

ITP48 Overview

Deployment Location: 9/9/2011, 8:00 UTC at 84° 48.8'N, 166° 12.9'E

Last Location: 9/11/2014, 23:00 UTC at 83° 28.1' N, 73° 22.4' W

Duration: 1099 days

Distance Traveled: 5173 km

Number of profiles: 1374 in 437 days

Other instruments: IMBB 2011-L, ITAC, ITBOB

ITP 48 was deployed on a 1.2 m thick ice floe in the Transpolar Drift during the ARK-XXVI/3 cruise (TransArc) on the *R/V Polarstern* as a contribution to the Hybrid Arctic/Antarctic Float Observation System (HAFOS). On the same icefloe, an Optimare ITAC with GPS mast, an Ice-Tethered Bio-optical Buoy (ITBOB), and a US Army Cold Regions Research and Engineering Laboratory (CRREL) Ice Mass Balance Buoy (IMB 2011-L) were also installed. The ITP included a dissolved oxygen sensor and full biosuite system and operated on a pattern profiling sampling schedule.

ITP48 Deployment Operations

The second ITP deployed on the ARK-XXVI/3 expedition was ITP 48, which was deployed as part of an Ice-based Observatory (IBO) consisting of an ITAC, ITBOB, and IMB on a 1.2 m thick, level ice floe with some melt ponds. The profiler on this particular ITP was one of the first two systems outfit with prototype biosuite sensor packages, and the first deployed in the Makarov Basin (the other, on ITP 52, had been deployed in the Canada Basin a month earlier).

Poor visibility and high winds hampered the deployment operations, while the *Polarstern* struggled to stay on station against the floe. While one group deployed the ITP, another group deployed the ITAC and ITBOB a safe distance away, and other scientists conducted ice measurements. Immediately after deployment, the deployment team was rushed from the ice due to the worsening weather so were unable to conduct the final inductive modem circuit test, but communications between the underwater and surface units proved to be fine.

ITP48 Data Processing

The 1374 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 while traversing the Arctic Basin so the profiler covered the full extent of nearly every profile that it communicated to the surface package until the very end of the record.

Spikes were found and removed in both the CTD temperature and salinity data, along with some extended deviations, particularly in the salinity data. It is likely that not all of the deviations in the dataset have been removed, as it is sometimes difficult to distinguish slight outliers. Thermohaline staircases were present during the time series, enabling lag correction estimates. Generally, the lags were in typical ranges over most of the time series except between profiles 252 to 307, and 914 to 1168 where likely fouling or icing of the sensors resulted in mostly longer response times. The lags were mostly correctable so that there was little hysteresis in T-S plots between up and down profiles throughout the halocline and in the potential conductivity (rat) corrections. The potential conductivity corrections were mostly constant at one level until profile 386, then reduced to a lesser constant level until profile 1250. The quality of the temperature and salinity data that were retained afterwards is questionable.

The spikiness of the temperature and salinity data appear in the dissolved oxygen (DO) data, so those points were also removed. Due to a problem with an internal seal on this generation of DO sensors, there were many occurrences where there were extended deviations which were removed, and the measurements drifted over the record until the sensor finally failed after profile 1197. Corrections were applied to correct the drift (dorat) within reason, but the quality of this product is uncertain.

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>.

ITP48 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 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.

After deployment, the buoy drifted eastward generally about 85°N latitude over the Mendeleev Ridge and Alpha Cordillera bottom topography. On November 17, 2012, the profiler began dragging over shallow topography where the Lomonosov Ridge meets the Canadian continental shelf, and 2 days later the last communications with the underwater profiler were received. The surface package continued to send status and GPS locations for over another 21 months while it

zigzagged southward, eventually ceasing transmissions just off the northern tip of Ellesmere Island, Canada.

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

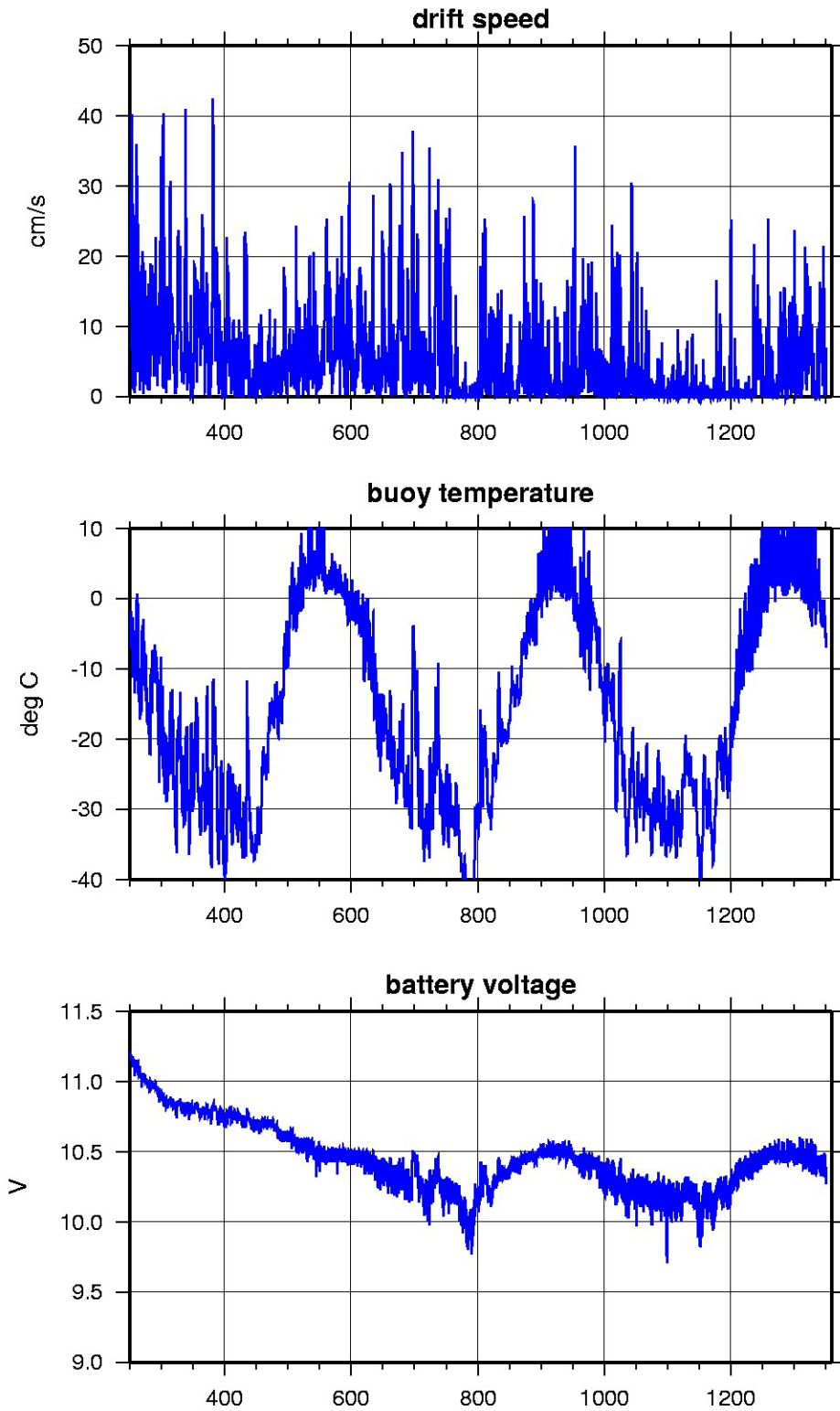
Level II hourly buoy location data in ASCII format: itp48rawlocs.dat

Level III 1-Hz processed profile data in MATLAB format: itp48cormat.tar.Z or itp48cormat.zip

Level III 1-db bin-averaged processed profile data in MATLAB format: itp48final.mat

Level III 1-db bin-averaged processed profile data in ASCII
format: itp48final.tar.Z or itp48final.zip

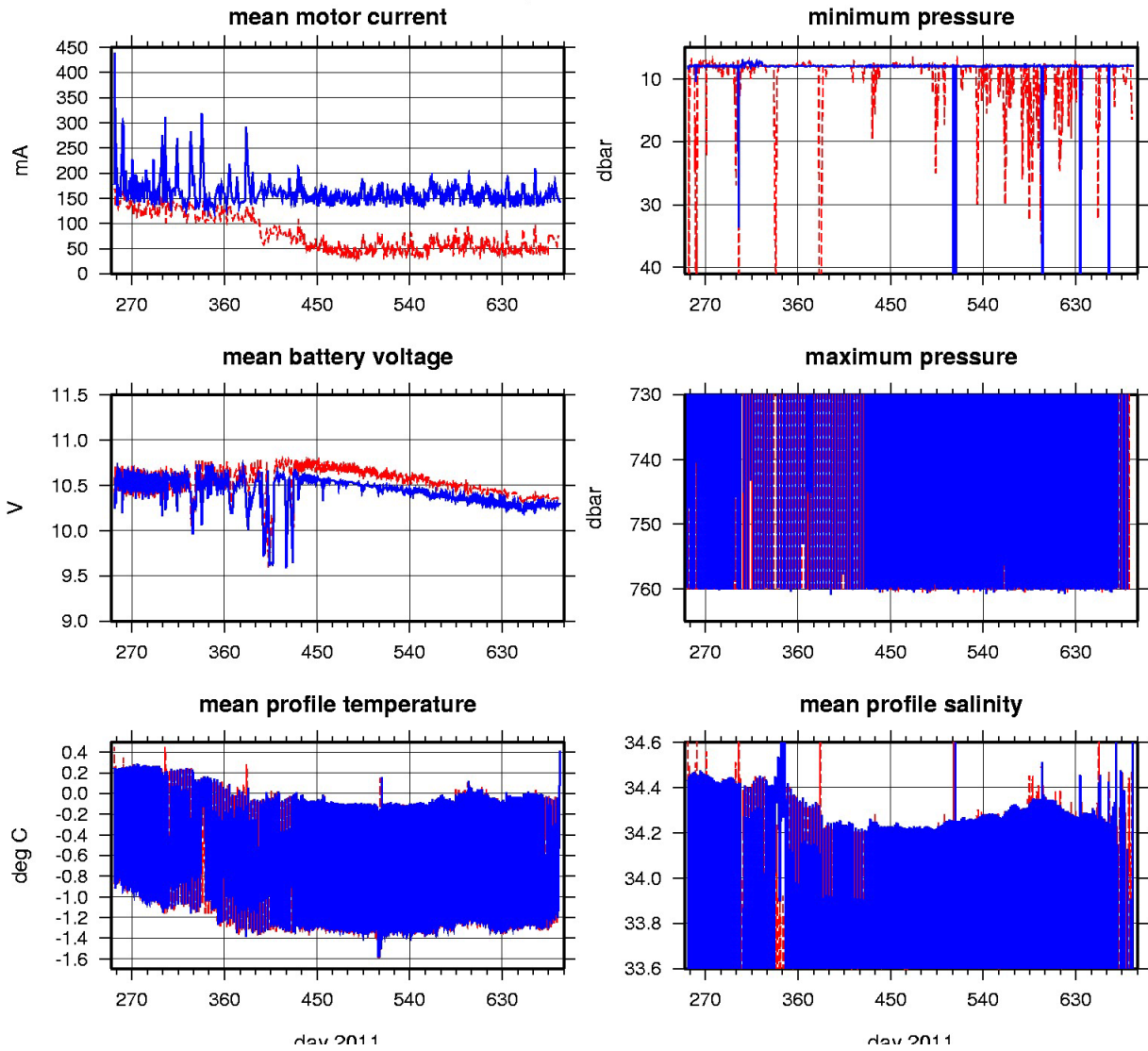
ITP48 Buoy Status (as of 2014/09/11)



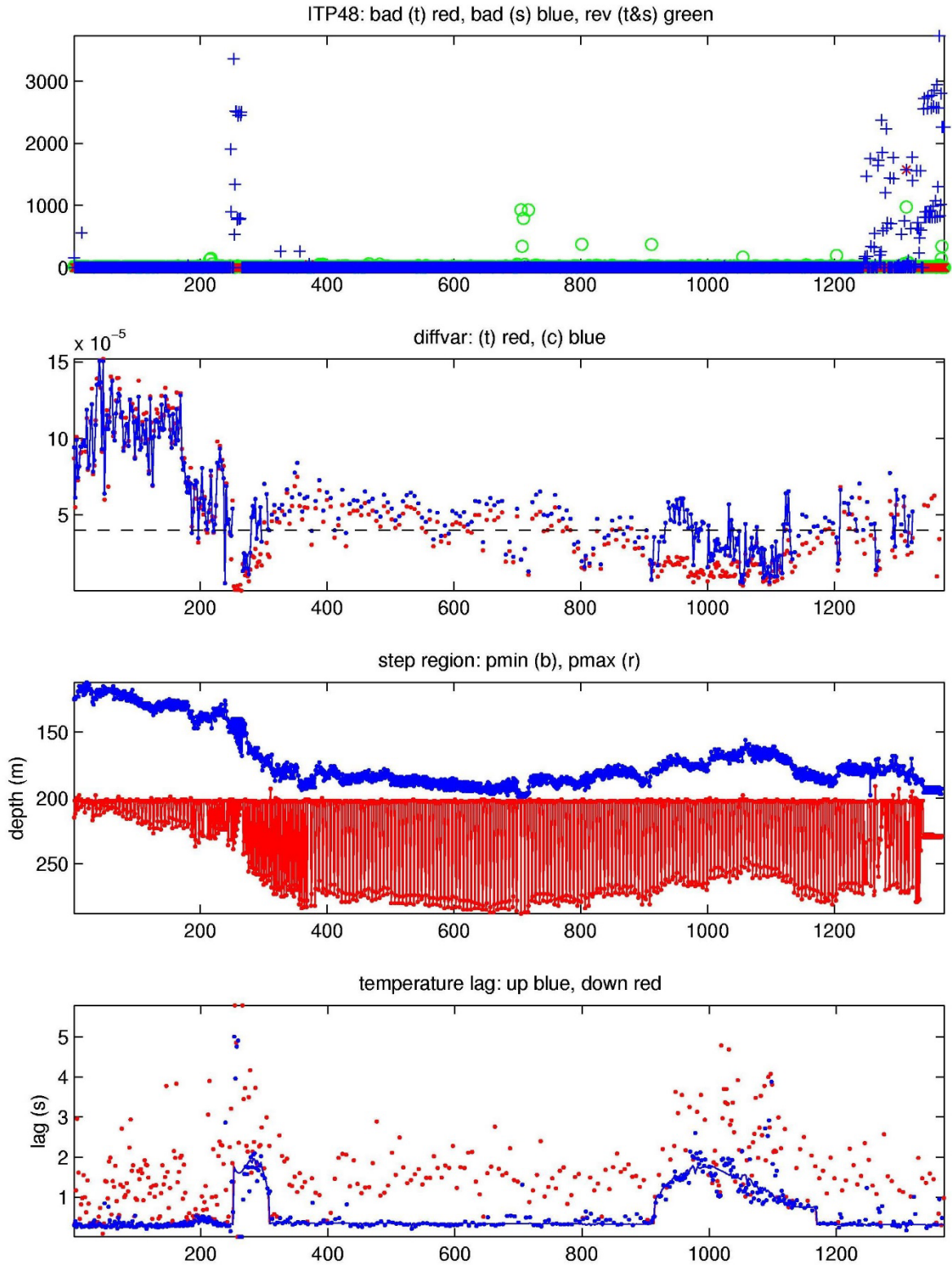
Nov 2011
ITP surface buoy status.

ITP48 Profiler Status (up to profile 1374)

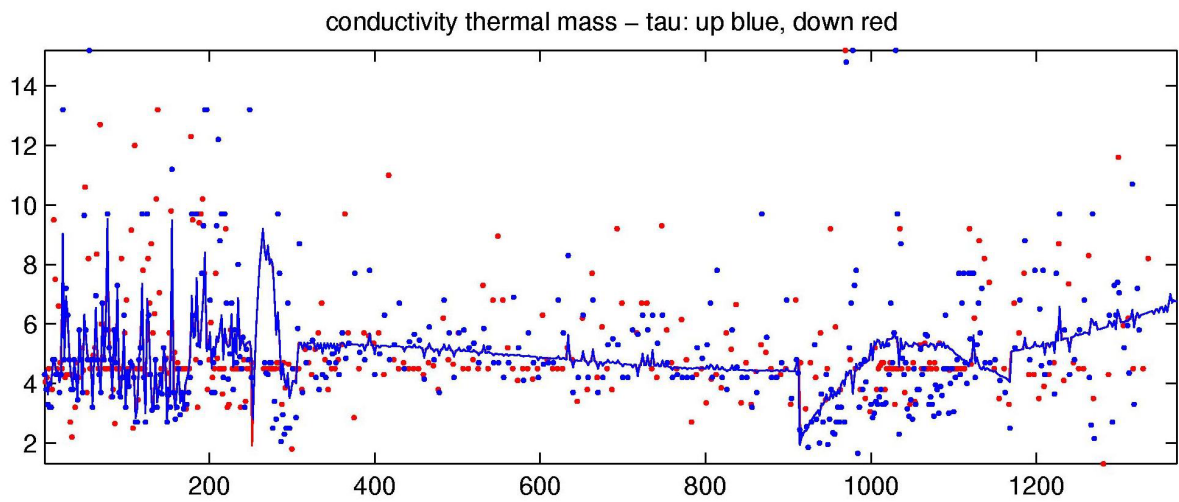
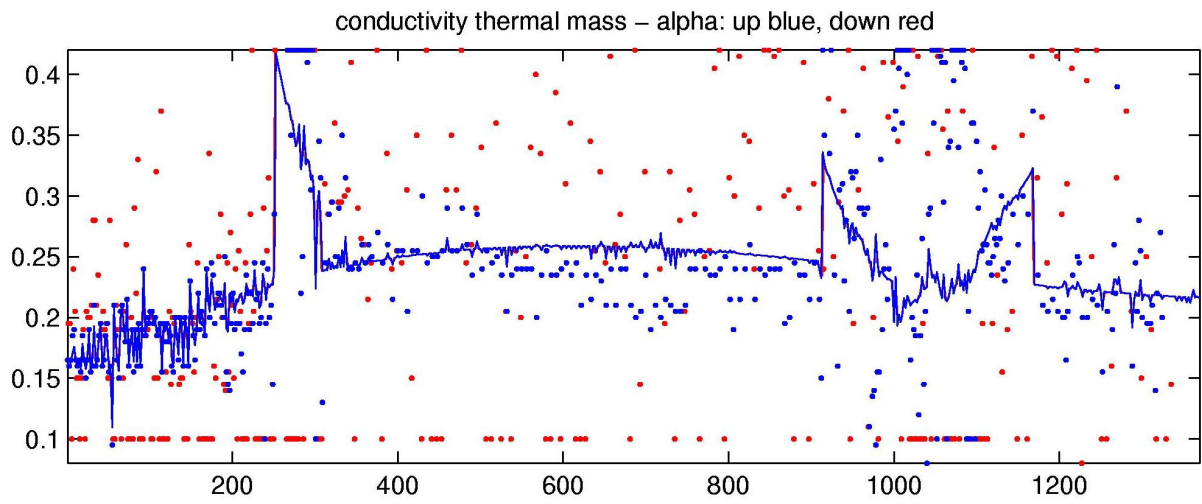
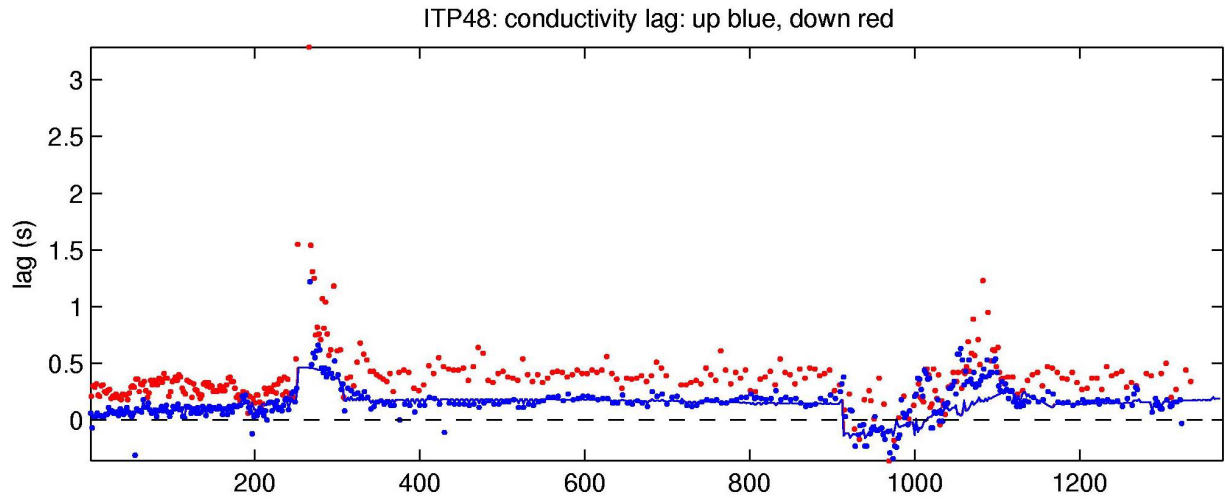
up solid, down dashed



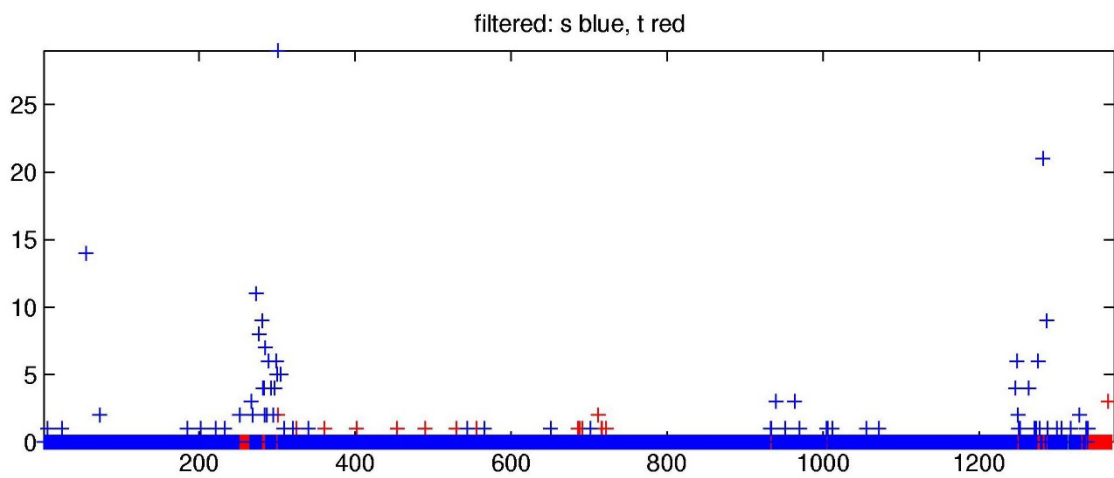
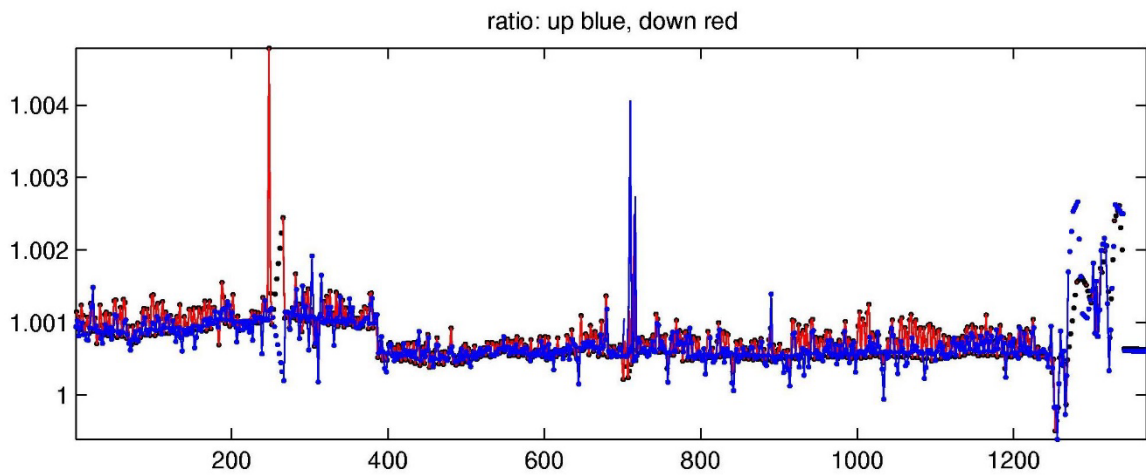
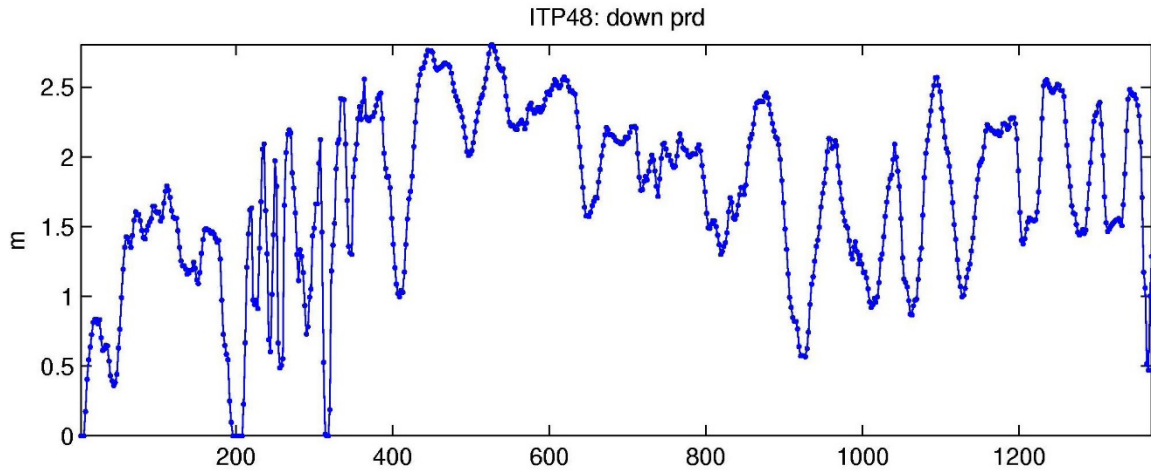
ITP profiler engineering data.



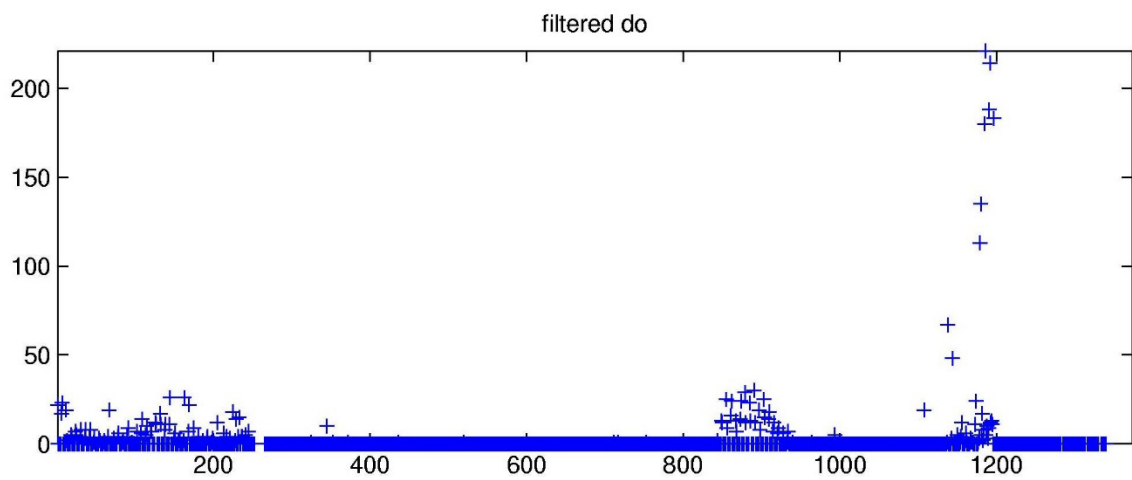
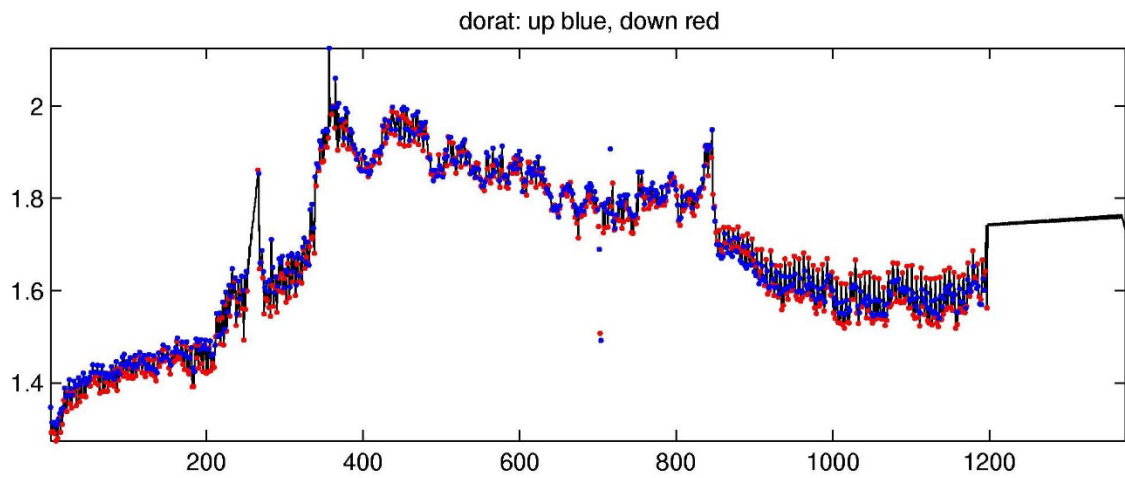
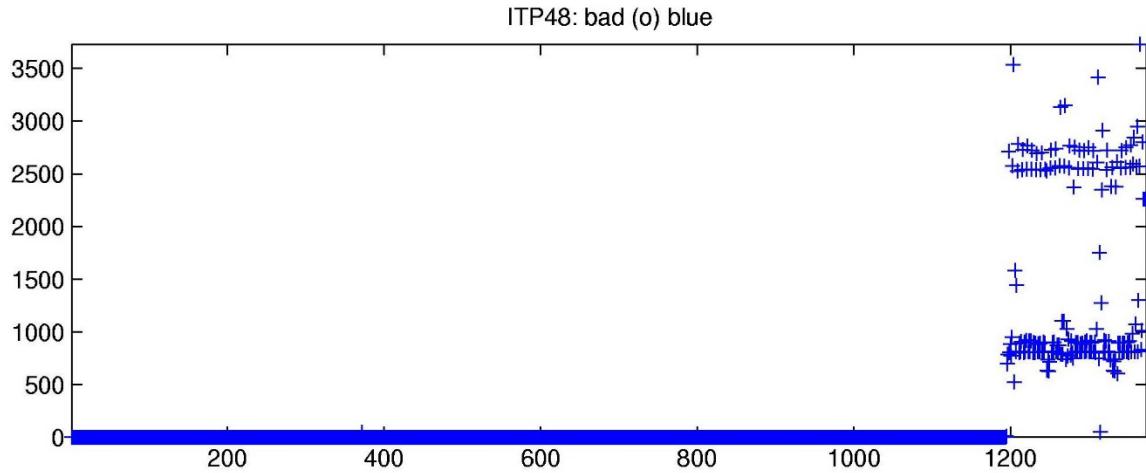
Number of bad points removed (top); variance of vertical difference of temperature and salinity in step region for up-going profiles; depth of staircase layer; temperature lag (bottom).



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

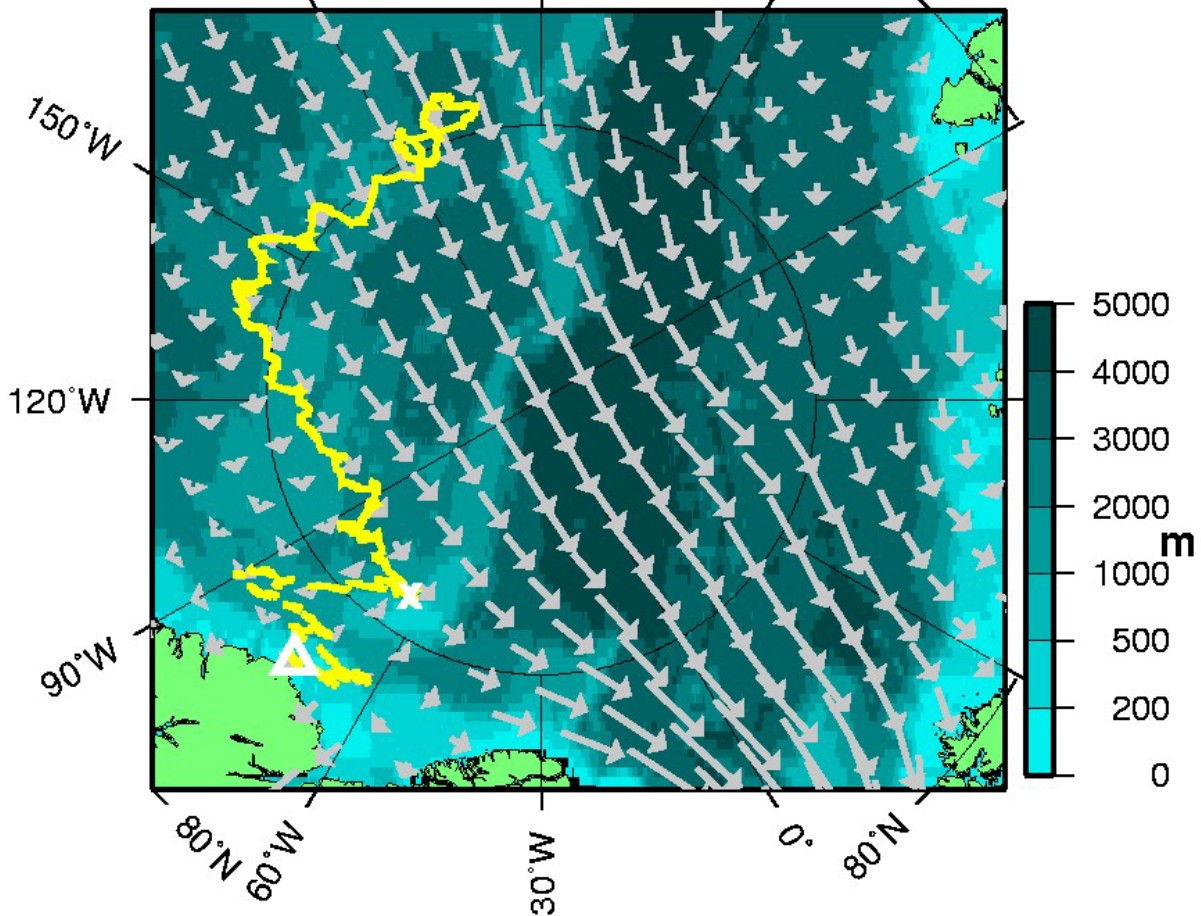


Top: down pressure deviation correction, Middle: salinity ratio adjustment, Bottom: Number of filtered spikes.



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

ITP48 Drift Track (as of 2014/09/11)

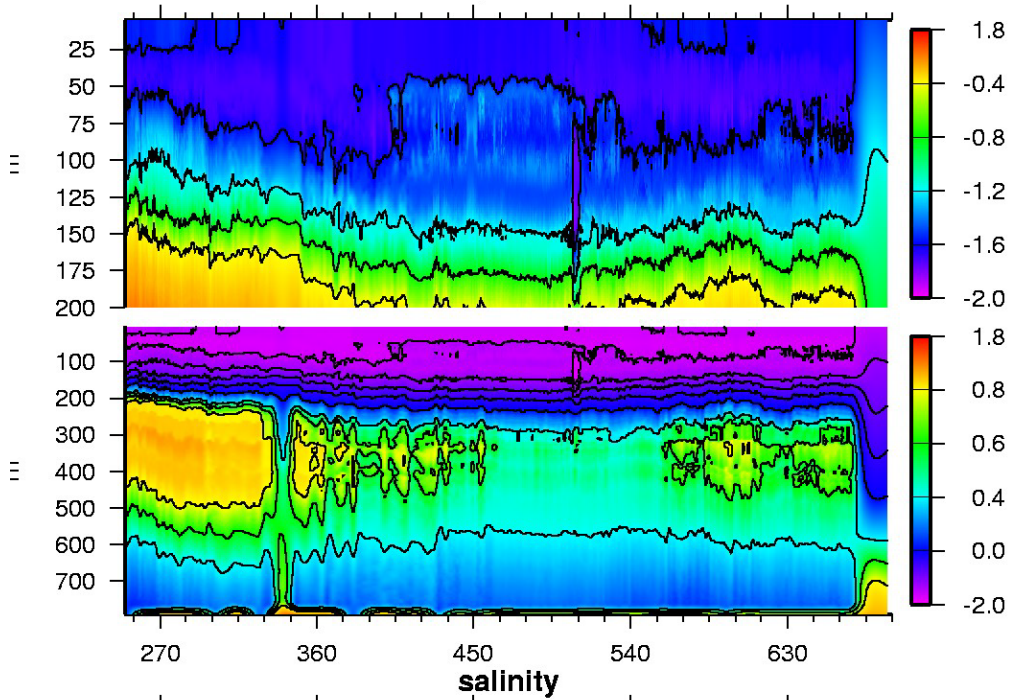


ITP drift (yellow line), last profile (x), last location (triangle), and annual ice drift from IABP (grey vectors) on IBCAO bathymetry (shading).

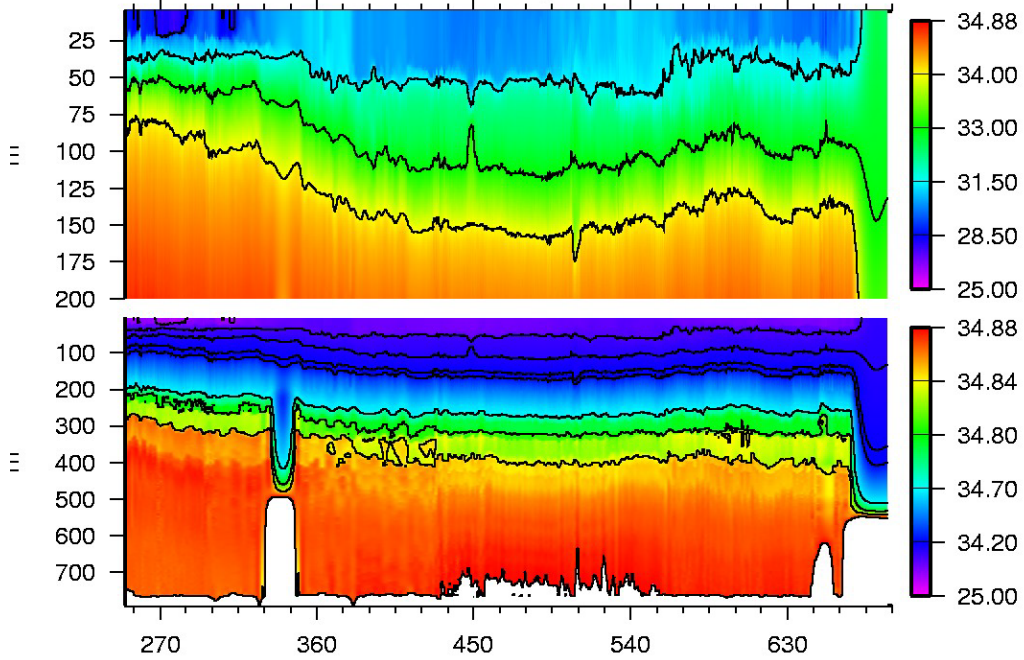
Plot of buoy locations.

ITP48 Up Profile Contours (to profile 1374)

temperature



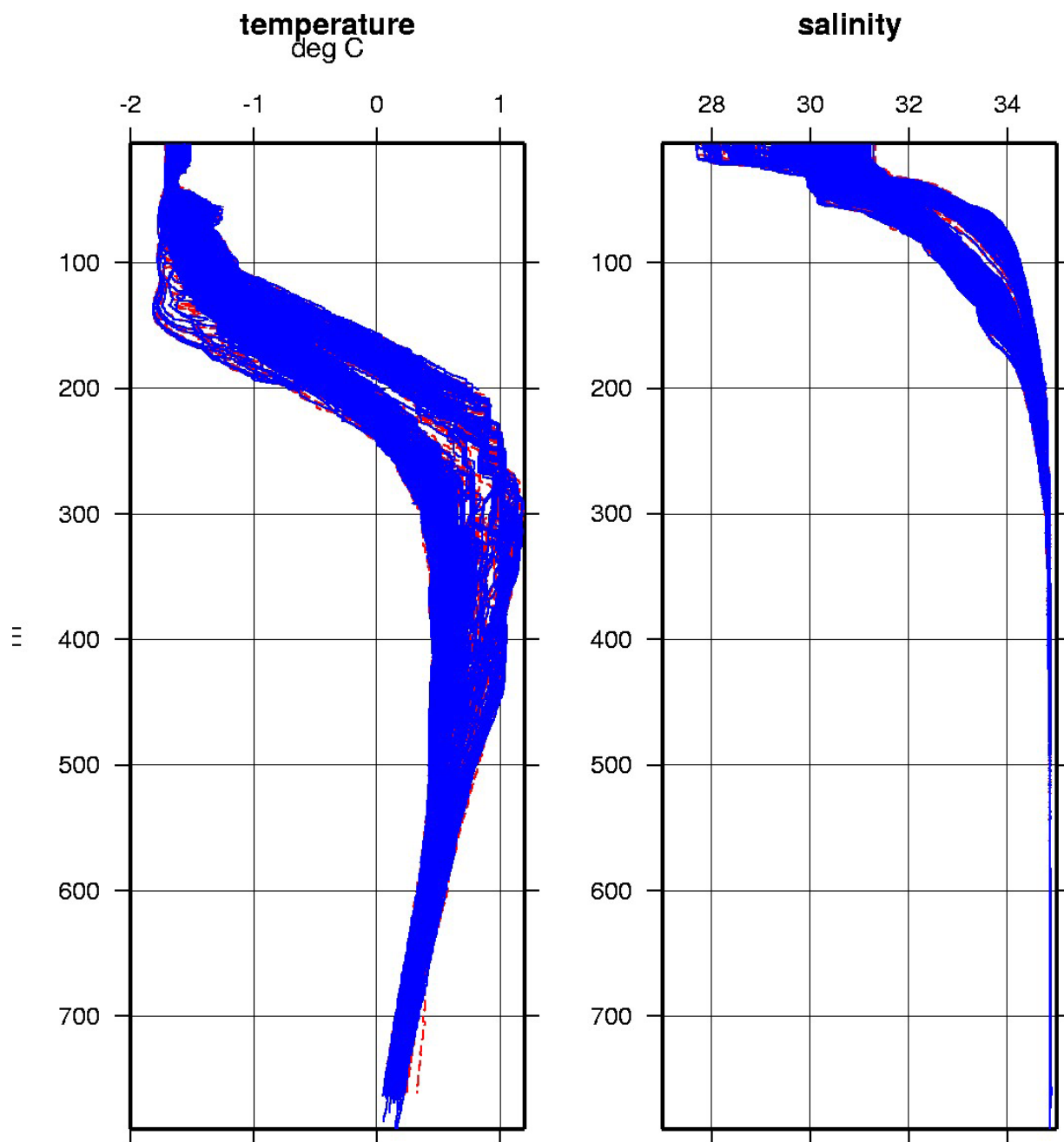
salinity



day 2011

ITP 48 Temperature and Salinity contours.

All ITP48 Profiles (up to profile 1374)

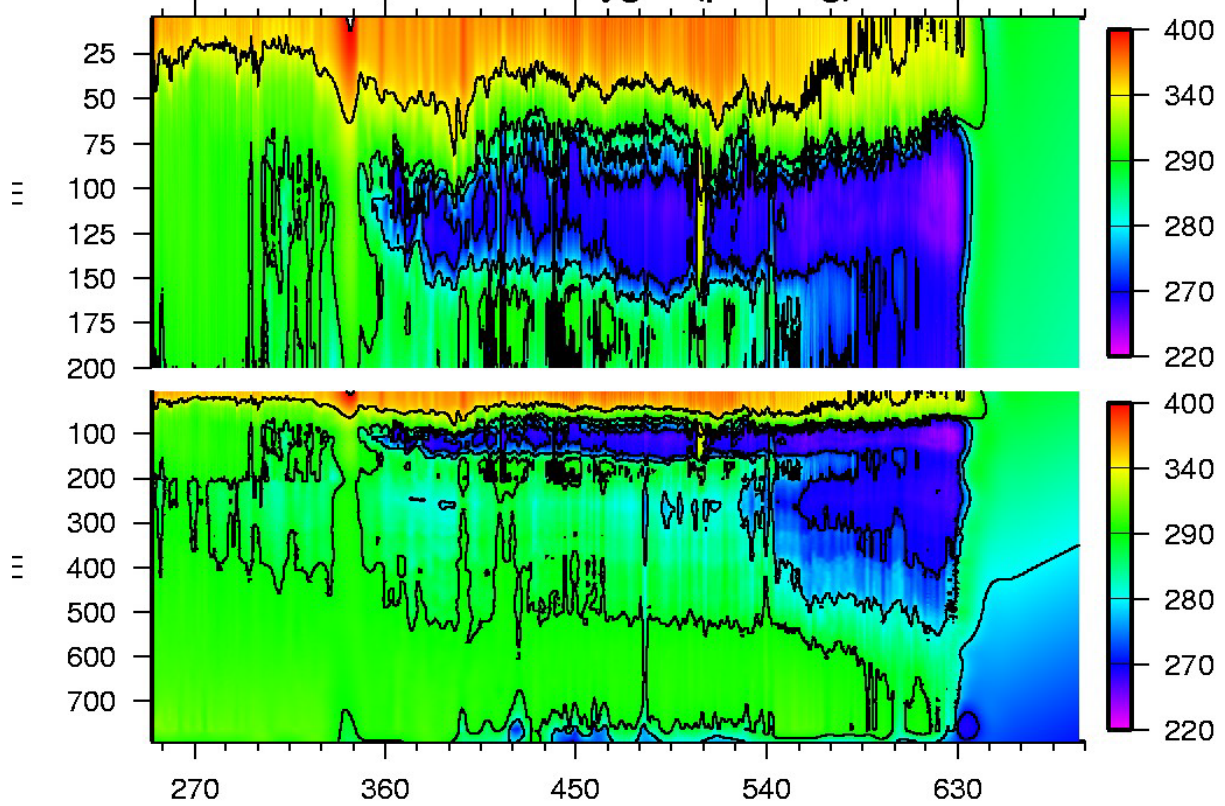


up solid, down dashed

Composite plot of ITP temperature and salinity profiles.

ITP48 Up Profile Contours (to profile 1373)

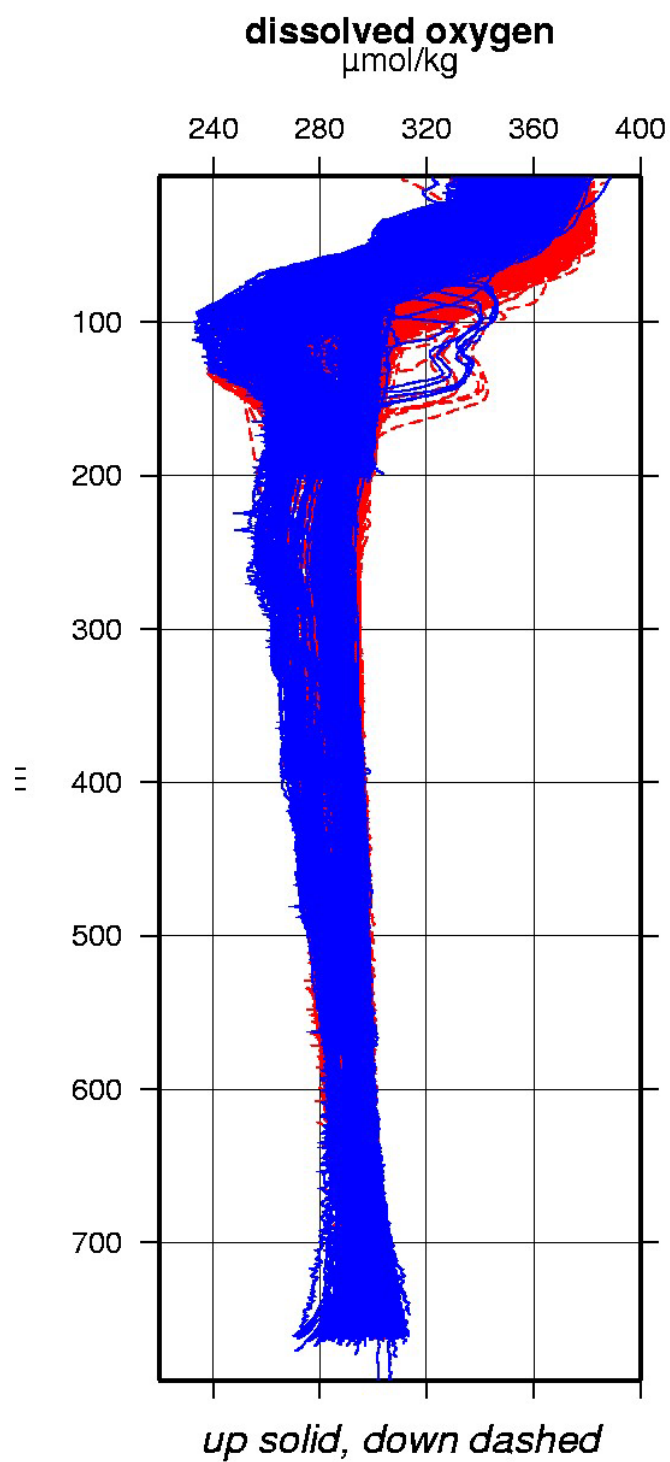
dissolved oxygen ($\mu\text{mol/kg}$)



day 2011

ITP 48 dissolved oxygen contours.

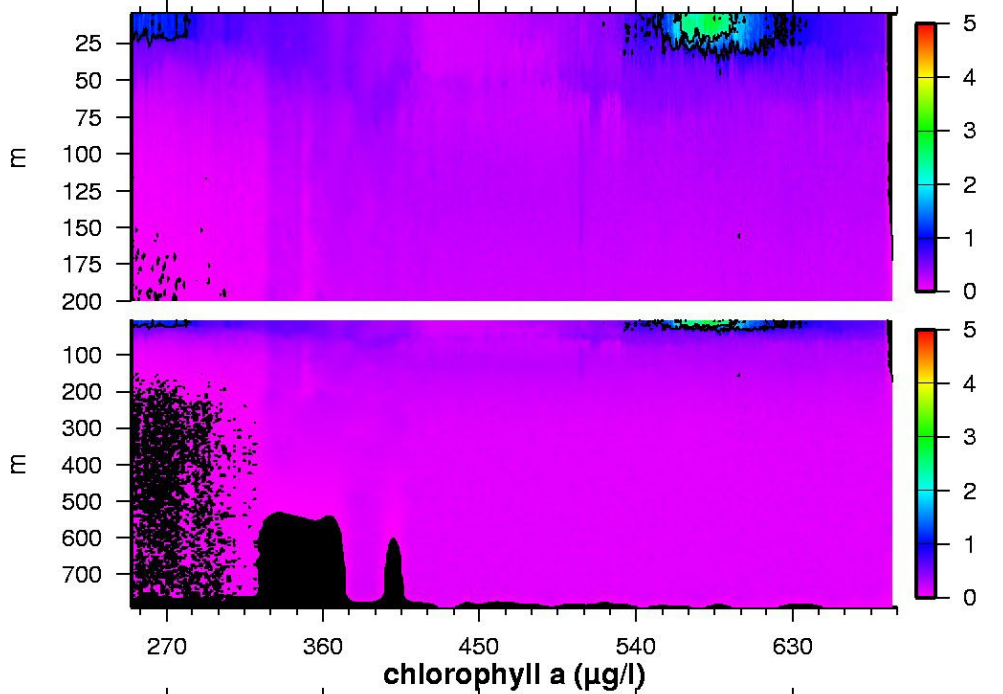
All ITP48 Profiles (up to profile 1373)



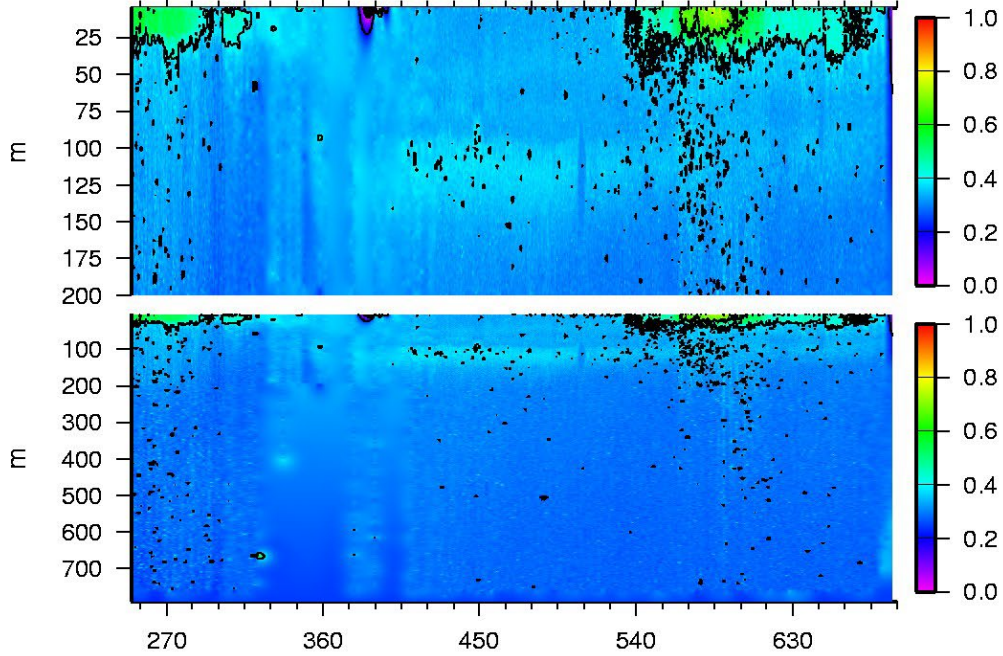
Composite plot of dissolved oxygen profiles.

ITP48 Up Profile Contours (to profile 1373)

turbidity ($m^{-1}sr^{-1} \times 10^{-4}$)



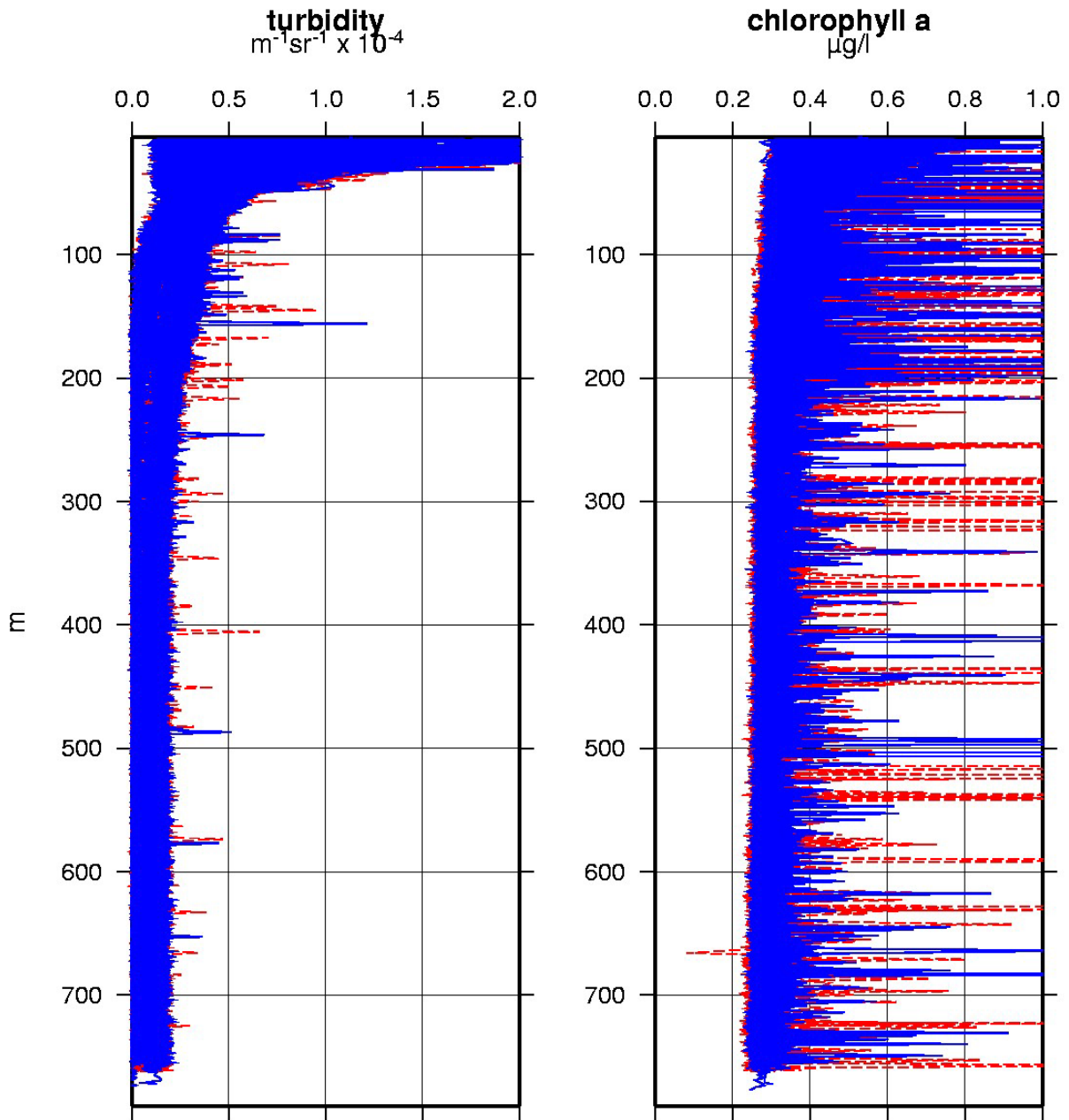
chlorophyll a ($\mu g/l$)



day 2011

ITP 48 Turbidity and Chlorophyll a contours.

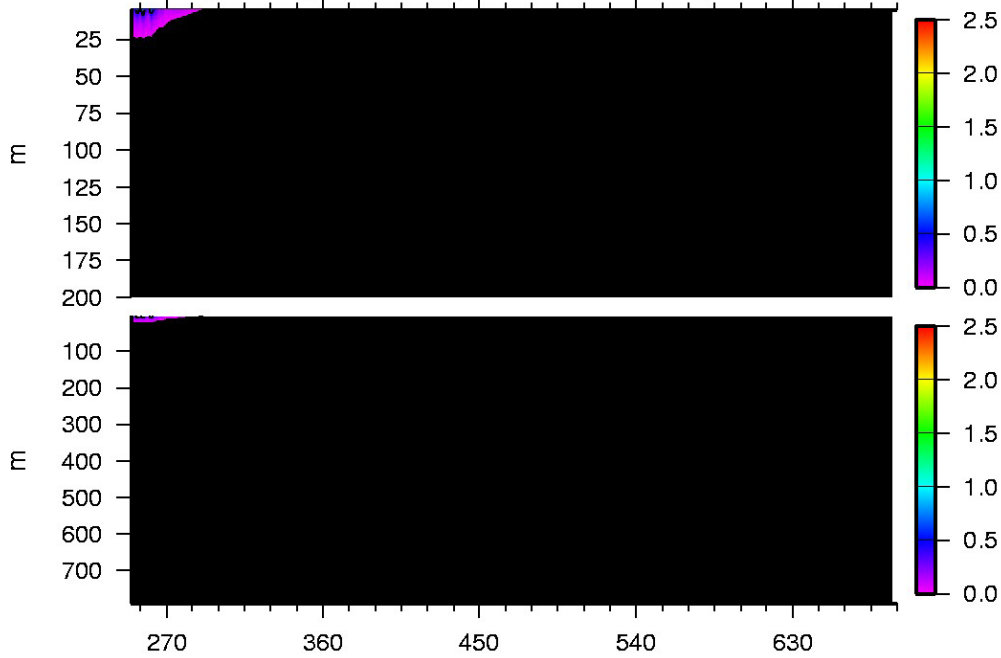
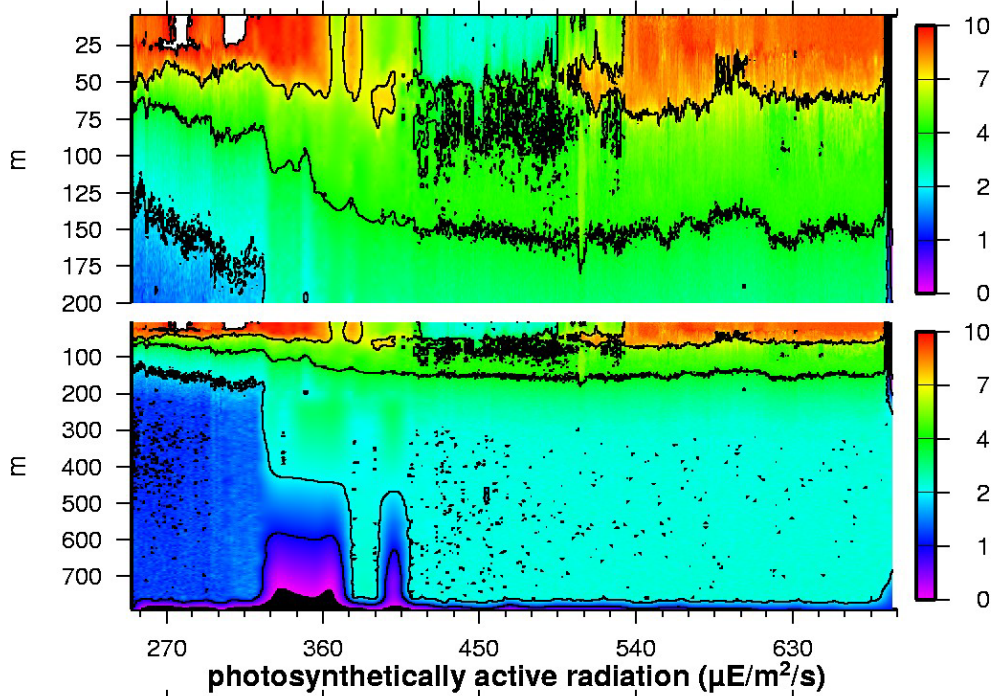
All ITP48 Profiles (up to profile 1373)



up solid, down dashed

Composite plot of ITP turbidity and chlorophyll a profiles.

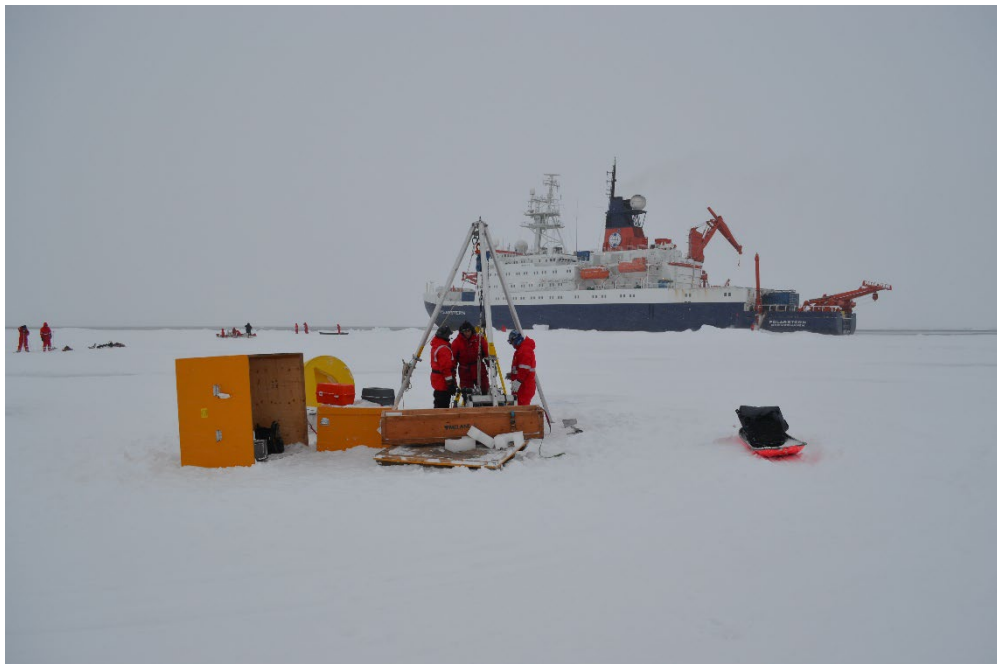
ITP48 Up Profile Contours (to profile 1373)
colored dissolved organic matter (ppb)



day 2011
ITP 48 CDOM and PAR contours.



A view of the ITP deployment operations from the site of the ITAC & IBOB buoys after the hole drilled has been through the ice floe.



With nearly all of the wire out, a Yale grip secures the ITP tether just prior to attaching the surface package near the end of the deployment.



Meanwhile, the ITAC and IBOB deployments are conducted a distance away to ensure that the underwater instruments do not interfere with each other in any way.