

NERC/MoD Joint Grant Scheme: Improving Surface Marine Meteorological Data Using Metadata

Knowledge of present and past climate over the ocean is limited both by a lack of metadata about observational methods and incomplete knowledge of the effect of different observing practices on observational accuracy. The aims of this project are therefore firstly to improve our knowledge about how marine observations were made; historically through to the present day. We then aim to assess the impact of changing observational technique on the climate record and on the quality of modern data.

This work will directly contribute to continued implementation and development of the VOS system, one of the long term monitoring activities needed to understand processes and changes in the climate system. Improvements in marine climatology will contribute to improvements in operational ocean forecasting and benefit research on the role of the oceans in regulating climate.

The work will make use of the International-Comprehensive Ocean Atmosphere Data set (I-COADS). I-COADS is a collation of surface marine observations from the World Meteorological Organisation (WMO) Voluntary Observing Ship (VOS) programme, buoy, island station and historical marine data used extensively by climate researchers. I-COADS contains observations made since 1784, but only data post-1940 will be used in this study.

Improving Marine Meteorological Metadata

Metadata are important, particularly for climate studies, because there are biases in surface marine data that depend on how the observation was made. For example, wind and air temperature measurements made on ships need to be corrected for the observation height, preferably using the specific instrument height for each individual ship. A range of metadata are available for merchant ships participating in the VOS programme but often it is in a form that cannot be easily applied to the data. Metadata resources include instructions to observers published by the WMO and National Meteorological Agencies, the scientific literature, electronic lists of instrumentation carried by individual VOS published approximately annually by the WMO and the results of a questionnaire on historical observational practice.

Deliverables: We will collate information from these diverse sources to construct a metadata resource covering the period after 1940 suitable for use with the I-COADS.

Assessment of Bias: VOSclim Analysis

The effects of climate change imply a greater need for an accurate climate record now and in the future. The accelerating tendency to automate weather observations threatens the continuity of the climate record. Analysis methods to reveal any spurious climate trends and to measure any improvement in observing network performance need to be developed. VOSclim is a World Meteorological Organisation Programme to produce a 'climate-quality' subset of VOS. Because the VOS provide a key data source that cannot yet be replaced by remote sensing, VOSclim will be a significant step in the future development of *in situ* marine

data. It is expected that VOSClim will provide an important contribution to the ocean component of the GCOS (Global Climate Observing System) for monitoring the climate system, detecting and attributing climate change, and improved climate prediction.

VOSClim recruits existing VOS with good reporting records and extensive metadata, including ship photographs, are collected. The Met Office then extracts data for these ships from its operational system. Collocated values from the operational Met Office Numerical Weather Prediction (NWP) model are then appended. Comparison of the ship reports with the model output, informed by the metadata, will identify and quantify biases in the ship data, and may indicate biases in the NWP values.

Deliverables: Analysis of the VOSClim dataset to give information on biases and random errors in VOSClim ship data and, where appropriate, in the model comparison fields.

Application to I-COADS

Data correction algorithms derived from analysis of the VOSClim data set will next be assessed by application to the I-COADS. A more general assessment of I-COADS data quality by metadata type will also be made, taking advantage of the improved metadata information described above. The random errors in subsets of the data will be quantified as a function of environmental parameters where appropriate.

The impact on climatological fields of this improved information on data quality and biases will be assessed. There are several potential benefits. Identification and correction of biases will have an immediate impact on climatology. Improved knowledge of the error structure of the data will allow the effective use of optimal interpolation schemes and should help to reduce spurious variability in climatologies. Information on the errors in individual observations and their temporal and spatial variability is an important contribution to the estimation of uncertainty in climatological fields and time series.

Operational atmospheric and ocean forecasting models presently assimilate surface observations of SST and surface pressure from VOS. VOS data are assimilated with a low weight (relative to buoy data for example) as some VOS reports are of very low quality. General guidelines for the assessment of real-time VOS data quality will be developed. This quality assessment will highlight poor observing practice. Feedback will be provided to VOS operators leading to improved observations in the future. With regard to existing data, the metadata-related quality information will allow the exclusion or down-weighting of ship reports expected to be of poor quality and could lead to a more effective assimilation of VOS data into models.

Deliverables: Improved knowledge of errors and biases in VOS data in the I-COADS. Strategy for the assignment of data quality indices for real-time VOS data.

Further Information:

I-COADS: <http://www.cdc.noaa.gov/coads/>

VOSClim: <http://www.ncdc.noaa.gov/oa/climate/vosclim/vosclim.html>