

ITP 15 Overview

Deployment Location: 9/11/2007, 00:00 UTC at 86° 39'N, 177° 19'E

Last Location: 8/14/2010, 13:58 UTC at 72° 12.9' N, 72° 33.2' W

Duration: 1068 days

Distance Travelled: 2995 km

Number of profiles: 1305 in 433 days

Other instruments: Ice Beacon (Meteorological)

ITP15 was deployed on a 2.5-3.0 m thick icefloe in the Transpolar Drift from the German icebreaker *Polarstern* as part of the European Union DAMOCLES Program. The ITP operated on a rapid sampling schedule of 3 one-way profiles between 7 and 760 m depth each day, even while the surface buoy was pushed beneath the ice after the first two months of drift. Over 2.5 years later the surface package (with tether but not profiler) resurfaced south of Nares Strait and was retrieved by the *CCGS Des Groseilliers*. Upon surfacing, data from an additional 1140 profile attempts buffered in the surface package were transmitted, including when the profiler fatally dragged over shallow bathymetry north of Nares Strait.

ITP 15 Deployment Operations

The deployment operation for ITP 15 was conducted by German, Japanese, and Russian scientists. This deployment was decided upon at the last minute and was conducted in the early hours of the morning. The deployment site selected was a relatively robust 2.5-3 m thickness, which would be expected to provide a durable platform for the system (yet the surface package would later be pushed below the ice during ridging and not resurface for over 2 years). The deployment operation concluded with the as-deployed inductive modem test from the surface unit to the profiler functioning well upon the second attempt. Only paces away, a MetOcean meteorological ice beacon was deployed which was equipped with air temperature, barometer, GPS receiver and telemetry.

More information on the buoy deployments and expedition is provided in the ARK-XXII/2 cruise report.

ITP 15 Recovery Operations

On November 5, 2007, less than 2 months (and only 165 profiles) after deployment, data stopped being received from ITP 15 surface package. Surprisingly, data transmission resumed on June 17, 2010 -- over 2.5 years later! It took over 3 weeks to transmit the backlog of files stored in its buffer which included profile attempts up to 1305. These data ultimately provided an additional 5 times more valid profiles to those received prior to resurfacing. Unfortunately, the record also

revealed that the mooring tether apparently dragged several times over shallow bathymetry, eventually dragging the profiler completely off on the continental shelf at the mouth of Nares Strait.

Upon the buoy resurfacing, GPS positioning resumed showing that the package was located on the east coast of Ellsmere Island near Griese Fiord. Over the next couple of months, it drifted south and crossed Lancaster Sound nestling with the ice up against northern Baffin Island near Pond Inlet before being recovered by the *CCGS Des Groseilliers* in bergy water on August 14, 2010. Using the latest GPS locations broadcast by the surface package, it took only about 10 minutes of search time to locate it and 2 hours to recover the buoy and nearly 800 meters of wire which was still attached. Our thanks are extended to the Canadian Coast Guard Regional Operations Center as well as the captain, officers, and crew of the *Des Groseilliers* for their recovery support.

ITP 15 Data Processing

The 1305 profiles that were recovered from the ITP were processed according to the procedures described in the ITP Updated Data Processing Procedures. The processing parameters are shown in the figures to the right. However, only 820 profiles traversed vertically more than 700 m, while 424 less than 50 m (including 38 resets due to software error). In particular, large segments of profiles 342 through 471, 860 through 999, and all after 1189 did not traverse vertically, but the instrument was stuck at a single depth or hovered over a narrow depth range while motor currents exceeded typical values. During the first period, the profiler may have become trapped in the ice when the surface package was submerged. For the latter two periods, this behavior could be due to slackening of the mooring tether when the anchor dragged over shallow bathymetry, although the precise position of ITP 15 after November 5 2007 is not exactly known while the surface package GPS antenna was beneath the ice. **Consequently, the locations of all profiles after 165 were reconstructed using Fowler (2003) daily ice motion vectors.** Note that location errors could influence the pressure correction for down profiles which depends on drift speed and the profile-to-profile conductivity adjustment which depends on location.

Profiles 106 and 107 stand out from the rest due to colder and fresher anomalies below the Atlantic Layer. These data appear to be real, as opposed to other profiles which were removed due to suspected sensor fouling or icing (particularly between profiles 687 and 710). Clear thermohaline staircases appear only at the beginning and middle of the time series for the determination of sensor lags which are interpolated or extrapolated for the other profiles. In the final product, only about 60% of the profiles are free of any corrupted temperature and salinity points.

ITP 15 Data Description

In the surface package, the GPS receiver obtained locations, and buoy temperature and battery voltage every hour for 55 days until the surface package was apparently pushed beneath the ice surface. While the Iridium and GPS antennae lost access to the sky and could not communicate or locate, the ITP profiler continued to operate and send data to the surface unit for another 379

days. During this time, the reconstructed drift track indicates that the system crossed from the Makarov Basin over the Lomonosov Ridge and entered the Lincoln Sea. After data collection ceased, the ITP apparently drifted through Nares Strait and resurfaced 995 days in Baffin Bay.

The plots below are of the final, calibrated, edited data (as opposed to the raw data presented on the active instrument pages).

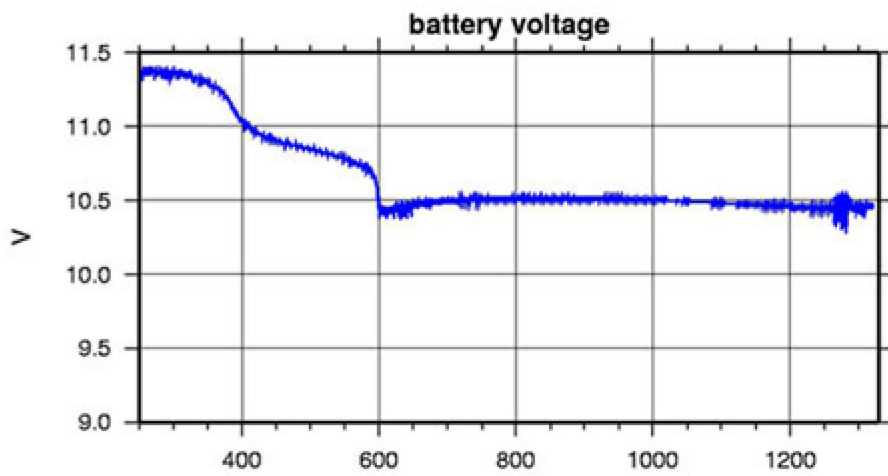
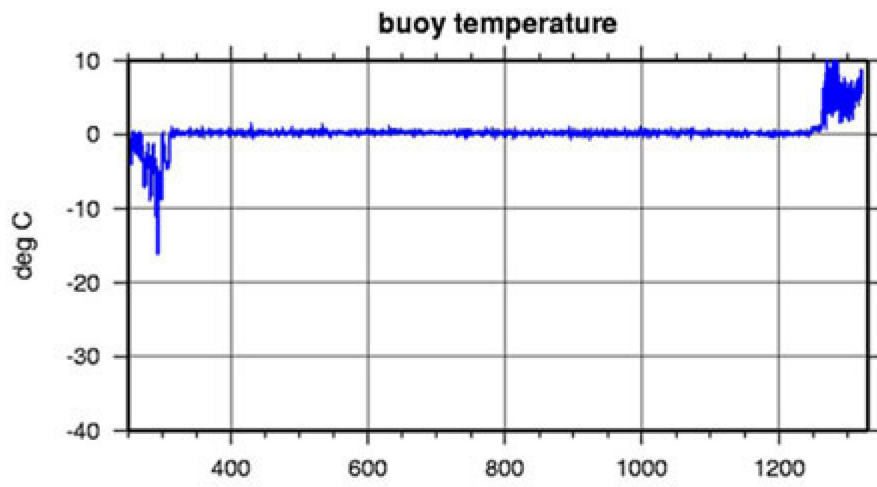
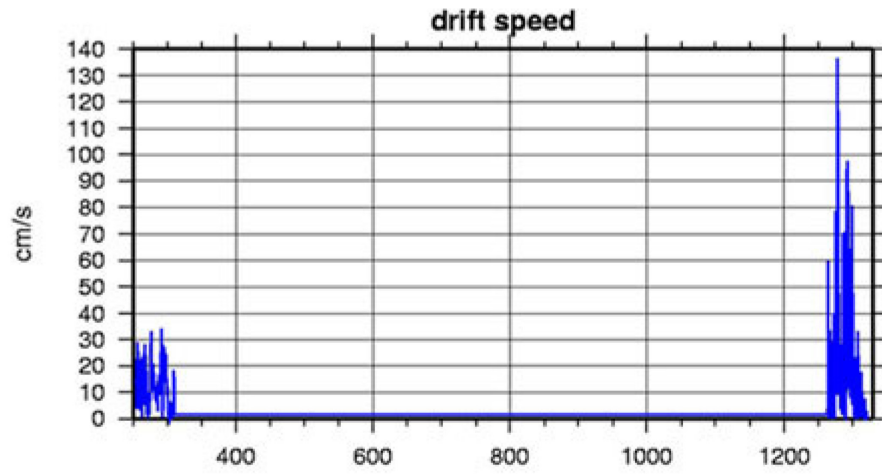
Level II hourly buoy location data in ASCII format: `itp15rawlocs.dat`

Level III 1-Hz processed profile data in MATLAB format: `itp15cormat.tar.Z` or `itp15cormat.zip`

Level III 1-db bin-averaged processed profile data in MATLAB format: `itp15final.mat`

Level III 1-db bin-averaged processed profile data in ASCII format: `itp15final.tar.Z` or `itp15final.zip`

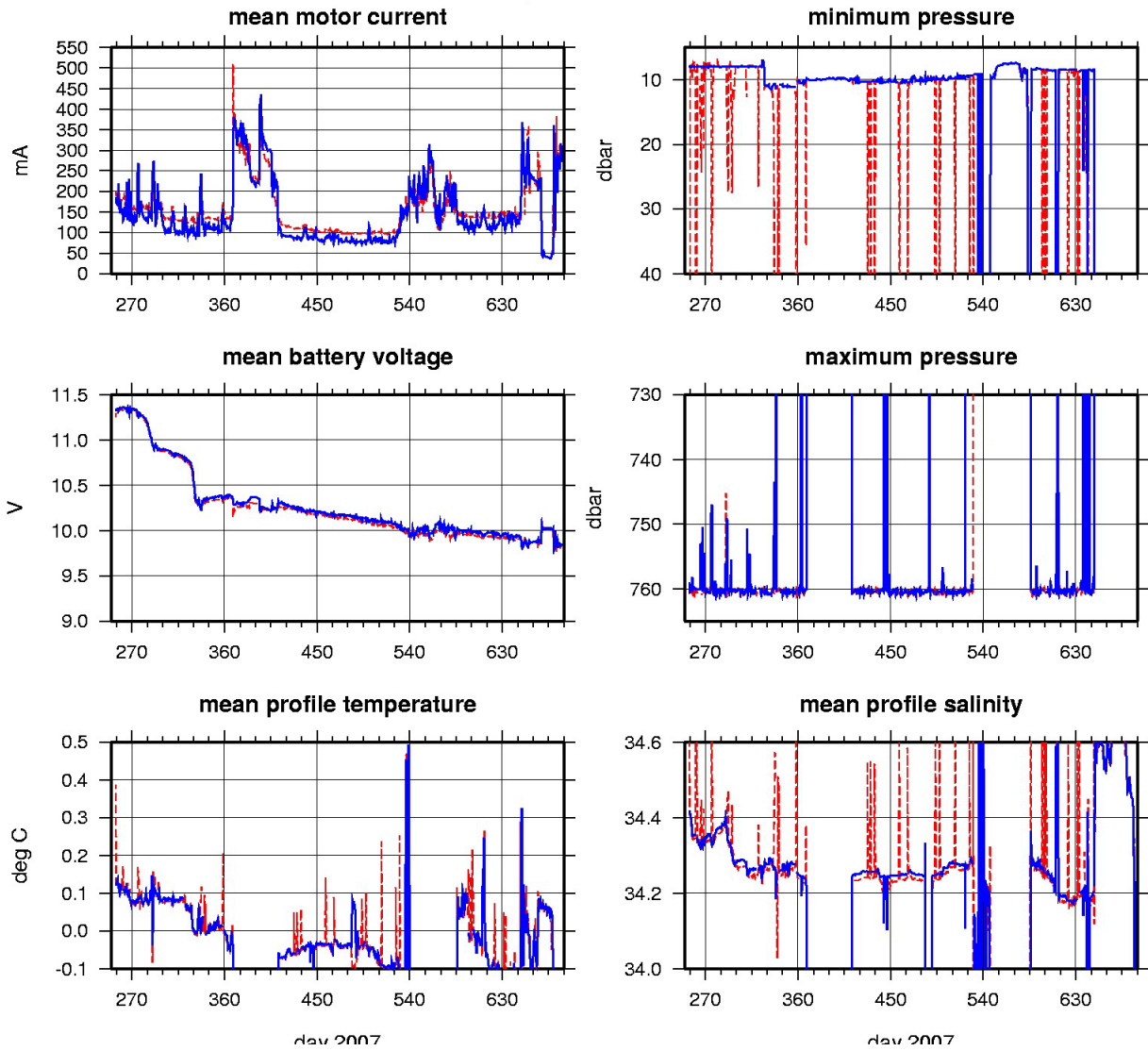
ITP15 Buoy Status (as of 2010/08/13)



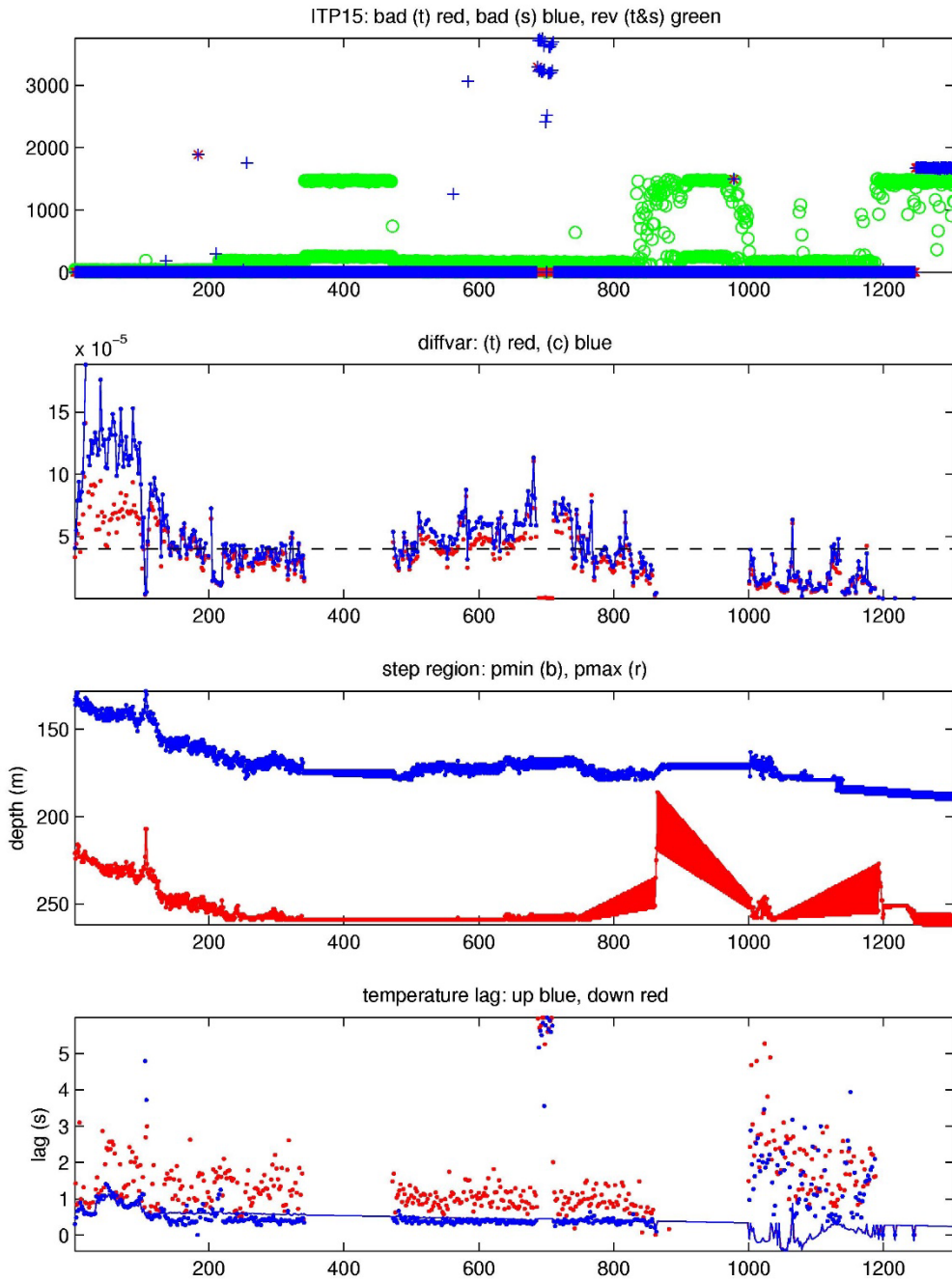
ITP surface buoy status

ITP15 Profiler Status (up to profile 1305)

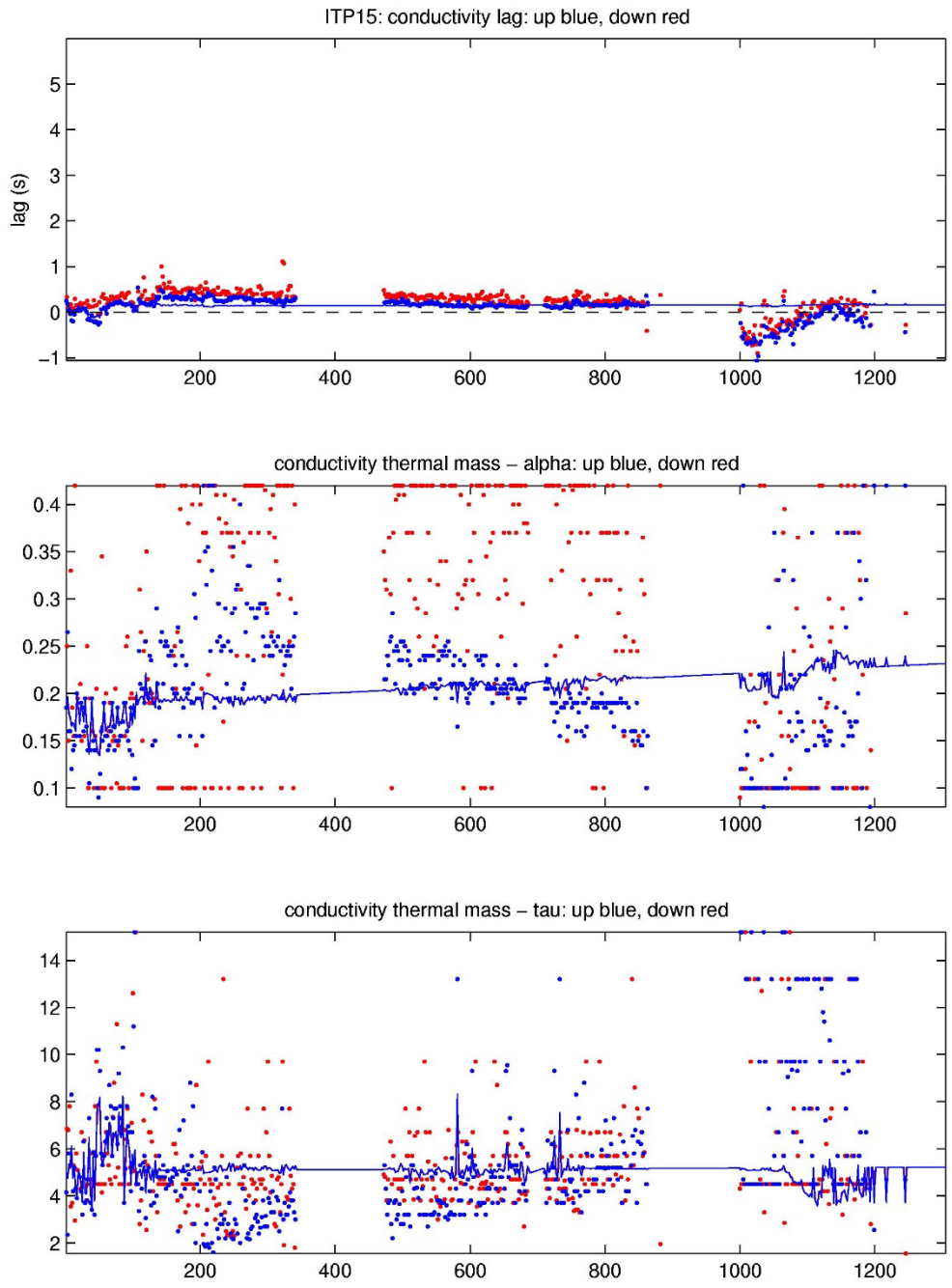
up solid, down dashed



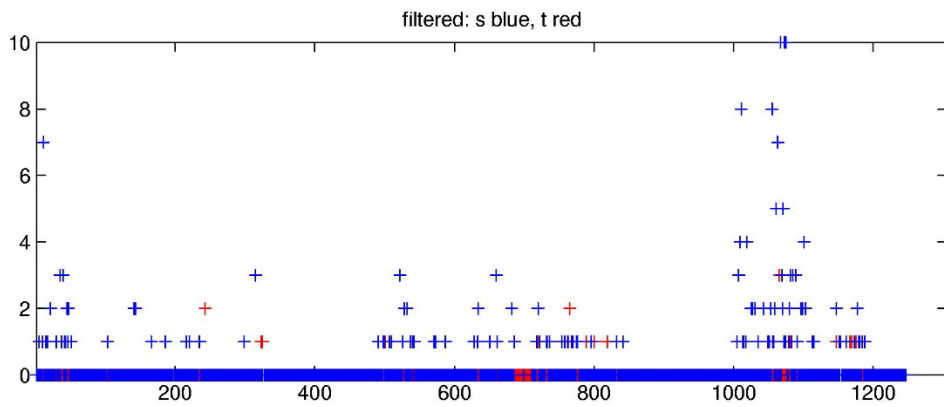
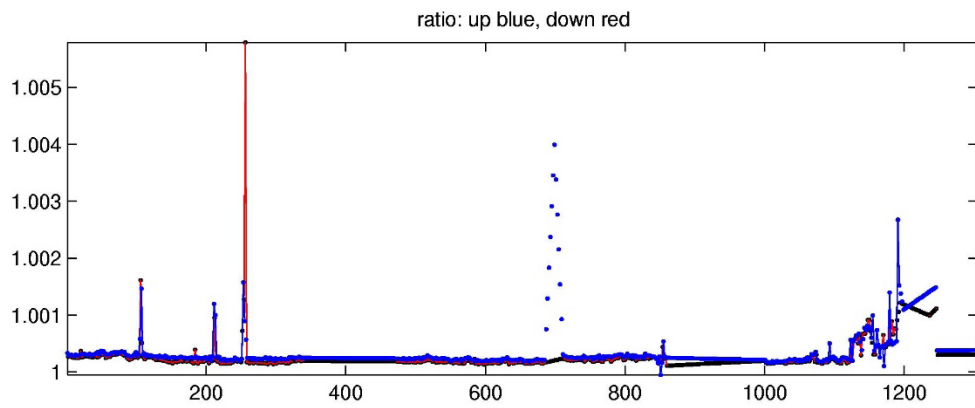
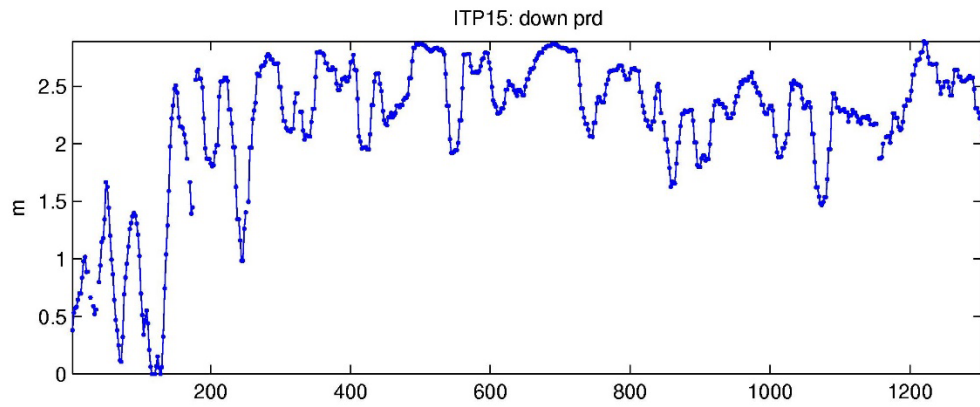
ITP profiler engineering data.



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.

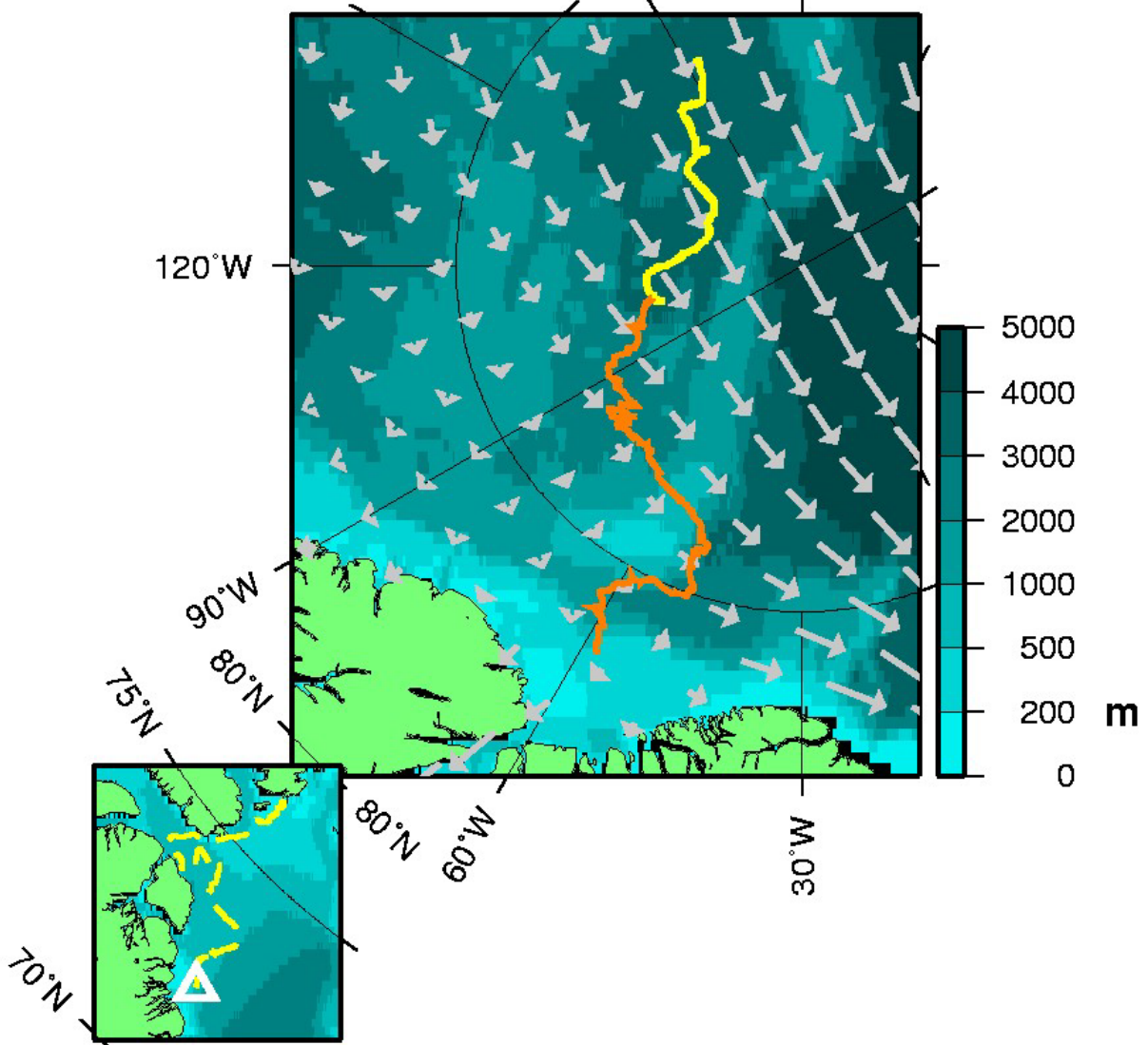


Top: conductivity lag, Middle: conductivity thermal mass amplitude correction, Bottom: conductivity thermal mass lag correction.



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

ITP15 Drift Track (as of 2010/08/13)

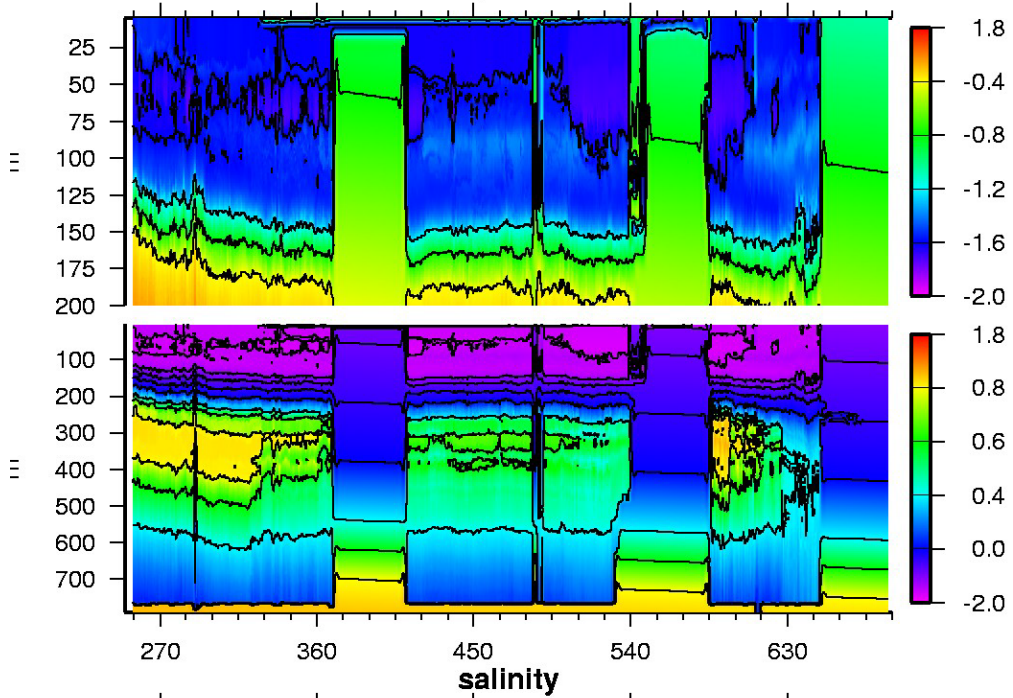


ITP drift (yellow lines), estimated drift (orange), recovered location (triangle), and annual ice drift from IABP (grey vectors) on IBCAO bathymetry (shading).

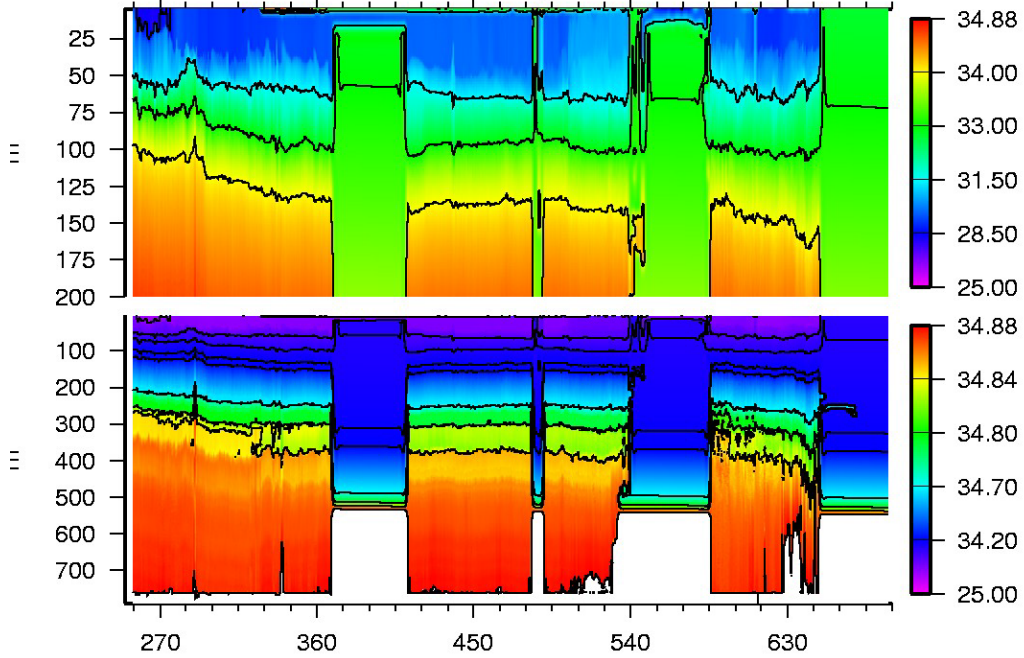
Plot of buoy locations.

ITP15 Up Profile Contours (to profile 1305)

temperature



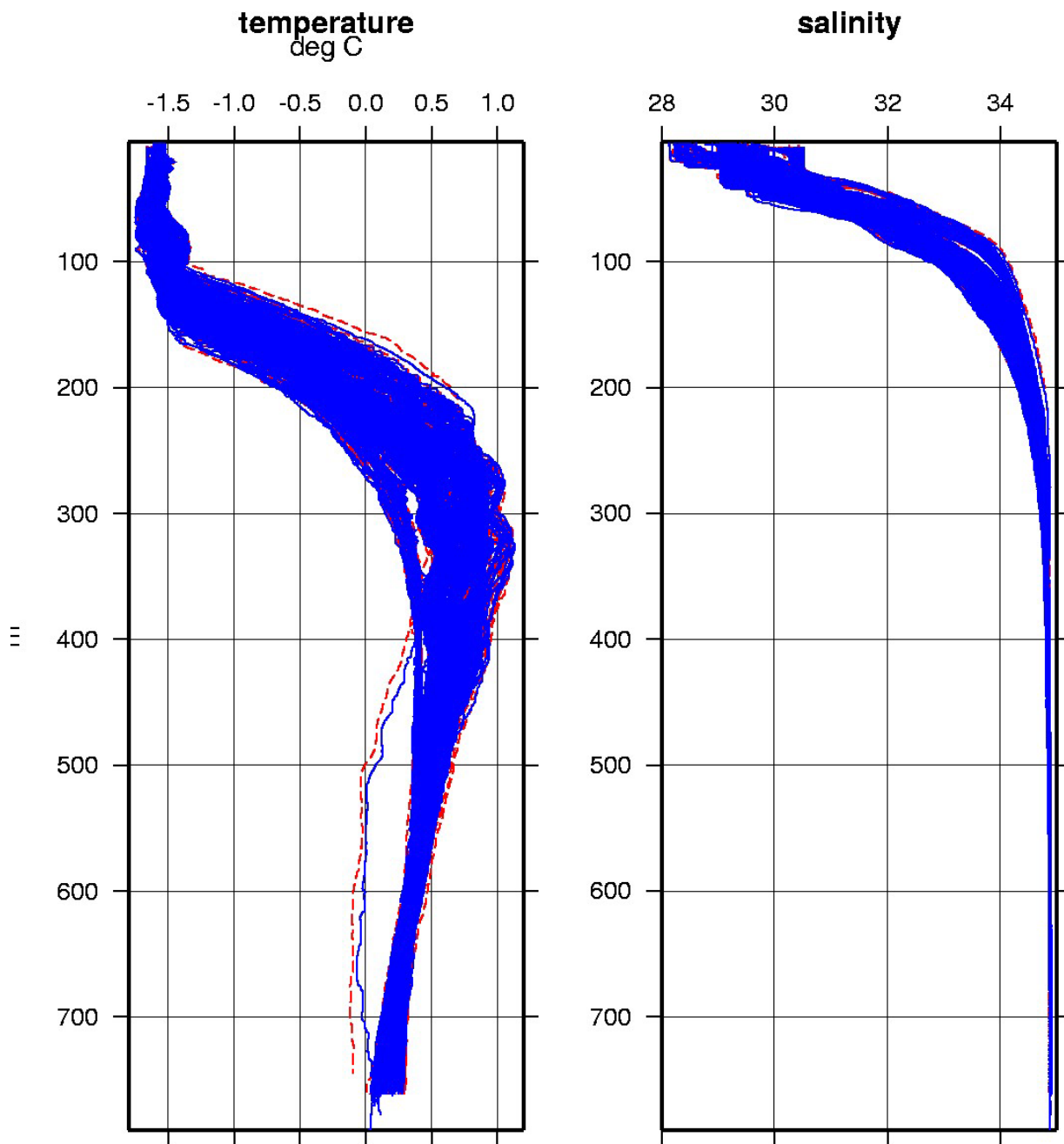
salinity



day 2007

ITP15 temperature and salinity contours

All ITP15 Profiles (up to profile 1305)

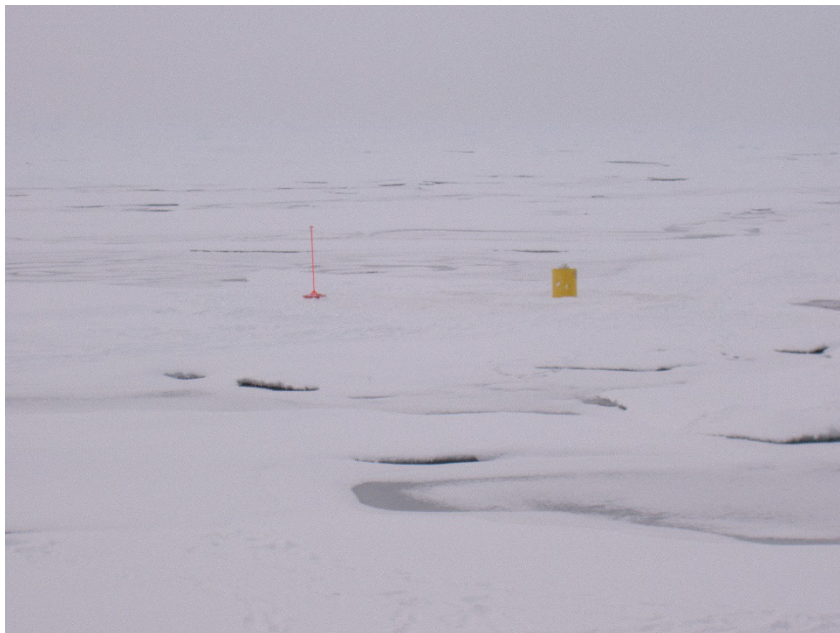


up solid, down dashed

Composite plot of ITP temperature and salinity contours.



ITP 15 surface package after recovery by the CCGS Des Groseilliers in Baffin Bay three years after being deployed in the Arctic Basin. Note the crack that circumscribes the middle of the foam which was likely caused by ice ridging or compression amongst the bergy bits. (Photo courtesy of Brent Cauthier)



A meteorological Ice Beacon and ITP 15 shortly after deployment during the ARKXXII-2 expedition in 2007. (Photo by Ben Rabe)