



Modelling OC/BC in NORPAC: Status

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Emissions

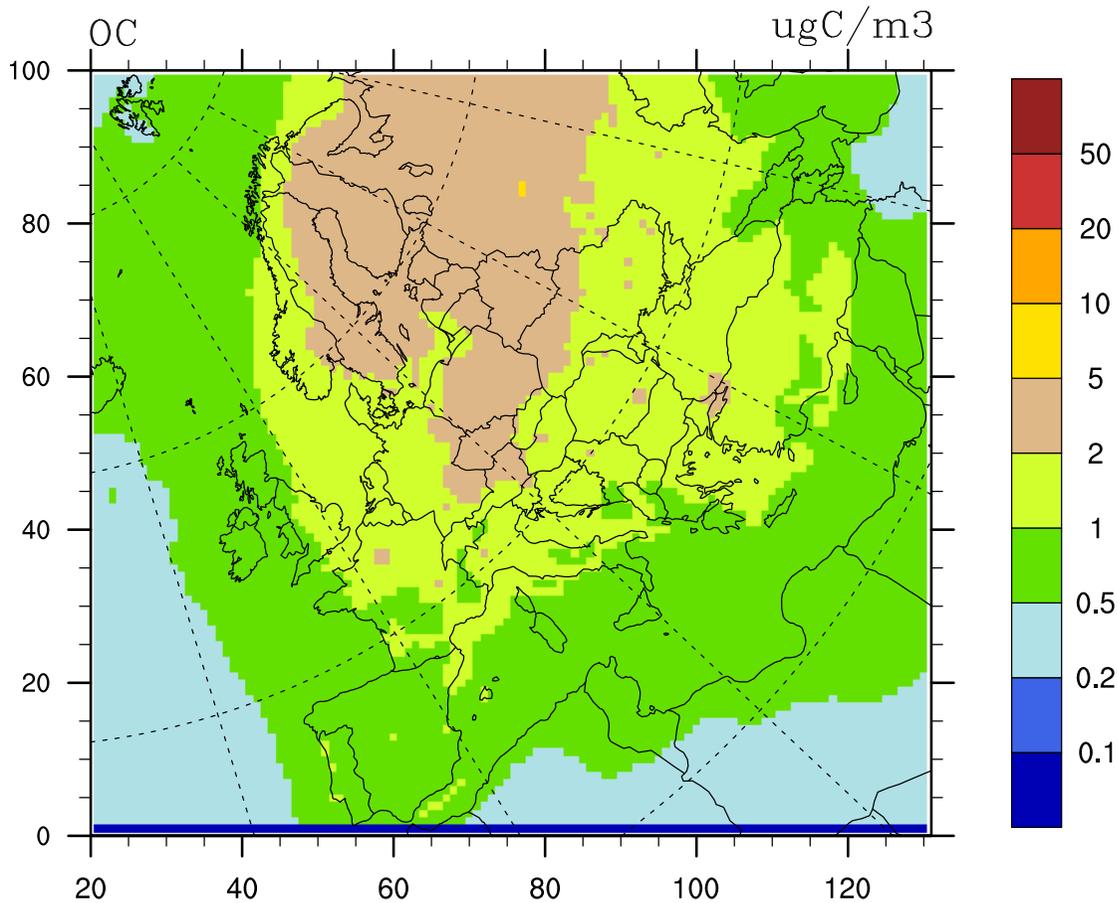
- Revised BC/OC inventory for 2000, IIASA, Feb 2005-Mar 2006 (Kupiainen, and Klimont, 2006)
- Focus on PM₁
- In consultation with national experts

Emissions

| SNAP Code | Sources | Emissions (Gg/yr) | | | Fraction of total TCM (%) |
|-----------|---|-------------------|---------|---------|---------------------------|
| | | BC | OM | TCM | |
| 1 | Combustion in energy and transformation industries | 3.50 | 3.57 | 7.07 | (0.4) |
| 2a | Non-industrial combustion plants | 89.78 | 140.13 | 229.91 | (12.5) |
| 2b | Residential/comm. wood-burning | 165.13 | 456.36 | 621.49 | (33.7) |
| 3 | Combustion in manufacturing industry | 3.79 | 10.32 | 14.11 | (0.8) |
| 4 | Production processes | 34.77 | 23.58 | 58.35 | (3.2) |
| 5 | Extraction and distribution of fossil fuels and geothermal energy | 13.33 | 2.67 | 16.00 | (0.9) |
| 7 | Road transport | 212.76 | 147.15 | 359.91 | (19.5) |
| 8 | Other mobile sources and machinery | 205.57 | 148.31 | 353.88 | (19.2) |
| 9 | Waste treatment and disposal | 14.85 | 41.56 | 56.41 | (3.1) |
| 10 | Agriculture | 30.06 | 94.90 | 124.96 | (6.8) |
| Sum | | 773.55 | 1068.56 | 1842.11 | (100) |

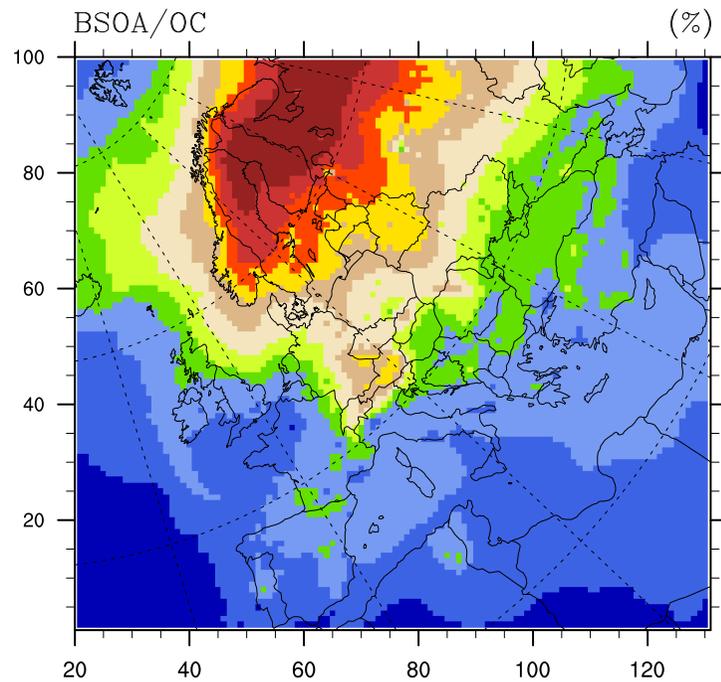
Results

Results: Annual Average OC, year 2002 (ugC/m³)

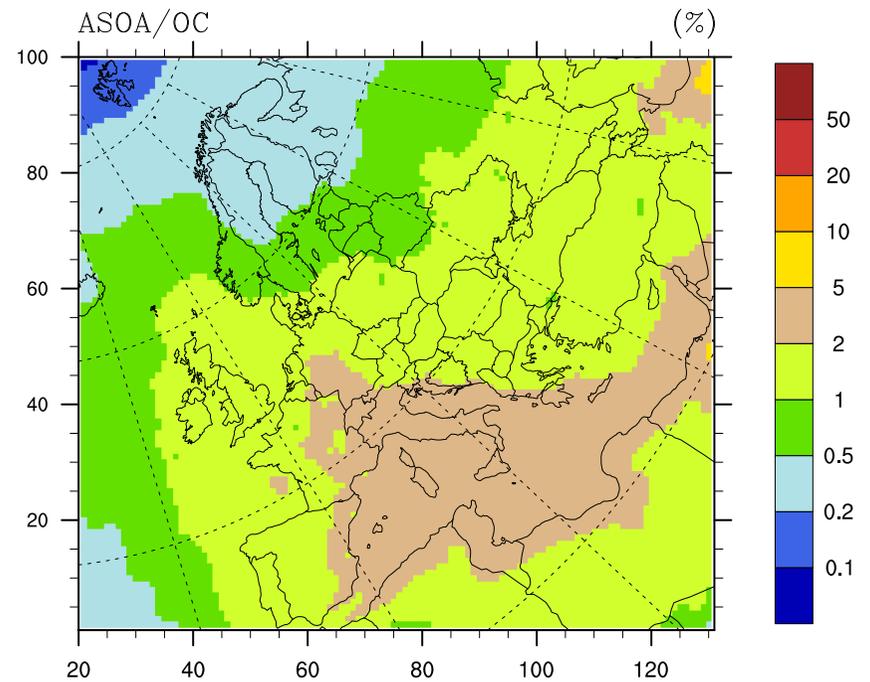


BSOA contribution

BSOA/OC (%)



ASOA/OC (%)

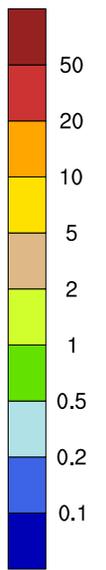
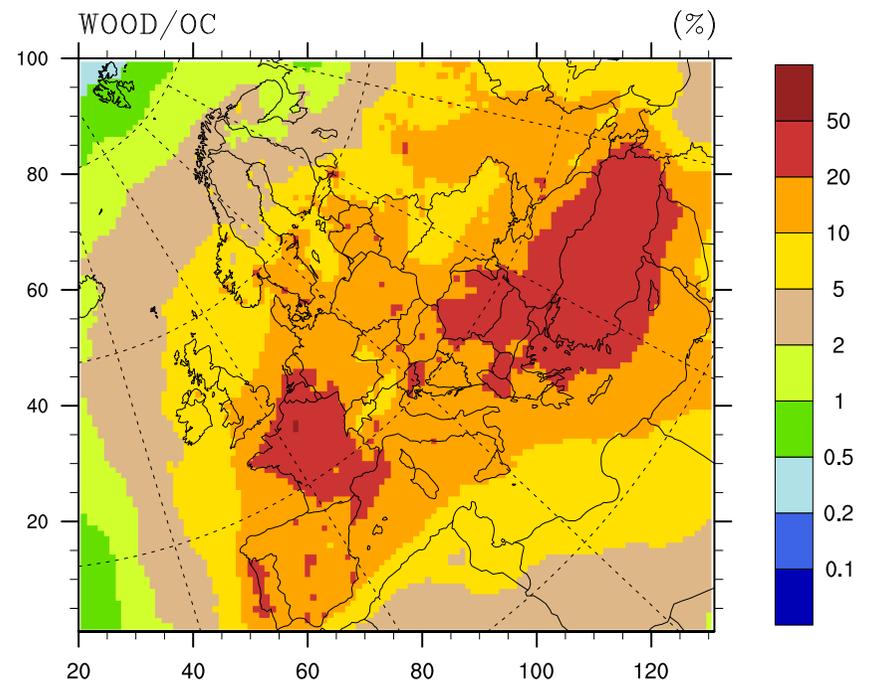
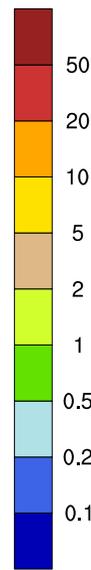
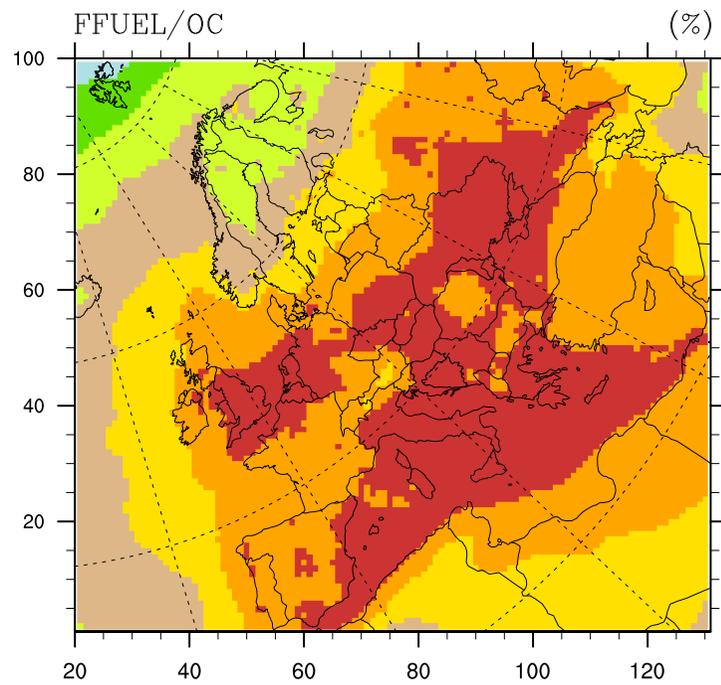


Primary OC

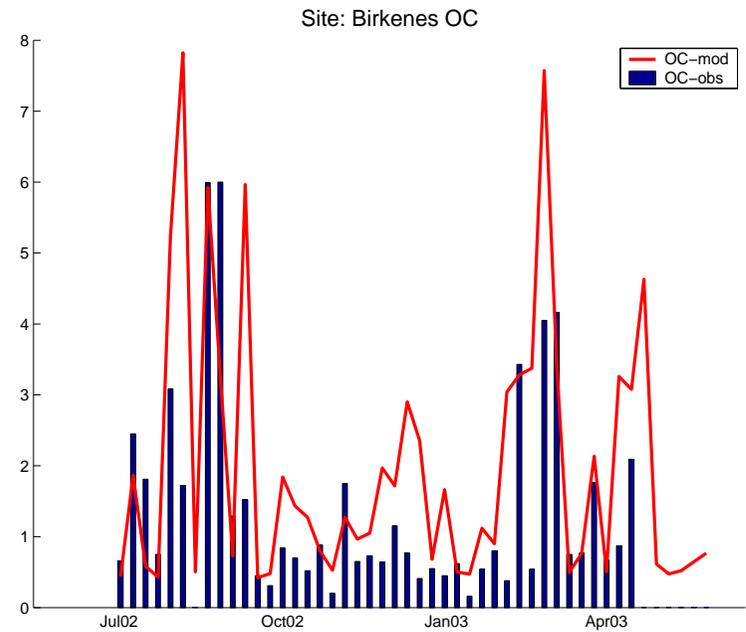
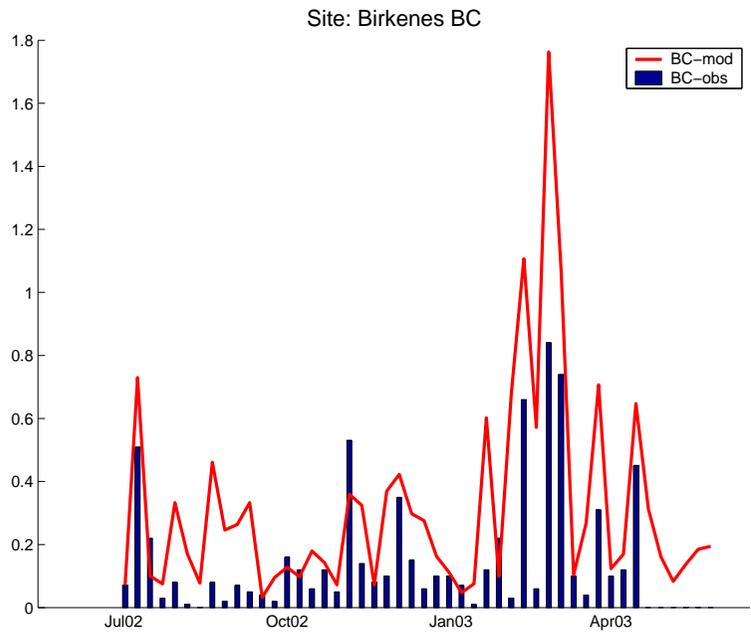


FFUEL

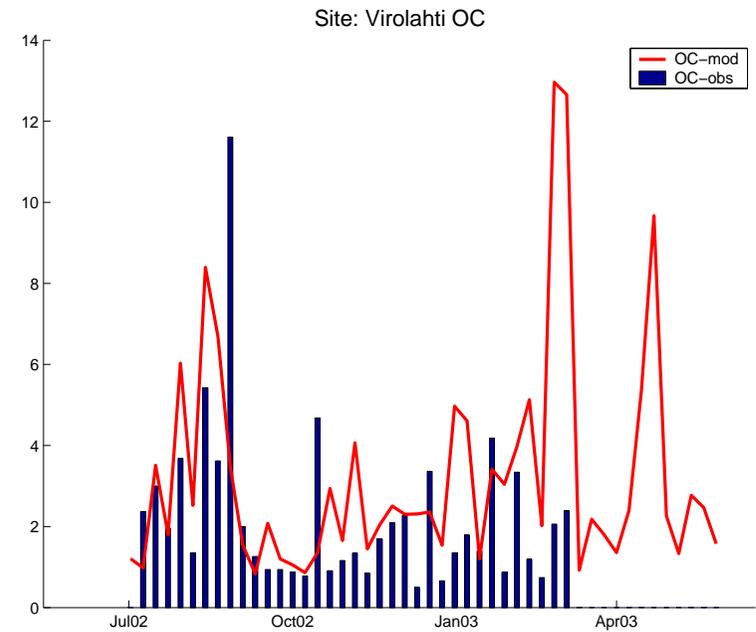
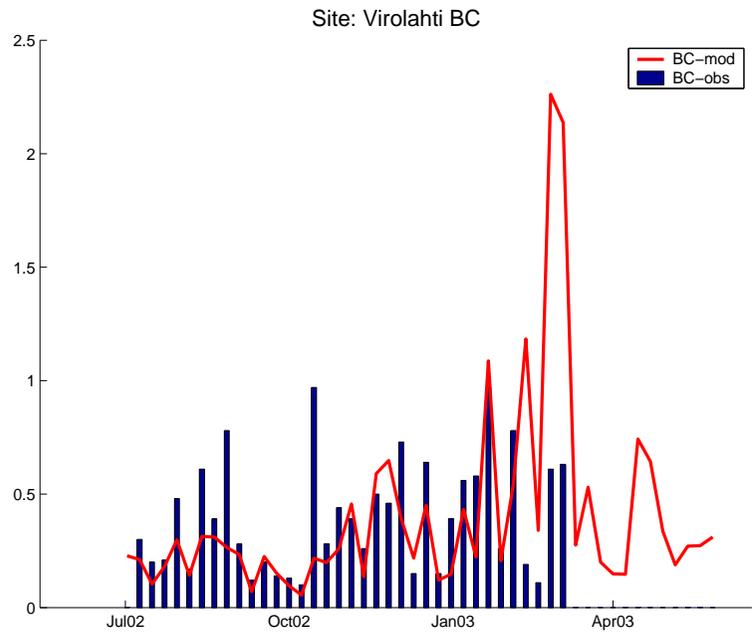
WOOD



EMEP Comparisons

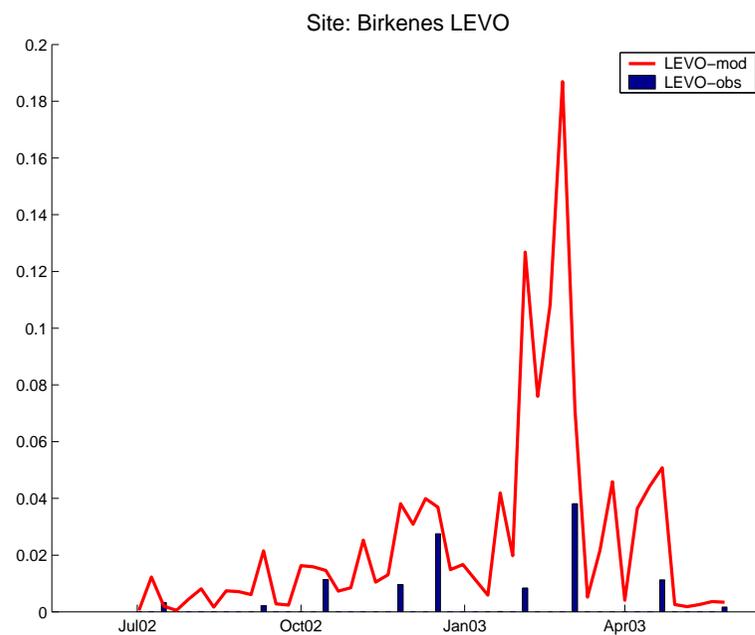
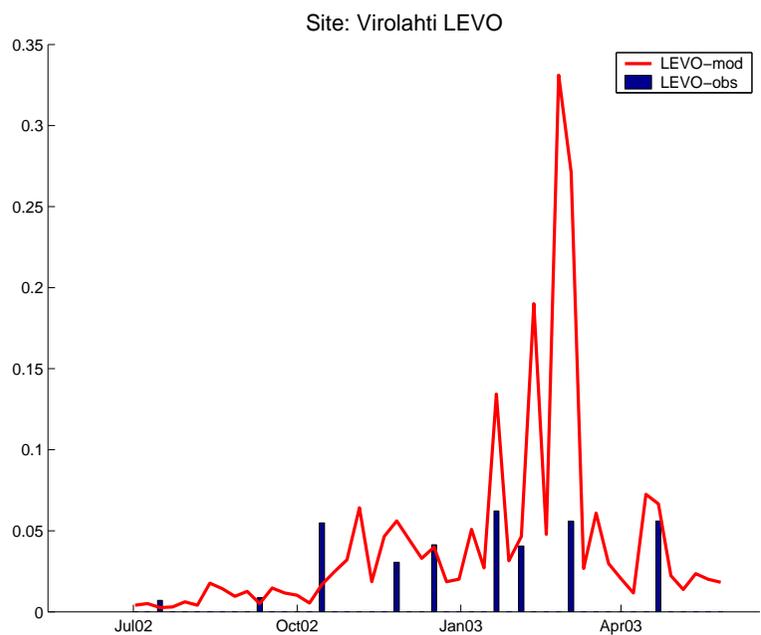


EMEP Comparisons



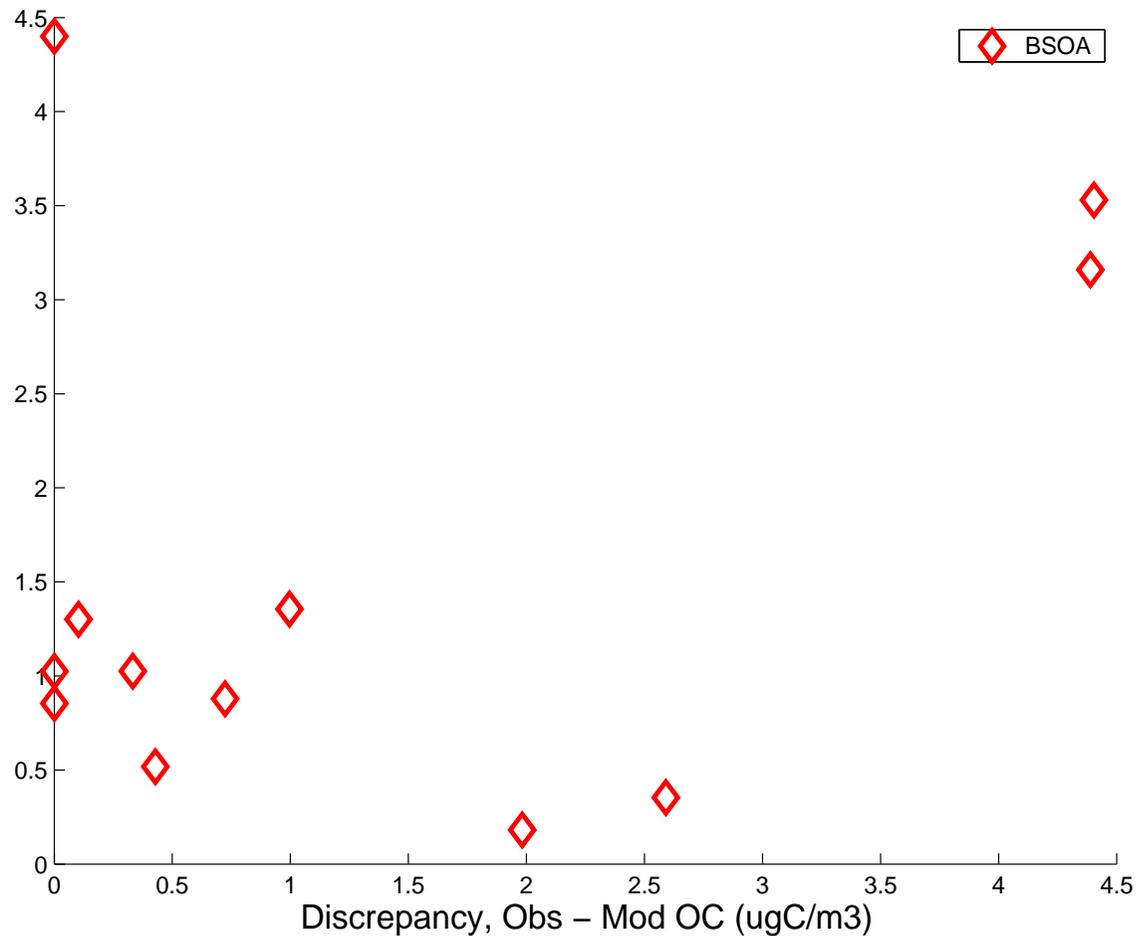
Levoglucosan

Tracer of wood-burning ($\sim 10\%$ of emission)

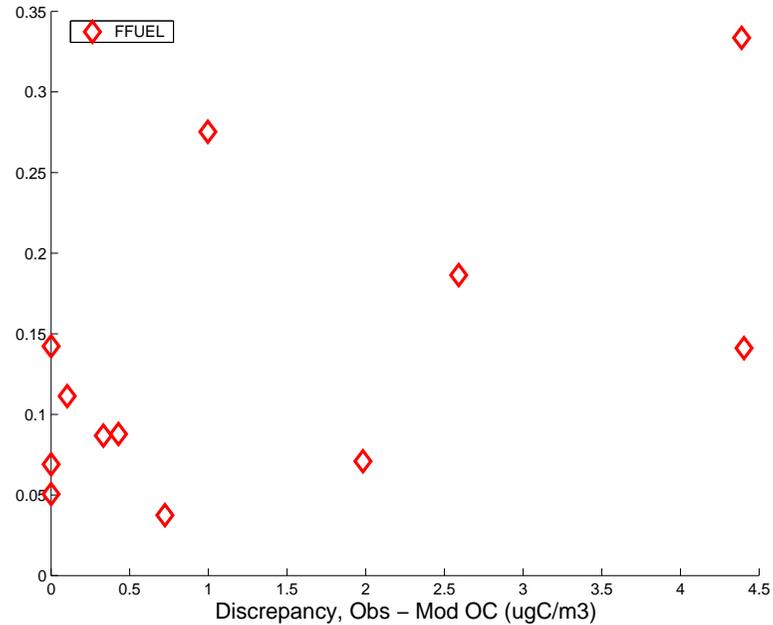


Correlations?

Correlate Obs-Modelled discrepancy against model BSOA (Aspvreten, Sweden):



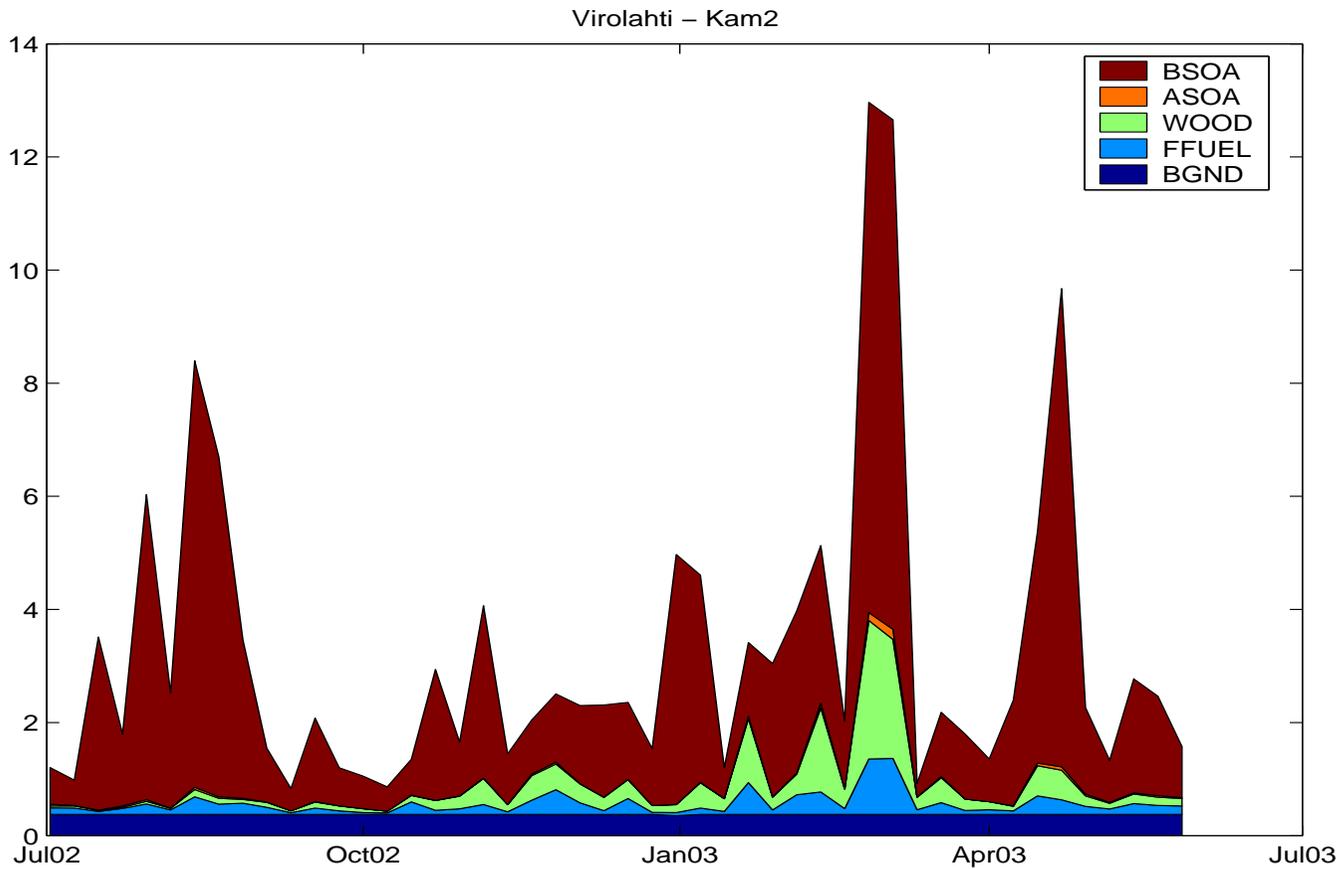
Correlations?



Fossil-fuel?:

Overall - results vary very much from site to site. No obvious 'easy' answers.

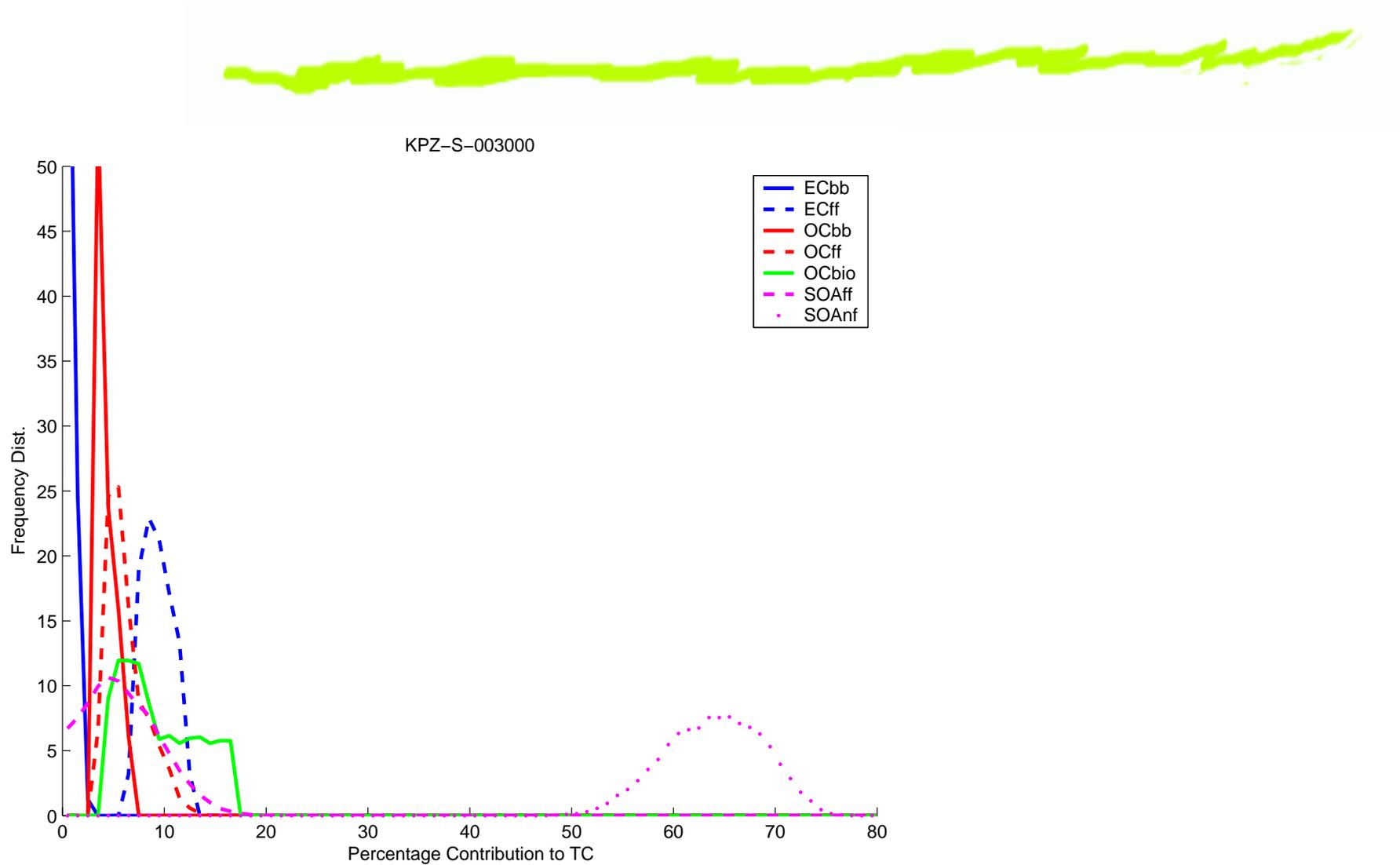
Origin of OM: Virolahti



CARBOSOL

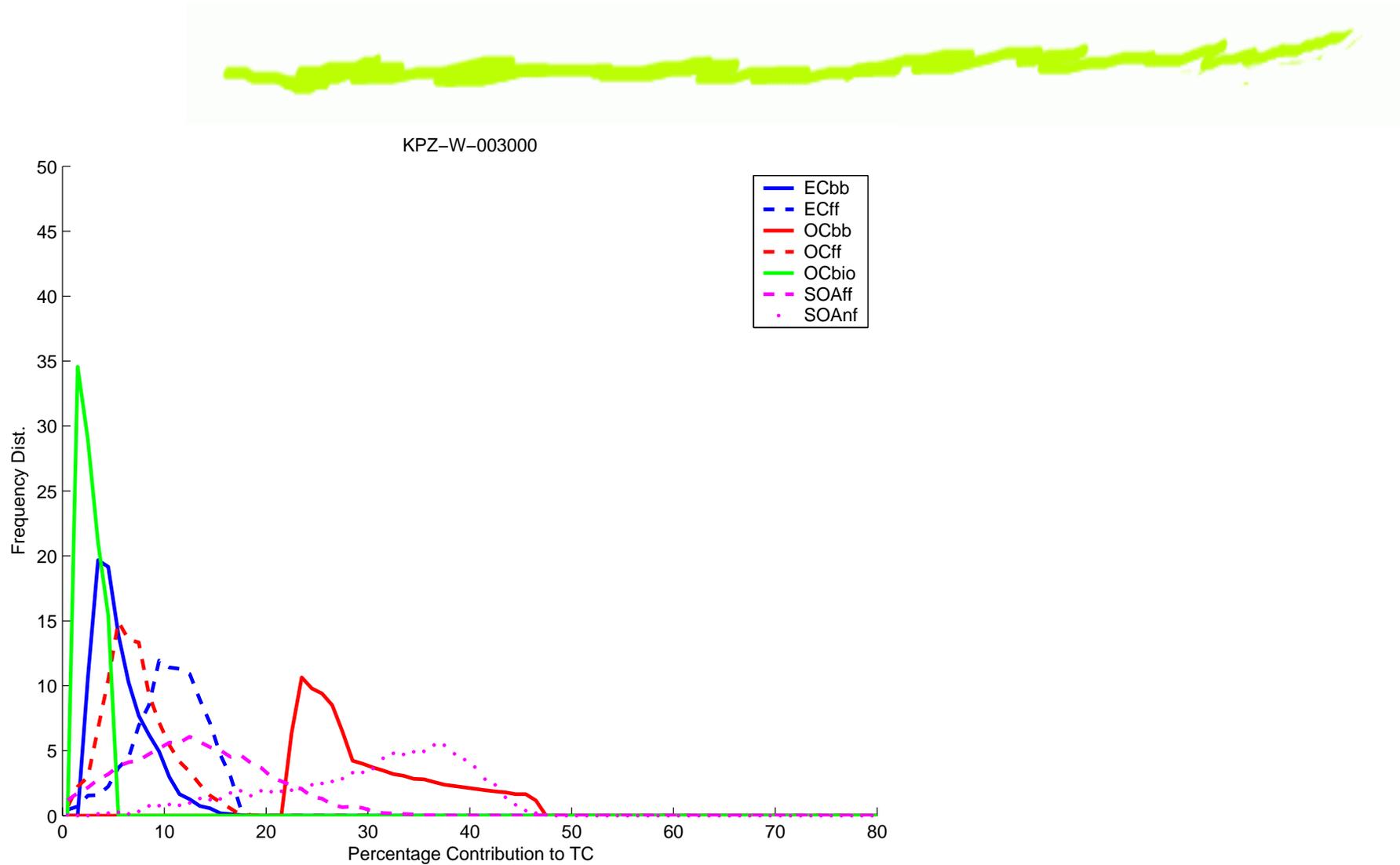
- 6 sites across south-central Europe
- 1-week filters (PM₂), analysed for:
 - cellulose ⇒ biological particles
 - levoglucosan ⇒ biomass-burning
 - OC/EC ⇒ primary emissions
 - ¹⁴C ⇒ modern/fossil
- - all factors approximate

OM: K-Pusztá, Summer



(Gelencsér et al., 2006, PROVISIONAL)

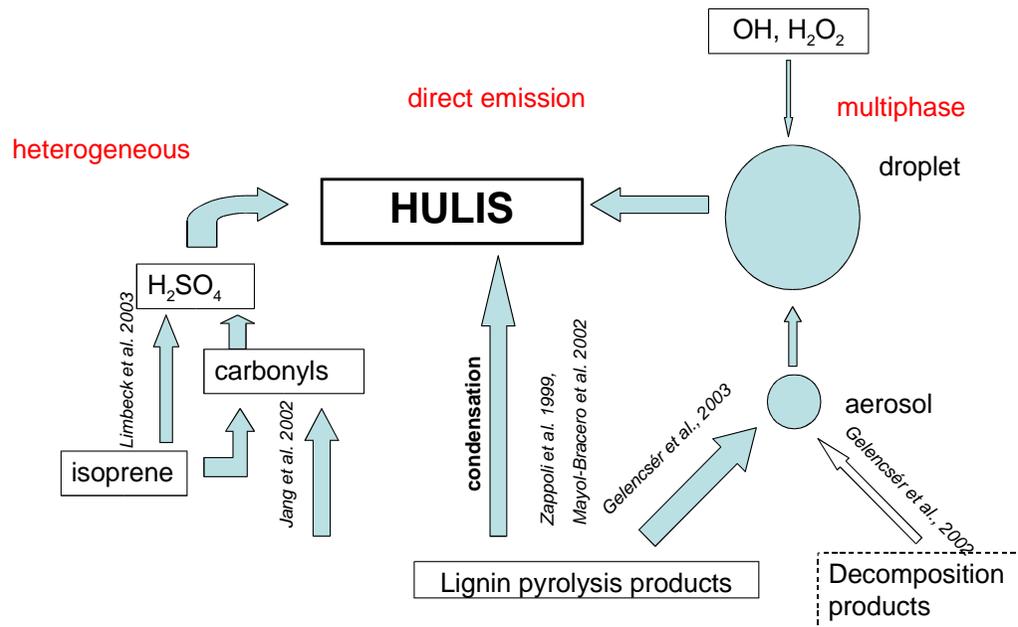
OM: K-Pusztá, Winter



(Gelencser et al., 2006, PROVISIONAL)

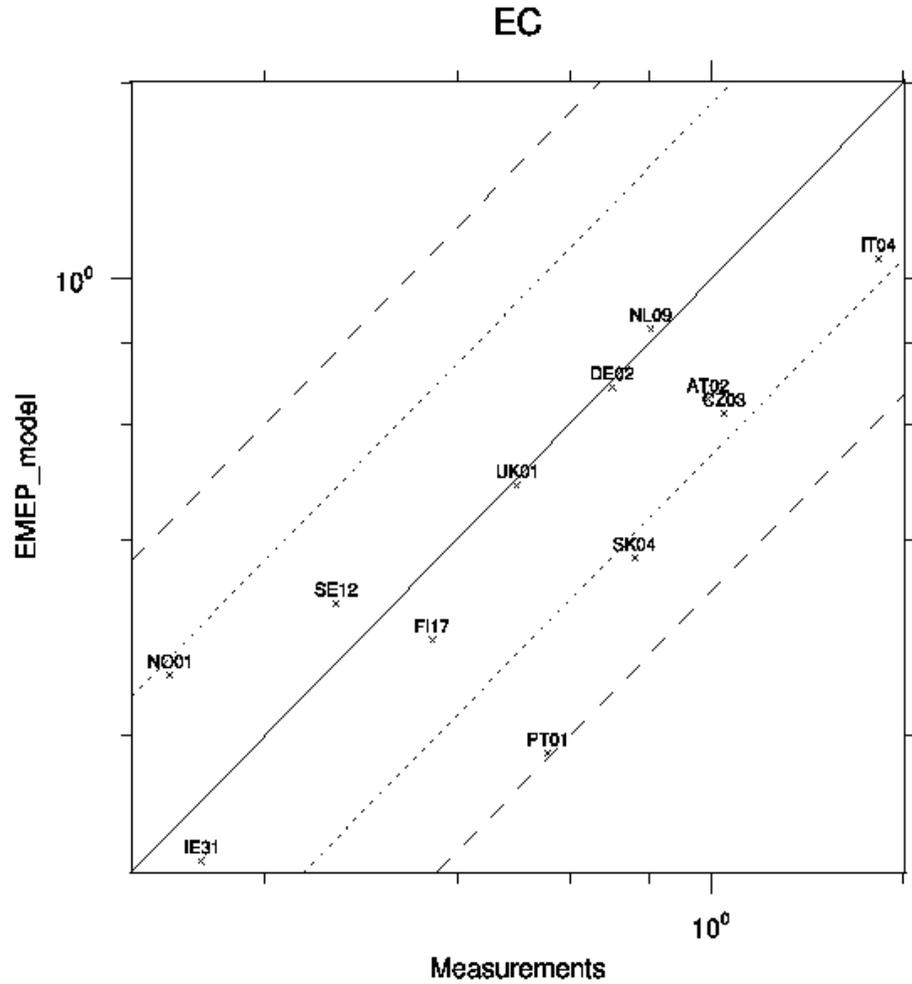
Alternatives

Working hypotheses for HULIS formation



- Still changing - e.g. Warneck, Ervens suggested aqueous pathways with oxalic acid as source of SOA

EMEP BC?



Bias -30%

Conclusions

- A model with current emissions underpredicts OC across Europe
- Levoglucosan suggests strong under-prediction of POC from wood-burning at some sites (- local sources?), but overprediction at others (emissions inventory)
- Correction for this might help explain a significant fraction of missing OC in wintertime at some sites, not all, and not for summer
- Summer problems probably partly due to lack of polymer formation and/or aqueous pathways?
- Correlation analysis suggests that the missing OC results from both SOA and missing POC.

Conclusions

- State of OC science 'in infancy' (Donahue et al., 2005)
- Modellers have no "mechanism" for in-aerosol reactions
- Model results are extremely sensitive to assumptions!
- But, model's can serve to test theories and emissions
- Measurements are required to constrain models and validate emissions
- Needs chemical speciation, tracers, many locations
- Long-term field data + campaigns+supersites ideal
- Emissions? Primary OC/BC emissions need verification (near-source measurements?)

Acknowledgements

- IIASA & FEI (SYKE) - Z. Klimont and K. Kupiainen - emissions
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- CARBOSOL - A. Gelencsér, H. Puxbaum, A. Kasper-Geibl, Pio, M. Legrand