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Correlations between different spatial scales in a regional climate model

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The spatial variances in a regional climate model simulation with the COSMO-CLM (CCLM) are analysed on different spatial scales. The CCLM was run at a resolution of 0.165 degrees (∼18 km), forced by a global model simulation with ECHAM5 at T63 (∼200 km) resolution. The Discrete Cosine Transform (DCT) is used to transform the fields of the main prognostic variables to the spectral space. The spatial-spectral variances of one year of simulation with CCLM are then compared to the variances global model simulation with ECHAM5, which was used for the lateral boundary forcing. In the case of wind speed and humidity the CCLM adds spatial variability to the ECHAM5 data at wavelengths below 700 km throughout the whole troposphere, while pressure and temperature develop an increased variability mainly in the higher troposphere.

Regional models tend to deviate from the lateral boundary forcing on the large scale, what eventually leads to anomalies along the model boundary. To study the relation between this large scale deviation and variability on the small scales of the CCLM, the DCT is applied as a spectral filter to separate the different scales. Consequently, the variability on the short wavelengths in CCLM (which are not resolved in ECHAM5) is correlated to the deviation of the CCLM fields from ECHAM5 on the large scales (which are resolved by both models). Correlation coefficients of 0.5 to 0.7 are found in the case of wind speed on most tropospheric model levels. This correlation is to a large extent related to variations on the synoptic time scale of several days.