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Validation of the German Mid-Range Climate Prediction (MiKlip) decadal ensemble prediction system using radiosonde observations.

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We report validation results for three simulations by the Max-Planck-Institute's Earth System Model (MPI-ESM) ensemble prediction system (EPS), which is used for hindcasts and predictions of global-scale decadal climate variability in the framework of the German MiKlip project. Three experiments were analyzed: Baseline0 simulations with ocean anomaly field initialization, Baseline1 simulations with additional atmospheric full field initialization, and Prototype simulations with full field initialization for both ocean and atmosphere. Our validation compares homogenized radiosonde observations to the decadal ensemble hindcast projections. So far, we focused on the European region.

Comparison of observed and simulated European temperature profiles showed noticeable model cold bias, about 1 K near the surface, increasing to about 3 K near the tropopause. This has implications for atmospheric stability, which is underestimated in the simulations compared to the radiosonde profiles. The simulations also tend to overestimate humidity throughout the troposphere. Both biases combine to give, e.g., much larger simulated values for standard severe weather indices, which might be interpreted as higher severe weather probability in the simulations. While Baseline 0 and Baseline 1 simulations showed no dependence of temperature bias on simulation lead years, the temperature bias of Prototype simulations increased systematically with increasing lead years.

Apart from bias and probability density functions, the predictive skills of the Ensemble Prediction System were also analyzed with respect to the radiosonde observations. Here the Mean Square Error Skill Score (MSESS) and Continuously Ranked Probability Skill Scores (CRPSS) were used. For tropospheric temperatures, the full-field initialized Prototype experiments showed the best skills (MSESS and CRPSS), compared to the Baseline 0 and 1 experiments. In the stratosphere predictive skills were comparable for all experiments.