Use of surface concentrations and absorption measurements for evaluation of modelled BC

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Major scientific foci of the study

Linking AEROCOM/ FP6 EUCAARI/ FP6 EUSAAR/ AERONET model and observations to explore the link from BC emissions to forcing over Europe:

- four General Circulation Models (GCM):
  - MPI-HAM- Max Planck Institute – Hamburg, DE
  - CAM4-Oslo - University of Oslo, NO
  - HadGEM2 - Hadley Center, UK
  - LSCE - MET-NO, NO

Major scientific foci of the study

- Harmonisation of measurements-models interface

EUSAAR
EUropean Supersites for Atmospheric Aerosol Research

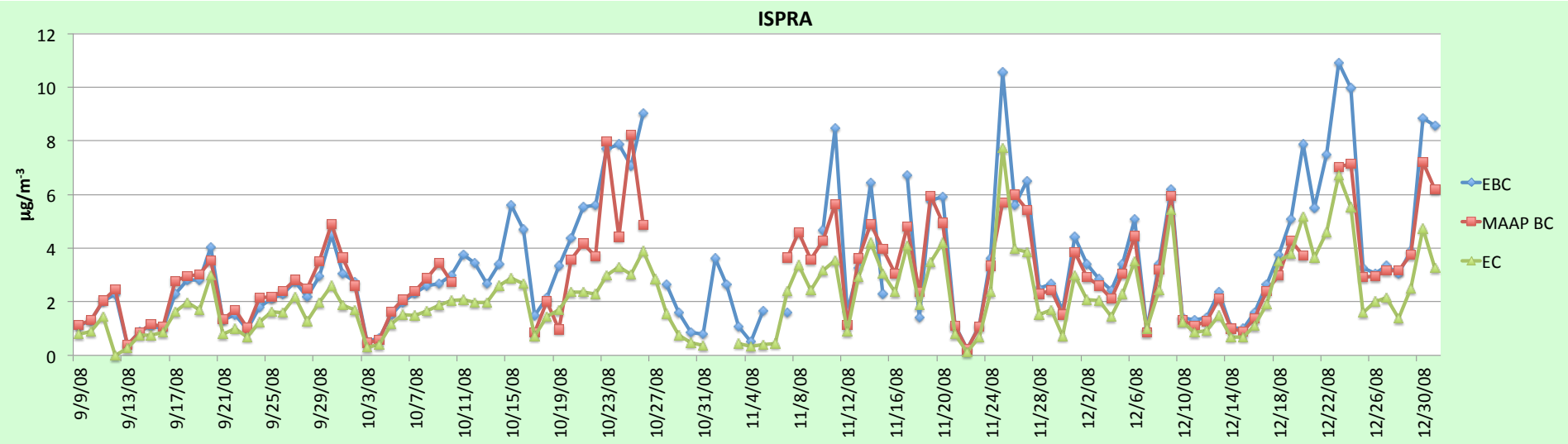
- high quality measurements of surface concentrations and absorption in Europe 2008-2009(-2010):
  - Not only evaluation of concentrations and absorption, but also testing the modelled relation between them using the measurements

Use of observations for model evaluation

- Black carbon: light absorbing portion of carbonaceous particles ….. but …..
- emission inventories used in models are of elemental carbon (EC) (Vignati et al, ACP, 2010)

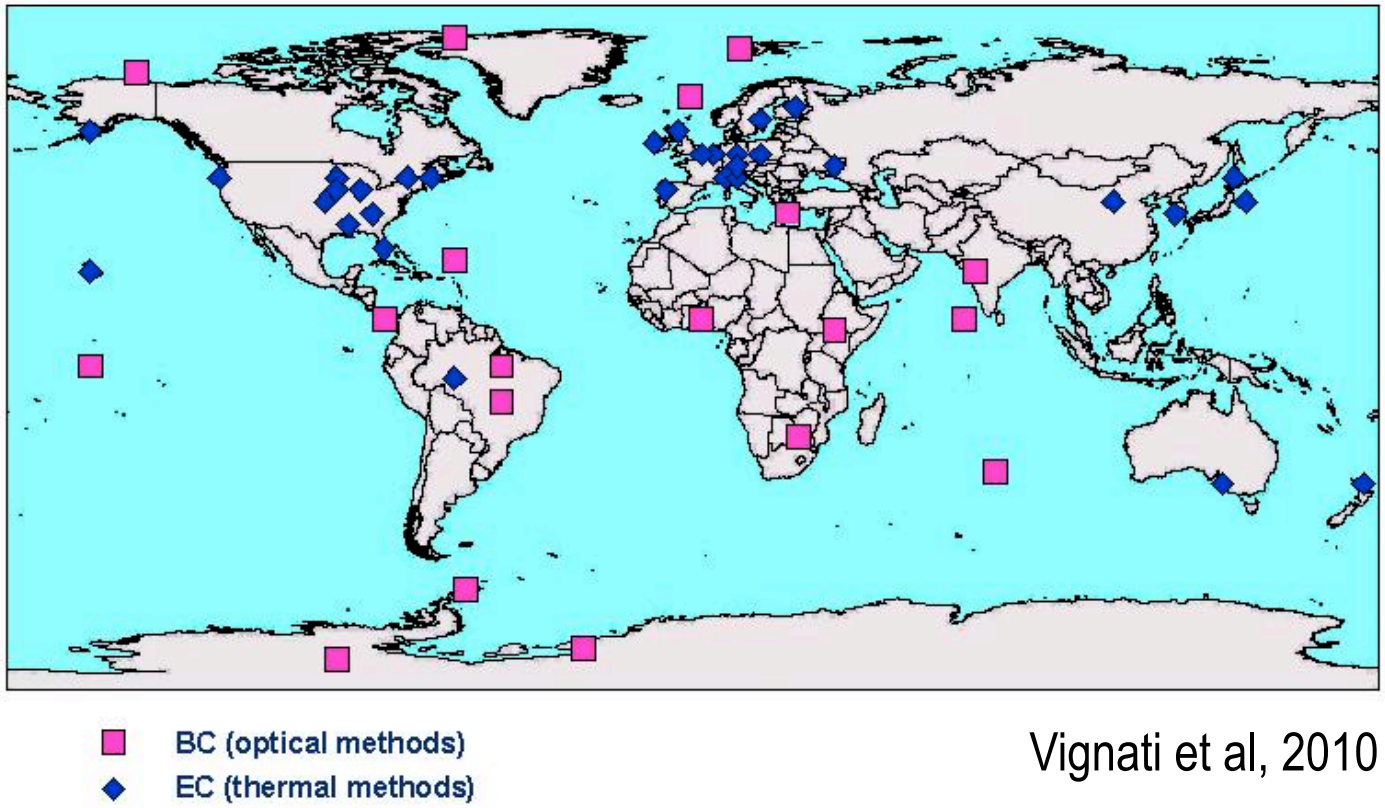
  ➢ concentrations must be compared to EC measurements

EC – BC – EBC ?????



EBC – Aethalometer

EBC/EC and MAAP/EC from 0.8 – 2.5



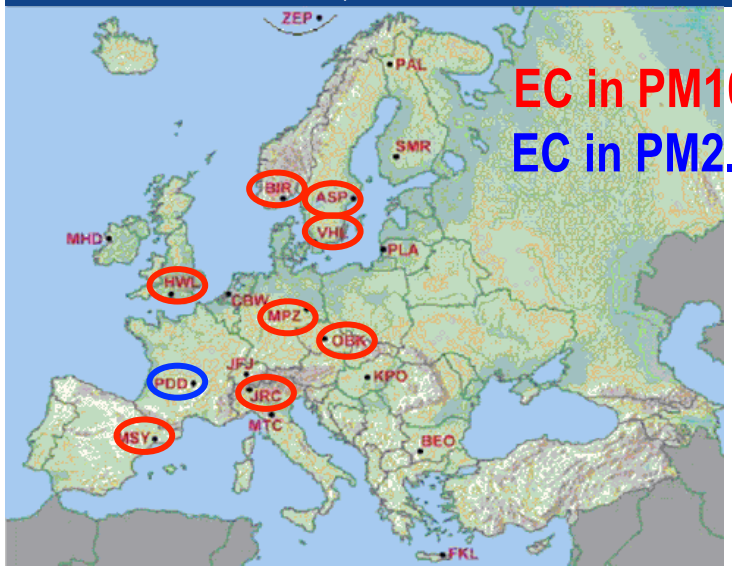
Vignati et al, 2010

BC/EC from 1 to 3 (highest values in urban environment)

season dependent: ex. Alert =1 in winter, =1.5 summer (Sharma et al. 2004)

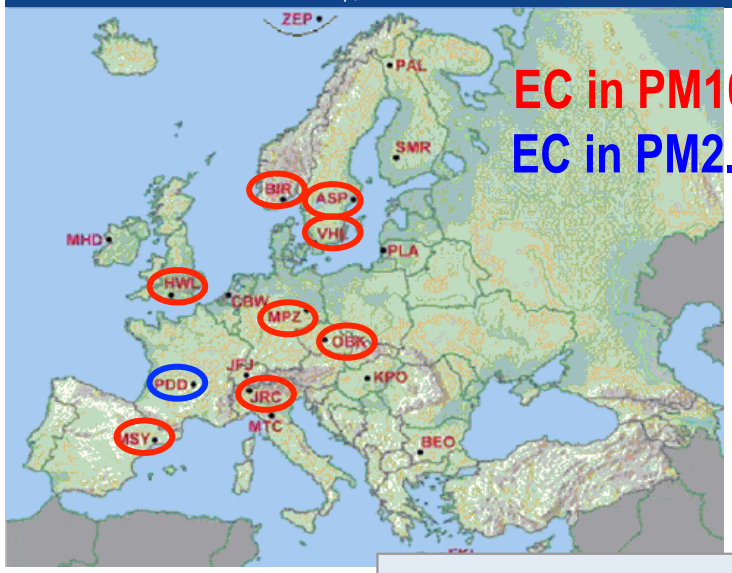
If BC/EC is known, stations could be considered

Observed surface EC concentrations



EUSAAR measurements

Observed surface EC concentrations

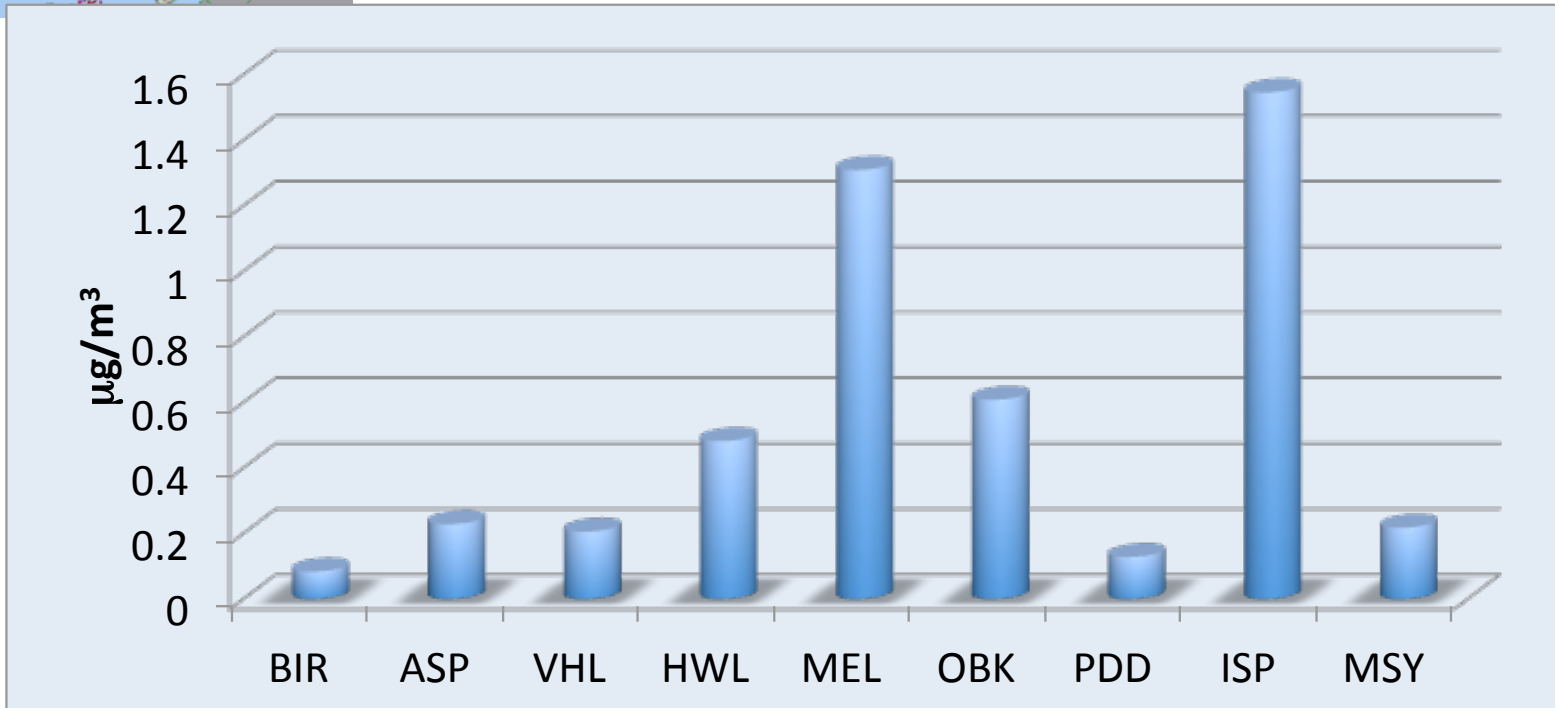


EC in PM10

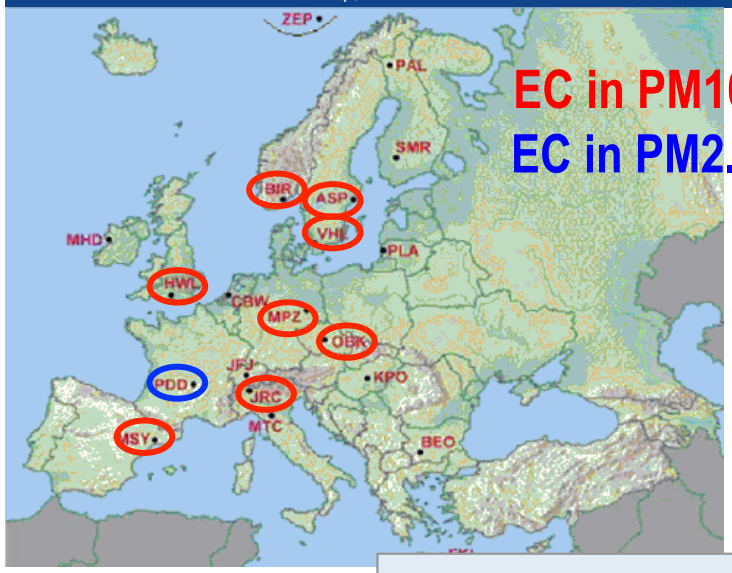
EC in PM2.5

EUSAAR measurements

2008 annual average



Observed surface EC concentrations



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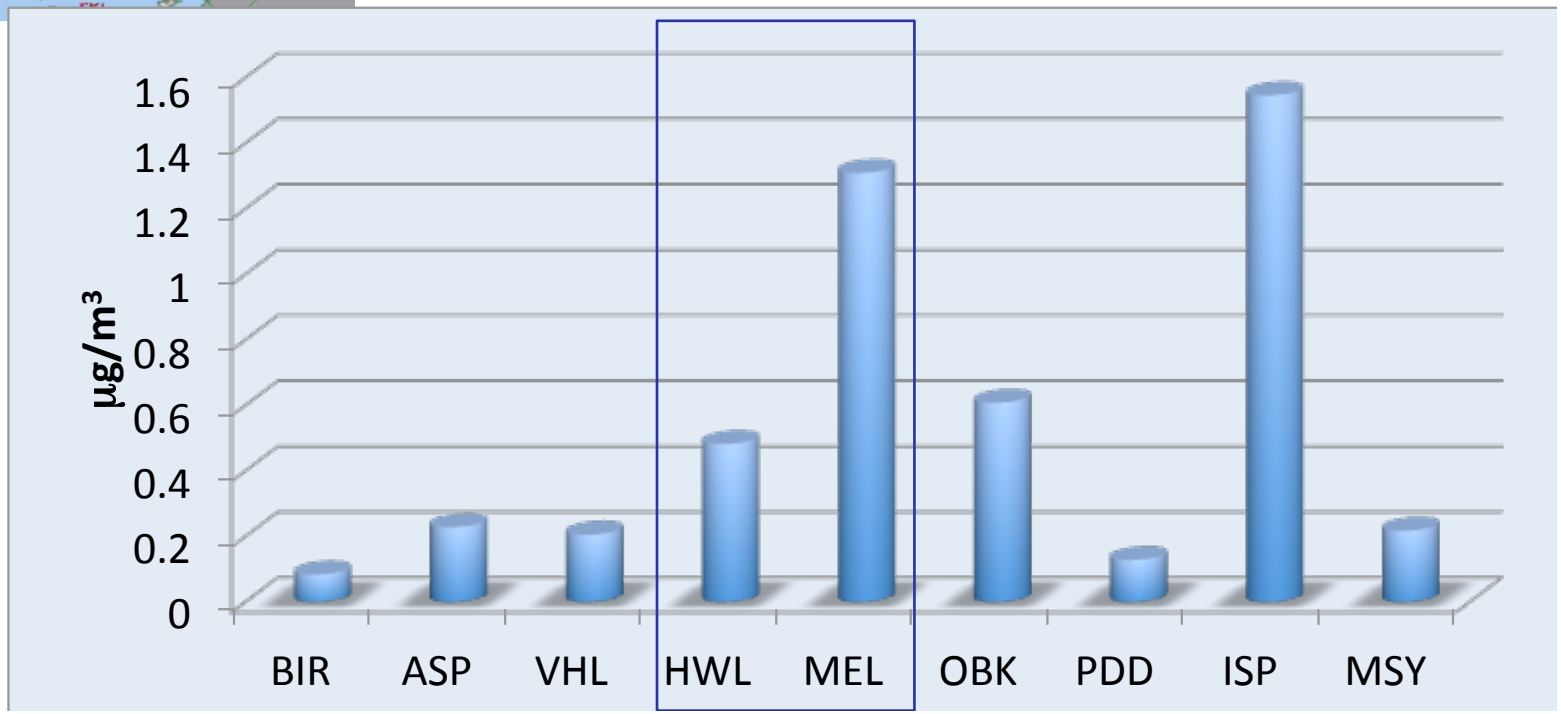
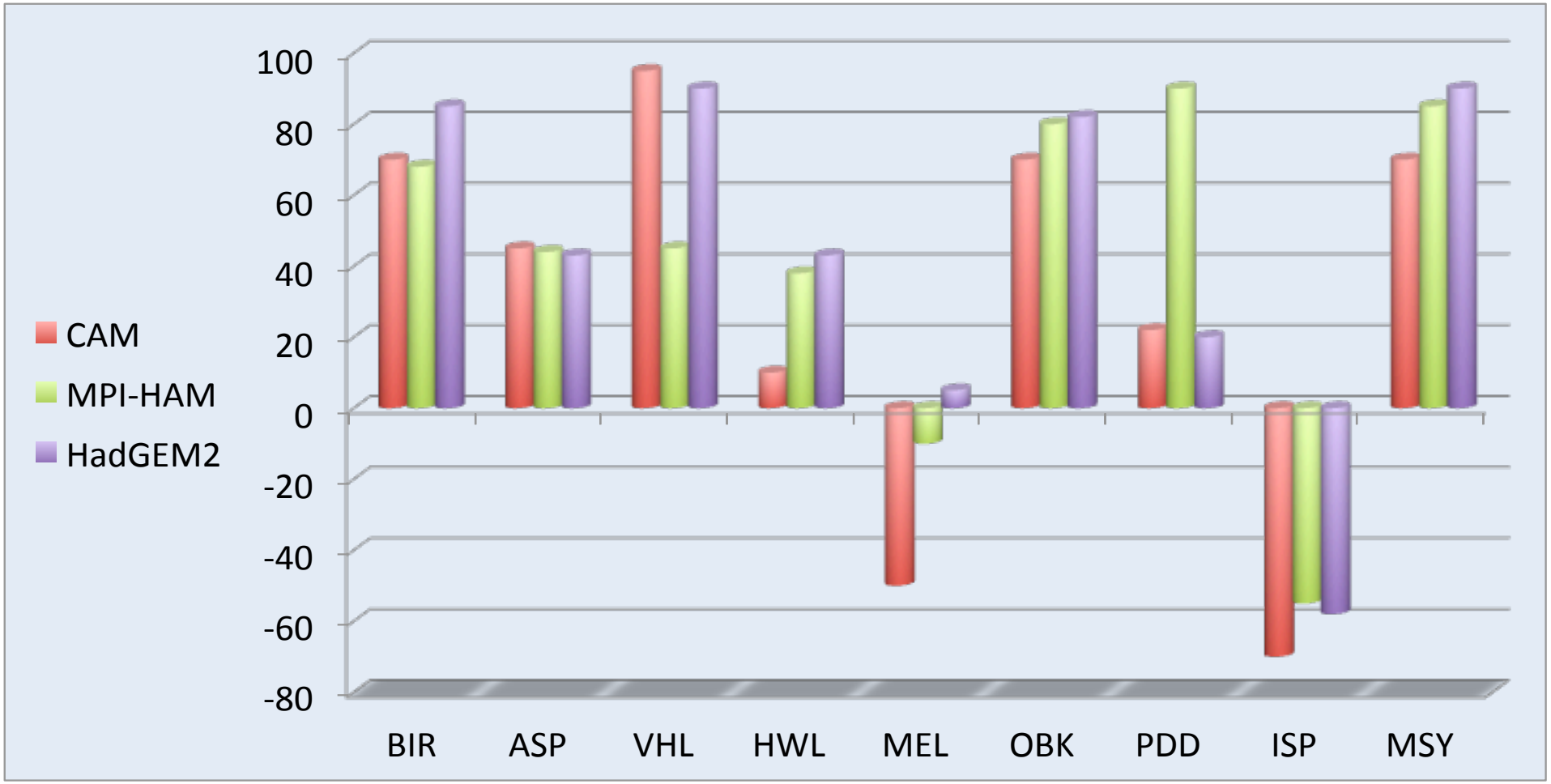


Normalised model bias



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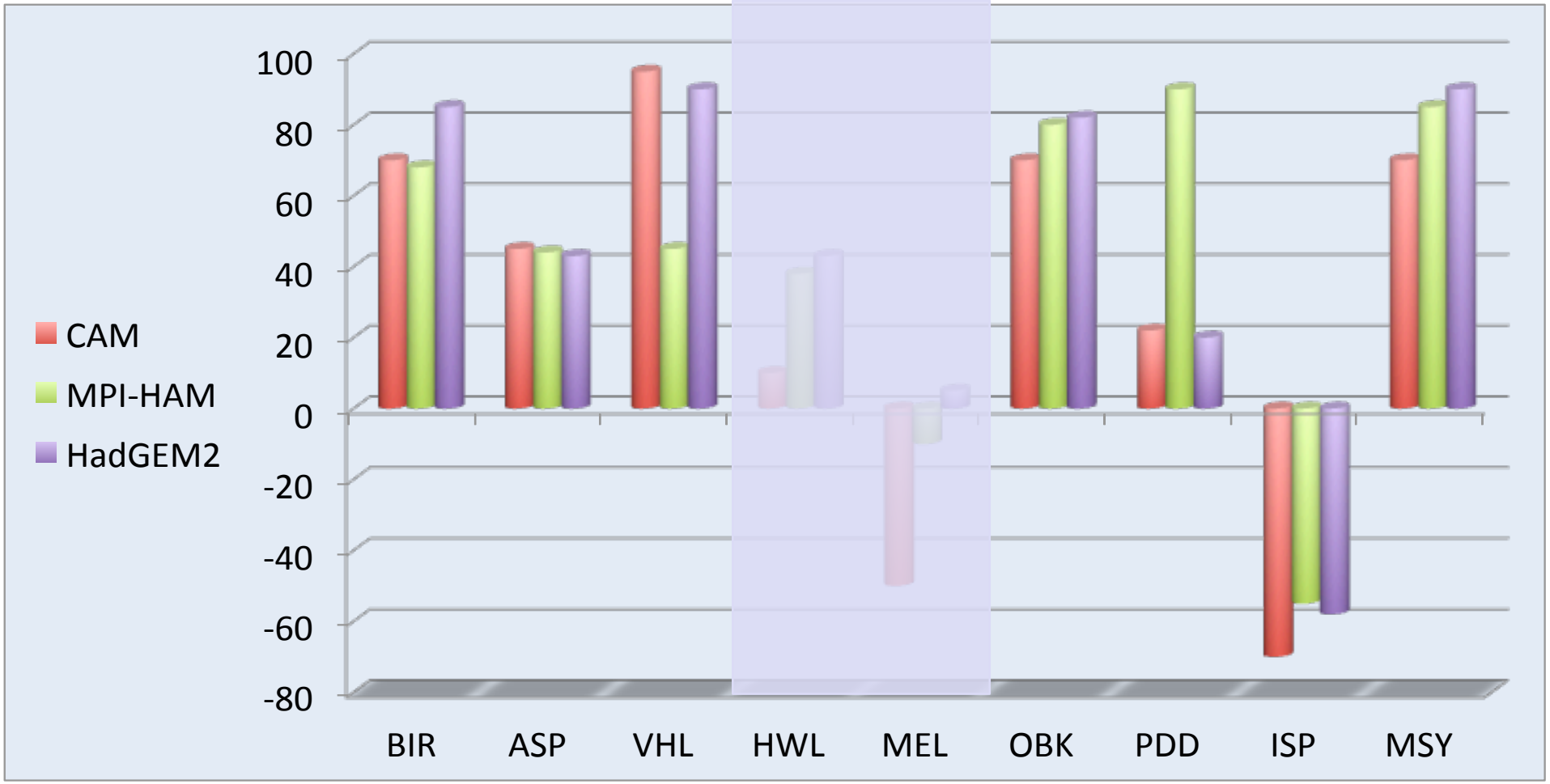


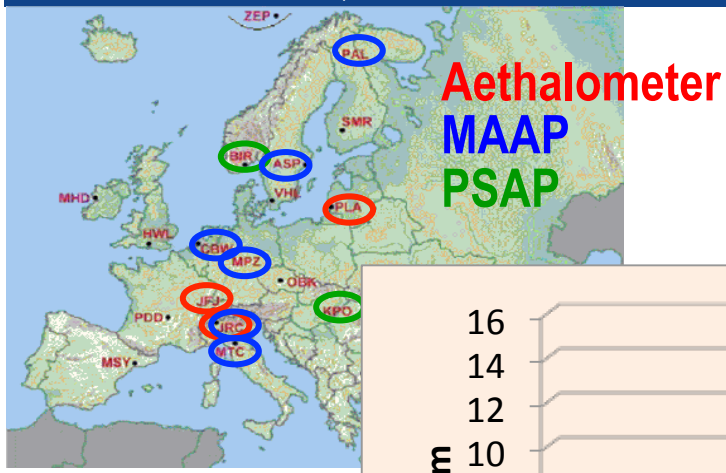
Use of observations for model evaluation

- Black carbon: light absorbing portion of carbonaceous particles ….. but …..
- emission inventories used in models are of elemental carbon (EC) (Vignati et al, ACP, 2010)

  ➢ concentrations must be compared to EC measurements

- modelled surface absorption coefficient (output at 550 nm) should be compared to observations at close wavelength

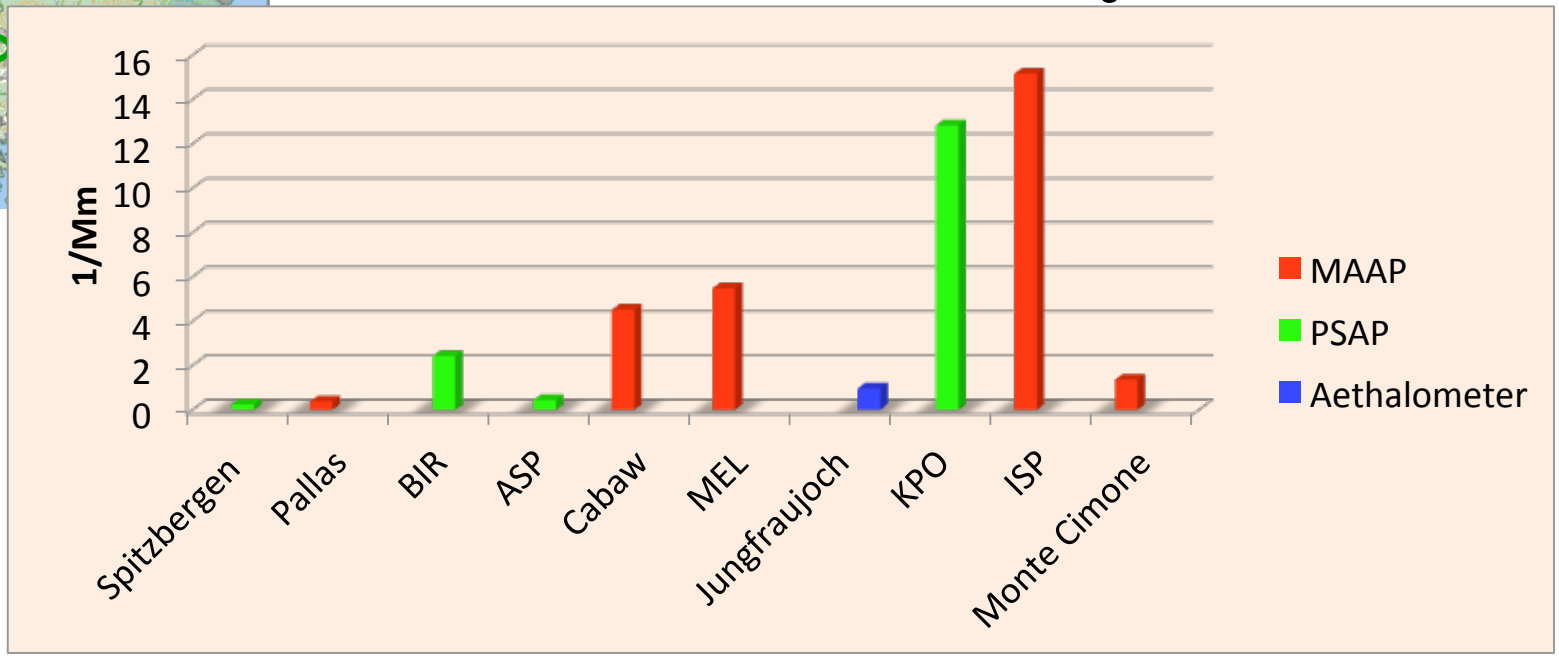
Evaluating surface absorption



Aethalometer
MAAP
PSAP

EUSAAR measurements on EBAS dataset (NILU)

2008 annual average



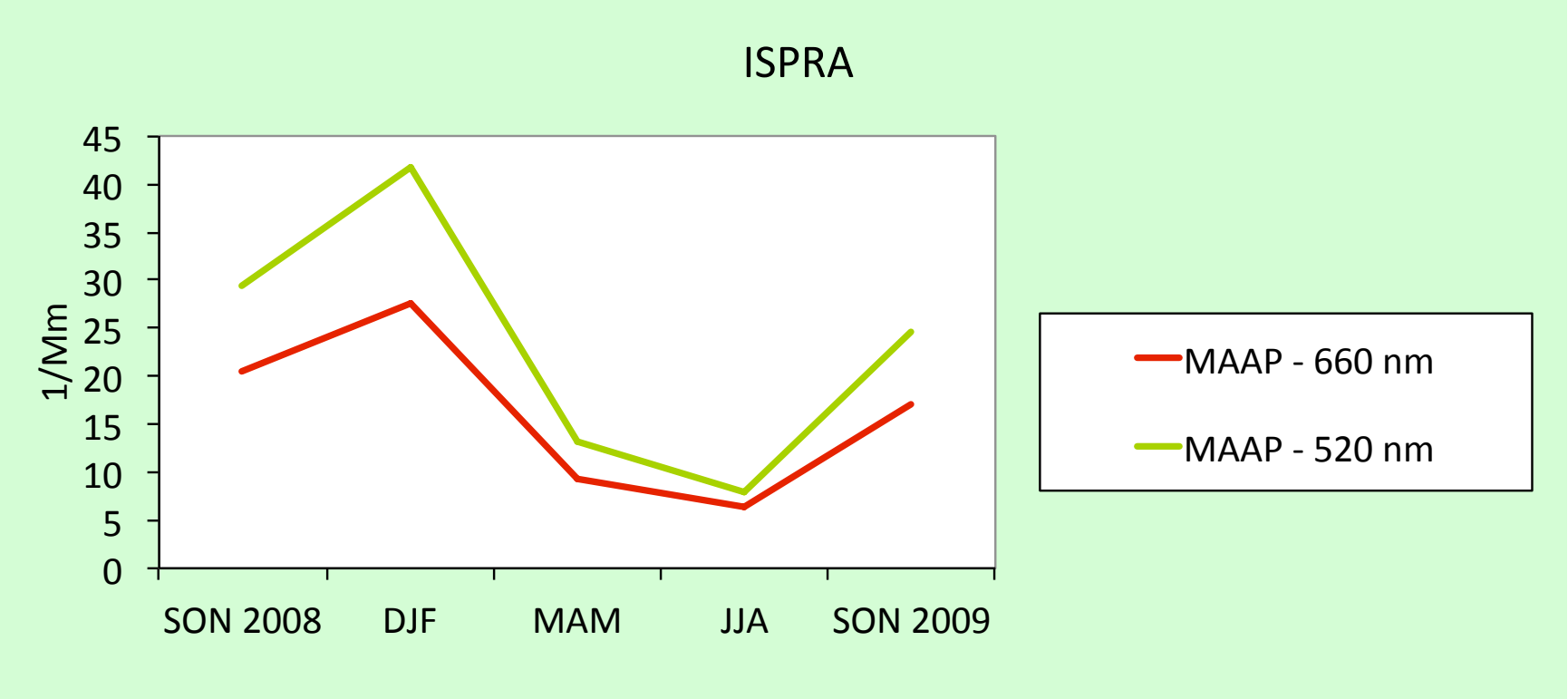
MAAP – 660 nm

PSAP – 520-530 nm

Aeth – not corrected

Modelled absorption output at 550 nm

Absorption at different wavelengths

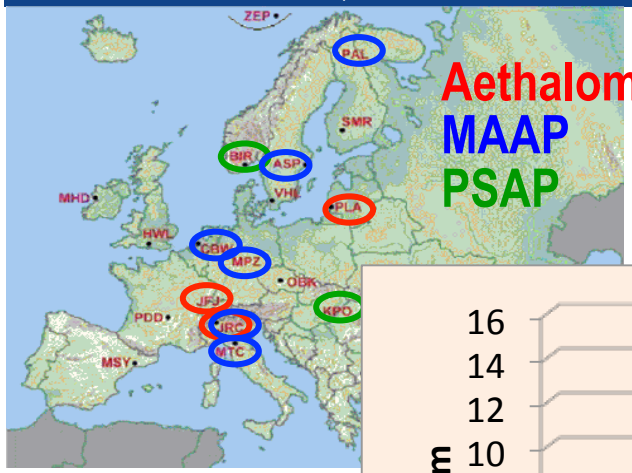


$$\sigma(520)/\sigma(660) = 1.2 - 1.5$$

Possible correction with the aethalometer

Depending on the “colouring” particles: brown carbon, dust,…

Evaluating surface absorption



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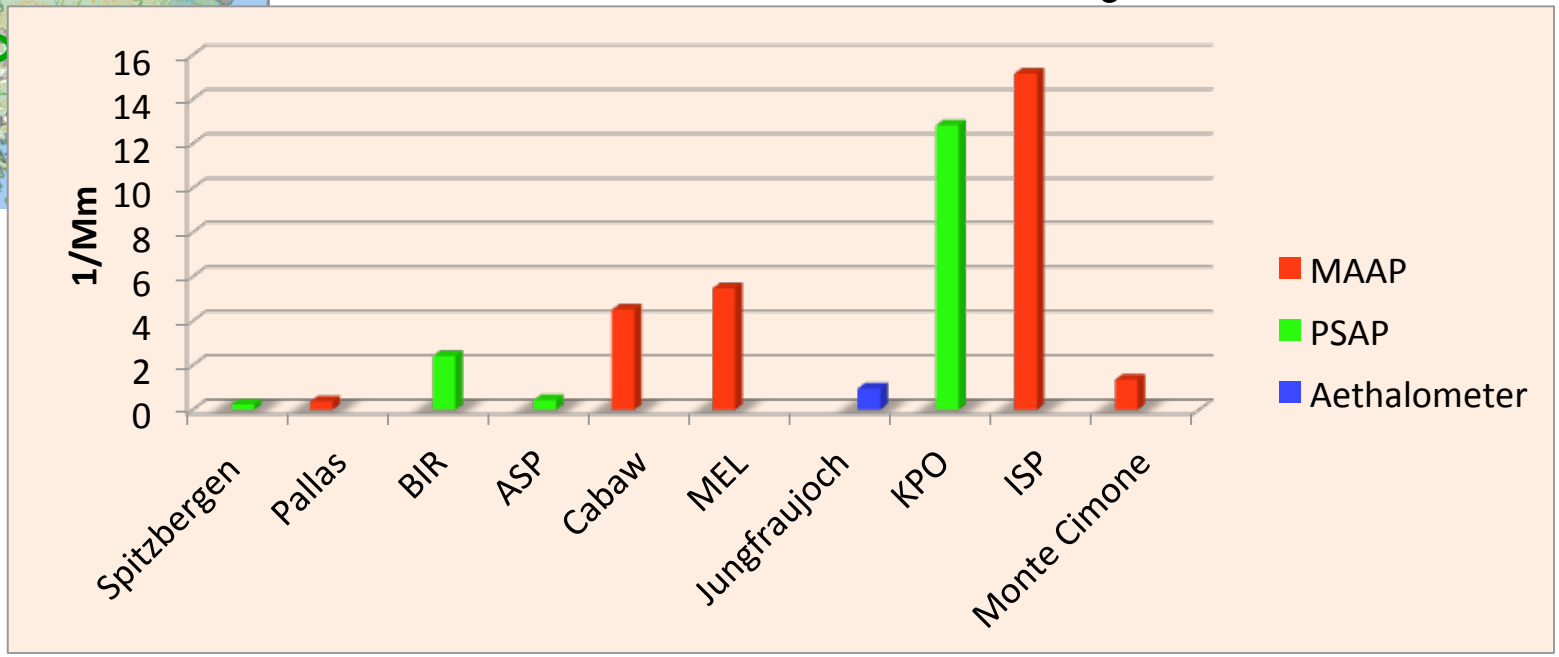

MAAP – 660 nm

PSAP – 520-530 nm

Aeth – not corrected

Modelled absorption output at 550 nm

Do not use the absorption data uploaded on AEROCOM website yet!

Station	2008	2009	2010	Problems
MSY		M	M	No info for λ corr.
PDD	M	M		No info for λ corr.
ASP	P			No nephel.
MEL	M	M	M (to 6)	No info for λ corr.
ISP	M, A	M, A	M, A	
BIR	P (from 5)	P (to 5)		Half 2009 corr.
FKL	A	A	A	
Spitz.	P, A	P, A		No nephel.
Pallas	M	M	M (to 5)	No info for λ corr.
Jungf.	A, M	A, M	M	
Cabaw	M	M	M	No info for λ corr.
K-pusta	P (from 5)	P	P	
Schl.	M	M (to 6)		No info for λ corr.
Schauf.	M	M (to 6)		No info for λ corr.
Bosel	M			No info for λ corr.
Monte Cimone	M	M	M	No info for λ corr.
Preila	A	A	A	No nephel.
Hyytiala	A	A	A	0nly BC no abs.
Harwell		A	A	0nly BC no abs.
Mace Head	A	A, M	A	0nly BC no abs.

Station	2008	2009	2010	Problems
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Pallas	M	M	M (to 5)	No info for λ corr.
Jungf.	A, M	A, M	M	
Cabaw	M	M	M	No info for λ corr.
K-pusta	P (from 5)	P	P	
Schl.	M	M (to 6)		No info for λ corr.
Schauf.	M	M (to 6)		No info for λ corr.
Bosel	M			No info for λ corr.
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ISP	M, A	M, A	M, A	
BIR	P (from 5)	P (to 5)		Half 2009 nephel.
FKL	A	A	A	
Spitz.	P, A	P, A		No nephel.
Pallas	M	M	M (to 5)	No info for λ corr.
Jungf.	A, M	A, M	M	
Cabaw	M	M	M	No info for λ corr.
K-pusta	P (from 5)	P	P	
Schl.	M	M (to 6)		No info for λ corr.
Schauf.	M	M (to 6)		No info for λ corr.
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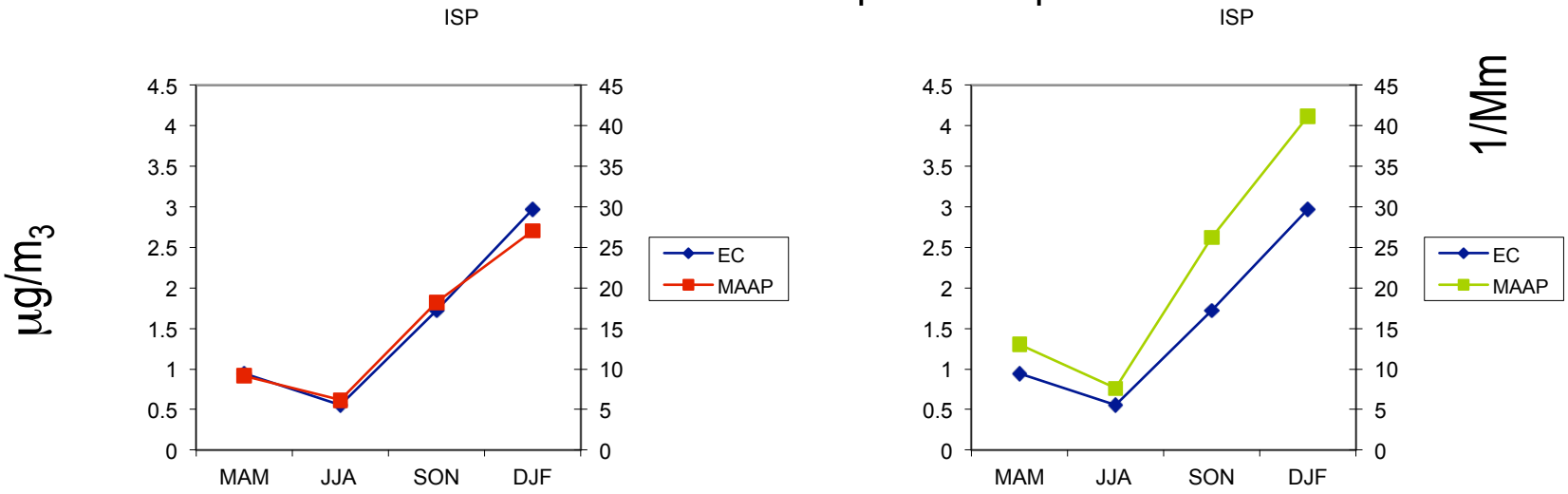
Absorption/EC ratio

Measured EC and absorption in Ispra



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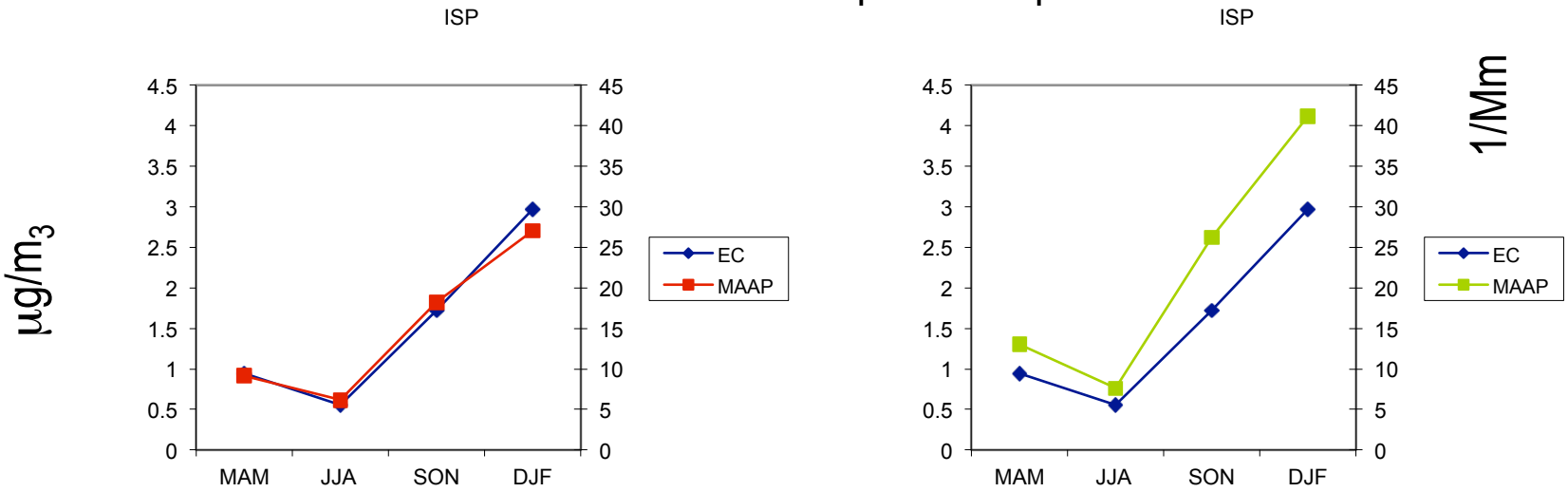
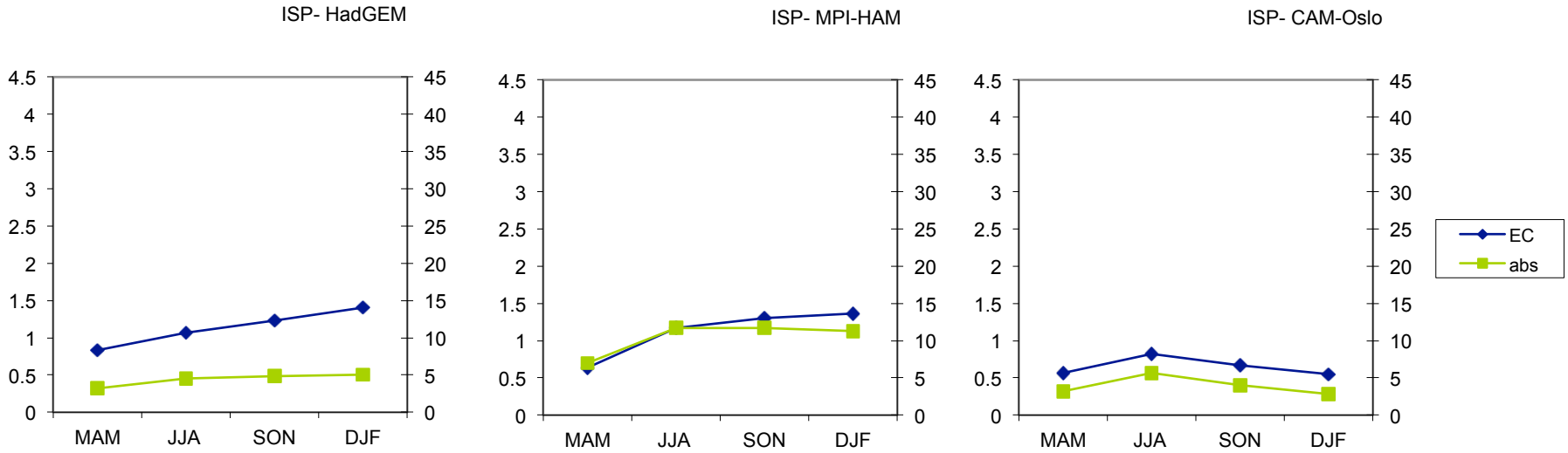


Modelled EC and absorption in Ispra



EUSAAR stations with both observations

Station	2008	2009	2010	Problems
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Harwell		EC, A	A	0nly BC no abs., EC overestimated

EUSAAR stations with both observations

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PDD	EC, M	EC, M		No info for λ corr.
ISP	EC, M, A	EC, M, A	EC, M, A	
FKL	A	EC, A	A	
Harwell		EC, A	A	0nly BC no abs., EC overestimated

Unresolved issues

- The present EUSAAR absorption dataset on AEROCOM cannot be used
- How do we have a coherent absorption dataset? (EUSAAR/ACTRIS meeting, Ispra, October 2011)
  - Corrections properly done
  - Aethalometer data compatible with MAAP and PSAP?
- Model output at 550, MAAP at 660, how to compare them?
- If the problem is solved, may we consider to run the models for 2009?
- Including other models in the analysis ?

Beyond Europe

- Is there the possibility to have quality controlled data to further evaluate the models (absorption/EC)?