# The Development of the New Hadley Centre Sea Ice and Sea-Surface Temperature Analysis, HadISST2; Exploring Uncertainty in Boundary Forcing for Reanalyses

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Reanalyses assimilate a wide variety of observations, assigning to each an estimate of the likely uncertainty. Recent long-term reanalyses, which extend into data sparse periods, explore the uncertainty further by running an ensemble of reanalyses that give a physically consistent picture of uncertainties in data voids. In order to more fully explore the uncertainties it is necessary also to include uncertainty in the boundary conditions provided by prescribed sea-surface temperature fields.

The current generation of long-term sea-surface temperature analyses has had a great deal of attention focused on homogeneity of the mean state, with bias adjustments applied to reduce the effects of changing measurement methods. Recent research has highlighted inadequacies in the bias adjustments generally applied to global SST data sets, and showed that uncertainty in the bias adjustment schemes is an important contribution to uncertainty even in the post-1945 period.

Also, by focusing on the “best-estimate” solution, the analysis methods used to produce the globally complete fields needed to drive atmosphere only reanalyses and models tend, in the absence of data, to reconstruct too little variance. Others impose homogeneous spatial variability upon the analysed fields. This can potentially lead to SST gradients that are too slack where they ought to be tight or an unrealistic lack of variability in key regions for global variability such as the tropical Pacific.

The new version of the Met Office Hadley Centre sea-Ice concentration and Sea-Surface Temperature data set, HadISST2, aims to build on the successful elements of HadISST1, while making improvements targeted on the needs of the reanalysis community in a number of key areas.

1. Improvements to source data sets: HadISST2 is based on version 2.5 of the International Comprehensive Ocean Atmosphere Data Set (ICOADS), which contains several million more observations than the in situ data set on which HadISST1 was based. Improved AVHRR data from the Pathfinder data set are being used, as are SST retrievals from the ATSR series of instruments. Sea ice data sources have also been updated and extended.

2. Bias corrections: more comprehensive homogeneity adjustments are applied to the in situ SST, AVHRR SST and sea ice retrievals to correct for known biases in the data.

3. Improved reconstruction techniques allow us to make use of every single observation to inform the estimation of the data covariances and reconstruction. These techniques also mean that we can make a reconstruction of the data at a resolution of 1 degree all the way back to 1850. By separately analysing large and small scale structures, fine scale features that are supported in the data are preserved.

4. Increased resolution: the base SST climatology is now 0.25x0.25 degrees and daily resolution allowing improved representation of features such as the Gulf Stream.

5. Uncertainties: HadISST2 will be presented as a set of realisations drawn from the posterior distributions of the analyses. These explore the uncertainty range associated with data biases and analysis uncertainty. Each realisation has realistic and homogeneous spatial variability that is consistent with the known covariance structure of SST, the available observations and their uncertainties.

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