Relevance of surface flux aggregation for different meteorological situations

K. Heinke Schlünzen1, Sylvia Bohnenstengel1, Alfred Trukenmueller1,2
Meteorological Institute, ZMAW, University of Hamburg, Hamburg, Germany
schluenzen@dkrz.de
1) Meteorologisches Institut, Universität Hamburg, Germany; 2) Umweltbundesamt, Dessau, Germany

Motivation
The performance of atmospheric models considerably depends on the used parameterisations which should be different for different model resolutions. In contrast to many global and regional climate models, several high resolving mesoscale models employ parameterisations for effects of multiple sub-grid-scale land-uses. These models use horizontal resolutions of several to a few ten kilometres.

Model investigations that employ different parameterisations for surface fluxes have shown that the parameterisation impact is especially high for low wind condition (Schlünzen and Katzfey, 2003). The need of (expensive) sub-grid-scale land-use parameterisations for a large variety of meteorological situations still needs to be investigated.

Parameterisations for effects of multiple sub-grid-scale land-uses. These models use horizontal resolutions of several to a few ten kilometres.

The performance of atmospheric models considerably depends on the used parameterisations which should be different for different model resolutions. In contrast to many global and regional climate models, several high resolving mesoscale models employ parameterisations for effects of multiple sub-grid-scale land-uses. These models use horizontal resolutions of several to a few ten kilometres.

Model investigations that employ different parameterisations for surface fluxes have shown that the parameterisation impact is especially high for low wind condition (Schlünzen and Katzfey, 2003). The need of (expensive) sub-grid-scale land-use parameterisations for a large variety of meteorological situations still needs to be investigated.

Evaluation method
The model results were compared with measured data at the surface by linearly interpolating to the measurement site and comparing with the data. The following adjustments were made:

- Direct use of 10 m values
- Direct use of 10 m values
- 2 m values using surface fluxes and constant flux approach
- 2°C
- 1.7 hPa Standard atmosphere

The temporal development of the model hit rates is calculated per additional forecast day (B cases).

Evalulation results

Table 2: Hit rate (in %) for the different forecasts.

<table>
<thead>
<tr>
<th>Case</th>
<th>First day</th>
<th>Δx (km)</th>
<th>Forecast interval</th>
<th>ff (m/s)</th>
<th>dd (°)</th>
<th>T (°C)</th>
<th>Td (°C)</th>
<th>ΔT (°C)</th>
<th>ΔTd (°C)</th>
<th>p0 (hPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1a</td>
<td>22-07, 16</td>
<td>6-30h</td>
<td>11 sites</td>
<td>49</td>
<td>10</td>
<td>1-25</td>
<td>1-25</td>
<td>51</td>
<td>51</td>
<td>1100</td>
</tr>
<tr>
<td>A-2b</td>
<td>28-01, 16</td>
<td>48-72h</td>
<td>11 sites</td>
<td>49</td>
<td>10</td>
<td>1-25</td>
<td>1-25</td>
<td>51</td>
<td>51</td>
<td>1100</td>
</tr>
<tr>
<td>A-3b</td>
<td>23.05, 16</td>
<td>48-72h</td>
<td>11 sites</td>
<td>49</td>
<td>10</td>
<td>1-25</td>
<td>1-25</td>
<td>51</td>
<td>51</td>
<td>1100</td>
</tr>
<tr>
<td>B-1a</td>
<td>03.05, 18</td>
<td>1-25h</td>
<td>15 sites</td>
<td>49</td>
<td>10</td>
<td>1-25</td>
<td>1-25</td>
<td>51</td>
<td>51</td>
<td>1100</td>
</tr>
<tr>
<td>B-2a</td>
<td>09.05, 18</td>
<td>1-25h</td>
<td>15 sites</td>
<td>49</td>
<td>10</td>
<td>1-25</td>
<td>1-25</td>
<td>51</td>
<td>51</td>
<td>1100</td>
</tr>
</tbody>
</table>

Conclusions
- Using parameter averaging in contrast to blending height approach with flux aggregation is clearly superior for a locally driven meteorological situation (case A1). This result can not be supported in B-cases which are less well resolved.
- It seems that in the selected cases wind speed is quite dependent on the large-scale situation (low hit rates for wind speed “low hit rates in pressure”), while temperature and dew point temperature are less dependent on a good pressure forecast (B-1b).
- The spread of model answers provokes the widely drawn but never the less true conclusion: more studies are needed to understand origins of model uncertainties and improve the parameterisations.

References


Acknowledgements
Parts of this work were funded by the Federal Minister of Education and Research (BMBF) in AFO2000 project VALIUM and the Deutsche Forschungsgemeinschaft with special research area “Quantitative precipitation Forecast”.

Model set-up

Figure 1: Simulation areas for the studies. Orography for area A (left) and land use for area B (right). Figures are not to scale.

Figure 2: Diurnal cycle of temperature (top) and scatter diagrams for T, Td; diurnal cycle of dew point and wind speed (bottom).