

ICES Guidelines for Surface Drifting Buoy Data

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Drifting buoys (UNESCO, 1988) have a long history of use in oceanography, starting in late 1978 with the First GARP Global Experiment (FGGE), principally for the measurement of currents by following the motions of floats attached to some form of sea anchor or drogue. Since 1988, over 1500 Lagrangian drifters have been deployed in the world oceans in the Surface Velocity Program (SVP) of the World Ocean Circulation Experiment (WOCE) and the Tropical Ocean and Global Atmosphere Program (TOGA). The buoys were standardised in 1991, with small spherical hull and floats, and large Holey-Sock drogue centred at 15 meters below the surface. Since 1993, Lagrangian Drifters with barometer ports and other sensors, including thermistor chains, have been in operation. Separate guidelines are available for Profiling Floats that record sub-surface variables.

1.0 RECEIVING DATA

Data Centres may receive these data by several mechanisms:

- Raw data from the transmission service (e.g. Service Argos, Iridium)
- Real-time messages via the Global Telecommunication System (GTS)
- Delayed-mode data from the Principal Investigators (PI).

The Data Centres require the following information to be supplied by the data supplier together with the data.

1.1 *Data Standard*

Delayed-mode quality controlled drifting buoy data provided by PIs to the Data Centres should contain:

- A full description of the data format used for the data submission.
- Metadata information about the calibration (equations and coefficients) applied to the data set.
- Quality controlled data, reported at the original sampling interval of the instrumentation.
- A description of the quality control procedures applied to the data set.

All observed variables should be clearly specified and described. If parameter codes are used, then the source data dictionary must be specified in the metadata documentation. Variable units and precision must be clearly stated. If computed values are included, the equations used in the computations should be stated.

All relevant calibrations should be applied to the observed data including laboratory and field calibrations. Instrument calibration data should be included in the data file. The data should be fully checked for quality and flagged for erroneous values such as spikes, gaps, etc. An explicit statement should be made of the checks and edits applied to the data.

1.2 *Format Description*

Data Centres may receive drifting buoy messages in real-time coded formats transmitted on the GTS and in delayed-mode quality controlled drifting buoy data formats from PIs. The WMO coded formats (WMO, 1995) used for GTS distribution of real-time drifting buoy messages are WMO FM [18-XII BUOY](#) (ASCII), [FM 94 BUFR](#) (binary).

The contents of the data and ancillary information should adhere to the Formatting Guidelines for Oceanographic Data Exchange http://ocean.ices.dk/formats/GETADE_Guidelines.aspx prepared by IODE.

The PIs data formats for the exchange of delayed-mode surface drifting buoy data set should include:

- A full description of the format used (preferably a fully documented ASCII format).
- The files should be homogeneous (i.e. each piece of information must always be in the same place in the file).
- Individual fields and units should be clearly defined.
- Ideally all of the data from the instrument should be stored in a single file.
- All data values should be in SI units.
- Time reported in UTC is strongly recommended.

1.3 *Collection Details*

Details on the collection of drifting buoy data should always be included. Metadata such as WMO number, buoy type, drogue type etc are important for proper use and understanding of the data. While the BUOY format can allow some extra data in real-time, BUFR can provide more. Refer to the drifting buoy BUFR template listed in 1.2 for the list of variables that should be included.

Metadata requirements for delayed-mode quality controlled drifting buoy data provided by PIs to the Data Centres include:

- Deployment platform name
- Country, organisation, Principal Investigator
- Project name
- Float number
- WMO number
- Sensor resolutions
- Information about the instruments and sensors (type and manufacturer, serial and model numbers, board type and serial number, software version)
- Information about the data precision and final accuracy.

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use should also be included.

2.0 VALUE ADDED SERVICE

When processing and quality controlling data, the Data Centres of the ICES community shall strive to meet the following guidelines.

2.1 *Quality Control*

The primary responsibility for data quality control lies with the PIs from which the observations originate. In many cases, drifting buoy data originate from a national meteorological service, an oceanographic institute or a PI for a particular research project.

Real-time

All real-time drifting buoy data go through Service Argos to be distributed on to the GTS. PIs and other data centres and services carry out appropriate quality control of observational messages they receive. Automatic Quality Control (QC) checks can quickly detect erroneous messages by comparing sensor data with constant limits.

Variable	Lower limit	Upper limit
Sea level air pressure (hPa)	800	1080
Station air pressure (hPa)	400	1080
Air pressure tendency (hPa/3H)	0	100
Water temperature (deg)	- 1.8	+ 45
Air temperature (deg)	- 80	+ 50
Wind speed (m/s)	0	100
Wind direction (deg)	0	360

The DBCP QC Guidelines for GTS Buoy Data (<http://www.jcommops.org/dbcp/data/qc.html>) was set up to exchange QC information amongst participants. Erroneous messages and questionable data can be brought to the attention of buoy operators, manufacturers and others interested in the quality of GTS drifting buoy data by posting to the distribution list buoy-qir@vedur.is.

Delayed-mode

There are three main components to the quality control of delayed-mode surface drifting buoy data. All three components are used at the Data Centres or the PI to quality control the datasets.

The first component examines the characteristics of each float track looking to identify errors in either position or time based on calculated buoy speed versus time.

The second component is subjective as each observed variable is viewed independently to identify values that appear to be outside prescribed climatic limits for the area in question. A time series of one month of observations for each individual buoy is treated at one time. Knowledge of the different types of real and erroneous oceanographic and meteorological features is critical. This knowledge, when combined with a local knowledge of water mass structure, statistics of data anomalies, and cross validation with climatological data, ensures a data set of the best possible quality.

The third component is to identify and eliminate duplicate data. Duplicate observations occur either by having received the data more than once, or because real-time messages arrive before the delayed-mode data on which the real-time message was based.

To deal with both the real-time and delayed mode data, it is recommended that the Data Centre manage surface drifting buoy data in a continuously managed database. This will provide to the client those messages reported in real-time when these represent the only version available, or the delayed-mode data of higher quality which replace the original real-time data set. An overview of the data management practices for delayed mode drifting buoy data in a continuously managed database is provided in [Annex A](#) (Wilson, 1998).

2.2 Problem Resolution

The quality control procedures followed by the Data Centres will typically identify problems with the data and/or metadata. The Data Centre will resolve these problems through consultation with the originating PI or data supplier. The Data Centre may also consult the Joint IOC/WMO Data Buoy Cooperation Panel (DBCP)(<http://dbcp.noaa.gov>) or ISDM (Formerly MEDS), the IODE Data Center for Drifting Buoys for advice when needed.

2.3 History Documentation

All procedures applied to a dataset should be fully documented by the Data Centre. These include all quality control tests applied and should accompany that dataset. All problems and resulting resolutions should also be documented with the aim to help all parties involved; the Collectors, Data Centre, and Users. A history record will be produced detailing any data changes (including dates of the changes) that the Data Centre may make.

3.0 PROVIDING DATA AND INFORMATION PRODUCTS

When addressing a request for information and/or data from the User Community, the Data Centres of the ICES community shall strive to provide well-defined data and products. To meet this objective, the Data Centres will follow these guidelines.

3.1 Data Description

The Data Centre shall aim to provide well-defined data or products to its clients. If data are provided, the Data Centre will provide sufficient self-explanatory information and documentation to accompany the data so that they are adequately qualified and can be used with confidence by scientists/engineers other than those responsible for their original collection, processing and quality control.

- A data format description fully detailing the format in which the data will be supplied
- Variable and unit definitions, and scales of reference
- Definition of flagging scheme, if flags are used
- Relevant information included in the metadata or data file (e.g. buoy type, drogue type, etc.)
- Data history document (as described in 3.2 below)

3.2 Data History

A data history document will be supplied with the data to include the following:

- A description of data collection and processing procedures as supplied by the data collector (as specified in Section 1.1 and 1.3)
- Quality control procedures used to check the data (as in Section 2.1)
- Any problems encountered with the data and their resolution
- Any changes made to the data and the date of the change

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use should also be included.

3.3 Referral Service

ICES member research and operational data centres produce a variety of data analysis products and referral services. Data and information products are disseminated as widely as possible and via a number of media including mail, electronic mail, internet websites, ftp and CD/DVD. The DBCP supports several [Action Groups](#) who produce data and information for specific ocean areas. By dividing ocean areas into regions of responsibility, and by developing mutually agreed guidelines on the format, data quality and content of the products, better coverage is obtained. By having the scientific experts work in ocean areas with which they are familiar, the necessary local knowledge finds its way into the products.

If the Data Centre is unable to fulfil the client's needs, it will endeavour to provide the client with the name of an organisation and/or person who may be able to assist. In particular, assistance from the network of Data Centres within the ICES Community will be sought.

REFERENCES

UNESCO. 1988. Guide to Drifting Data Buoys, IOC/WMO Manuals and Guides # 20.

Wilson, J.R. 1998. Global Temperature-Salinity Profile Programme (GTSPP) - overview and future, Intergovernmental Oceanographic Commission technical series 49, SC-98/WS/59.

WMO. 1995. WMO Manual on Codes No. 306.

UNESCO. 1991. Manual on International Oceanographic Data Exchange, IOC/ICSU Manual and Guides # 9, Revised Edition.

Annex A

Both the real-time messages and delayed mode surface drifting buoy data are available at the sample interval set by the manufacturer. This interval is typically hourly or synoptic hours depending on the requirements. The delayed mode data undergo calibration and quality control often incorporating site specific knowledge and experience of the PI. Real-time messages are often those surface drifting buoy data that undergo automatic, bulk quality control tests within operational time frames. The extensive quality control incorporating site-specific knowledge and experience of the PI often take longer. Real-time messages are most useful to those involved in operational forecasts, while delayed mode data are more useful to research.

To manage surface drifting buoy data, a Continuously Managed Database (CMD) system is implemented. As data are acquired in both real-time and delayed mode they are added to the database. Calibrated and quality controlled delayed mode data replaces the messages obtained in near real-time. The CMD therefore holds the most current and highest quality data set at all times. The database is continuously refined as additional quality checks are undertaken. Observations that have passed quality control and entered the database are not removed but are flagged to indicate that a higher quality version of the observation exists in the database.