TITLE: CTD casts, BEST Spring Cruise 2010, R/V Thompson (TN249)

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SAME AS ABOVE and

This documentation/data/metadata: Peggy Sullivan peggy.sullivan@noaa.gov

Data Files: Dave Kachel dave.kachel@noaa.gov

FUNDING SOURCE AND GRANT NUMBER:

National Science Foundation through BEST (Bering Sea Ecosystem Study) Award Numbers 0732430

DATA SET OVERVIEW:

-Introduction or abstract

This CTD data set, consisting of 245 casts, was collected during a multi-disciplinary Bering Sea ice cruise on the R/V Thompson (TN249, May 9- June 14, 2010). The cruise was funded by NSF for the BEST (Bering Sea Ecosystem Study) program, and supported by numerous agencies and institutions. The CTD operations on this cruise were managed by personnel from NOAA/PMEL in the EcoFOCI program, with deployment assistance from Thompson personnel. Water samples from casts were collected by various parties relative to their research needs. Profile data from CTD instruments were processed at NOAA/PMEL/EcoFOCI using standard techniques. Data from bottle samples include phosphate, silicate, nitrate, nitrite, ammonium, and chlorophyll. Data files are an array on a 1-meter grid and combine both averaged CTD profile data, and bottle samples where depths with no data are listed as "-1E+10" in text data files, and as 1.0e-35 in NetCDF files. CTD data contacts: Phyllis Stabeno, Peggy Sullivan. Nutrient and bottle data contact: Calvin Mordy.

- -Time period covered by the data: May 9- June 14, 2010
- -Physical location of the measurement or platform (latitude/longitude/elevation) 245 CTD casts deployed within latitude 55N to 63N and longitude 163W to 180W
- -Any World Wide Web address references (i.e. additional documentation such as Project WWW site)

Cruise Site: http://www.ecofoci.noaa.gov/cruiseWeb/Thompson May2010/

BEST/BSIERP Site: http://bsierp.nprb.org/

BEST Data Management: http://bsierp.nprb.org/data_mgt/

NSF Award: http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0732430

INSTRUMENT DESCRIPTION:

-Brief text describing the instrument with references

SeaBird SBE-911plus CTD unit with dual temperature and conductivity sensors, and added instruments as listed (www.seabird.com/products/profilers.htm):

Conductivity S/N 2903 Conductivity S/N 2881 Temperature S/N 1703 Temperature S/N 2131

Pressure Digiquartz with TC S/N 94112-0216
PAR /Irradiance, Biospherical/Licor S/N 4747
Transmissometer, Chelsea/Seatech/Wetlab CStar S/N CST-401DR
Fluorometer, WET Labs ECO-AFL/FL S/N 229
Oxygen sensor, SBE-43 S/N 0023
Oxygen sensor, SBE-43 S/N 0542

Altimeter S/N 1137

-Figures (or links), if applicable

Web reference to instrument:

<u>http://www.seabird.com/products/spec_sheets/911data.htm</u>
Figure showing CTD transect map: tn249 PMEL CTDmap.gif

-Table of specifications (i.e. accuracy, precision, frequency, etc.)

Page 10 of Seabird instrument reference (above)

DATA COLLECTION and PROCESSING:

-Description of data collection

Data were collected via CTD platform operated by PMEL with assistance from ship technicians. At each CTD location, the CTD rosette was lowered to 10 meters to equilibrate, brought to surface, then lowered to within 5m of the bottom, at ~30m/minute down to 150 m (on average) and ~50m/minute below that. Water bottles were fired at desired depths on the upcast. Once on board, numerous water samples were taken from Niskin bottles by members of the interdisciplinary science team.

-Description of derived parameters and processing techniques used

All data are either instrument variables, calculated variables, or measured from bottle samples. <u>Instrument variables</u>: pressure, temperature (primary, secondary), oxygen, transmissivity, attenuation, PAR, fluorometer.

<u>Calculated values</u>: salinity (primary and secondary, derived from conductivity and temperature, corrected by calibration with salt samples), chlorophyll-a (factory calibration), sigma-t, and dynamic height.

<u>Bottle samples</u>: nutrients (phosphate, silicate, nitrate, nitrite, ammonium), chlorophyll-a (total and size fractionated using two methods; acidification and Welschmeyer). Phaeopigments (total and size fractionated) were obtained from Chlorophyll-a samples.

Not all variables were sampled from all bottles or on all casts. Selected variables have dual-unit listings. Two chlorophyll methods were used: the acidification technique (Holm-Hansen, O., et al, 1965), and the Welschmeyer method (Welschmeyer, 1985). Calibration coefficients for instruments are available in the attached file tn249 CTDCalFile.txt

-Description of quality control procedures and Processing

Data are processed using Seabird CTD software and calibration file. Post-processing at the Pacific Marine Environmental Laboratory includes filtering extreme outliers, extrapolation of values from the top value collected at 3-5m to the surface. Each cast is visually reviewed for reasonableness and density inversions (greater than 0.02 sigma-t) caused by spurious measurements. This process is facilitated by comparison of the outputs of the 2 temperature and conductivity sensors. Profile data are bin-averaged to 1 meter. Nutrient samples were analyzed according to the methods of Gordon, et al (see reference below). Samples were collected in 50 ml high-density polyethylene bottles that were rinsed first with 10% HCl prior to each station, and rinsed at least three times with sample before filling. Some samples were refrigerated for 3-12 hours prior to analysis, and some frozen for later analysis.

DATA FORMAT:

-Data file structure, format and file naming conventions (e.g. column delimited ASCII, NetCDF, GIF, JPEG, etc.)

Data sets include continuous profile data and bottle samples from discrete depths. Data files are provided in two formats: NetCDF, and tab-delimited ASCII text.

NetCDF (EPIC standard) format includes meteorological and other metadata. "Code" is an EPIC-NetCDF-specific key code defining variables and units (see list below). Missing data are denoted by 1.0e-35. The format is defined at Unidata and PMEL-EPIC Web Sites.

http://www.epic.noaa.gov/epic/software/

http://www.unidata.ucar.edu/software/netcdf/

The text format is a tab-delimited file with 1-line header and .odv suffix, formatted for use with Ocean Data View and other ASCII-friendly software. Missing data are designated using -1.0e+10.

-Data format and layout (i.e. description of header/data records, NetCDF format) List of Variables with Short Name and Units (included in header) and grid definition

Axes:				
code name	type	lower corner	upper corner	units
501 x lon	EVEN	174.3463 W	I	degree_west
500 y lat	EVEN	58.2220 N		degree_north
1 z dep	EVEN	0.00	895.00	dbar
624 t time	EVEN	22-May-2010 04	4:20	True Julian Day
Variable(s):				
code	name	units		
28 T	TEMPERA	TURE (C)	C	
35 T2	Secondary	Temperature	C	
41 S	SALINITY	(PSU)	PSU	
42 S	SALINITY	(PSU)	PSU	
70 ST	SIGMA-T	(KG/M**3)	kg m-3	

```
10 DYN DYNAMIC METERS
                                   dyn-m
65 O
         OXYGEN (UMOL/KG)
                                      umol/kg
62 OST OXYGEN, %SAT
107 TRN TRANSMISSOMETER VOLTAGE 7 volts
904 Tr
         Transmissometry (CTD)
                                    %
55 ATTN ATTENUATION
                                   m-1
916 PAR Photosynthetically Active Radiation(volts) V
905 PAR Photosynthetic Active Radiation uEin m-2 s-1
918 SPAR Surface Photosynthetically Act uEin m-2 s-1
103 BTL NISKIN BOTTLE NUMBER
286 PO4 PHOSPHATE (micromoles/kg)
                                        uM/kg
288 SI
          SILICATE (micromoles/kg)
                                     uM/kg
282 NO3 NITRATE (micromoles/kg)
                                     uM/kg
284 NO2 NITRITE (micromoles/kg)
                                     uM/kg
289 NH4 AMMONIUM (micromoles/kg)
                                         uM/kg
971 rFv
          raw fluorometer Volts(CTD)
                                      Volts
2930 Cla CTD Chlorophyll-a factory calibration ugrams/l
2931 Cla CTD Chlorophyll-a laboratory calibration ugrams/l
2932 Cla CTD upcast Chlorophyll-a laboratory calibration ugrams/l
933 Cla
         Chlorophyll ugrams/l
2933 Cla Chlorophyll-a total ugrams/l
2934 Cla Chlorophyll-a Large Size Fraction ugrams/l
2935 Cla Chlorophyll-a Small Size Fraction ugrams/l
2936 Cla
          Welschmeyer Chlorophyll-a Total ugrams/l
2937 Cla
          Welschmeyer Chlorophyll-a Large Size Fraction ugrams/l
2938 Cla Welschmeyer Chlorophyll-a Small Size Fraction ugrams/l
907 Fph Phaeopigments ugrams/l
2907 Fph Phaeopigments Large Size Fraction ugrams/l
2908 Fph Phaeopigments Small Size Fraction ugrams/l
```

Sample Data Records with Column Headers (NetCDF format):

Variables

T, T2, S, S, ST, DYN, O, OST, TRN, Tr, ATTN, PAR, PAR, SPAR, BTL, PO4, SI, NO3, NO2, NH4, rFv, Cla, Cla, Cla, Cla, Cla, Cla, Fph, Fph, Fph

Epic codes

28,35,41,42,70,10,65,62,107,904,55,916,905,918,103,286,288,282,284,289,971,2930,933,2933,2934,2935,2936,2937,2938,907,2907,2908

Pres(db)	T	T2	S S	ST	DYN	O	OST	TRN	Tr	ATTN
PAR	PAR	SPAR	BTL	PO4	SI N	O3 1	NO2	NH4	rFv	Cla
Chl	Cla	Cla Cla	a Cla	Cla	Cla	Fph	Fph	Fph		
3.00	-1.6976	-1.6996	31.6135	31.6219	25.4258	0.76204E	E-02 36	9.2490	95.9914	3.7441
74.4813	1.1785	3.5457	341.3700	932.3900	1e+35	5 1e+3	35 le	+35 1e	+35 16	+35
1e+35	1.2635	-0.1241	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35
4.00	-1.7002	-1.6995	31.6091	31.6155	25.4223	0.10164E	E-01 36	9.5974	96.0763	3.7510
74.6194	1.1711	3.4366	265.4000	932.2800	1e+35	i 1e+3	35 le	+35 1e	+35 16	+35
1e+35	1.3054	0.0251	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35
5.00	-1.7024	-1.7013	31.6054	31.6109	25.4193	0.12711E	E-01 36	9.8159	96.1282	3.7473
74.5444	1.1751	3.3289	206.7900	932.2800	1e+35	i 1e+3	35 le	+35 1e	+35 16	+35
1e+35	1.3203	0.0810	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35
6.00	-1.7036	-1.7042	31.6020	31.6071	25.4166	0.15261E	E-01 36	9.9674	96.1622	3.7451
74.4997	1.1775	3.2295	164.1700	932.2800	1e+35	i 1e+3	35 le	+35 1e	+35 16	e+35
1e+35	1.3504	0.1974	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35	1e+35

```
-1.7036
  7.00
         -1.7049
                              31.6003
                                        31.6043
                                                   25.4153 0.17812E-01
                                                                         370.4406
                                                                                     96.2833
                                                                                                3.7512
74.6238
           1.1709
                    3.1319
                             131.3600
                                        932.2800
                                                     1e+35
                                                               1e+35
                                                                         1e+35
                                                                                   1e+35
                                                                                             1e+35
1e+35
         1.3863
                   0.3516
                             1e+35
                                       1e+35
                                                 1e+35
                                                           1e+35
                                                                     1e+35
                                                                               1e+35
                                                                                         1e+35
                                                                                                   1e+35
  8.00
         -1.7060
                   -1.7047
                              31.5984
                                        31.6020
                                                   25.4137 0.20365E-01
                                                                         370.3354
                                                                                     96.2578
                                                                                                3.7488
74.5747
          1.1735
                    3.0338
                             105.0800
                                        932.2800
                                                     1e+35
                                                               1e+35
                                                                         1e+35
                                                                                   1e+35
                                                                                             1e+35
                                                                     1e+35
                                                                                         1e+35
1e+35
         1.3940
                   0.3859
                             1e+35
                                       1e+35
                                                 1e+35
                                                           1e+35
                                                                               1e+35
                                                                                                   1e+35
  9.00
         -1.7059
                   -1.7039
                              31.5980
                                        31.6005
                                                   25.4134 0.22918E-01
                                                                         370.3262
                                                                                     96.2450
                                                                                                3.7484
74.5670
           1.1739
                    2.9385
                              84.1430
                                        929.8100
                                                     1e+35
                                                               1e+35
                                                                         1e+35
                                                                                  1e+35
                                                                                            1e+35
         1.3660
1e+35
                   0.2631
                             1e+35
                                       1e+35
                                                 1e+35
                                                           1e+35
                                                                     1e+35
                                                                               1e+35
                                                                                         1e+35
                                                                                                   1e+35
                                                    25.4120 0.25472E-01
                                                                                      96.2456
  10.000
           -1.7051
                     -1.7039
                               31.5963
                                          31.5991
                                                                          370.3313
                                                                                                  3.7468
74.5345
           1.1756
                     2.8459
                              67.9040
                                        928.1800 0.60000E+01 0.12570E+01 0.24222E+02 0.62446E+01
                            1.3874
0.99058E-01 0.33846E+01
                                      0.3556  0.18099E+00  0.37034E+00  0.12910E+00  0.31026E+00
0.38443E+00 0.13305E+00 0.21908E+00 0.25785E+00 0.25785E+00 0.25785E+00
```

Sample Attributes (Metadata) in NetCDF files

Attribute(s):

Number of attributes listed: 21 Number of attributes in file: 21

CRUISE = TN249CAST = 077

INST_TYPE = Sea-Bird CTD SBE 9

 $DATA_TYPE = CTD$

DATA CMNT = Data from Seasoft File 24905701.cnv

COORD_SYSTEM = GEOGRAPHICAL

WATER_MASS = B
BAROMETER = 1019
WIND_DIR = 8
WIND_SPEED = 18
AIR_TEMP = -1.60000002
WATER_DEPTH = 907

WATER_DEPTH = 907 PROG CMNT1 = cat ctd v1.36 06Aug2010

STATION NAME = nz11.5

EPIC FILE GENERATOR = SEASOFT2EPIC CTD (Version 1.35, 01-May-2003)

CREATION DATE = $13:20\ 15$ -MAR-11

PROG CMNT2 = EDIT CTD (v1.03, rev 01Aug07)

EDIT_COMMENT_01 = eps41: depth(0:10000) mod_coefs(a,b)= 1.000000 0.005000 EDIT_COMMENT_02 = eps41: depth(0:1) mod_coefs(a,b)= 1.000000 -0.000500

PROG CMNT3 = CTDVAR added 1 var

PROG_CMNT4 = Variables Extrapolated from 4 db to 0

Sample Data Records with Column Headers (text format):

Cruise cast type station_number station_name ctd_type yyyy-mm-dd hh:mm longitude [degrees east] latitude [degrees north] Bot.Depth [m] PRESSURE [dbar] TEMPERATURE [C] Secondary Temperature [C] SALINITY [PSU] SALINITY2 [PSU] SIGMA-T [kg m-3] DYNAMIC METERS [dyn-m] TRANSMISSOMETER VOLTAGE 7 [Volts] Transmissometry [%] ATTENUATION [m-1] raw fluorometer Volts [Volts] CTD Chlorophyll-a factory calibration [ugrams/l] Photosynthetically Active Radiation [Volts] Photosynthetic Active Radiation [uEin m-2 s-1] OXYGEN [umol/kg] CTD Oxygen [umol/kg] OXYGEN %SAT [%] NISKIN BOTTLE NUMBER PHOSPHATE [umol/kg] SILICATE [umol/kg] NITRATE [umol/kg] NITRITE [umol/kg] AMMONIUM [umol/kg] ctd bottle upcast chlorophyll factory cal [ugrams/l] Chlorophyll-a total [ugrams/l] Chlorophyll-a Small Size Fraction [ugrams/l] Welschmeyer Chlorophyll-a total [ugrams/l] Welschmeyer Chlorophyll-a Large Size Fraction [ugrams/l] Phaeopigments [ugrams/l] Phaeopigments Large Size Fraction [ugrams/l] Phaeopigments Small Size Fraction [ugrams/l]

```
tn249
                                                  001
                                                                                                      C
                                                                                                                                                           00101 test
                                                                                                                                                                                                                                                                 test
                                                                                                                                                                                                                                                                                                                      2010-05-11 00:17191.783 56.64617
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        110.0
                                                   2.285000
                                                                                                                                                           59.08460
                                                                                                                                                                                                                                                                  28.95600
                                                                                                                                                                                                                                                                                                                                                                         26.38650
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 23.11437
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        0.000000
                                                                                                                                                                                                                                                                 0.2309000
                                                   4.535800
                                                                                                                                                           94.39170
                                                                                                                                                                                                                                                                                                                                                                         2.700200
                                                    13.84000
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 -1.0e+10-1.0e+10-1.0e+10-1.0e+10
                                                                                                                                                           378.5420
                                                                                                                                                                                                                                                                  342.8960
                                                                                                                                                                                                                                                                                                                                                                           109.8225
                                                    -1.0e + 10 - 1.0e + 10 - 1.0
```

tn249	001	C	00101	test	test	2010-05	-11 00:	17191.783	56.646	17	110.0	1.000	
	2.28500	285000 59.08460		0	28.95600 26.38650		50	23.11437		0.4745780E-02			
	4.53580			0	0.2309000		0.6850	0.6850000E-01		0.4560000E-01		2.700200	
	13.84000		378.5420		342.8960		109.8225				0-1.0e+10-1.0e+10		
	-1.0e+1	0-1.0e+10	0-1.0e+10	0-1.0e+10	-1.0e+10)-1.0e+10)-1.0e+	10-1.0e+10)-1.0e+1	0-1.0e+1	0-1.0e+10	0-1.0e+10	
tn249	001	C	00101	test	test	2010-05	-11 00:	17191.783	56.646	17	110.0	2.000	
	2.28500	00	59.0846	0	28.9560	0	26.386	50	23.1143	37	0.94915	29E-02	
	4.535800		94.3917	0	0.2309000		0.6850000E-01		0.4560000E-01		2.700200		
	13.8400	00	378.542	8.5420 342.8960		0	109.8225 -1.0e+1			0-1.0e+1	-1.0e+10-1.0e+10-1.0e+10		
-1.0e + 10 - 1.0e + 10 - 1.0										0-1.0e+10			
tn249	001	C	00101	test	test	2010-05	-11 00:	17191.783	56.646	17	110.0	3.000	
	2.28500	00	59.0846	0	28.9560	0	26.386	50	23.1143	37	0.14237	25E-01	
	4.535800		94.3917	0	0.2309000		0.6850000E-01		0.4560000E-01		2.700200		
	13.8400	00	378.542	0	342.896	0	109.82	25	-1.0e+1	0-1.0e+1	0-1.0e+10	0-1.0e+10	
-1.0e + 10 - 1.0e + 10 - 1.0										0-1.0e+10			
tn249	001	C	00101	test	test	2010-05	-11 00:	17191.783	56.646	17	110.0	4.000	
	2.28500	00	59.0846	0	28.9560	0	26.386	50	23.1143	37	0.18982	94E-01	
	4.535800		94.3917	0	0.230900	00	0.6850	000E-01	0.45600	000E-01	2.70020	0	
	13.8400	00	378.5420 342.8960 109.8			109.82	8225 -1.0e+10-1.0e+10-1.0e+10-1.0e+1						
-1.0e + 10 - 1.0e + 10 - 1.0										0-1.0e+10			
tn249	001	C	00101	test	test	2010-05	-11 00:	17191.783	56.646	17	110.0	5.000	
	2.28420	00	59.0856	0	28.95630	0	26.387	00	23.1146	56	0.23728	45E-01	
	4.531400 94.298		94.2980	0	0.2348000		0.6870000E-01		0.4750000E-01		2.630300		
	12.7940	00	378.499	0	342.6070	0	109.81	23	-1.0e+1	0-1.0e+1	0-1.0e+10	0-1.0e+10	
	-1.0e + 10 - 1.0e + 10 - 1.0												

-Description of flags, codes used in the data, and definitions (i.e. good, questionable, missing, estimated, etc.) Missing data are denoted by 1.0e-35 (NetCDF) or -1.0e+10 (text files). All data points are either accepted (retained) or rejected (deleted) during processing, so data are all defined as good. Data values above 5-10 meters depth may have been extrapolated to surface.

DATA REMARKS:

-Software compatibility (i.e. list of existing software to view/manipulate the data)
Software for viewing and manipulating NetCDF data are listed at the Unidata/UCAR site
http://www.unidata.ucar.edu/software/netcdf/software.html. "ncdump" tool is suggested as a start.
Ferret software (NOAA/PMEL) and Matlab can read and manipulate NetCDF files and grids.

REFERENCES:

-List of documents cited in this data set description

- Seabird SBE 911plus CTD manual http://www.seabird.com/products/spec_sheets/911data.htm
- o CTD map: tn249 PMEL CTDmap.gif
- o CTD Calibration file: tn249 CTDCalFile.txt
- O Gordon, L.I., Jennings, J.C., Jr., Ros, A.A. and Krest, J.M., 1993. A suggested protocol for continuous flow automated analysis of seawater nutrients (Phosphate, nitrate, nitrite and silicic acid) in the WOCE Hydrographic Program and the Joint Global Ocean fluxes Study. WOCE Operations Manual, Part 3.1.3 "WHP Operations and Methods" (WOCE Hydrographic Program Office, Methods Manual 91-1) Bundesamt für Seeschiffahrt und Hydrographie, Postfach 30 12 20, 2000 Hamburg 36 Germany.

- $\underline{http://chemoc.coas.oregonstate.edu:16080/\sim lgordon/cfamanual/whpmanual.pdf--N.A.}$
- Welschmeyer. 1985(1994). Fluorometric analysis of chlorophyll- a in the presence of chlorophyll b and pheopigments, Limnol.Oceanogr. 39(8), 1994, 1985-1992.
- o HOLM-HANSEN, O., C. J. LORENZEN, R. W. HOLMES, AND J. D. STRICKLAND. 1965. Fluorometric determination of chlorophyll. J. Cons. Int. Explor. Mer 30: 3-15.
- o NSF Award: http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0732430