Western North Pacific SST Analyses based on Ship and Buoy Observations

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The 1980s marked the beginning of multichannel infrared monitoring of SST from space and microwave observations have since become available as well. These data have permitted high spatial and temporal resolution analyses to be made (Reynolds et al. 2002), although for the period prior to the 1980s, SST analyses and observational summaries have generally been produced at one–month intervals (Rayner et al. 2003). This temporal limitation is one of many challenges in the search for systematic short–period interactions between the atmosphere and ocean. The objective of this work is to explore a simple method of interpolating not only *in situ* SST observations, but also measurement method, under the assumption that physical understanding is dependent on both.

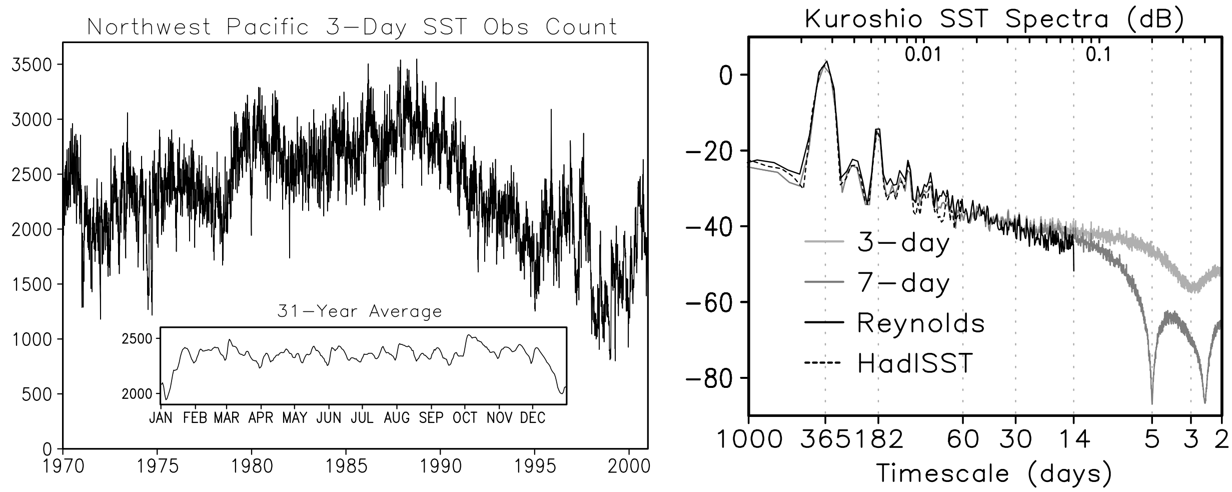

Figure 1: [Left] A 31–year (1970–2000) timeseries of the number of quality controlled ICOADS SST observations during consecutive three–day periods for the western North Pacific domain (shown in Fig. 2). A 31–year average for each day of the year is shown in the inset. [Right] Power spectral density (PSD) estimates of Kuroshio current extension SST variations during 1982–1989. These are based on timeseries of daily 3–day (light line) and 7–day (medium line) *in situ* analyses, weekly Reynolds analyses (dark line), and monthly HadISST analyses (dashed line). Each PSD estimate is an average of the local spectra within a $16^\circ \times 25^\circ$ box centered on the Kuroshio current extension. The ordinate is PSD in $^\circ C^2$ (cycles per day)$^{-1}$ and is expressed in dB.

The International Comprehensive Ocean–Atmosphere Data Set (ICOADS; Worley et al. 2005) is a compilation of the world's *in situ* surface marine observations. We consider only those ICOADS observations of high quality (i.e., within 2.8 estimated standard deviations of a smoothed monthly climatology). For the western North Pacific region, there are often more than 2000 observations during any three-day period (Fig. 1), with fewer observations at the end of December and beginning of January (see inset), presumably owing to the working schedules of voluntary observing ships.

The feasibility of a simple analysis for one three–day period with only 810 observations is given in Fig. 2. Here, a simple two–step analysis scheme is employed, where the first step defines a gridded value as a weighted average of the 15$^{\text{th}}$ nearest observation and a spatially variable influence radius is employed. This step has a well known bias (Daley 1991) that results from an uneven distribution of influential observations perpendicular to the strong SST gradient (inside the oval). We thus calculate a weighted average for positional displacement in the same way that the weighted average for SST is obtained. This yields an unstructured grid, from which we obtain gridded SST values by Delaunay triangulation and interpolation (using the GMT package). The result compares well with the corresponding Reynolds et al. (2002) analysis, although an average of five consecutive daily analyses (Fig. 2f) appears more similar. The quality of the three–day and seven–day analyses can also be examined by comparing their SST spectra (Fig. 1). The *in situ* and Reynolds analyses are quite consistent down to timescales of about one month, below which the *in situ* analyses start to resolve more variance (i.e., they are noisier) than the Reynolds spectrum.

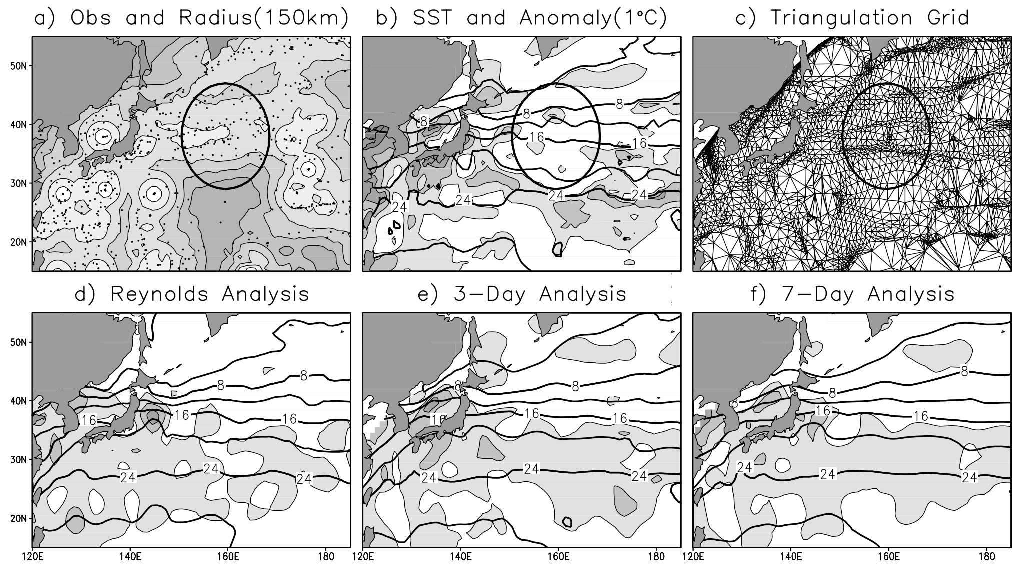

Figure 2: Example of an SST analysis based on only 810 ship and buoy observations taken on December 27–29, 1998. Shown are a) the observation positions (dots) and a spatially varying influence radius (shaded at 150 km intervals), b) interpolated SST (4°C intervals) and SST anomaly relative to a 31-year (1970–2000) average for December 28 (1°C intervals), and c) unbiased positions of the interpolated SST values in (b) (at the vertices of each Delaunay triangle). The remaining panels are as in (b), but d) the Reynolds et al. (2002) SST analysis for the week beginning December 27 and SST anomaly relative to a 19–year (1982–2000) average for December 30, e) interpolated from the triangulated grid and smoothed, and f) an average of five consecutive three–day analyses (using a total of seven days of ship and buoy observations).

A growing addition to ICOADS is metadata (e.g., measurement method) that facilitate an interpretation of the observations that have been retained. This is leading to a better understanding of systematic and random errors (e.g., Kent and Challenor 2006). In turn, this permits a physical interpretation of moderate quality *in situ* analyses. Future work will be based on the assumption that their use is appropriate for composite diagnostic studies (cf. Gyakum and Danielson 2000), in which random errors become small, but biases related to measurement method remain. The simplicity of our analysis scheme also facilitate an examination of such biases.

References

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