ITP 52 Overview

Deployment Location: 8/5/2011, 8:00 UTC at 78° 0.4'N, 139° 55.5'W

Last Location: 1/19/2012, 23:00 UTC at 75° 55.5' N, 131° 45.5' W

Duration: 167 days

Distance Traveled: 1313 km

Number of profiles: 378 in 110 days

Other instruments: IMB 2011-I, O-Buoy 5

ITP52 was deployed on a 4.20 m thick ice floe in the Beaufort Sea as part of the Beaufort Gyre Observing System (BGOS) during the JOIS 2011 cruise on the *CCGS Louis S. St. Laurent*. On the same icefloe, a US Army Cold Regions Research and Engineering Laboratory (CRREL) Ice Mass Balance Buoy (IMB 2011-I), and an autonomous atmospheric chemistry buoy (O-Buoy 5) were also installed. The ITP included a dissolved oxygen sensor and full biosuite system and operated on a pattern profiling sampling schedule including one full one-way profile between 7 and 760 m depth every 1.5 days.

ITP52 Deployment Operations

The second ITP deployed during the JOIS 2011 expedition was the first prototype ITP with biosuite sensor package deployed in the Arctic Ocean (another biosuite prototype, ITP 48, was deployed a month later during the ARK-XXVI/3 expedition on the *Polarstern*). In addition to the Sea-Bird Electronics CTD head with dissolved O_2 measurement capability, the biosuite included a Satlantic Photosynthetically Active Radiation (PAR) sensor and a Wetlabs Triplet sensor for measuring turbidity, chlorophyll A, and colored dissolved organic matter (CDOM). This ITP would be deployed as part of an Ice-based Observatory (IBO) including an O-Buoy and IMB.

The ice conditions in the region were favorable and the weather reasonable, so only a 20 minute helicopter reconnaissance was necessary before a good sized floe with lighter blue melt ponds (indicating thicker ice) was located. Ice thicknesses measured between 1.8 and 3.2 m, and freeboards were between 25 and 45 cm, so the floe was selected for the deployment site. An hour and thirty minutes later, the deployment operations began after the *CCGS Louis St. Laurent* had maneuvered to the site.

Simultaneously, installations of an O-Buoy, IMB, and an Arctic Ocean Flux Buoy (AOFB) were conducted by different teams while other scientists surveyed the icefloe. The AOFB sensor was damaged, so that installation was aborted, and that instrument was returned to the ship. Then ITP deployment was conducted. Five hours after the first deployment operations began, the ITP

was installed and successfully tested. Shortly thereafter all scientists and gear were back onboard the icebreaker.

ITP52 Data Processing

The 378 profiles that were recovered 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). Buoy drift speeds were almost always less than 30 cm/s so the profiler covered nearly the full extent of nearly every profile that it communicated to the surface package, except for profiles 63 to 68, 367-370, and 378 which were influenced by excessive drift speeds.

The temperature and salinity data were mostly free of obvious fouling. Only 9 profiles out of the first 365 had a large amount of bad salinity points (>100) that were removed, but all of the salinities after profile 370 were corrupted. Thermohaline staircases were present during the time series in the deep profiles, enabling lag correction estimates. However, the lags were not typical and generally increased over the timeseries. The profile-to-profile potential conductivity corrections were mostly constant for the first 60 profiles, and then varied greatly for the remainder of the time series. Part of the variability is likely due to the fact that the short 200 m profiles could not be corrected to the deeper, more stable conductivity levels. Due to a problem with an internal seal on this generation of DO sensors, the sensor failed after profile 37.

References:

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.

ITP52 Data Description

The ITP profiler was configured to operate on a pattern profiling schedule with different summer and winter schedules. In the summer (between March 1 and October 31), 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 (between November 1 and February 28 or 29), the instrument conducted a 3-day repeating pattern of an up profile from 750 to 7 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 complicate 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.

After circling about a bit, the buoy generally meandered northward along 140°W during the first month to attain its northernmost location over 150 km north of the deployment site. Thereafter it drifted generally east and south with the Beaufort Gyre circulation. The profiler stopped

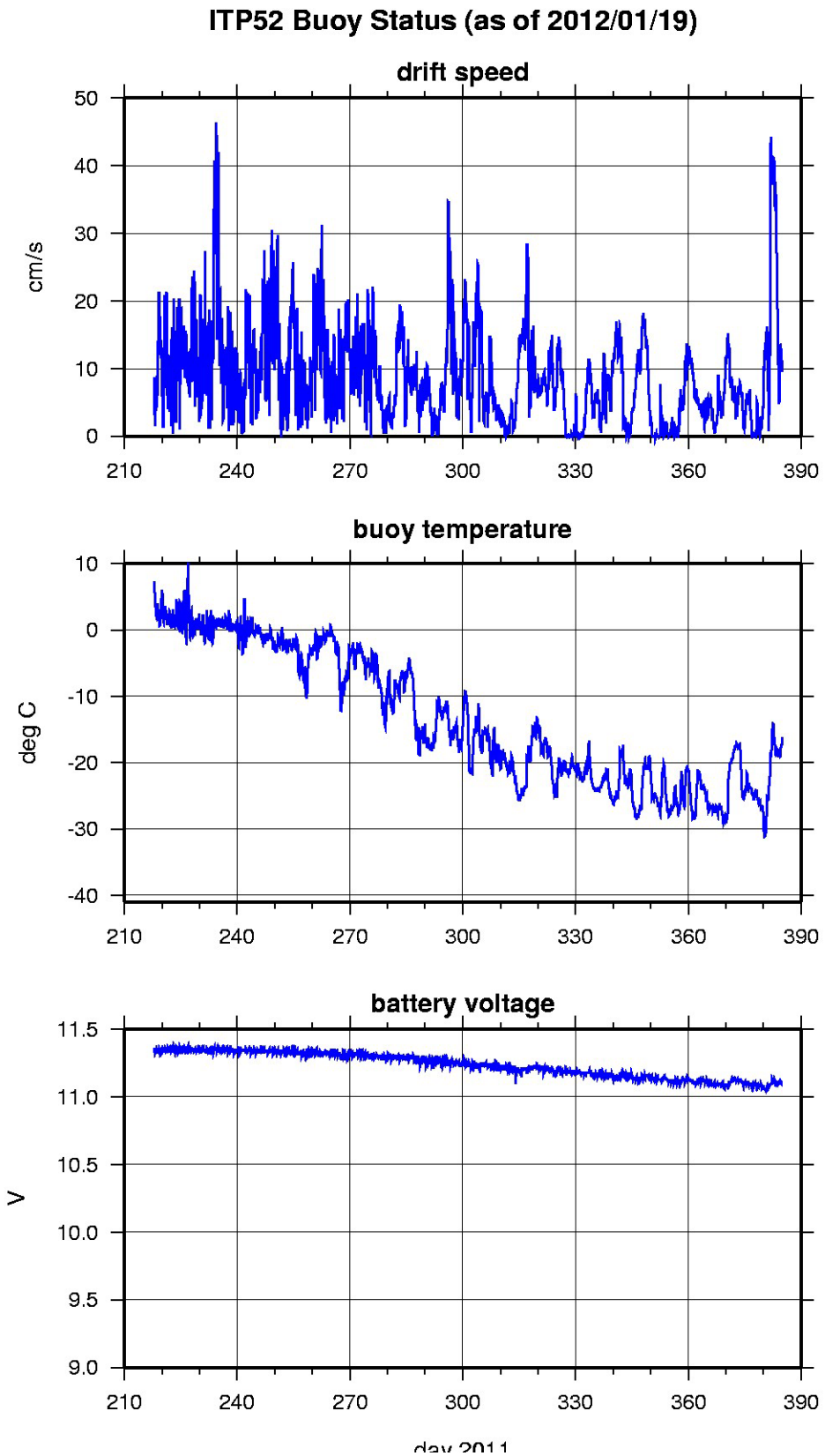
communicating with the surface package after 3.5 months on November 23, 2011. Two months later, the surface package ceased transmitting on January 19, 2012.

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

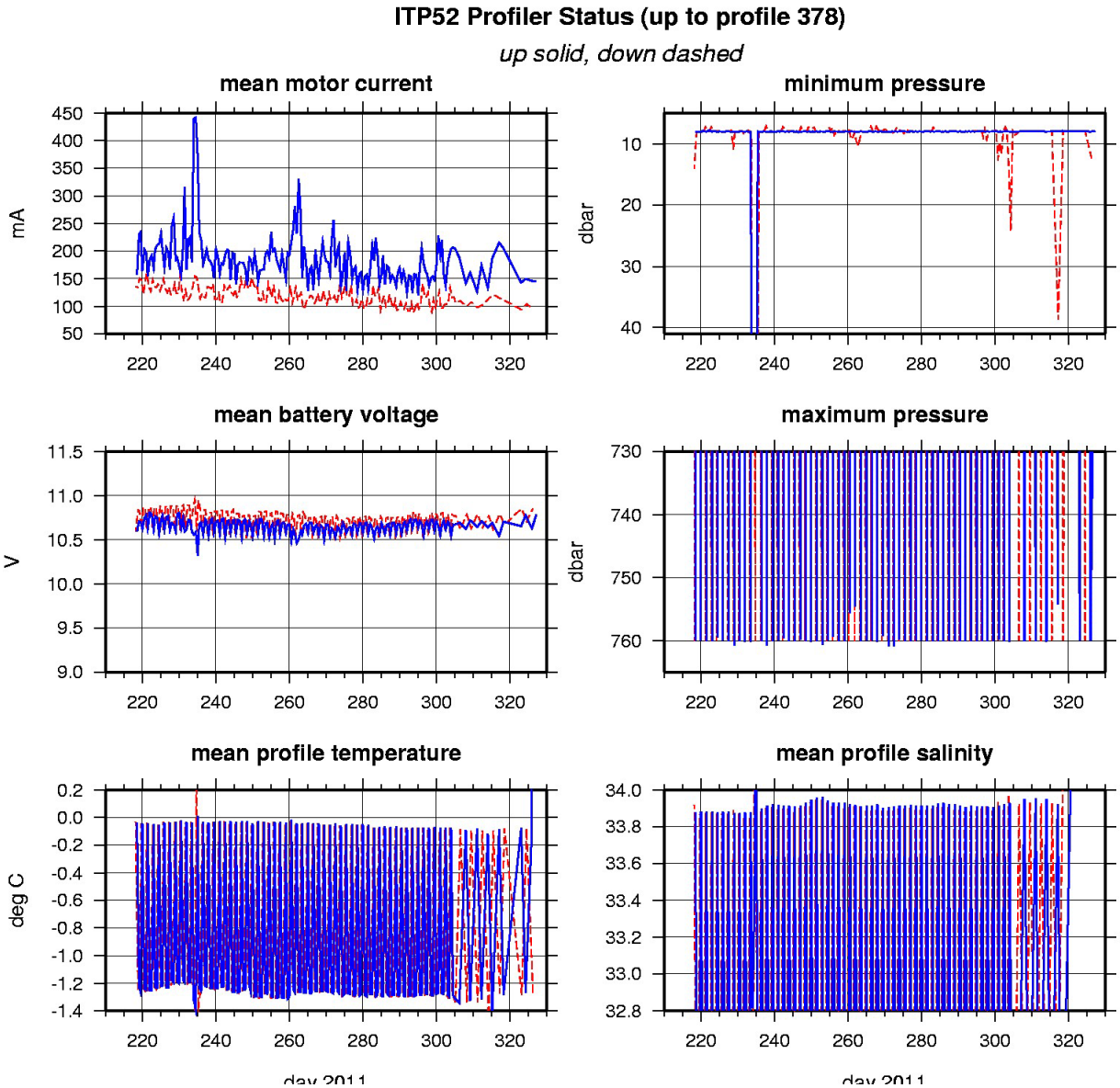
Level II hourly buoy location data in ASCII format: itp52rawlocs.dat

Level III 1-Hz processed profile data in MATLAB format: itp52cormat.tar.Z or itp52cormat.zip

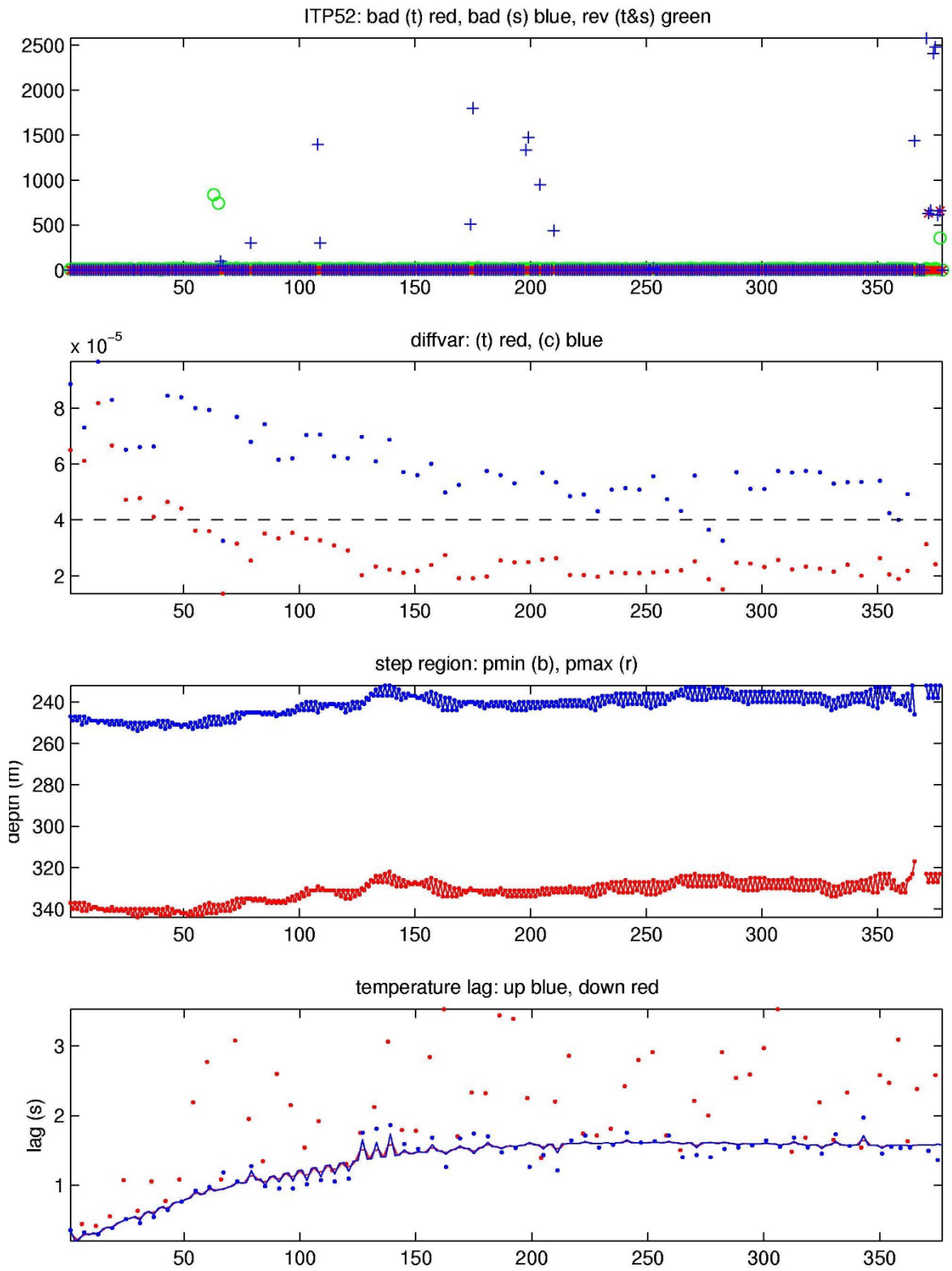
Level III 1-db bin-averaged processed profile data in MATLAB format: itp52final.mat
Level III 1-db bin-averaged processed profile data in ASCII
format: itp52final.tar.Z or itp52final.zip



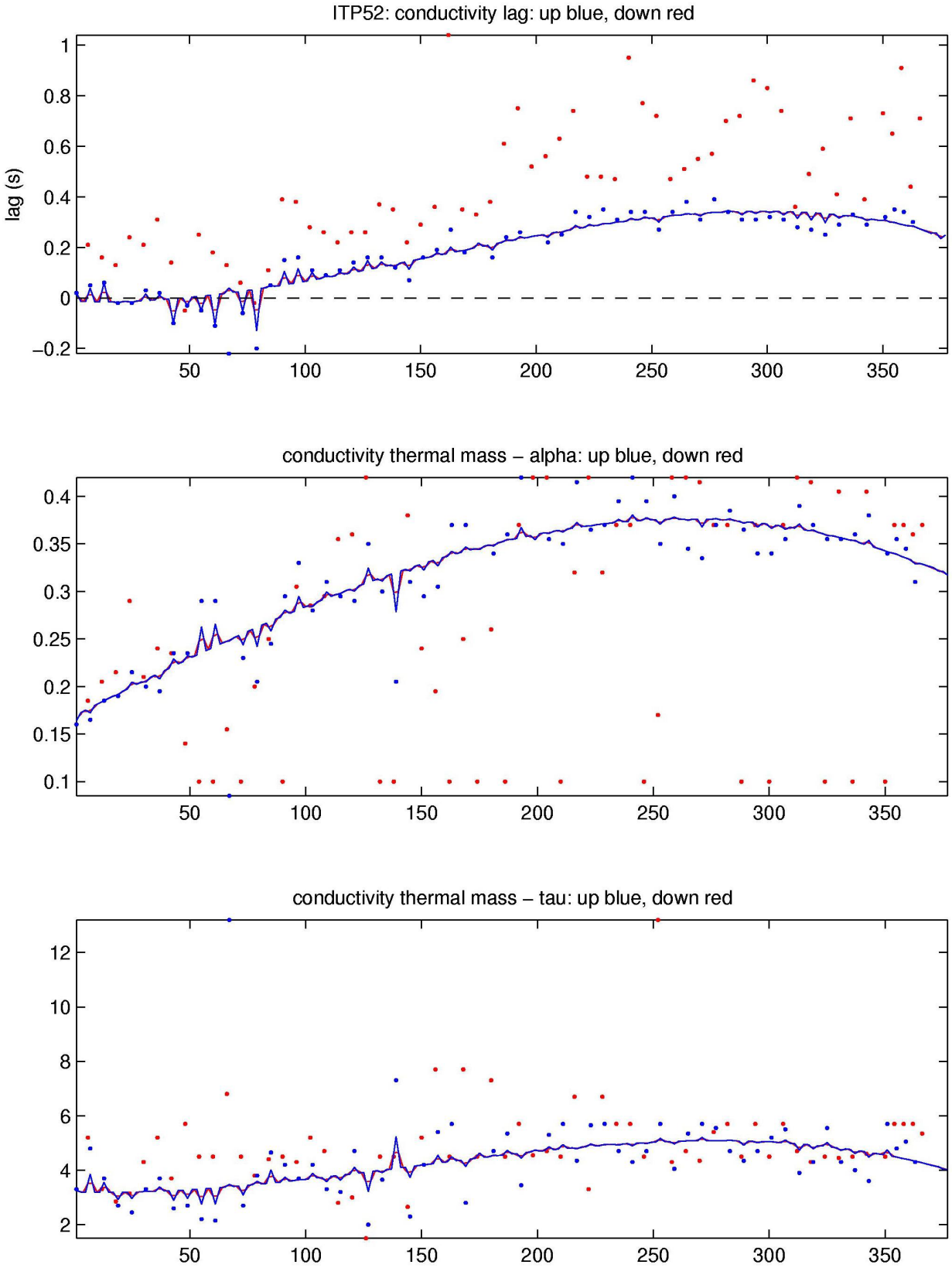
ITP surface buoy status.



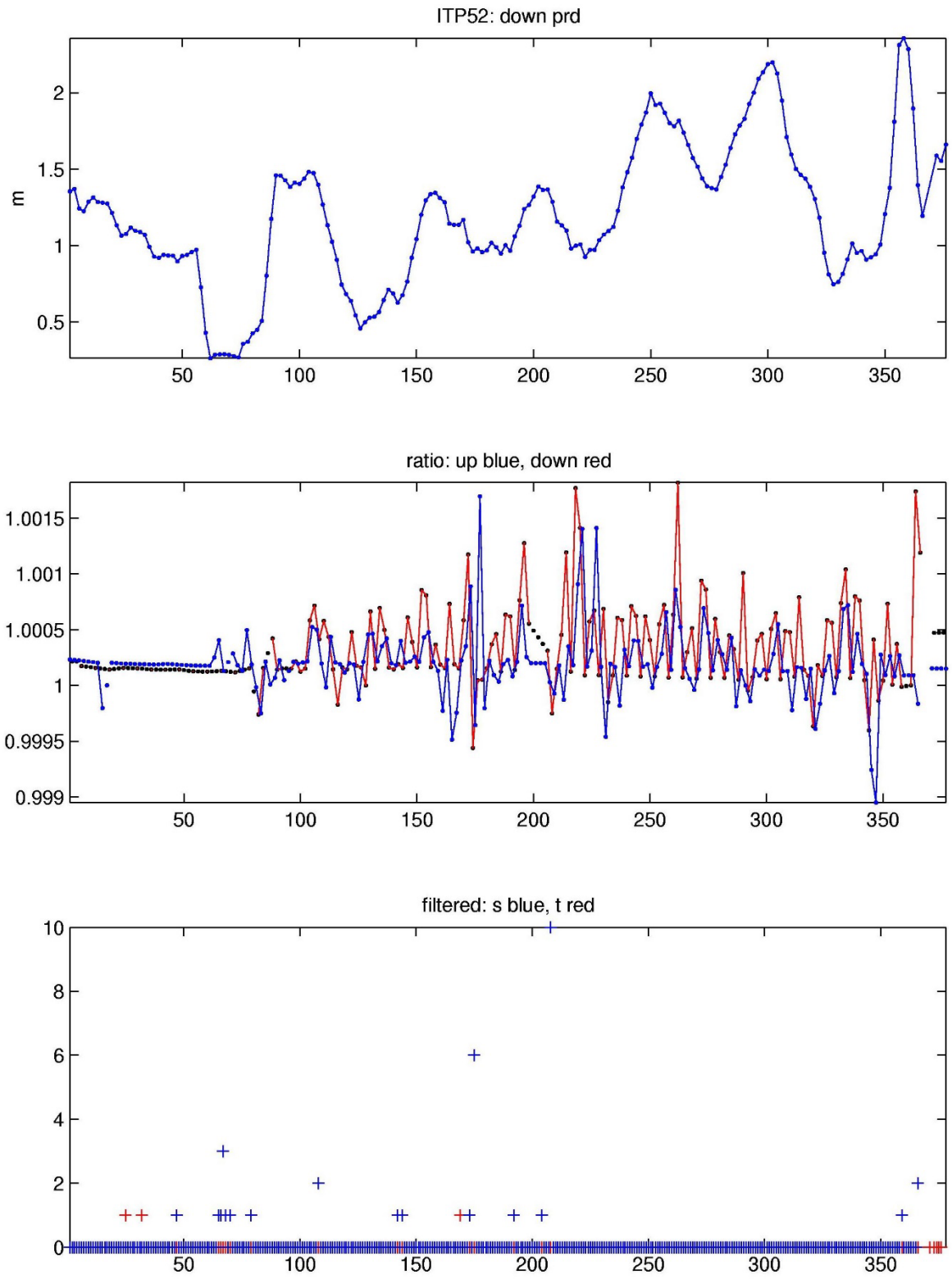
ITP profiler engineering data.



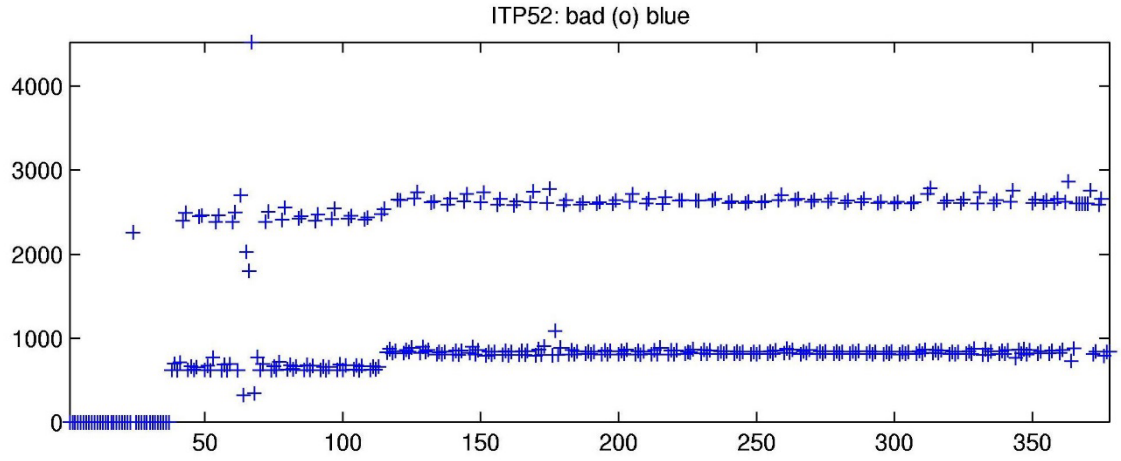
Number of bad points removed (top); variance of vertical difference of temperature and salinity in step region for up-going profiles; depth of staircase layer; temperature lag (bottom).

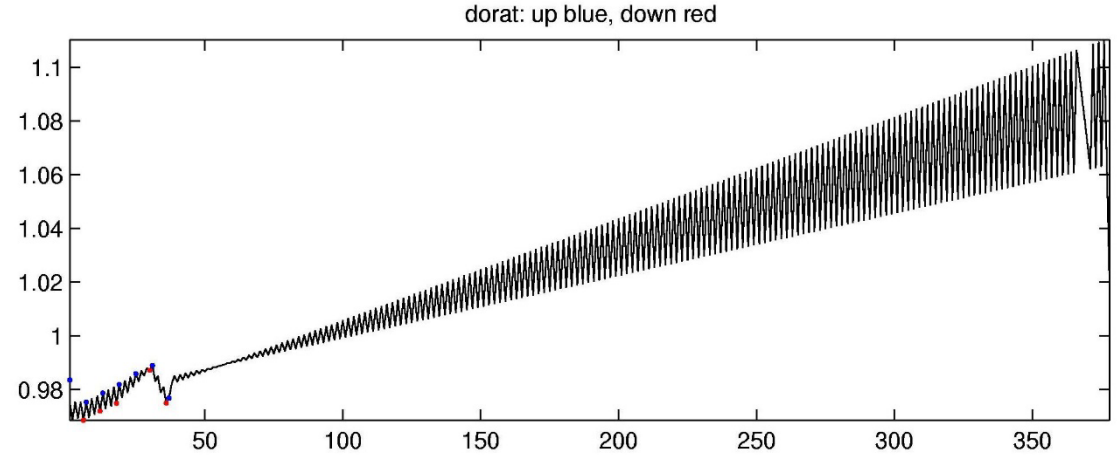


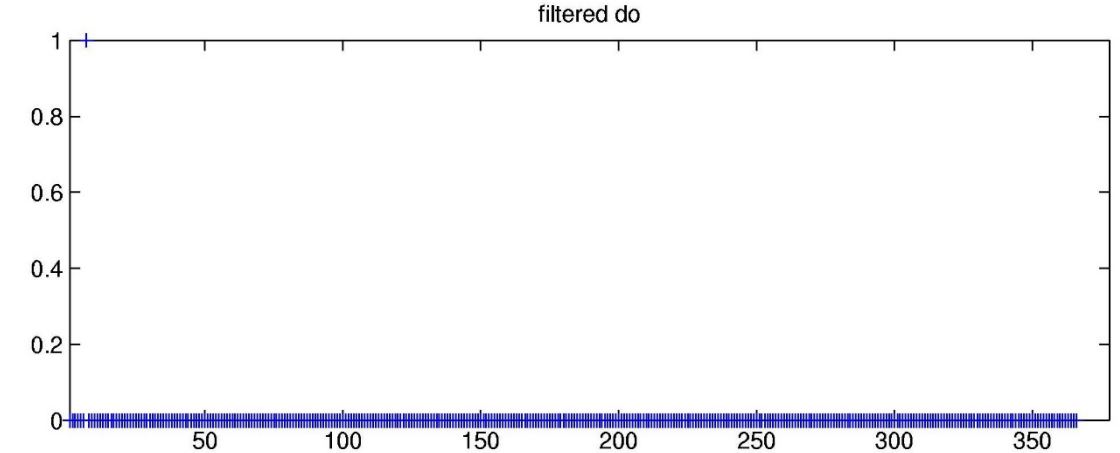
Top: conductivity lag, Middle: conductivity thermal mass amplitude correction, Bottom: conductivity thermal mass lag correction.



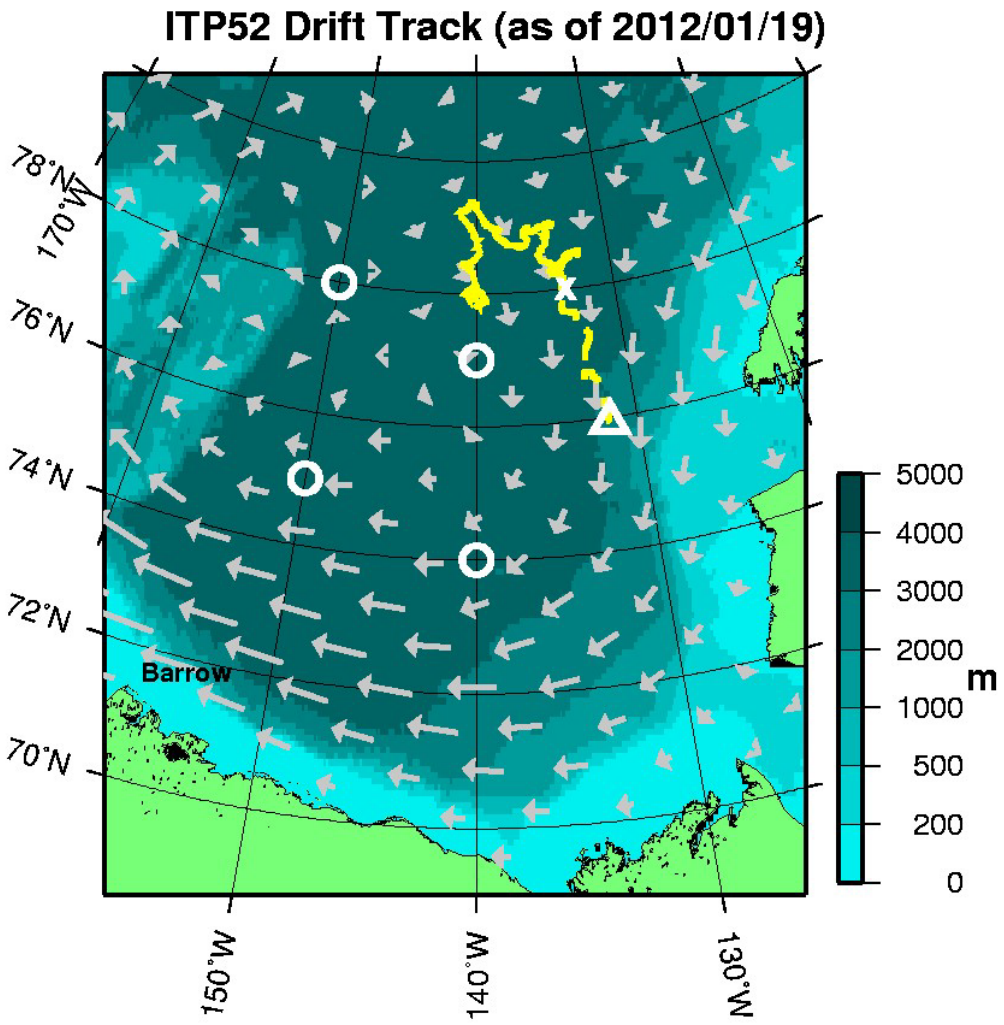
Top: down pressure deviation correction, Middle: salinity ratio adjustment, Bottom: Number of filtered spikes.





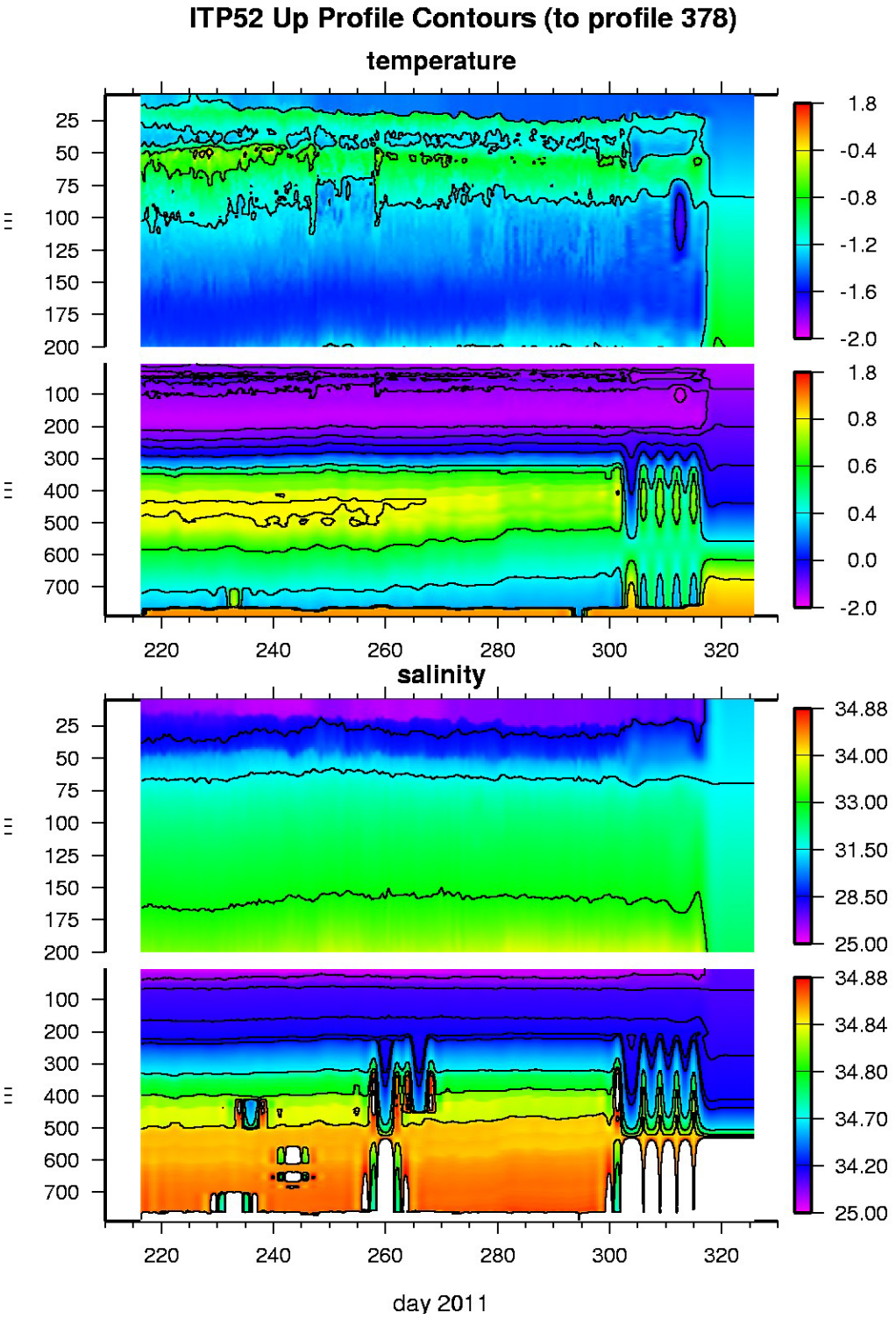


Top: number of bad dissolved oxygen points removed, Middle: dissolved oxygen ratio adjustment, Bottom: Number of filtered spikes.

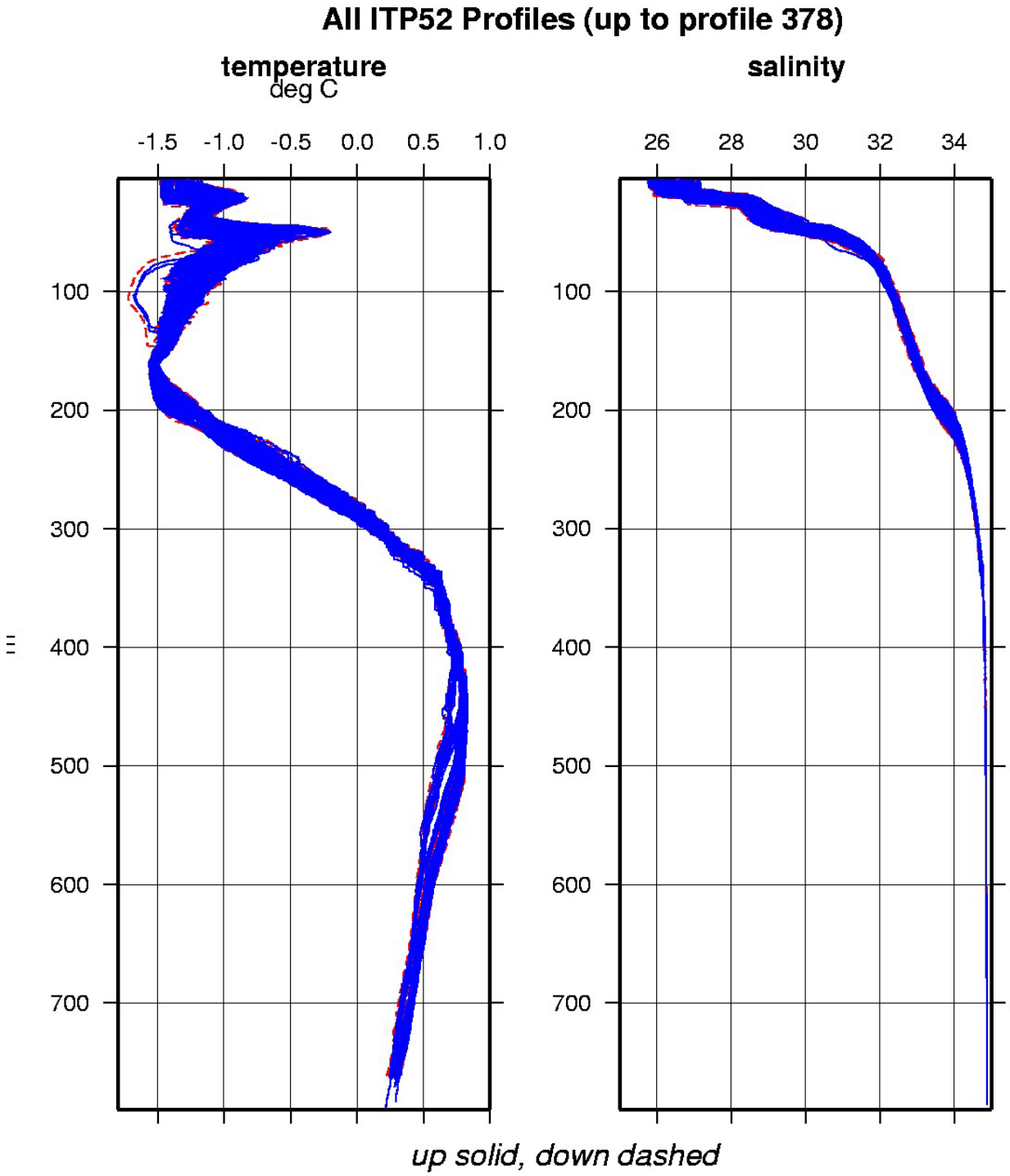


ITP drift (yellow line), last profile (x), last location (triangle), BGOS moorings (white circles) and annual ice drift from IABP (grey vectors) on IBCAO bathymetry (shading).

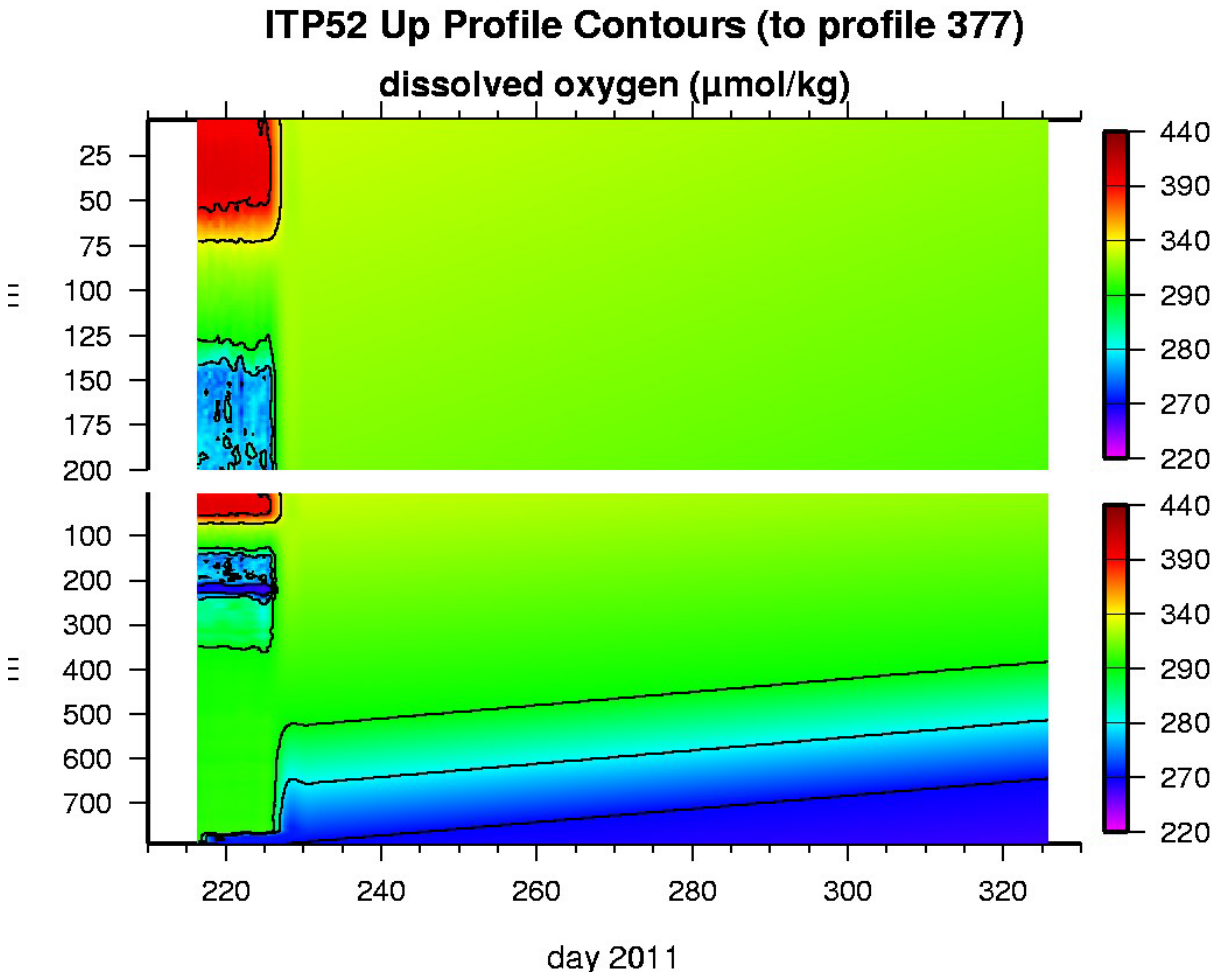
Plot of buoy locations.



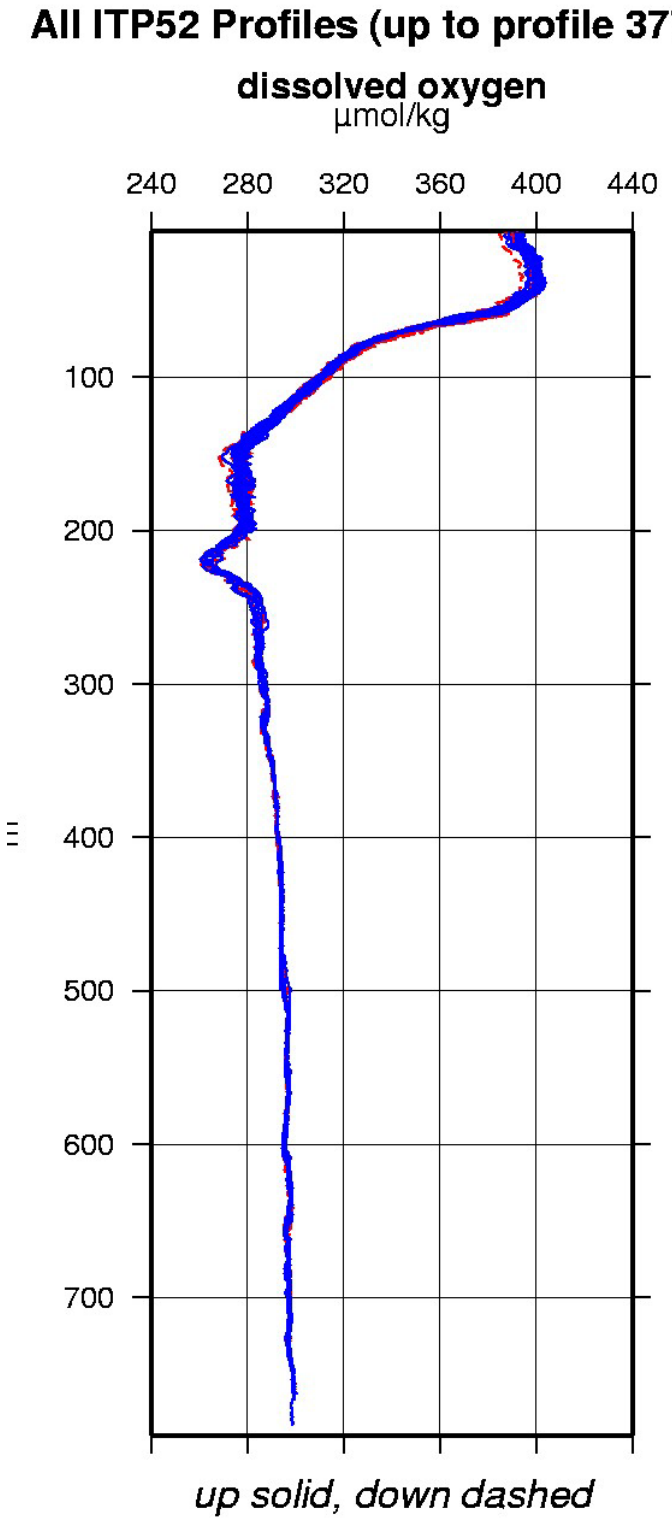
ITP 52 Temperature and Salinity contours.



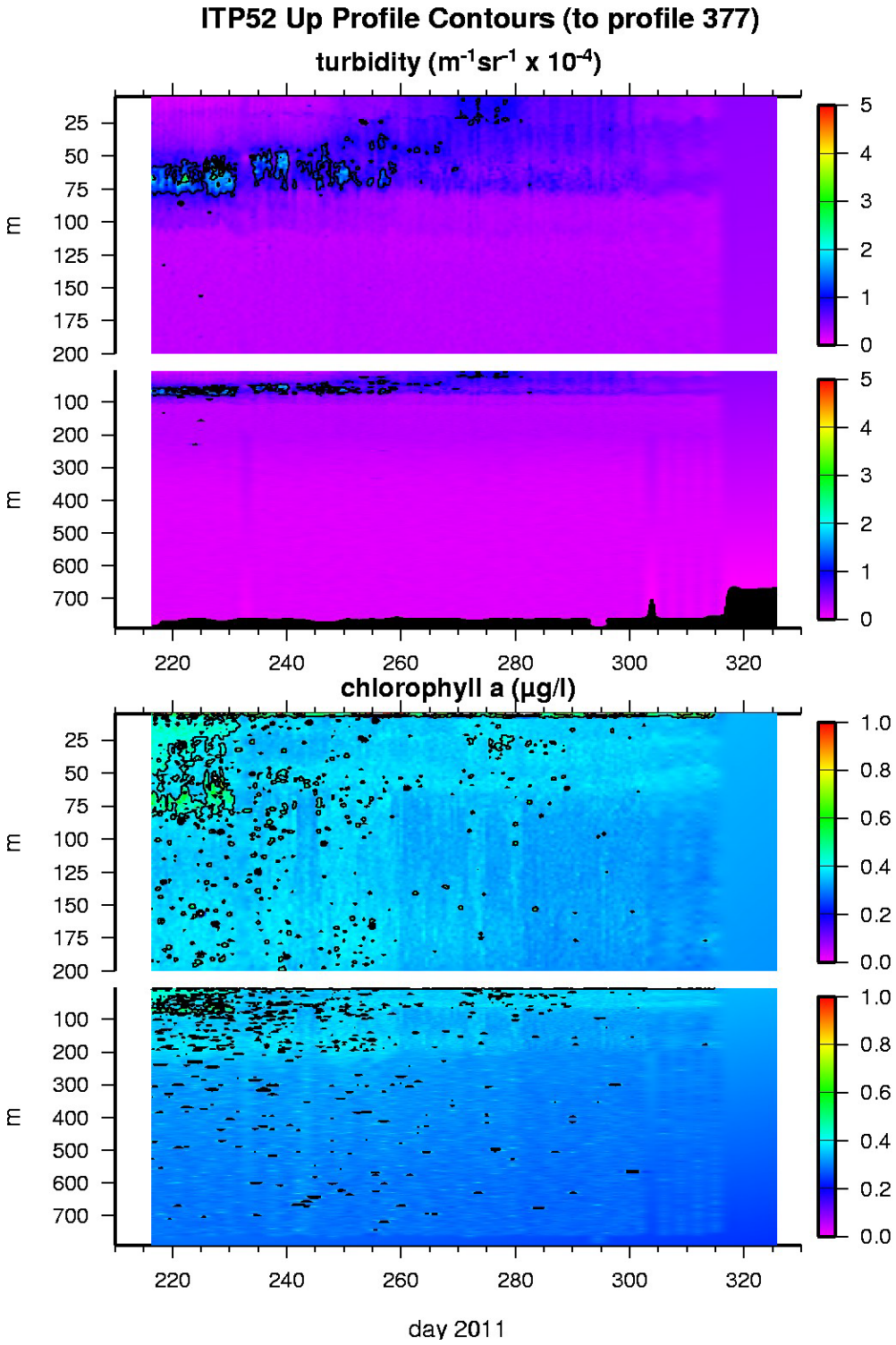
Composite plot of ITP temperature and salinity profiles.



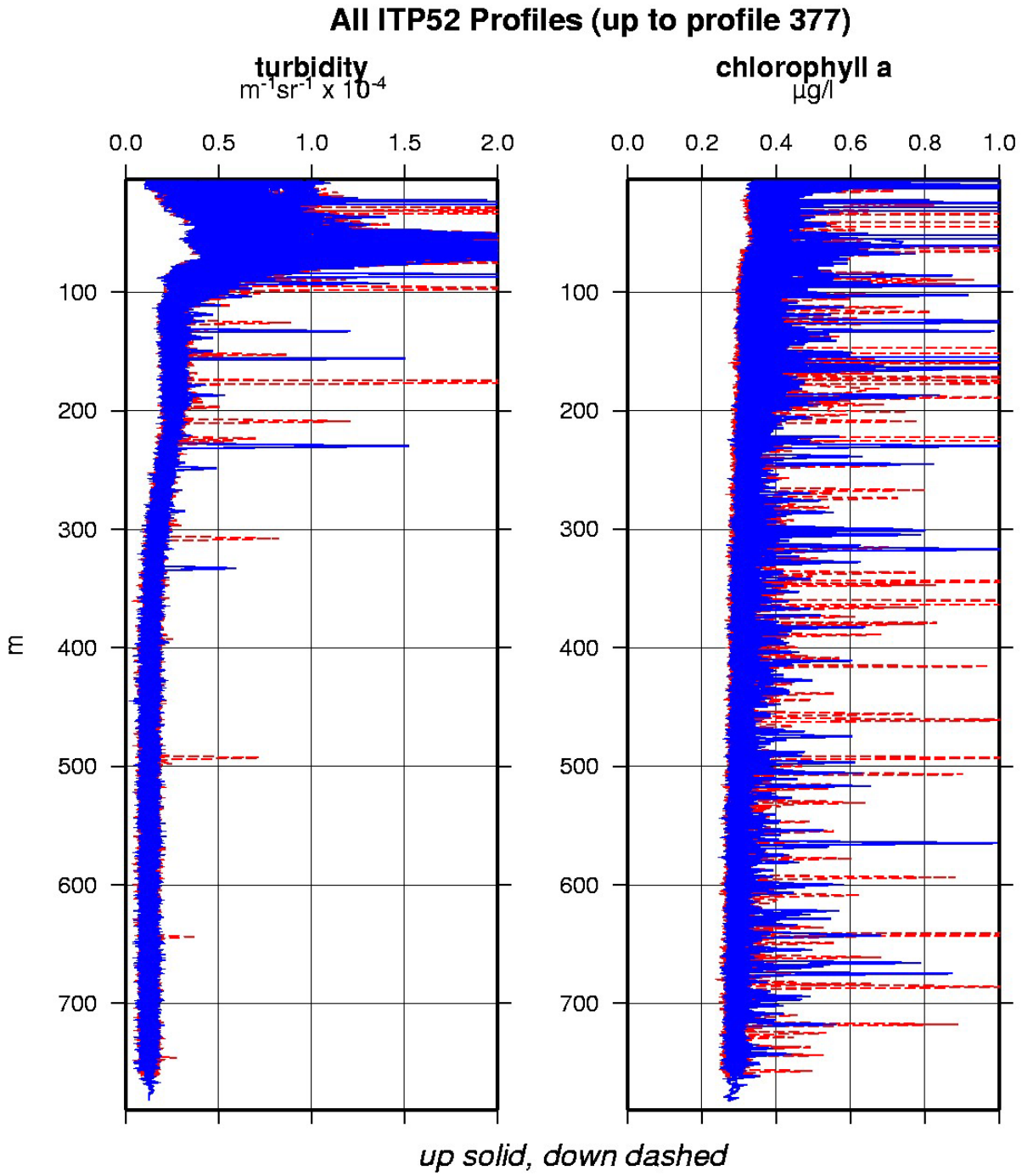
ITP 52 dissolved oxygen contours.



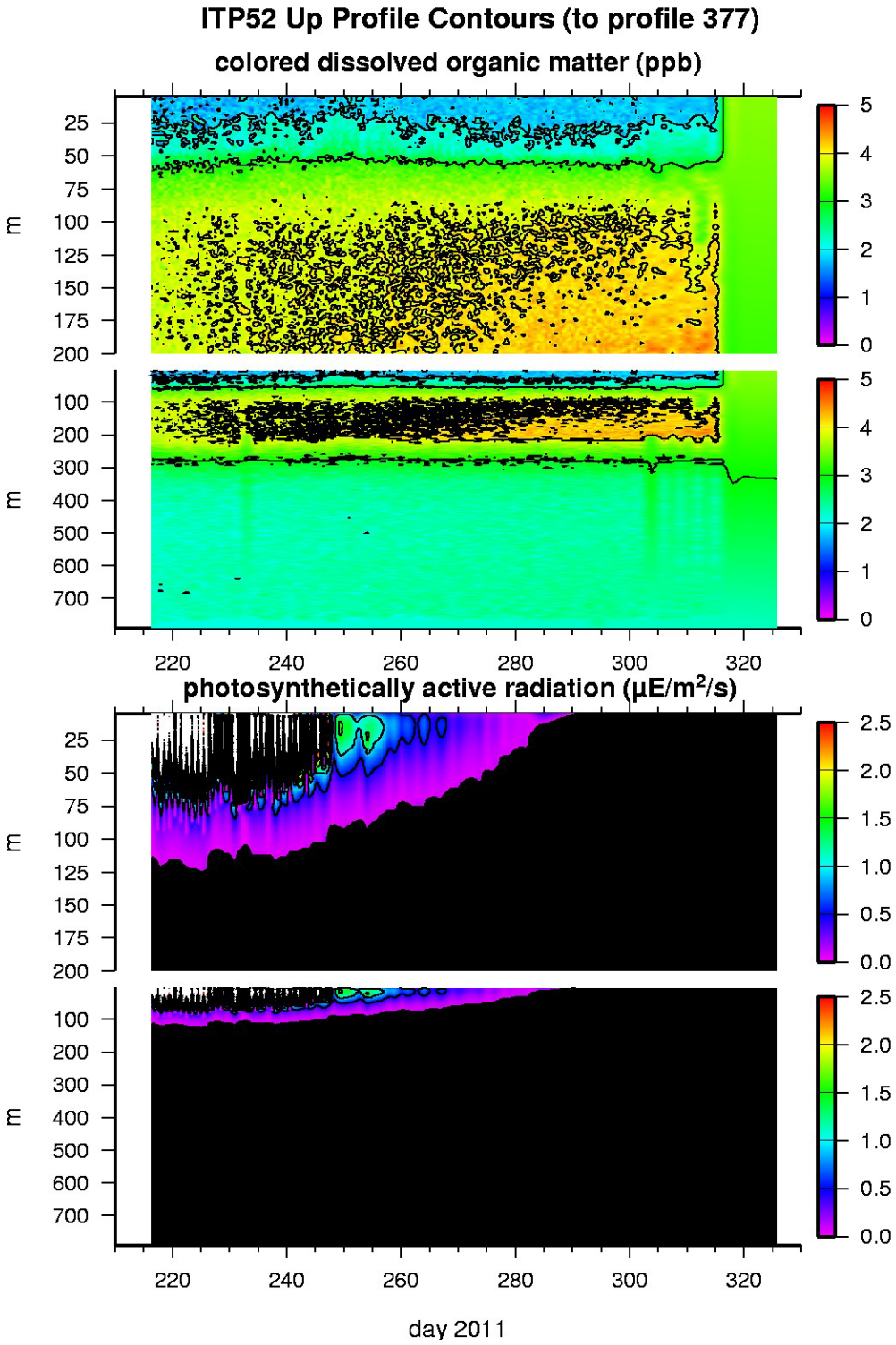
Composite plot of ITP dissolved oxygen profiles.



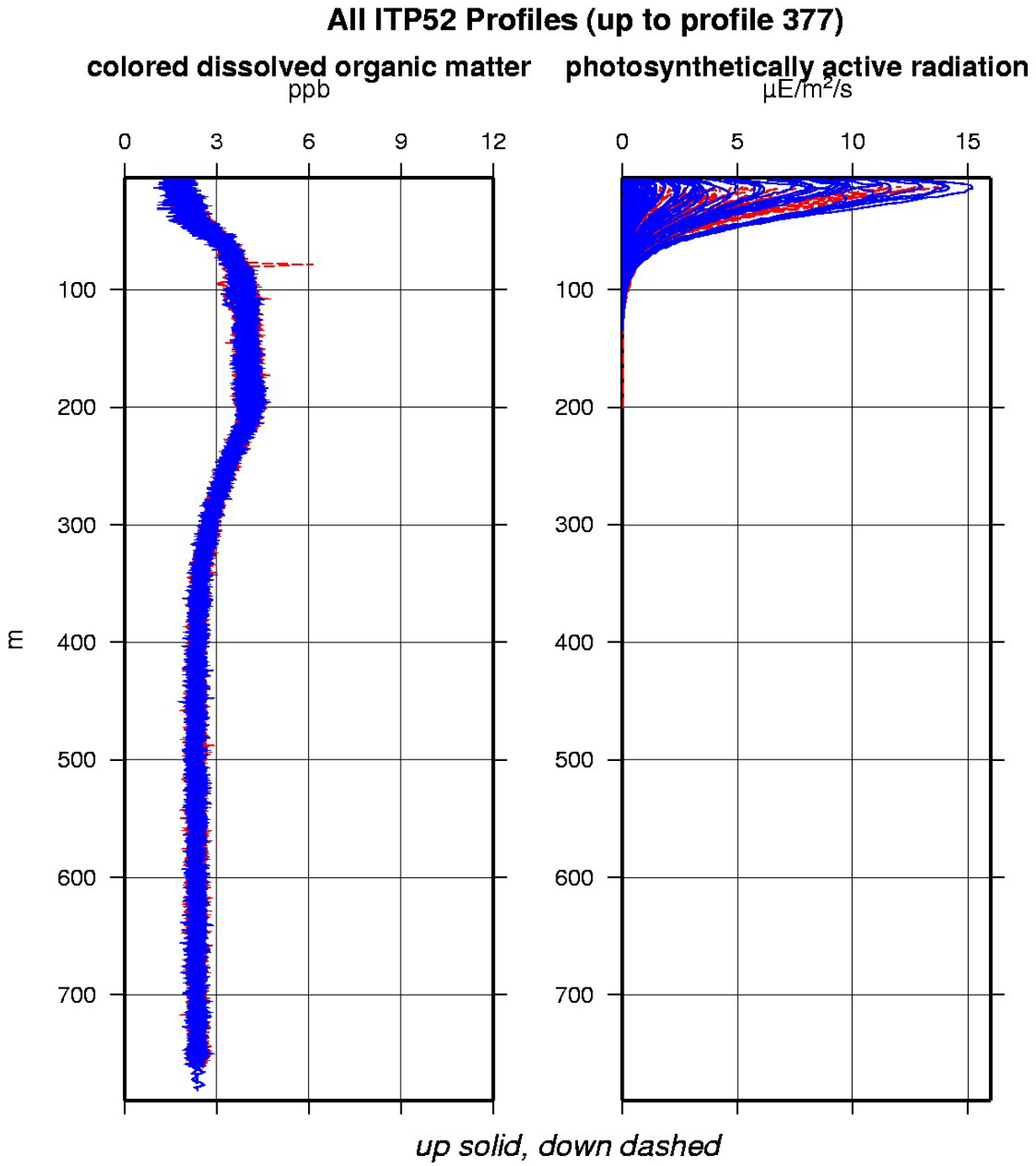
ITP 52 Turbidity and Chlorophyll a contours.



Composite plot of ITP turbidity and chlorophyll a profiles.



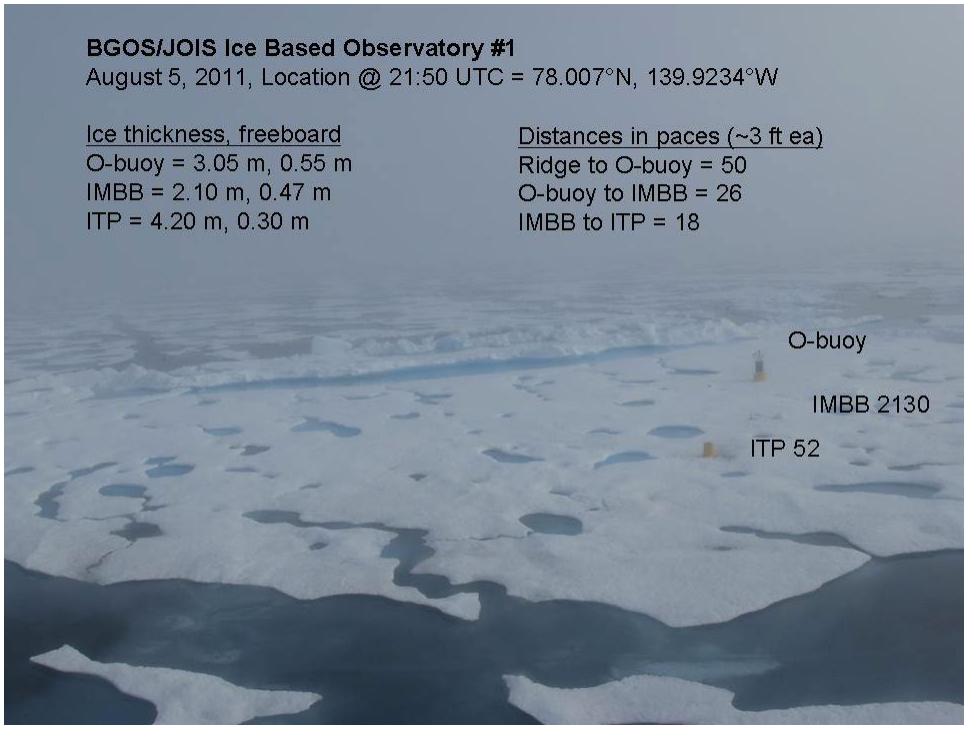
ITP 52 CDOM and PAR contours.



Composite plot of ITP CDOM and PAR profiles.

First Ice-Based Observatory deployed during the JOIS 2011 cruise consisted of O-buoy 5, IMB 2011-I and ITP 52 with biosuite package. (Rick Krishfield)

Despite the light fog, the CCGS Louis St. Laurent looms large behind ITP 52 shortly after deployment. (Rick Krishfield)



View from the last helicopter flight of the first IBO deployed during the JOIS 2011 expedition showing distribution of the buoys on the floe, ice thickness and freeboard measurements at the buoy sites. (Rick Krishfield)