S1T2

Improving the global SST record: estimates of SST biases in the modern era using high quality satellite data

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Sea surface temperature (SST) is typically used as the marine component of the global surface temperature record, a primary metric of climate change. SST observations from ships form one of the longest instrumental records of surface marine climate. However, over the years different methods of measuring SST have been used, each with different bias characteristics. The estimation of systematic biases in the SST record is critical for climatic decadal predictions, and uncertainties in long-term trends are expected to be dominated by uncertainties in biases introduced by changes of instrumentation and measurement practices. Although the largest systematic errors in SST observations are typically assumed to relate to the period before about 1940, where SST measurements were mostly made using uninsulated buckets, there are also issues with modern data, in particular when the SST reported is the temperature of the engine-room cooling water intake (ERI). On the other hand, biases associated with modern buckets observations are assumed to be typically smaller but yet not negligible. Even in the well sampled modern era, existing studies on SST biases only provide broad estimates based on subsamples of the data and ignoring ship-by-ship differences. Moreover, although most of the observations in this period have known measurement type, this information can still be missing or wrongly reported. Here we take advantage of a new, high spatial resolution, gap-filled, daily SST for the period 1992-2010 from the European Space Agency Climate Change Initiative (ESA CCI) for SST dataset version 1.1. In this study, we use a Bayesian statistical model to characterise the uncertainty in the SST reports for individual ships using the ESA CCI SST as a reference. A Bayesian spatial analysis is used to model the differences of the observed SST from the ESA CCI SST for each ship. Known metadata and differences in the diurnal cycle are used to classify ships according to their measurement method and different models are then applied to characterise buckets and ERI biases. For bucket observations the difference between the observed SST and the ESA CCI SST is modelled as a function of the climatological air-sea temperature difference, while for ERI reports a constant offset plus a function of the climatological SST is used. By explicitly modelling the spatial correlation present in the data, this method allows us to better estimate the seasonal mean bias and the related uncertainty for each ship, down weighting observations taken at the same site as well as whole regions which where found artificially warm or cold relative to other areas sampled by the ship. Future work will use the results from this well-characterised period to understand how to extend the analysis back in time to periods where such high quality reference SST is not available, leading to a full characterisation of the SST ship biases and their uncertainty and a better estimate of the SST trend.

Oral

- **Data homogenization (benchmarking, bias adjustments, step change analysis, metadata)**