

ITP 1 Overview

Deployment Location: 8/15/2005, 18:50 UTC at 78° 51.1'N, 150° 15.4'W

Recovery Location: 8/8/2007, 19:00 UTC at 74° 40.3' N, 151° 21.2' W

Duration: 723 days

Distance Travelled: 4940 km

Number of profiles: 2043 in 511 days

Other instruments: IMB 2005C

The second ITP that was fielded was ITP1, which was deployed in the Beaufort Sea as part of the Beaufort Gyre Observing System (BGOS) during the JWACS 2005 cruise on the CCGS Louis S. St. Laurent. ITP 1 and a US Army Cold Regions Research and Engineering Laboratory (CRREL) Ice Mass Balance Buoy were deployed on a 4.6 m thick multiyear ice floe in a location designed to drift through the BGOS array over the following year. The profiler unit operated until it exhausted its memory on 8 January 2007, but the surface unit continued to provide status enabling the system to be recovered the following summer during the JOIS 2007 cruise.

Deployment Operations

ITP 1 was deployed as part of an Ice-Based Observatory cluster with IMB 07949 in 2005. To find a suitable floe for deploying the cluster, a helicopter reconnaissance was undertaken in the afternoon of August 14. One old floe was landed on and drilled with a 2" hand auger; however, the thickness was greater than 5 m, so was too thick. The second floe that was surveyed was relatively small (only about 100 m in length), ridged all around, and had sufficient level area between several large melt ponds. When drilled, it measured 4.6 m in thickness with 55 cm of freeboard so was suitable. The GPS position was obtained, and the site was marked with several trash bags filled with snow so that it could be relocated.

By the next morning, the ship was positioned in the lead next to the selected ice floe, where a lone seal was spotted swimming. Between 10:00 and 11:30 MDT (16:00-17:30 UTC), all of the personnel and gear are conveyed to the ice floe in 3 flights and 4 sling loads. While drilling the 10" diameter hole for the ITP we are pleased to find that the ice is much harder than the rotten ice ITP 2 was deployed on last year. The deployment proceeds smoothly and the ITP is completely deployed only 1.5 hours after everything arrived on the ice.

Meanwhile, the helicopter required repairs, so after the IMB installation was finished, all of the deployment gear had to be hauled to an adjacent ice floe and loaded onto the small boat for transportation back to the ship. All operations were complete, and everyone was back onboard by 22:30 UTC. More information and photos on the deployment operation are also available on the WHOI ITP website.

Recovery Operations

After the profiler stopped acquiring data, preparations were made to recover ITP 1 if the opportunity presented itself during the summer 2007 Joint Ocean Ice Study (JOIS) on the CCGS Louis S. St. Laurent. Based on the failed recovery attempt of ITP 3 in 2006, a hydraulic hydro block apparatus was assembled to be utilized for recovering ITPs from uneven ice surfaces (where the deployment winch could not be used). The power-block apparatus would be used in the field for the first time on ITP1, if it could be located. Fortunately, status locations transmitted daily from the system surface package put ITP 1 near the cruise track on August 5, 2007.

Immediately after receiving the latest ITP 1 status file (with most recent position several hours old) via phone call from WHOI just after midnight UTC (18:17 local time), a helicopter reconnaissance flight was taken to the location, and the package spotted on a small, pond studded ice floe after within 30 minutes. It was too late in the day and the ship was still too far away for recovery operations to begin this evening, so photos and measurements were taken of the site, supplemental flotation was attached to the buoy, and the site was marked with a red flag and a boat radar reflector to assist in finding the site again the next day.

The next morning, after recovering a bottom-tethered mooring, reconnaissance by helicopter to relocate the site began. Visibility was limited by fog however, and the system could not be relocated, although later it was determined that the ship had passed within 2.5 miles during the search. The next day, ship operations were farther west, so ITP1 was not successfully located again until August 8. Better visibility allowed the system to be seen over 2 miles away from the ship's bridge, who headed to the spot after dead reckoning the previously received buoy locations.

With the ship up against the floe, the recovery operations began with the transfer of personnel and cargo by helicopter from the back deck to the adjacent floe. The floe which contained ITP 1 was still 2.3 m thick, though the ITP surface package itself was located on the edge of a relatively large melt pond about 0.25 m deep. In order to operate all around the buoy, wooden sawhorses and staging were used over the melt pond. First a 30" diameter hot water drill ring was used to cut through the floe, then the ice plug was cleared using a chainsaw (these operations took over 2 hours). The 800 m of wire rope was hauled in using the power-block in a little over an hour, and the ITP profiler removed from the wire. The instrument had light biofouling and a broken spring but was otherwise in good shape.

The whole recovery operation took about 5.5 hours but was well justified by the instrument performance information that was analyzed for engineering improvements. In addition, the same ITP surface package and profiler would later be refurbished, upgraded and reused (in the Antarctic as ITP 31).

Data Processing

The 2043 profiles that were recovered from the ITP were processed according to the procedures described in the ITP Data Processing Procedures. The processing parameters for ITP1 are shown in the figures to the right. The time series is particularly influenced by a deep eddy(s) between profiles 70-79 and 140-176, which also coincide with shifts in the conductivity calibration ratio. Consistent sensor lags are obtained through the thermohaline staircases except in the eddy and after profile 1257 (when the staircases are not as prevalent). After about profile 1534, the profiler had more frequent difficulties completing full profiles vertically. Some of this could be related to increased ice drifts, by icing, or wire/roller wear could also be factors. No CTD information is available for profiles 1755-1802 when the instrument was stuck at the top, and from profile 1544, as apparently an instrument reset occurred in the underwater unit. Bad points due to suspected biofouling or sensor icing are removed. In the final product, 2037 profiles (99.7%) are free of more than one bad temperature measurements, and 1979 (96.9%) are free of more than one bad conductivity spikes.

Data Description

The ITP profiler was configured to operate with an accelerated sampling schedule of 4 one-way profiles between 10 and 750 m depth each day in order to more quickly evaluate endurance and component fatigue and was outfit with an extra battery slice (50% more capacity than standard). In the surface package, the GPS receiver was powered every two hours to obtain locations, and buoy temperature and battery voltage status were recorded. After 511 days of reliable operation and data telemetry, the ITP profiler stopped profiling and acquiring data when the internal flash card memory was filled (the operation software was subsequently rewritten to enable file deletion after successful transferring of data to the surface package to prevent this situation on later profilers). The surface package continued to transmit GPS locations and status for a total of 723 days, when the system was recovered.

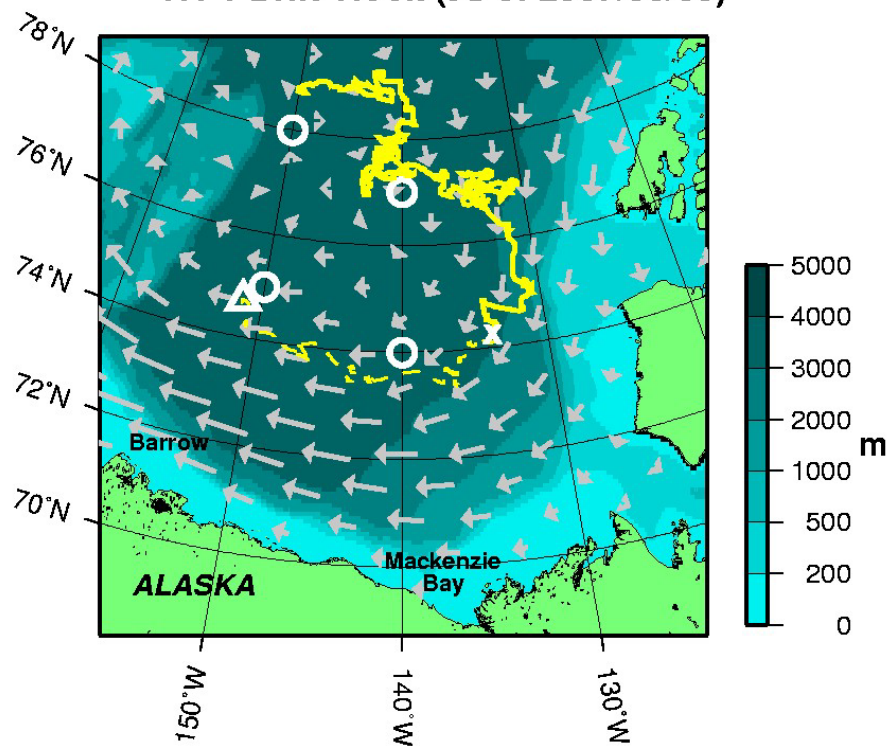
At the time of publication, alternate formats for ITP 1 data may also be found on the WHOI FTP site <ftp://ftp.who.edu/whoinet/itpdata> using the following naming convention:

Level II bi-hourly buoy location data in ASCII format: `itp1rawlocs.dat`

Level III 1-Hz processed profile data in MATLAB format: `itp1cormat.zip`

Level III 1-db bin-averaged processed profile data in MATLAB format: `itp1final.mat`
Level III 1-db bin-averaged processed profile data in ASCII format: `itp1final.zip`

ITP1 Drift Track (as of 2007/08/08)

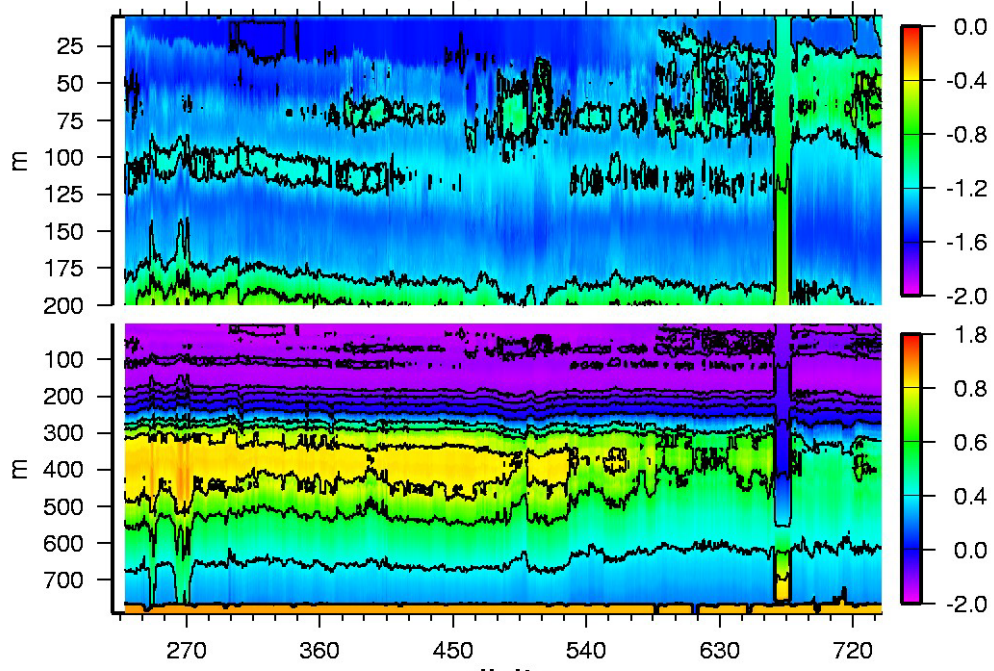


**ITP drift (yellow line), last profile (x), last location (triangle),
BGOS moorings (white circles) and annual ice drift
from IABP (grey vectors) on IBCAO bathymetry (shading).**

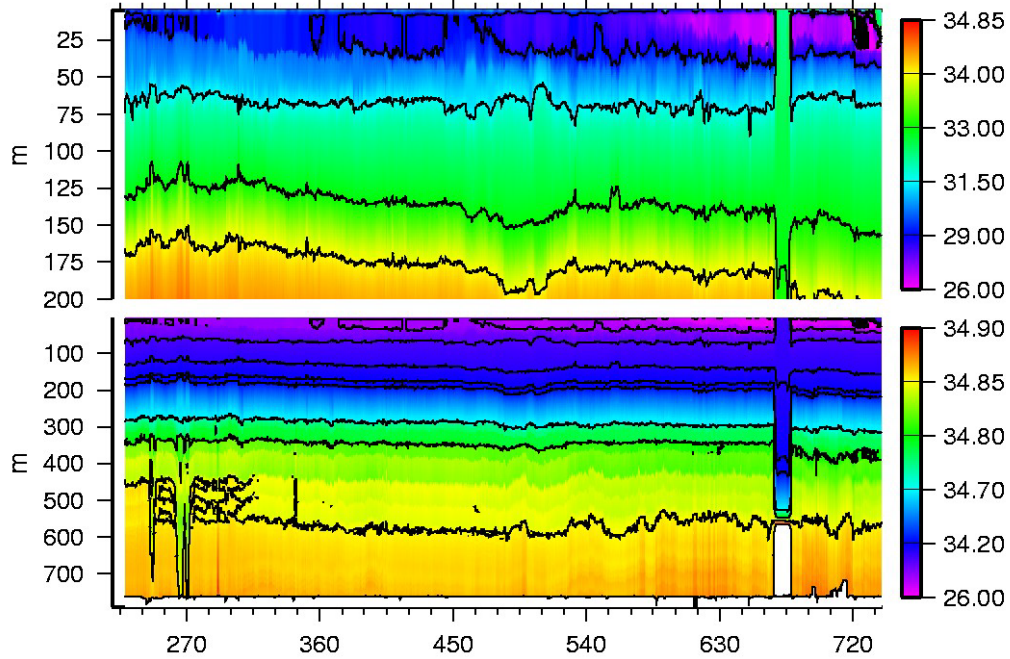
Plot of buoy locations.

ITP1 Up Profile Contours (to profile 2042)

temperature



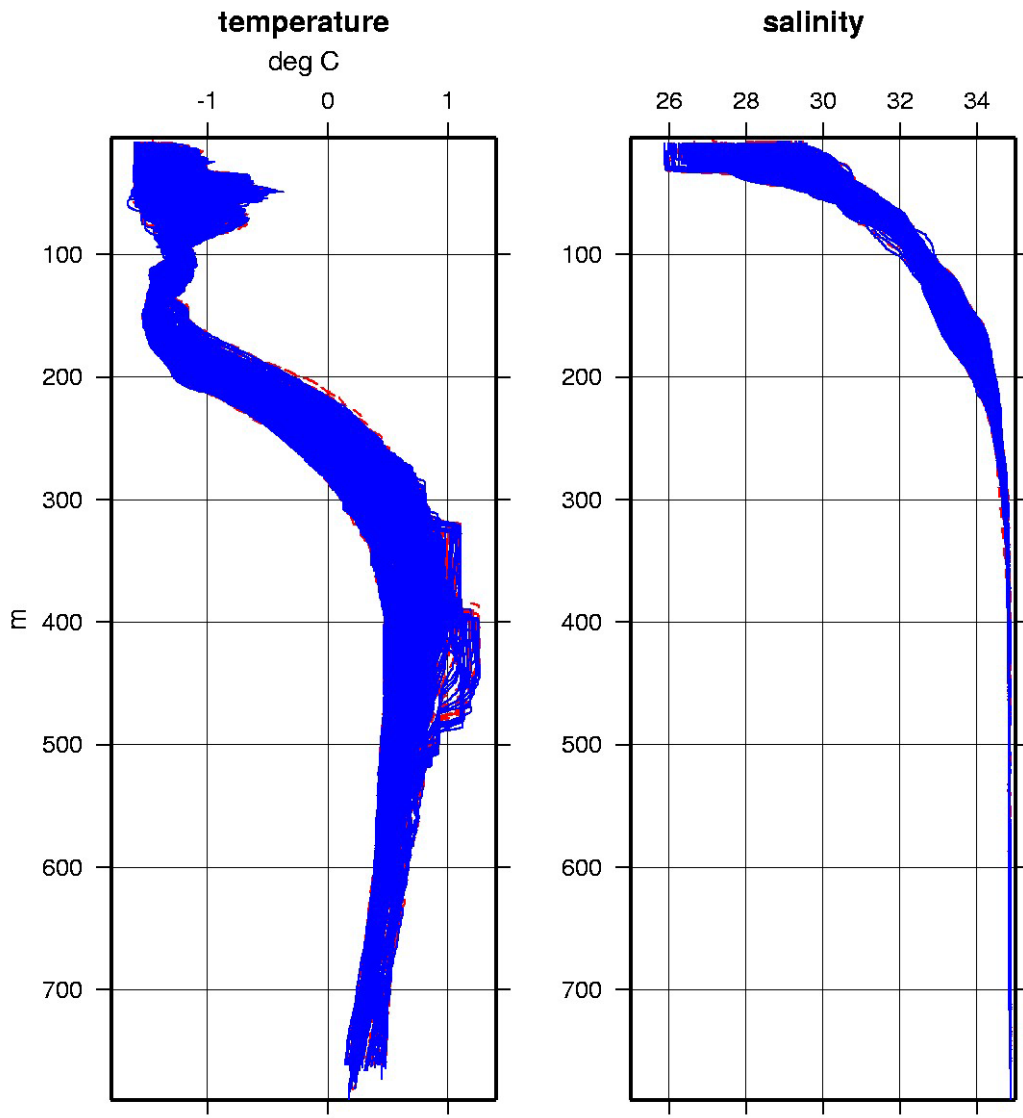
salinity



day 2005

ITP 1 Temperature and Salinity contours.

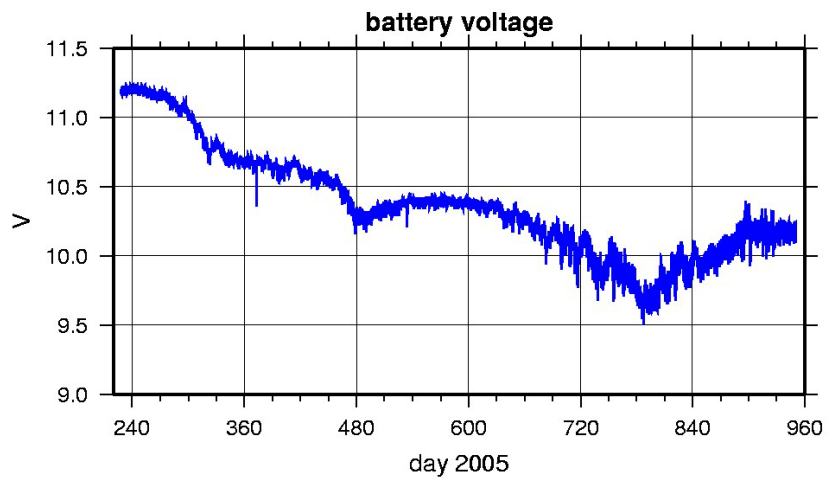
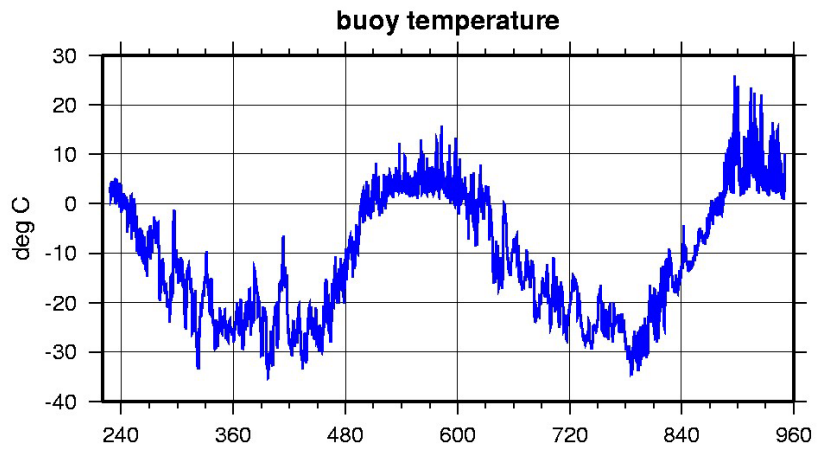
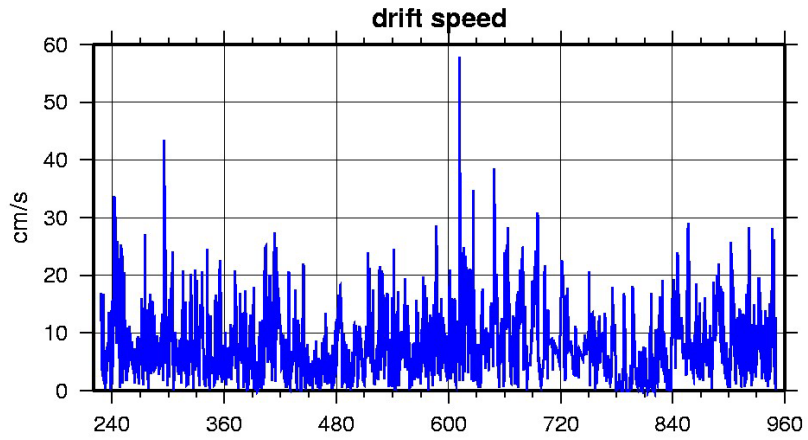
All ITP1 Profiles (up to profile 2042)



up solid, down dashed

Composite plot of ITP temperature and salinity profiles.

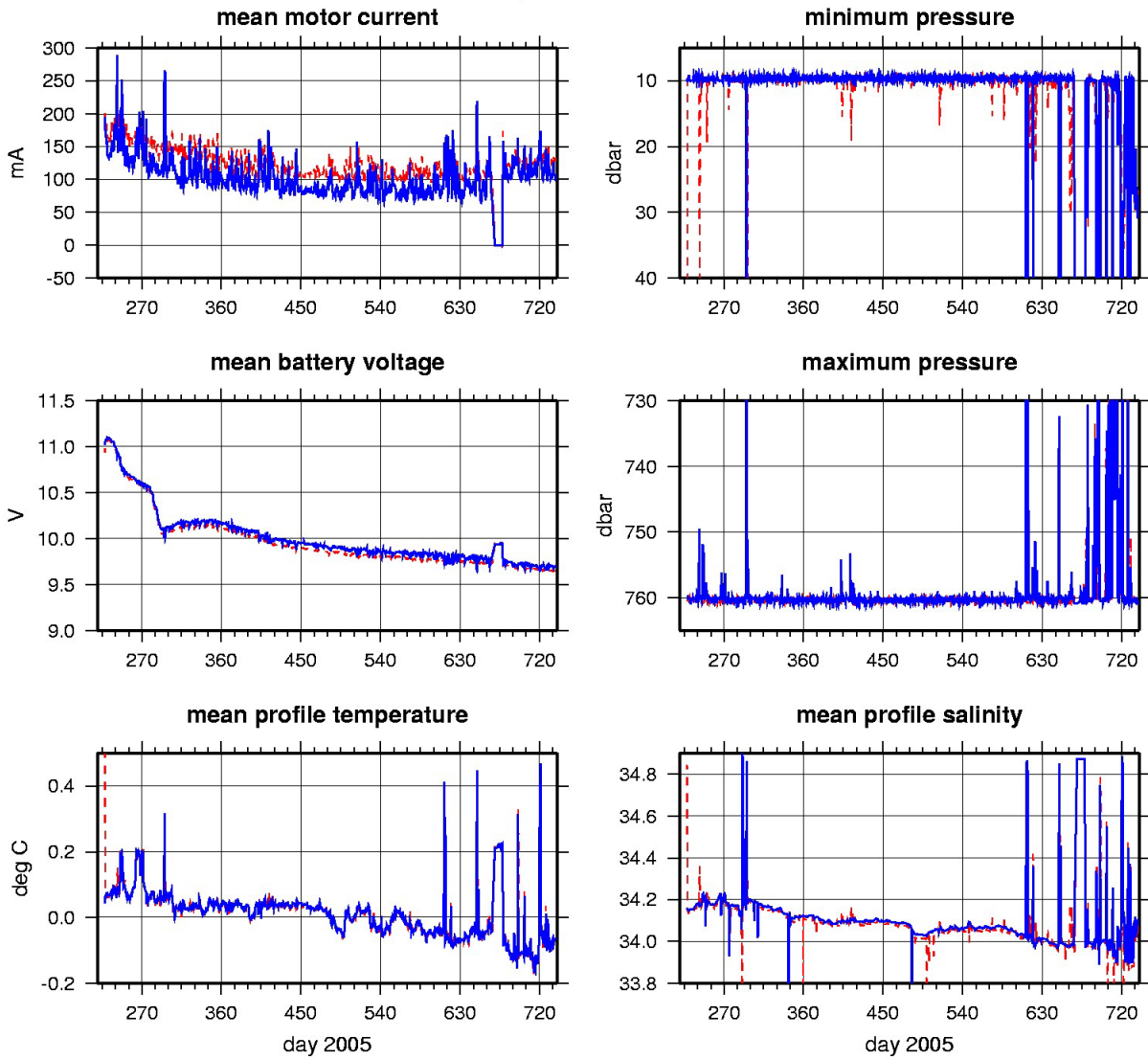
ITP1 Buoy Status (as of 2007/08/08)



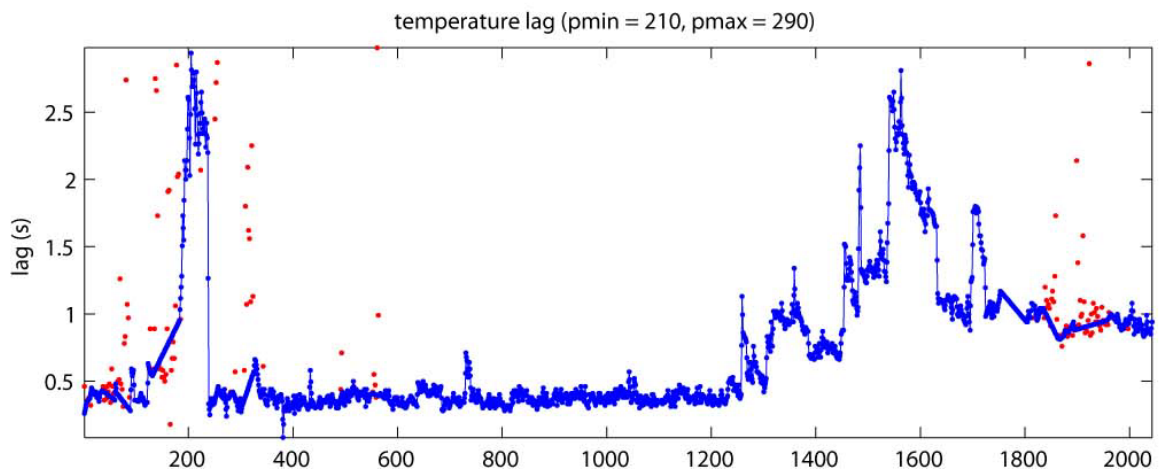
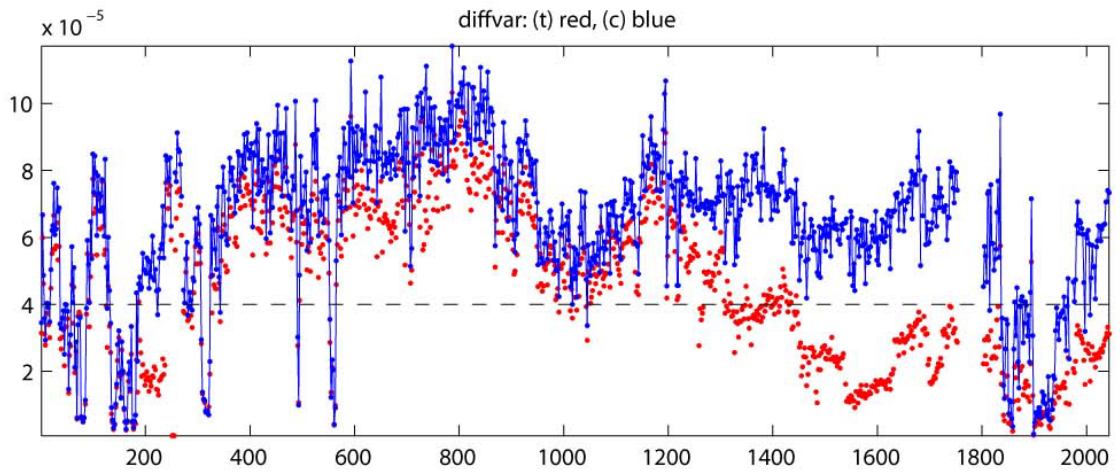
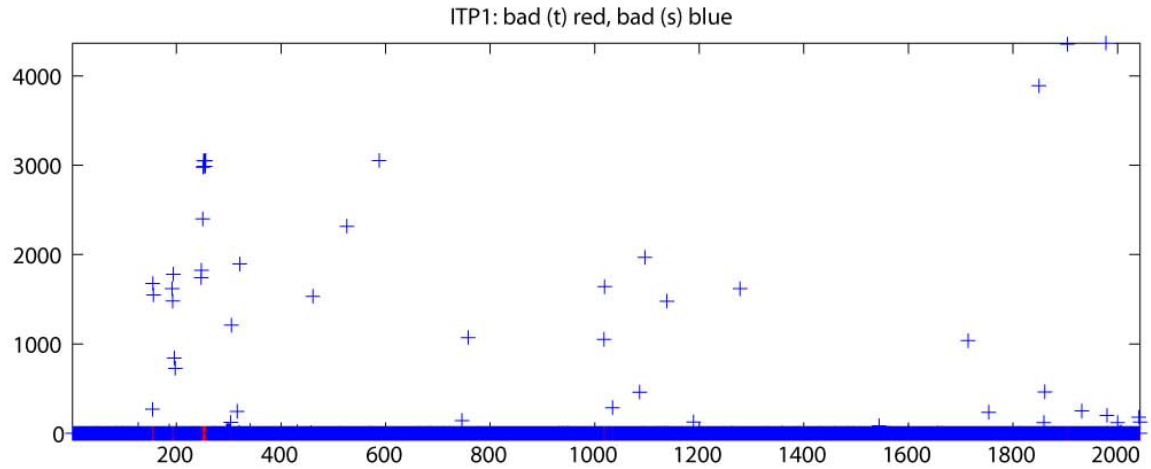
ITP surface buoy status

ITP1 Profiler Status (up to profile 2043)

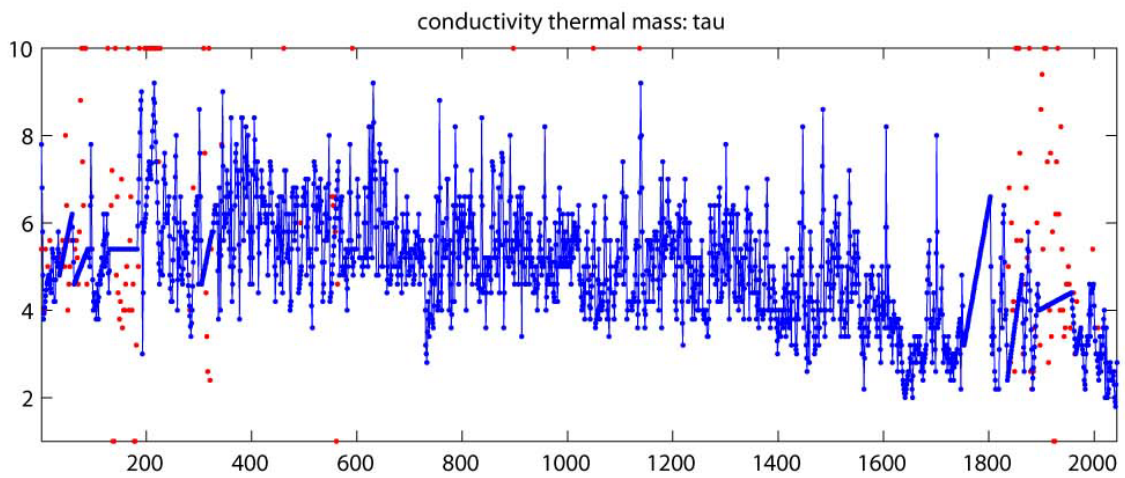
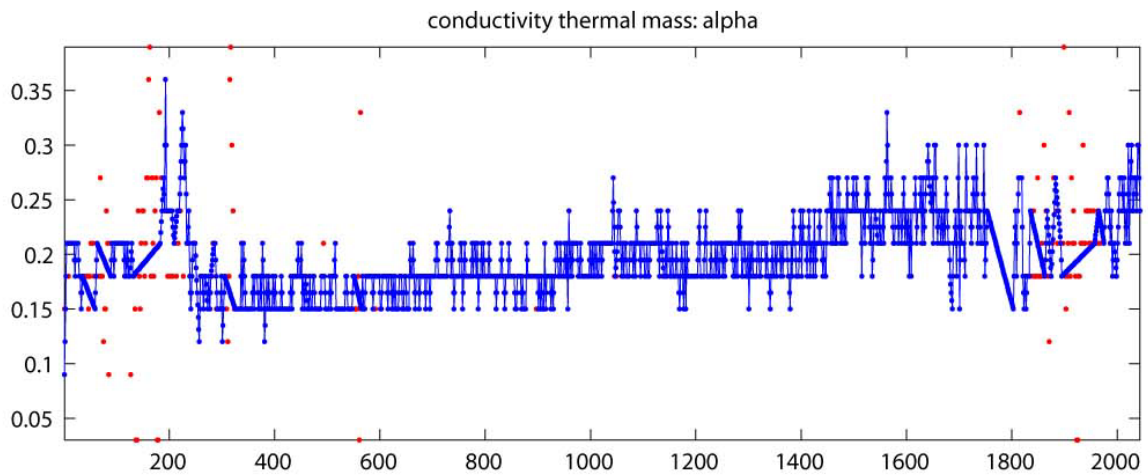
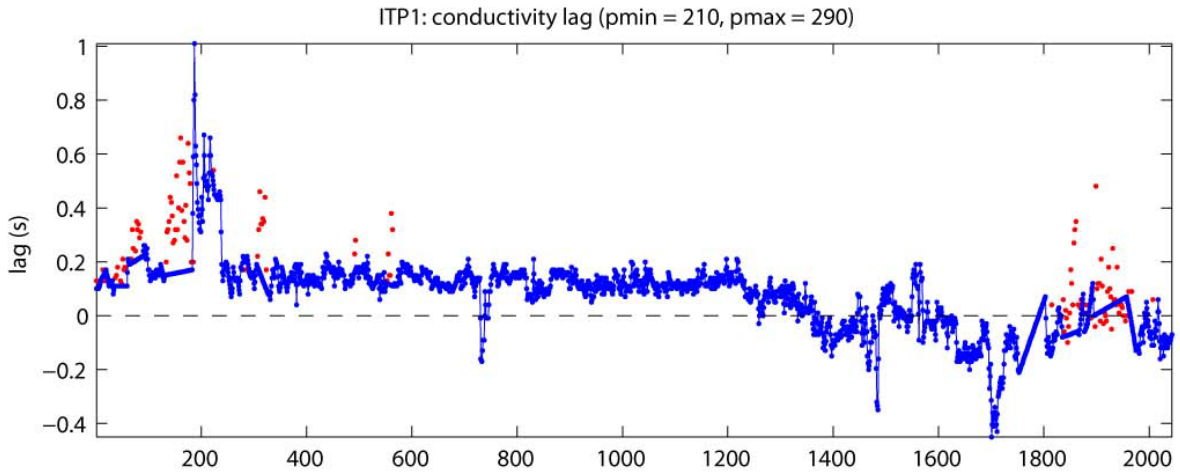
up solid, down dashed



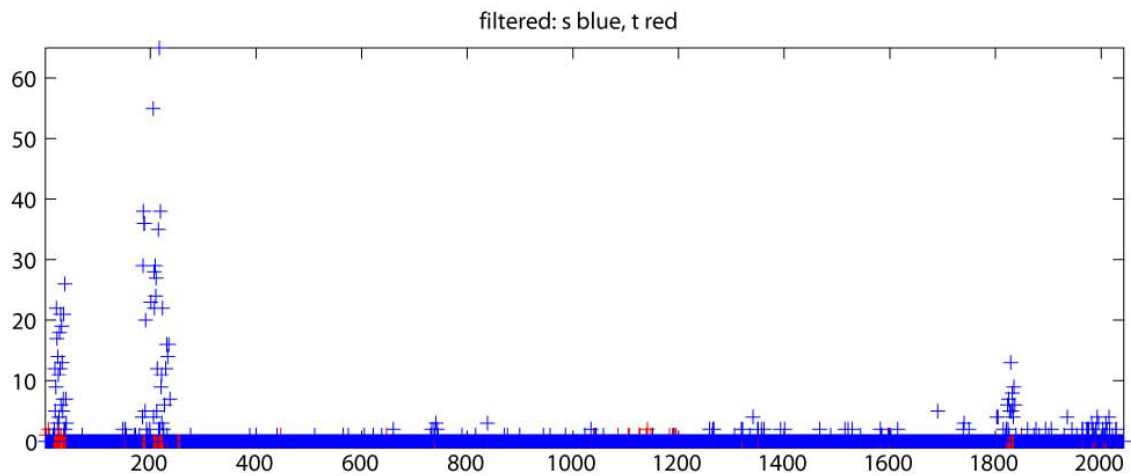
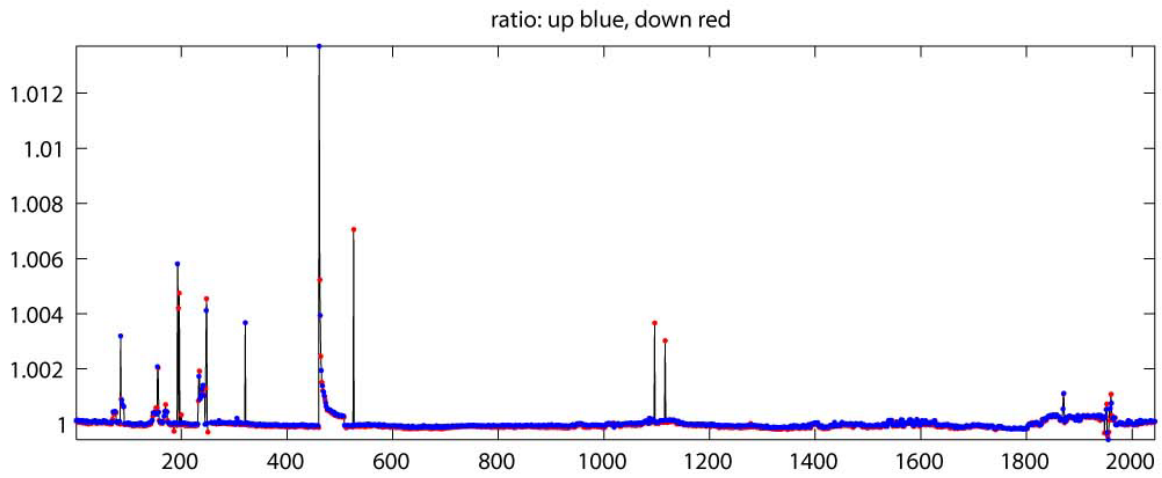
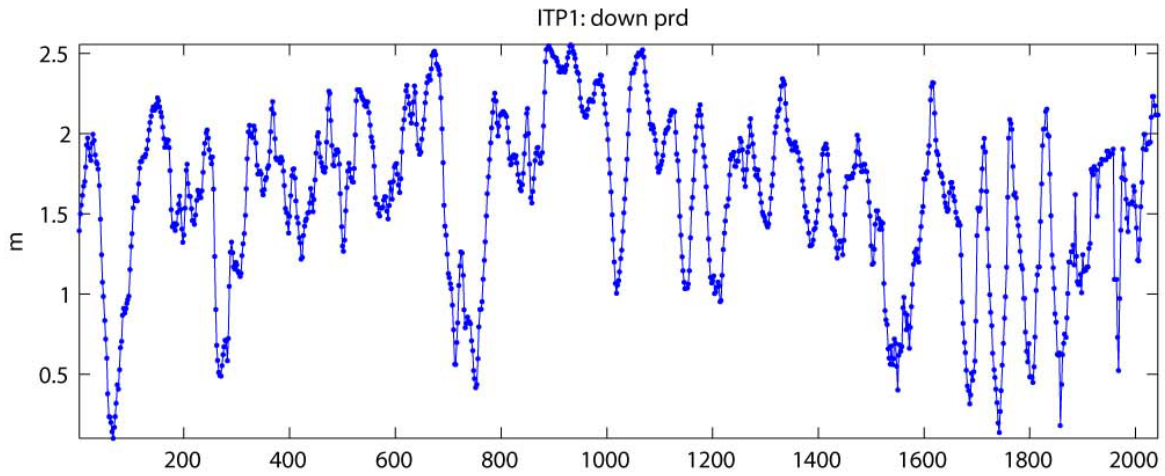
ITP profiler engineering data



Top: number of bad points removed, Middle: variance of vertical difference of temperature and salinity in step region for up-going profiles, Bottom: temperature lag.



Top: conductivity lag, Middle: conductivity thermal mass amplitude correction, Bottom: conductivity thermal mass lag correction.



Top: down pressure deviation correction, Middle: salinity ratio adjustment, Bottom: Number of filtered spikes.



ITP1 and IMB 2005-C as deployed on August 15, 2008, with CCGS Louis St. Laurent in background. Photo by Chris Linder.



ITP1 and IMB 07949 on August 5, 2008, nearly two years after deployment.