# 2015 AVOS Processing Notes

Last updated 14 July 2015

**1- Introduction**

The Canadian research icebreaker CCGS *Amundsen* is equipped with Environment Canada AVOS (Automated Voluntary Observing Ship) system to record continuous data on atmospheric pressure, wind speed, wind direction, air temperature and humidity. This document provides information on the processing of data collected with the AVOS system.

Table 1: Instruments and recorded variables

| Instrument | Variable | Specifications |
|---|---|---|
| Vaisala Digital Barometer – PTB-210 | Atmospheric pressure | Range: 50 to 1100 hPa<br>Accuracy: 0.35 hPa<br>Resolution: 0.1 hPa |
| Young R.M. Anemometer - 05103 | Wind speed | Range: 0 to 100 m/s<br>Initial accuracy: 0.3 m/s |
| | Wind direction | Range: 0 to 360°<br>Initial accuracy: 3° |
| Rotronic Meteorological – MP10 | Air temperature | Range: -40 to 60°C<br>Initial accuracy: 0.2°C |
| | Humidity | Range: 0 to 100% RH<br>Initial accuracy: 1% RH |

Sensors are at 21.6m above the waterline and at 5.5m above the wheelhouse roof (mast length).

**2- Processing Protocol**

Computing steps applied at the level of AVOS acquisition system:

1. The system automatically computes:
   – True wind using the *Amundsen*'s gyrocompass and the recorded apparent wind.
   – Dew point (degrees C) using the recorded air temperature and humidity.
2. The raw data time series (1Hz) is averaged to a 1 hour time series.

Processing steps using the software: Processing_Amundsen_AVOS.m (Matlab script)

3. Converts AVOS Environment Canada files to csv
4. Reads NAV data from Navigation data processing (Compilation of POSMV and CNav data, see Amundsen_NAV_2015_README.txt distributed with NAV data)

5. Divides the time series by leg period
6. Flags impossible values (out of range): see limits in Annex 1.
7. Interpolates NAV data to be used with AVOS data
8. Flags biased data produced by the effect of the ship's structure (shape): measurements (except barometer) are unreliable when the wind blows from behind the vessel (heading - 180°): impact of the vessel structure.
   - If gyrocompass data are available from NAV, then using the NAV gyrocompass and the wind direction, data are flagged if -45° < Wind direction – vessel heading < 45°
   - If gyrocompass data are not available from NAV, then using the NAV vessel tracking and the wind direction, data are flagged if -45° < Wind direction – vessel tracking < 45° or if vessel speed < 2 knots. The vessel speed is used because when the vessel has a low speed, the tracking and the heading can be different.
9. Allows for a last manual check on sensors that still present suspicious values after step 8.
10. Saves the data: data are saved in text format with the extension *.int. One folder per year and one file per leg are created.

| Col | Content | Format | Units |
| --- | ----------------- | ------ | ----- |
| 1 | Date | S10 | yyyy/mm/dd |
| 2 | Hour UTC | S8 | HH:MM:SS |
| 3 | Latitude | F12.3 | deg N |
| 4 | Longitude | F12.3 | deg E |
| 5 | True wind direction | F10.0 | deg N |
| 6 | True wind speed | F10.0 | knt |
| 7 | Air temperature | F10.1 | deg C |
| 8 | Dew point | F10.1 | deg C |
| 9 | Atmospheric pressure | F10.1 | hPa |

NaN stands for: Not a Number. It indicates that no data was recorded or that the data were flagged and not trusted.

## 3- Final data uncertainty

Given the work environment (e.g. vessel at sea) and following the AVOS data QA/QC process, the estimated uncertainty for each variable is described hereunder.

| Variable | Uncertainty |
|---|---|
| Atmospheric pressure | ±0.1hPa |
| Wind speed | ±1 knt |
| Wind direction | ± 5° |
| Air temperature | ±0.5°C |
| Dew point | ±0.5°C |

## Annex 1: impossible values limits

- ✓ -90 < Latitude < 90
- ✓ -180 < Longitude < 180
- ✓ 0 < Wind direction < 360
- ✓ 0 < Wind speed < 70
- ✓ -40 < Air temperature < 40
- ✓ -40 < Dew point < 40
- ✓ -800 < Atmospheric pressure < 1200
- ✓ -5 < water temperature < 30