ITP64 Overview

Deployment Location: 8/28/2012, 17:58 UTC at 78° 46.5'N, 136° 39.8'W

Last Location: 9/2/2013, 23:00 UTC at 73° 43.56' N, 169° 37.62' W

Duration: 3703 days

Distance Traveled: 3946 km

Number of profiles: 1123 in 361 days

Other instruments: none

ITP64 was deployed in open water in the Beaufort Sea as part of the Beaufort Gyre Observing System (BGOS) during the JOIS 2012 cruise on the CCGS Louis S. St. Laurent. The ITP included a dissolved oxygen sensor and full biosuite system and a fixed SAMI pCO2 with SBE-37 microcat at 6 m depth and operated on a pattern profiling sampling schedule including one full one-way profile between 7 and 760 m depth every 1.5 days.

ITP64 Deployment Operations

After deploying ITPs (numbers 65 & 66) on ice stations the previous 2 days, limited ship time and limited ice floes required that ITP 64 be deployed over-the-side of the ship into open water near an ice edge. Deploying an ITP directly in the ocean is less preferable than on ice, since it may encounter significant wave motion which obstructs the profiler before the ice freezes around the buoy, and can decrease instrument durability. However, not having to stage an ice operation nor auger a hole through an ice floe saves a significant amount of deployment time.

The ice nearby and lack of winds produced light fog for the deployment. The ITP buoy, wire, anchor and winch were moved from the helicopter staging area to the foredeck for the deployment which occurred using the starboard A-frame and crane. The same ITP deployment winch that would have been used on the ice was secured to the hydro winch bolted to the ship's deck, and the wire fed through a block suspended from the A-frame.

Light winds kept the ice away from the side of the ship during the deployment, and without the need to drill a hole in a floe, the ITP profiler could be lowered over-the-side on the bottom bumper on the wire above the anchor. The wire was unspooled using the winch brake in an hour, then the SAMI assembly consisting of SAMI pCO2, SBE 37 microcat and SBE inductive modem were clamped to the top the wire at ~6m, just below the potted section of cable and above a top bumper placed to mechanically prevent the ITP from profiling into the SAMI. Ten minutes later, the mooring was transferred to the buoy, and the system released into the Arctic.

ITP64 Data Processing

The 1123 profiles that were transmitted from the ITP were processed according to the procedures described in the ITP Updated Data Processing Procedures. The processing parameters for are shown in the figures to the right. The biosuite sensor data handling are described in Laney et al., (2014), while SAMI data validation are described in Islam et al., (2017). Despite being deployed in open water, any wave motion before freeze-up did not seem to hamper the vertical motion of the profiler, and buoy drift speeds were usually less than 30 cm/s so the profiler covered nearly the full extent of most profiles that it communicated to the surface package.

Thermohaline staircases were present during the first 4 months of the time series in the deep profiles, and the lag correction estimates were in typical ranges and mostly constant over time. The profile-to-profile potential conductivity corrections were also mostly typical and constant. The dissolved oxygen sensor data were also very clean while the profile-to-profile corrections increased slightly. The biosuite sensors all obtained excellent data over the lifetime of the profiler, as well.

The SAMI pCO2 sensor mounted at 6 m returned excellent data for the first 49 days, but ceased communicating with the surface package on October 19, 2012.

References:

Islam, F., M.D. DeGrandpre, C.M Beatty, M.-L. Timmermans, R.A. Krishfield, J.M Toole, and S.R. Laney, 2017. Sea surface pCO2 and O2 dynamics in the partially ice-covered Arctic Ocean. Journal of Geophysical Research, Vol. 122, doi:10.1002/2016JC012162.

Laney, S.R., R.A. Krishfield, J.M. Toole, T.R. Hammar, C.J. Ashjian, and M.-L. Timmermans, 2014. Assessing Algal Biomass and Bio-optical Distributions in Perennially Ice-Covered Ocean Ecosystems. Polar Science, Vol. 8, http://dx.doi.org/10.1016/j.polar.2013.12.003.

ITP64 Data Description

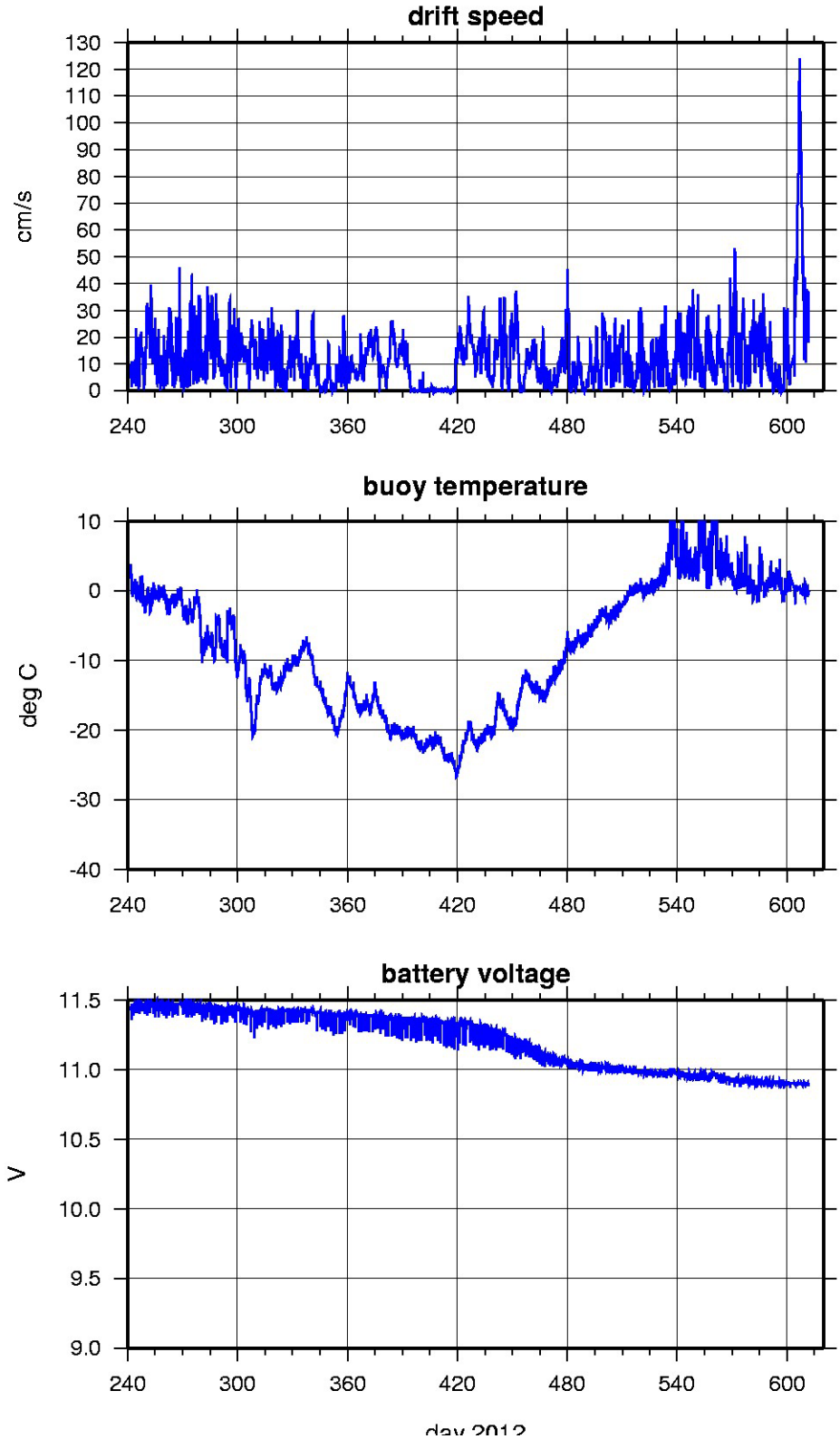
The ITP profiler was configured to operate on a pattern profiling schedule with different summer and winter schedules. In the summer (between deployment and October 31, and after the following March 1), the instrument conducted a 1.5 day repeating pattern of an up profile from 750 to 7 m, followed by 4 one-way (down, up, down, up) profiles between 7 and 200 m, followed by a down profile from 7 to 750 m, all spaced 6 hours apart. In the winter (from November 1 to February 29), the instrument conducted a 3 day repeating pattern of an up profile from 750 to 8 m, followed 6 hours later by a down profile from 7 to 200 m, followed 24 hours later by an up profile from 200 to 7 m, followed 6 hours later by a down profile from 7 to 750 m, followed by a 36 hour gap before the pattern repeated. The complicated scheme was designed to conserve battery power to extend the lifetime of the instrument, while maximizing the acquisition of the bio-optical data during the summer months. In the surface package, the GPS receiver was powered hourly to obtain locations hourly, and buoy temperature and battery voltage status were recorded.
For the first 3 months after deployment the ITP generally stayed within a radius of 100 km from

where it was deployed, then circulated south and west with the Beaufort Gyre for the next 9 months, eventually dragging the mooring (and ceasing communications with the profiler) on the southern end of the Northwind Ridge. Next the surface package briefly disappeared (pushed under ice?), then the ITP (likely without the mooring still attached) was pushed rapidly west for another 8 days before the surface package ceased transmitting.

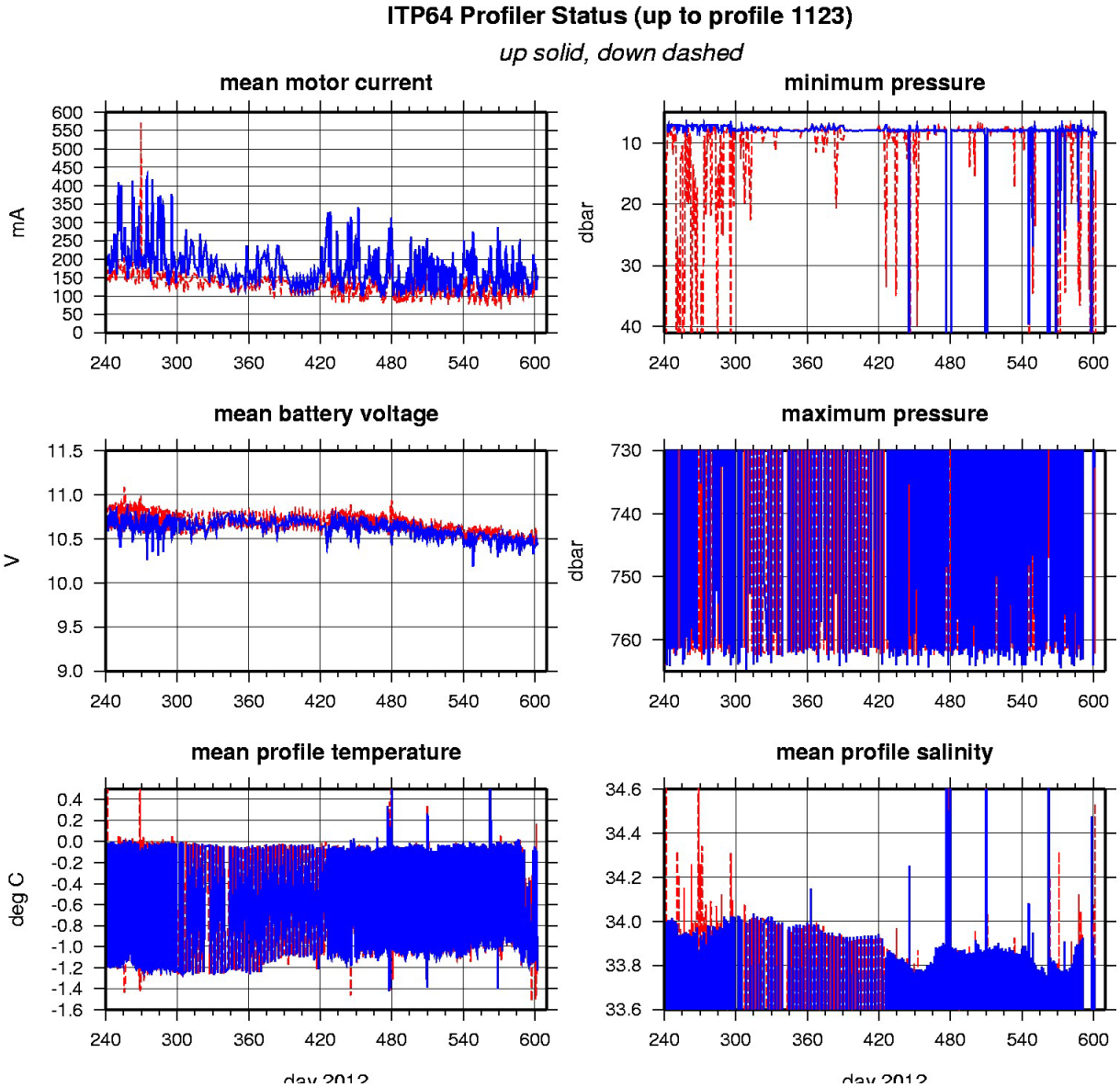
The plots below are of the final, calibrated, edited data (as opposed to the raw data presented on the active instrument pages).

Level II hourly buoy location data in ASCII format: itp64rawlocs.dat
Level III 1-Hz processed profile and SAMI data in MATLAB format: itp64cormat.tar.Z or itp64cormat.zip
Level III 1-db bin-averaged processed profile and SAMI data in MATLAB format: itp64final.mat
Level III 1-db bin-averaged processed profile and SAMI data in ASCII format: itp64final.tar.Z or itp64final.zip

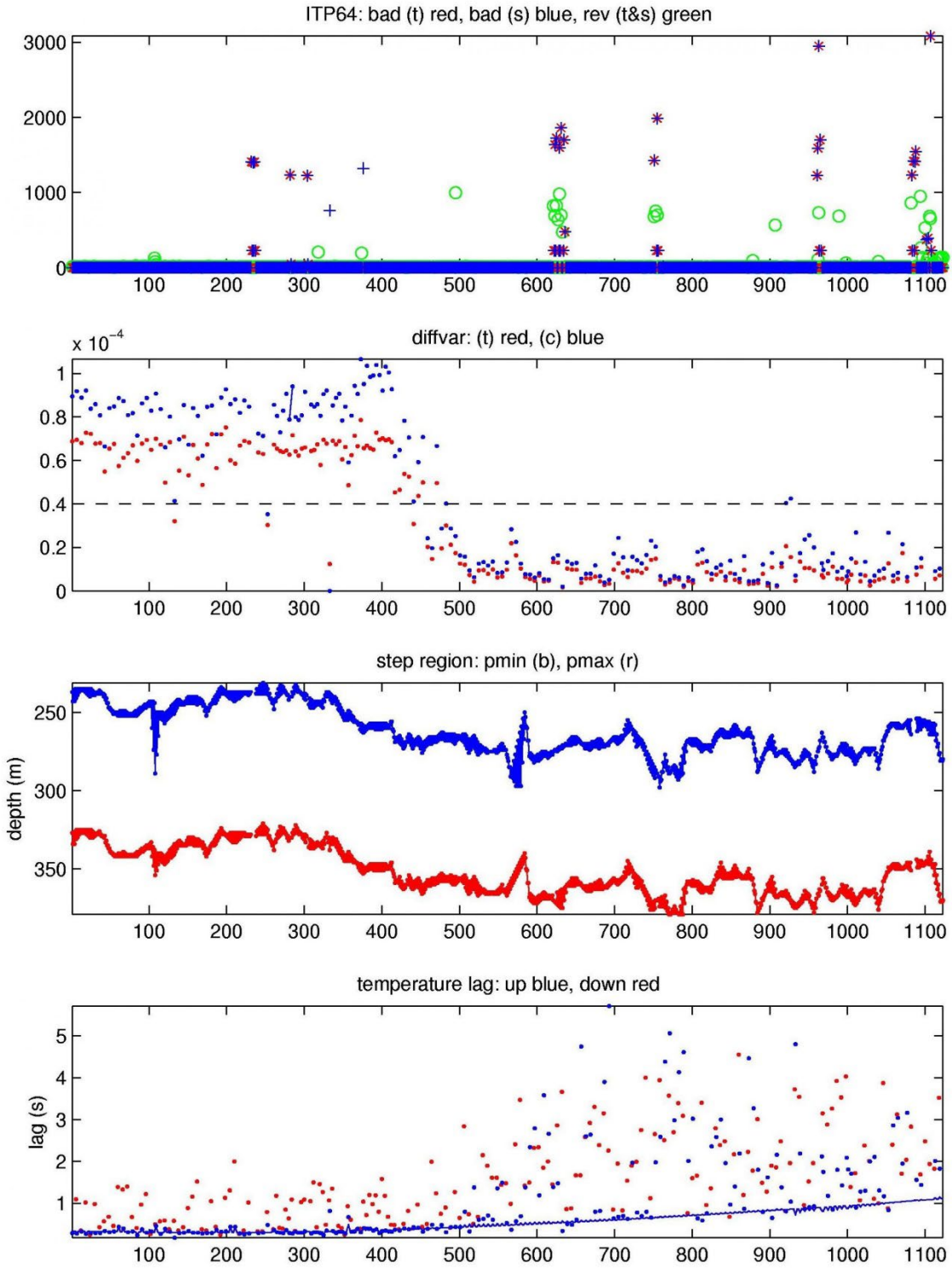
ITP64 Buoy Status (as of 2013/09/02)



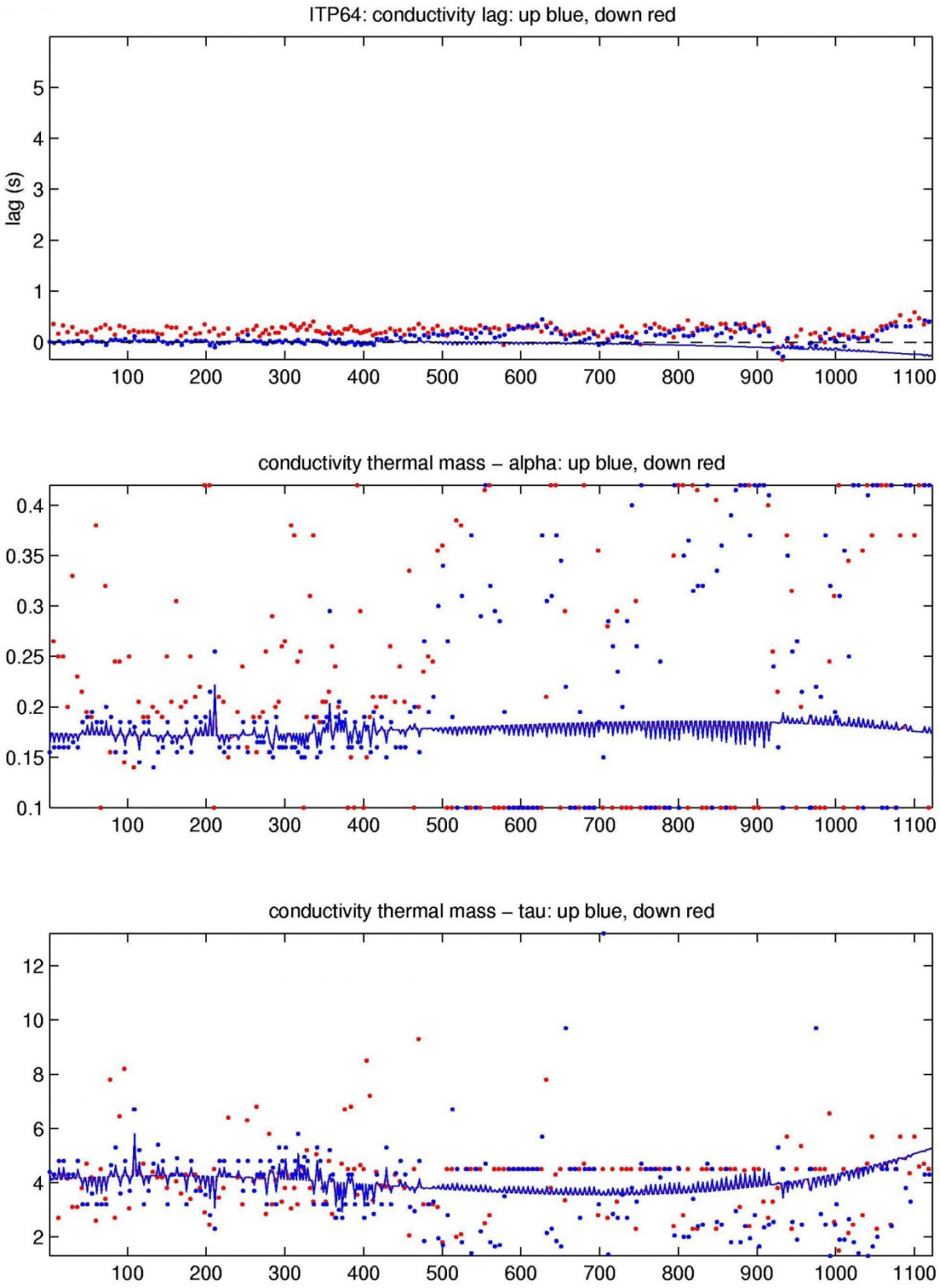
ITP surface buoy status.



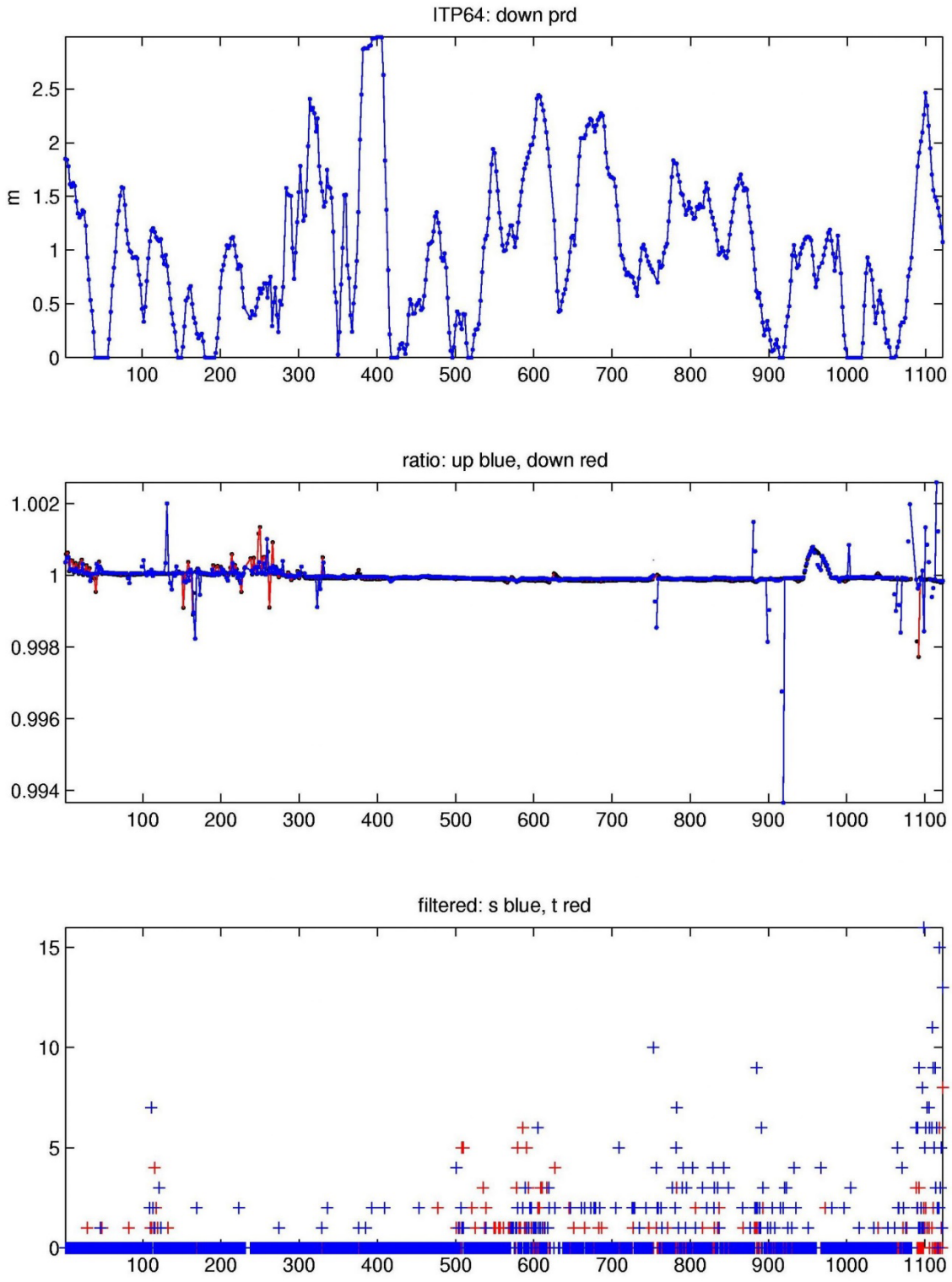
ITP profiler engineering data.



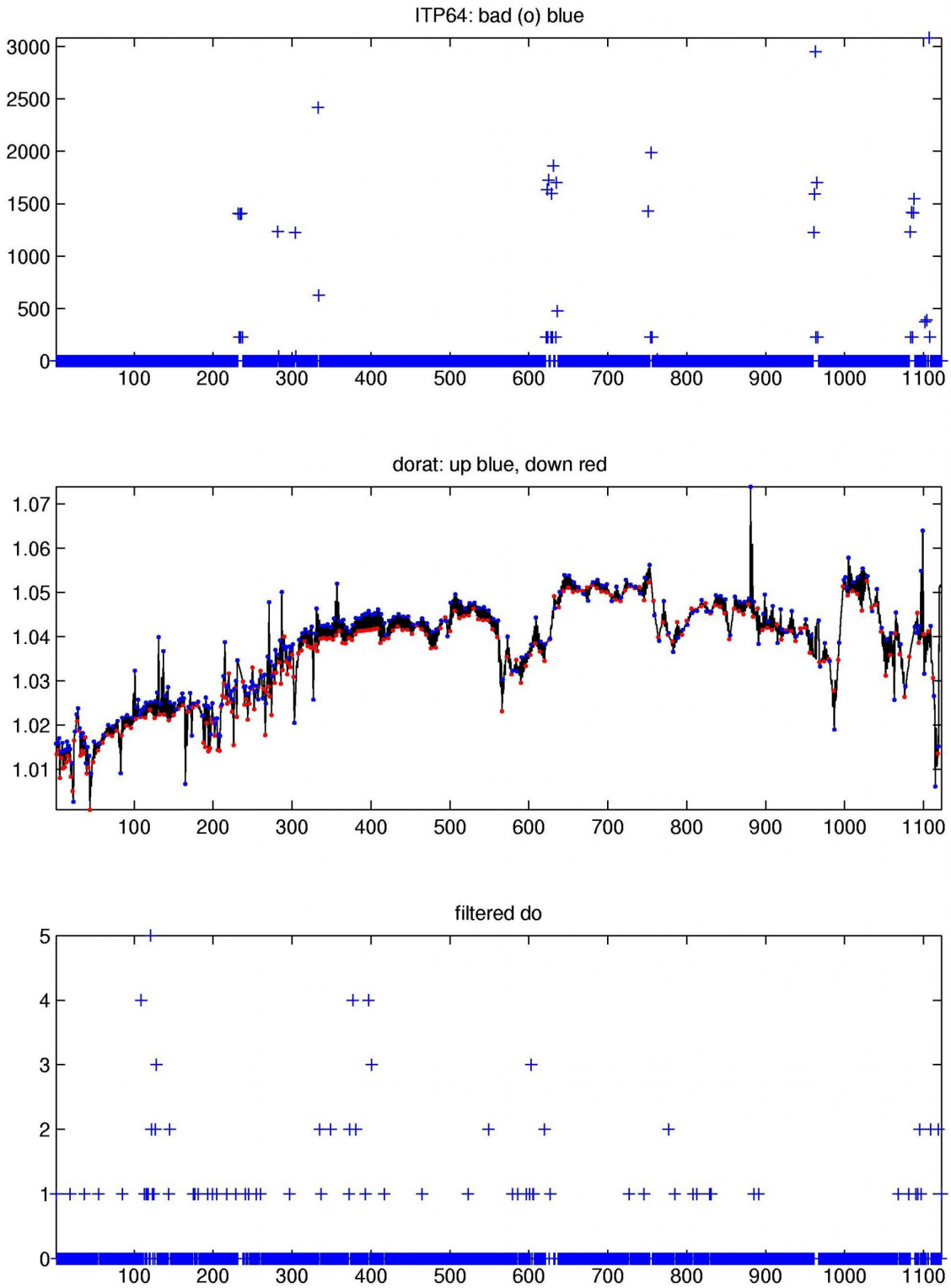
Number of bad points removed (top); variance of vertical difference of temperature and salinity in step region for up-going profiles; depth of staircase layer; temperature lag (bottom).



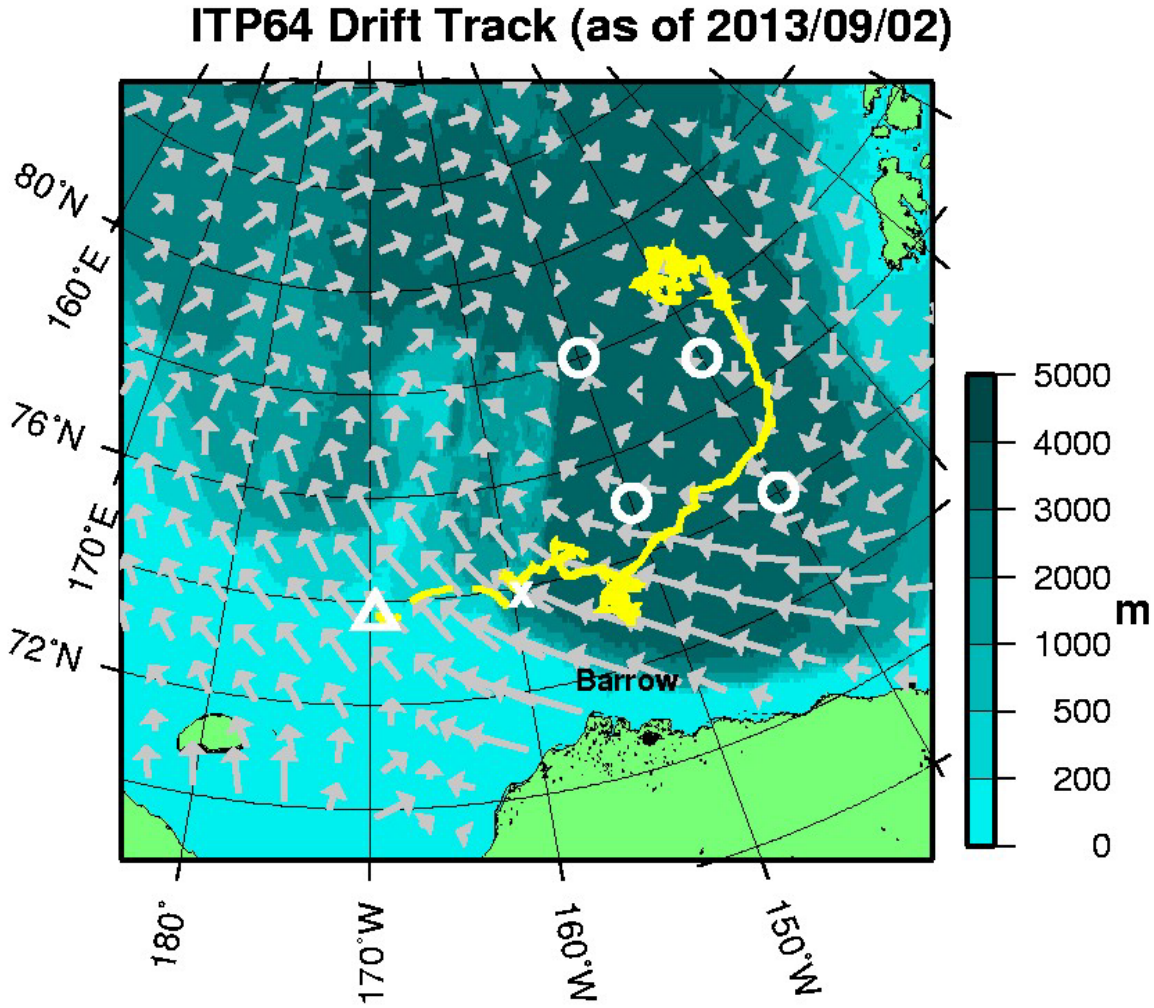
Top: conductivity lag, Middle: conductivity thermal mass amplitude correction, Bottom: conductivity thermal mass lag correction.



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

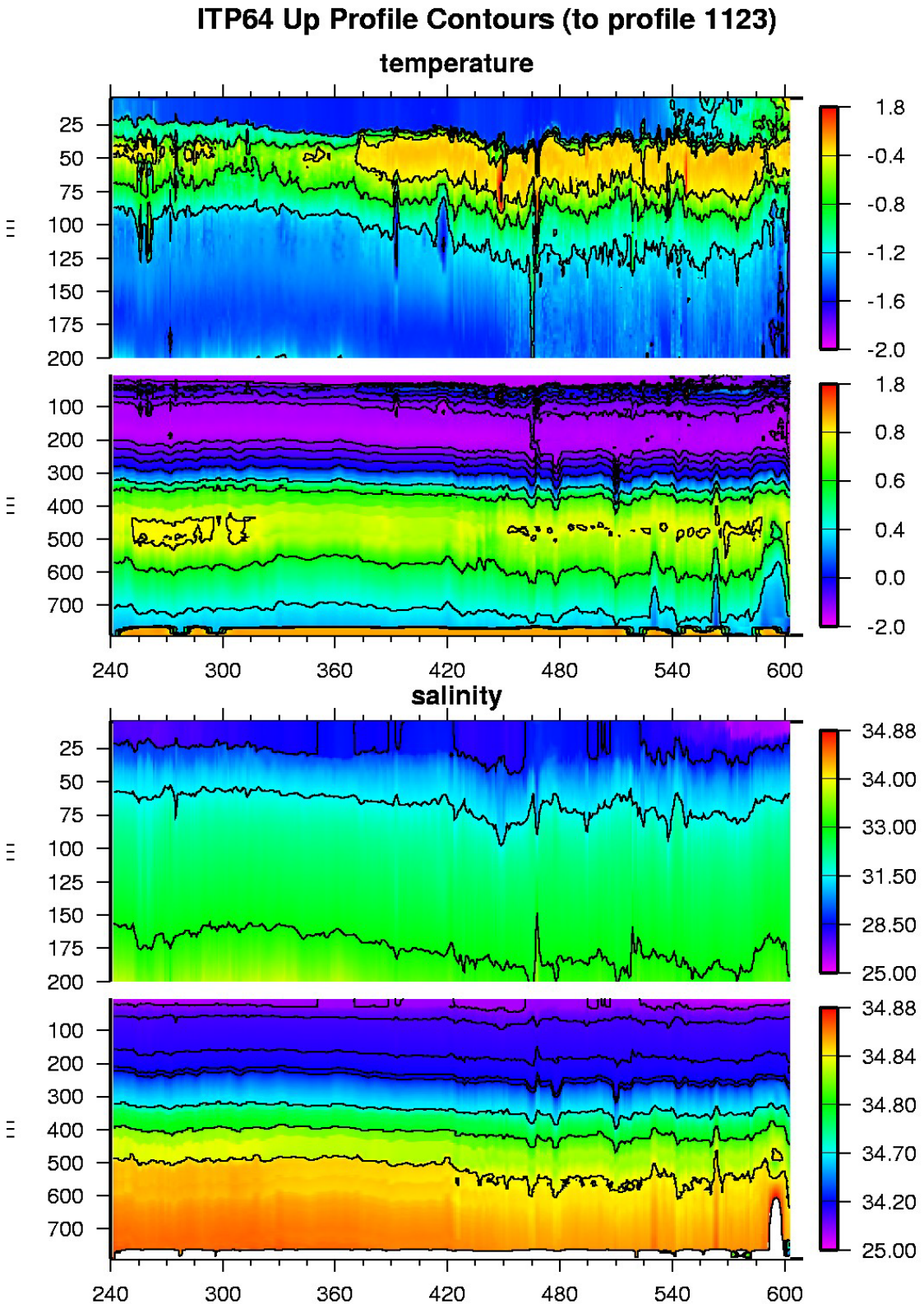


Top: number of bad dissolved oxygen points removed, Middle: dissolved oxygen ratio adjustment, Bottom: Number of filtered spikes.

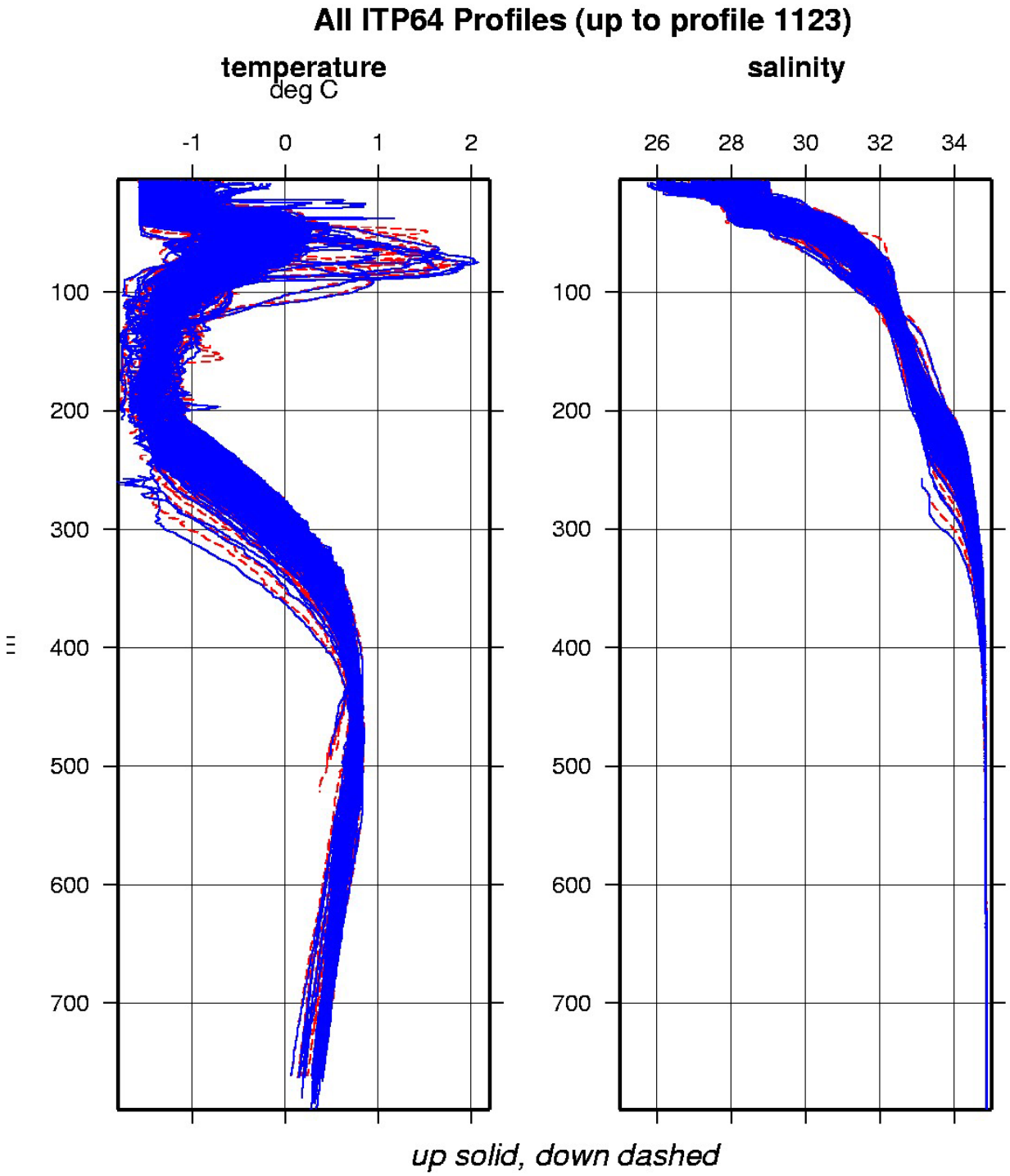


ITP drift (yellow line), last profile (x), last location (triangle), BGOS moorings (white circles) and annual ice drift from IABP (grey vectors) on IBCAO bathymetry (shading).

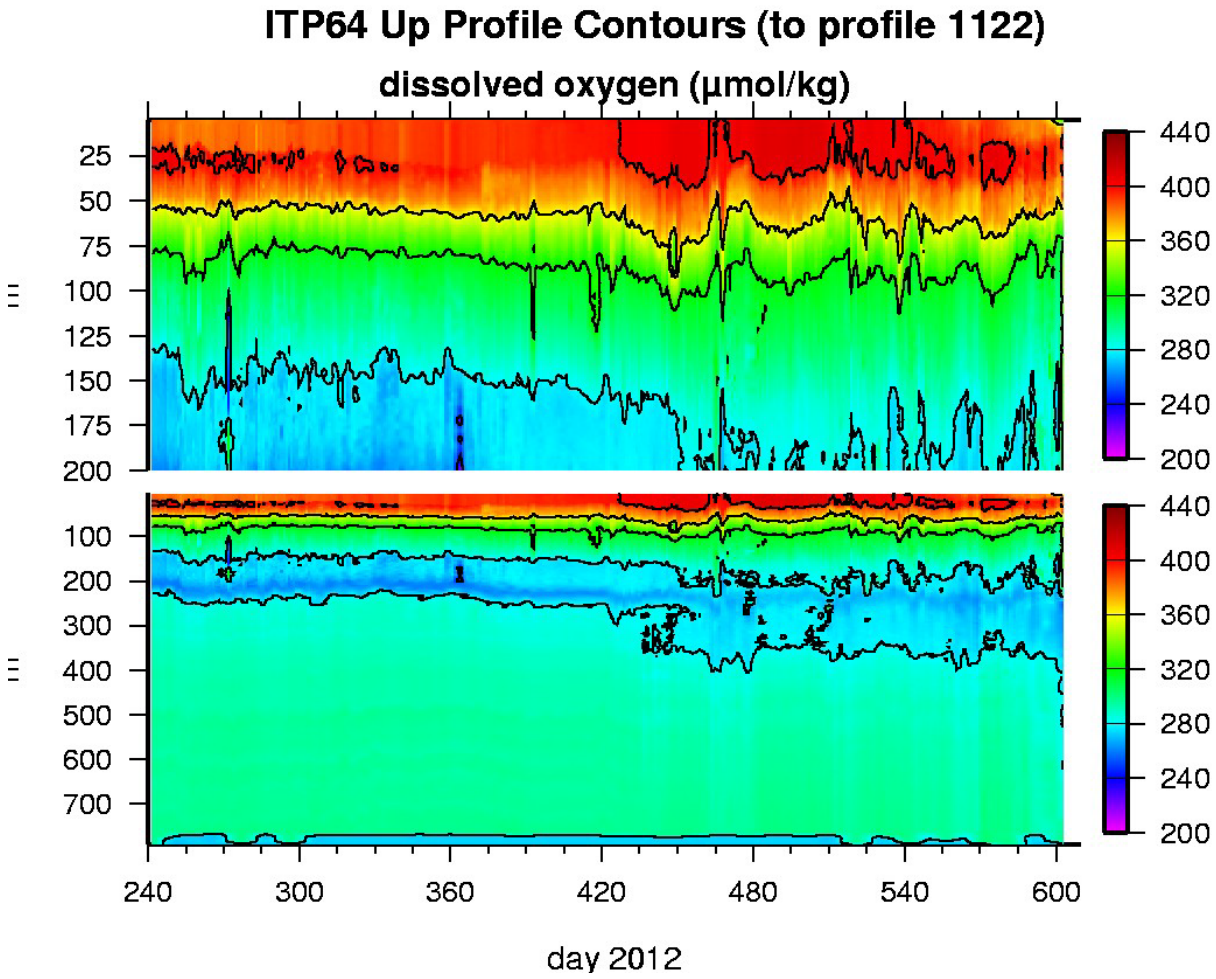
Plot of buoy locations.



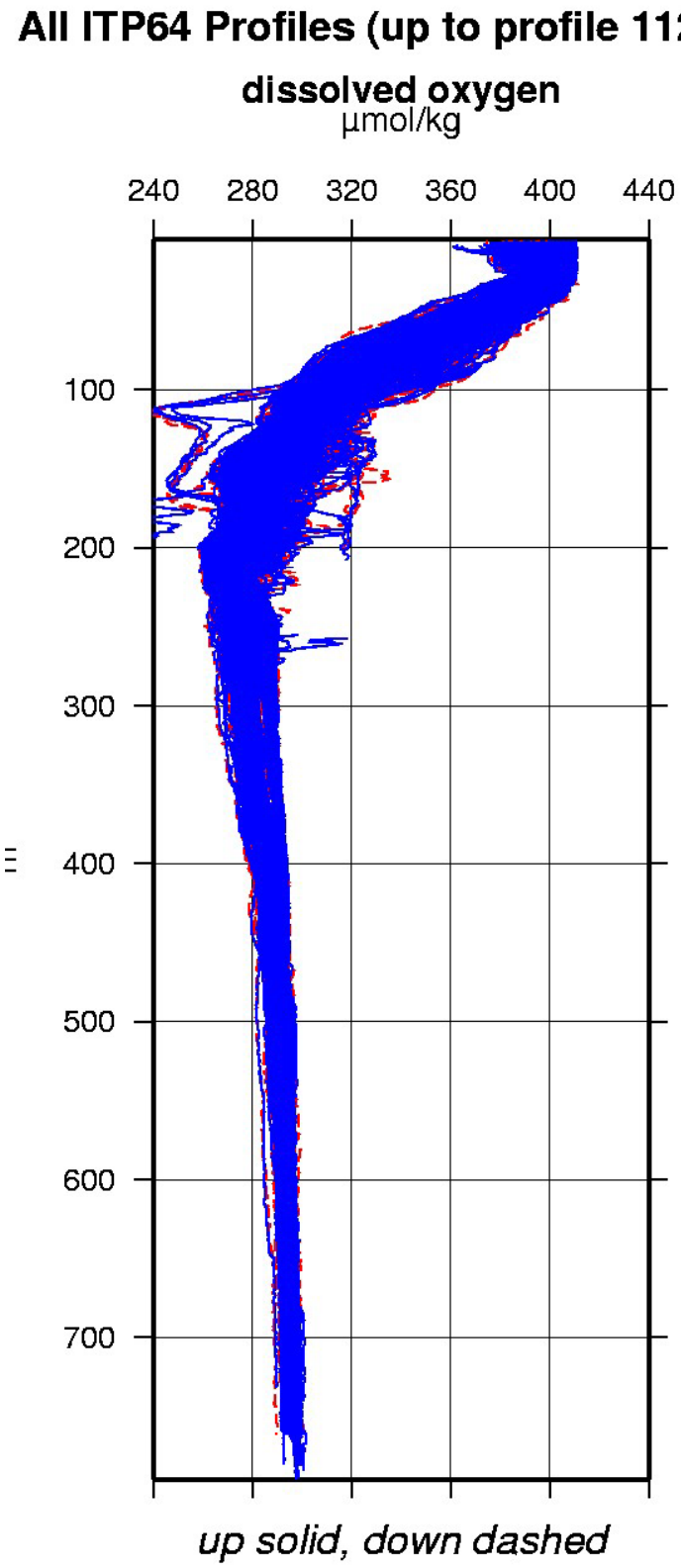
ITP 64 Temperature and Salinity contours.



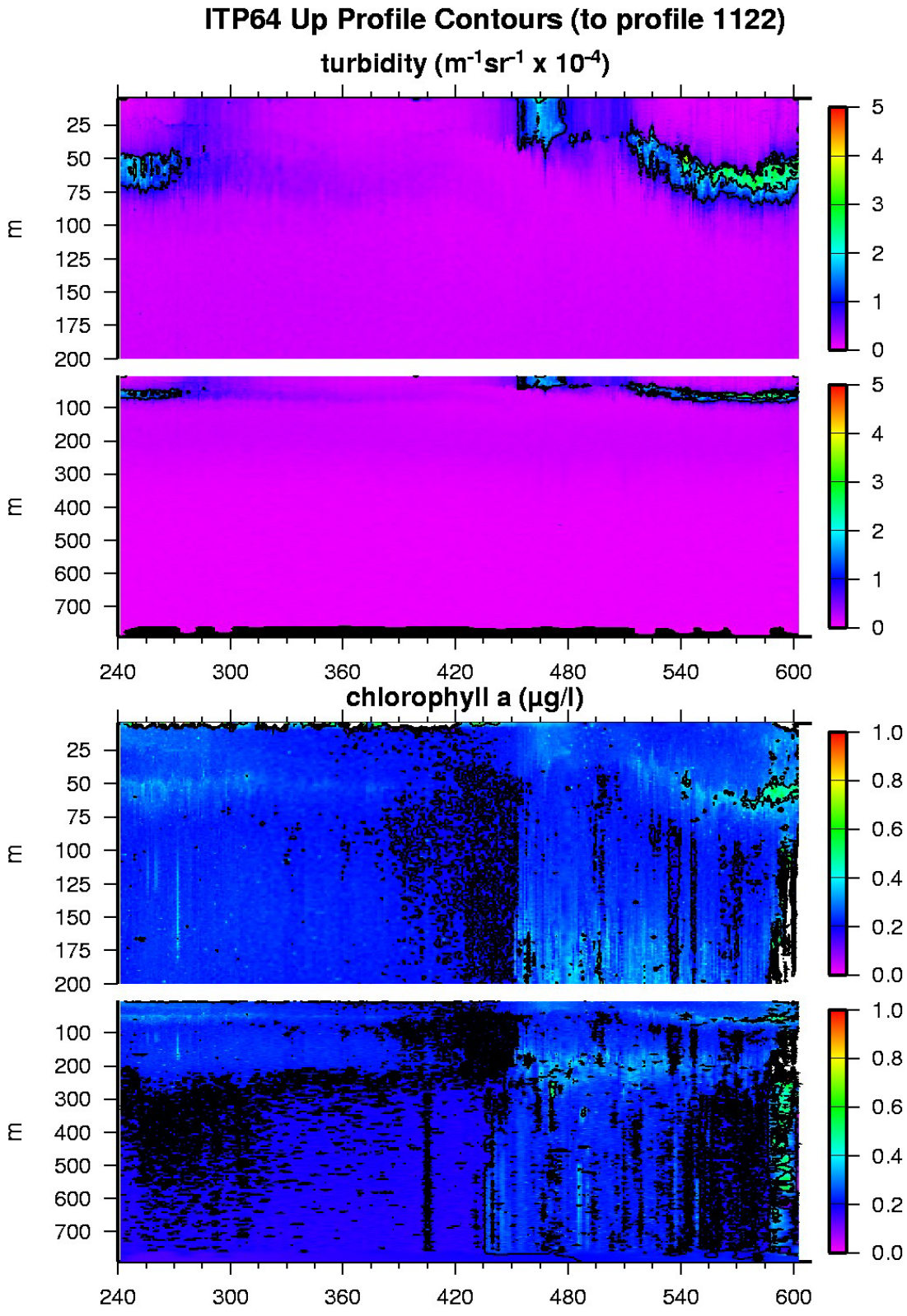
Composite plot of ITP temperature and salinity profiles.



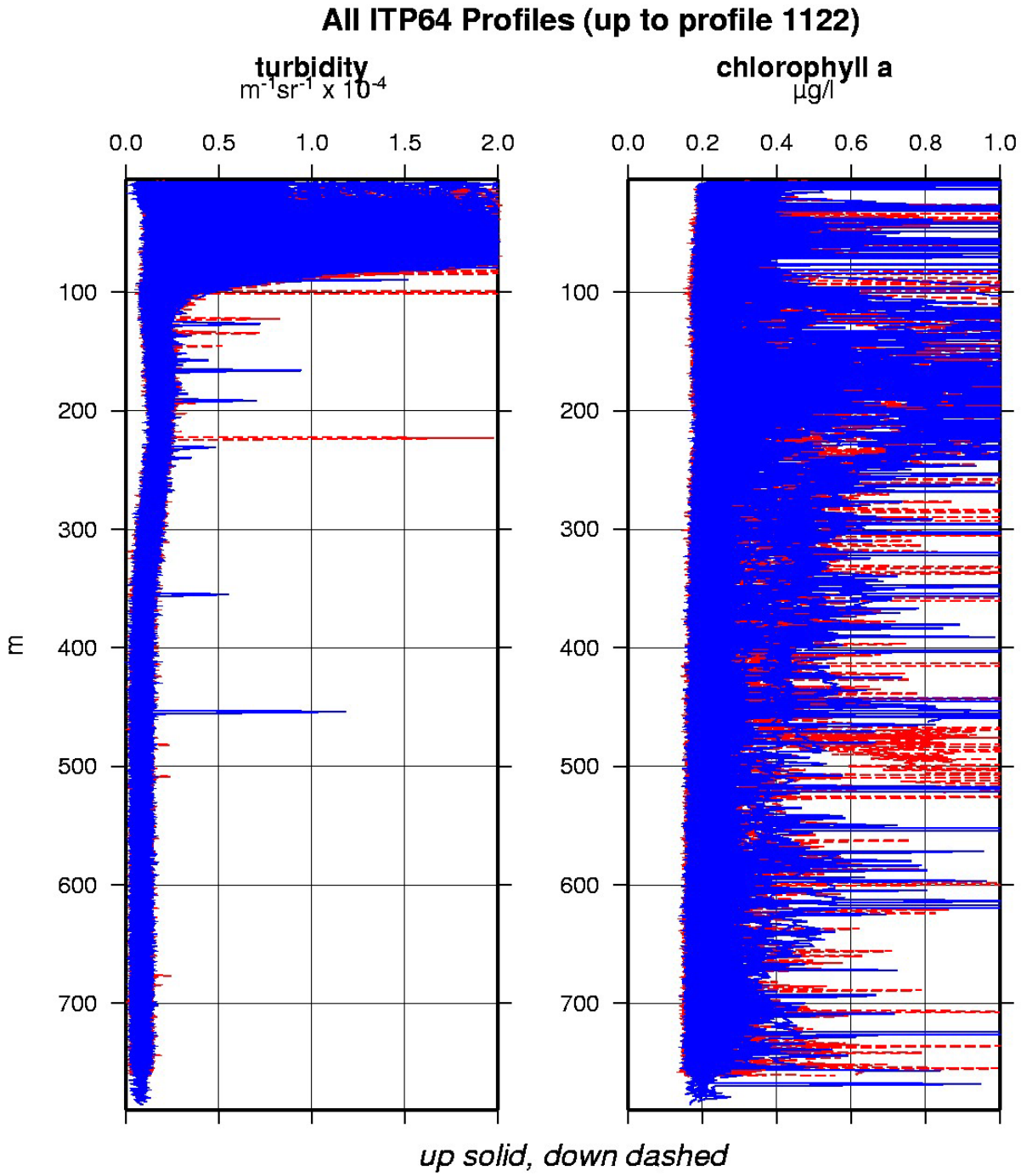
ITP 64 dissolved oxygen contours.



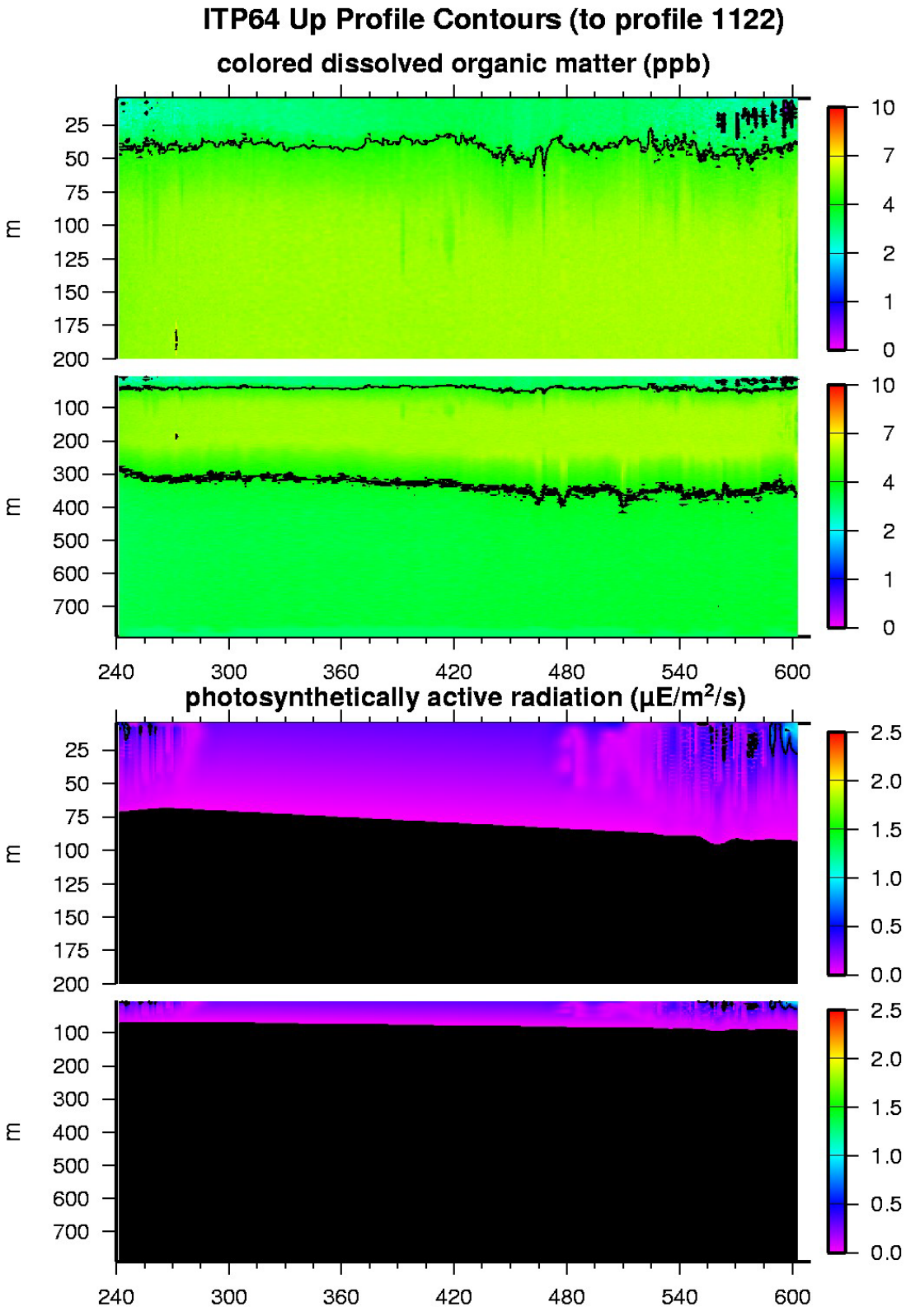
Composite plot of ITP dissolved oxygen profiles.



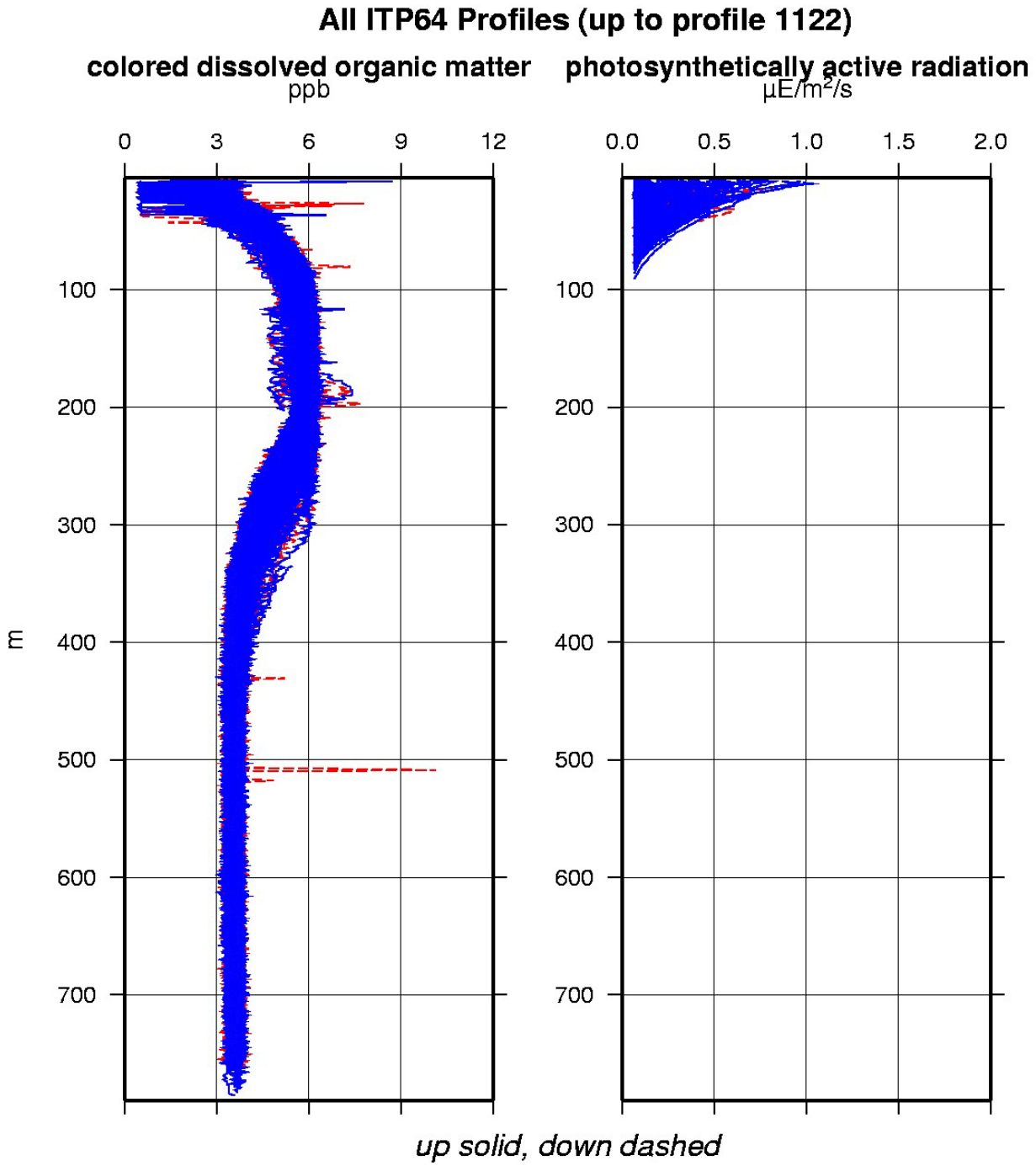
ITP 64 Turbidity and Chlorophyll a contours.



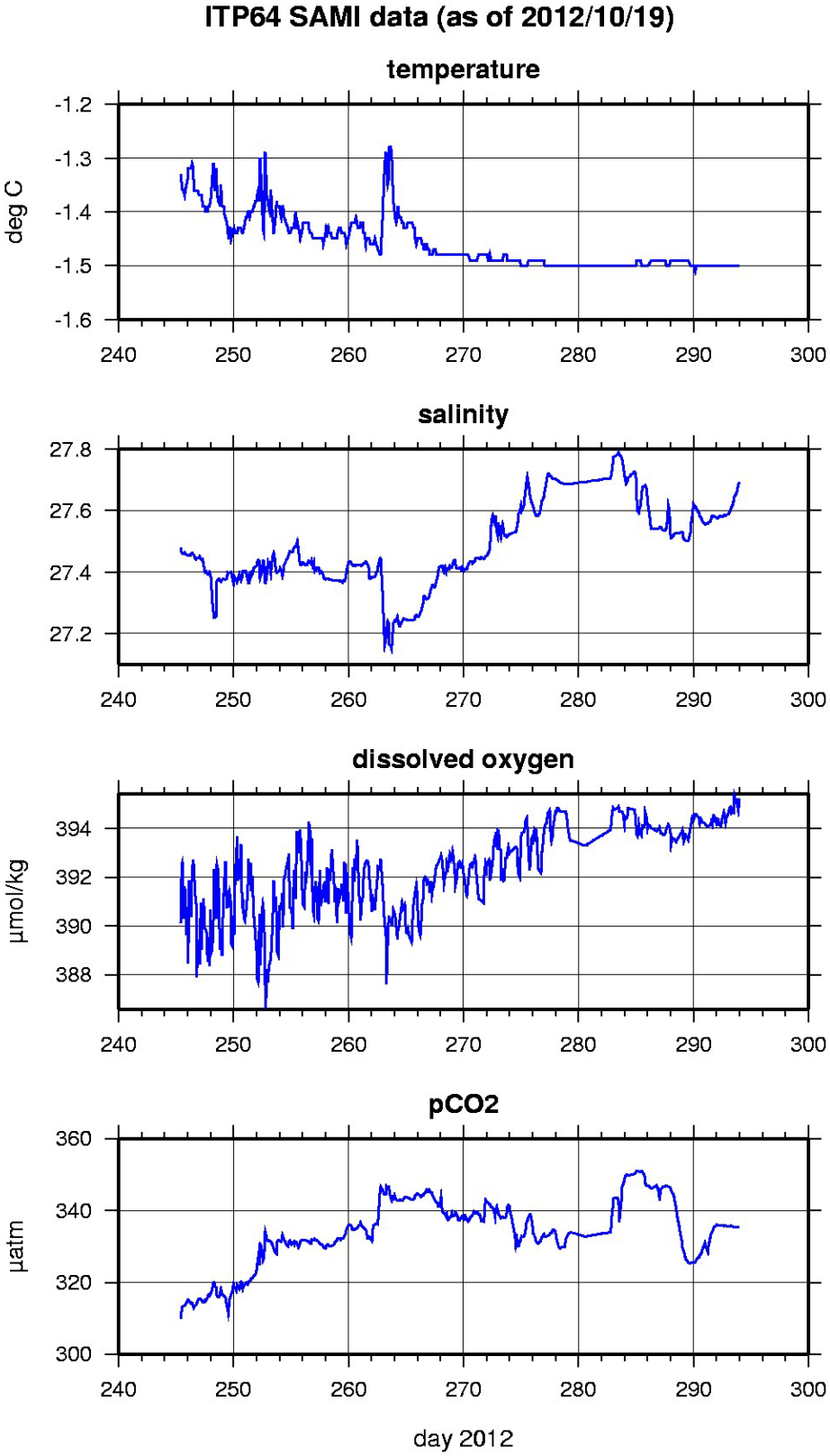
Composite plot of ITP turbidity and chlorophyll a profiles.



ITP 64 CDOM and PAR contours.



Composite plot of ITP CDOM and PAR profiles.

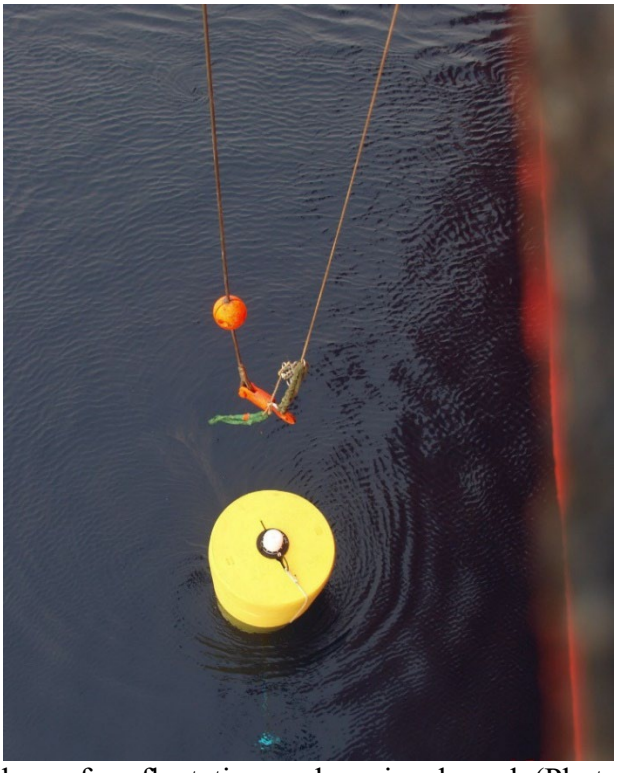


Plot of SAMI time series.

Shortly after being released over-the-side of the ship into open water, ITP 64 waits to be surrounded by the nearby ice floes and frozen into the pack. (Photo by Gary Morgan)

The ITP deployment winch and reel are fastened to the hydro winch on the foredeck for deployment over-the-side. (Photo by Rick Krishfield)

The complete ITP system is lowered into the seawater by the ship's crane. (Photo by Rick Krishfield)



The moment that the surface floatation package is released. (Photo by Gary Morgan)