Comparisons of VOS and Research Vessel Marine Meteorological Data

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A new ocean surface meteorology and flux dataset is being developed at the National Oceanography Centre Southampton (NOC). It is based on the International Comprehensive Ocean-Atmosphere Data Set (ICOADS, Worley et al. 2005) and will initially cover the period 1970 to 2005.

This poster illustrates an example of one of the ways the new dataset could be used: to provide a wider-scale context for Research Vessel Meteorological data.

Introduction

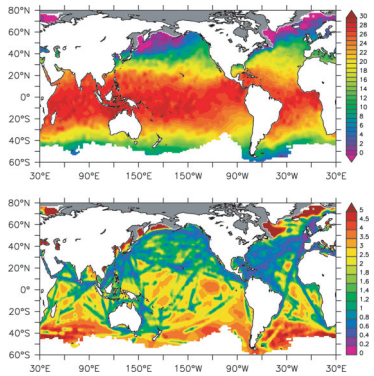
ICOADS contains the routine weather reports from ships, buoys, drifters, and fixed platforms along with near-surface data from oceanographic profiles. These measurements of sea surface temperature (SST), air temperature, near surface humidity, winds and pressure can be used with parameterisations known as "bulk formulae" to estimate the surface turbulent exchange of heat and moisture, the sensible and latent heat fluxes.

A different approach is being taken to previous *in situ* datasets (e.g. da Silva et al. 1994, Josey et al. 1999). We are using optimal interpolation (e.g. Reynolds 1988) to produce daily fields of SST, air temperature, near surface humidity, winds and pressure on a 1˚x1˚ area grid. Random error estimates for the ship data were taken from Kent and Berry (2005). The previous day's analysis, incremented to allow for a seasonal cycle, has been used for the background field. The background error field is the previous day's analysis error relaxed towards the climatological intra-monthly standard deviation using a 3 day time scale. The spatial scale chosen was 300 km. In the absence of data, anomalies are allowed to persist, but the uncertainty increases toward the climatological variability.

An example of one of the global fields generated, air temperature for the 12th March 1992, is shown in the panel below.

Daily Air Temperature Field (˚C)

Air temperature (˚C) for 12th March 1992 calculated from ICOADS using Optimal Interpolation. Grey represents areas of sea ice from passive microwave (Cosimo 1999). Ocean regions which are blank are very poorly sampled, we have not yet decided how to fill these areas.



Air temperature random uncertainty (˚C) for the daily OI field shown above. Random uncertainty accounts for the random component of measurement error and for variations in the spatial and temporal sampling. Uncertainty due to representativeness is also accounted for implictly through the OI scheme.

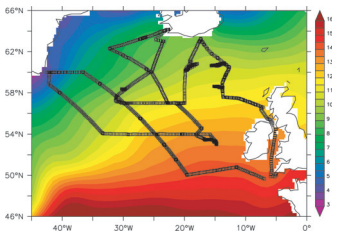
Co-location with Research Vessel Data

We have used the hourly composite reports from Research Vessels prepared by the Center for Ocean Atmosphere Prediction Studies which will be incorporated into ICOADS. See the poster by Woodruff, Lubker, Worley and Reynolds for more details. The poster by Smith compares these research-quality observations with the bridge observations from these same Research Vessels. The daily OI fields generated from ICOADS use only the bridge observations, when available, along with observations from other nearby ships.

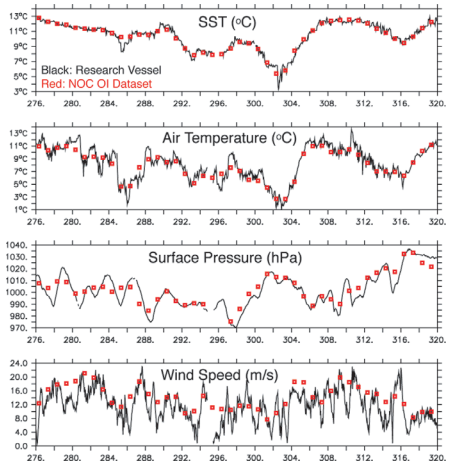
We have taken the Research Vessel observations and extracted data from the daily ICOADS-derived fields, interpolated to the location and time of the Research Vessel observation.

For validation purposes we will exclude the bridge observations from the Research Vessels from a version of our analysis. When we understand the differences between the Research Vessel science observations and the derived fields, a final product using all available data will be developed.

RRS Discovery North Atlantic Winter 1996



As an example some data comparisons from a cruise by the Discovery in the Northern North Atlantic from October to December 1996 are shown. The cruise track is shown above, superimposed on the Sea Surface Temperature (SST, ºC) field for the period from the NOC OI dataset.



Timeseries Comparisons

The time series show data from the RRS Discovery cruise shown above along with co-located daily output from the NOC OI dataset. For SST and air temperature the comparisons are good, with most of the variability captured. The Research Vessel data shows the sub-daily variability missed in the daily OI dataset.

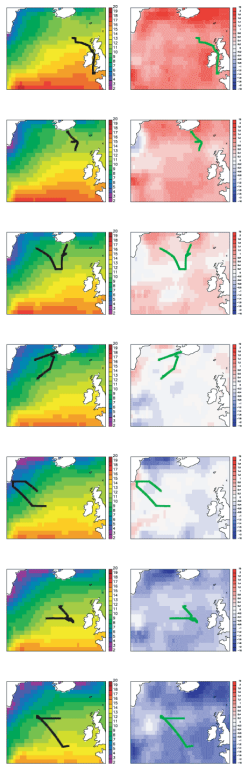
Comparisons for pressure and wind speed show greater differences. The variations in pressure shown in the Research Vessel data are not particularly well represented in the OI dataset, especially in the early part of the record. The strong winds experienced on this cruise are evident in the OI dataset which includes the routine deck observations made on the Research Vessel. The comparison shows that the Research Vessel wind speed exhibits large variability on the sub-daily timescale which cannot be represented in the current version of the OI dataset.

SST anomalies

The NOC OI fields can be used to provide a context for the Research Vessel observations. The maps on the right show successive weekly averages of SST (ºC) for the Discovery cruise. The ship track for the period of the SST average is overlaid.

The plots on the far right show the SST anomaly from the whole-cruise average. The seasonal cooling is clearly seen in the anomaly plots.

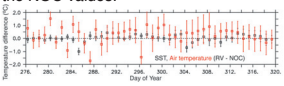
The ICOADS reports are of sufficient quantity and quality to define the larger scale field and aid interpretation of the Research Vessel data.



Daily differences

We have shown that the NOC OI fields can help interpretation of the Research Vessel timeseries, but how accurate are they?

The plot below shows the daily differences between the Research Vessel and the co-located NOC OI fields for the Discovery cruise. Error bars show the random uncertainty (the contributions to uncertainty from random measurement and sampling errors) in the NOC values.



Mean differences are 0.15±1.1ºC for SST and 0.41±1.09ºC for air temperature. We have not yet investigated the possible size of any biases in the Discovery data.

This demonstrates that daily fields can be constructed from ICOADS observations which are comparable with data from Research vessels.

The new NOC OI dataset, including surface fluxes and uncertainty estimates should be available later this year. Although initially the main product will be the monthly fields, we will be making the daily values for well-sampled regions available on request.

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References

Comiso, J. 1999, updated 2005. Bootstrap sea ice concentrations for NIMBUS-7 SMMR and DMSP SSM/I, Boulder, CO, USA: National Snow and Ice Data Center. Digital media.

daSilva, A.. A. C. Young, and S. Levitus, 1994: Atlas of surface marine data 1994, Volume 1.: Algorithms and procedures., Tech. Rep. 6, U.S. Department of Commerce, NOAA, NESDIS, 83pp.

Josey, S. A., E. C. Kent and P. K. Taylor, 1999: New Insights into the Ocean Heat Budget Closure Problem from Analysis of the SOC Air-sea Flux Climatology. J. Climate, 12(9), 2856 - 2880.

Kent, E. C. and D. I. Berry, 2005: Quantifying Random Errors in Voluntary Observing Ships Meteorological Observations, Int. J.Climatol., 25(7), 843-856, DOI: 10.1002/joc.1165.

Reynolds, R.W., 1988: A real-time global sea surface temperature analysis. J. Climate, 1, 75-86.

Worley, S.J., S.D. Woodruff, R.W. Reynolds, S.J. Lubker, and N. Lott, 2005: ICOADS Release 2.1 data and products. Int. J. Climatol., 25, 823-842.

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