



The ability of mesoscale meteorological models - driving chemical transport models - to predict the vertical profiles of meteorological parameters - COST728 evaluation study

Batchvarova, Ekaterina; Gryning, Sven-Erik

Published in:
Proceedings (CD-ROM)

Publication date:
2009

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Batchvarova, E., & Gryning, S-E. (2009). The ability of mesoscale meteorological models - driving chemical transport models - to predict the vertical profiles of meteorological parameters - COST728 evaluation study. In *Proceedings (CD-ROM)* University of Hamburg.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

The ability of mesoscale meteorological models
- driving chemical transport models - to predict
the vertical profiles of meteorological
parameters – COST728 evaluation study

Ekaterina Batchvarova¹
Sven-Erik Gryning²

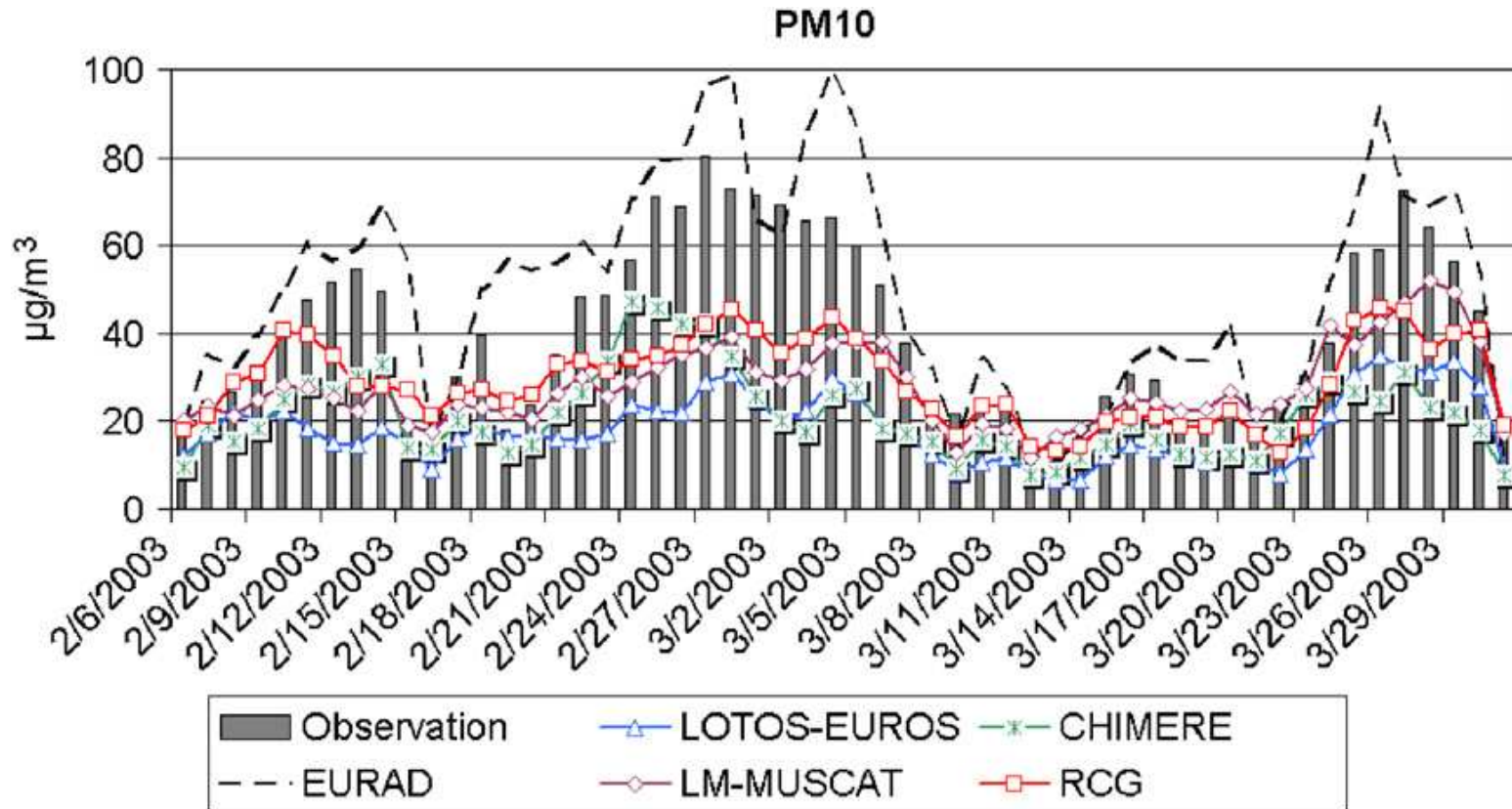


¹National Institute of Meteorology and Hydrology,
Sofia, Bulgaria

²Risø DTU, Roskilde, Denmark



Daily mean PM₁₀ concentrations averaged over the area



It can be seen that the models generally underpredict the PM₁₀ concentration during episodes, and there is a wide scatter between the models.

All models predict and use different Atmospheric Boundary-Layer height. How is this related to observations? The ABL height is a parameter defined in different way in the fields of temperature, humidity, wind, aerosol. The different measuring techniques correspond also to diverse definitions.

Therefore the discussions within COST728 concluded that modeled and measured profiles of meteorological parameters are to be compared rather than ABL height.

Model evaluation

We note that we can have a perfect model without an exact match with the measurements.

How close is close enough to be within the limits of representativeness?

In other words when will it be worthwhile to look for improvements in the models and when are the model predictions within the statistical range given by the representativeness of the measurements.

The mean square relative error, \mathcal{E}

$$\mathcal{E}^2 = \frac{\sigma_{x,T}^2}{\langle x \rangle^2} = \frac{2\sigma_x^2}{\langle x \rangle^2} \frac{\tau}{T}$$

depends on the averaging time T of the parameter x .

$$\sigma_{x,T}^2 / \langle x \rangle^2$$

- is the mean-square relative error when integrating over duration T

τ

- is the integral time scale of the parameter.

For the wind speed:

$$\mathcal{E}^2 = \left(\sigma_{u,T} / \langle u \rangle \right)^2$$

For the sensible heat flux:

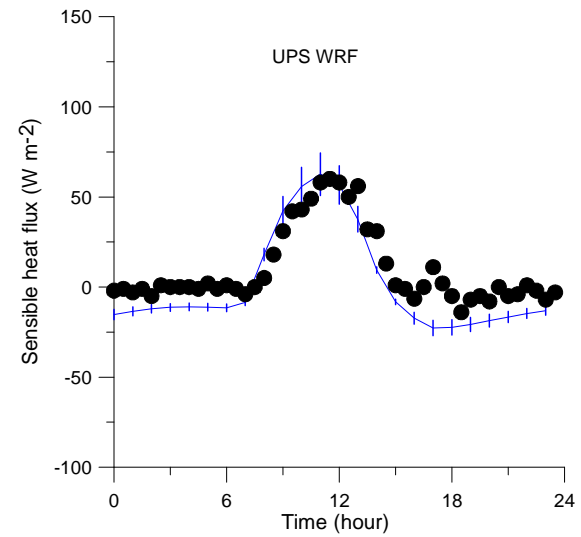
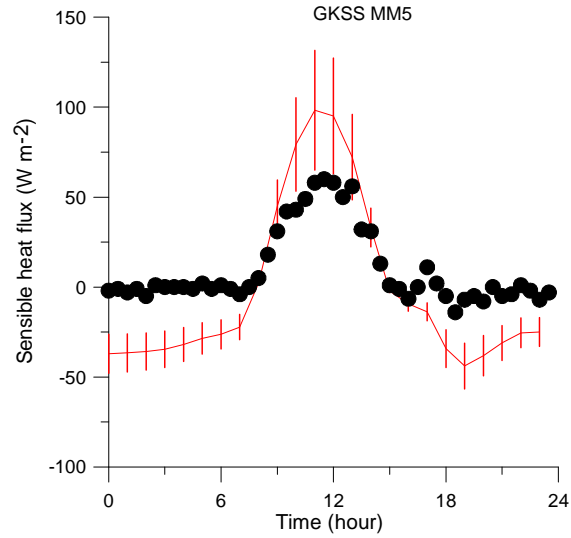
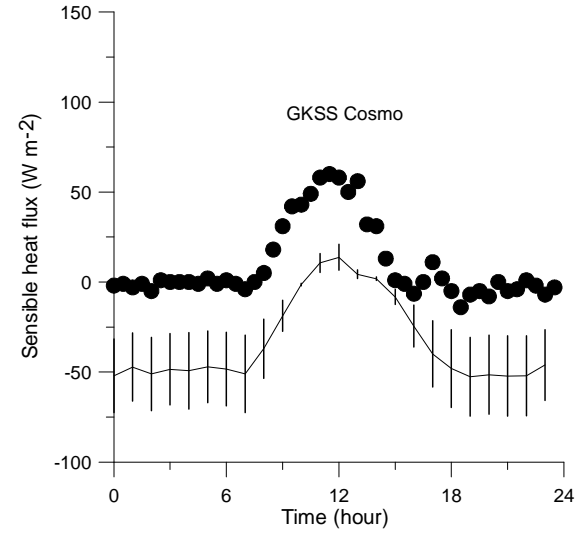
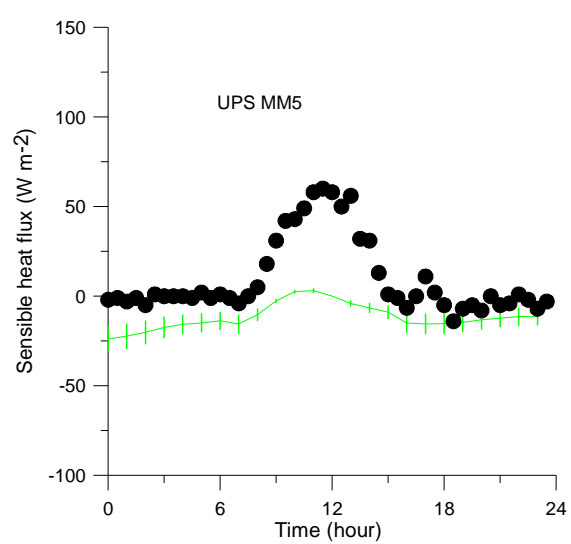
$$\mathcal{E}^2 = \left(\sigma_{w\theta,T} / \langle w\theta \rangle \right)^2$$

Sreenivasan et al, 1978 suggest to determine the relative error for wind speed and sensible heat flux for a given averaging time T as follows:

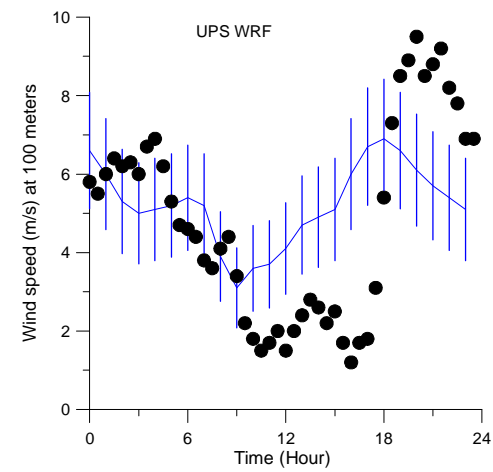
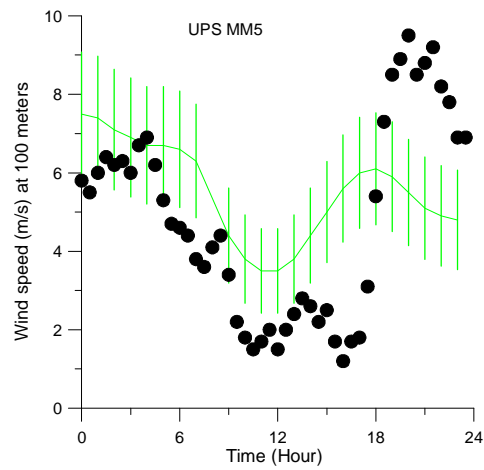
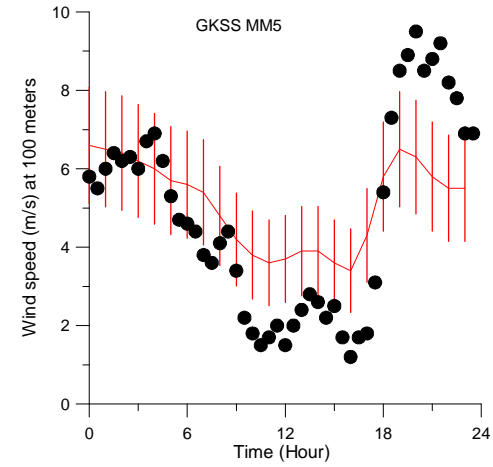
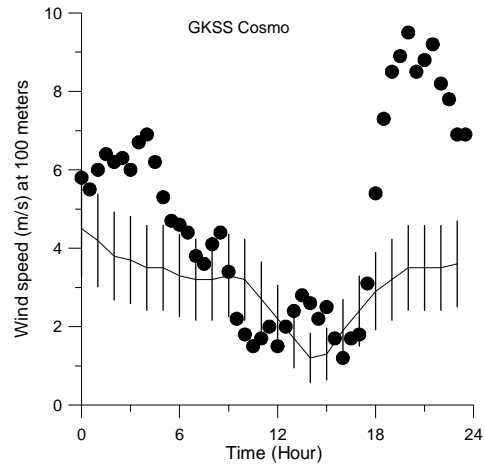
$$\sigma_{u,T} = \sqrt{12} \sqrt{\frac{z}{T u}} u \quad \sigma_{w\theta,T} = 8 \sqrt{\frac{z}{T u}} w \theta$$

The method is used in Batchvarova and Gryning, 2009 to associate an uncertainty interval for the model predictions, based on averaging time (in a simplified calculation the uncertainty interval is found to be 2/3 of the sensible heat flux value and for the wind speed).

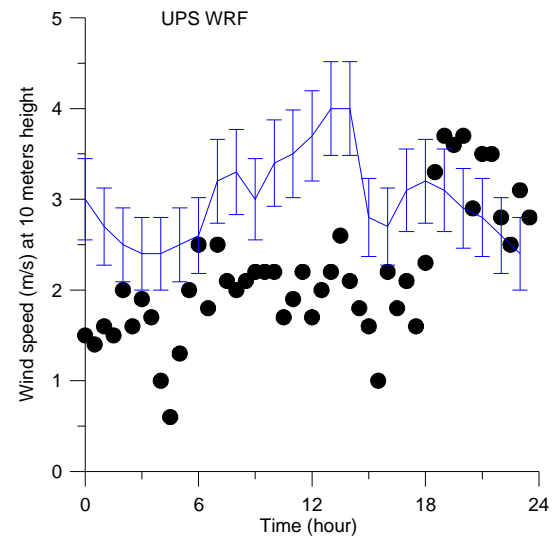
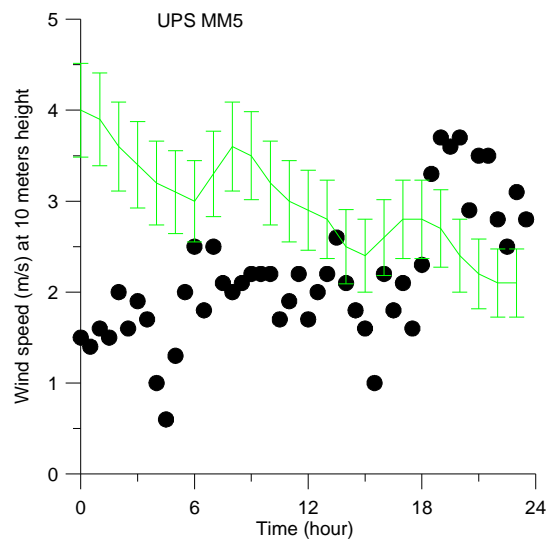
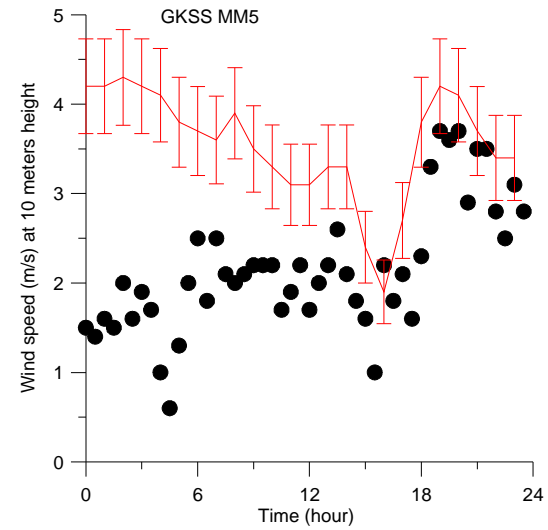
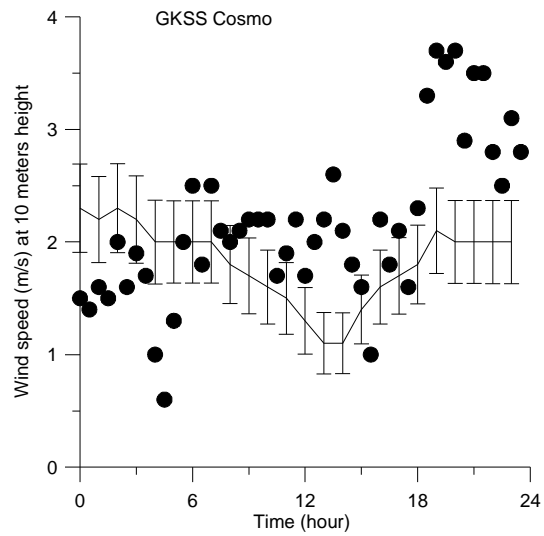
Lindenberg: sensible heat flux at 2.4 meter over grassland



Lindenberg: wind speed at 100 meters over grassland



Lindenberg: wind speed at 10 meters over grassland



Conclusions:

Progress in model developments is based on comparison with data.

It is essential to evaluate the models on profile measurements, not just traditional surface measurements

The representativeness of the measurements should be taken into account in any model evaluation against measurements.

The representativeness is a function of the length scale of turbulence (height in the surface layer) and averaging time of the measurements (as a first rough approximation)

We note that we can have a good model without an exact match with the measurements.

In other words a model cannot be improved if the measurements fall within the statistical range.

Acknowledgements

The data from Cabauw and Lindenberg are provided through the CEOP/GEWEX (Coordinated Energy and Water Cycle Observations project/Global Energy and water Cycle Experiment) BALTEX (Baltic Sea Experiment) database and it is a pleasure to acknowledge the Royal Netherlands Meteorological Institute and Deutscher Wetterdienst (DWD) - Meteorologisches Observatorium Lindenberg / Richard Aßmann Observatorium who originally provided the data for the data base.

The work is part of collaboration within COST 728 and supported by the Danish Council for Strategic Research, Sagsnr 2104-08-0025 and the EU FP7 Marie Curie Fellowship VSABLA.