sDoG **extends** a daily air **temperature record** at a high alpine site with **high accuracy**. True uncertainties grow larger for past periods than the cross-validation error estimates.

Extending limited in situ mountain weather observations to the baseline climate: A true verification case study

Marlis Hofer and Johannes **Horak**

INTRO

In high mountain regions long-term climate records with 20+ years of data are virtually absent. Unfortunately the grid spacing of globally available atmospheric model-based products (e.g., reanalysis data such as ERA-Interim) is too coarse to account for the orographic detail necessary to represent the variability found in local weather and climate.

METHODS

The statistical downscaling method sDoG combines in situ observational records with globally available and complete reanalysis data. It is applied to extend gaussian target variables, here the short term daily air temperature records from the Vernagtbachstation in the European Alps (2640 MSL), to a baseline climate period. The training period extends from 2002 to 2012 and the validation period from 1979 to 2001. sDoG is compared to a selection of reference models (ERA-Interim, ERA5, ALARO and a nearby observational time series) at climatological cycle, day-to-day and year-to-year time scales. Cross-validation based uncertainty estimates are compared to true uncertainties from the validation period.

RESULTS

- sDoG outperforms all reference models at all time scales.
- The true uncertainty increases with temporal distance to the training period compared to the cross-validation estimate

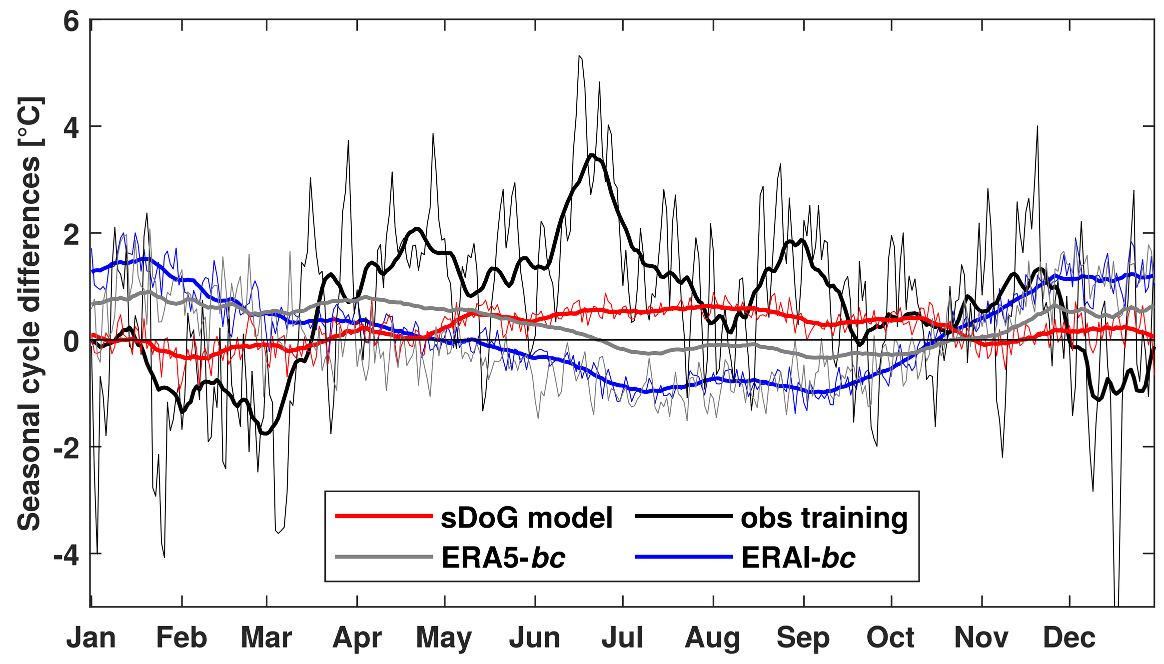

Figure 1. Difference of mean seasonal cycles to validation period measurements (1979-2001)

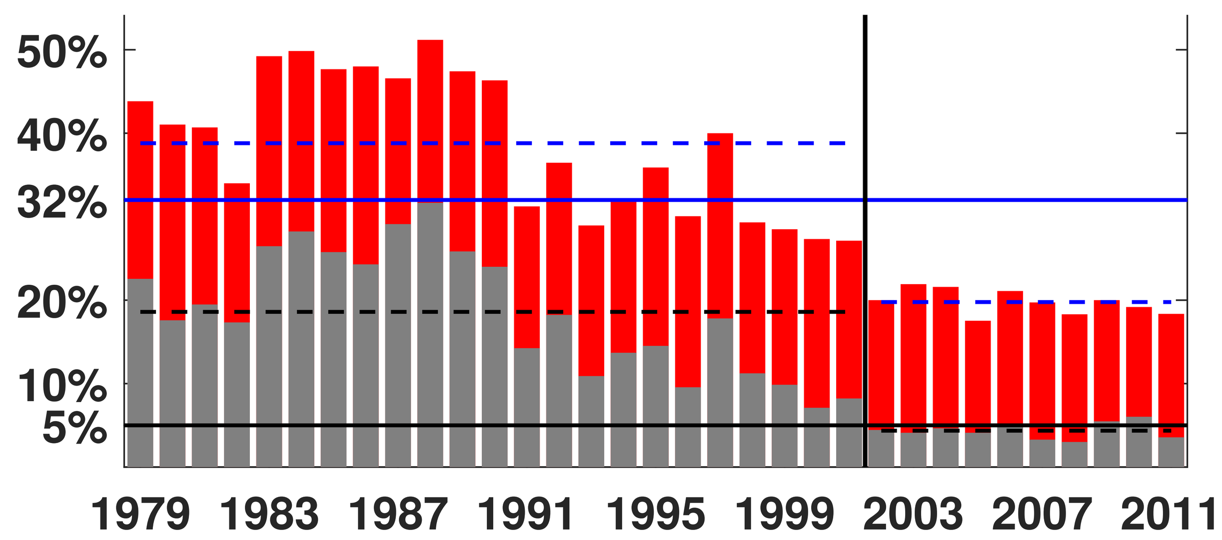

Figure 2. Percentage of data exceeding the cross-validation-based uncertainty estimates. Red and gray bars: percentage of data exceeding 1σ and 2σ respectively. Gray bars should on average not exceed 5% of the data (black horizontal solid line) and red bars not 32% of the data (blue solid line). Averages of red and gray bars are indicated by the blue and black dashed line respectively.

DISCUSSION

The past increase in true uncertainty, particularly in summers, is potentially attributable to a violation of the stationarity assumption; the nearby glacier tongue retreated, rocky terrain remained.

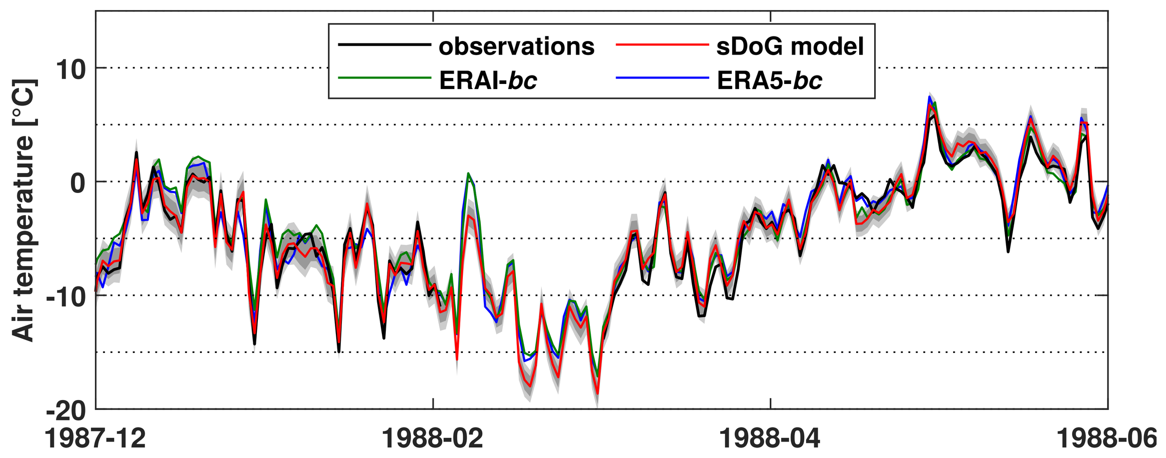

Figure 3. Daily air temperature (measured and modelled) at the study site during an arbitrary 6 month time-slice of the validation period.

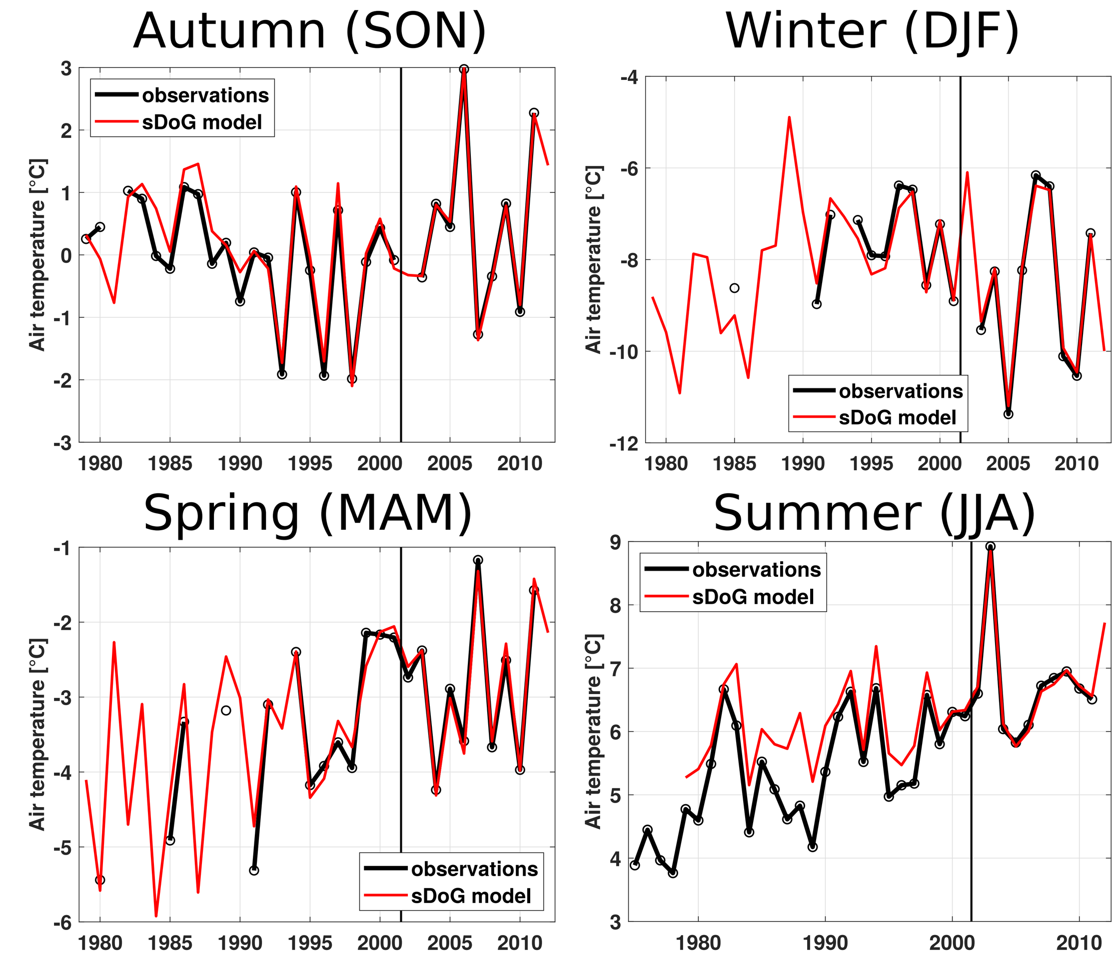

Figure 4. Seasonal mean temperatures. sDoG exhibits a high accuracy during the validation period (1979-2001) for all seasons except summer. Here the model overestimates the seasonal average.

Bias correction method

$$\Delta = \Delta h \cdot \frac{T_{750}(t) - T_{\mathrm{sfc}}(t)}{Z_{750}(t) - h_{\mathrm{sfc}}}$$

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