

2009 AVOS Processing Notes

Last updated 14 July 2015

1- Introduction

The Canadian research icebreaker CCGS *Amundsen* is equipped with an 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 Accuracy: 0.35 hPa Resolution: 0.1 hPa
Young R.M. Anemometer - 05103	Wind speed	Range: 0 to 100 m/s Initial accuracy: 0.3 m/s
	Wind direction	Range: 0 to 360° Initial accuracy: 3°
Rotronic Meteorological – MP10	Air temperature	Range: -40 to 60°C Initial accuracy: 0.2°C
	Humidity	Range: 0 to 100% RH 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 10 minutes 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_2009_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 $-45^\circ < \text{Wind direction} - \text{vessel heading} < 45^\circ$
 - If gyrocompass data are not available from NAV, then using the NAV vessel tracking and the wind direction, data are flagged if $-45^\circ < \text{Wind direction} - \text{vessel tracking} < 45^\circ$ 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
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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	$\pm 0.1 \text{ hPa}$
Wind speed	$\pm 1 \text{ kt}$
Wind direction	$\pm 5^\circ$
Air temperature	$\pm 0.5^\circ \text{C}$
Dew point	$\pm 0.5^\circ \text{C}$

Annex 1: impossible values limits

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