A simple and cost-effective approach for assessing uncertainties in gridded data

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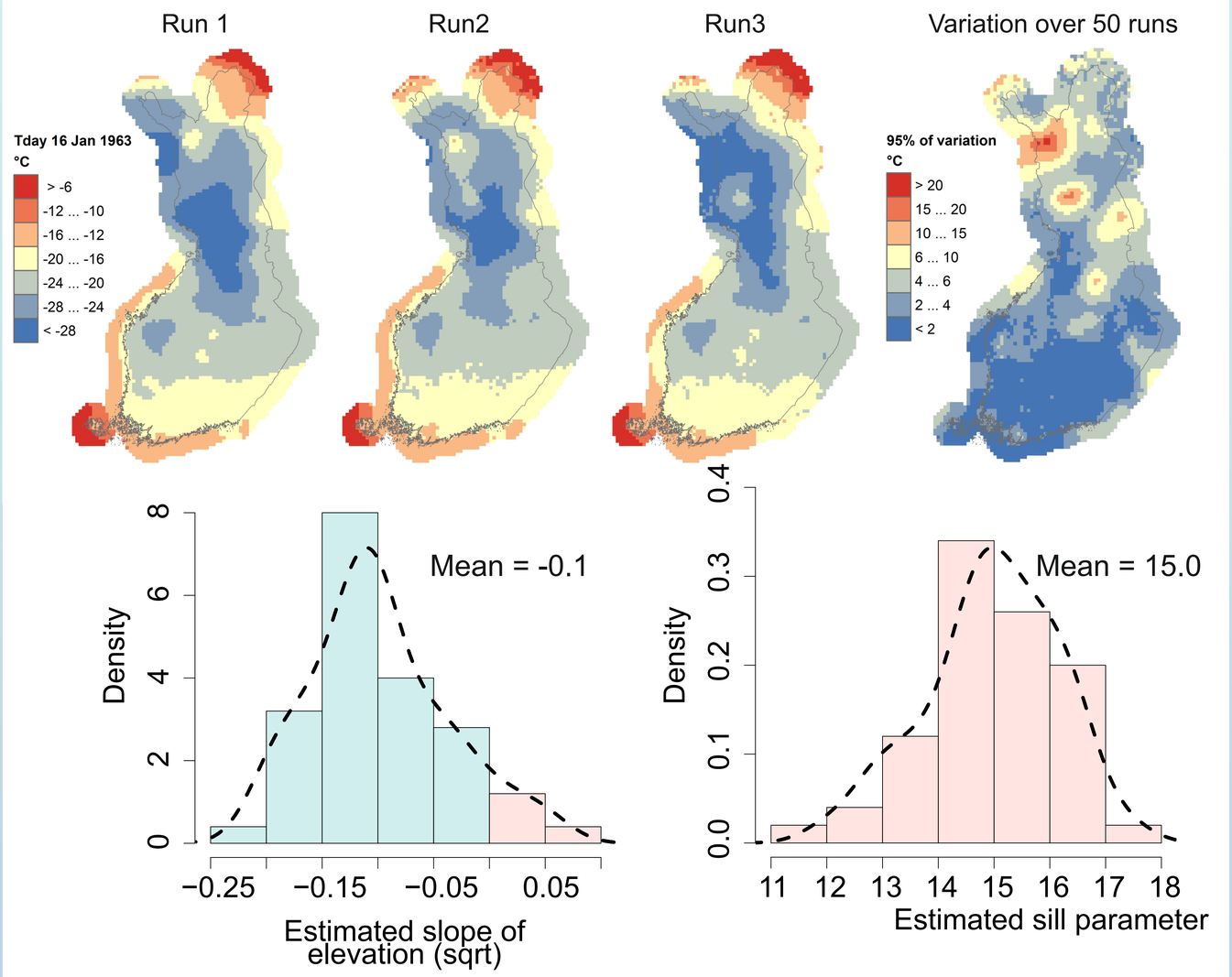

Figure 1. The variation in the gridded temperature data (top) and two interpolation model parameters (bottom) based on 50 interpolation runs and 75 % of the data (16 January 1963).

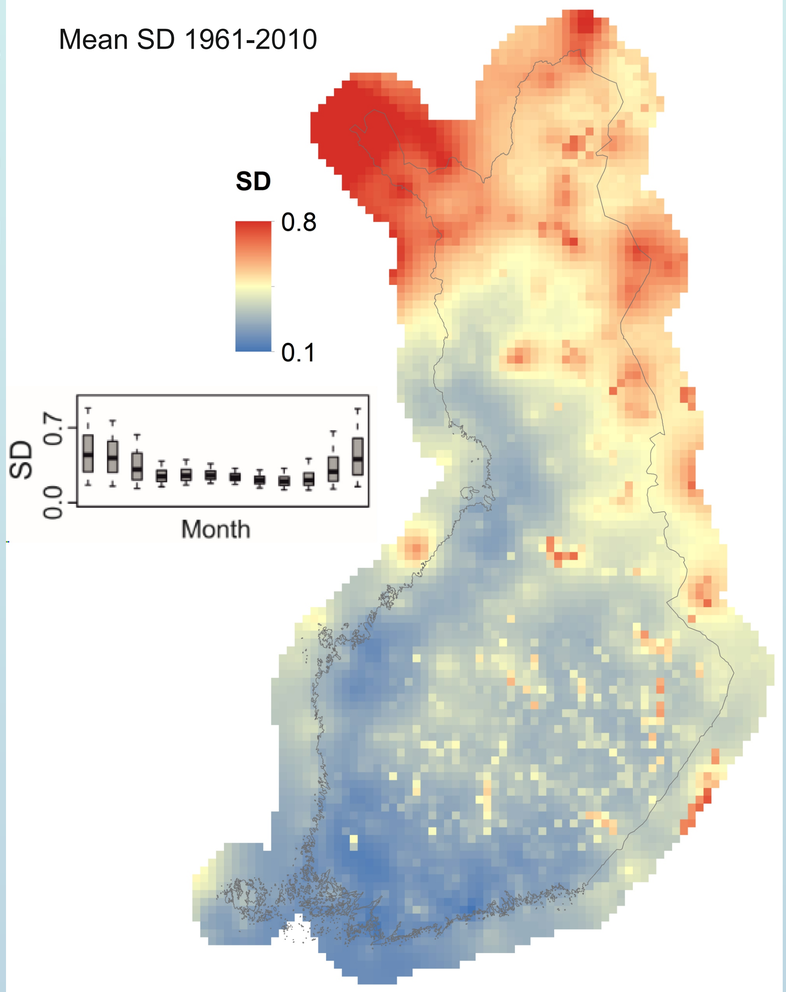

Figure 2. Spatio-temporal patterns of the interpolation uncertainty (SD) for mean daily temperature over the period of 1961–2010.

1. Background

- Long-term gridded data are needed in various applications.
- Gridded data inherently contain uncertainty, related to e.g. input data and methodology, that end users should be aware of.
- Sophisticated simulation methods for uncertainty analysis are computationally heavy to conduct over long daily time series.
- A repeated re-sampling approach can provide useful insights on uncertainties in gridded data.

2. Data and methods

- Mean daily temperature observations (Tday) from *FMI* and *ECA&D* covering 1961-2010.
- Kriging interpolation with auxillary variables of topography and water cover (10 km x 10 km; Aalto *et al*., 2016).
- Our repeated re-sampling approach: 75 % random sample of daily data with 50 interpolation runs.
- Uncertainty for each location is quantified as the standard deviation over 50 interpolation runs, SD.

3. Key findings

- Interpolation model parameters and consequently the gridded outputs are sensitive on data sample (**Figure 1**).
- The analysis identified locations with the highest overall uncertainty (**Figure 2**).
- Interpolation uncertainty is significantly ($p \leq 0.001$) related to the variation in observation data (**Figure 3**).
- Our method is robust over sample sizes and the number of interpolation runs (**Figure 4**).
- Uncertainty information is useful in subsequent analysis (e.g. Aalto *et al.*, 2016) and network planning.

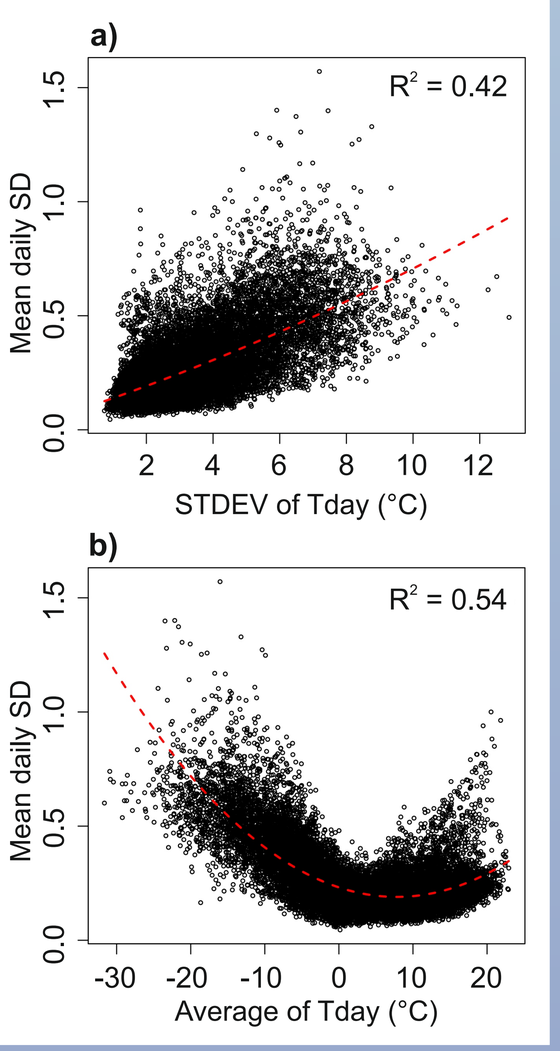

Figure 3. The relationship between daily interpolation uncertainty and station observations (1961-2010). In a) the mean daily uncertainty (SD) is plotted against standard deviation (STDEV) of daily mean temperatures (Tday). In b) the daily uncertainty is contrasted with averages of mean daily temperatures.

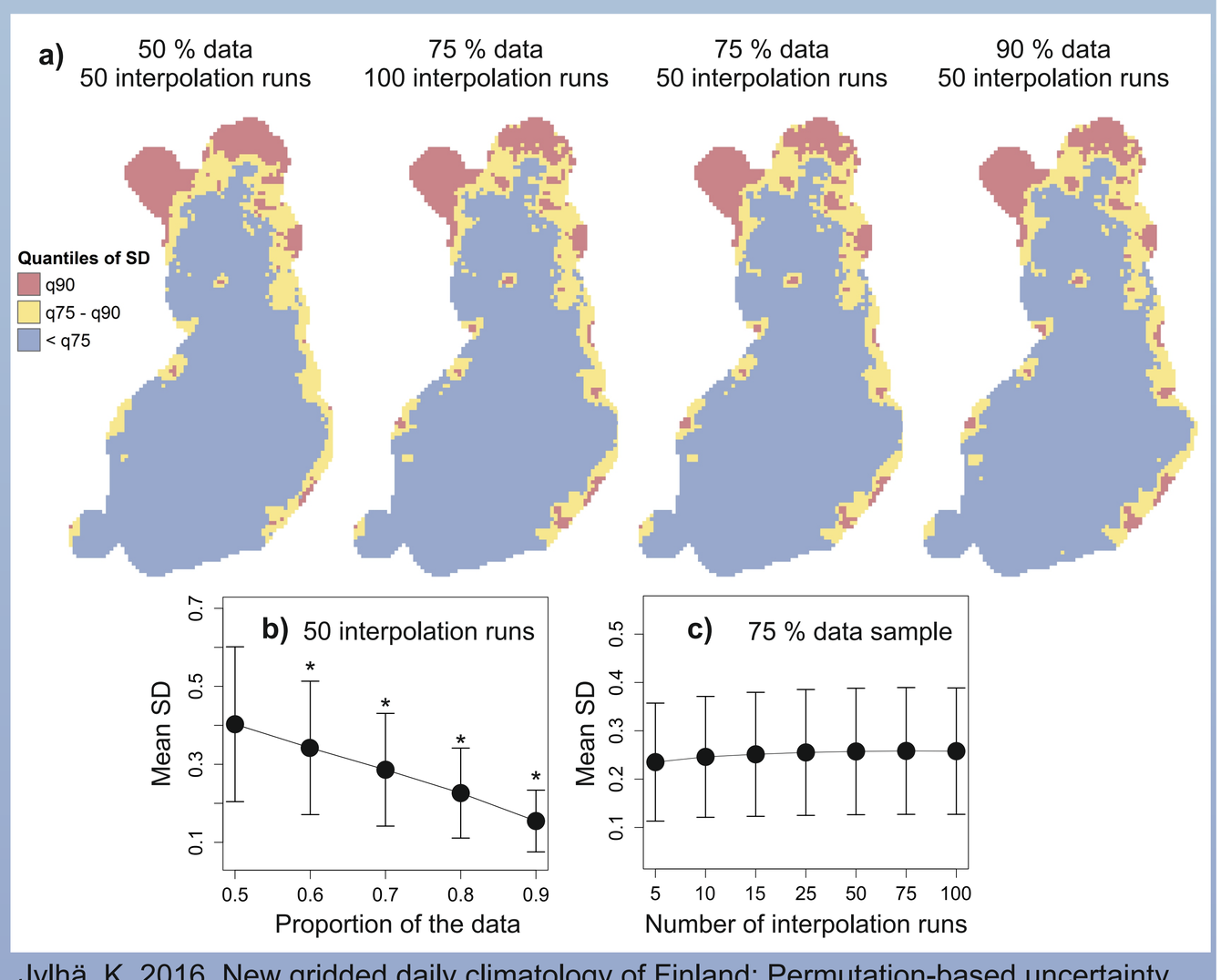

Figure 4. The influence of sample size and the number of interpolation runs on the uncertainty estimate over a one year daily period (2010). In a) the maps present SD using different sample sizes and the number of interpolation runs. In b) uncertainty is plotted as a function of data sample while in c) uncertainty is contrasted with the number of interpolation runs. Asterisk (*) indicate a statistically significant change ($p \leq 0.05$) compared to previous step.

Aalto, J., Pirinen, P., Jylhä, K. 2016. New gridded daily climatology of Finland: Permutation-based uncertainty estimates and temporal trends in climate. *Journal of Geophysical Research: Atmospheres* 121: 3807–3823.