Surface Marine Programme

MINIMUM SPECIFICATIONS AND INFORMATION FOR MOORED BUOYS CONTRIBUTING TO THE E-SURFMAR PROGRAMME

Version 1.0

July 2012

Introduction

This document supersedes EGOS Technical Document no. 257. It should be noted that many different designs of moored buoys are currently in operation, depending on the ocean area (open ocean, near-shore or coastal) and specific data requirement (meteorological, oceanographic or waves). This document is intended to provide information on the minimum specifications recommended for all moored weather buoy networks contributing to the EUCOS Surface Marine (E-SURFMAR) programme. Given the diversity of moored buoy designs now in use, this document no longer contains technical details about any individual buoy system or network. A list of moored buoy networks operating in European waters is given at http://esurfmar.meteo.fr/wikisurf-wa/index.php/Moored_buoy_networks with various links to web-sites describing the individual networks.

Nowadays moored buoys are generally regarded as providing the highest quality observations of a wide range of marine meteorological variables and, in addition to their use by forecasters and assimilation into NWP models, the data are also used to provide information on the climatology of oceanic areas, 'ground truth' reference data for satellite calibration/validation and for estimates of surface fluxes.

Data from the moored buoy networks falling within the E-SURFMAR programme should meet the requirements of the World Meteorological Organisation (WMO). In particular meteorological and oceanographic measurements derived from E-SURFMAR moored buoys should comply with the specifications given in WMO Publication No 8 – 'Guide to Meteorological Instruments and Methods of Observation' (available at ftp://ftp.wmo.int/Documents/MediaPublic/Publications/WMO8_CIMOguide/).

As far as possible the observed data should represent the environment undisturbed by the presence of the buoy.

Minimum Specifications

1. Data Requirements

Data derived from E-SURFMAR moored buoys should include as many as possible of the following parameters:

- Wind Speed
- Wind Gust
- Wind Direction
- Air Pressure
- Air Temperature
- Sea Surface Temperature
- Humidity
- Wave Height
- Wave Period

2. Data Accuracy, Resolution and Range

The accuracy, range and resolution of data measurements should meet the following minimum specifications.

Variable	Requirements			
	Range	**Resolution**	**Mean Error**	**Typical sample period**
Wind Speed (including gust)	0 to 75 m/s	0.5 m/s	±1 m/s < 20 m /s ±5% > 20 m/s	10 minutes
Wind Direction	0 to 360°	1°	±10°	10 minutes
Maximum Gust	0 to	0.5 m/s	±10%	Highest 3s average over 10 minutes
Air Pressure	900 to 1050hPa	0.2hPa	±0.5hPa	1 minute
Air Temperature	-20 to +40 ℃	0.1 ℃	±0.2 ℃	1 minu te
Sea Surface Temperature	-5 to +25 ℃	0.1 ℃	±0.2 ℃	1 minute
Relative Humidity or	38-100%	1%	±5% < 85% ±3% > 85%	1 minute
Dew-Point	-20 to +40 ℃	0.1 ℃	±0.4 ℃	1 minute
Wave Height	±10m rel MSL	0.1m	±10% (or ±20cm if greater)	20 minutes
Wave Period	0 to 20 sec	0.1 sec	±5% (or ±0.5 sec if greater)	20 minutes

Note the mean errors stated in the table refer to the mean errors of the measuring system (sensors, interface and data processor). Errors due to an exposure unrepresentative of the undisturbed atmosphere are not included.

For wave height and period there are a number of different parameters that may be measured, e.g. significant wave height, maximum wave height, average wave period, peak wave period etc. as well as wave direction.

3. Spectral wave measurements

In addition Directional Wave Spectrum measurements are required from specific buoys within E-SURFMAR. Spectral wave measurements from moored buoys are generally made using sensors manufactured by Datawell, Axys Technologies or Fugro-Oceanor. The number of frequency bands resolved varies with manufacturer (e.g. 66 for Datawell, 123 for Triaxys) which is usually more than adequate for satellite and model validation (e.g. the Wavewatch III model resolves the wave energy into 25 bands). A range of different wave parameters may be derived by the instruments which include: maximum wave height, significant wave height, average wave period, peak wave period, mean wave direction and directional spread in addition to the detailed spectral information.

It is recommended (Swail et al, 2010) that directional spectral wave measuring systems should reliably estimate the so-called “First 5” standard. Technically, this refers to 5 defining variables at a particular wave frequency (or wave period). The first variable is the wave energy, which is related to the wave height, and the other four are the first four coefficients of the Fourier series that defines the directional distribution of that energy. At each frequency band, not only is the wave direction defined but the spread (second moment), skewness (third moment) and kurtosis (the fourth moment). The skewness resolves how the directional distribution is concentrated (to the left or right of the mean) and the kurtosis defines the peakedness of the distribution. Obtaining these three additional parameters (spread, skewness and kurtosis) for each frequency band yields an improved representation of the wave field. Further information on wave measurement is given at http://www.jcomm.info/wet.

4. Data Dissemination

Data must be disseminated on the WMO Global Telecommunications System (GTS) within a short time of the observation to enable their use by the various National Meteorological Services for monitoring weather conditions and for NWP. The target for E-SURFMAR is for ≥ 85% of data to be issued to GTS within 30 minutes of the observation time. The location of the buoy must be transmitted either within the body of the data stream or by another method as this is a necessary parameter within the reported observation.

The data must be transmitted to the GTS in a standard WMO format. For moored buoy data this is usually FM-13 SHIP code (although FM-18 BUOY is sometimes used). However these TAC (Traditional Alphanumeric Codes) are expected to be withdrawn and replaced by the FM-94 BUFR (Binary Universal Form for the Representation of meteorological data) in the coming years. Similarly detailed wave measurements that are presently transmitted using FM-65 WAVEOB, will also be superseded by BUFR.

5. Metadata

Since 2002 the National Marine Data and Information Service (NMDIS) of China has hosted the ODAS Metadata Management Center responsible for collection, processing and management of ODAS metadata operated by JCOMM Member States, international organizations and cooperative projects. However, metadata submission to NMDIS has, at best, been patchy. Over the last few years the WMO-IOC Data Buoy Cooperation Panel (DBCP) has redefined the metadata that is appropriate for moored buoys and this is documented at http://www.jcommops.org/dbcp/data/metadata.html. These metadata will be collected by JCOMMOPS, who will make the metadata available to users via the web and periodically forward it to the ODAS Metadata Management Service in China. It is anticipated that the data will be made available in netCDF (network Common Data Form). Over the coming years, those metadata that are required in the real-time data transmitted on the GTS will be included within the appropriate BUFR templates.

6. Battery Safety

Accidents, occasionally fatal, have occurred due to explosions emanating from battery compartments and caused by the ignition of hydrogen and oxygen emitted from overcharged batteries. In considering the safety of battery compartments the buoy manufacturers and operators are advised to take account of the design recommendations of the Data Buoy Co-operation Panel which are available at: http://www.jcommops.org/dbcp/safety.html.

7. Buoy Markings

In accordance with the Technical Annexes to the Convention on the legal status of ODAS (Ocean Data Acquisition Systems), see following section, each buoy shall be assigned a unique identification number prefixed by the letters 'ODAS' and suffixed by letters indicating the national State (taken from the Table of Allocation of International Call Sign Series of the Radio Regulations promulgated by the International Telecommunication Union), e.g. **ODAS 23GB** (in this case 23 is the buoy's allocated number and GB is the national identifier). Each ODAS shall display its identification number clearly on an exterior surface where it can best be seen and, in addition, if feasible, the name and address of its owner.

The Technical Annexes also state that surface-penetrating ODAS shall have their visible portions painted in bands of red and yellow, with at least two bands of each colour; if

practicable, horizontal in the case of drifting and vertical in the case of anchored ODAS. However, in reality most types of buoy hulls are plain yellow.

8. Radar reflectors

It is recommended that the data buoy should have two multi-element radar reflectors each capable of giving a reflected signal equivalent to $6m^2$ of steel plate. The elements should be completely enclosed against ingress of water in a plastic housing. The reflector shall produce a radar echo at a range of at least 2 miles in accordance with the safety provisions of Ocean Data Acquisition Systems, Aids and Devices (ODAS) published by the International Maritime Organisation (IMO). The reflectors should be capable of withstanding a wind speed of 150 knots.

9. Navigation Lamp

The data buoy should have a navigation lamp giving amber light. The illumination cycle shall produce a group of 5 flashes in a period of 10 seconds, followed by a pause of 10 seconds with no illumination. The lamp is to be visible from at least 5 nautical miles in clear conditions, in accordance with safety provisions of Ocean Data Acquisition Systems, Aids and Devices (ODAS) published by International Maritime Organisation (IMO). It should be capable of withstanding a wind speed of 75 m/s.

On the legal requirements for ODAS

The need to clarify the legal status of ODAS was recognised by the IOC at its first session in 1961 and in 1962 UNESCO was asked to study the question, in consultation with IMCO, with a view to drafting a convention. In 1972 a preliminary Draft Convention on ODAS, with technical annexes, was produced. Although this Draft Convention was never completed it was agreed that three of the Technical Annexes to the Draft Convention should be issued so that States could use them, on a voluntary basis. Annex I deals with the procedures for notification and deployment, activities and other information concerning ODAS. Annex II (updated in 1985) deals with day marking, lights and sound signals for different types of ODAS. Annex III deals with construction, fire protection, life-saving appliances, radio-communications and other safety aspects of ODAS. In 1990 and 1993 Revisions of the Draft Convention on ODAS were presented to IOC, although the Draft Convention has still not been completed or adopted as it not seen as high priority in IOC, IMO or other international institutions. Hence at this time Annexes I to III of the Draft ODAS Convention are simply providing States with non-binding guidelines for national measures.