Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Predictive skill of seasonal forecasts of climate indices

Jonas Bhend, Irina Mahlstein, Christoph Spirig, Mark Liniger
Federal Office of Meteorology and Climatology MeteoSwiss, Zurich, Switzerland
jonas.bhend@meteoswiss.ch

Introduction

We analyze the skill of seasonal forecasts (ECMWF System 4) of various indices derived from daily temperature and precipitation. Two different seasonal index types are studied in more detail: counts of events such as number of dry days and aggregation of threshold exceedances such as degree days.

Conclusions

Forecasts of climate indices may be more relevant to users, yet at the same time such forecasts tend to be less skilful than forecasts of seasonal mean quantities. We find that forecasts of counts and accumulated exceedances of thresholds can be issued without major loss in skill as long as these indices characterize events that are not very rare.

Forecast quality of ECMWF System 4

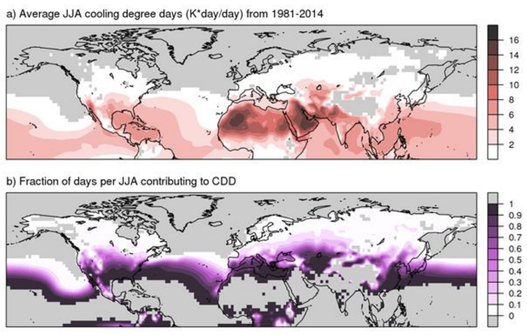

Figure 1: Climatology of summer (JJA) cooling degree days from 1981-2014 derived from ERA Interim (a) and fraction of days per season that are cooling days (b). Areas in (b) where cooling days never occur or where every day is a cooling day are marked in grey.

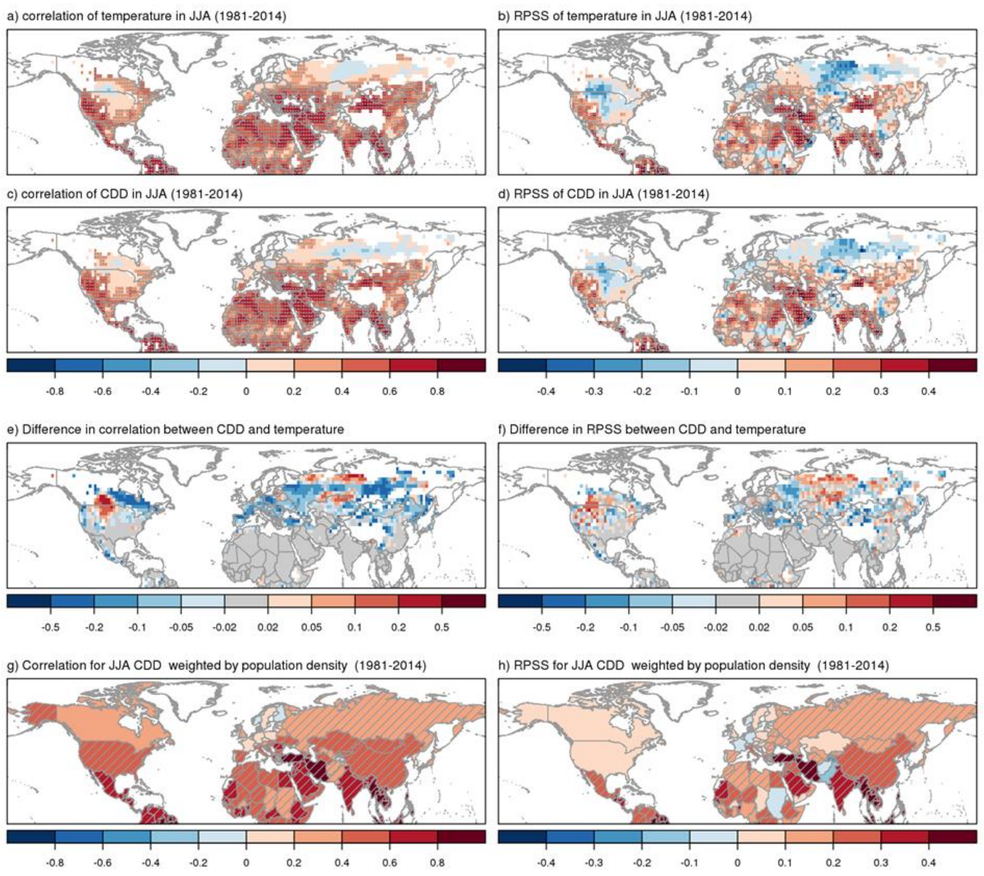

Figure 2: Correlation (a, c) and RPSS (b, d) of summer (JJA) mean temperature (a, b) and cooling degree days (c, d), the difference in correlation of the index minus seasonal mean temperature (e) and difference in RPSS (f), and the correlation (g) and RPSS (h) of population weighted national CDD averages. Stippling and hatching denotes correlations and RPSS that are significantly (10% level) larger than zero.

Toy model results

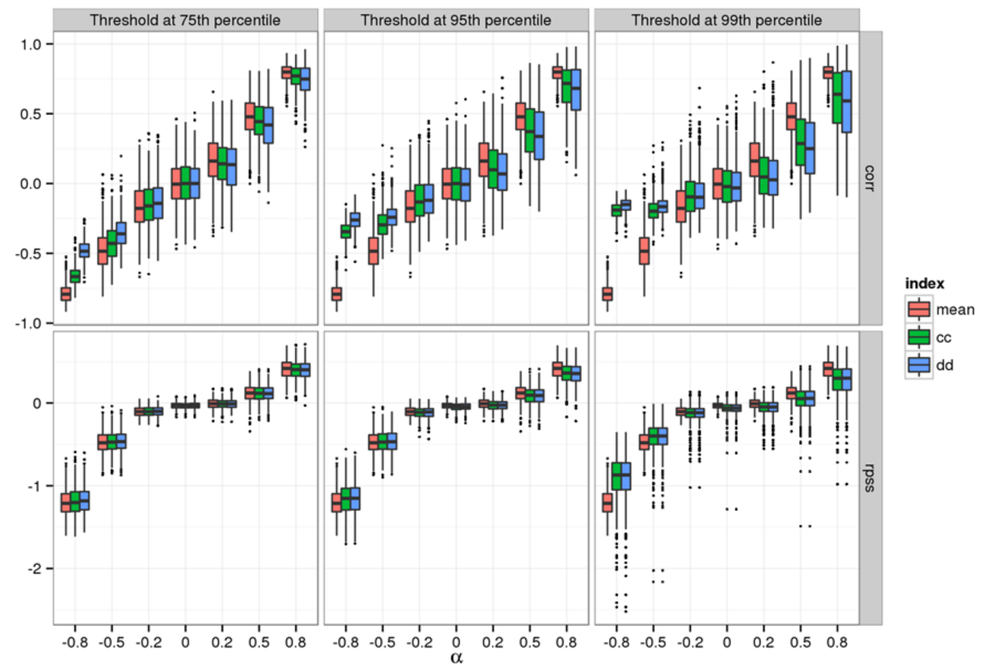

Figure 4: Forecasts of the seasonal mean (red box and whiskers) and counts of threshold exceedances (green) and accumulated threshold exceedances (blue) derived from daily time series with a toy model (Weigel et al., 2009, extended to include daily variability). The nominal correlation skill of the toy model is controlled by alpha, the box and whisker diagrams summarize the distribution of 500 random draws of 33 forecasts with 51 ensemble members.

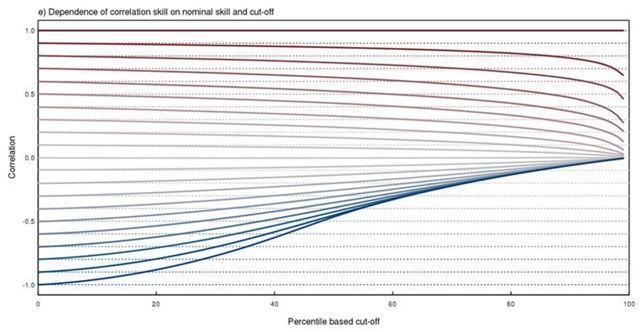

Figure 5: Dependence of the correlation of the count index on threshold and nominal correlation skill level of the underlying mean quantity.

Synthesis

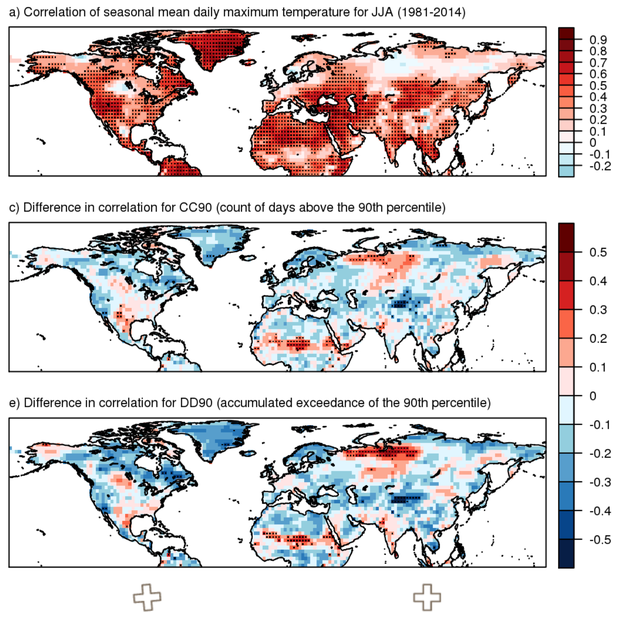

Figure 6: Correlation of seasonal mean daily maximum temperature in JJA (1981–2014, a), difference in correlation of counts (c) above the 90th percentile and of accumulated threshold exceedances respectively (e). Stippling in panels (c, e) indicates correlations for the index that are significantly different from what is expected due to the correlation in the seasonal mean and predictability of the seasonal mean only (see above). None of the differences in (c,e) are field significant after controlling the False Discovery Rate.

Benefits of aggregation

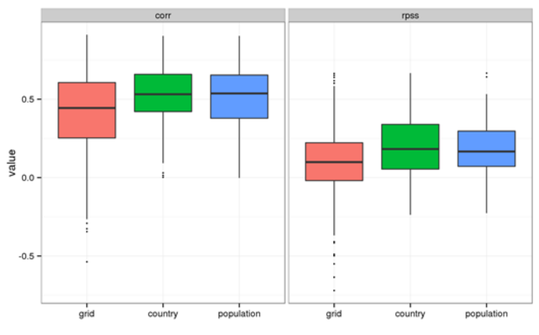

Figure 3: Area weighted distribution of correlation (left panel) and RPSS (right panel) for JJA CDD. Aggregation to the 2x2 degree grid is shown in red, aggregation to the country level (and subsequent disaggregation to 2x2 grid) in green, aggregation to country level with weighting by population density in blue.

MeteoSwiss