Norwegian Meteorological Institute
met.no

Activities on acidification, eutrophication and photo-oxidants Progress and plans

Michael Schulz

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Outline

- Gothenborg protocol achievements and comments on revision
- EMEP model development
- Air pollution under climate change scenarios
- Evaluation of EMEP model with satellite data
- Short lived climate forcers
- Web site and Plans for 2012-2013

Emission trends 1990-2010

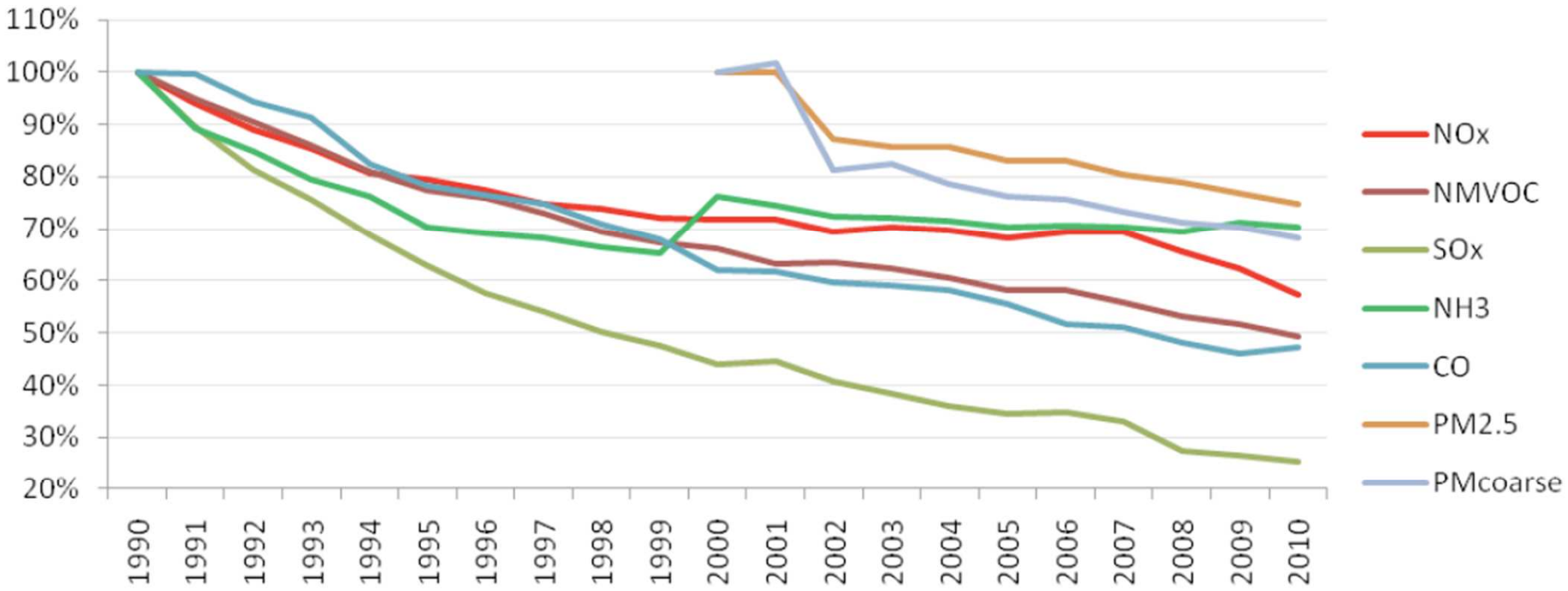


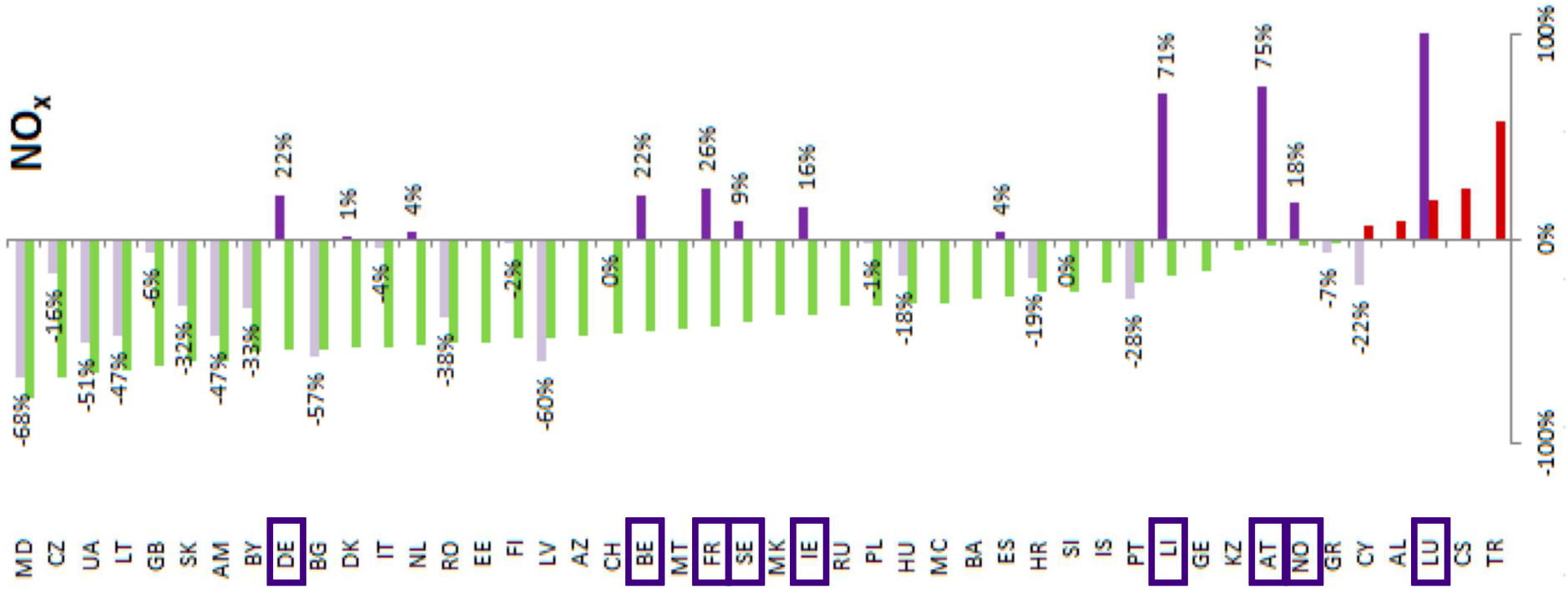
Figure 2.4: Expert estimates of the emission trends [%] in the EMEP area, 1990-2010.

Gothanborg Protocol achievements

Pollutant	Reduction expected (1990 to ceilings)	Reduction reported (1990 to 2010)
SO_x	66%	81%
NO_x	45%	49%
NMVOC	46%	57%
NH_3	14%	37%

Table 3.1: Comparison of emission reductions planned under the GP with reported emission reductions. The comparison is made using 1990 emissions as reported in 2012. These 1990 emissions differ from the emissions reported in 1999, when the GP was adopted.

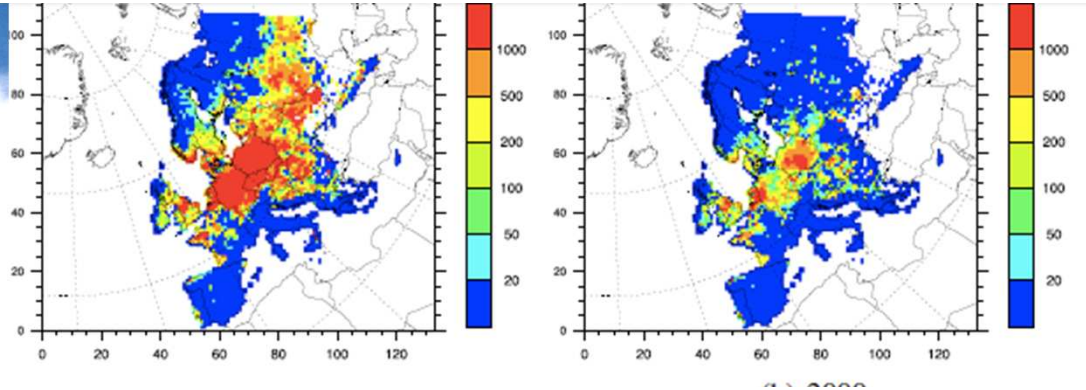
Green/Red = Actual reduction 2010 versus 1990
Gray/Lila = Over/Under-Achievement versus goals



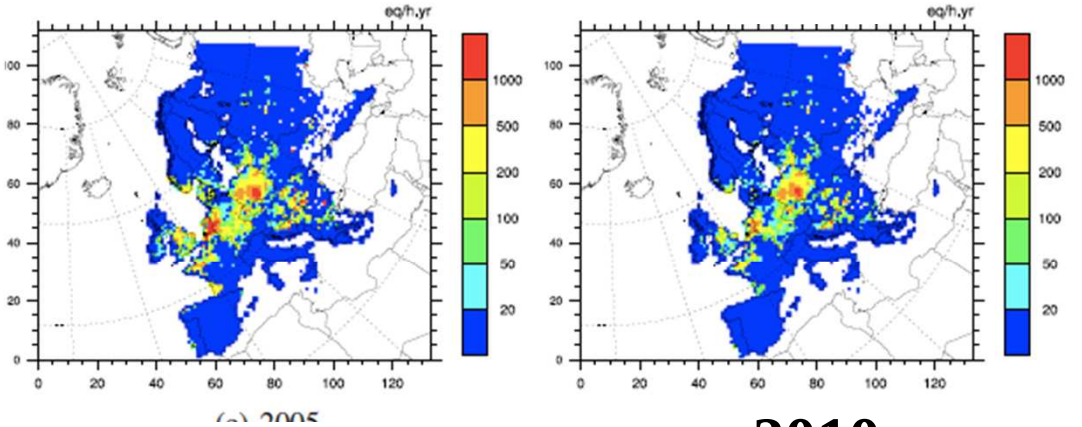
Critical loads Exceedance of acidity Eq ha^{-1} yr^{-1}

Areas at risk
1990 = 33%
2010 = 6%

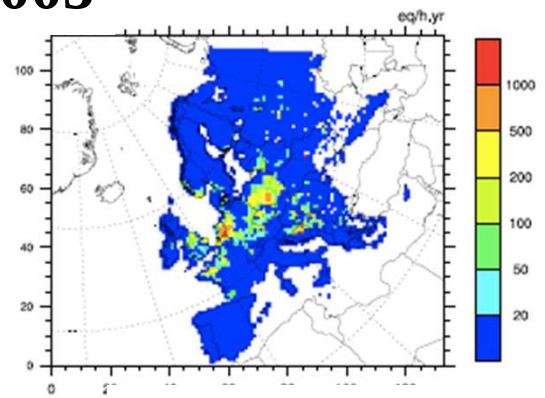
2020 = 4%



1990 2000



2005 2010

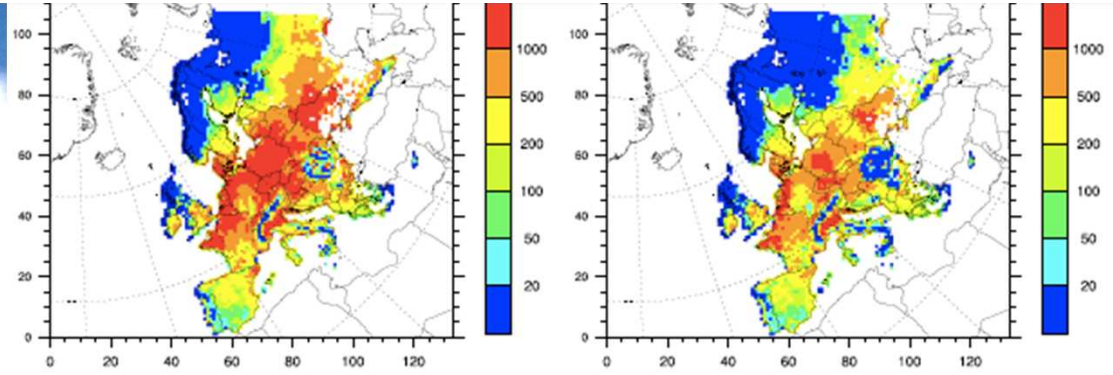


2020 revised GP

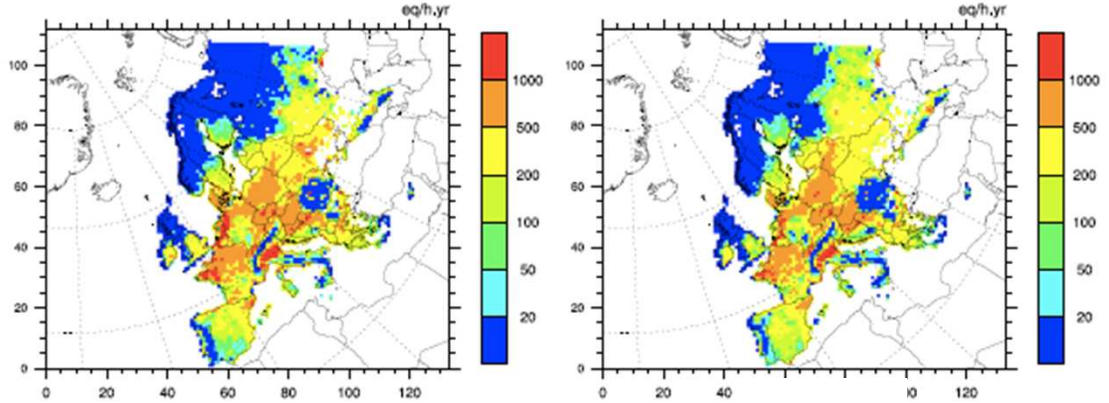
Critical loads
Exceedance
of nutrient nitrogen
Eq ha^{-1} yr^{-1}

Areas at risk
1990 = 63%
2010 = 52%

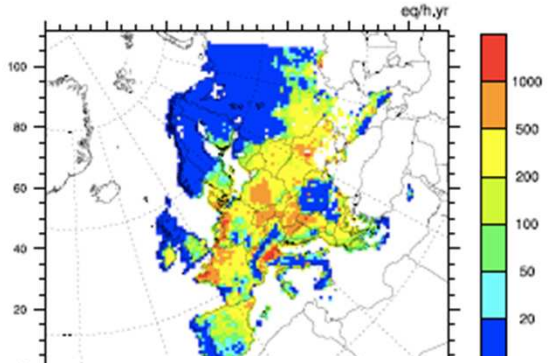
2020 = 37%



1990 2000



2005 2010



2020 revised GP

EMEP model development (I)

- Most recent EMEP model code just published
- 12 papers published in ACP- EMEP special issue since Sep 2011

Atmos. Chem. Phys., 12, 7825–7865, 2012
www.atmos-chem-phys.net/12/7825/2012/
doi:10.5194/acp-12-7825-2012

Atmospheric Chemistry and Physics

The EMEP MSC-W chemical transport model – technical description

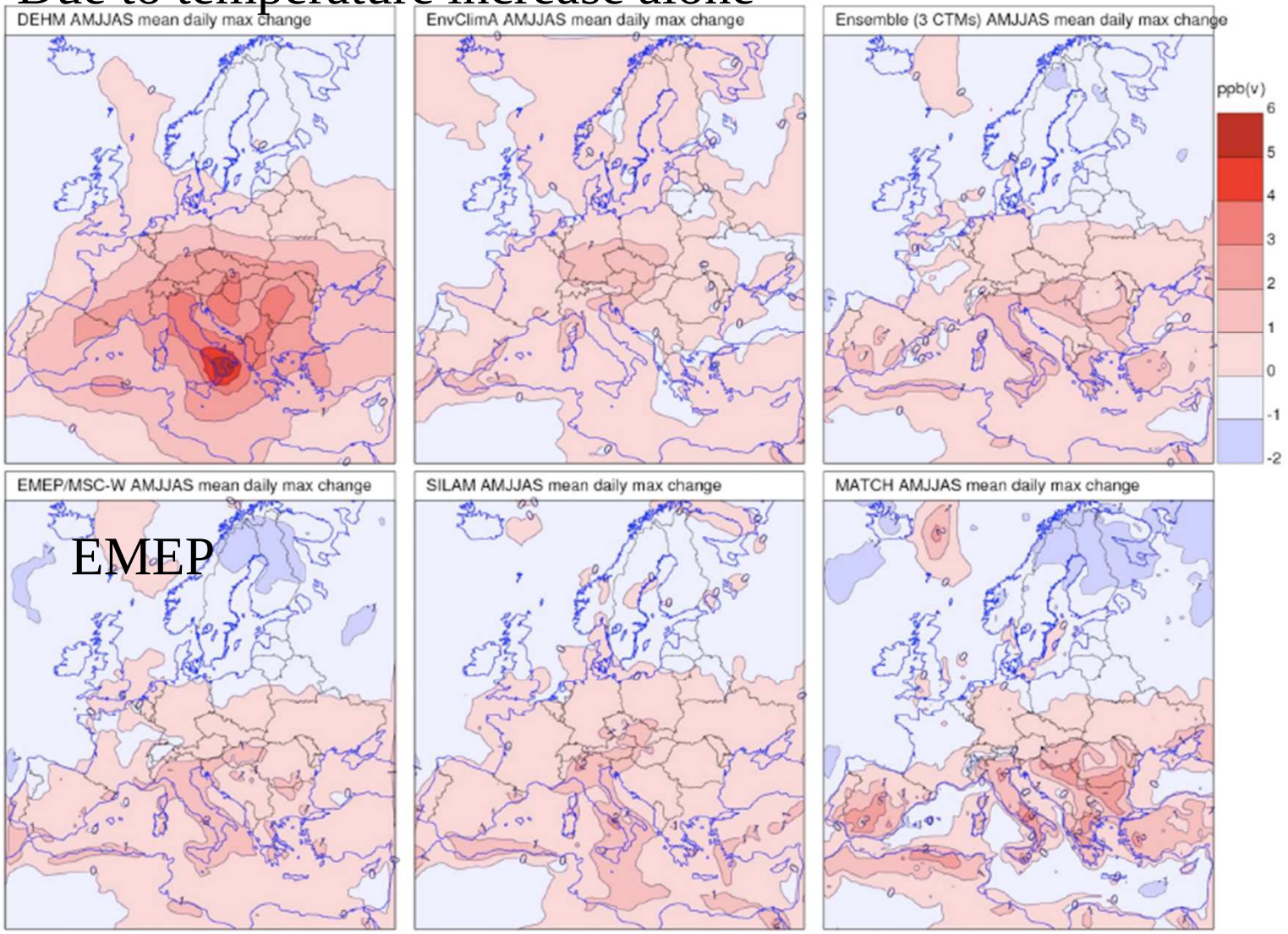
D. Simpson[1,2], A. Benedictow[1], H. Berge[1], R. Bergström[3,4], L. D. Emberson[5], H. Fagerli[1], C. R. Flechard[6], G. D. Hayman[7], M. Gauss[1], J. E. Jonson[1], M. E. Jenkin[8], A. Nyíri[1], C. Richter[9], V. S. Semeena[1], S. Tsyro[1], J.-P. Tuovinen[10], Á. Valdebenito[1], and P. Wind[1,11]

EMEP model development (II)

- Secondary organic aerosol in standard code
- pH in cloud water calculated (assumed constant before)
  Change of atmospheric chemistry over time!
- Several adjustements to reactive nitrogen scheme
- Soil NO emission taking into account Nox deposition
- Elemental carbon ageing
- Road dust emission module
- Desert dust source linked to soil properties
- Soil moisture from ECMWF
- Extension of the volcanic emission module for emergencies
- Daily forest fire emissions

=> Bias reduction in PM consolidated

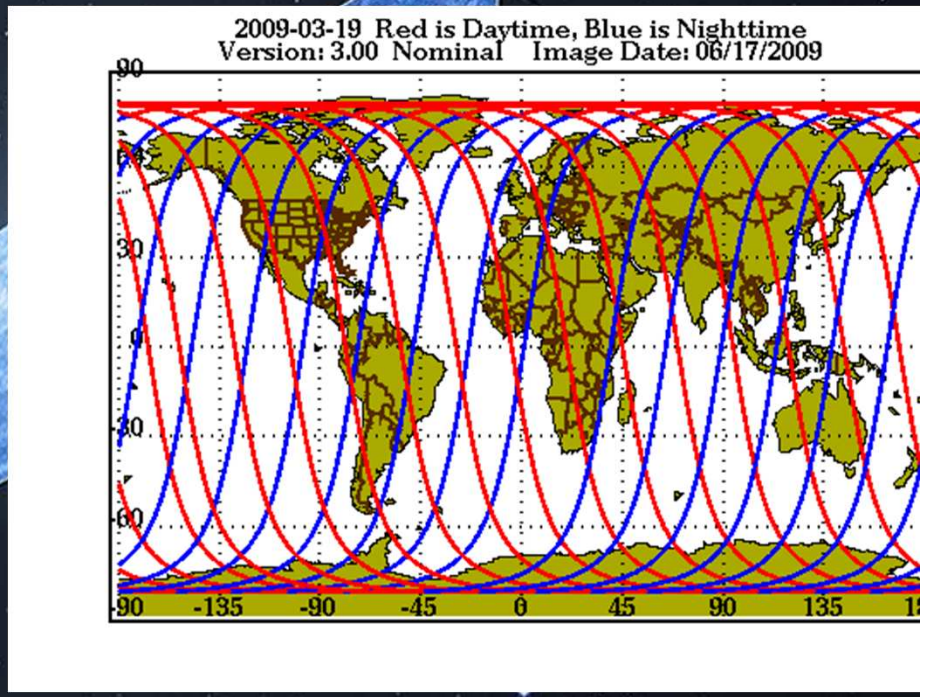
Increase in surface daily ozone maximum in 2040-49
Due to temperature increase alone



Langner et al., 2012

Figure 7.2: Simulated April-September change 2000-2009 to 2040-2049 in average daily maximum

Using a 3D aerosol climatology from CALIPSO/CALIOP to complement EMEP monitoring



Courtesy

Brigitte Koffi, LSCE

Dave Winker, NASA LaRC

Why should we use CALIOP data for EMEP ?

Aerosol extinction = Mass x Extinction coefficient$_c$

[m^{-1}] = [g m^{-3}] x [m^{-2} g^{-1}]

⇒Correlated to PM (better than passive sensor AOD)

⇒If aerosol optical properties calibrated its equivalent to PM

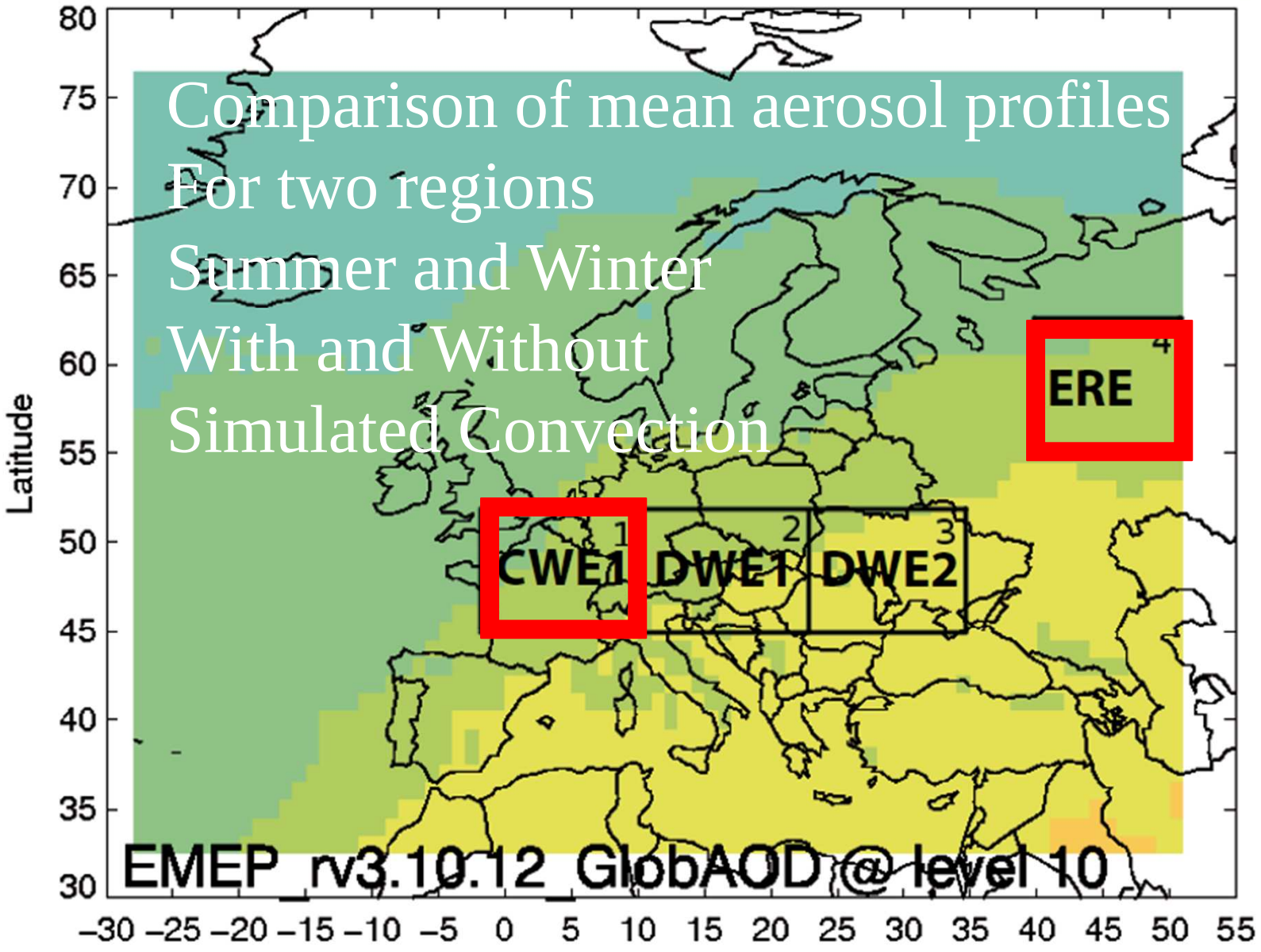
Active sensor is independent of surface reflectance

=> Observes in region with little monitoring

Observes vertical profile of aerosol down to the ground

⇒Independent check on dispersion of ground level emission

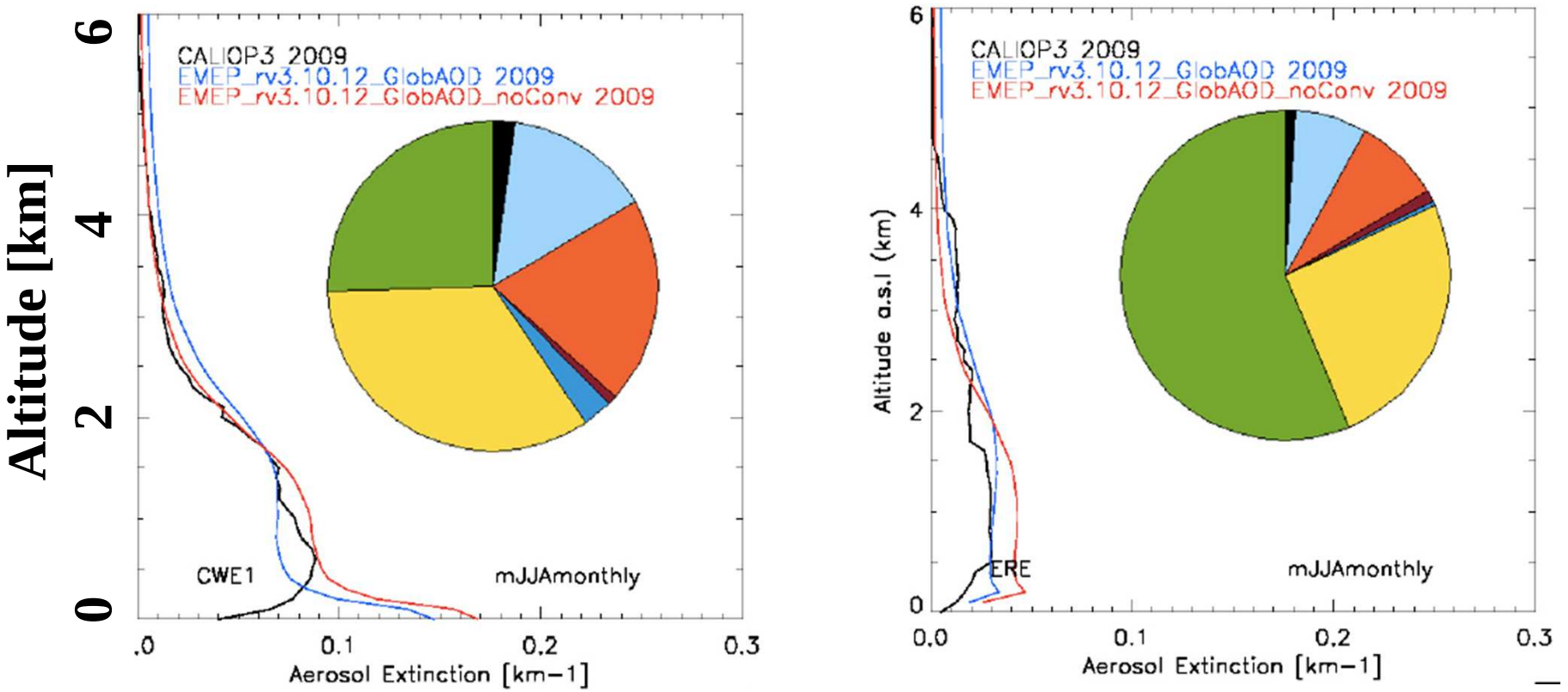
⇒Long-range transport removal constraint


Comparison of mean aerosol profiles
For two regions
Summer and Winter
With and Without
Simulated Convection
ERE
4
CWE1
1
DWE1
2
DWE2
3
EMEP_rv3.10.12_GlobAOD @ level 10
Latitude
80
75
70
65
60
55
50
45
40
35
30
–30 –25 –20 –15 –10 –5 0 5 10 15 20 25 30 35 40 45 50 55

Summer JJA

CWE Central West Europe

ERE Northern Russia



Caliop vs EMEP EMEP with no convection

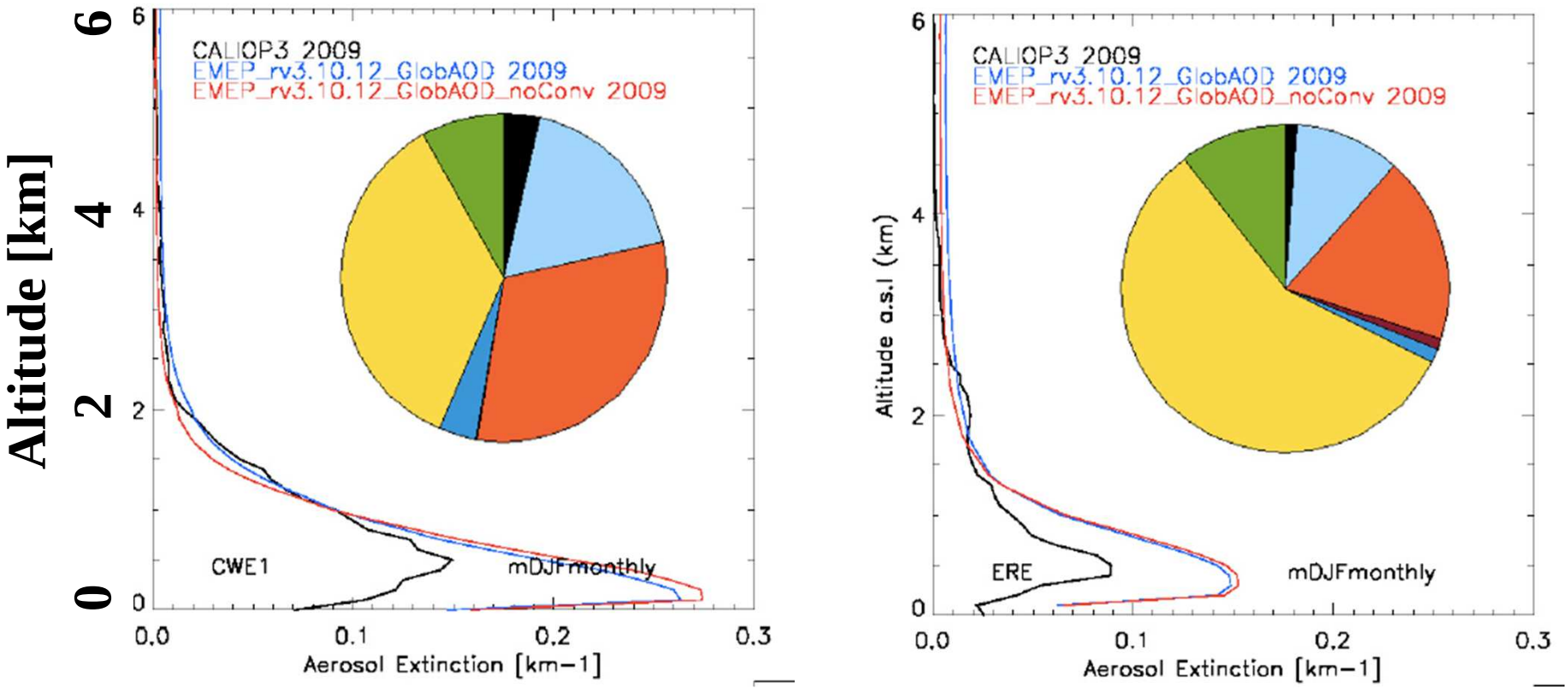
Pie => Aerosol Composition from EMEP model

Organic Sulfate SeaSalt Nitrate Ammonium BlackCarbon

Winter DJF

CWE Central West Europe

ERE Northern Russia



Caliop vs EMEP EMEP with no convection

Pie => Aerosol Composition from EMEP model

Organic Sulfate SeaSalt Nitrate Ammonium BlackCarbon

Conclusions EMEP-CALIOP work

Convection parameterisation has a useful effect for simulate summer time aerosol dispersion

The form of the winter versus summer vertical dispersion Is correctly simulated by EMEP model

Aerosol loads in summer seem correct, while overestimated in winter, OR optical properties in winter incorrect

Relative difference in aerosol concentration in between subregions of Europe can be captured with CALIOP (and model)

Profile near surface level requires further research

Work on short lived climate forcers, eg black carbon

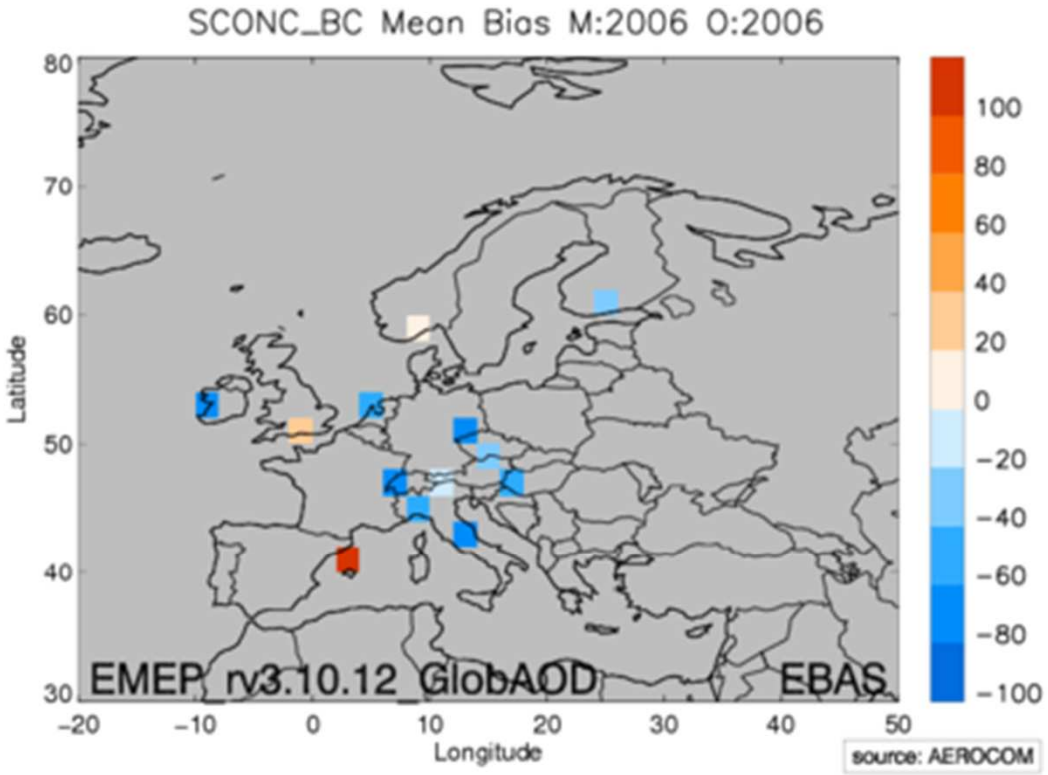
EUSAAR/ACTRIS/EMEP supersites provide high quality elemental carbon and absorption coefficients since ca 2008

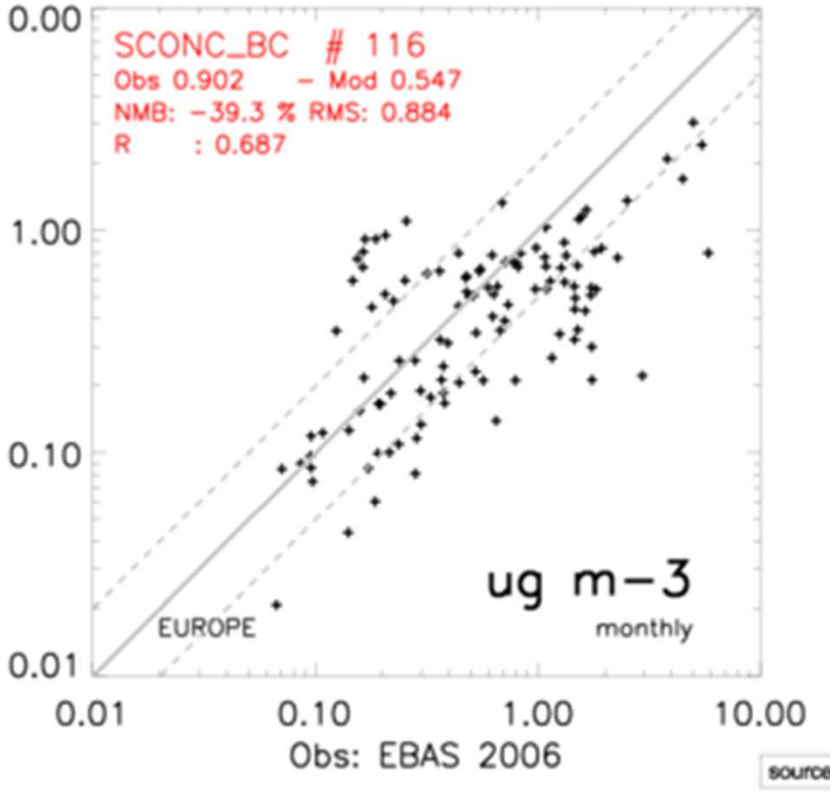
Global models and EMEP model underestimate "BC"

Mass absorption efficiency evaluation
links to BC forcing estimate

Consistency check of global black carbon dispersion

EMEP model evalution of BC





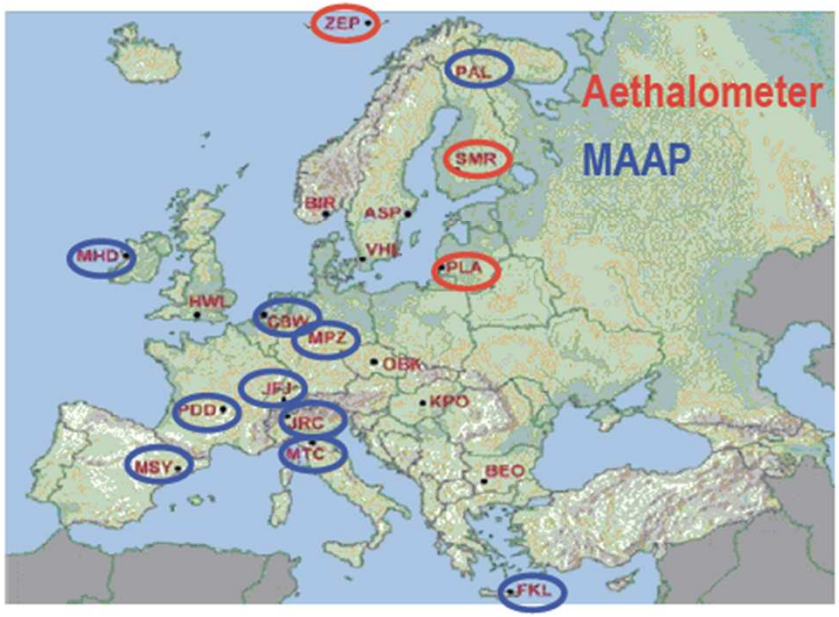
EUSAAR
EUropean Supersites for Atmospheric Aerosol Research

European Commission

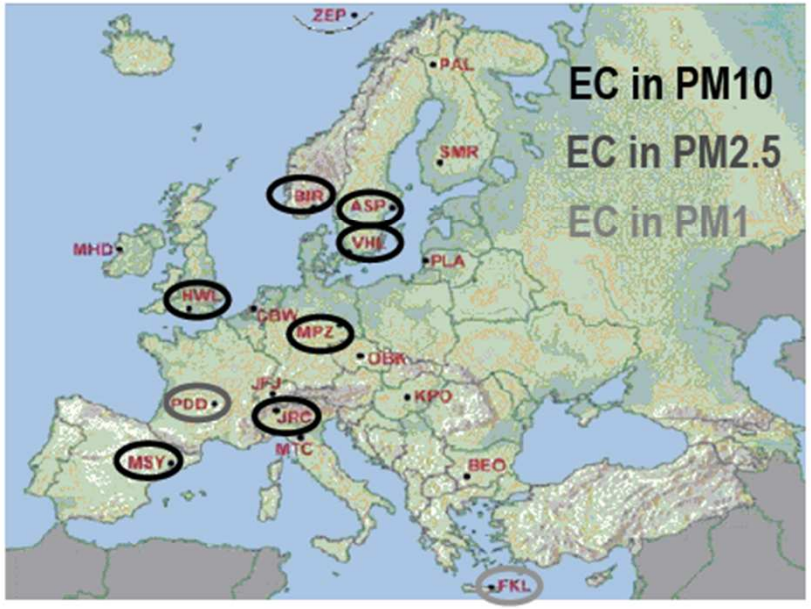
ACTRiS

Stations used in the study

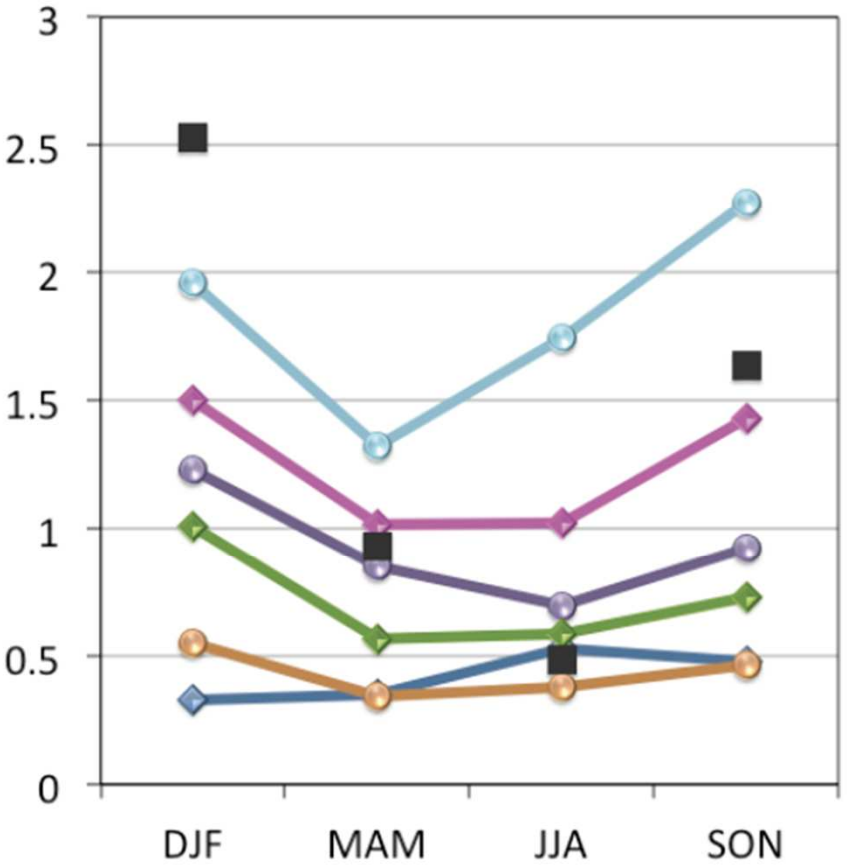
Absorption coefficient



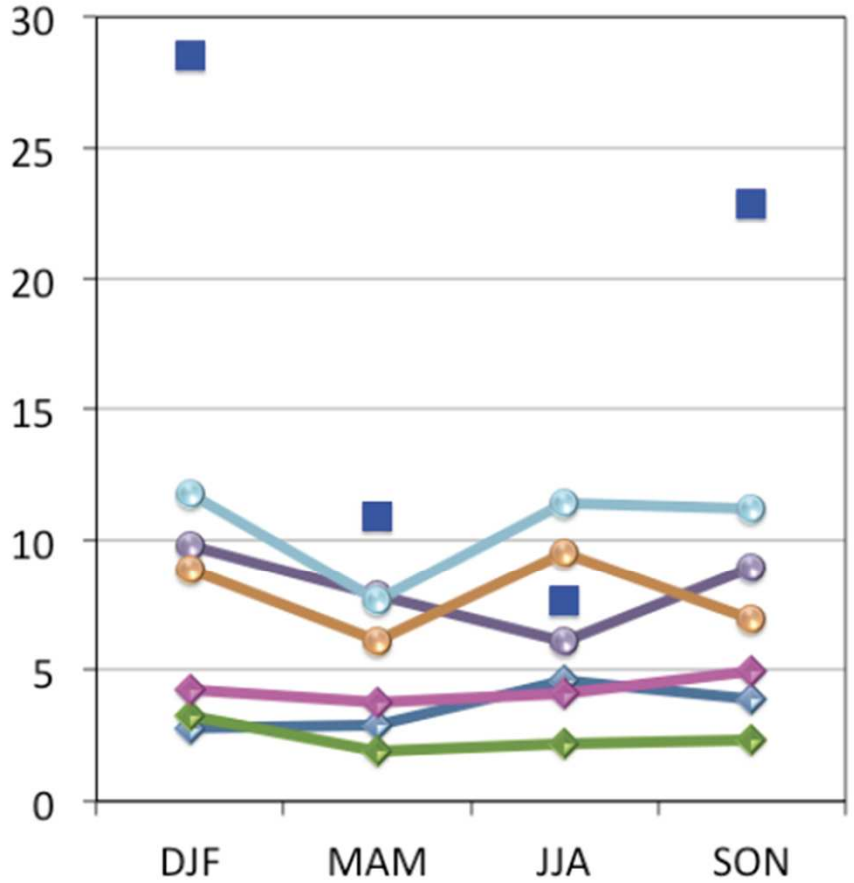
Elemental Carbon



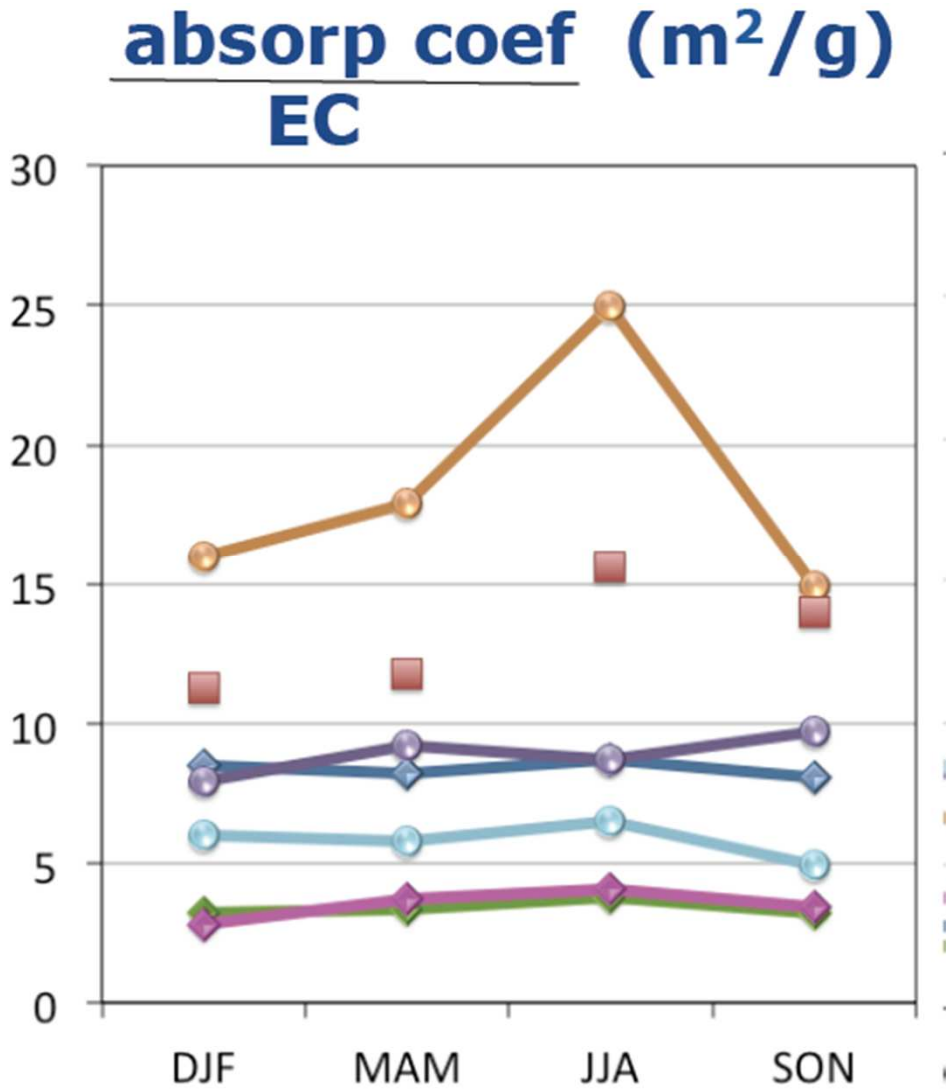
EC (μg/m³)



absorp coef (1/Mm)



Courtesy E. Vignati, F. Cavalli, T. Mueller, A. Virkkula, C. Lund Myhre, A. Wiedesohler, J. Ogren and P. Laj

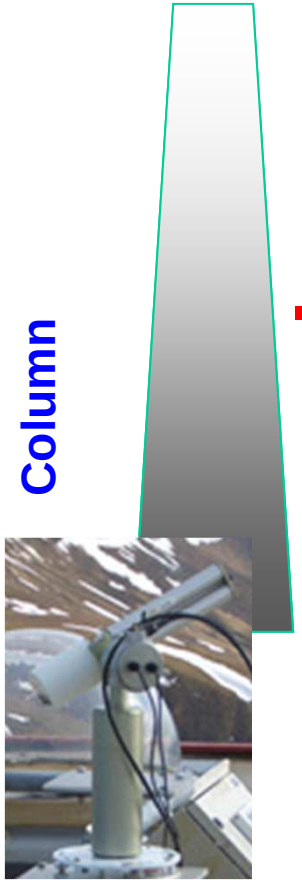


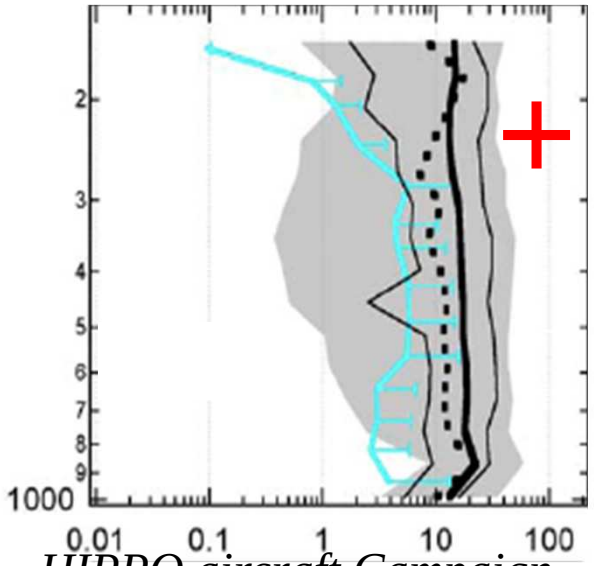
Courtesy E. Vignati, F. Cavalli, T. Mueller, A. Virkkula, C. Lund Myhre, A. Wiedesohler, J. Ogren and P. Laj

Inconsistent evaluation of black carbon in AeroCom model intercomparison

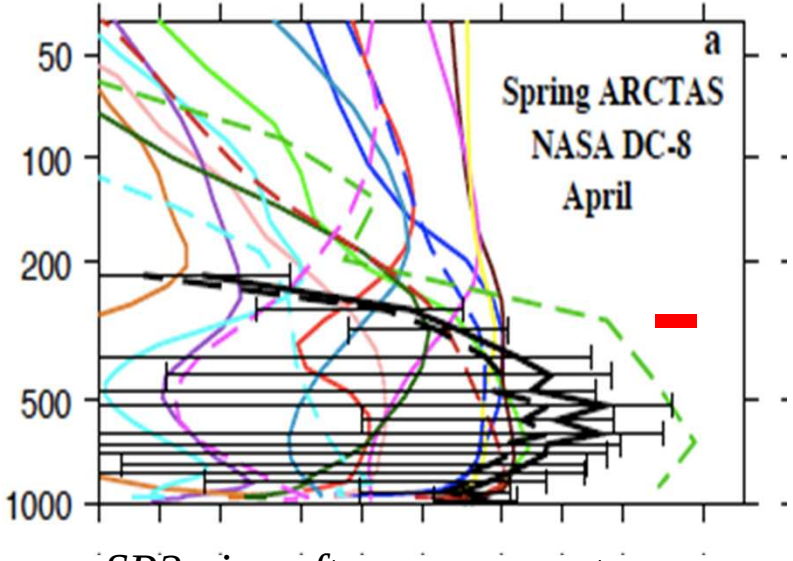
upper Troposphere

Column





HIPPO aircraft Campaign



SP2 aircraft measurements

surface

[Model bias]

Next steps wrt to black carbon

IGAC "BC bounding" Bond et al., in revision

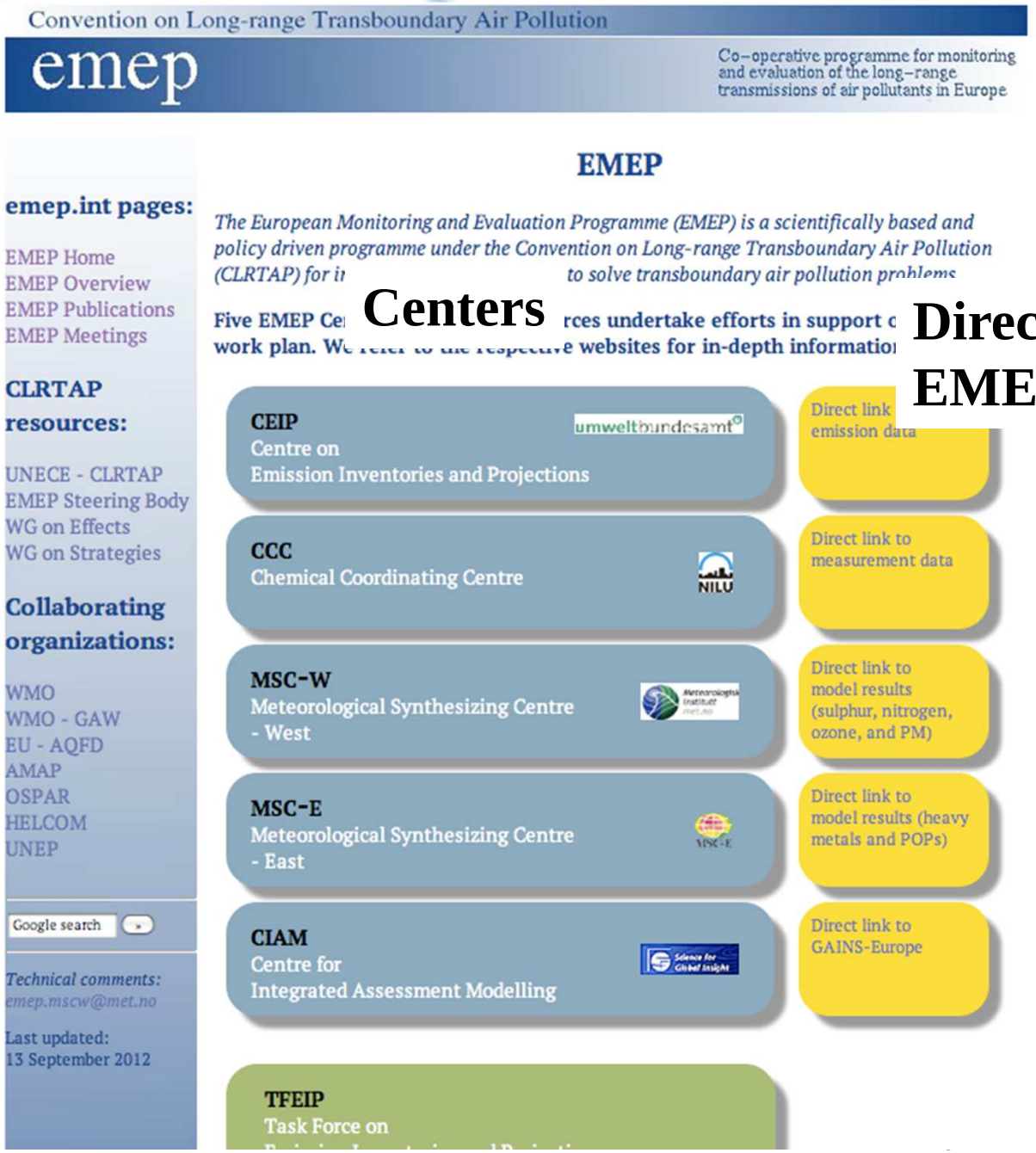
Evaluation of seasonal BC simulation at European supersites

BC, NOx … S/R studies and climate response investigation in EU-ECLIPSE project

Quantification of role of fires, wood burning, diesel with EMEP model

NEW EMEP website

emep.int/index_mg.html



Centers

Direct access to EMEP products

Interactive Country Report ?

NEW EMEP website

emep.int/index_mg.html

Reports from EMEP bodies

Better link to Peer-reviewed publications

Plans 2012-2013

- Revision of EMEP.INT web site in collaboration with SB and Centres
- Trend analysis for (1990-) 2000-2010 period / focus on reactive nitrogen
- Analysis of monitoring capacity and vertical dispersion with CALIOP
- Change of grid to new standard EMEP grid, model improvements
- Analysis of high resolution SR simulation with up to date emissions
- Influence of hemispheric background on European O3 and PM levels
- Support of the new HTAP process
- Methane in the EMEP model, dynamic source
- Regional black carbon transport and radiative forcing
- Response of regional climate to regional SLCF perturbation using NorESM and EMEP models
- Cooperation in several in-kind projects on chemical forecasting MACC, ash forecasting, model evaluation (AeroCom&EBAS), emission evaluation, climate-air quality interaction