Meta Data for North Pole Environmental Observatory 2003 Aerial CTD-O_2 Survey

Measurements were made with a Seabird SBE-19 Seacat outfitted with an SEB43 O_2-sensor as part of the observational program of NPEO'03, following landing of the Twin Otter aircraft at the positions on the Arctic sea ice listed in the table below. Also listed are parameters relevant to the calibration of the O_2 data as explained below.

Cast	Station	Latitude	Longitude	Date	Time UTC	S_{oc}	V_{offset}
4	4	87°24.3'N	87°52.3'W	5/6/2003	22:38	0.4400	-0.128
5	5	85°59.8'N	68°48.0'W	5/7/2003	17:42	0.4400	-0.212
6	6	84°53.5'N	66°29.7'W	5/8/2003	15:25	0.4400	-0.245
7	1 (North Pole)	89°49.0"N	113°00.0'W	5/9/2003	18:38	0.4405	-0.120
8	2	88°59.0'N	88°59.0'W	5/9/2003	22:27	0.4420	-0.120

Three additional casts were taken before these by helicopter. They were subject to somewhat different environmental conditions and so they were not processed for O_2. The complete suite of NPEO'03 CTD data has been archived separately at NSIDC.

The CTD-O_2 package was set to acquire data at 2 scans/second. Files provided in this archive include the following 11 parameters from the downcasts below 5 m in a tab-delimited ASCII format:
scan, time-J-day, press db, temp degC (ITS-90), potemp degC, cond S/m, Ox volt, depth m, sal (PSS78), sigma-theta and O2 ml/L
This list also serves as the column headers for each file.

CTD processing followed the SEASOFT recipe to minimize salinity spiking, with certain constants determined empirically. Conductivity and temperature were low-pass filtered with a time constant of 0.5 seconds, pressure was filtered with a time constant of 2.0 seconds and temperature was advanced relative to pressure by 0.5 seconds. Potential temperature, depth and sigma-theta parameters were calculated according to EOS80 (Fofonoff and Millard, 1983).

Processing of the dissolved O_2 voltage was somewhat unusual because it appears that the sensor membrane underwent stretching when the fluid (distilled water) used by Seabird to fill a pressure compensation bladder froze. This invalidated the pre-mission calibration and caused the sensor response to be diminished but not eliminated. Bottle samples taken for calibration purposes suffered from challenging field conditions such that only 2 were trustworthy. Further details are provided with the archived bottle data. Hence, the calibration strategy relies heavily upon the assumption that water in the surface mixed layer is at saturation with respect to atmospheric O_2. A time constant of 7 seconds was used to align the down and up oxygen with the adjusted in-situ temperature. Aligned oxygen voltage data were processed using a modified variant of the Owens and Millard algorithm (Owens and Millard, 1985) as described in the Sept 2002 Seabird Application Note No. 64:

$$O_2\ (ml/L) = \{S_{oc} * (V + V_{offset})\} * O_{2sat}(T,S) * e^{(Tcor * T)} * e^{(Pcor * P)}$$

where S_{oc} is the oxygen signal slope, V is the SBE43 temperature compensated output oxygen signal (Ox volts), V_{offset} is the voltage at zero oxygen signal, $O_{2sat}(T,S)$ is the oxygen saturation value in ml/L calculated using in-situ temperature and salinity following Weiss (1970) (Weiss, 1970), and T_{cor} and P_{cor} are residual temperature and pressure correction factors applied to in-situ temperature and pressure. Slightly varying calibration parameters S_{oc}, and V_{offset} for each profile are given in the table above. Values of $1.1x10^{-3}$ for T_{cor}, and $1.350x10^{-4}$ for P_{cor} based on the pre-mission calibration were applied to all of the profiles. The magnitude S_{oc} was determined by fitting casts 7 & 8 to surface saturation and coherence with the bottle O_2 at about 300 m depth. This required a small adjustment of V_{offset}. For casts 4-6, S_{oc} was set to the cast 7 values and V_{offset} adjusted to generate saturation in the mixed layer. Based on comparison with the bottle O_2 results, we estimate that the data have an uncertainty of about 0.1 ml/L. We have provided the aligned voltages, should anyone wish to undertake a different strategy in processing this data. *Obviously, the processed from of the O_2 data should not be used to examine issues related to surface saturation state*.

This data was collected under the support of NSF grant OPP-9910335 to K. Falkner and OPP-9910305 to J. Morison.

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