**Meta Data for North Pole Environmental Observatory 2011 ISUS Nitrate Survey**

CTD and nitrate data consisting of casts numbered 1-10 were acquired using a Seabird SBE19 *plus* Seacat CTD, outfitted with an SBE43 oxygen sensor, and a Satlantic ISUS V2 nitrate sensor. The ISUS was fitted with a sample volume accessory during Casts 1-2 and 6-7 so that the pumped seawater outflow from the CTD sensors was also pumped through the ISUS sample volume. The tubing connecting the sample streams clogged with ice during Cast 3, resulting in no data acquisition by the ISUS. Casts 4-5 were conducted with the ISUS un-pumped (probe open to water column) while the Seabird CTD pump was replaced and inspected for damage. The ISUS sample volume was re-connected to the CTD system for Casts 6-10 after it was determined that the CTD pump did not malfunction. ISUS data acquired during Casts 8-10 are not reported due to loosening of the probe tip and flooding of the sample window with seawater.

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| --- | --- | --- | --- | --- | --- | --- |
| **Cast** | **Station** | **Latitude** | **Longitude** | **Date** | **Filename** | **Pumped?** |
| 1 | Barneo | 89˚ 28.293’N | 134˚ 01.954’E | 2011-4-16 | ISUS2011\_Brno2011.txt | Yes |
| 2 | 86N, 90E | 86˚ 03.954’N | 89˚ 39.967’E | 2011-4-17 | ISUS2011\_Sta86\_90E.txt | Yes |
| 4 | 87N, 90E | 86˚ 59.142’N | 90˚ 29.739’E | 2011-4-18 | ISUS2011\_Sta87\_90E.txt | No |
| 5 | 89N, 90E | 88˚ 56.768’N | 89˚ 34.707’E | 2011-4-18 | ISUS2011\_Sta89\_90E.txt | No |
| 6 | 87N, 180 | 87˚ 02.029’N | 179˚ 52.794’E | 2011-4-19 | ISUS2011\_Sta87\_180.txt | Yes |
| 7 | 90N | 89˚ 57.741’N | 33˚ 34.757’W | 2011-4-19 | ISUS2011\_Sta90.txt | Yes |

The final published data set consists of downcast data only. Casts were begun by lowering the instruments to a depth of about 15 meters and allowing the instruments to start to come to ambient temperature. They were then raised to near the surface before proceeding with the bottle hydrocast, during which Niskin bottles were placed on the line and lowered to target depths for water sampling. Following the bottle cast, the main downcast and upcast were conducted using only the CTD and ISUS. This order of operations was found to be optimal for ISUS measurement as it allowed sufficient time for the instrument to warm up and equilibrate with its environment.

The CTD-O2 data processing steps are described separately in the metadata file (NPEO\_2011\_CTDs\_ReadMe.txt) accompanying those data and will not be repeated here. These data can also be accessed at CADIS.

Details regarding ISUS data processing have been previously reported in Alkire et al. (2010). Here the data processing steps are briefly described. Since the ISUS does not record pressure or external temperature, the separate ISUS and CTD casts were merged after collection using their respective internal timestamps of their first data record. This synchronization did not include the advance in time required to account for the lag in nitrate data due to the time it took the seawater to flow from the intake of the CTD sensors to the ISUS sample volume. The advance required to precisely synchronize the nitrate record with the CTD data was determined by requiring that the shift in time necessary to superimpose the downcast and upcast temperature data would be the same as that required to superimpose the advanced downcast and upcast nitrate data. This advance was determined for each cast in several steps as follows. First, the advance in time required to superimpose the downcast and upcast temperature records was determined. (Note, the value for this advance is not applied to the temperature data; the value obtained is used solely as a baseline). Second, the advance in time required to superimpose the downcast and upcast nitrate records was determined. Finally, the advance in time actually applied to the nitrate data was determined from the difference of the values found in the second and first steps.

Following synchronization, the resulting data files were then processed using a program (ISUSDataProcessor) developed by Ken Johnson (MBARI), which incorporates salinity and temperature data from the CTD and applies algorithms that correct the spectral data collected by the ISUS for temperature effects on the bromide absorption (Sakamoto et al., 2009). Each nitrate concentration calculated has an associated fit-error (RMS deviation of observed nitrate absorbance from modeled values). Any concentrations with fit-errors exceeding 0.002 were omitted from the final data files to accommodate known instrumental noise (Ken Johnson, personal communication). Resulting nitrate profiles were then smoothed using a 5-point running mean.

Seawater samples collected at various depths during each station occupation served as calibration points for the ISUS instrument. A simple linear regression was performed between the bottle nitrate concentrations and ISUS downcast concentrations at the same depths collected at each station. The coefficients yielded from the regression were used to correct the full ISUS nitrate profile. Different regressions were applied to each cast. A separate correction was also completed for each cast assuming a constant offset between ISUS downcast concentrations and bottle nitrate concentrations (i.e., baseline correction). Both corrections of the ISUS data are given in each data file for user convenience. An average of the regression coefficients computed from Casts 1, 2, 4, 5, and 7 was applied to correct the ISUS data acquired from station 87N, 180 (Cast 6) since only two bottle samples were available from this cast.

***Casts 8-10***

The ISUS experienced an unusually high bromide absorption during casts 8-10, presumably due to the loosening of the probe tip, allowing seawater to penetrate and pool on the inside of the sample window. As a result of the uncertainty in the measured absorption spectra, these casts have not been reported.

The final data files are tab-delimited ASCII text files, each consisting of 11 columns of data:

**(1) = Depth [salt water, m]**

**(2) = Temperature [ITS-90, deg C]**

**(3) = Potential Temperature [ITS-90, deg C]**

**(4) = Salinity [PSU]**

**(5) = Potential Density [sigma, kg m-3]**

**(6) = Dissolved Oxygen [mL L-1]**

**(7) = Dissolved Oxygen [mmol m-3]**

**(8) = Dissolved Oxygen [mmol kg-1]**

**(9) = Oxygen Percent Saturation [%]**

**(10) = Nitrate, linear regression fit [M]**

**(11) = Nitrate, constant offset fit [M]**

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