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# Validating different versions of the German Mid-range Climate Prediction system MiKlip with radiosonde data

Ewelina Walawender (1), Margit Pattantyús-Ábrahám (2,3), and Wolfgang Steinbrecht (2)

(1) Deutscher Wetterdienst, Offenbach, Germany, (2) Deutscher Wetterdienst, Hohenpeissenberg, Germany, (3) now at Helmholtz Zentrum München, Neuherberg, Germany

MiKlip is a decadal climate prediction system, developed within a collaborative research project in Germany. The current phase of the project is focused on improvement and evaluation of the MiKlip system, before it is transferred to operational use.

In the present study, quality-controlled and homogenized radiosonde observations are used to validate different experiments of the MiKlip system, with a focus on global and regional hindcasts above Europe. Five variables are validated: air temperature, relative humidity, specific humidity, wind speed (eastward and northward components) and geopotential height. Both vertical profile biases and lead-time dependent biases were investigated for four different MiKlip experiments (Baseline0, Baseline1, Prototype, and Pre-operational), and for low, medium and high resolution configurations (as available).

Generally, the most recent global model configuration (Pre-operational) shows the lowest bias for all variables, especially when used in high resolution (one degree). The regional simulations based on the Regional Climate Model COSMO-CLM (CCLM) also perform very well. In most European regions, the global model simulations show a slightly colder, moister and vertically less stable troposphere, compared to the radiosondes. Mean temperature bias is increasing from close to 0 K in the lower troposphere to about -3 K in the upper troposphere. Near the tropopause, bias changes to positive, and reaches about +1 K in the lower stratosphere. Relative humidity bias also changes vertically – from about +5% to +15%. The relative humidity bias can, in part, be explained by the temperature bias. Specific humidity bias is only present in the lower troposphere, and varies from -0.2 to +0.4 g/kg, depending on European region. Positive wind speed bias, about 1 to 4 m/s for the eastward wind and less than 2 m/s for the northward wind, is seen over the whole vertical profile. Consistent with the findings for temperature, negative geopotential height bias increases with altitude from values close to 0 m in the lower troposphere to -50 m in the stratosphere. Smaller biases are found for the regional model. Generally, no lead-time dependence of these biases was found, except for the Prototype global model configuration, which uses assimilation of full ocean fields (instead of ocean anomaly fields). In this case, temperature bias in the atmosphere does change with time over the first couple of simulation years.

Our next step will be a bias correction for the global simulations, mapping the modelled probability density functions onto the radiosonde observations.

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