

QUALITY CONTROL PROCEDURE APPLIED TO INODC BATHYTHERMOGRAPH DATA FILE

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Quality control to oceanographic data, in general:

Before discussing the quality control measures applied to the INODC bathythermograph data file it is worth examining the possible errors likely to occur in a data record at different stages of its path from the origin to a specific data file. In general the errors can be classified into three categories with regard to their origin.

1. Physical Errors
2. Coding Errors
3. Transmitting Errors

Physical Errors

These errors arise from the malfunctioning of instruments and become visible in both data and header level of information. This type of errors originate onboard a platform.

Coding Errors

Coding errors are primarily caused by men, in case they do not encode a measurement according to the rules or in case they insert a wrong value. Due to this reason the coding errors will appear as physical errors. Coding errors in this sense occur at two stages of a record, at the observing platform and at the data centre.

Transmitting Errors

This type of errors appear during transmission of data from one place to another, or if the data changes from one storage medium to another, or because of misunderstanding between two persons. Also this type of errors come to existence at all stages in the path of a record from its origin to a particular data file.

Considering all these sources of errors, it is very obvious that it is not practically possible to develop a quality control programme, which can take care of all these errors. However all these errors can be corrected to a good extent, if the data is treated by an expert, who is well aware of the sources of errors and also the ranges of the physical values. It is on principle not possible to identify these errors definitely, due to lack of the original data. But with some simple statistical checks - e.g. a check against temperature/salinity limits, a check against spikes, a check against vertical stability etc. a lot of obviously erroneous data can be discarded and also the doubtful data can be flagged. In the forthcoming part one of such quality checks applied to the INODC bathythermograph data file has been discussed.

Procedure Applied for INODC Temperature File

It is difficult to apply quality control measures for the upper ocean temperature data, because of the high degree of natural variability. However, taking two basic stands of temperature distribution a two level quality check has been applied for the entire data from surface to bottom of observation. The two basic standards are the following:-

1. The characteristic property of vertical temperature profile (decrease of temperature with depth).
2. Watermass property: An abrupt change in values of consecutive stations of a particular cruise is an uncommon feature except in thermal fronts of high horizontal gradient. Such fronts are not reported from this area.

The programme incorporates these two standards in two different levels, namely Level-I and Level-II.

Level-I:

This level uses the characteristic property of vertical temperature profile in checking the BT records. The general tendency of vertical temperature profile is a decrease of temperature with increasing depth. Of course, a subsurface inversion may also be present in some records. Therefore in Level-I the first step of operation is sorting out the inversion records and putting the inversion flag. The inversion records are then passed through inversion filter ($> + 0.5$ C/m). In this check it is found that this inversion is of the order of less than 0.2 degree centigrade/meter thereby matching with the inversion caused by night cooling. Inversion may also be due to stability adjustment. In any case, it is found that inversion confines in the upper 100 meter layer for the entire data records. So for this data set we have selected the limit of inversion depth as 100 meter from the surface. While passing the temperature records through this filter, it is observed that only few records fall into this category. By this way the suspicious inversion value is corrected (if possible) or discarded and the corrected data have been sent back to the corresponding data record. To find out the limiting value of inversion using the stability criteria, the salinity values are not available for the same stations where BT data are available.

In Level-I the data is therefore flagged for inversion and online correction is applied for suspicious records.

Level-II:

In this level the standard used for checking is the Intra cruise variability. Within a particular cruise, covering a time scale of the order of a month, abrupt changes in temperature of consecutive stations are considered as suspicious data. Instead of taking the station to station difference a seven-station moving average and the deviation of this average from the individual station data has been opted for. Seven station moving average is chosen for the statistical convenience.

This check is done for surface to bottom-of-observation for all records

of each station. If majority of the records of particular stations show deviation greater than 2 sigma or 3 sigma, depending on open ocean or coastal, the station itself is flagged. By adopting a seven station moving average and standard deviation the filter used in this check has been kept wider so that only those records showing too abnormal value would be flagged. Provision is given to keep this "abnormal intracruise variability flag" with each depth value. If the flag is observed in the four depth levels, one surface layer (0-100m) and bottom layer (> 100m), the station is flagged for abnormal variation. When the abnormal intracruise variability is found in either surface or bottom layer it is informed accordingly.

Quality flags:

The quality flags are tagged with the temperature data records thereby keeping quality as a characteristic of the data. The three flags, incorporated in the reports are the following:

1. For temperature inversion - 'S'
2. For abnormal intra cruise variability in coastal area - '@'
3. For abnormal intra cruise variability in open ocean - '*'

These flags are also tagged with station to indicate that the station is having either inversion or abnormal intracruise variability or both without going to depth to depth values.