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Predictability of 2-m temperature across space and time scales

Thomas Haiden and Zied Ben Bouallegue
ECMWF, Evaluation Section, Reading, United Kingdom (thomas.haiden@ecmwf.int)

In the extra-tropics, 2-m temperature is arguably one of the most important parameters provided by weather forecasts. Although the skill of 2-m temperature forecasts from numerical weather prediction (NWP) models is slowly increasing, major issues remain. One of the main sources of uncertainty in the short range relates to difficulties in predicting the amount of vertical mixing in very stable boundary layers and associated uncertainties in the low cloudiness forecast. During the convective season, uncertainties in the timing and location of precipitation limit 2-m temperature forecast skill. Here we evaluate NWP model output from the TIGGE dataset against global SYNOP observations to evaluate the current level of 2-m temperature skill as a function of spatial and temporal scale for both deterministic and probabilistic forecasts. By comparing different types of verification metrics such as the generalized discrimination score, anomaly correlation, root mean square error, and mean error we can quantify predictability separately from representativeness errors and conditional biases. Spatial aggregation from the grid-box to the synoptic scale is performed to assess the contribution of synoptic-scale uncertainty on the 2-m temperature error at different lead times from the short range through the medium and extended range. Results allow inferences to be made about possible future improvements in the 2-m temperature forecast associated with improved model physics and spatial resolution.