ITP21 Overview

Deployment Location: 8/3/2008, 21:00 UTC at 80° 0.6'N, 150° 5.3'W

Recovery Location: 9/23/2009, 23:30 UTC at 72° 33.4' N, 140° 49.7' W

Duration: 416 days

Distance Traveled: 3535 km

Number of profiles: 832 in 415 days

Other instruments: none

ITP21 was deployed on a 3.3 m thick ice floe in the Beaufort Sea as part of the Beaufort Gyre Observing System (BGOS) during the JOIS 2008 cruise on the *CCGS Louis S. St. Laurent*. The ITP operated on a standard sampling schedule of 2 one-way profiles between 7 and 760 m depth each day, although hindered after the first month by extremely fouled CTD sensors which cleared 5 months later, and then hampered by problems profiling the full depth range. Fortunately, the JOIS 2009 cruise on the *Louis S. St. Laurent* allowed the opportunity to recover the system 13 months later and 500 miles south. Upon examination a broken tension spring was found on the profiler, explaining the profiling problems.

ITP21 Deployment Operations

Finding no good ice floe on a helicopter reconnaissance flight the previous day, two landings were made this morning on icefloes that were greater than 5 m thick (rafted) before one was found around 3.3 m thick (although rafted on one side) for the first ITP deployment of the summer. An ITP-only deployment, the entire instrument, personnel and deployment apparatus were transported to the ice in 3 passenger loads (with cargo) and 3 sling loads. Supplemental flotation (large cone) was used with the standard buoy to enhance durability of surface package in response to the thinner ice conditions encountered the previous year. The complete deployment including transportation took less than 3 hours.

ITP21 Data Processing

The 831 profiles that were recovered from the ITP were processed according to the procedures described in ITP Updated Data Processing Procedures. The processing parameters for ITP 21 are shown in the figures to the right. **Profiles 65 to 359 had excessive sensor lags (10 to 50 s for conductivity) due to either icing or biofouling and even with correction the salinities still contained great error so were discarded. The temperature sensor was less influenced and its lags were less (~6 s), correctable, and those profiles preserved, but include greater uncertainties than the remainder of the time series.** In general, ice motion was not too great, as to prevent profiling due to drag. However, shortly after the CTD cleared (around profile 400) the profiler spring must have broken, because thereafter the vertical range of the profiles became

gradually less on average, and zeroed around profile 800. During this time, the instrument was effectively slipping on the wire, and consequently the number of points removed where the profiler reversed was large.

The sensors recovered very well after being fouled for 6 months. Except for the fouled period, the lags were typical and stable. In fact, recovery of the instrument allowed post calibrations to be performed on the CTD by the manufacturer. The temperature and conductivity sensors were within 0.001 of the pre-deployment calibrations. Also noteworthy, no profiler data files were missing in the record due to the reset software error which was corrected in the 2008 version of the profiler software.

ITP 21 Recovery Operations

The following year, a few weeks later in the season, ITP 21 was in a convenient location along the cruise track of the JOIS 2009 cruise of the *CCGS Louis S. St. Laurent* so that an attempt could be made to locate and recover the buoy as it was clear that the profiler was no longer climbing the wire. The problem was that the latest location broadcast from the system was at least 15-16 hours old and the system could have drifted 10s of miles in the meantime. In the southern Beaufort Gyre and close to the annual minimum, the sea ice in the area was broken up into smaller sized floes and relatively thin looking. An hour was spent on the first reconnaissance searching in one direction, and then a half an hour into the second flight the package was spotted.

We landed on the floe (which was too small to recover from) and attached a hoisting strap just below the buoy for assisting a shipboard recovery. Back on the ship, the captain steered the vessel into the floe and directly over the buoy. In the wash astern, ITP 21 buoy popped up with a red stripe where the multi-ton icebreaker marked it. Another hour and a half were spent attaching to the sling on the buoy, hauling it and the cable onboard, and retrieving the profiler on the bottom wire bumper. The profiler was in excellent shape, without any significant visible fouling, but one of the two wire-tension springs had parted in the middle.

ITP21 Data Description

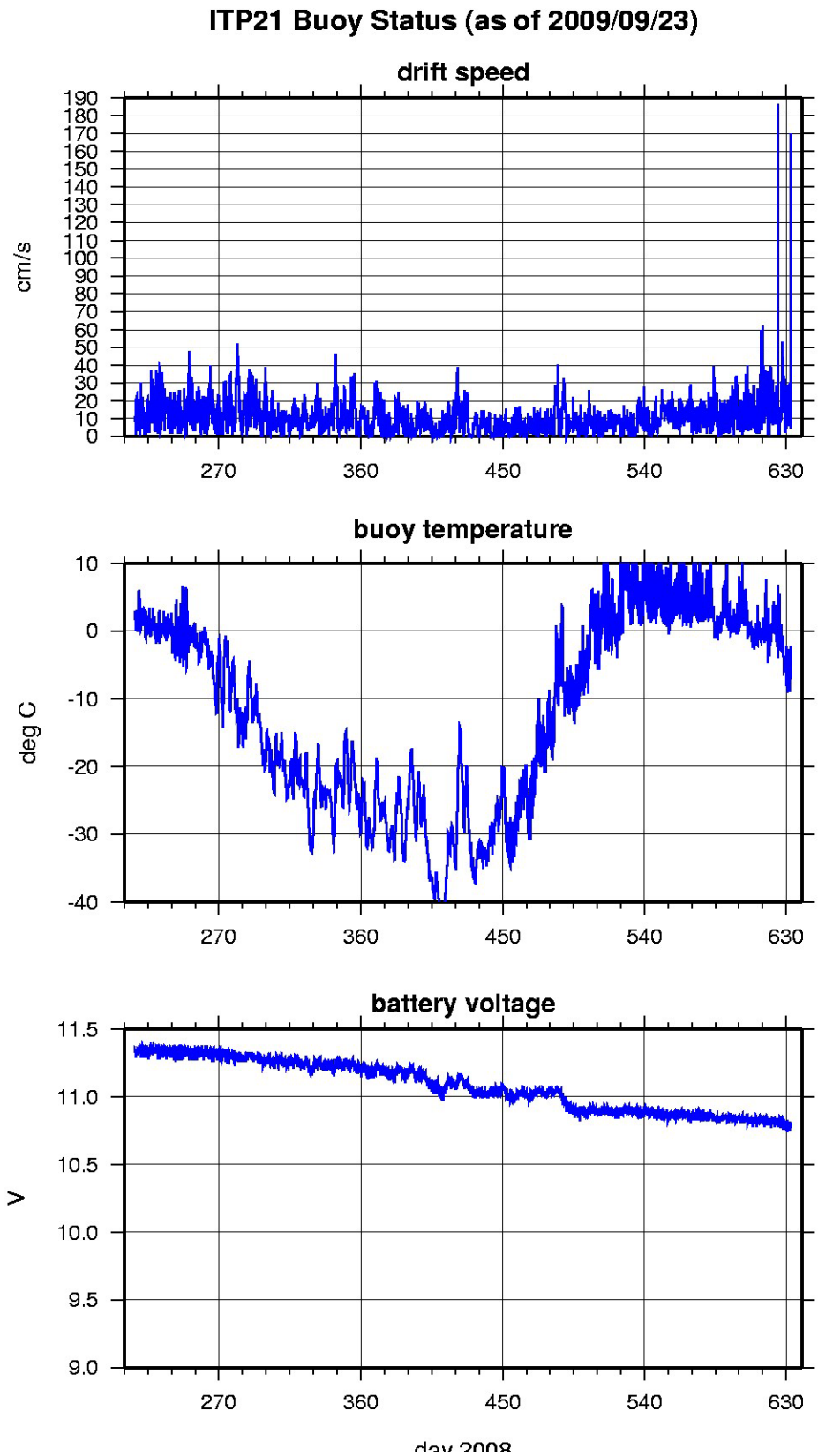
The ITP profiler was configured to operate with a standard sampling schedule of 2 one-way profiles between 7 and 750 m depth each day. In the surface package, the GPS receiver was powered hourly to obtain locations, and buoy temperature and battery voltage status were recorded. After 416 days, the ITP surface package and profiler were recovered after the system had completed a nearly 1000 km meridional section, along a 3900 km staggered path, transecting the Beaufort Gyre. For several profiles while the CTD salinity sensor was fouled beyond use, the temperature sensor likely detected a significant warm core eddy (close to 1° C) centered around 100 m.

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

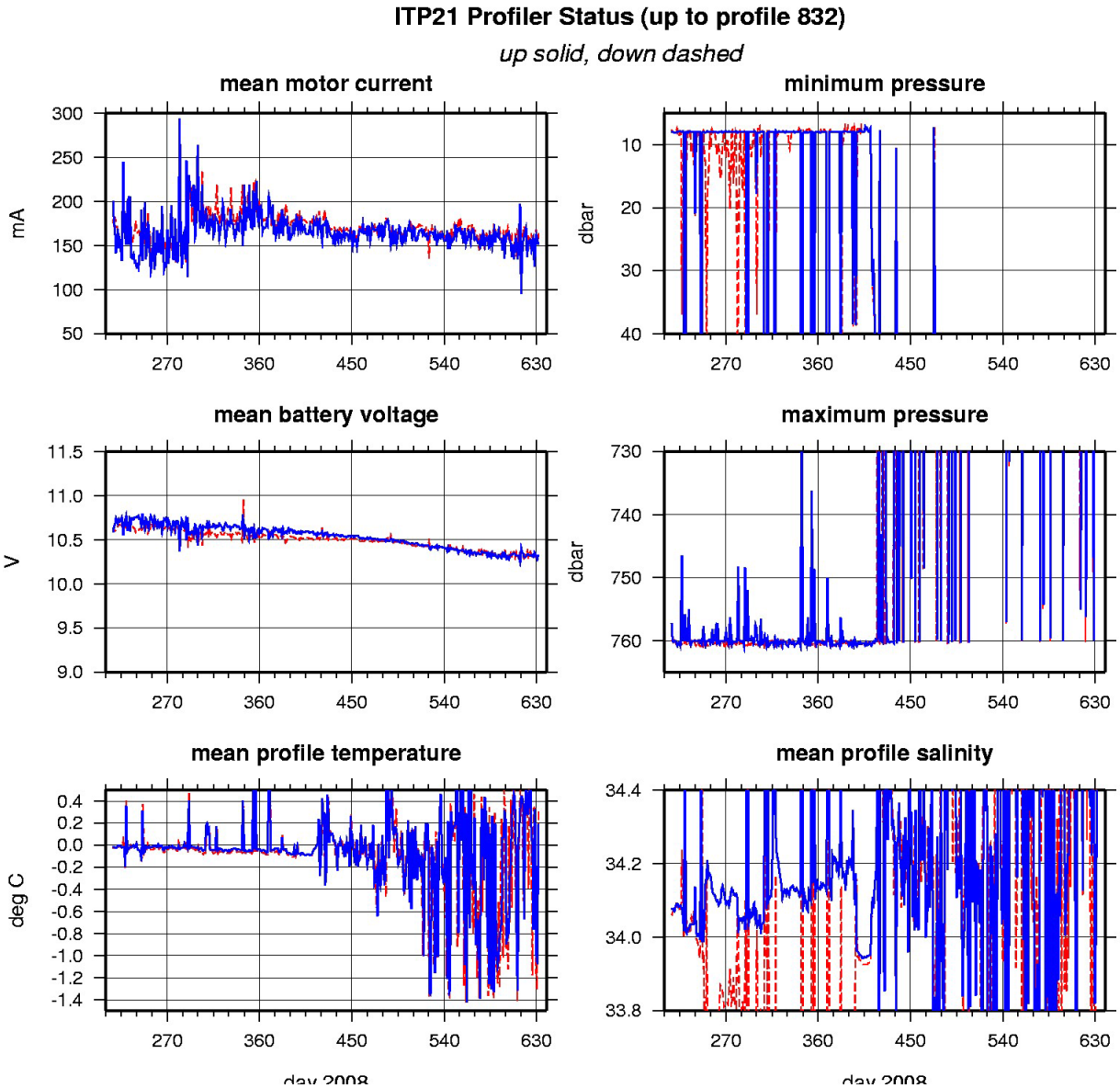
Level II hourly buoy location data in ASCII format: itp21rawlocs.dat

Level III 1-Hz processed profile data in MATLAB format: itp21cormat.tar.Z or itp21cormat.zip

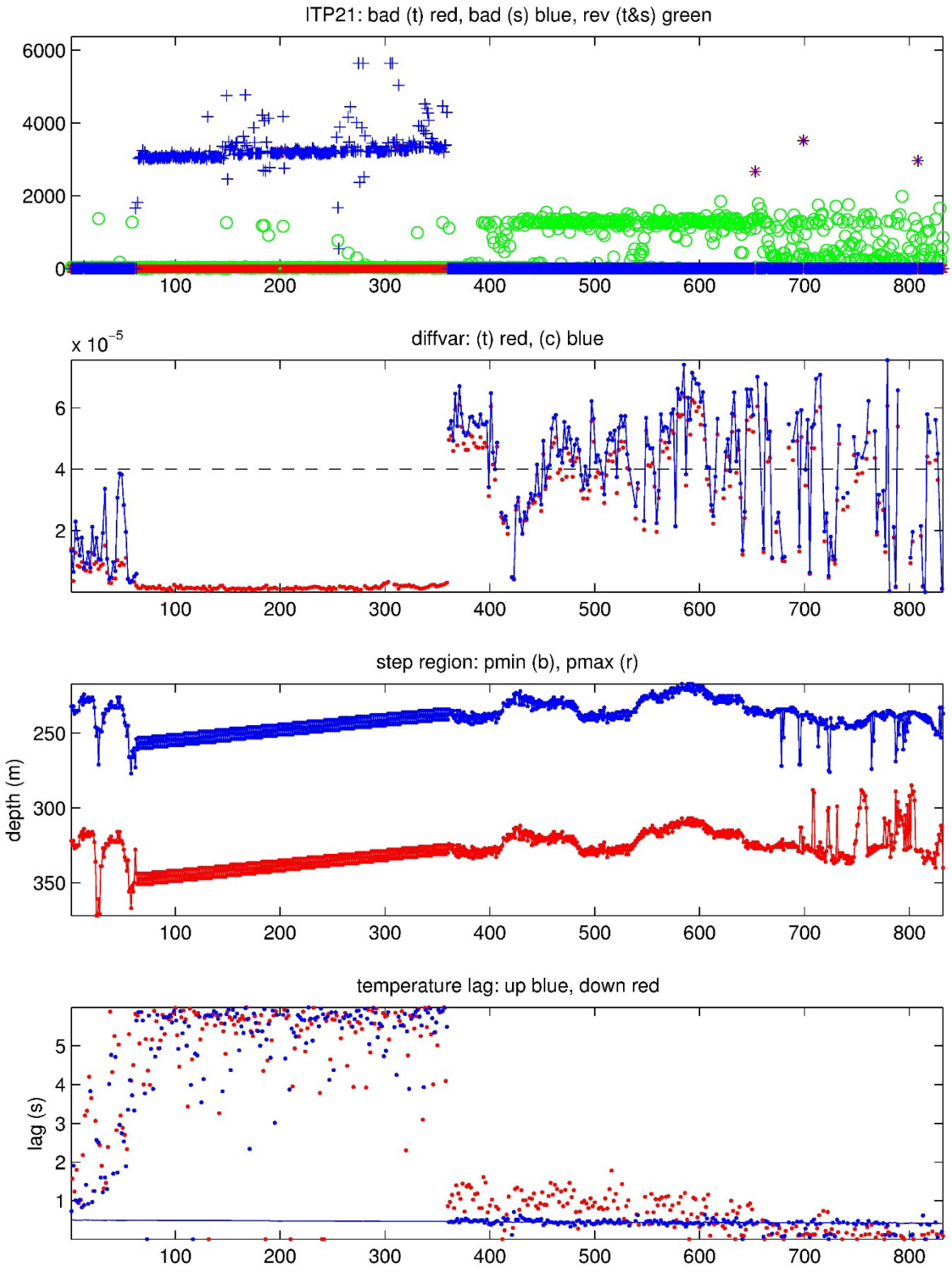
Level III 1-db bin-averaged processed profile data in MATLAB format: itp21final.mat
Level III 1-db bin-averaged processed profile data in ASCII format: itp21final.tar.Z
or itp21final.zip



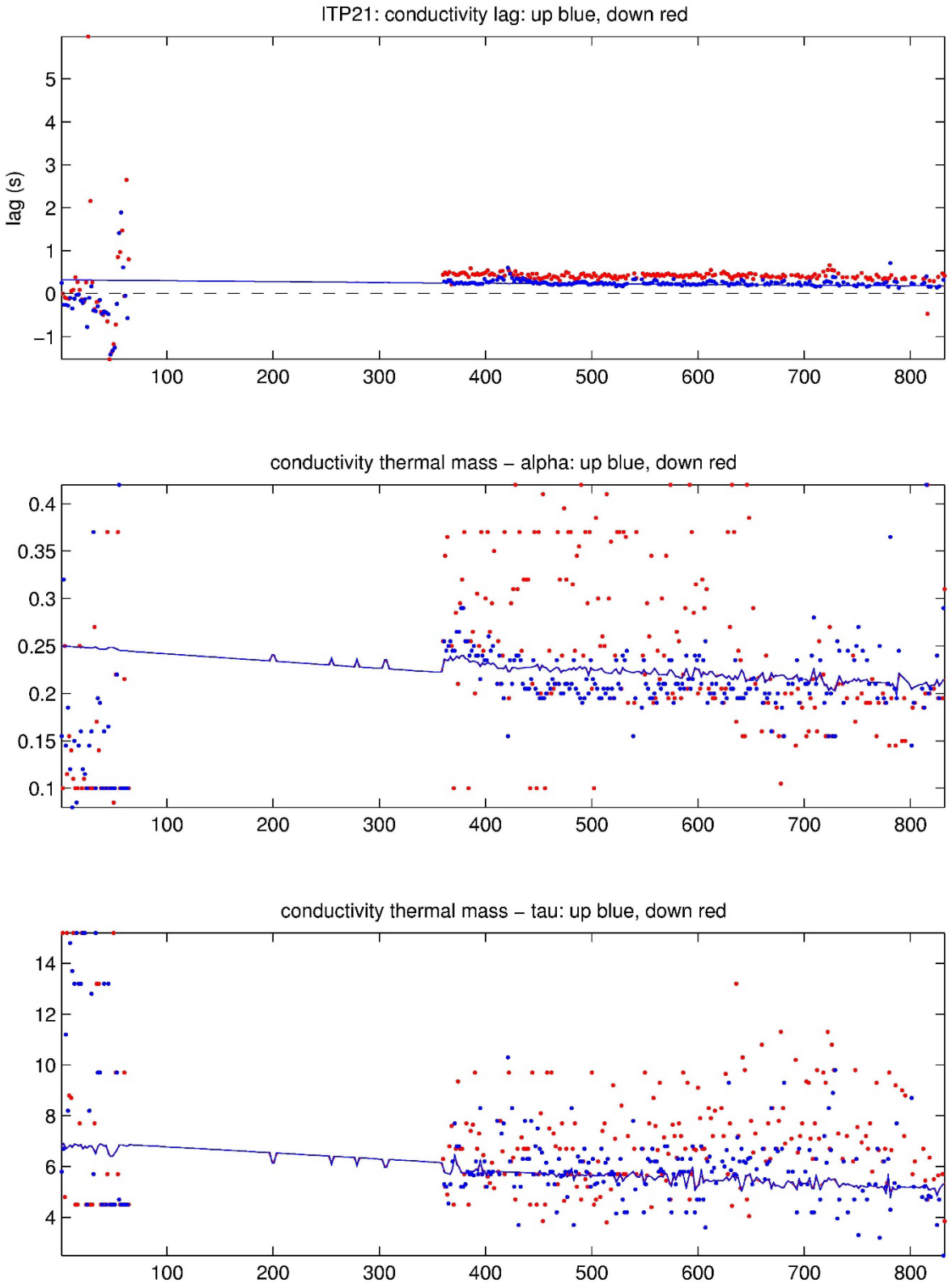
ITP Surface Buoy Status



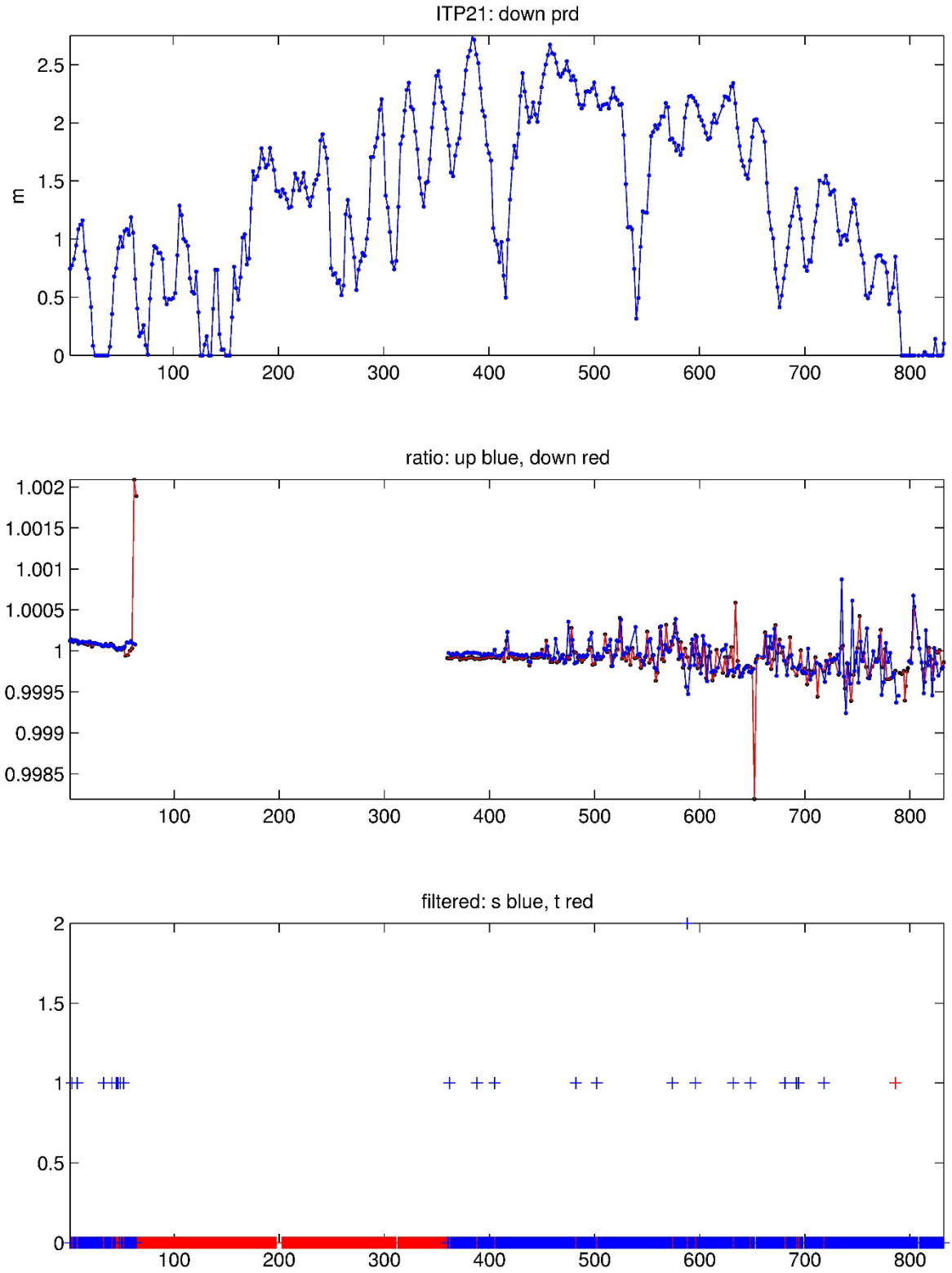
ITP profiler engineering data.



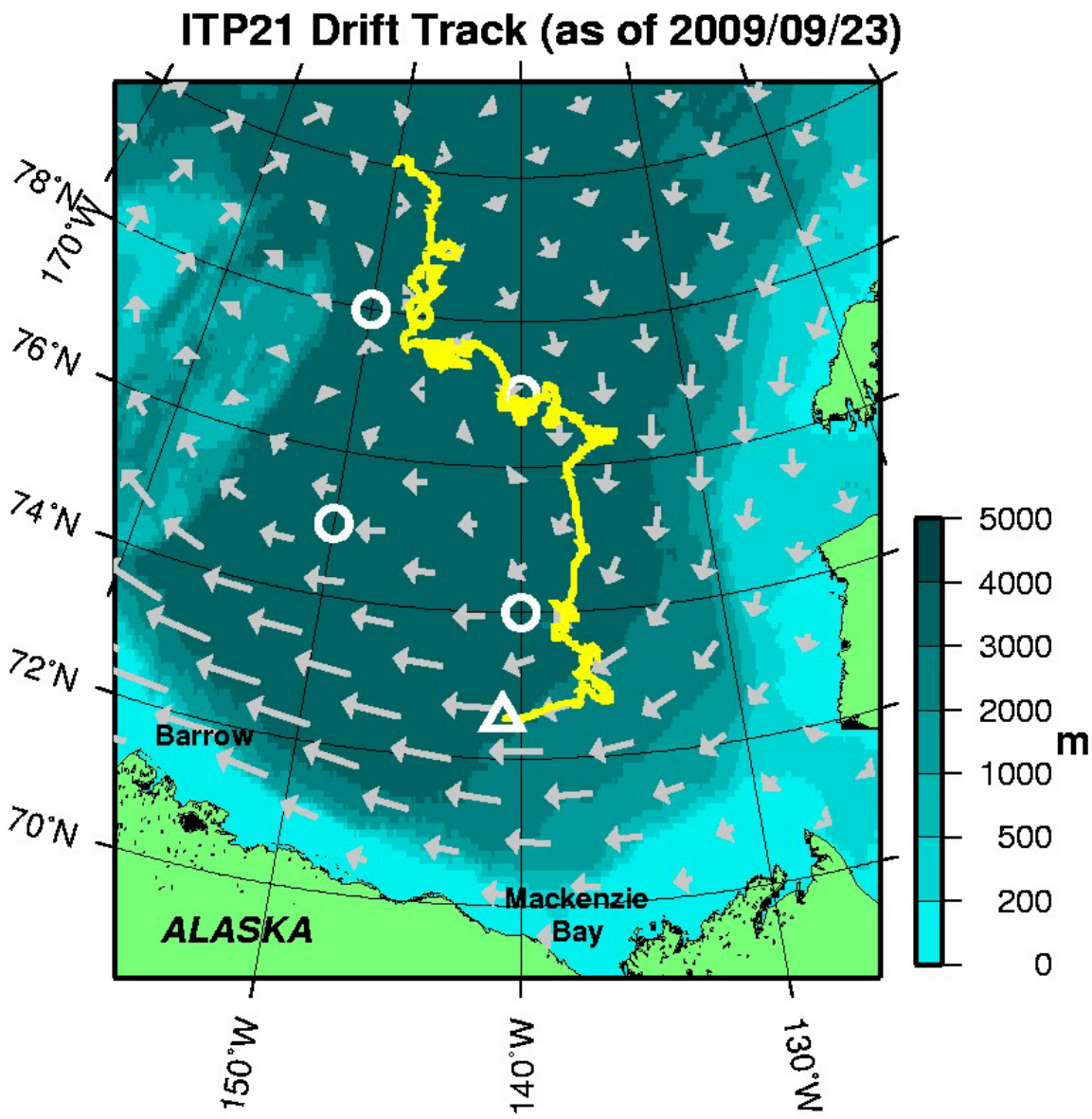
Top: number of bad points removed, Middle: variance of vertical difference of temperature and salinity in step region for up-going profiles, Bottom: temperature lag.



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

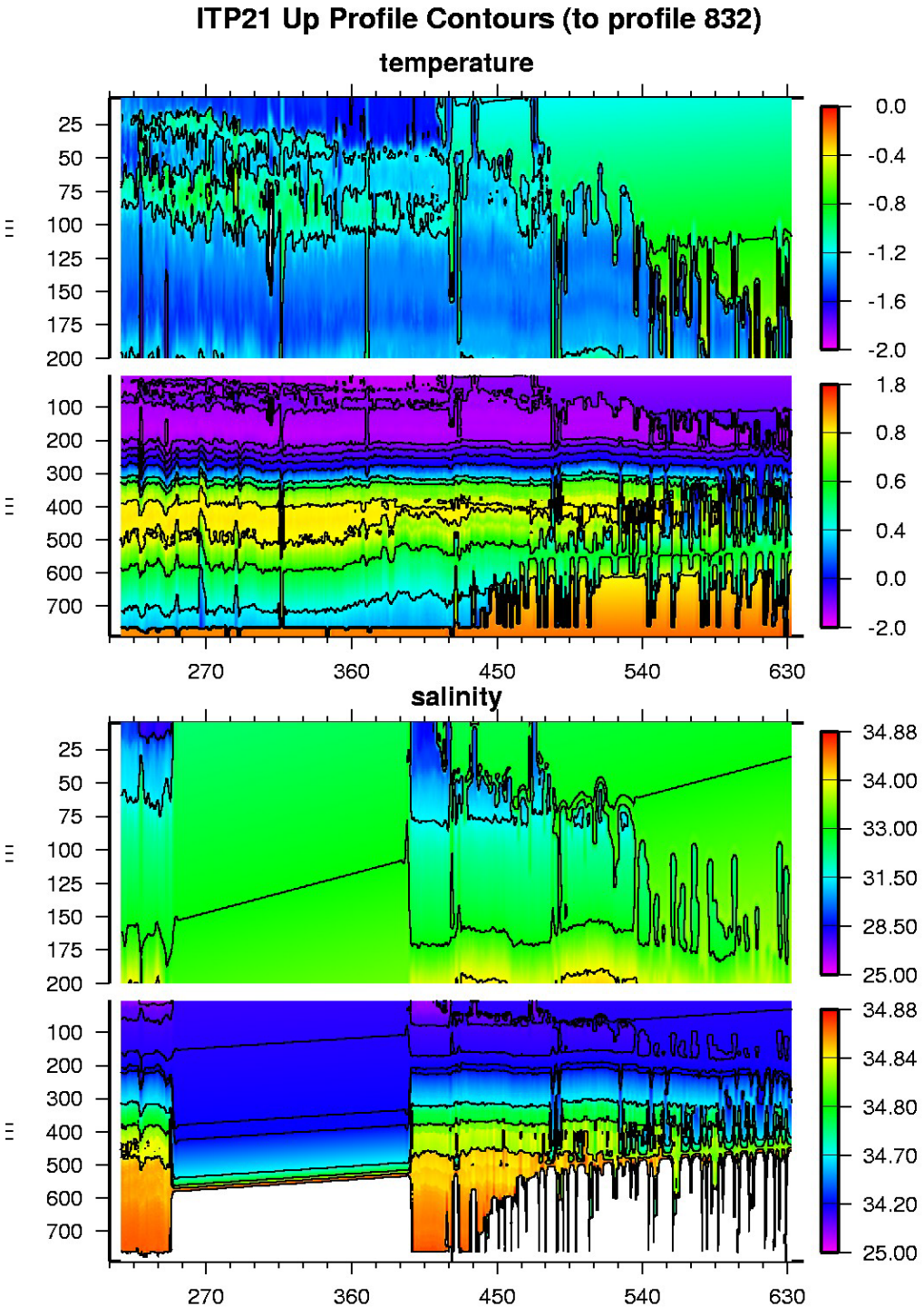


Top: down pressure deviation correction, Middle: salinity ratio adjustment, Bottom: Number of filtered spikes

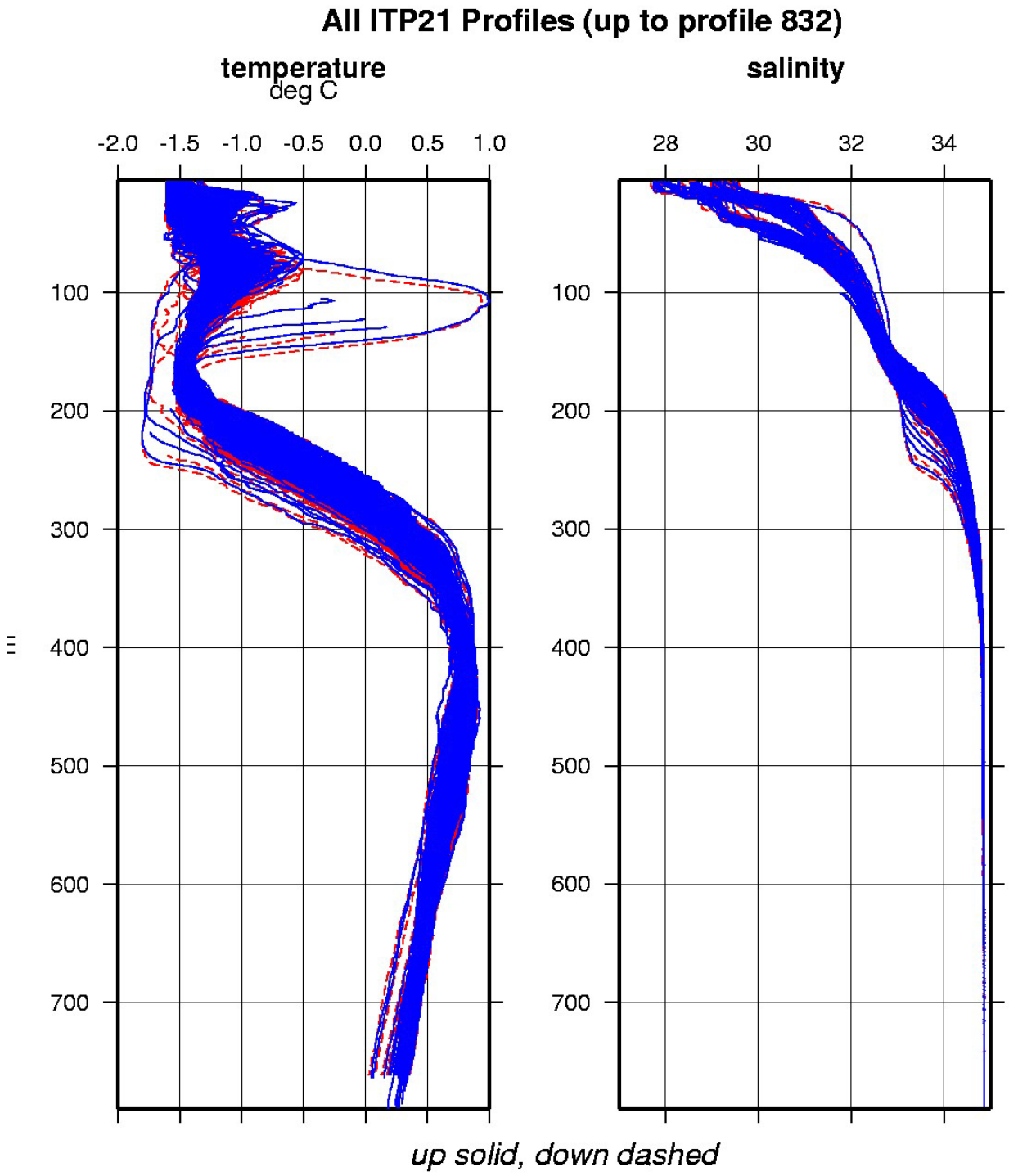


ITP drift (yellow line) and latest location (triangle), BGOS moorings (white circles) and annual ice drift from IABP (grey vectors) on IBCAO bathymetry (shading).

Plot of buoy locations.



ITP21 temperature and salinity contours



Composite plot of ITP temperature and salinity contours.

ITP 21 (and all ITPs deployed in summer 2008) included a supplemental conical flotation collar added to the standard ITP buoy in order to bring the surface electronics higher above the ice (in the event of ridging) and hopefully prolong the lifetime of the systems in less robust ice conditions. (Photo by Rick Krishfield)

View from the helicopter on the last flight back to the Louis. (Photo by Gary Morgan)

A little over a year after deployment, ITP 21 if found laying sideways on the ice because the cable is still frozen into the floe. (Photo by Rick Krishfield)

Released from the ice after being run over by the Louis, ITP 21 sports a new red stripe amongst the scattered remains of the floe that supported it the previous year. (Photo by Rick Krishfield)

Grappled and hooked to the ship's crane, the ITP is ready to be hauled up on the sling. (Photo by Rick Krishfield)