ITP65 Overview

Deployment Location: 8/27/2012, 01:32 UTC at 80° 53.3'N, 137° 26.3'W

Last Location: 9/10/2013, 23:02 UTC at 74° 10.60' N, 149° 59.50' W

Duration: 380 days

Distance Travelled: 3761 km

Number of profiles: 903 in 306 days

Other instruments: AOFB 24, IMB 2012-L, O-buoy 7, ITM1

ITP65 was deployed on a 1.52 m thick ice floe 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. On the same icefloe, a Naval Postgraduate School Arctic Ocean Flux Buoy (AOFB 24), a US Army Cold Regions Research and Engineering Laboratory (CRREL) Seasonal Ice Mass Balance Buoy (IMB 2012-L), an autonomous atmospheric chemistry buoy (O-Buoy 7) and an Ice-Tethered Micro (ITM 1) were also installed. The ITP includes a dissolved oxygen sensor and full biosuite system and a fixed SAMI pCO2 with SBE-37 microcat at 6 m depth and is operating on a pattern profiling sampling schedule including one full one-way profile between 7 and 760 m depth every 1.5 days.

ITP65 Deployment Operations

Ice-Based Observatories (IBOs) consisting of several automated buoys with complementary instrumentation provide coincident data from the atmosphere, sea ice, and ocean from the sites that they are deployed and provide opportunities for cross correlating observations. As part of the first IBO deployed during JOIS 2012, ITP 65 included biosuite sensors on the profiler and a SAMI pCO2 clamped on the wire to further increase the variables measured at the IBO site. In addition, while the buoys making up the IBO were being deployed, other scientists obtained detailed ice surveys, core samples, and made other measurements providing a detailed description of the initial conditions at the site.

Ice floe selection for IBOs can be tricky as the spacing requirements of the buoys may require separation of more than 25-100 m so typically larger sturdy floes are desired. A relatively flat surface with not too much snow cover also facilitates the hauling and deployment operations on the ice. This year was a particularly bad year for ice in this region, so when an apparently decent floe appeared in the morning near the ship a quick survey was taken using the helicopter to land on the ice which was drilled to determine a depth greater than 1.5 m at several sites.

Two hours later, after staging all the equipment loads for the helicopter to ferry to the selected site, the deployment team landed on the floe. Several groups worked simultaneously on different buoy deployments. First, the portable 14" hydraulic auger was used by the ITP team to bore through the 3.55 m thick ice for the O-Buoy, that buoy lowered into position by the helicopter, then the complicated superstructure assembled by the O-buoy team. Then the auger was moved and used first to drill the hole for the AOFB, the tripod positioned, and that buoy installed in less than an hour. Then the tripod was moved to the ITP hole and that operation completed 4 hours later, and then to the ITM site for a half hour deployment. Meanwhile, the IMB was deployed by a third team.

ITP65 Data Processing

The 903 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). Buoy drift speeds were usually less than 30 cm/s so the profiler covered nearly the full extent of the majority of profiles that it communicated to the surface package, except for a 10 day stretch in early May and the last 2 days in late June when the profiler seemed unable to climb the wire despite slow drift speeds.

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 41 days, but ceased communicating with the surface package on October 6, 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.

ITP65 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 (after November 1), 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 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 4 months after deployment the ITP generally stayed within a radius of 100 km from where it was deployed, then headed south along 140° W, then southwest, and then east over the next 6 months, eventually losing communications with the profiler unexpectedly in deep water. Afterwards the surface package (presumably without mooring) was pushed rapidly west for another 74 days before the surface package ceased transmitting.

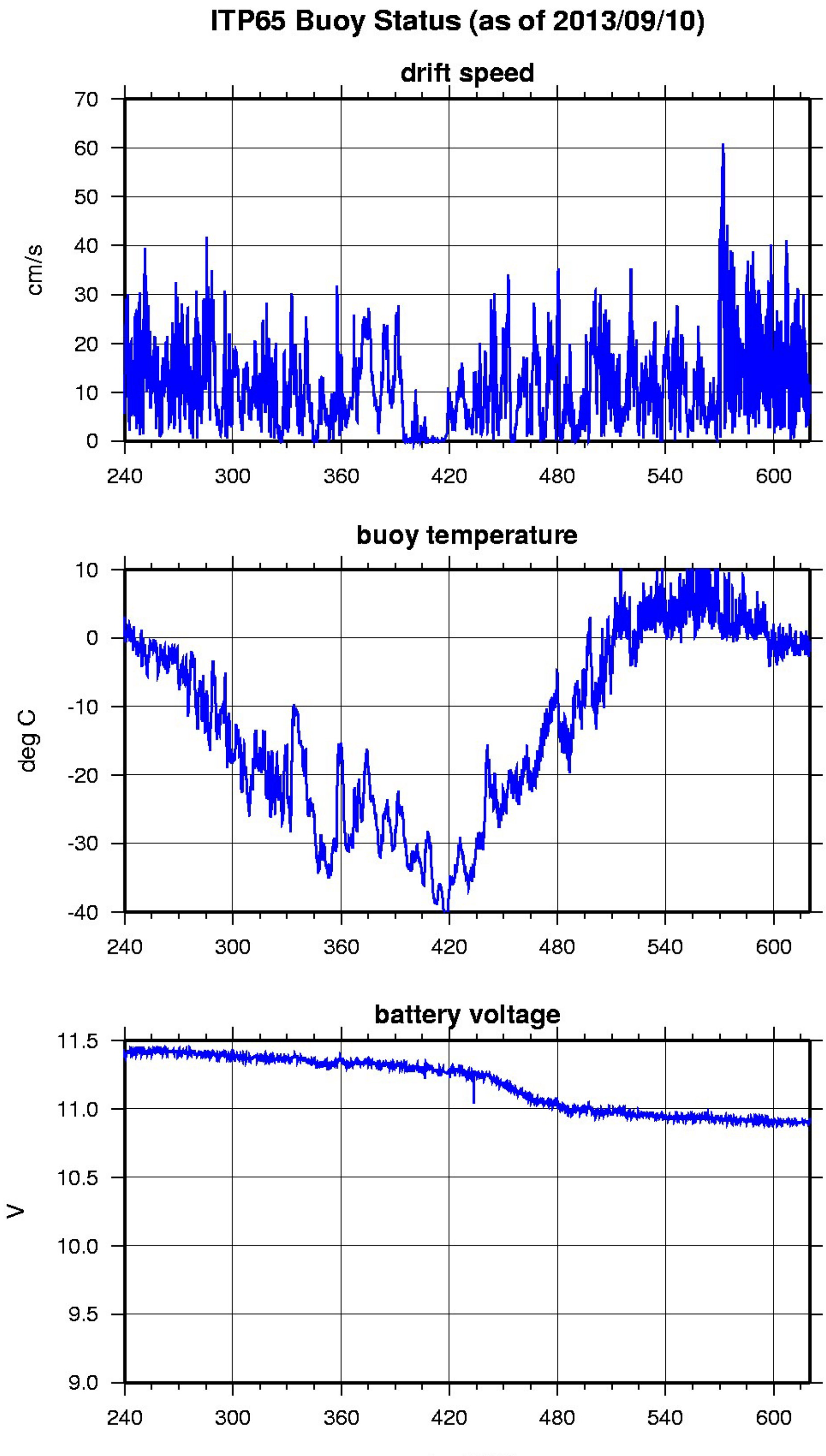
The plots below are of the final, calibrated, edited data (as opposed to the raw data presented on the active instrument pages).

Level II hourly buoy location data in ASCII format: itp65rawlocs.dat

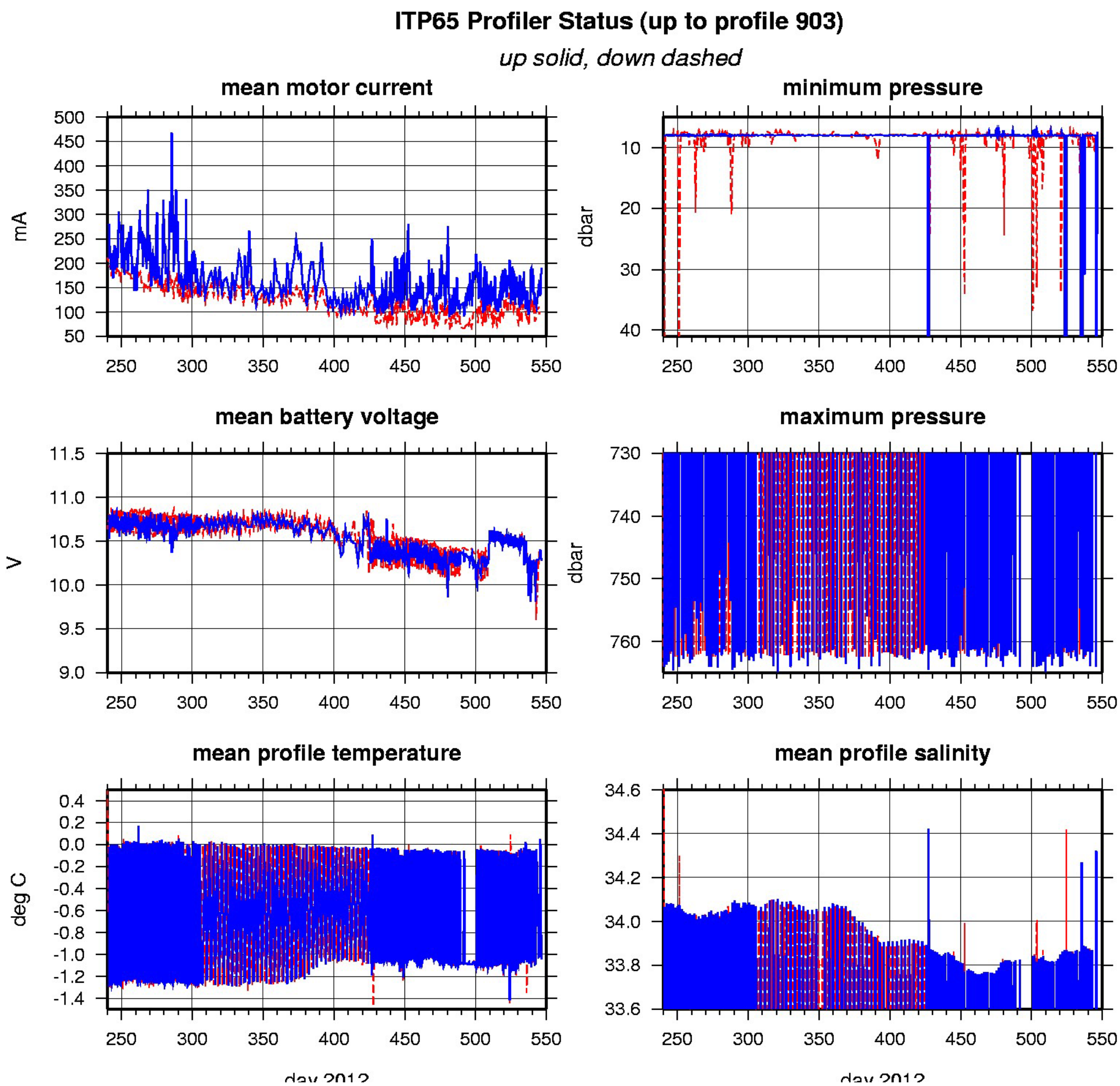
Level III 1-Hz processed profile and SAMI data in MATLAB format: itp65cormat.tar.Z or itp65cormat.zip

Level III 1-db bin-averaged processed profile and SAMI data in MATLAB format: itp65final.mat

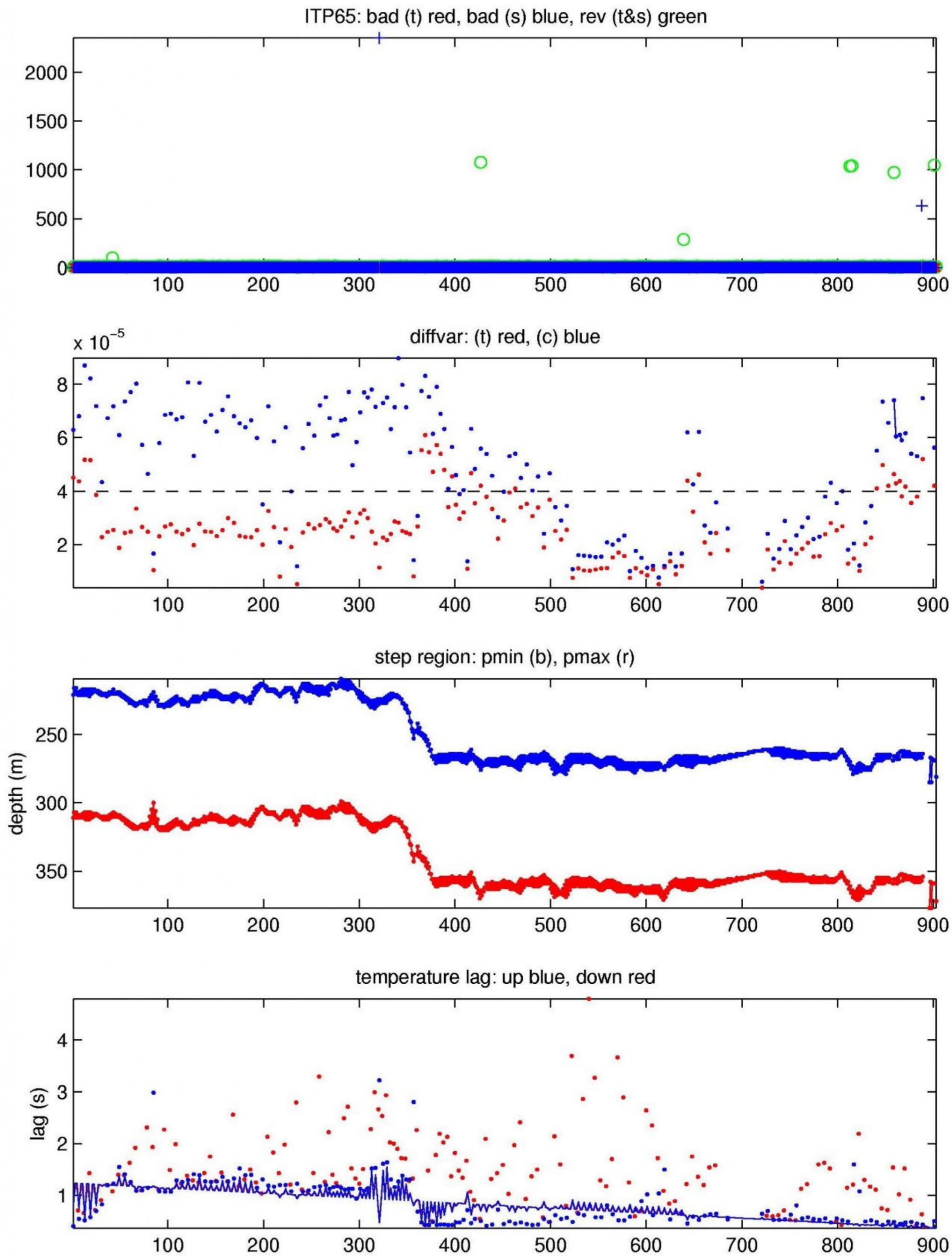
Level III 1-db bin-averaged processed profile and SAMI data in ASCII format: itp65final.tar.Z or itp65final.zip



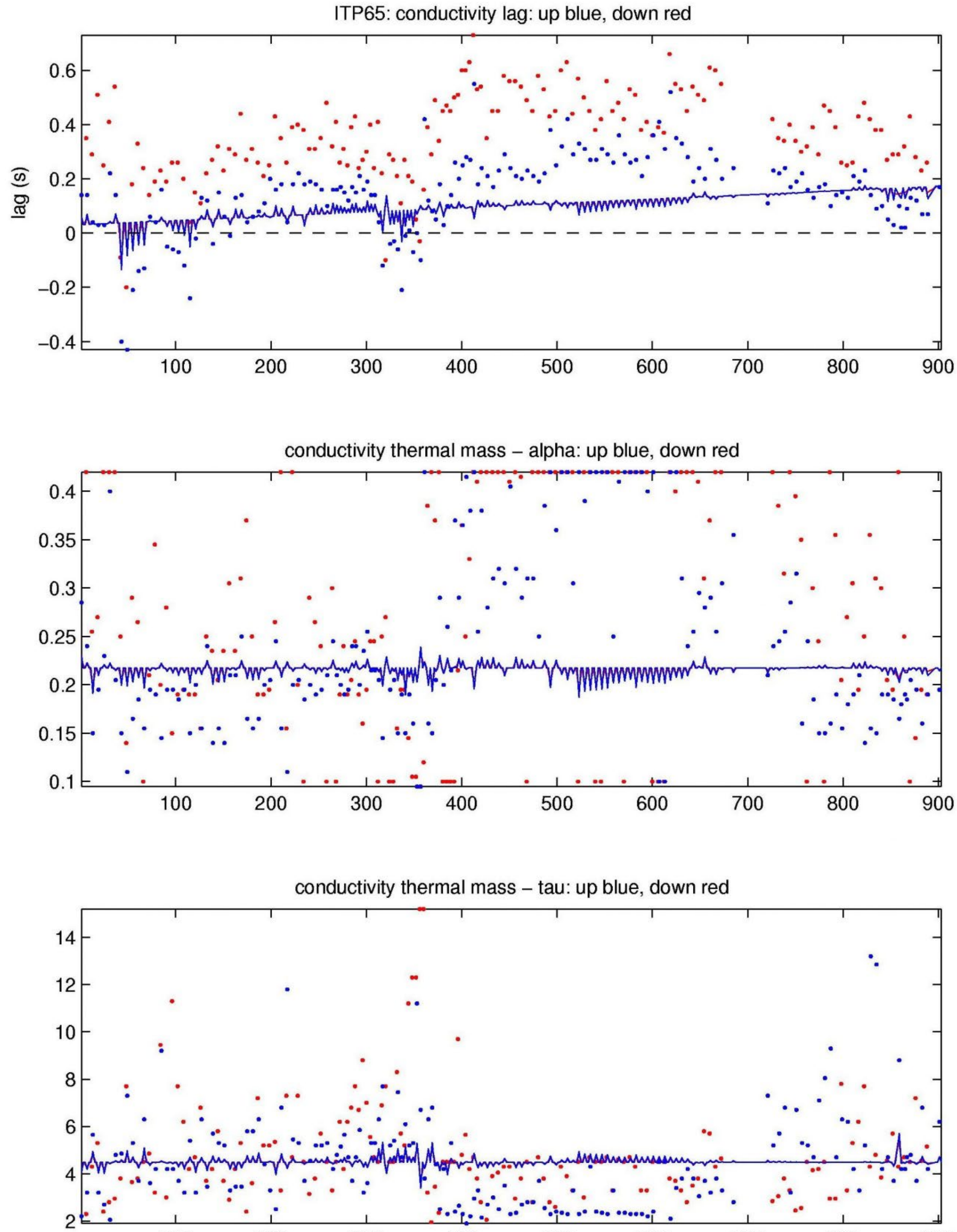
ITP surface buoy status.



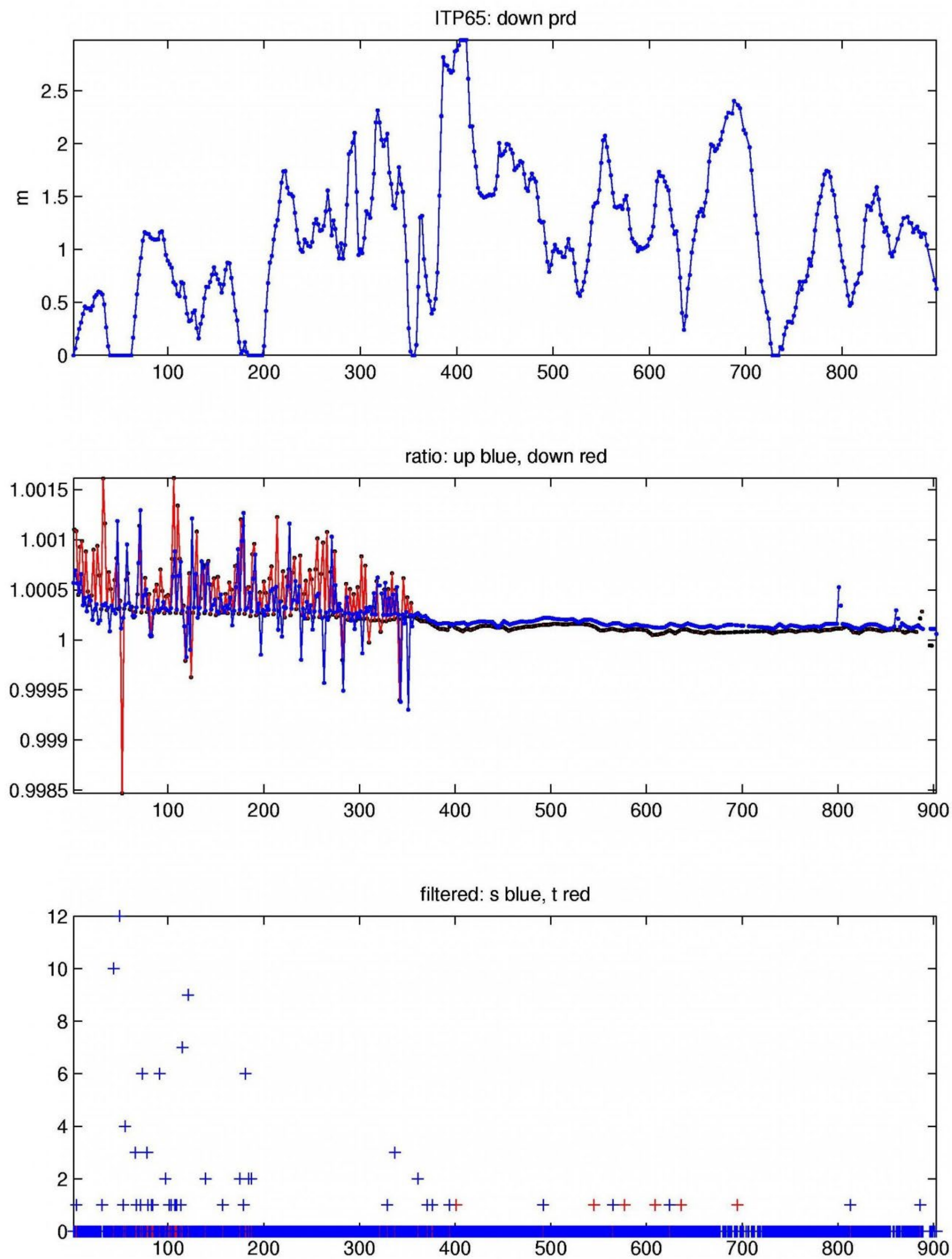
ITP profiler engineering data.



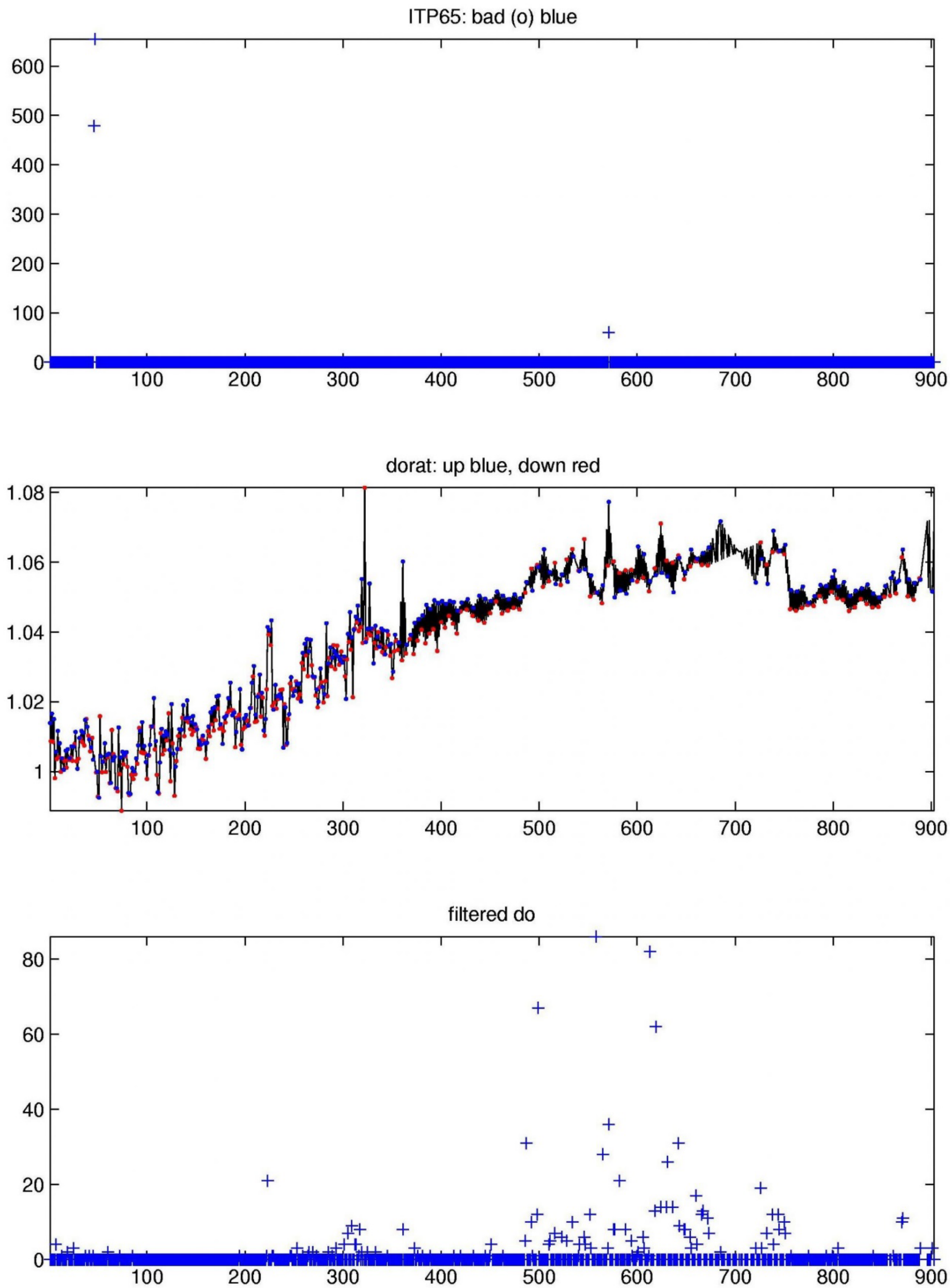
Number of bad points removed (top); variance of vertical difference of temperature and salinity in step region for up-going profiles; depth of staircase layer; temperature lag (bottom).



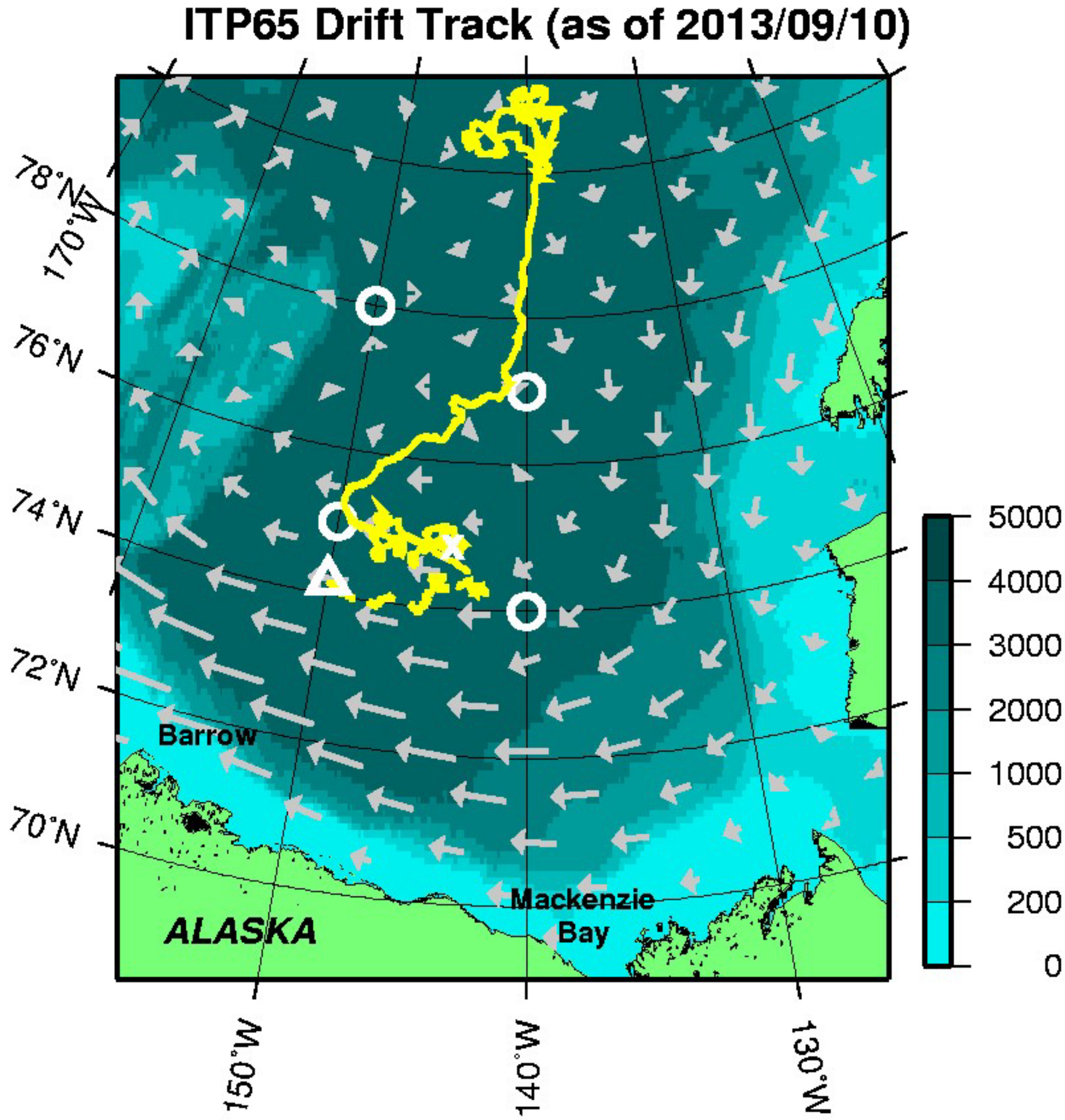
Top: conductivity lag, Middle: conductivity thermal mass amplitude correction, Bottom: conductivity thermal mass lag correction.



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

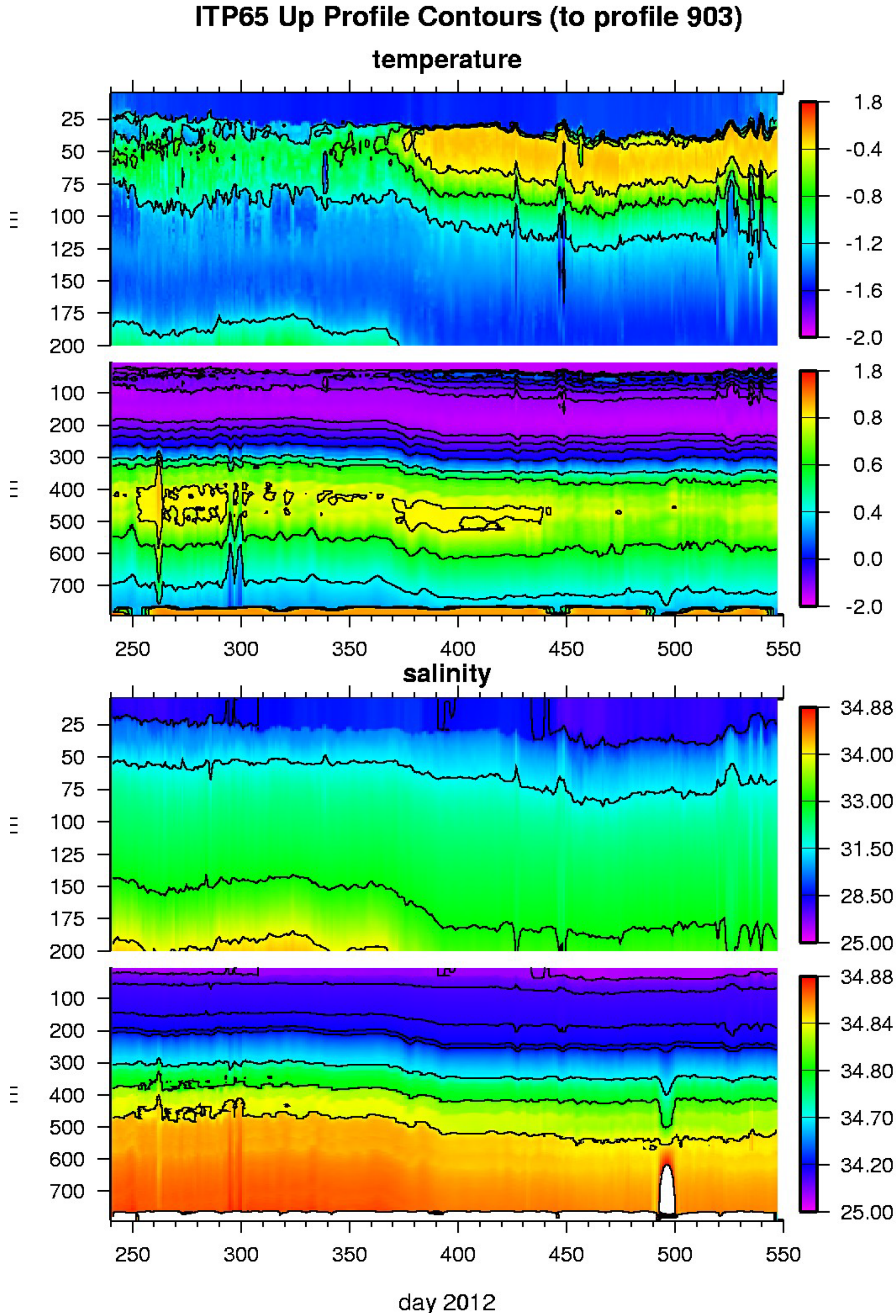


Top: number of bad dissolved oxygen points removed, Middle: dissolved oxygen ratio adjustment, Bottom: Number of filtered spikes.

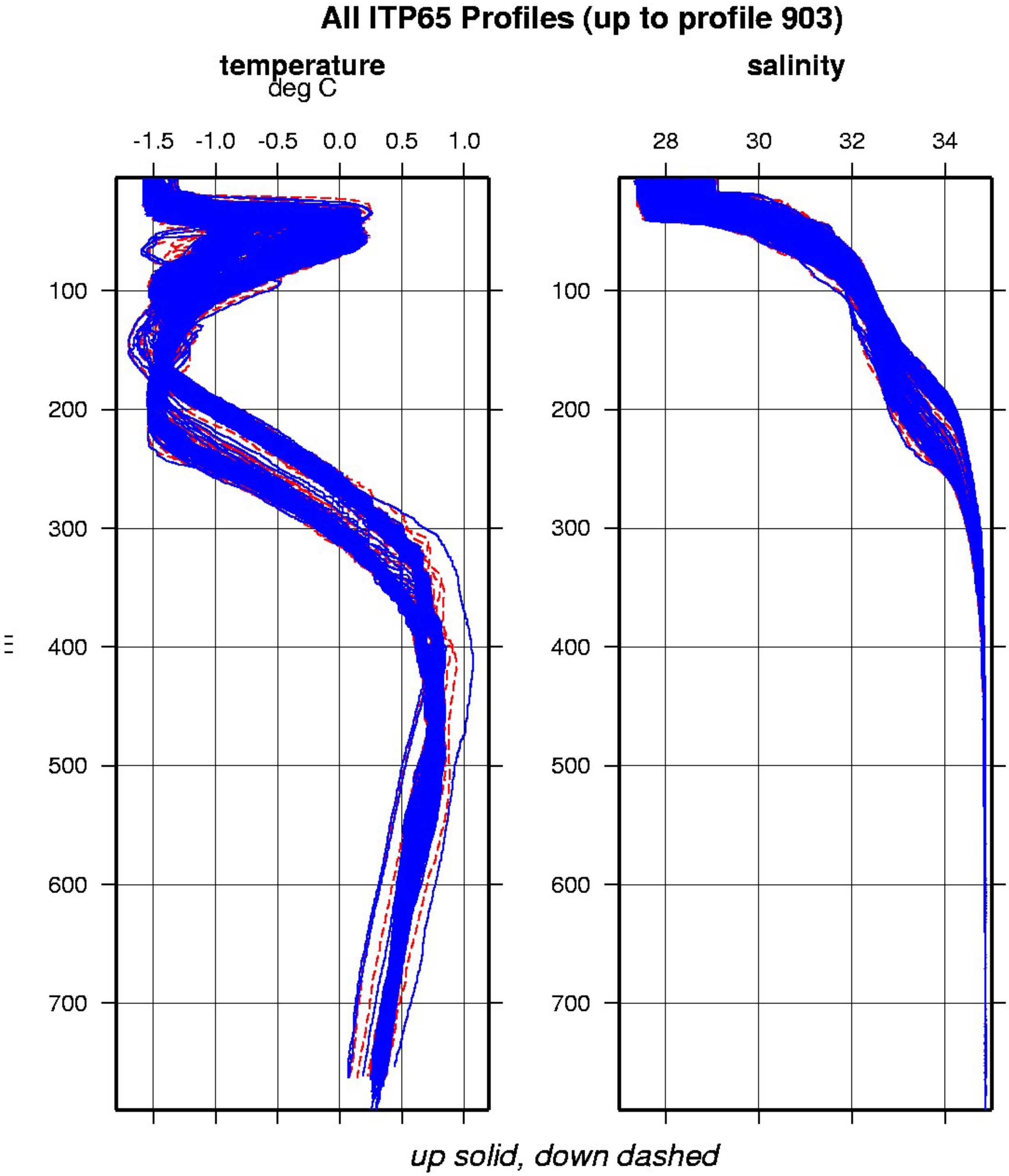


ITP drift (yellow line), last profile (x), last location (triangle), BGOS moorings (white circles) and annual ice drift from IABP (grey vectors) on IBCAO bathymetry (shading).

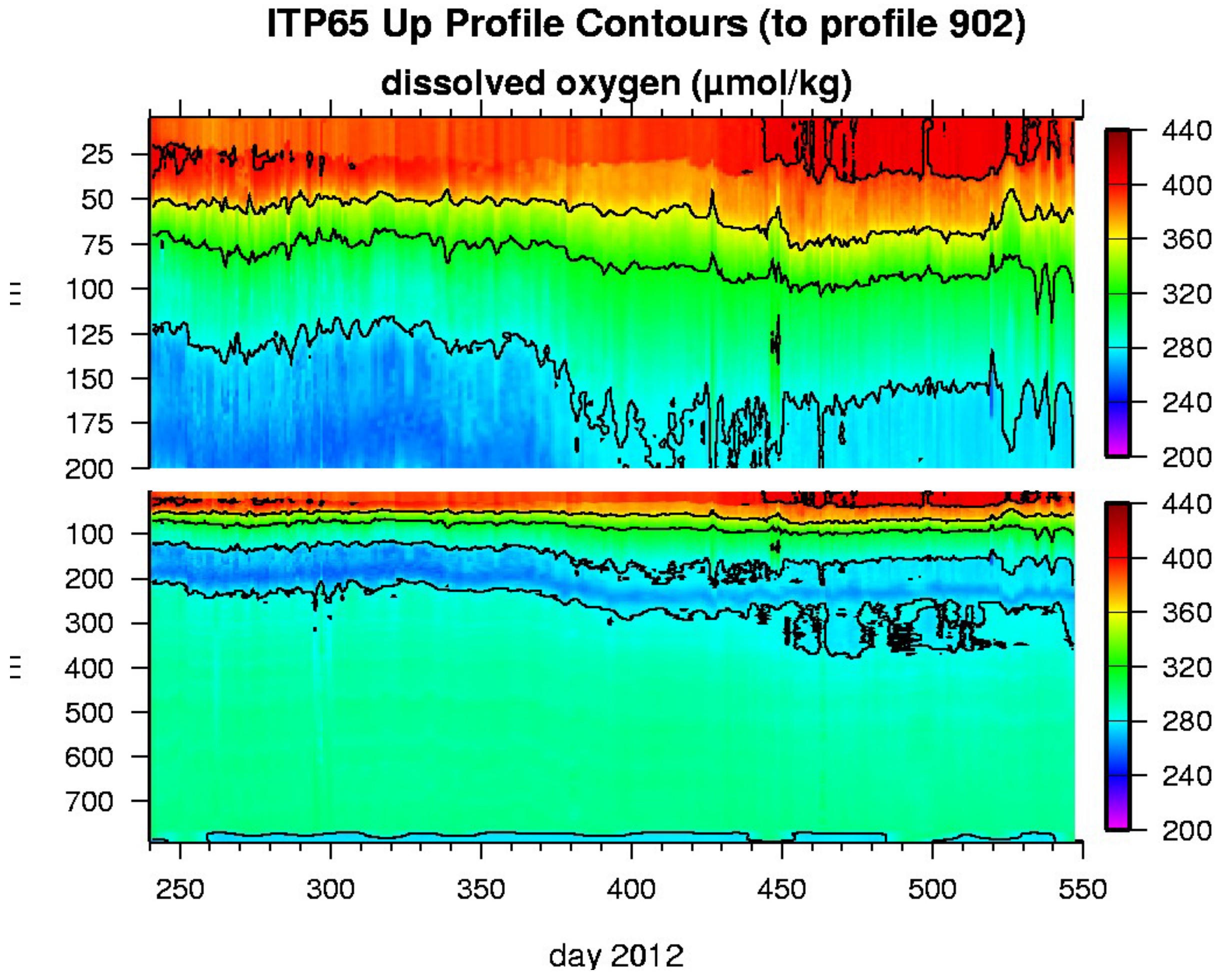
Plot of buoy locations.



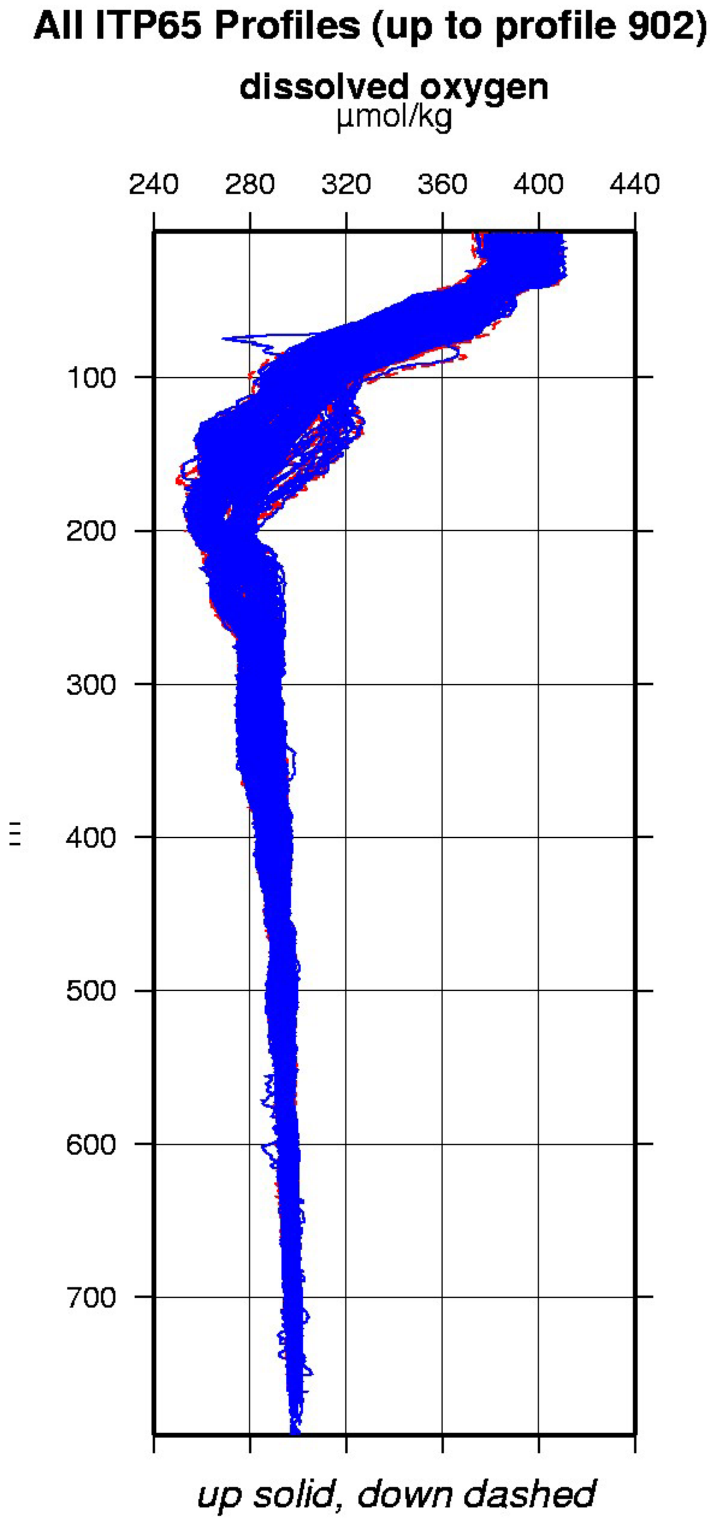
ITP 65 Temperature and Salinity contours.



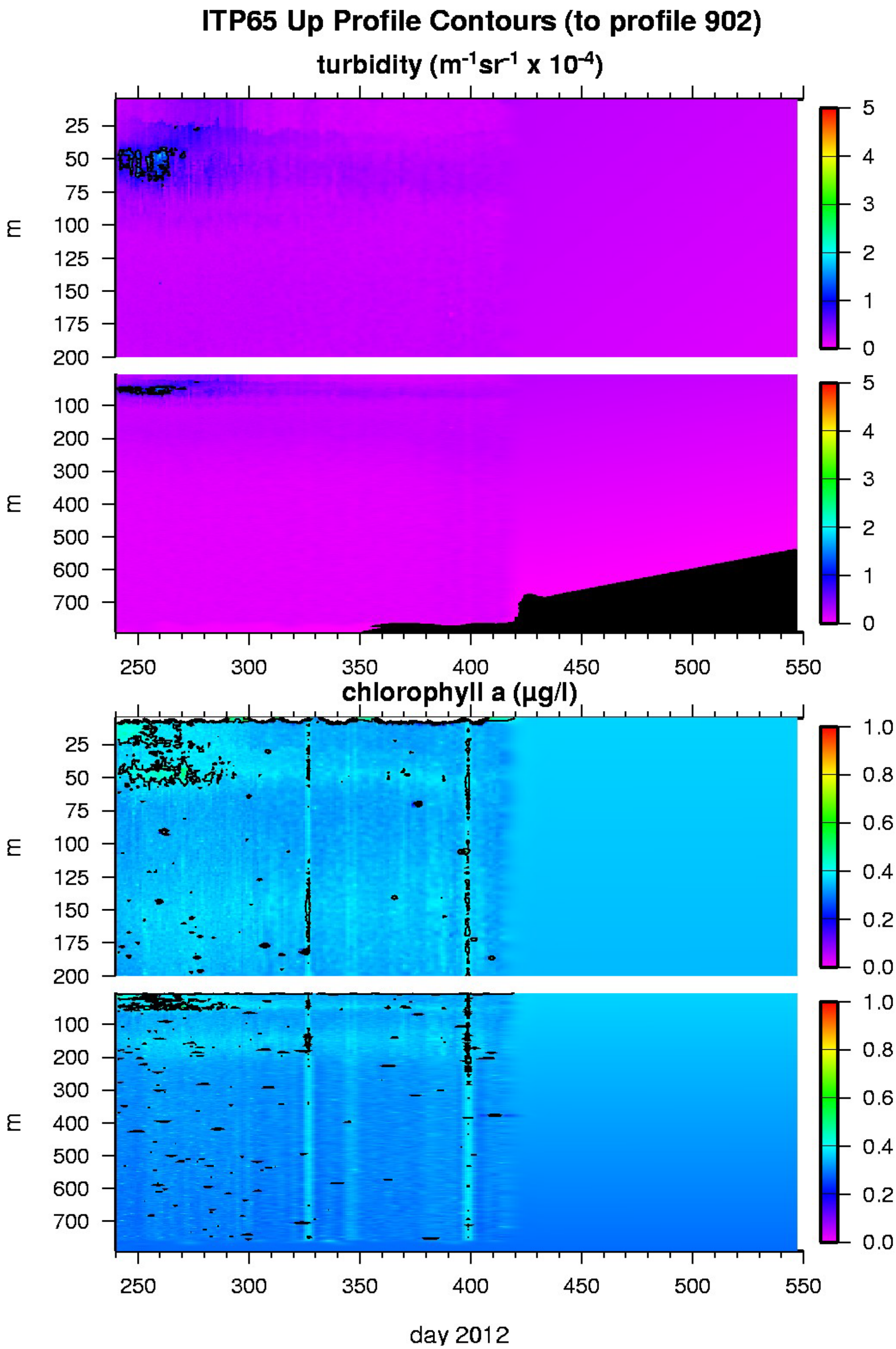
Composite plot of ITP temperature and salinity profiles.



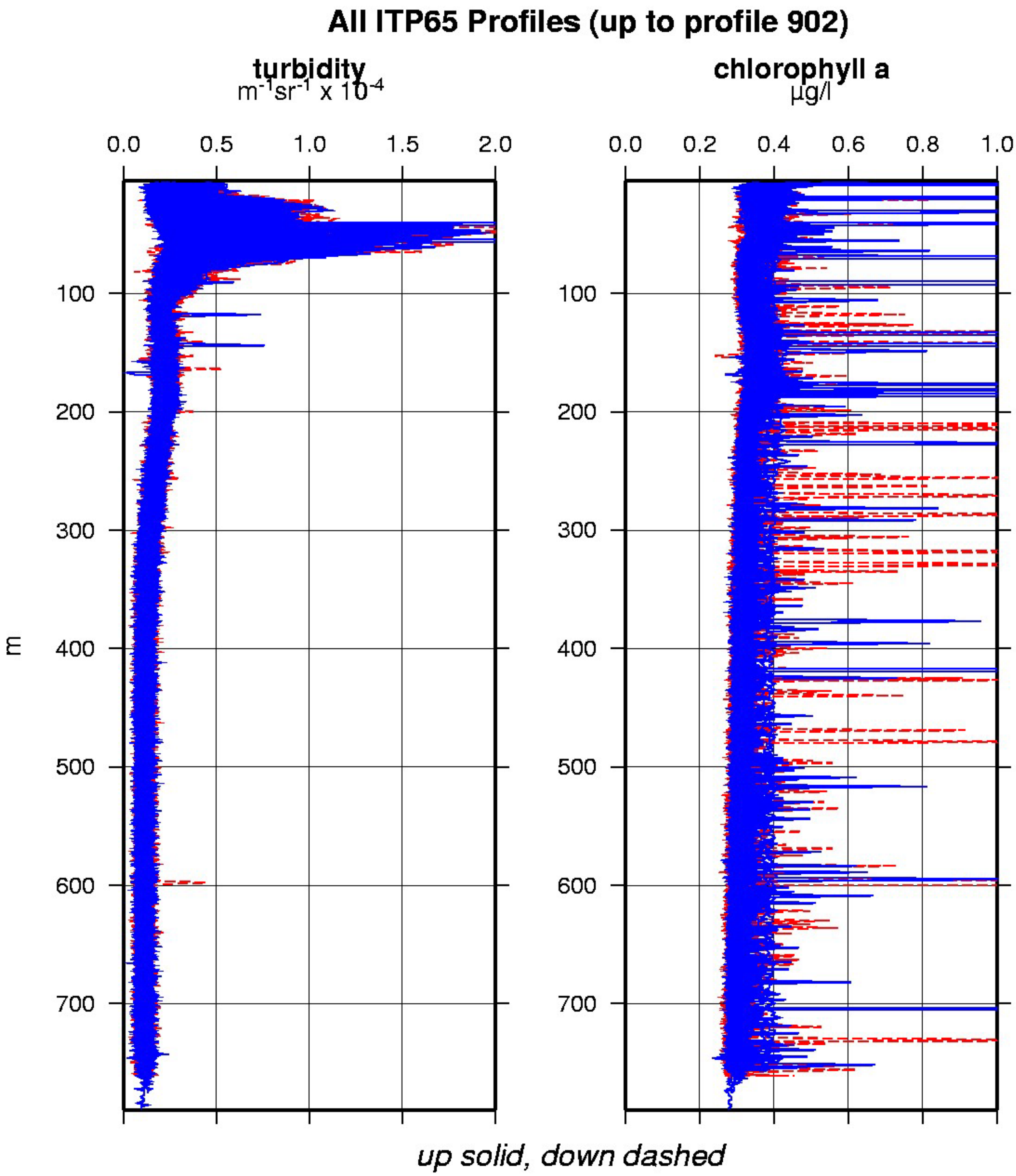
ITP 65 dissolved oxygen contours.



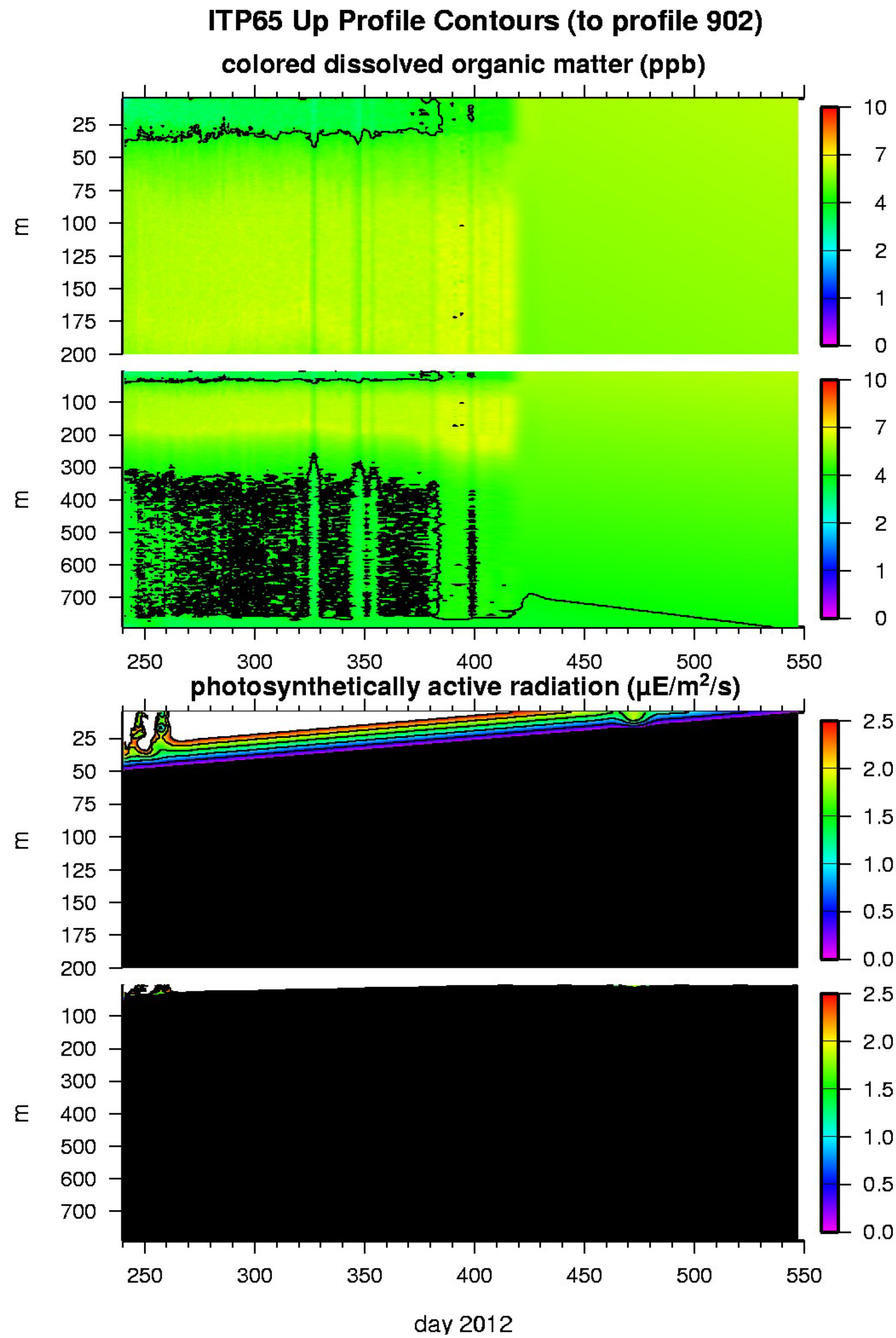
Composite plot of ITP dissolved oxygen profiles.



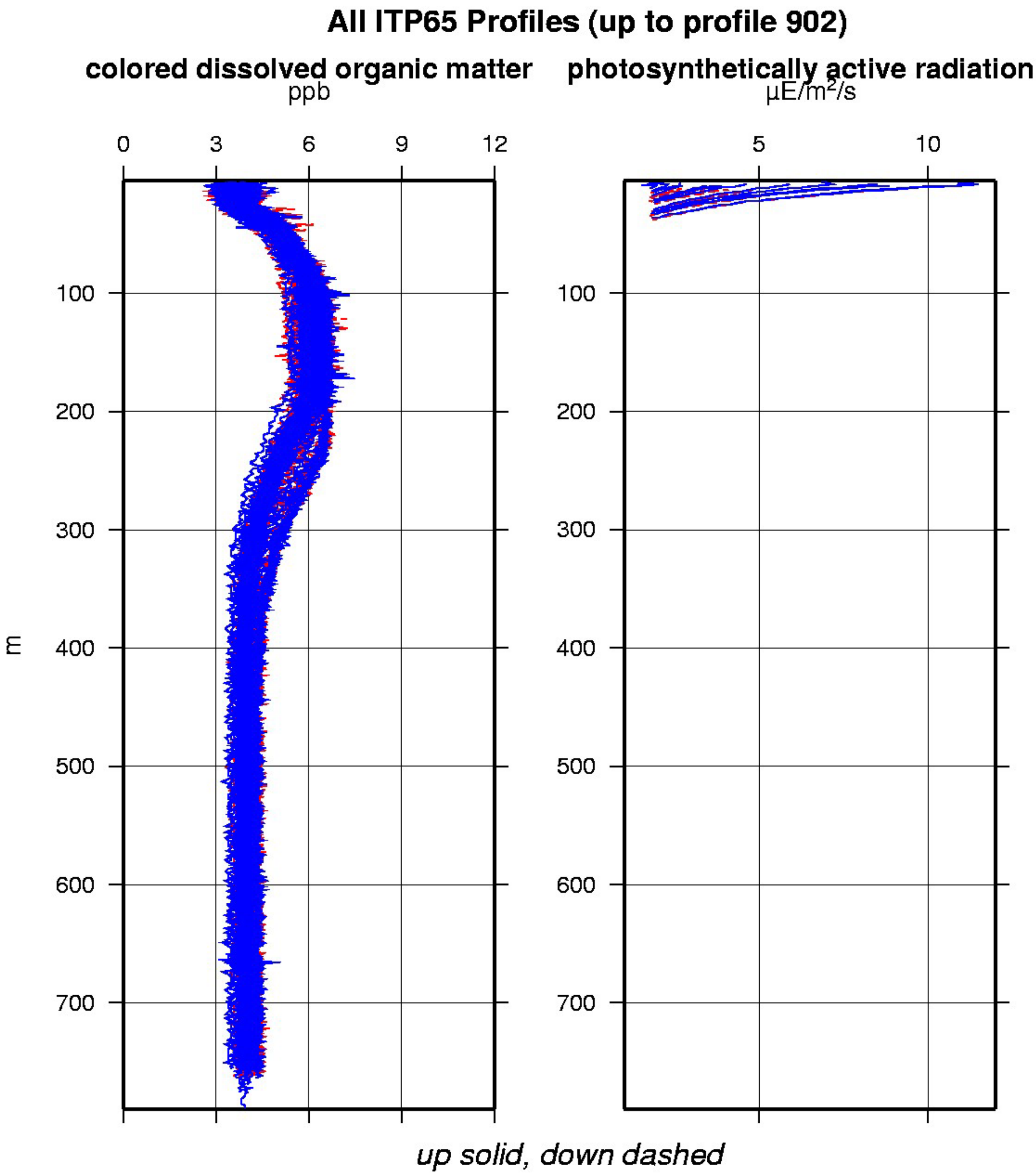
ITP 65 Turbidity and Chlorophyll a contours.



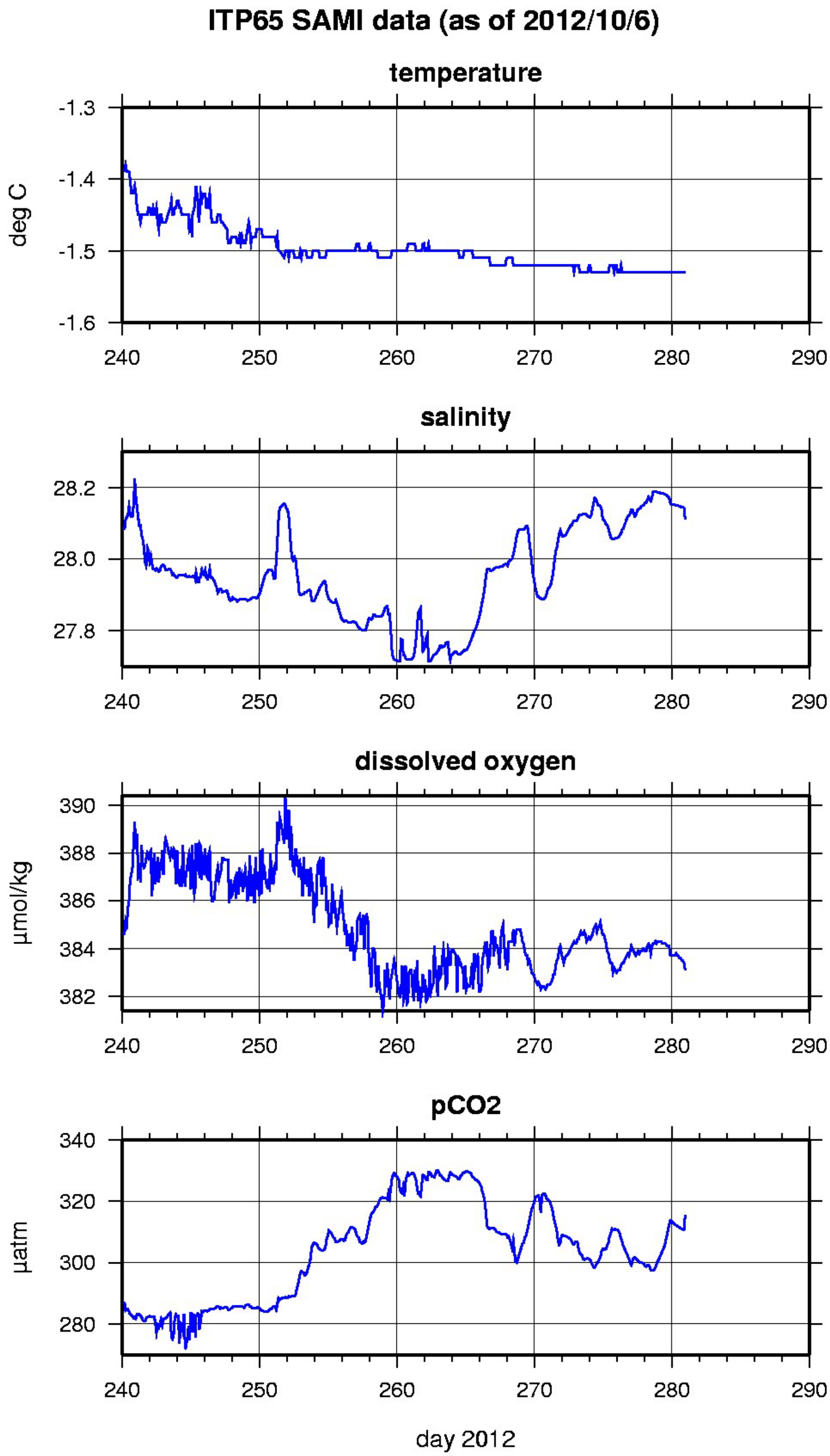
Composite plot of ITP turbidity and chlorophyll a profiles.



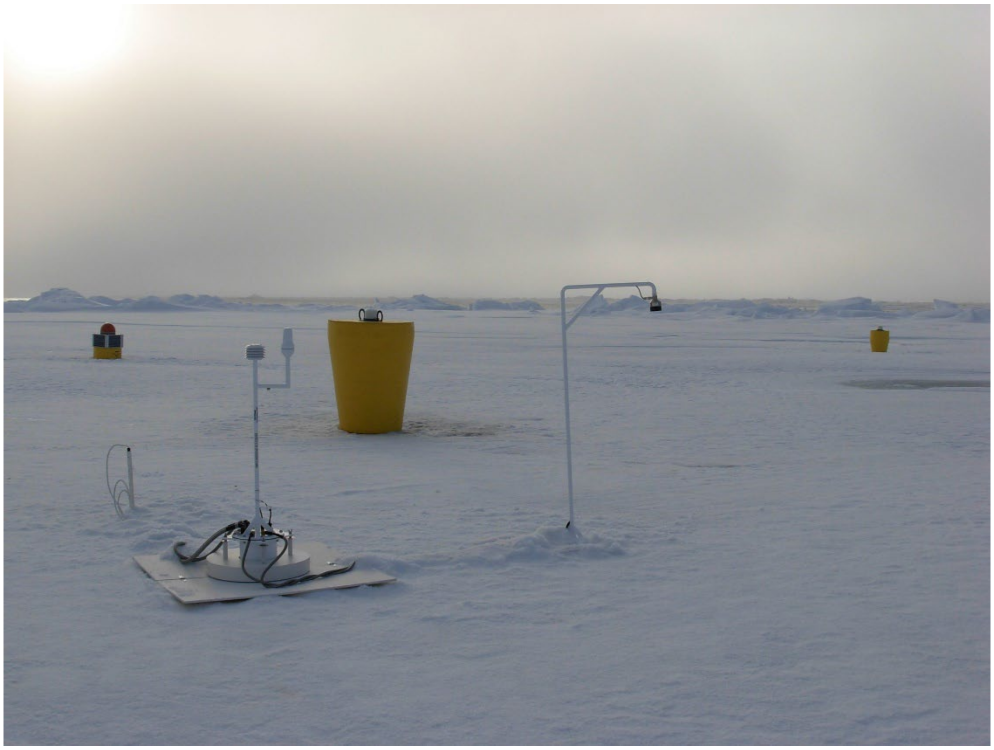
ITP 65 CDOM and PAR contours.



Composite plot of ITP CDOM and PAR profiles.



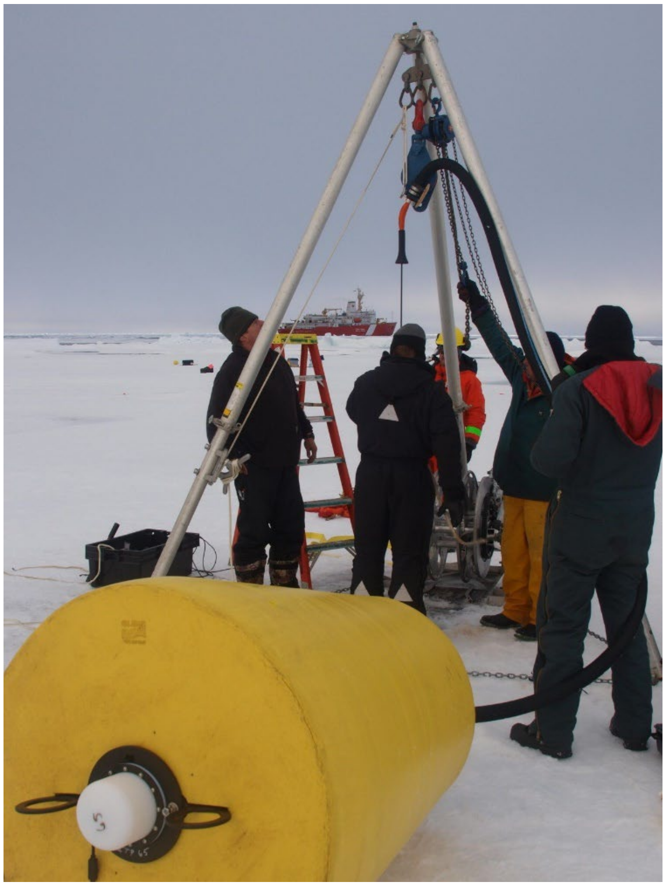
Plot of SAMI time series.



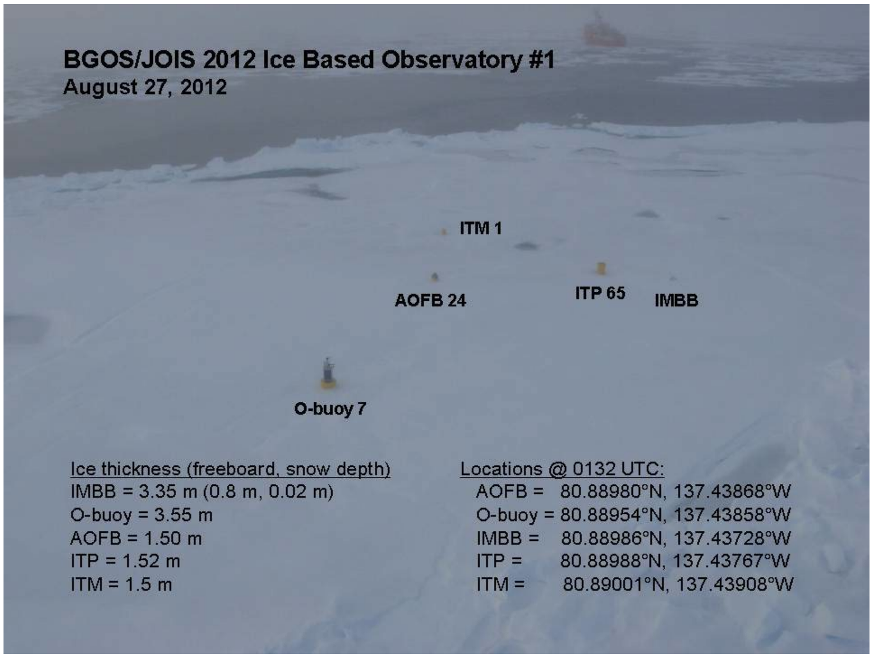
ITP 65 as deployed within Ice-Based Observatory (IBO) surrounded by AOFB (left), IMB (front), ITM (right) and O-buoy (not shown). (Photo by Rick Krishfield).

View from the ship of the helicopter landed on the ice while the thickness of the floe is determined at several sites prior to selection of it as the deployment site of the IBO. (Photo by Gary Morgan)

O-Buoy (with superstructure removed) being lowered through the 14” diameter hole in the ice by the helicopter. (Photo by Rick Krishfield)



The ITP mooring load is transferred to the slip line prior to the jacketed cable and buoy being lowered into place. (Photo by Gary Morgan)



Aerial view immediately after deployment of the first IBO with ITP 65 deployed during JOIS 2012. (Photo by Rick Krishfield)