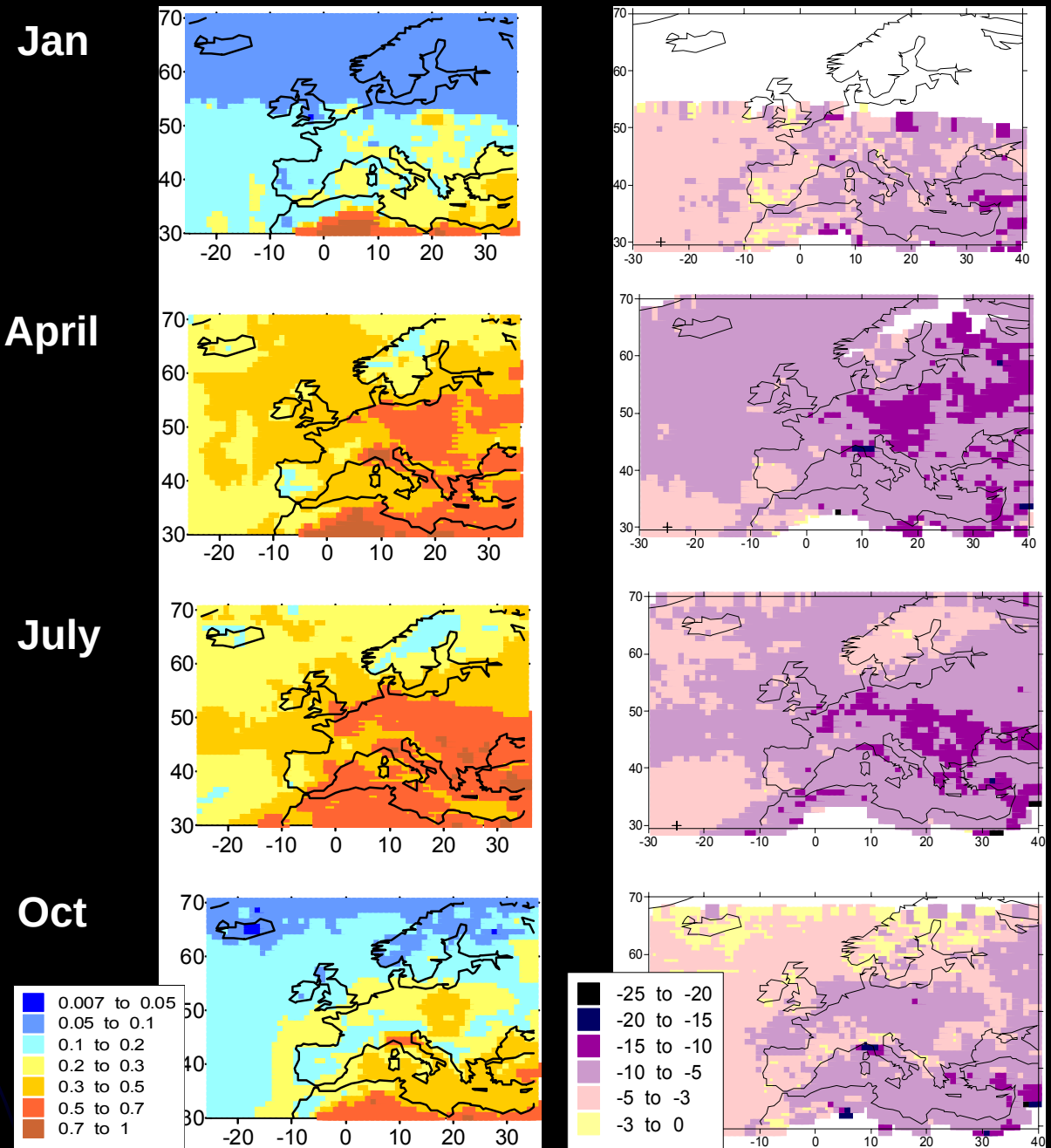
Comparisons with model calculations in clear sky conditions:



After matching the difference about 6%

AOT308 Relat. UVI changes

Relative attenuation in UV indice due to aerosol in January, April, July and October over Europe. Noon conditions.



AOT308 Abs. UVI changes

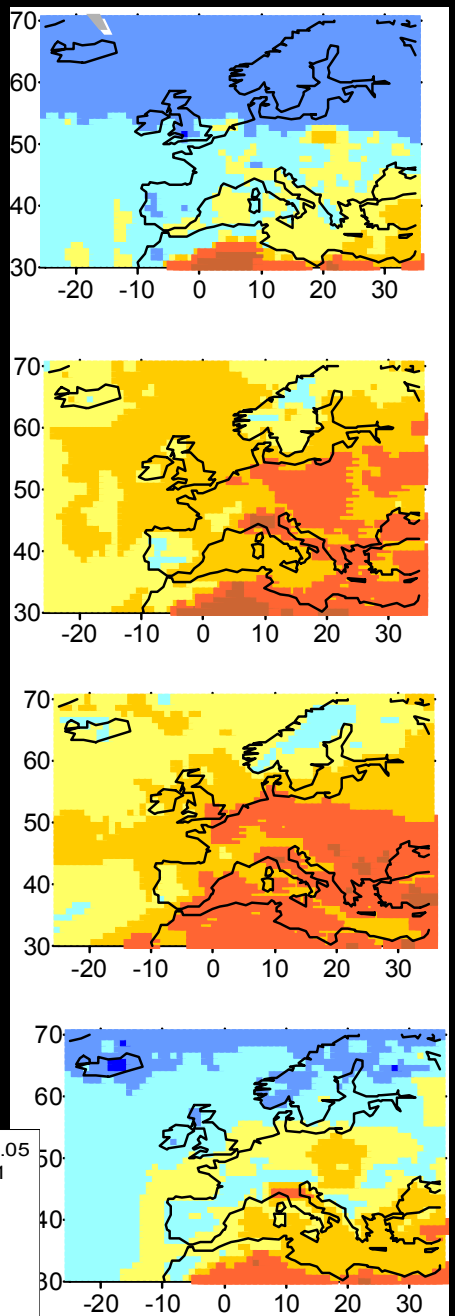
Absolute losses in UV indice due to aerosol in January, April, July and October over Europe. Noon conditions.

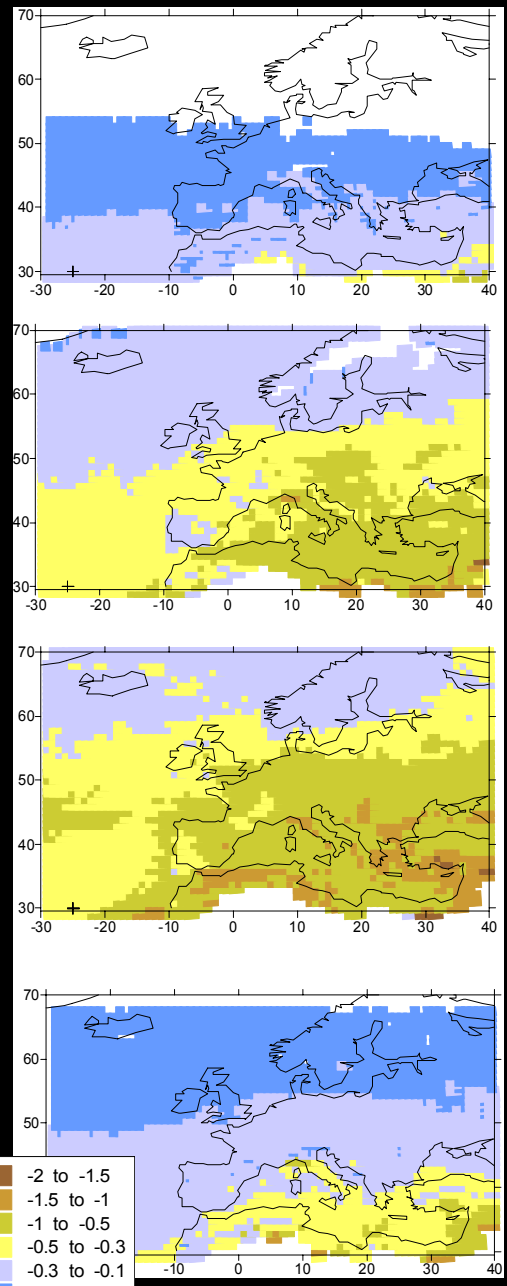
Jan

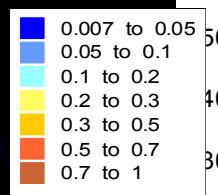
April

July

Oct







END

- Thank you!