SPURS-1 Final in situ Data Submission Report

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Abstract

This is a report documenting the final submission of the Salinity Processes in the Upper Ocean Regional Studies North Atlantic Field Campaign (SPURS-1) dataset to PO.DAAC and NODC. The report presents in narrative form the different types of instruments and sampling found in the SPURS-1 dataset.

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Introduction

SPURS-1 (Salinity Processes in the Upper Ocean Regional Study - North Atlantic Field Campaign; see white paper at spurs.jpl.nasa.gov, click on "Science" -> "Presentations & Reports", then on "Report" after "Pasadena SPURS Workshop Report, January 2010.") took place in the subtropical North Atlantic in 2012-2013. The purpose of the experiment was to examine the processes responsible for maintaining the subtropical surface salinity maximum in the North Atlantic (Schmitt, et al., 2015; Lindstrom et al., 2015; see also the March 2015 issue of Oceanography Magazine, http://tos.org/oceanography/archive/28-1.html). The field campaign consisted of a variety of observing assets, which we detail below. To deploy and recover these assets, there were 5 cruises, 3 on US ships and two on European ships. (For more detail on the data management aspects of SPURS-1, see Bingham et al., 2015.) Here are the cruises and dates.

Ship (cruise #)	Dates	Chief Scientist (nationality)
Thalassa	16-Aug - 13-Sep-2012	Reverdin (France)
Knorr (209)	6-Sep - 9-Oct-2012	Schmitt (US)
Endeavor-1 (522)	15-Mar - 15-Apr-2013	Schmitt (US)
Sarmiento	14-Mar - 10-Apr-2013	Font (Spain)
Endeavor-2 (533)	19-Sep - 13-Oct-2013	Fratantoni (US)

Full cruise reports have been issued for the US cruises and the Sarmiento cruise. These reports are included in this data submission. (The Sarmiento report is in Catalan!)

The submitted data archive consists of three parts. 1) There is a directory holding the unprocessed data in a somewhat unorganized form. These raw data have been obtained directly from data providers and SPURS PIs. Some parts of the raw data directory are simply copies of the science directories on the various cruises. Persons interested in accessing raw or lightly processed versions of the SPURS-1 in situ data do so with little support and with the idea that they know exactly what they are doing. 2) The second part is a directory containing versions of the datasets that have been converted to netCDF files. The SPURS-1 data management team highly recommends that future researchers interested in the SPURS-1 data use these netCDFs. Not all parts of all datasets have been converted - see below for details about each dataset. 3) Finally, there is a documentation section, with this file, the SPURS Data Quality Intercomparison Report (Baker et al., 2014), a couple of Google Earth animations of the sampling, the SPURS-1 white paper, all the cruise reports as mentioned above and a table to accompany this report.

References

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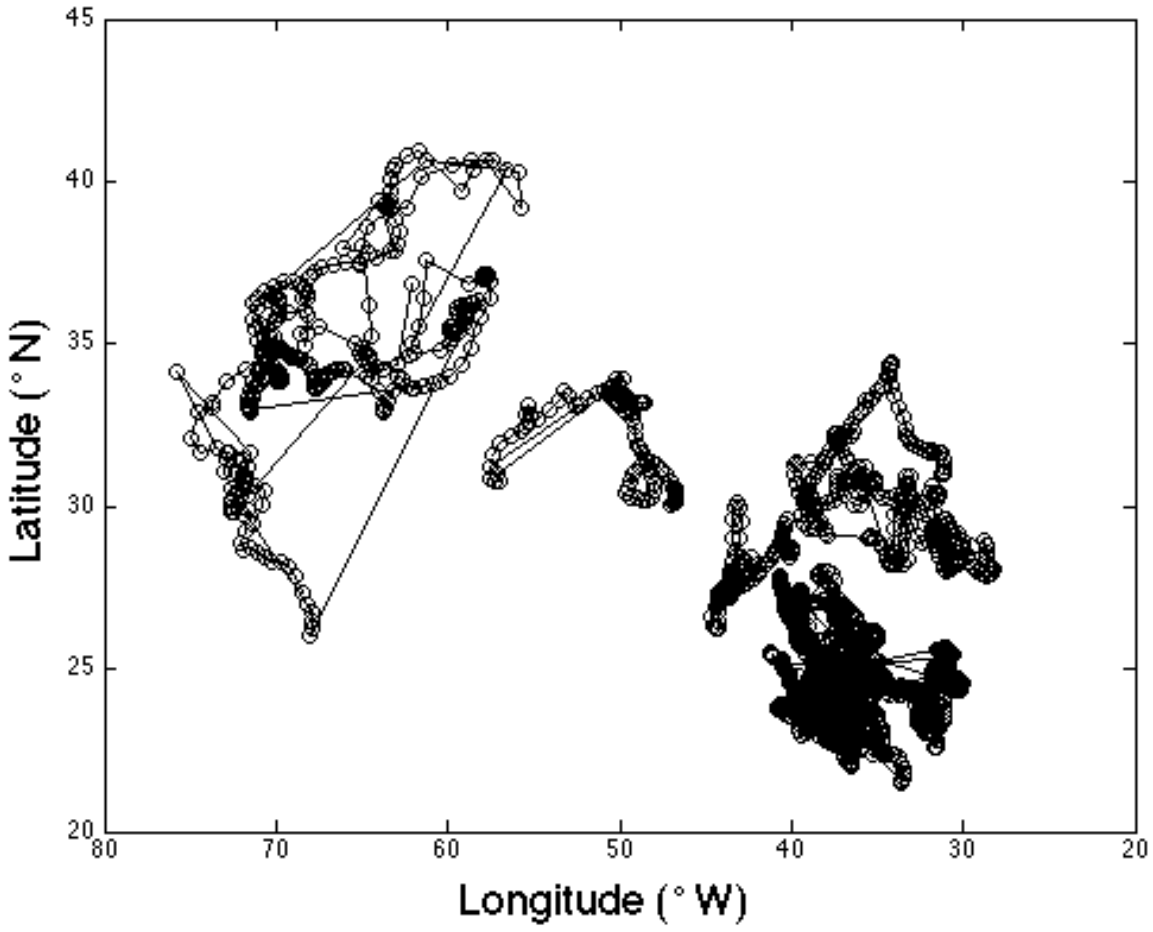
Floats

PI: Riser (riser@ocean.washington.edu)

Approximately 24 floats were deployed during SPURS-1 (Riser et al., 2015), mainly on the Knorr cruise (Sept - Oct 2012). However 2-3 of these collected almost no data. These were standard argo floats with the addition of surface temperature and salinity (STS) sensors and acoustic rain gauges. We submit netCDF files with full profiles. These files were downloaded from the Coriolis website (coriolis.eu.org) but had extra header information pertaining to SPURS-1 added to them. Each file tracks one float with multiple profiles. STS and rain gauge data are not included in the float netCDFs, though they are available in the unprocessed files. Here is a plot with the positions of the profiles. Data are updated to 25 August 2014, though there may have been floats operating after that.

References: Anderson and Riser, 2014. Riser et al., 2015.



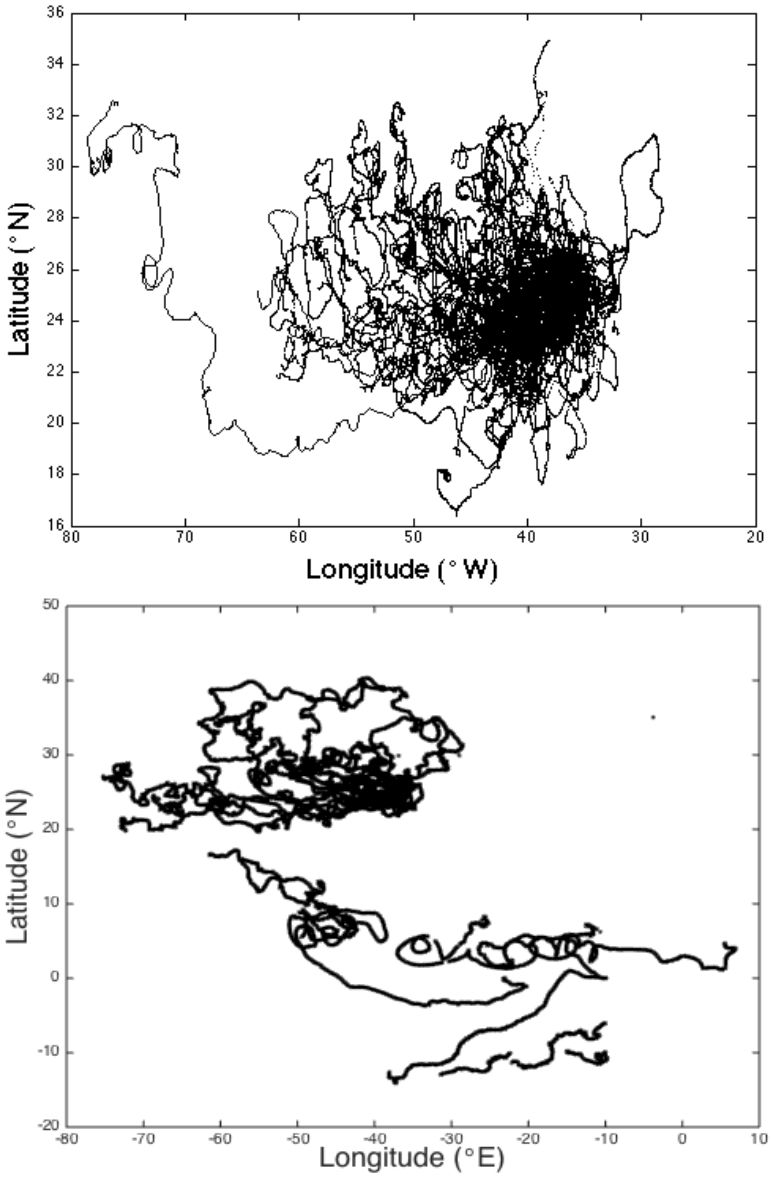
Drifters

PIs: Centurioni (lcenturioni@ucsd.edu), Reverdin (reve@locean-ipsl.upmc.fr)

Approximately 83 drifters were deployed during SPURS-1 by US PIs. These are standard Surface Velocity Programme (SVP) drifters with salinity sensors added (SVP/S). One combined file containing all of the drifter data is submitted. Data are updated to 10 April 2014, though there may have been drifters operating after that. Below is a plot of the ARGOS positions of the drifter dataset. Details of the extensive quality control are provided by Hormann et al. (2014).

Another 24 drifters were deployed by French and Spanish ships. The second plot below is their positions. Note that some of the drifters in this dataset were deployed well south of the SPURS region.

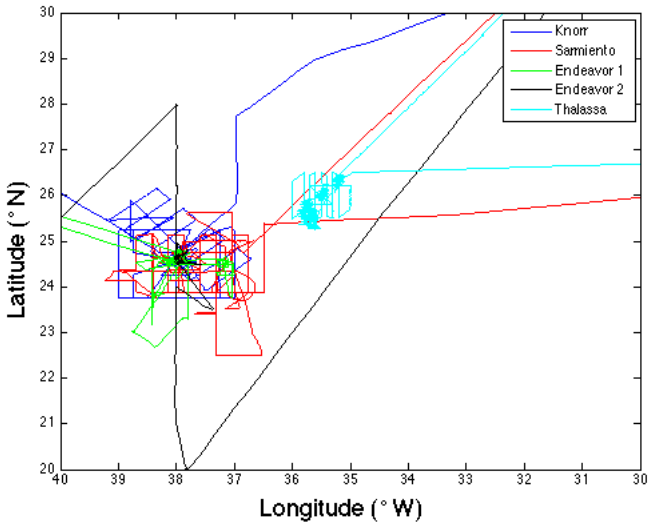
References: Hormann et al., 2014; Centurioni et al., 2015

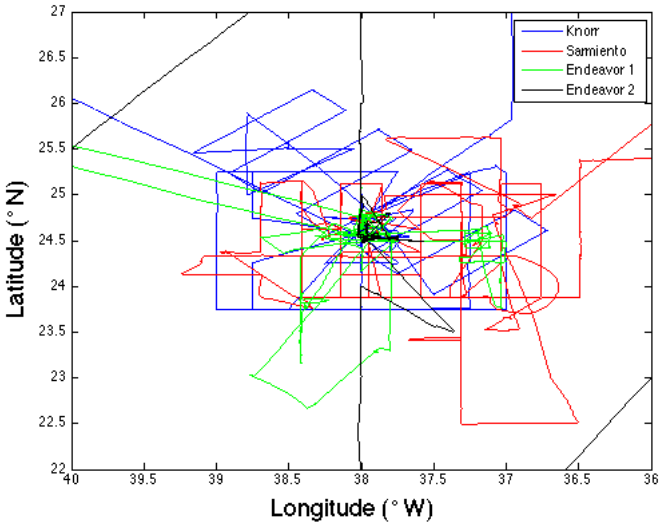


Thermosalinograph

PI: various

Each SPURS cruise had a thermosalinograph (TSG) instrument which took temperature and salinity measurements along the track. Measurements were calibrated using onboard salinometers during the cruises. TSG data are found in the Knorr, Endeavor, Sarmiento and Thalassa folders. Here are two plots of the TSG tracks.

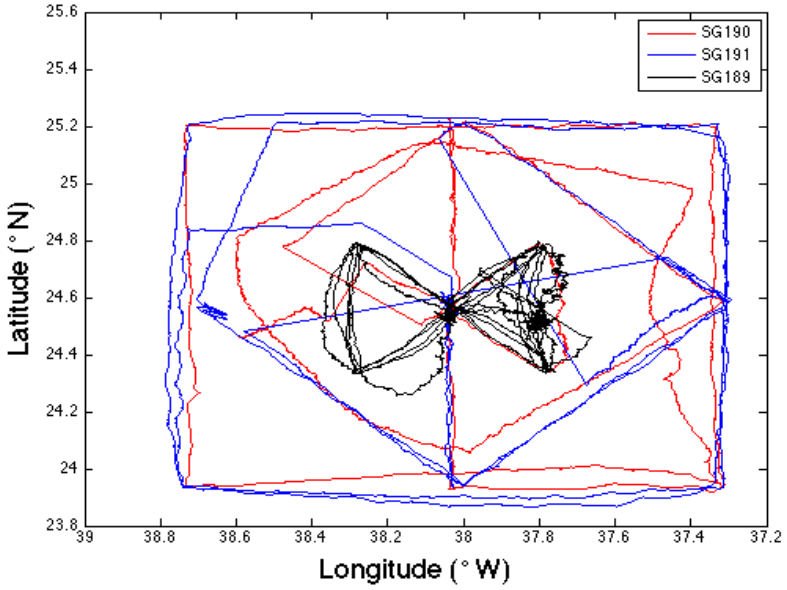


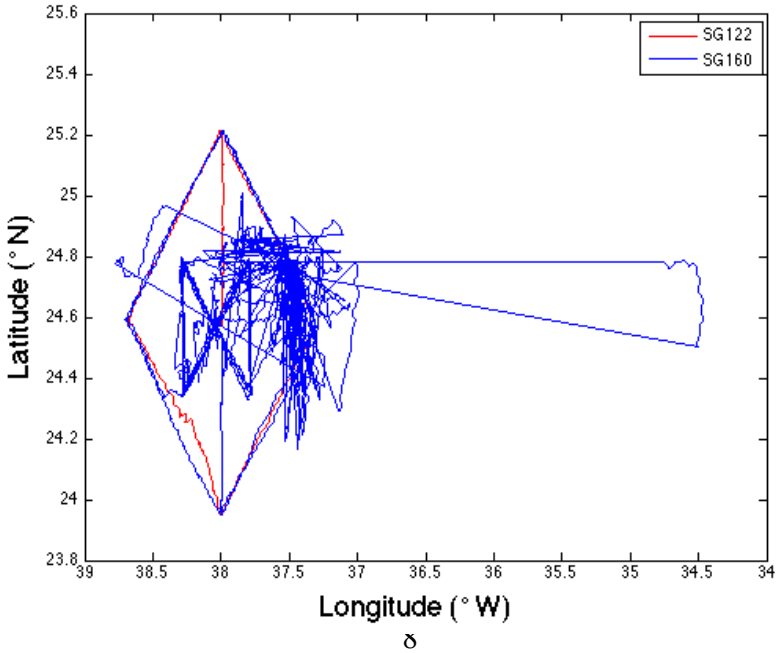


Seagliders

PIs: Charles Eriksen (eriksen@u.washington.edu), Craig Lee (craig@apl.washington.edu)

There were three seagliders deployed on the Knorr cruise in September 2012. These were retrieved during the first Endeavor cruise, and three were redeployed. One of these three was subsequently lost, so we only have records for two. The seagliders typically made loop or butterfly patterns around the central SPURS mooring, diving to 1000 m. The top figure shows the seaglider tracks for the first deployment, Sep-2012 to Mar-2013. The bottom panel has the second deployment, Mar-2013 to Sep-2013. Note the different longitude scales.



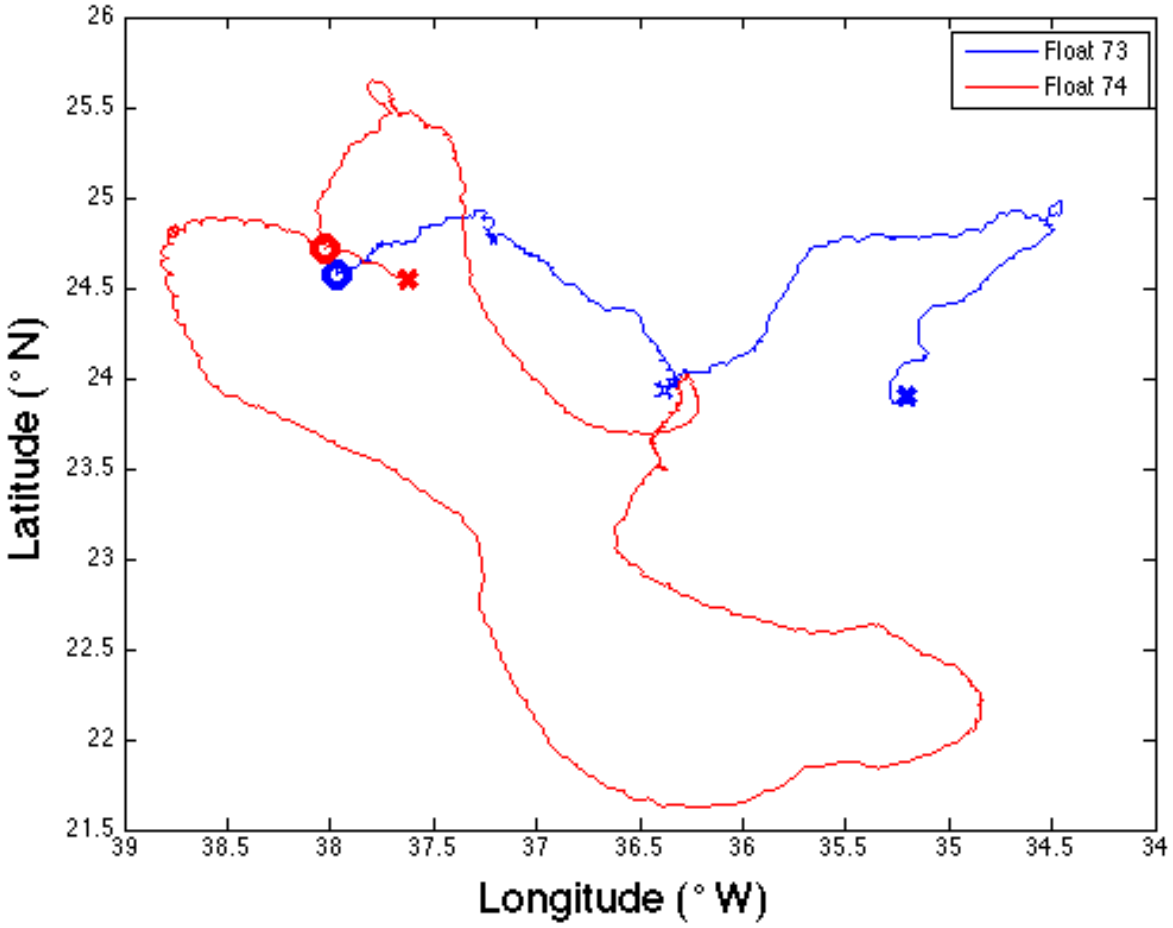


Neutrally Buoyant Float

PIs: Eric d'Asaro (dasaro@apl.washington.edu), Andrey Shcherbina (ashcherbina@apl.washington.edu)

A neutrally buoyant float (#73) was deployed on the Knorr cruise in September 2012, and recovered on the Endeavor cruise the following April. It stopped collecting data in January 2013. Another such float (#74) was deployed in April and recovered in September 2013. The data files include time, date, pressure, temperature, latitude, longitude. Each instrument had 2 CTDs on board. Here is a plot of the tracks of the floats. The "O" symbols are the deployment locations and the "X"'s are the recoveries.

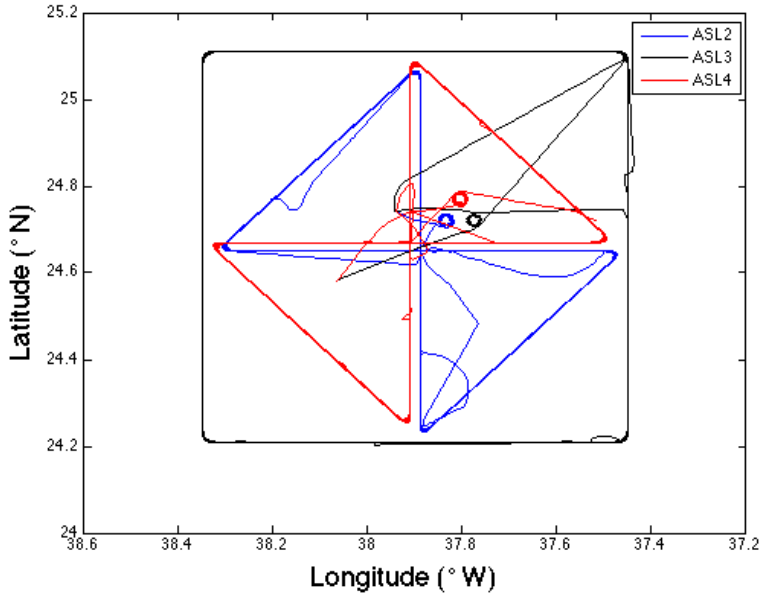
Reference: Shcherbina et al., 2015

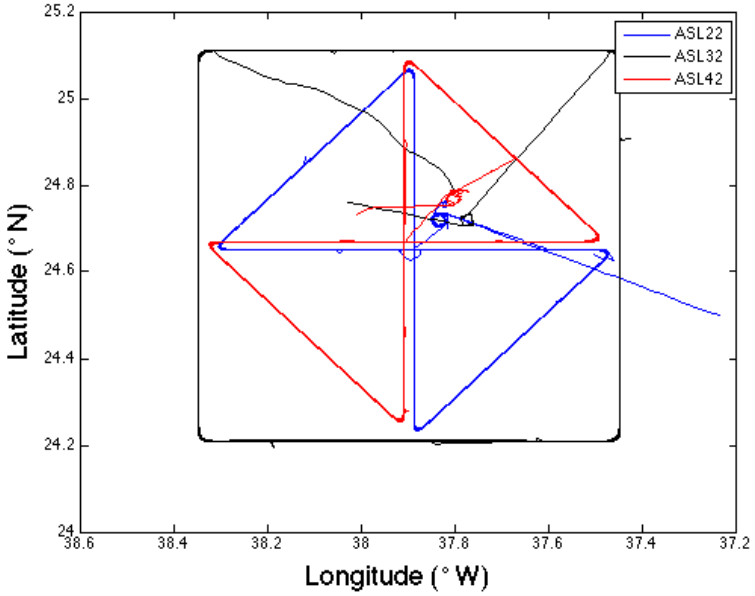


Wave Gliders

PIs: Dave Fratantoni (dave@horizonmarine.com), Ben Hodges (bhodges@whoi.edu)

Three wavegliders (ASL2, ASL3 and ASL4) were deployed from the Knorr in September 2012. These were recovered in April 2013 and redeployed (ASL22, ASL32 and ASL42). Final recovery was in September 2013. Each waveglider has one CTD at the near-surface and another at 6 m depth. The wavegliders followed a square loop or butterfly pattern around the central SPURS mooring. Each data file contains CTD data from the surface and 6 m sensors, current speed and direction, along with surface meteorological information, air temperature, air pressure and wind speed and direction.

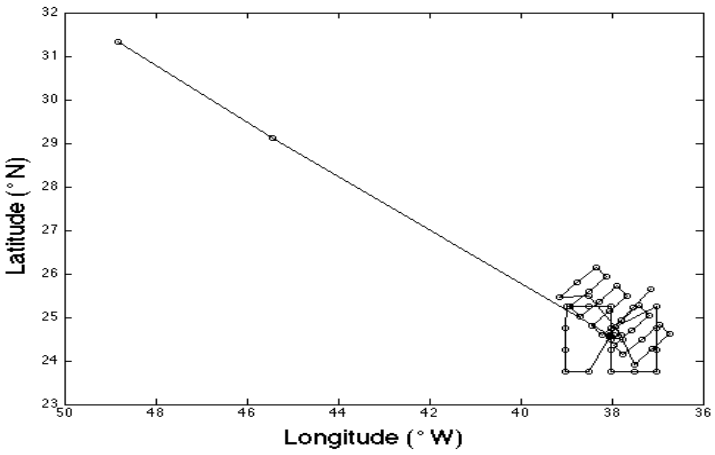


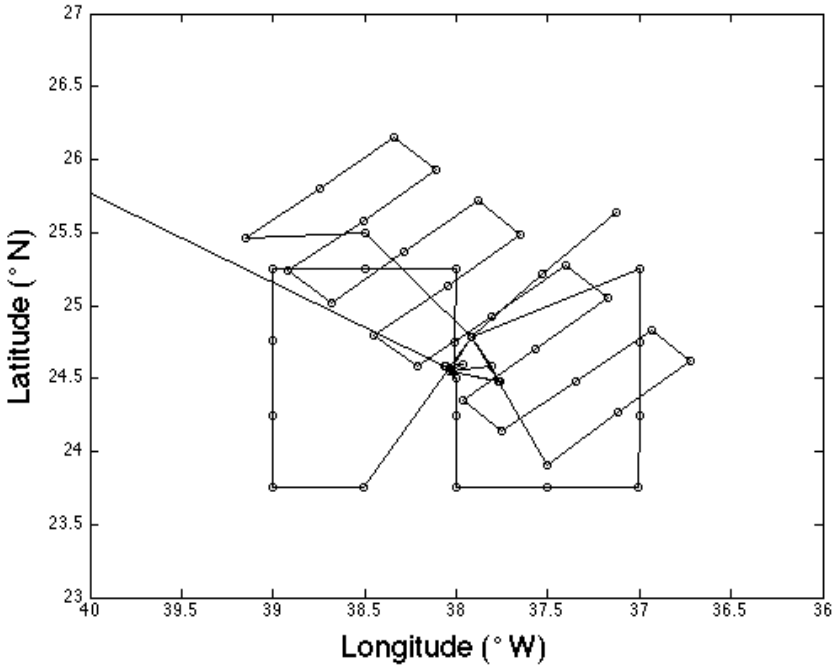


Knorr CTD

PI: none

There were 100 CTD casts made during the Knorr cruise. Knorr CTD data were calibrated using a shipboard salinometer which was calibrated using IAPSO standard seawater. The CTD NetCDF contains the CTD data averaged to 1 dbar intervals. The plots show the locations of the Knorr CTD casts.





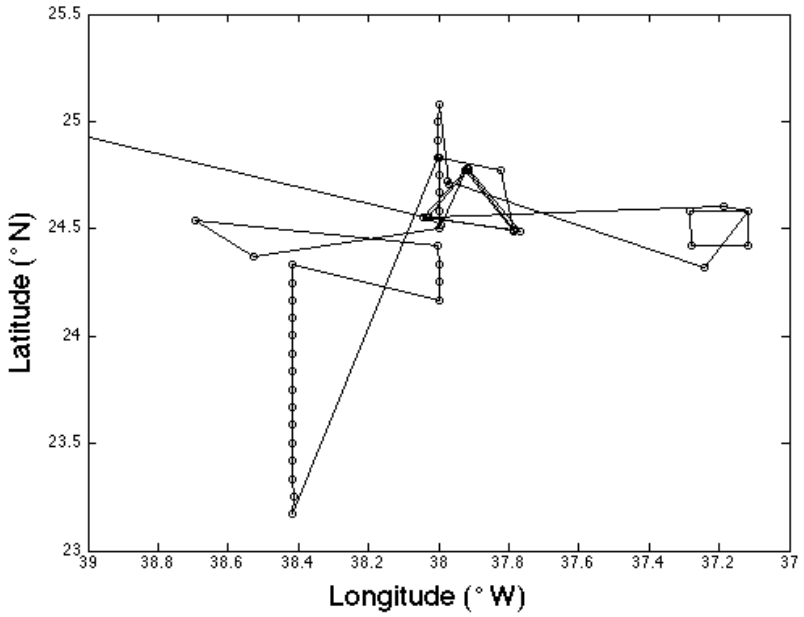
Knorr, Endeavor-1 and Endeavor-2 ADCP

ADCP data were collected during the three US cruises on the Knorr and Endeavor. There were 300 khz Workhorse, 75 khz broadband and 75 khz narrowband instruments operating. Data were collected using UHDAS software. NetCDF files are in the "knorr", "endeavor1" "endeavor2" directories.

Endeavor-1 CTD

PI: none

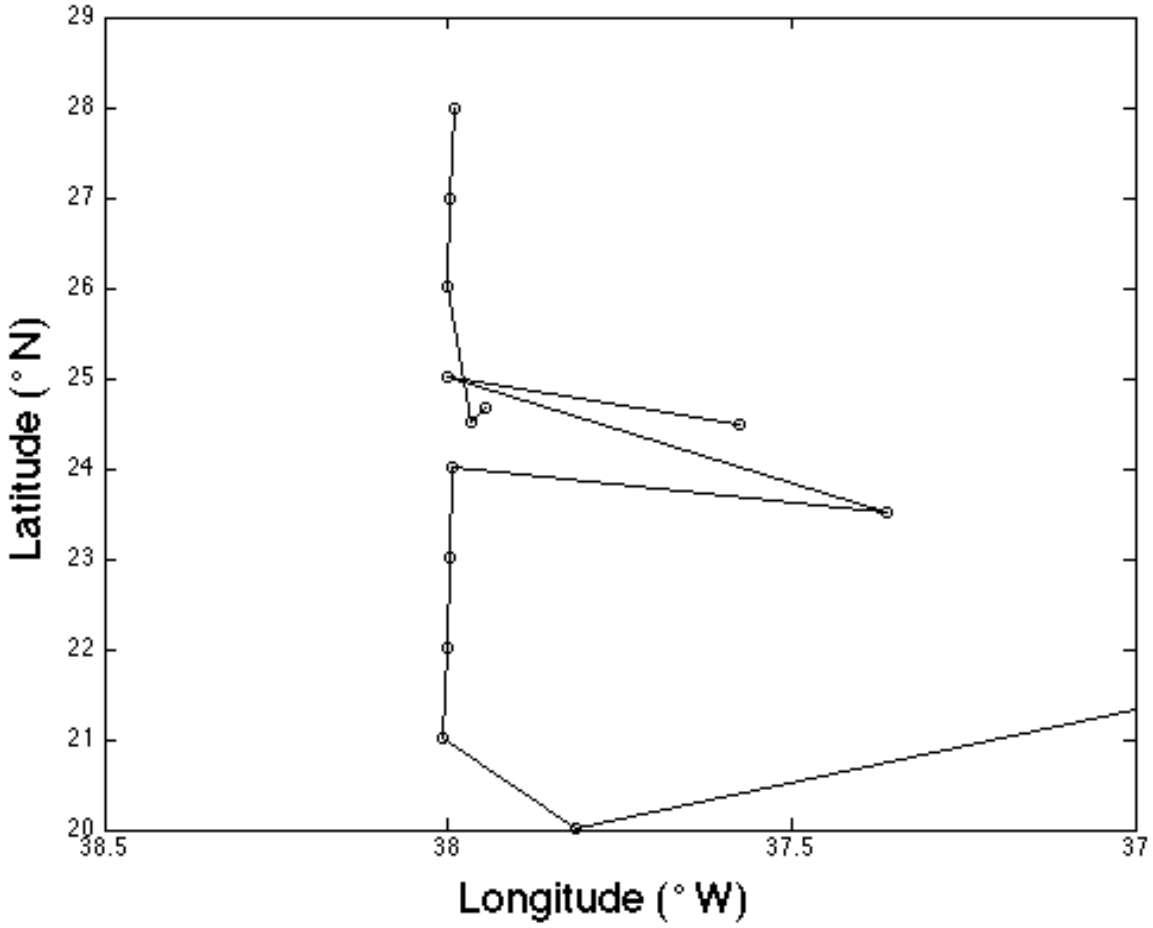
There were 52 CTD casts made during the Endeavor-1 cruise. Endeavor-1 CTD data were calibrated using a shipboard salinometer which was calibrated using IAPSO standard seawater. The CTD NetCDF contains the CTD data averaged to 1 dbar intervals. The plot shows the locations of the Endeavor-1 CTD casts. Note, one cast taken near the beginning of the cruise near Narragansett was omitted from the plot.



Endeavor-2 CTD

PI: none

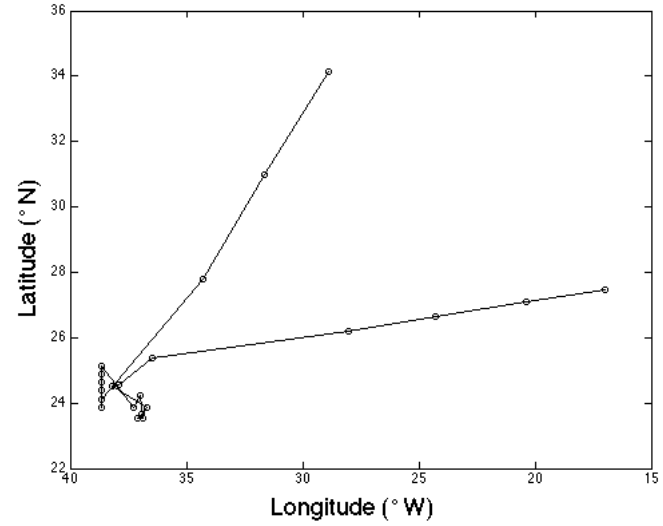
There were 17 CTD casts made during the Endeavor-2 cruise. Endeavor-2 CTD data were calibrated using a shipboard salinometer which was calibrated using IAPSO standard seawater. The CTD NetCDF contains the CTD data averaged to 1 dbar intervals. The plot shows the locations of the Endeavor-2 CTD casts. Note there are two casts from near the beginning of the cruise that are missing from the plot. Note also the elongated nature of the plot in the north-south direction.

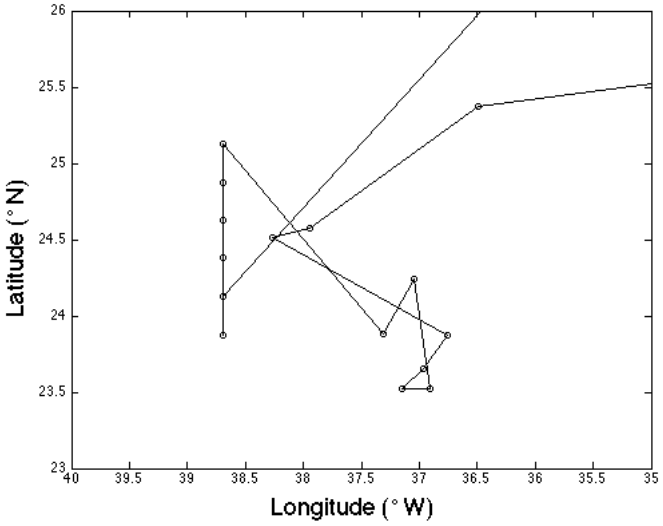


Sarmiento CTD

PI: Font (jfont@icm.csic.es)

There were 22 CTD casts made during the Sarmiento cruise. Sarmiento CTD data were calibrated using a shipboard salinometer which was calibrated using IAPSO standard seawater. The CTD NetCDF contains the CTD data averaged to 1 dbar intervals. These plots show the locations of the casts.





Sarmiento ADCP

PI: none

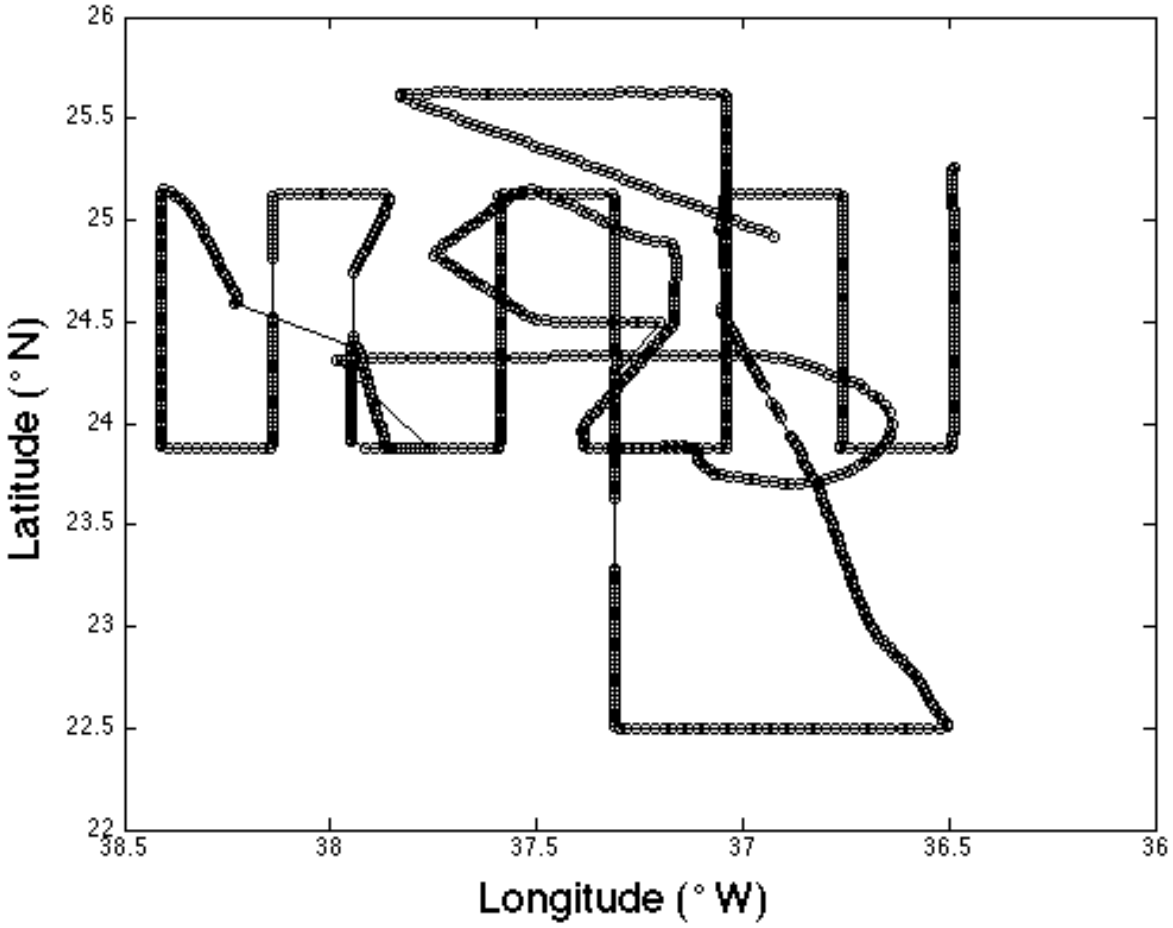
The Sarmiento used a 76.8 khz broadband ADCP. A version of the raw data is in .mat files in the "LASACA_SCIENCE_SHARED/JULIUS/TEMP_ADCP_PROCESSED" directory. Another version is in the "SADCP" directory. The data were collected using the proprietary RDI processing software. No netCDF has been created.

Shipboard data - Sarmiento (SeaSoar)

PI: Busecke (julius@ldeo.columbia,edu)

The SeaSoar instrument on the Sarmiento was run from 22 March to 8 April 2013. The netCDF version is a highly processed 1-meter gridded dataset. Less processed versions can be found in the SARMIENTO directory under SPURS_data. Here is a plot of the grid positions.

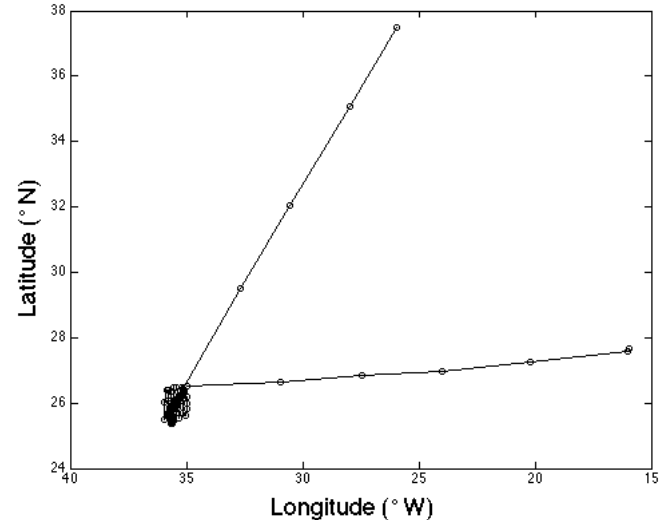
References: Busecke et al., 2014.

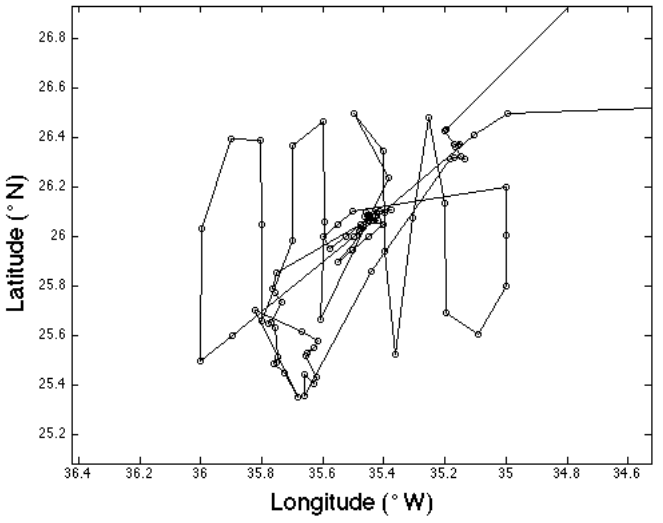


Thalassa CTD

PI: Reverdin (reve@locean-ipsl.upmc.fr)

There were 94 CTD casts made during the Thalassa cruise. Thalassa CTD data were calibrated using a shipboard salinometer which was calibrated using IAPSO standard seawater. The CTD NetCDF contains the CTD data averaged to 1 dbar intervals. These plots show the locations of the casts.





Lowered ADCP

Knorr PI: Schanze (jschanze@esr.org)
Sarmiento PI: none

Lowered ADCP data were collected during the Knorr cruise on every CTD cast. Thus each CTD cast has an accompanying profile of water column velocity. As it is a considerable effort to translate the LADCP data into true Earth-referenced velocities, we have left the data in unprocessed form. No netCDF has been created.

Note, there are LADCP data for the Sarmiento cruise as well, but again these are left in raw form. They are in the "LASACA_SCIENCE_SHARED/LADCP" directory.

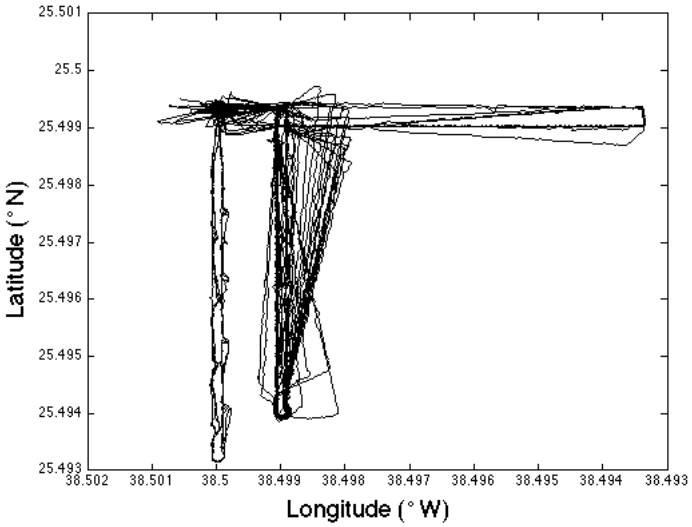
Ecomapper

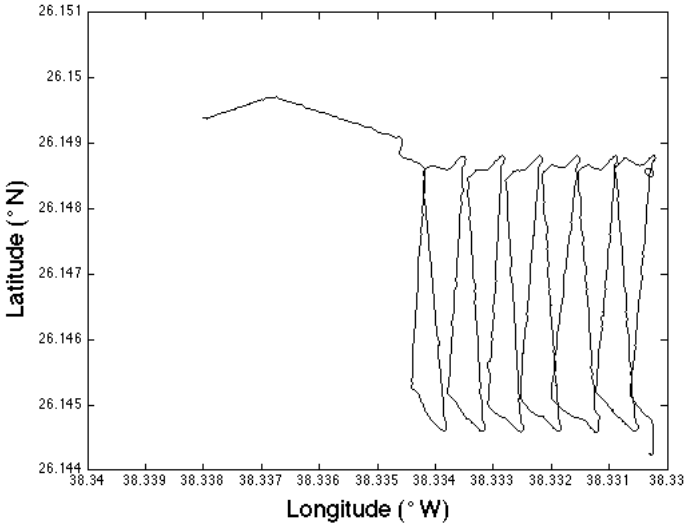
PIs: Dave Fratantoni (dave@horizonmarine.com), Ben Hodges (bhodges@whoi.edu)

The Ecomapper or "iver" was deployed on two days during the Knorr cruise, 29 and 30 September 2012. The data include temperature and salinity, as well as chlorophyll, oxygen and turbidity. The plots below show the survey tracks. The top one is from 29 Sept. and the bottom from 30 Sept.

NetCDFs were created and are in the knorr directory. The netCDFs include measurements of oxygen, turbidity and chlorophyll. We were not able to judge the quality of these data. In the absence of calibration in this very low-turbidity, low-chlorophyll regime, these data should be used as in indicator of structure only, not absolute magnitude.

References: Hodges and Fratantoni, 2014

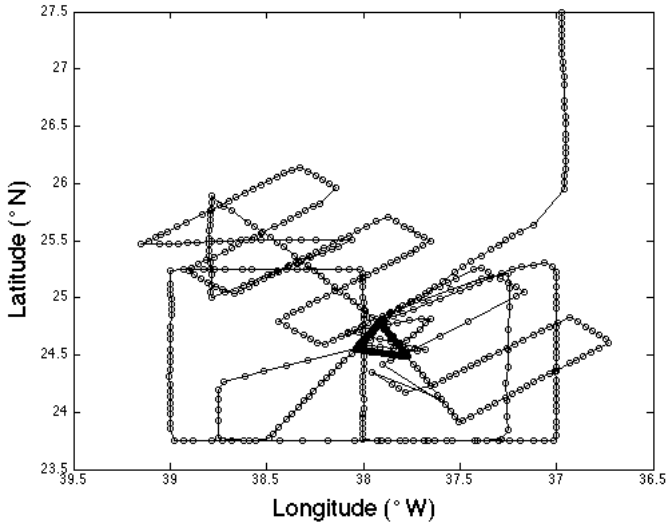




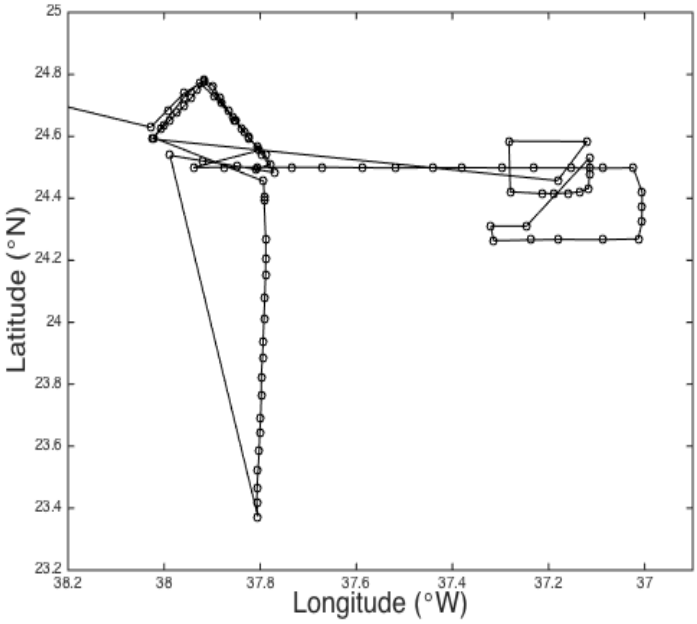
Underway CTD - Knorr and Endeavor-1

PI: Farrar (jfarrar@whoi.edu)

UCTD casts utilized an Oceanscience instrument. There were 771 UCTD casts during the Knorr cruise. Below is the distribution of stations.



There were 111 casts on the Endeavor-1 cruise. See below. Two casts (#'s 1 and 2) have no valid position information. No UCTD data were collected on the Endeavor-2 cruise.



Microstructure - St. Laurent (VMP Profiler, t-glider)

PI: St. Laurent (lstlaurent@whoi.edu), Schmitt (rschmitt@whoi.edu) and Clayson (cclayson@whoi.edu)

Numerous microstructure profiles were collected on the Knorr and Endeavor-1 cruises. We were not provided with copies of any of the data, processed or un-.

Microstructure - ASIP

PI: Ward (bward@nuigalway.ie)

The Air-Sea Interaction Profiler (ASIP) was deployed during the Sarmiento cruise, taking a total of 6 profiles. We have not received any copies of the data collected, processed or un-.

Flux Mooring (WHOI)

PI: Farrar (jfarrar@whoi.edu)

The SPURS central mooring was deployed in 5535 meters of water at (24° 34.867'N, 38°W) on 14 September 2012, serviced on 25 March 2013 and recovered on 30 September 2013. It consisted of a surface meteorological package, real-time surface oceanographic instruments, and subsurface, non-real time oceanographic instruments. For a full description, see

http://uop.whoi.edu/projects/SPURS/spurs.html

Click on "Detailed Description" for a full listing of all the available data. Files in the netCDF folder are the 1-hour average surface fluxes (SPURS_1_D_F1H.nc), the 1-hour average surface meteorological data (SPURS_1_D_M1H.nc) and the 5-minute subsurface data (SPURS_1_D_TS.nc). One minute surface meteorological data are in the unprocessed archive.

There were several current meters on the mooring. We have not received any of these data yet.

Reference: Farrar, J. T. and co-authors 2015.

PICO Moorings

PI: Kessler (william.s.kessler@noaa.gov)

Two moorings (PICO-1000 and PICO-3000) were deployed on the Knorr cruise in September 2012. Their positions of the north (1000) and east (3000) moorings were (24.74°N, 37.95°W) and (24.51°N, 37.81°W). The moorings contained a surface meteorological package and a "prawler", a CTD that could crawl up and down the mooring line from the near-surface down to about 500 m.

One of the moorings (PICO-1000) went adrift on 19-February 2013, during the time between the Knorr and Endeavor-1 cruises. So some time was spent on the Endeavor-1 cruise to chase it down and bring it back to the SPURS site. It was pulled out of the water on 2 April 2013, having collected good data while it was drifting. It was 100 km south of its original location. The other mooring was also recovered and redeployed during the Endeavor-1 cruise. One of the moorings (PICO-3000) failed after redeployment in April when the mooring line parted 2 m below the surface. The moorings were recovered on the Endeavor-2 cruise, including the surface buoy, which had drifter far from the original mooring location, and much of the subsurface part of the one that failed, which was on the bottom.

Note: We do not have the meteorological data from the moorings.

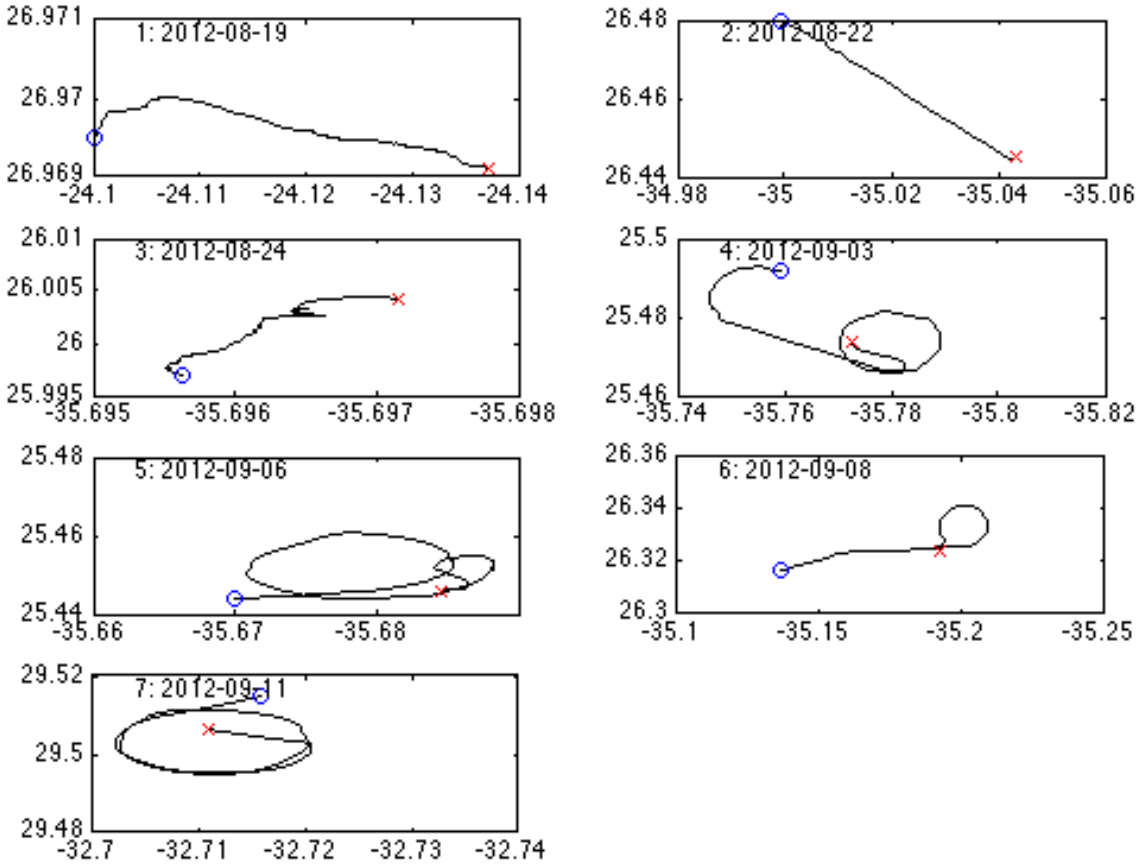
Surface Salinity Profiler

PIs: Asher (asherwe@apl.washington.edu) and Jessup (jessup@apl.washington.edu)

The Surface Salinity Profiler (SSP) is a specially-fitted sailboard with outriggers attached (. Also see link below). It samples the upper ocean while being towed from a ship. It was deployed from the Thalassa in a series of 7 short bursts between 19 August and 11 September, 2012. Each of these deployments had 3 instruments running.

Reference: Asher et al., 2014
See also:
http://spurs.jpl.nasa.gov/SPURS-Miami2013/20130117/Asher-SPURS-2013-Miami.pdf

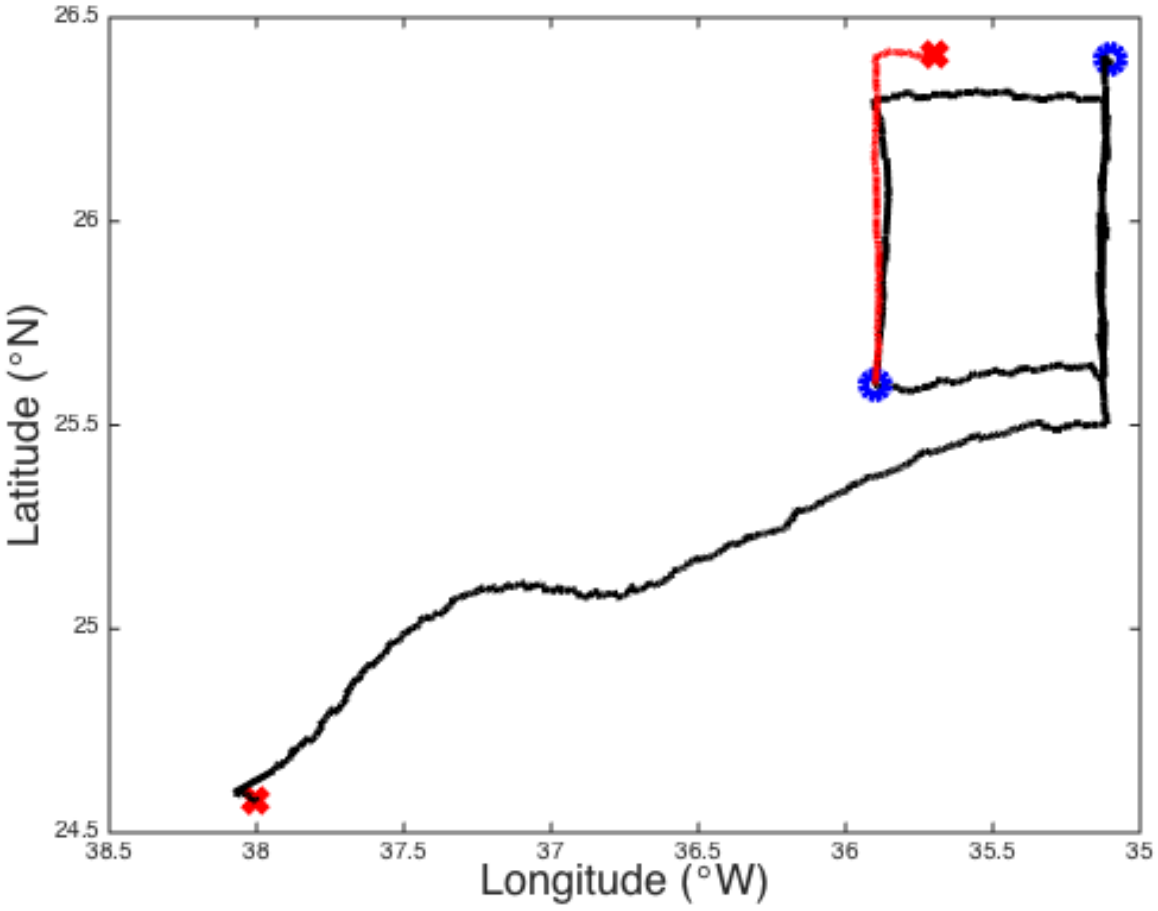
Below are plots of the deployment tracks. Starting locations are blue 'o's and ending are red 'x's. Also shown are deployment dates and numbers (number: date).



Tenuse and Crate Gliders

PI: Reverdin (reve@locean-ipsl.upmc.fr)

The Tenuse slocum glider was deployed from the Thalassa on 21-August and recovered by the Knorr on 4-October-2012 . It made a total of about 1400 profiles during that period (1-2 profiles/hour), going from the surface to 200 m. The Crate glider was deployed from the Thalassa on 22-August and recovered by the Thalassa on 27-August-2012 . It made a total of about 180 profiles going from the surface to 200 m. The plot below shows the track of the Tenuse (black) and Crate (red), with the deployments as blue 'O's and recoveries as a red 'X's.



Sea Snake

PI: Schanze (jschanze@esr.org)

This was a skin surface salinity measuring device created by Julian Schanze, which measured while the ship was moving. It was deployed on the first Endeavor-1 cruise.

Data from this instrument have been requested, but we have not received anything. These data should be considered experimental and used with extreme caution.

Shipboard Meteorological Data

PI: none

The Knorr thermosalinograph netCDF contains the shipboard meteorological data, winds, air temperature, humidity, etc.

There are separate meteorological data files for the two Endeavor cruises.

We do not have shipboard meteorological data for either of the European cruises.

Knorr Meteorology Mast

PI: Edson (james.edson@uconn.edu)

There was a meteorological mast set up on the Knorr cruise measuring pressure, temperature, humidity, IR and visible radiation, rain, SST, winds and direct covariance fluxes. We have not been provided with a copy of these data.