Utilising information on correlations in observation errors within OSTIA

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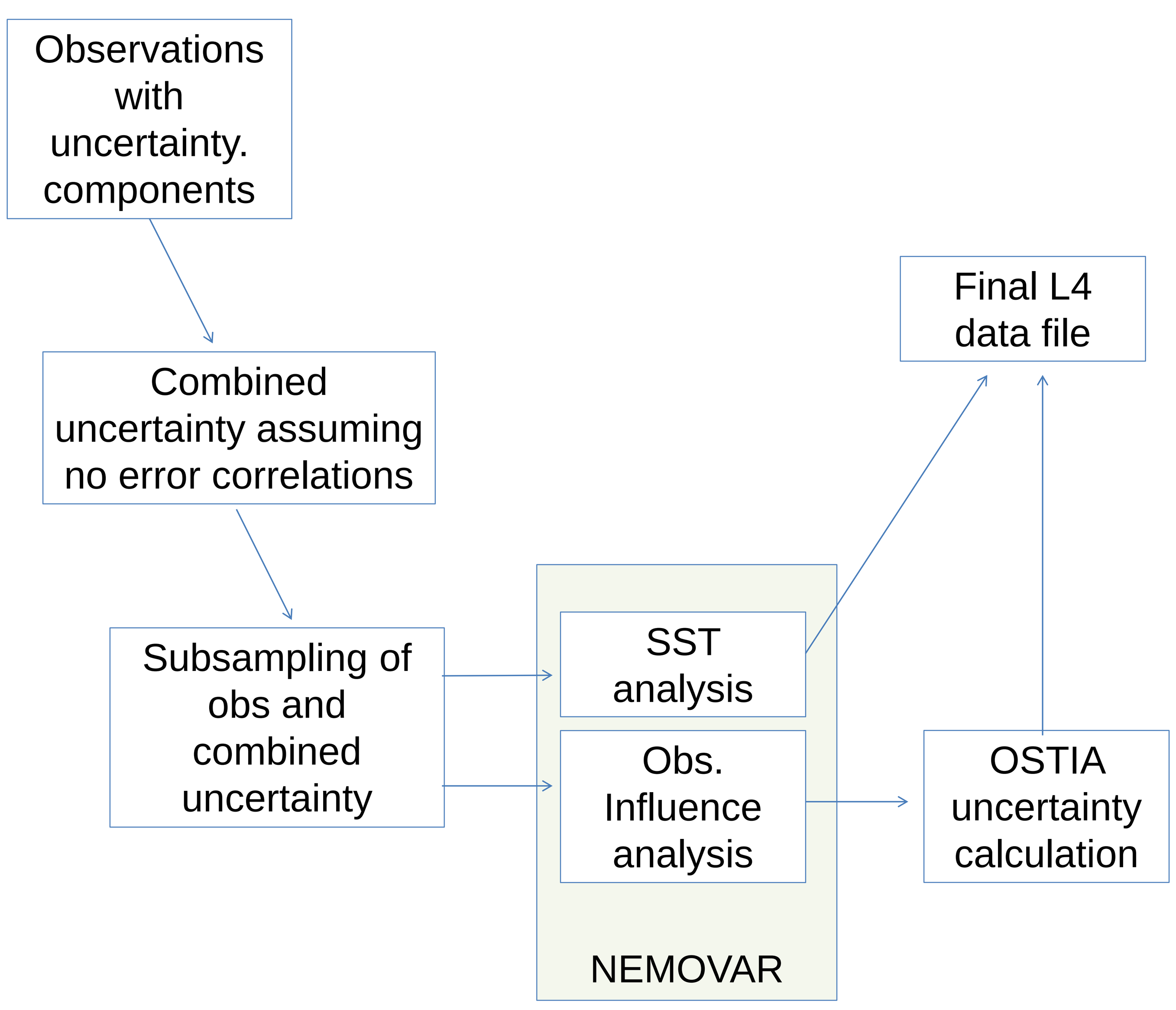
1. Introduction

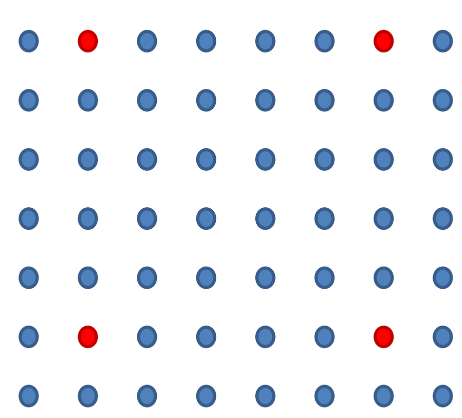
The ESA SST CCI (European Space Agency Sea Surface Temperature Climate Change Initiative) project provides level 2 and level 3 SST data which include observational uncertainties that are decomposed depending on the spatial scales over which the errors they represent are correlated. (See www.esa-sst-cci.org.)
The OSTIA (the Met Office Operational Sea Surface Temperature and Sea Ice Analysis) system is used to produce level four (L4) analyses for the ESA SST CCI project. It uses a data assimilation scheme to combine observations with a background that is based on the previous day's analysis (Donlon et al., 2012) . In common with many data assimilation schemes, this assumes that observation errors are uncorrelated. This is justified in part by the subsampling of observations, and the assumption that representativity errors are negligible due to the high-resolution of the SST analysis (however recent work shows this assumption is questionable (Roberts-Jones et al., 2016)) and measurement errors such as those provided with the CCI data dominate the observation error.

We aim to develop improvements to the OSTIA analyses by utilising the information about correlations in observation errors provided with the SST CCI data. We will produce a demonstration OSTIA system along with 6 months' data, and a draft paper. Here we present the proposed method, the progress so far and plans for the direction of this work.

2. Observations error correlations

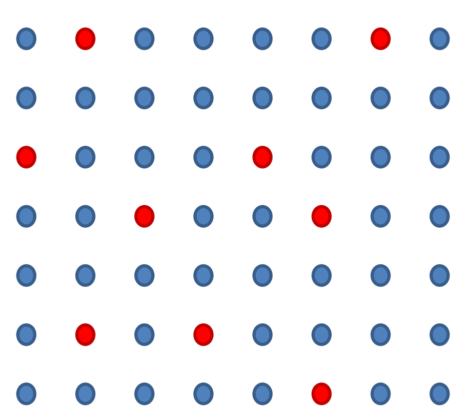
The information provided by ESA SST CCI includes uncertainties correlated on several spatial scales, which are given as standard deviations. This includes uncertainties due to errors that are spatially uncorrelated, correlated on synoptic scales (approximately 100km) and correlated on large scales. There is also a component of the uncertainty due to the adjustment of the sea surface temperature (SST) observations from a skin-SST to a depth-SST – this adjustment has uncertainties spatially correlated on the scale of approximately 100km. The distribution of the error correlations are currently assumed to take exponential form.





3. Current status

Currently, the OSTIA system assumes observation errors are uncorrelated. The data are subsampled to approximately 6km, to help prevent assimilation of observations with correlated errors. However, it is not known how ideal this current subsampling method is. Under-subsampling can allow correlated observation errors to be propagated, whereas over-subsampling can mean that useful information may be lost – both potentially degrading the analysis.



4. Intelligent subsampling

The proposed improvement is to develop an 'intelligent subsampling' scheme, where observations are selected for assimilation according to their uncertainty components rather than at a pre-set spacing. If a flexible method can be established that relates the uncertainty components to a suitable subsampling scheme, then this could also be reapplied if and when more knowledge is available about the nature of the errors and their correlations.

5. Method

An idealised experiment is being set up in order to investigate appropriate subsampling schemes. Synthetic observations and background data will be generated using the given information on observation error correlations, which will then be run through an analysis scheme. A Monte Carlo type approach will be used to calculate the analysis error variance. This will then be repeated with varying observation subsampling methods in place, to try to minimise the analysis error variance. The aim would be to find an algorithm that relates some measure of the correlations in the observations to the best subsampling to use. In finding this 'best' subsampling scheme, care must be taken not to under subsample real variations in SST. Once devised, the method could be reapplied if the knowledge of observation error correlations was improved.

References
Donlon C., M. Martin, J. Stark, J. Roberts-Jones, E. Fiedler, W. Wimmer, 2012. The operational sea surface temperature and sea ice analysis (OSTIA)Remote Sensing of Environment, 116, pp. 140–158.
Roberts-Jones J., K. Bovis, M.J. Martin, A. McLaren, 2016. Estimating background error covariance parameters and assessing their impact in the OSTIA system. Remote Sensing of Environment, 176, pp. 117–138.

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