Testing the HadISST2 Analysis in an Ideal World

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1. Met Office Hadley Centre sea ice and SST analysis (HadISST)

HadISST1 (Rayner et al, 2003) is a globally complete monthly analysis of SST and sea ice concentration since 1870 and has been widely used in various climate applications, including ERA40. The next generation, HadISST2, is currently being developed. This will incorporate many new observations of SST and sea ice and will extend back to 1850. We are developing an analysis system which is intended to be flexible enough to produce HadISST2 on different spatial and temporal resolutions, to suit different applications. As for HadISST1, we will take a reduced space approach in the analysis, using EOFs of anomalies to reconstruct complete fields.

2. Ideal world test framework

We are able to test our reconstructions and estimates of uncertainty in an "ideal world" framework using simulations from the HadGEM1 coupled climate model (Johns et al, 2006). We withhold data according to historical patterns of observations and add noise to mimic observational uncertainties. We then use Reduced Space Optimal Interpolation (RSOI) to produce reconstructions of the complete fields and compare these to the original perfect model fields. By progressively making our tests more realistic (and deviating from theoretical assumptions), we will be able to isolate the impact of each change on our reconstruction.

3. RSOI can handle correlated errors

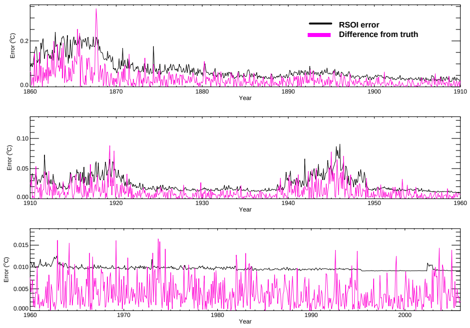


Figure 1. Errors in reconstructed SST if grid box uncertainties are uncorrelated

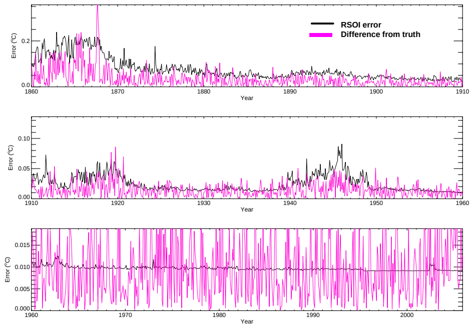


Figure 2. Errors in reconstructed SST if grid box uncertainties are correlated, but assumed uncorrelated

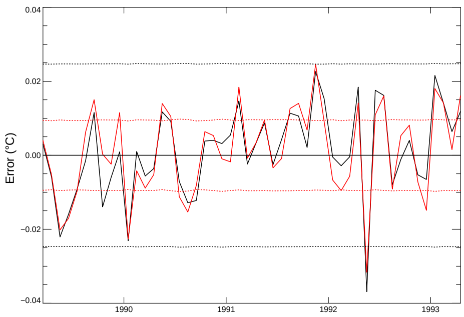


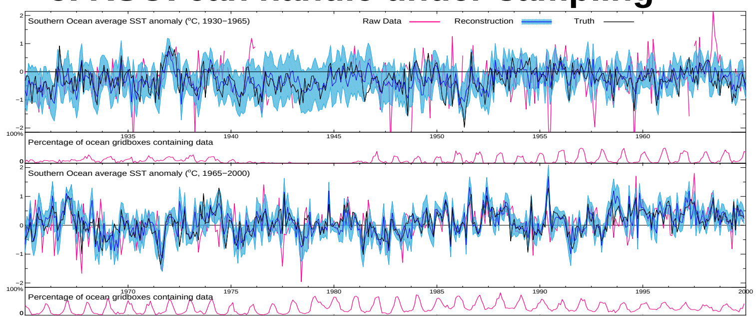
Figure 3. Errors in reconstructed SST if grid box uncertainties are correlated and assumed to be uncorrelated (red line) and correlated (black line).

One common assumption of optimal interpolation procedures is that observational uncertainties are uncorrelated between data points. However, many observational uncertainties are correlated. Here we test the consequence to the analysis errors of (i) making this assumption where it is not justified and (ii) adapting the system to allow correlated observational errors. Figure 1 illustrates the veracity of the analysis uncertainty when input errors are uncorrelated by comparison of the reconstruction with the truth. Figure 2 shows that analysis uncertainty is underestimated when observational errors are assumed uncorrelated, but are actually correlated. Figure 3 illustrates that the analysis uncertainty is correctly estimated when the correlation in the observational errors is acknowledged.

4. Biases have no effect

The observational SST data base comprises data taken from many different platforms. Each of these platforms produces data which is different in some way from that of another, causing relative biases. The relative dominance of each of these platforms changes with time, sometimes slowly and sometimes suddenly, resulting in slowly or suddenly varying biases. Some of the biases are currently corrected for and we are in the process of developing corrections for others. New or previously undetected biases are likely to arise in the future. We tested the effect of these on our reconstruction by creating a set of partially biased test data (mimicking biases in bucket-collected SST) using this to generate EOFs and producing a reconstruction with these EOFs, but applied to unbiased "observational" data. We found no effect on the reconstruction that we could attribute to the biased EOFs, giving us confidence that periods containing uncorrected or undetected biases are not likely to adversely affect periods without such biases.

5. RSOI can handle under-sampling



The Southern Ocean is very sparsely sampled and provides a tough test of the RSOI. Here, EOFs were generated from full, perfect data, so the test is not fully realistic. However, it does demonstrate that data in other oceans can be used to reconstruct data voids, when we know the large-scale covariances.

References:

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