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Merging in situ and satellite data for gridded multidecadal analyses of sea surface temperature fields

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Many climate-related applications require fully interpolated (i.e., with no spatial or temporal gaps) gridded data sets of available observations. Both the content and the uncertainty of such products depend on the error specification for individual observations as well as on the gridding technique. Optimal approaches to the gridding procedures make theoretical estimation of full uncertainty by far more expensive to compute and much more voluminous to report than the calculation of actual gridded fields. Currently popular methods of gridding sea surface temperature (SST) data are different for the satellite era and for the earlier period of sparse historical in situ observations. This difference is also reflected in typical approaches to uncertainty representation for the analyzed SST fields in these periods. Various heuristic approaches are currently used to achieve a measure of coherency when combining gridded fields for such periods of drastically different observational coverage into a single data set. A recently developed approach combines a large-scale low-rank component of the spatial covariance matrix with its high-rank component that represents smaller scales of variability in order to produce high-resolution analyses and to represent their uncertainty by an ensemble of SST fields sampled from their posterior distribution, conditional on the available data. This approach is proposed as a more systematic way to combine SST analyses for the satellite and in situ observational periods.