Deep SOLO

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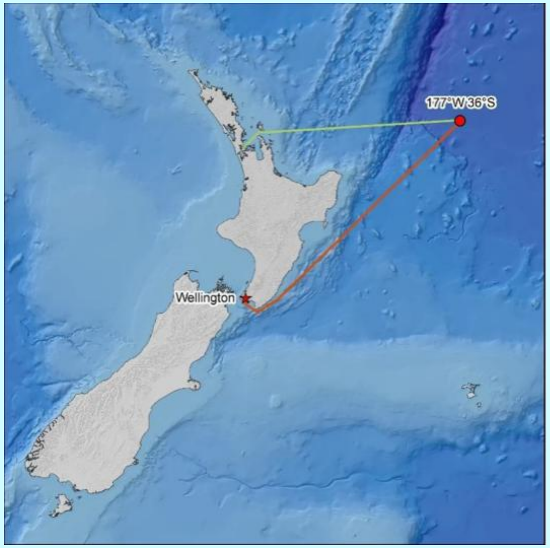


Deep SOLO Float deployment, R/V Tangaroa June 2014, south-west Pacific

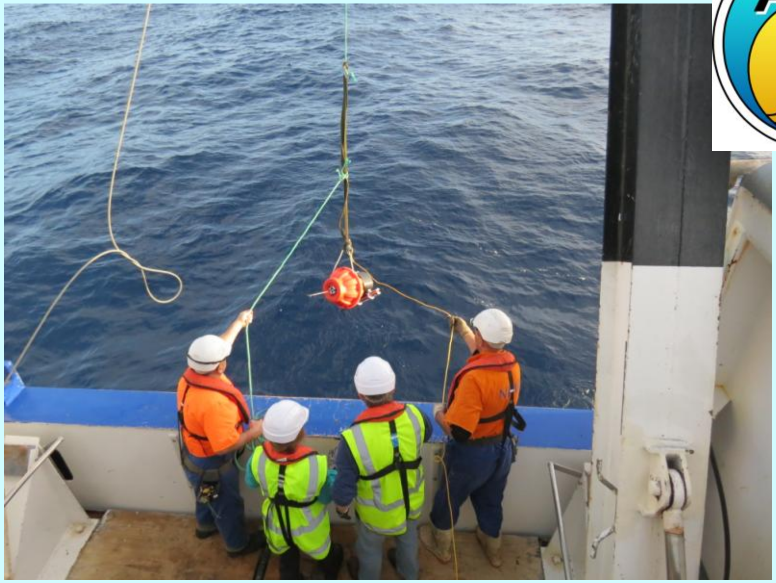
1. Deep SOLO float characteristics

2. Deep SOLO float Deployment

3. Deep SOLO temperature and salinity

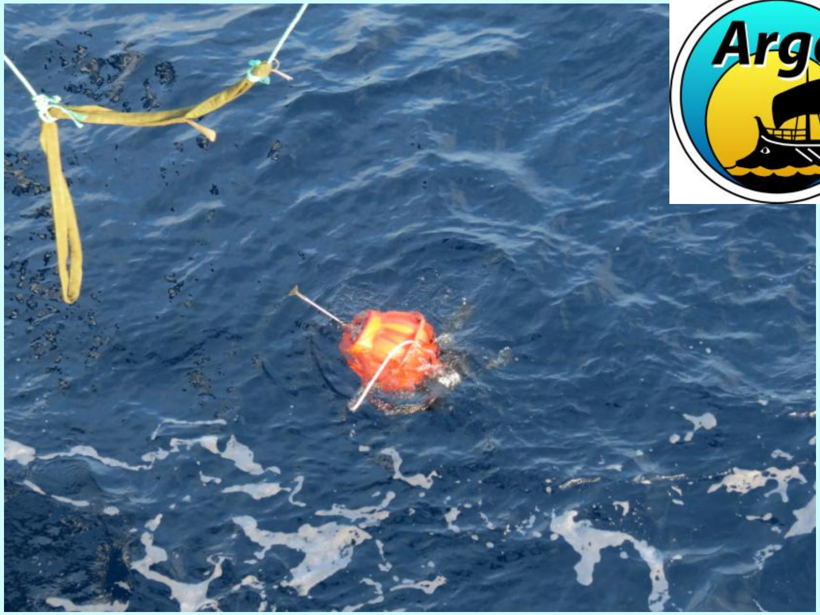
4. Summary

Deep SOLO Float characteristics



- 6000 m depth
- # of dive cycles: 160 (6.5-day cycle for the prototypes at present)
- Telemetry: Iridium
- Surface time: 30 minutes
- Mass: 25 kg (SOLO 2 weighs 18.6 kg)
- Housing: 13-inch glass ball
- Hydraulic pump runs at 50 m (sets float target depth), at max depth, and during ascent to maintain vertical speed.
- 2-meter wire rope used to “feel” the ocean bottom without snagging on the bottom or entraining mud. Wire length and density chosen for damping and keeping the float from hitting the bottom. Float will not hit bottom unless ocean bottom depth is less than 600 m from target depth.

Deep SOLO Float characteristics



❑ New CTD from Seabird = SBE61

❑ Energy/cycle is 24 kJ to 5500 m
Buoyancy is 89%, communication is 1%, and CTD is 10%. (SOLO 2 needs less than 10 kJ/cycle to 2000 m)

❑ Speed of ascent & descent is
~ 6 cm/s (SOLO 2 speed is 12 cm/s)

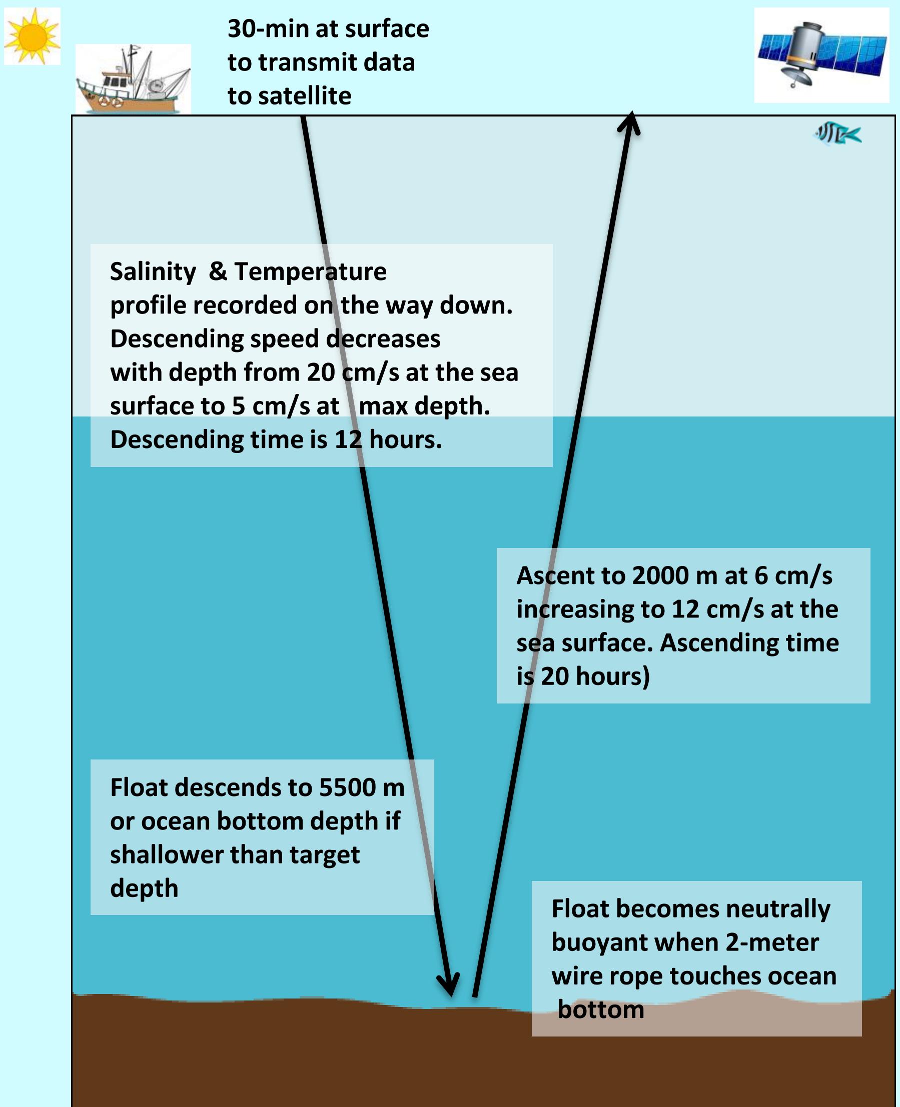
❑ Continuous profile to 500 m, at 2 dbar averaging bins, and then switch to discrete-mode: 5 dbar to 1000 m, 10 dbar to 2000 m, 20 dbar to 3000 m, 50 dbar to 6000 m (adjustable).

❑ The floats to deploy in Aug-Oct 2015 have 3-m chain. Float will not hit bottom unless ocean bottom depth is less than 900 m from target depth.

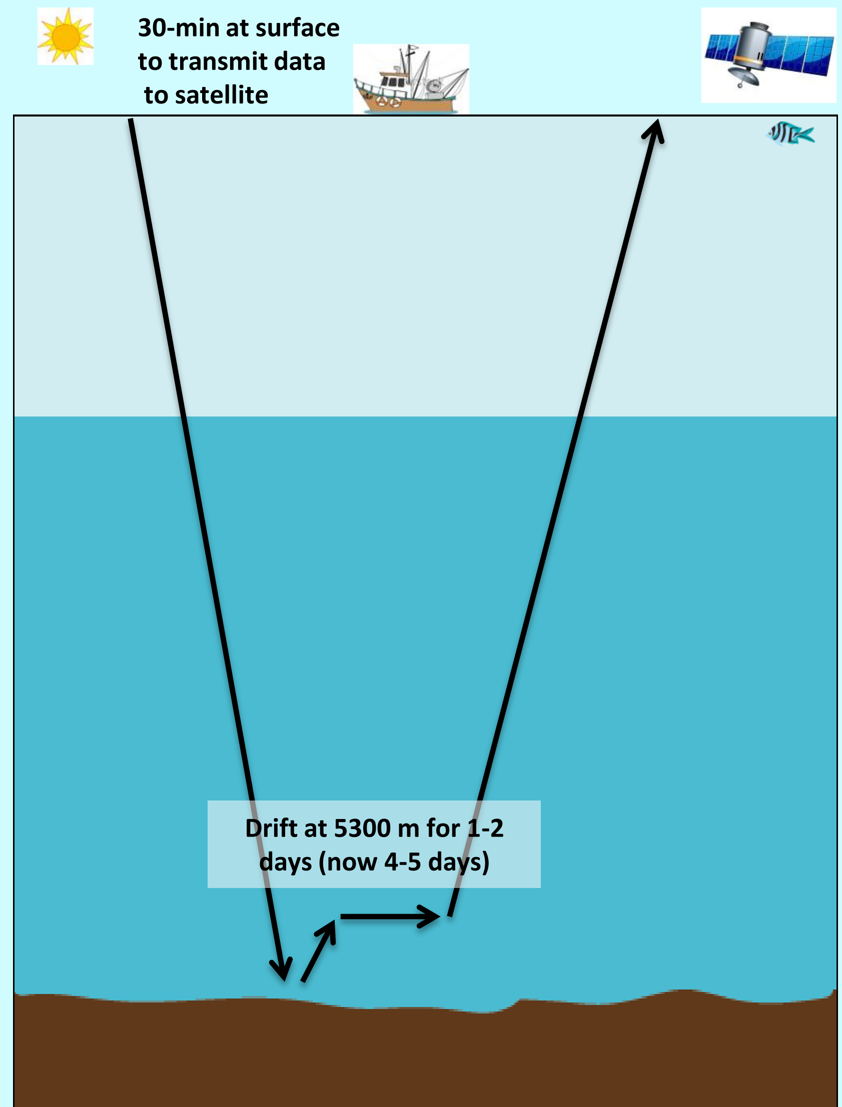
❑ New batch will also have a new controller with the option to measure TS on the way up or down.

Deep SOLO prototype cycle

Phase 1 = 32 hours, no parking



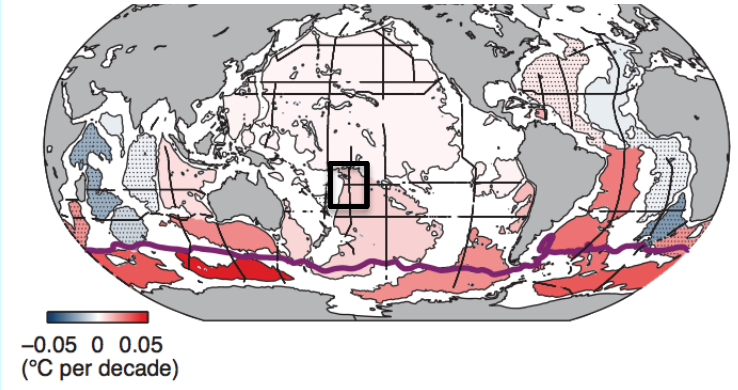
Phase 2 = 32 hours + 1-2 day (now 4-5 day) parking



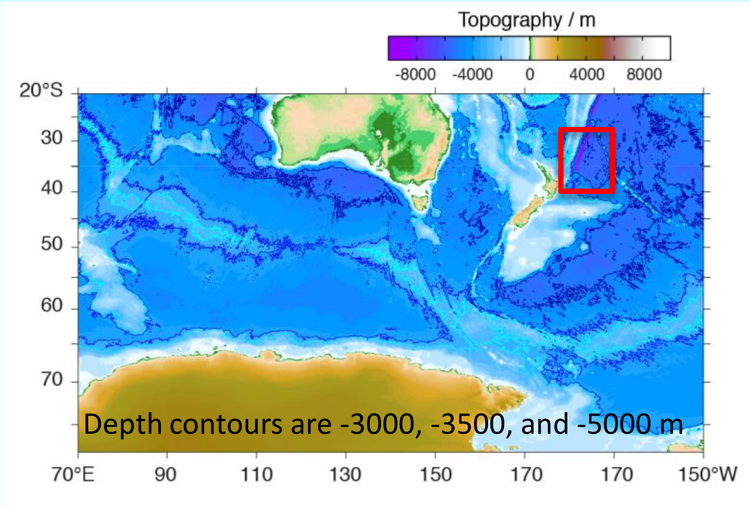
Region of choice: south-west Pacific region

❑ Region of deep ocean warming: Southern Ocean; avoid high variability regions (eddies)

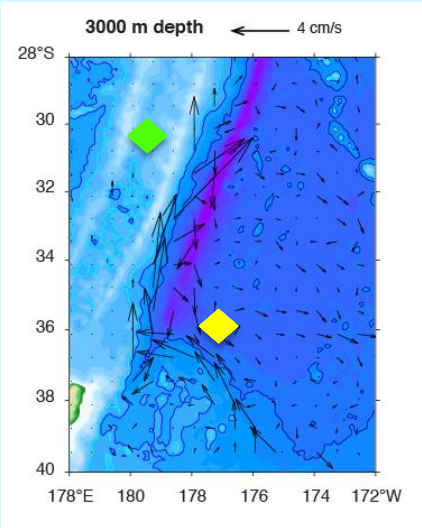
(IPCC 2013, data from Purkey and Johnson, 2010)



❑ Deep (5500-5580 m depth) and relatively flat area



❑ Away from the deep WBC on the eastern side of the Tonga Kermadec Ridge



SOSE

2005-2010 mean

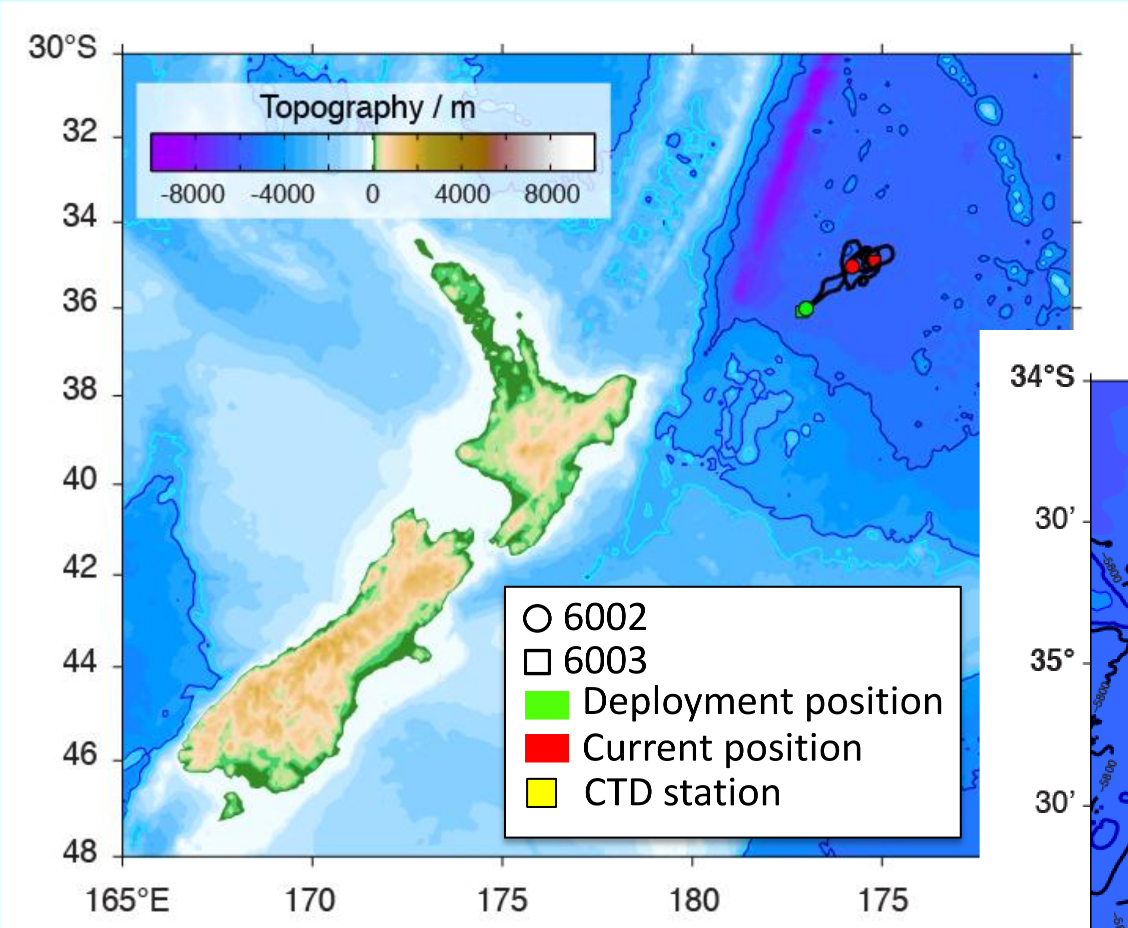
(Matt Mazloff and Jinbo Wang)

Tonga Kermadec Ridge

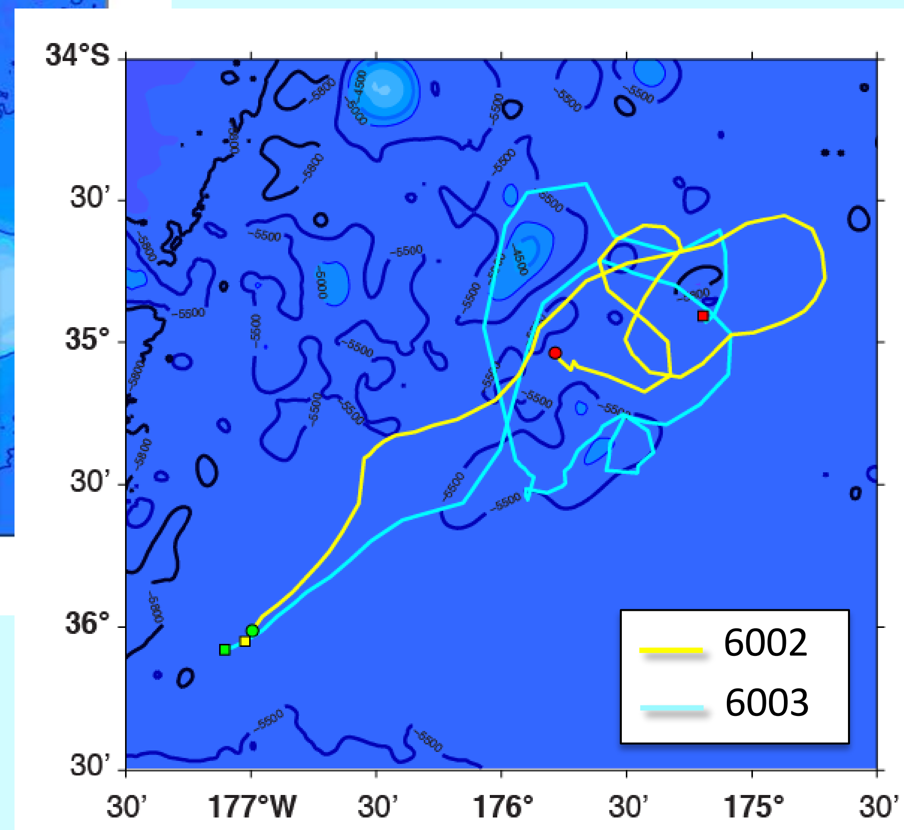
Deployment region

❑ Ship time was contributed by NIWA, June 16-25th 2014, with contribution from Australian Argo and US Argo

Deep SOLO prototypes 6003 and 6002 positions

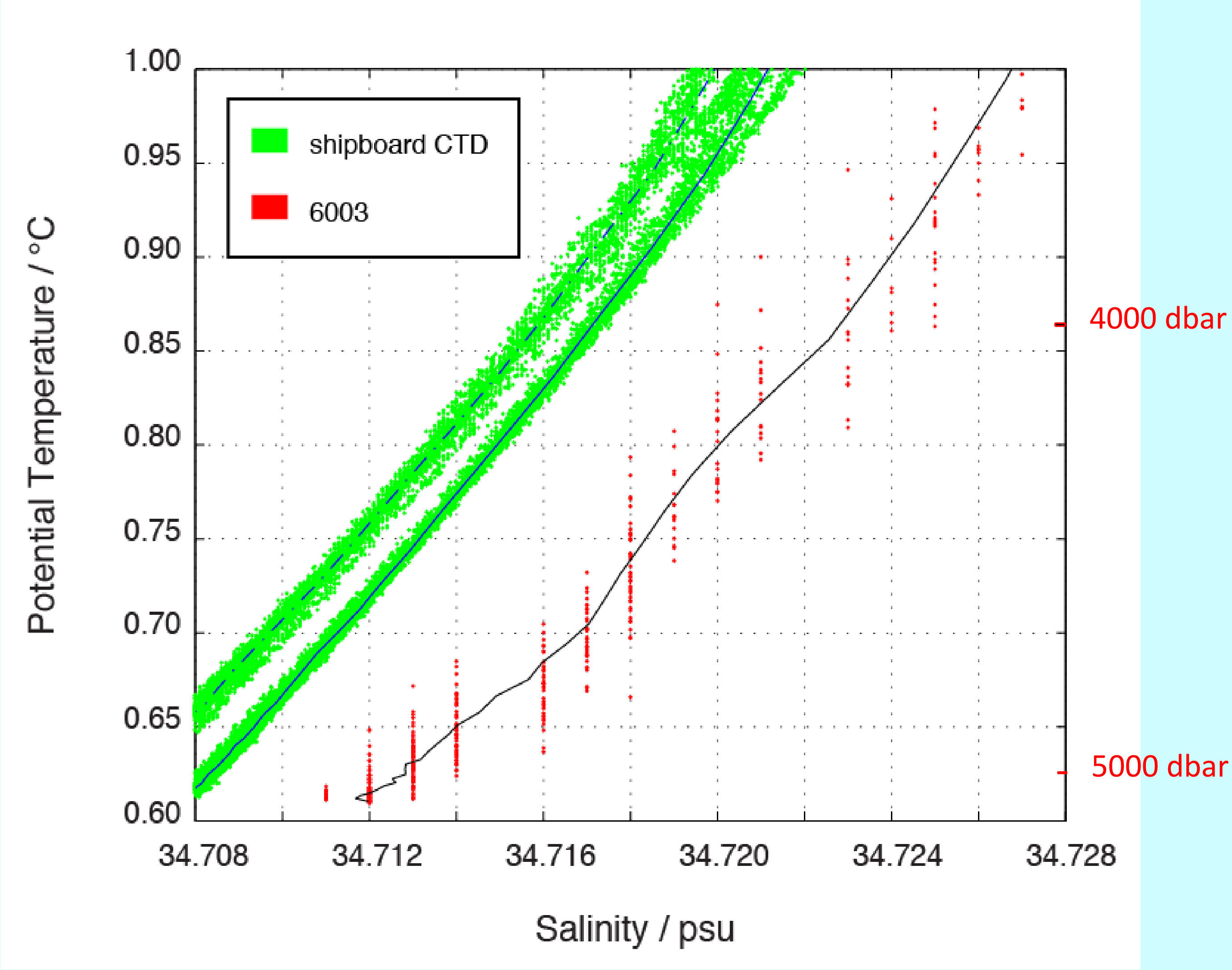


Depth contours are -3000 m, -3500 m, and -5000 m.



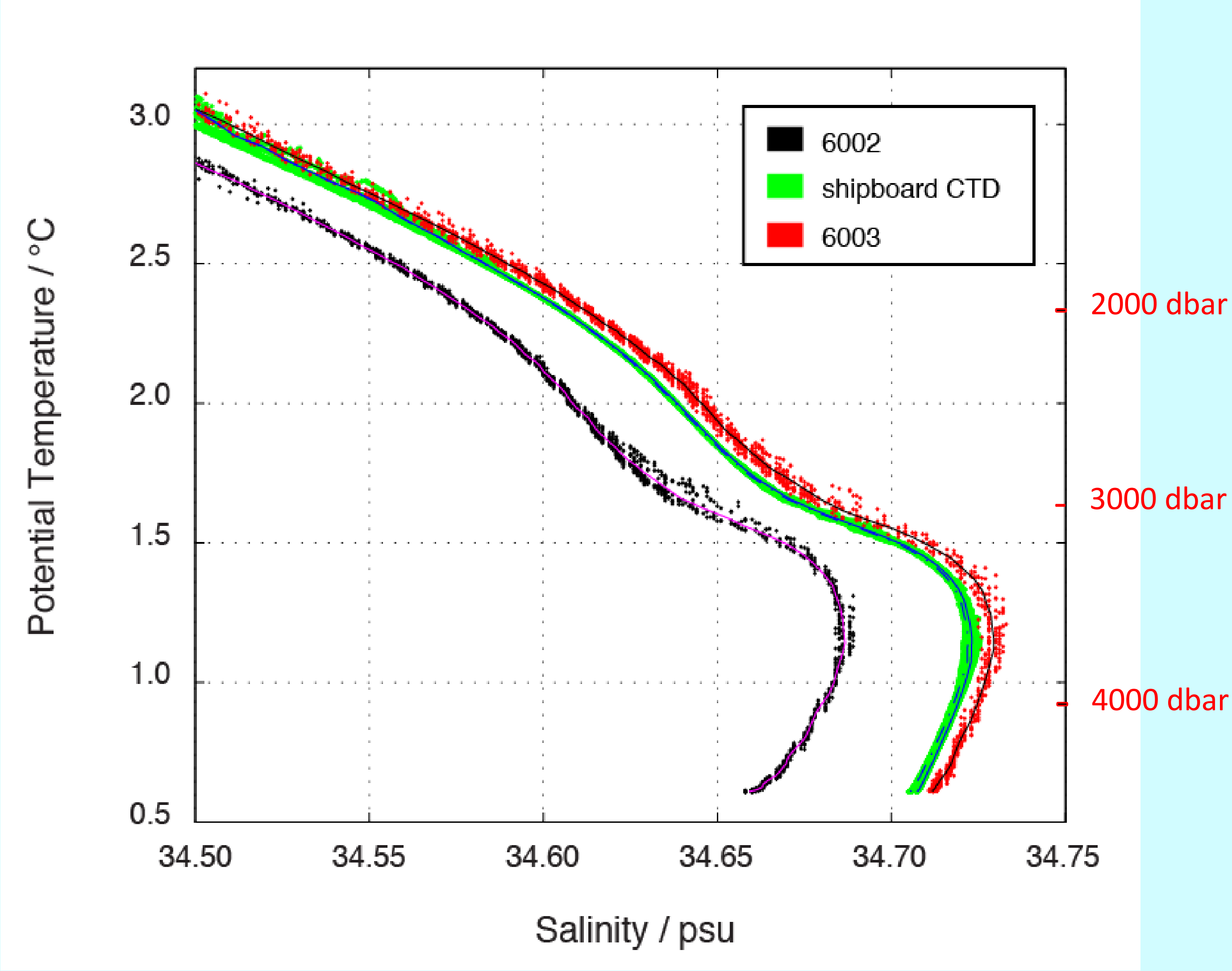
Depth contours are -4500 m, -5000 m, -5500 m and -5800 m.

Comparison of Deep SOLO 6003 and shipboard CTD data



- ❑ SBE 6003 CTD salinity is 0.005-0.006 saltier than shipboard CTD at pressure > 2000 dbar.

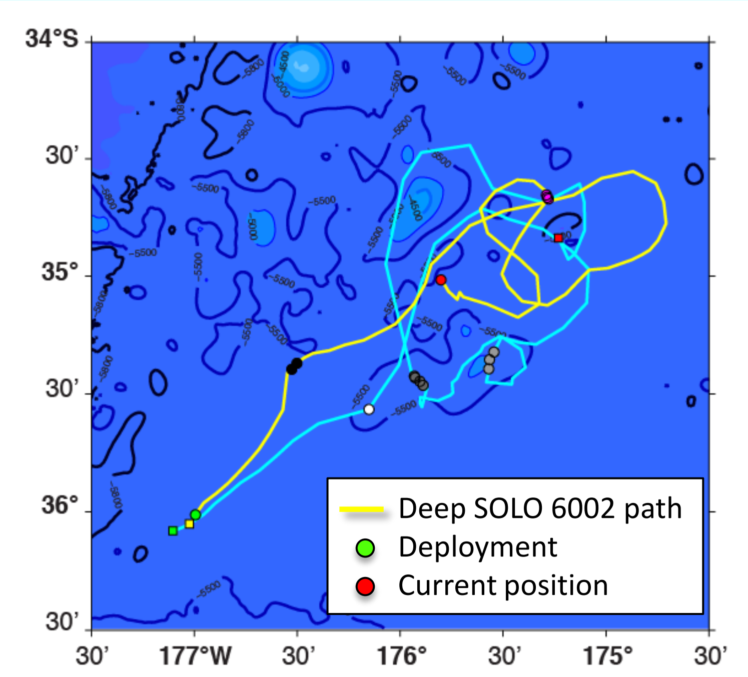
Comparison of Deep SOLO 6003 and 6002 and shipboard CTD data

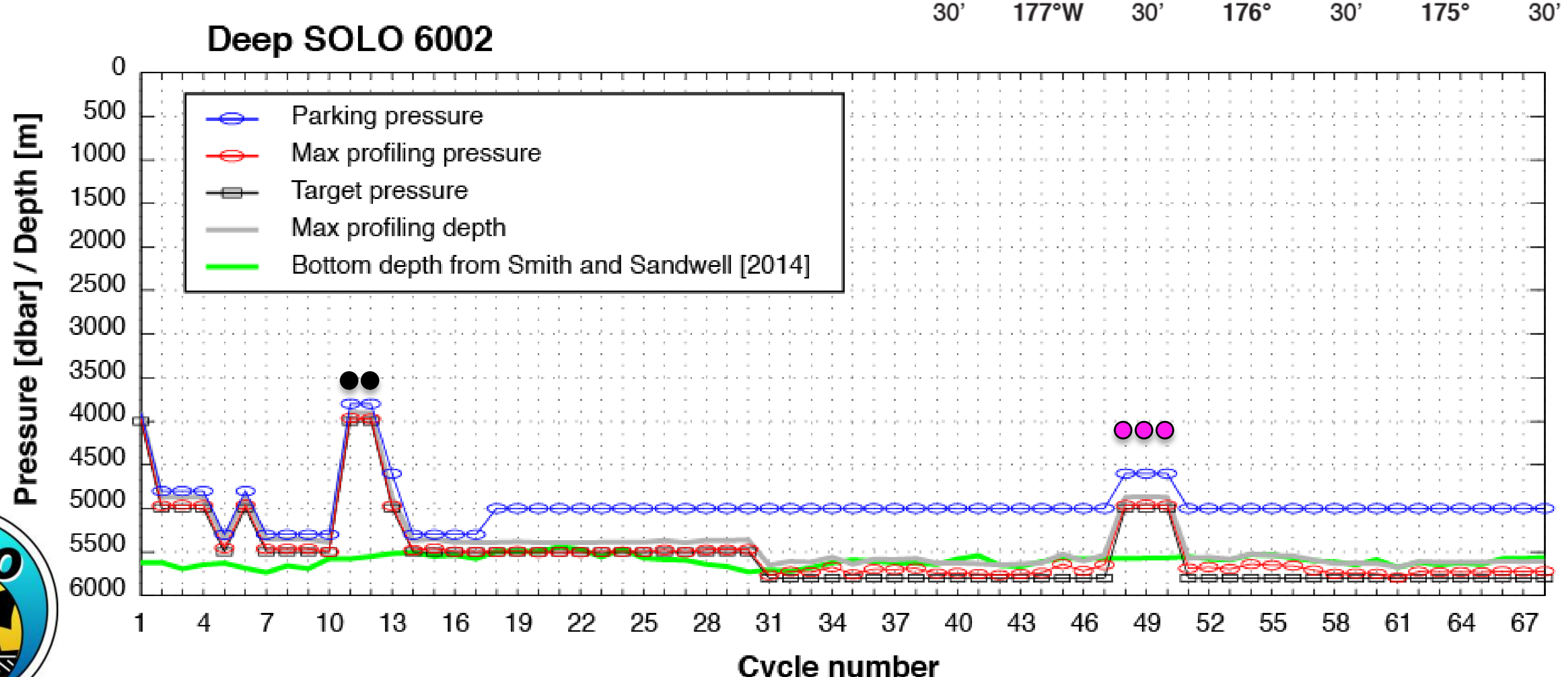


- SBE 6002 CTD salinity shows a 0.03-0.05 fresh bias compared with shipboard CTD at pressure > 2000 dbar.

Bottom depth 6002

- Max depth from 6002 in good agreement with Smith and Sandwell (1 minute x 1 minute grid) bathymetry [Sandwell et al., 2014] after cycle 31.

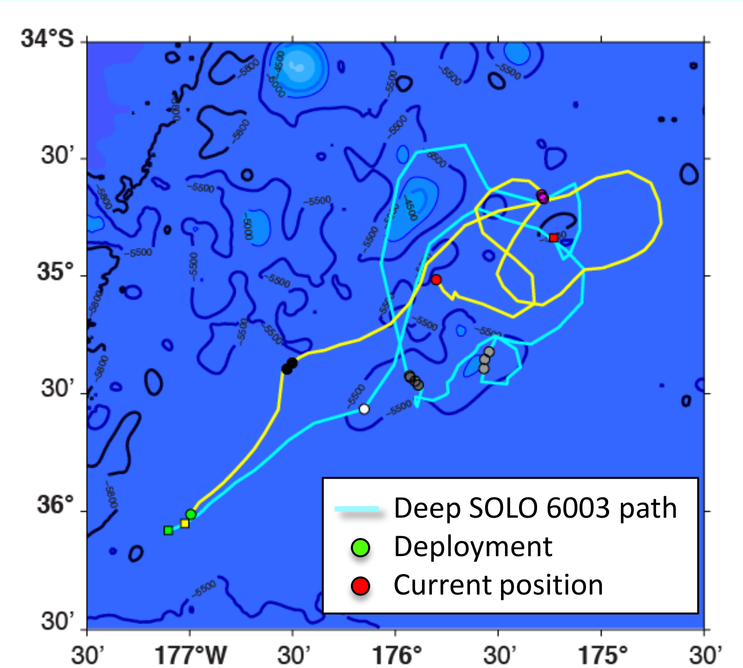


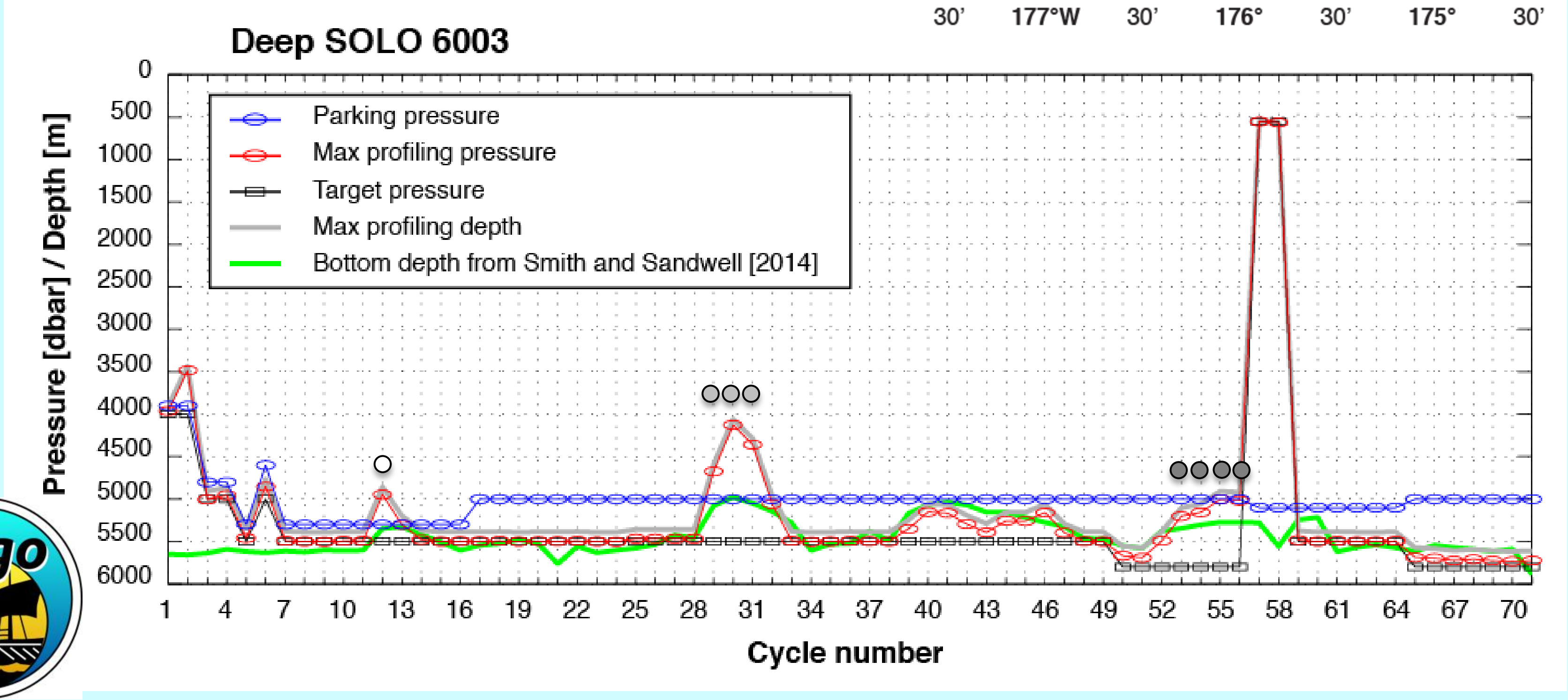


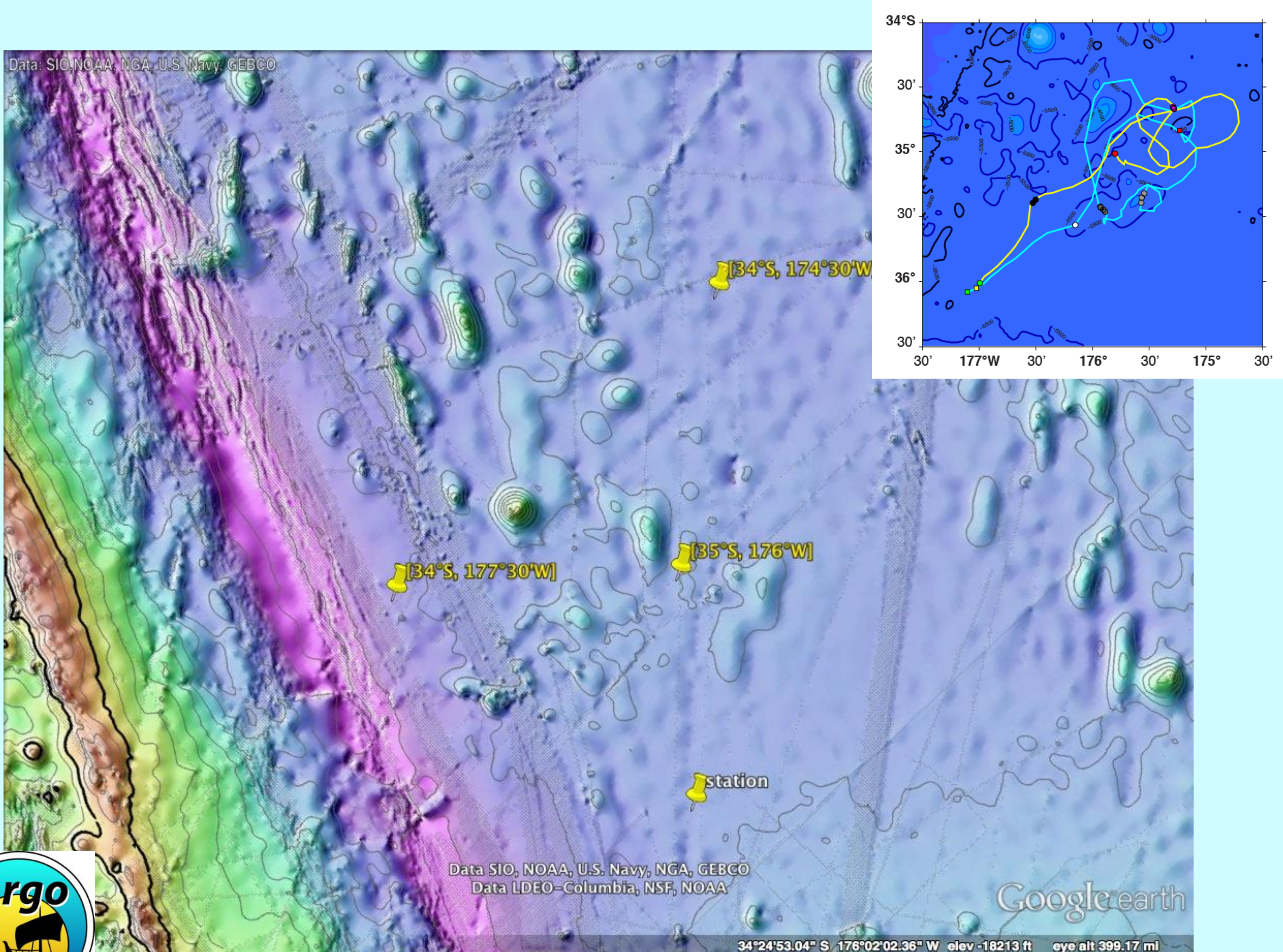
Bottom depth 6003

- ❑ 6003 parked at the bottom at cycles 12, 29-31, and 53-56. Max pressure > 600 m shallower than target pressure.

- ❑ Max depth from 6003 in good agreement with Smith and Sandwell bathymetry after cycle 28.

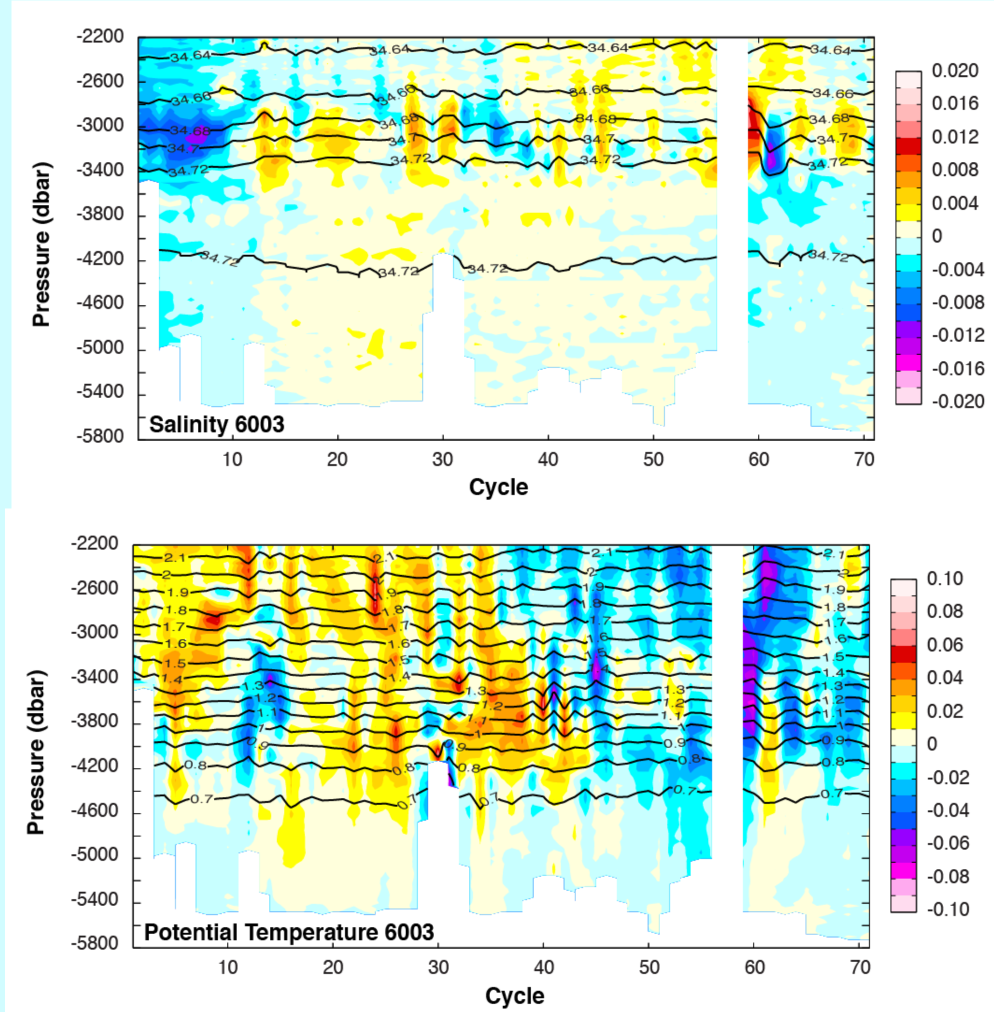






30 sec x 30 sec gridded bathymetry SRTM30 [Sandwell et al, 2014]

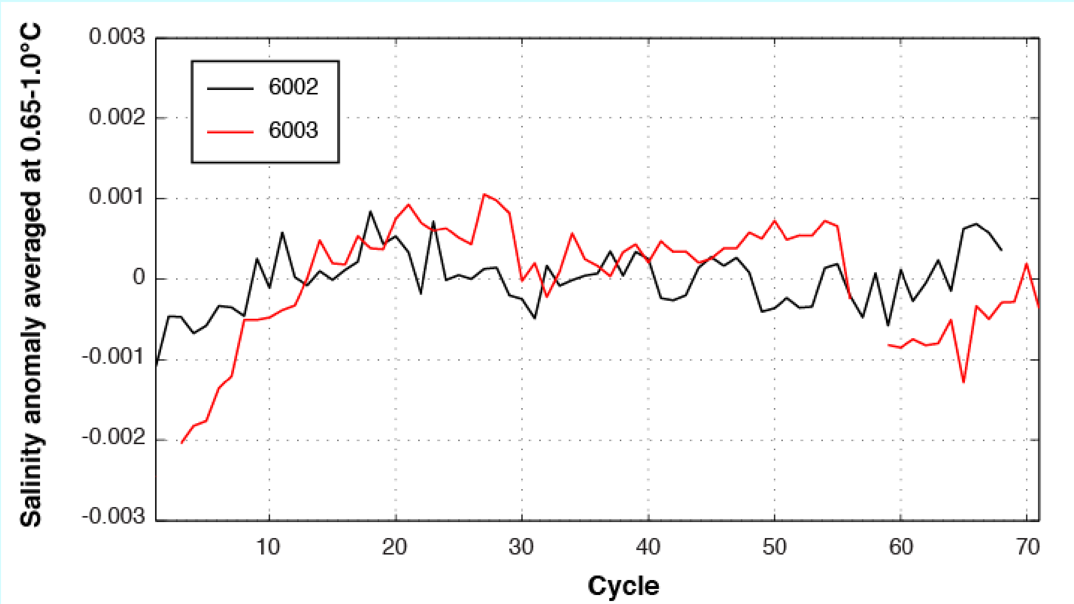
Time-variability in temperature and salinity below 2000 m



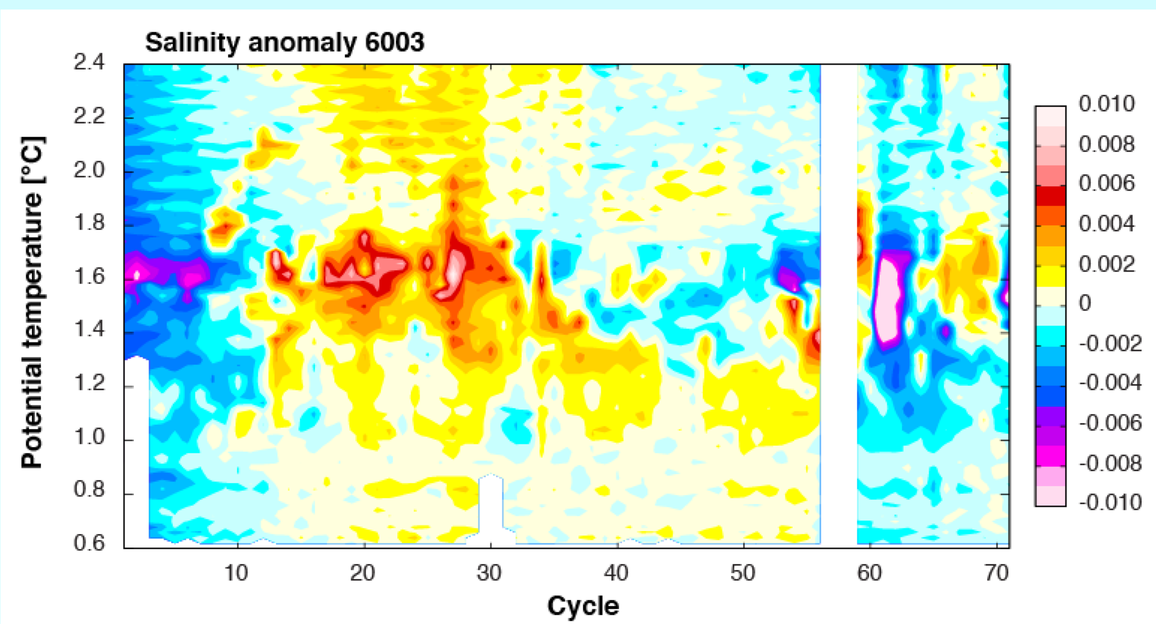
- ❑ Variability in temperature and salinity due to vertical displacement of isotherms and isohalines.

- ❑ 6002 CTD shows similar temperature and salinity changes.

Stability of 6002 and 6003 CTDs



- ❑ 6002 and 6003 CTDs are stable after 8 cycles.
- ❑ Salinity variability of 6002 and 6003 are mostly within ± 0.001, target accuracy of the instrument.

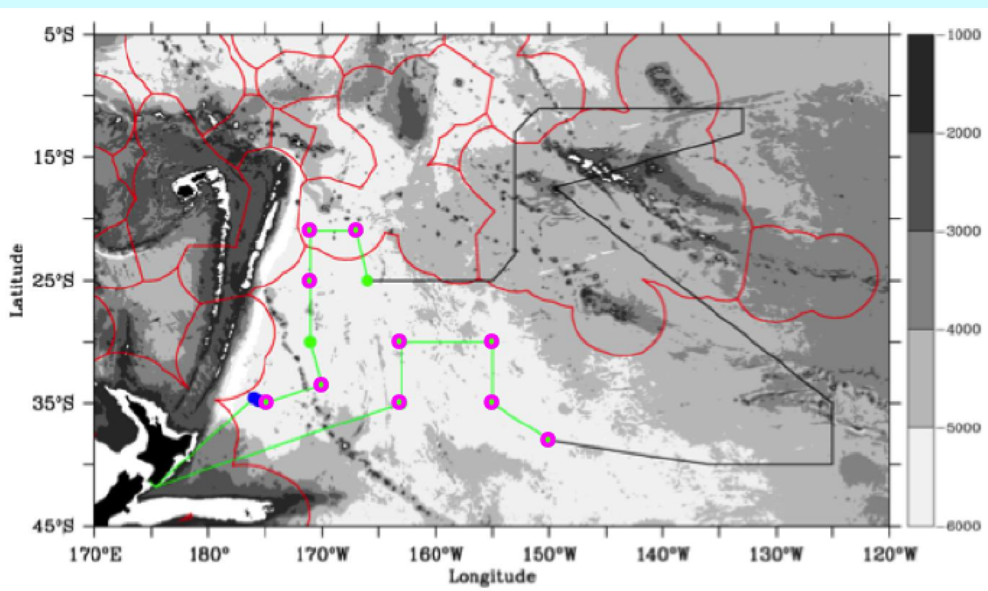


- ❑ Salinity variability at 1.2-1.8°C due to changes in water mass characteristics.

Deep SOLO float deployment
August-October 2015

R/V Kaharoa, Deep Argo 2015 Float Deployments

No.	Longitude	Latitude	Leg	Depth	EEZ
1	175° 00' W	35° 00' S	1	5601	
2	170° 00' W	33° 30' S	1	5674	
3	171° 00' W	30° 00' S	1	5530	
4	171° 00' W	25° 00' S	1	5786	Niue/NZ
5	171° 00' W	21° 00' S	1	5612	Niue/NZ
6	167° 00' W	21° 00' S	1	5386	
7	166° 00' W	25° 00' S	1	5676	
8	150° 00' W	38° 00' S	2	5513	
9	155° 00' W	35° 00' S	2	5458	
10	155° 00' W	30° 00' S	2	5140	
11	163° 00' W	30° 00' S	2	5235	
12	163° 00' W	35° 00' S	2	5339	



Tentative plan

- ❑ Aug-Oct 2015 (NOAA)
- ❑ Recover 2 deep SOLO float prototypes deployed in June 2014.
- ❑ Deploy 10 deep SOLO (SIO) and Apex (UW) floats.

New deep floats

- ❑ New controller
- ❑ An option to profile on the way up
- ❑ Higher precision in T and S through packing algorithm
- ❑ All other parameters (cycle time, parking depth, vertical resolution) are adjustable

Scientific objectives

- ❑ Deep water mass characteristics
- ❑ Deep water mass pathways in the southwestern Pacific Ocean

Summary

- 2 prototype Deep SOLO floats with SBE61 CTDs were deployed at 36°S 177°W, and are presently cycling to 5500 dbar every 6.5 days (> 67 cycles completed by each float over 9 months since deployment).
- 1 Deep SOLO (6003) CTD has a small salinity bias, ~.005 relative to shipboard data, and the other (6002) has a larger bias of - 0.04 (T and p appear ok).
- Bottom landing device efficient for avoiding snagging on the bottom or entraining mud.
- Deep SOLO CTDs are stable after 8 cycles.
- Both Deep SOLOs may be recovered in August-October 2015 after ~120 cycles (~80% of expected battery capacity), and replaced by a pilot array of 10 Deep Argo floats (Deep SOLOs and Deep APEXs) spread around the south-west Pacific Basin.
- Cruise photos and video available from www.learnz.org.nz