March 2009

AOML STEPS TO QUALITY CONTROL (QC) TSG DATA

The data are processed in real-time in three phases:

1. The incoming data files are interpreted, the data are stored in a standardized ASCII format.
2. The QC procedure is applied to detect sensor and formats errors. Several steps are applied (see bellow: 1, 2, 3, 5, 6, 8, and 10). After that, the raw data are sub-sampled onto a 3 minute spaced dataset.
3. The reduced dataset (containing one point every 3 minutes) is checked against all the steps bellow and the adequate flags are computed.

To obtain the reduced dataset, the original data is separated in groups of 3 minutes intervals, starting at the first record, and the median of each of these groups is selected. For example, in a particular group with 10 records, the record number 6 is selected; in a particular group with 9 records the record number 5 is selected. If at the end of the incoming data file it is not possible to get a complete 3 minutes group, no record is selected among those in the incomplete group.

Quality Control Steps

Step 1 : platform identification (flag = a)
The platform must have a valid call sign number. If this test fails, all measurements are flagged as 0; otherwise they are flagged as 1.

Step 2 : impossible date (flag = b)
The date and time of an observation have to be correct.

- Year on 4 digits
- Month in the range 1 to 12
- Day in a range expected for the corresponding month
- Hour in the range 0 to 23
- Minute in the range 0 to 59
- Second in the range 0 to 59

If any one of the conditions above fails, the date is flagged as 0; otherwise they are flagged as 1.

Step 3 : impossible location (flag = c)
This test requires correct latitude and longitude values for the observations.

- Latitude within the range -90 to 90
- Longitude within the range -180 to 180

If either latitude or longitude fails to be in the expected range, the position is flagged as 0, otherwise it is flagged as 1.

Step 4 : Position on Land Step (flag = d)
This test requires that the latitude and longitude of the observation is located at sea. The ETOPO2/TerrainBase file is used to see if each data point is located at sea. If the data cannot be located at sea, the position is flagged as 0; otherwise it is flagged as 1.

Step 5 : impossible speed (flag = e)
The speed between 2 observations cannot exceed a maximum value. If the speed is higher than permitted for the platform (usually cargo or research ship), the location, date or identification of the platform may be incorrect. The speed is calculated between an observation and the previous one. If there is no previous observation, the test is correct. If the test fails, the record is flagged as 0; otherwise it is flagged as 1.

Step 6 : global ranges (flag = f)
This test applies a gross filter on observed values for temperature and salinity. It needs to accommodate all of the expected extremes encountered in the oceans.

- Temperature within range –2.5 to 45.0 °C.
- Salinity within range 0.0 to 60.

If a value fails, the record is flagged as 0; otherwise it is flagged as 1.

Step 7 : regional ranges (flag = g)
This test applies to only certain regions of the world, where conditions can be further qualified. For example, specific ranges for observations from the Mediterranean and Red Seas further restrict what are considered sensible values. The Red Sea is defined by the region 10°N,40°E; 20°N,50°E; 30°N,30°E; 10°N,40°E and the Mediterranean Sea by the region 30°N,6°W; 30°N,40°E; 40°N,35°E; 42°N,20°E; 50°N,15°E; 40°N,5°E; 30°N,6°W.

- Red Sea:
  Temperature within range 21.7 °C to 40.0 °C
  Salinity within range 0.0 to 41.0
- Mediterranean Sea:
  Temperature within range 10.0°C to 40.0°C
  Salinity within range 0.0 to 40.0

Records that fail these ranges are flagged as 0; otherwise they are flagged as 1.

Step 8 : spike test (flag = h)
A difference between sequential measurements, where one measurement is quite different than adjacent ones, is a spike in both size and gradient.
Test value = $| V2 - (V3 + V1)/2 | - | (V3 - V1) / 2 |$,
where V2 is the measurement being tested as a spike, and V1 and V3 are the values previous and next.

- Temperature: The V2 value is flagged as wrong when the test value exceeds 6.0°C.
- Salinity: The V2 value is flagged as wrong when the test value exceeds 0.9.

Values that fail the spike test are flagged as 0; otherwise they are flagged as 1.

Step 9 : constant value test (flag = i)
This test is failed when there is no difference in the values of the measured parameters during a six hour period. Records that fail this test are flagged as 0; otherwise they are flagged as 1.

Step 10 : gradient test (flag = j)
This test is failed when the difference between adjacent measurements is too steep.
Test value = | V2 - (V3 + V1)/2 |
where V2 is the measurement being tested as a spike, and V1 and V3 are the previous and next values.

- Temperature: The V2 value is flagged as wrong when the test value exceeds 9.0°C.
- Salinity: The V2 value is flagged as wrong when the test value exceeds 1.5.

Records that fail this test are flagged as 0; otherwise they are flagged as 1.

Step 11 : climatology and NCEP weekly analysis (flag = k)
Each measurement is compared against a monthly climatology (Levitus 2001, 1°x1°, monthly) and against the NCEP weekly analysis fields.
The test fails if | V1 – V2 | > 3 * Sigma

- V1 : value to be controlled,
- V2 : value of the climatology or NCEP field.
- Sigma : standard deviation of the climatology

If for a given record the test fails, it is flagged as 0. If there is no climatology information for this record it is flagged as 2. Otherwise it is flagged as 1. Data that fail the climatology test are still distributed.

Step 12 : buddy check (flag = l)
Each measurement is compared with profiling floats, XBTs, CTDs, thermistor chain and drifter data (referred here as 'buddy') within 100 km and ± 5 days of the TSG measurement.
Test value = | V1 – V2 | ,
where V1 is the value to be controlled and V2 is the value of the buddy.

- Temperature: The V1 value is flagged when the test value exceeds 0.5°C
- Salinity: The V1 value is flagged when the test value exceeds 0.2

Records that fail this test are flagged as 0. If no "buddy" data is available the record is flagged as 2. Otherwise they are flagged as 1.

Step 13 : Water Samples
Salinity data are compared against salinity measurements derived from water samples taken during the transect (if available).

Step 14 : Calibrations
Data are corrected using the calibration coefficients provided by Seabird.

Note: As of February 2009, steps 12, 13 and 14 are not fully implemented.