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On the predictive skill of climate indices in seasonal forecasts

Seasonal forecasting models are increasingly being used to forecast application-relevant aspects of upcoming climatic conditions, often summarised by climate indices. There is even the hope that for some cases, predictive skill of forecasts of such indices may exceed that of forecasts of the corresponding mean quantity. Here we analyse forecasts of two generalised indices derived from daily minimum and maximum temperature based on the seasonal forecasting system of the European Centre for Medium-range Weather Forecasts (ECMWF System4): count of events such as the number of frost days and accumulated threshold exceedances such as degree days. We find that the predictive skill of forecasts of these two types of indices is generally lower than the skill of seasonal mean daily minimum and maximum temperature. By use of a toy model we demonstrate that this reduction in skill is more pronounced for skilful forecasts and climate indices defined relative to a threshold at the tail of the distribution. Based on the toy model results we conclude that there is no indication of additional predictability in forecasts of these indices in excess of what is expected due to the predictability of the seasonal mean. To further support this hypothesis, we show that the skill in predicting climate indices can be modelled successfully using the skill in the seasonal mean and the relationship between skill in seasonal mean and index forecasts inferred from the toy model. Nevertheless, we conclude that seasonal forecasts of indices with increased user relevance can be issued without major loss in skill as long as the events are not very rare.

Primary authors: Dr BHEND, Jonas (Federal Office of Meteorology and Climatology MeteoSwiss, Zurich, Switzerland);   Dr MAHLSTEIN, Irina (Oeschger Centre for Climate Change Research and Institute of Geography, University of Bern, Switzerland);   Dr SPIRIG, Christoph (Federal Office of Meteorology and Climatology MeteoSwiss, Zurich, Switzerland);   Dr LINIGER, Mark (Federal Office of Meteorology and Climatology MeteoSwiss, Zurich, Switzerland)

Presenter: Dr BHEND, Jonas (Federal Office of Meteorology and Climatology MeteoSwiss, Zurich, Switzerland)

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