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Seasonal Forecasts of Climate Indices: Impact of Definition and Spatial Aggregation on Predictive Skill

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Seasonal forecasting models are increasingly being used to forecast application-relevant aspects. A simple way to make such user-oriented predictions are application-specific climate indices. Little is known, however, on how the predictive skill of forecasts of such climate indices relates to the predictive skill in forecasting seasonal mean conditions.

Here we analyse forecasts of two types of indices derived from daily precipitation and temperature: counts of events such as the number of dry days and accumulated threshold exceedances such as degree days. We find that the predictive skill of forecasts of heating and cooling degree days and of consecutive dry days is generally lower than the skill of seasonal mean temperature and rainfall forecasts respectively. By use of a toy model we demonstrate that this reduction in skill is more pronounced for skilful forecasts and climate indices with a threshold in the tail of the statistical distribution. We further analyse the impact of spatial aggregation and find that aggregation generally improves the predictive skill. Using appropriate covariates for weighting – for example population density to derive a proxy for the national energy demand for heating – the usefulness of forecasts of climate indices can be further enhanced while retaining predictive skill. We conclude that processing of direct model output to derive climate indices in combination with spatial aggregation can be used to render still skilful and even more useful seasonal forecasts of user-relevant quantities.