IN2015_V02
ADCP trials and trouble shooting
May 2015

Susan Wijffels
With help from : Gabriela Semolini-Pilo, Pamela Brodie, Johan Gustafson, Ninna Ribbat, Steve Van Graas, Ian McRobert

Summary

- both ADCP Ocean Surveyors had transducer alignment errors. The current estimate of the angles to put into VMDAS are: OS150 = 44.35 (EA= 4435 in config file); OS75 = 52.44 (EA=5244 in config file)
- Both OS's were losing comms every 20 mins to 3 hours, then autostarting Sometimes the loss of comms would permanently stop acquisition (not auto restart). Changing out the Serial-USB comms cable might have fixed this.
- the OS150 has several issues in BroadBand Mode which degrades the data

1. It is badly affected by bubbles flowing under the ship. This is lessened with reduced ship-speed and lowering the drop keep. It never really disappears unless the ship is stopped. The first 1-5 bins need to be carefully screened for unrealistic shears. This affect is reduced in Narrow Band mode.
2. It suffers from strong interference from the OS75 and the EK60.

- The OS75 suffers much less from bubble problems. It does however suffer from interference from both the OS150 and more weakly the EK60 (needs checking).
- It is clear from the echograms that the sADCP's interfere with the EK60. This would have to either be edited out or prevented for **quantitative use** of the EK60 output.

Preliminary recommendations

1. Recheck and refine the transducer alignment settings when more bottom track data is available for both instruments
2. For ***the most accurate currents***:

- set both ADCPs to ping as fast as possible(to reduce error via averaging) and out of sync (to randomize the interference) and use CODAS to edit out the bins affected by interference (advice from UH expert group).
- To reduce hull bubble bias and to obtain the greatest range, run both the OS150 and OS75 in narrowband mode and drop the keep to 'medium' (2m). If near surface shear is needed, drop the ship speed.
- Turn off the EK60 to reduce interference

3. If there is a science need for both **quantitative** EK60 data and sADCP data (e.g. transits), some further work needs to be done to test and refine the use of K-Sync. While syncing the sonars stops interference (when done correctly), it does reduce the number of pings any single instrument collects, thus increasing the error through reduced averaging. However, using K-sync seems a useful compromise for use in transits for collecting data towards a national data base of both biological sonar data (EK60) and a velocity atlas (sADCP) as it allows both instruments to run at the same time. ***More ideal***, is to find out if the interference can be routinely edited out of all data streams, which will then negate the need to sync pings and the associated subsequent degradation of data quality (less averaging).
4. The capability for on-board processing via CODAS would greatly increase our ability to trouble shoot and optimize the sonar configurations. This should be aspired to.
5. Every person that runs the sADCPs, processes and uses the data should read the following sections of the RDI Ocean Surveyor technical manual: The Practical Primer; the Trouble Shooting Guide; the Commands and Output section.

Issue 1: Lack of attitude data.

For unknown reasons, the heading, tilt and roll NMEA feed from the Seapath attitude array was not reaching VmDAS. This was rectified in the second sets of ensembles.

Issue 2: Transducer Alignment errors

As RV IN steamed out of Sydney heads and across the shelf on the way north at the start of the voyage, both ADCP's were in broadband mode and were bottom tracking.

It quickly became apparent that both had alignment problems (stick plots on VMDAS disagreed with each other and the currents changed direction with ship heading changes). See two images below

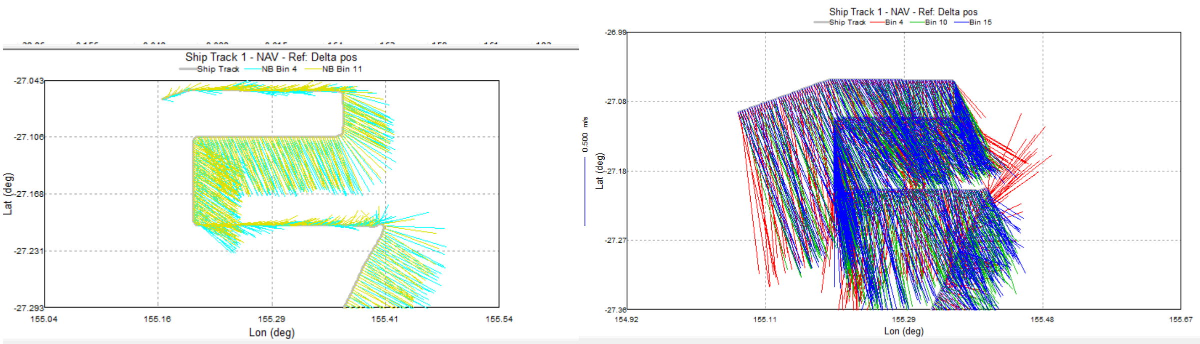


Figure 1. (left) Track from os75 at ensemble 748 17 May 2915 12:24:22.09 ; (right) Track from os150 at ensemble 781 17 May 2015 12:54:02.00

In addition, the OS150 had only 4 m bins with a 2m blanking distance. This is likely to result in noisy data, and useless data in the first bin.

Once we got the attitude data into the systems, and it did not fix the problems, it was clear that there was a transducer alignment problem.

I calculated the transducer misalignment using the bottom tracking data from the shelf.

Method for calculating EA from bottom track data (SEW May 18, 2015)

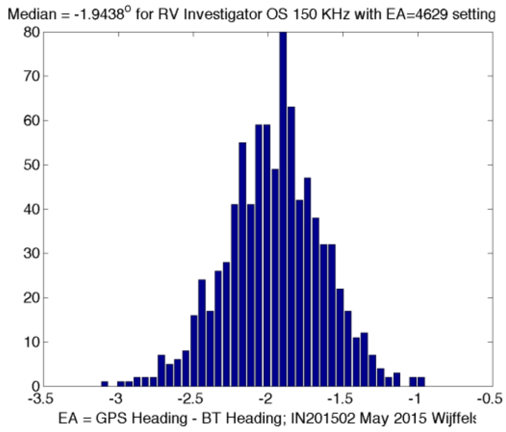
(see /current/science/matlab/check_adcp_sew.m script)

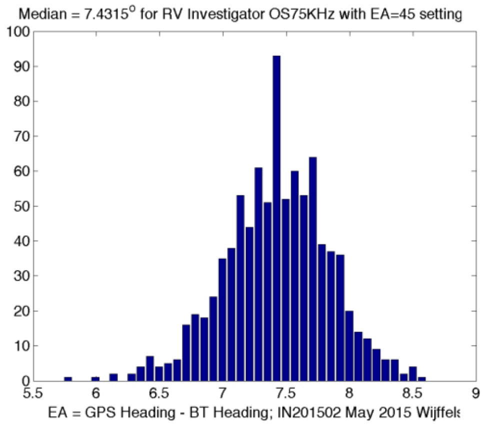
Export two versions of the STA (6 minute average) files from winADCP – with processing reference set to 'nav'. We need a reasonable run of data with bottom tracking and good nav data.

EA = bottom track heading (°T) – ship nav heading (°T).

°T = degrees clockwise from North (navigational convention).

For both ADCPs the values of EA based on the 1 minute STA ensembles were reasonably stable where the bottom track data was good. The median was used as the angle to adjust. See Figure below.





These values were then added to the ones that had been used in generating these ensembles:

OS150 EA(new) = 46.29 (old) - 1.94 (new) = 44.35 (4435 in config file)

OS75 EA(new) = 45 (old) + 7.43 = 52.44 (5244 in config file)

The config files for the two OS were edited to change this, extended the blanking distance on the OS150. The override in VmDAS was disabled.

Bottom tracking was switched of in both OS once we left the shelf to maximize the water ping count.

Issue 3: Instrument communication timeouts/restarts: SEW May 19-24,2015

Both OS instruments appear to undergo restarts every 1-3 hours. It is more frequent in the OS75. The error messages found in the ensemble .LOG files are:

[2015/05/17, 00:47:12.868]: ADCPCOMMTMO: PrevPingTime=[00:47:03.668] EnsBufIndex=0 Hdr=[7f 7f bc 04]

[2015/05/17, 00:47:12.868]:

[2015/05/17, 00:47:13.869]: Timeout waiting for response from ADCP!

[2015/05/17, 00:47:13.869]:

[2015/05/17, 00:47:14.869]: Timeout waiting for response from ADCP!

[2015/05/17, 00:47:17.947]:

Ian McRobert with Steve Van Graas' assistance, valiantly tried several workarounds, none of which worked. Eventually, it was suspected that the USB2Serial buses were the source of the intermittency. The mooring team had some onboard from a different supplier than those used for the ADCPs. Towards the end of the cruise, the bus on the OS150 was swapped out first. This greatly improved things. The OS75 was swapped out a coupled of days later. The .LOG files written by VmDAS should be monitored to see if this does fix the issue long-term. This intermittency might cause a re-zeroing of ensemble numbering in the .STA and .LTA files written by VmDAS.

Issue 4: Bad near surface shears in OS150 – likely due to hull induced bubbles

Unrealistic shears were quickly spotted in the near surface OS150 water velocities. At first we thought this was ringing due to poorly manufactured transducers (fixable) or due to a poor installation (harder to fix). Unlike the OS75, the OS150 is not 'in water' but is behind a cover at the end of the drop keel', which is known to sometimes increase ringing in the wrong materials are used.

However, after a while we realized that the shear was not always there and would disappear when the ship was not steaming. See examples below from ensemble adcp\os150\in2015_v02038_000000.STA (broadband mode)

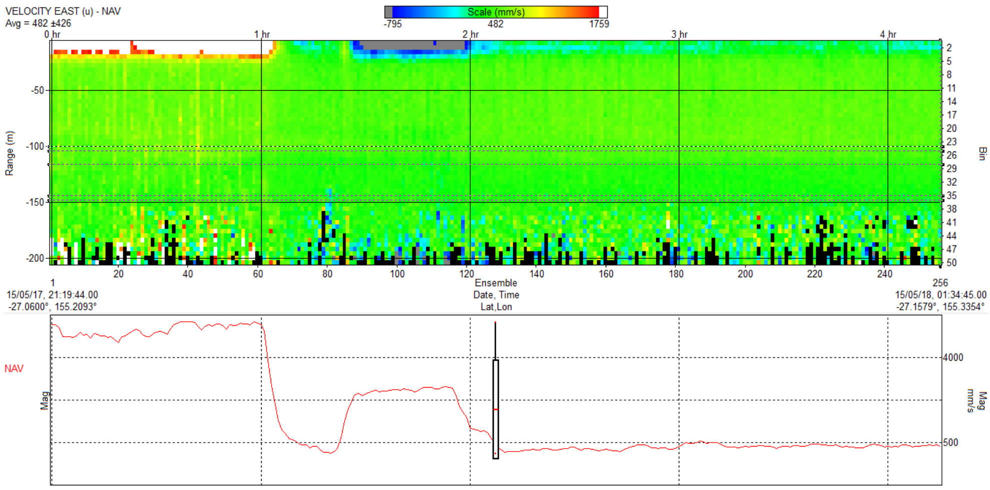


Figure 1 – Change in ship speed (bottom) from speed to still showing ADCP surface shear occurring during ship speed at high and mid speed. Intensity of surface shear also decreased with decreased ship speed. No shear while the ship was not moving. Depth of shear was 0 – 5 m.

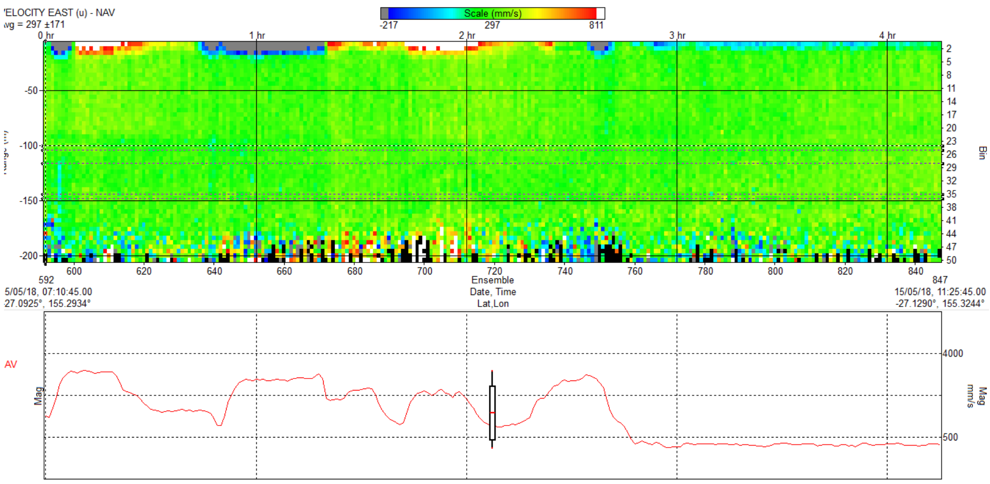


Figure 2 – The high near surface ocean velocities (bubble effect – top panels) was seen to vary with ship speed (red series bottom)

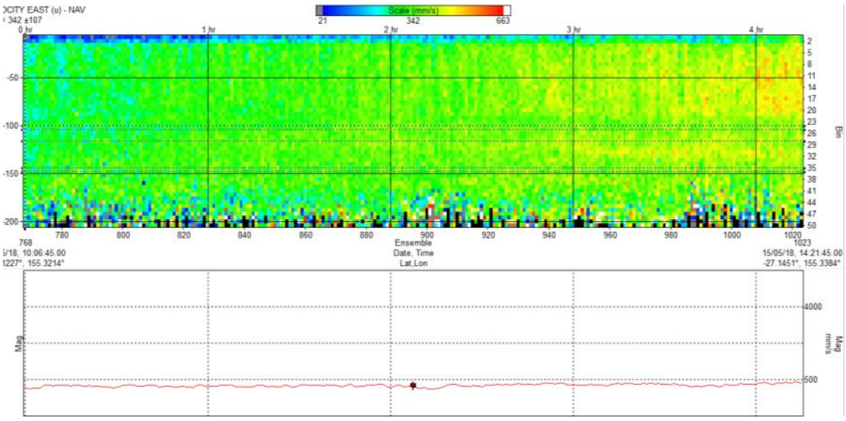


Figure 3 – Bubble effect was seen during constant low ship speed.

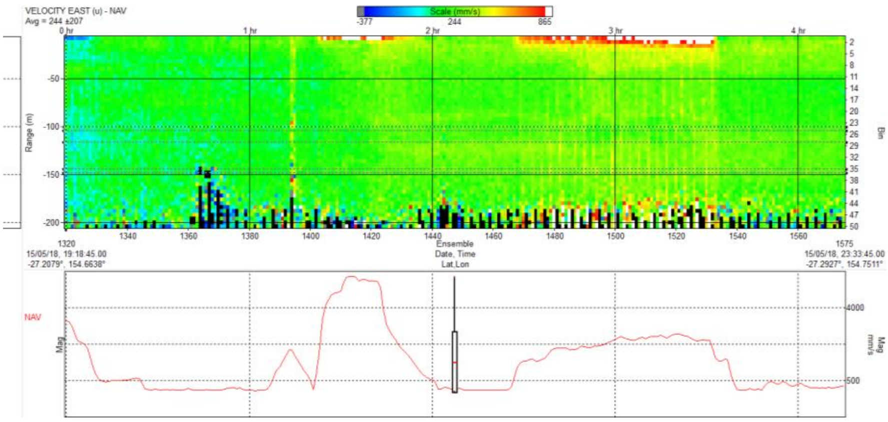


Figure 4 – Bubble effect only there during steaming.

On reading the manual and the UH Report by Jules Hammon on the RV Sikuliaq installation, we determined that it was likely due to bubbles flowing past the transducer head.

We then did a series of experiments to see if we could minimize this effect

1. changed to narrowband
2. drop the keel (on which the OS s are installed) – at 4m first then at 2m after.

The port drop keel was dropped 4 m (full extension) at 20th May 0716 (UTC). Below are plots from the OS150 file: in2015_v02044_000000.STA (narrowband)

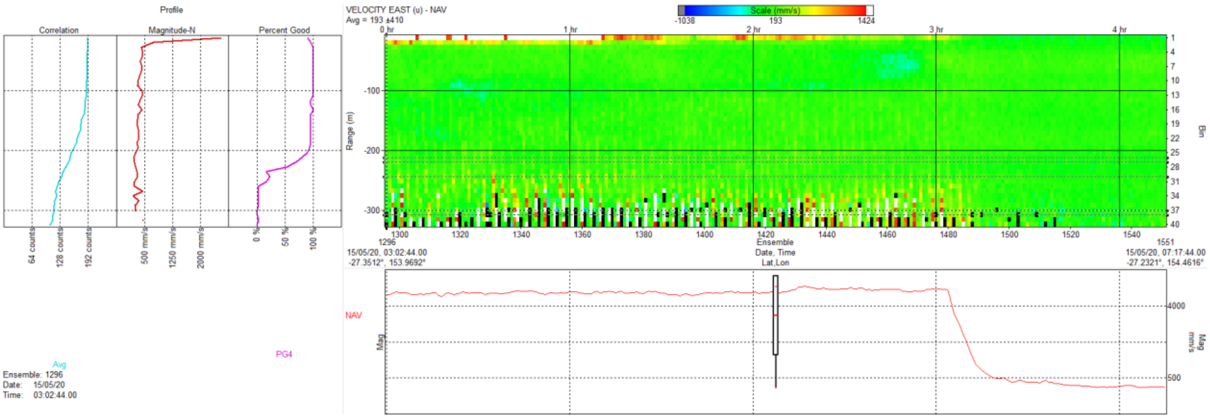


Figure 5 – ADCP magnitude for 20th-May for 0720 to 1125. Drop keel was lowered 4 m at 0716. The effect is still there but weaker.

As a last check, we returned the OS150 to BB mode with the drop keel at 2m.

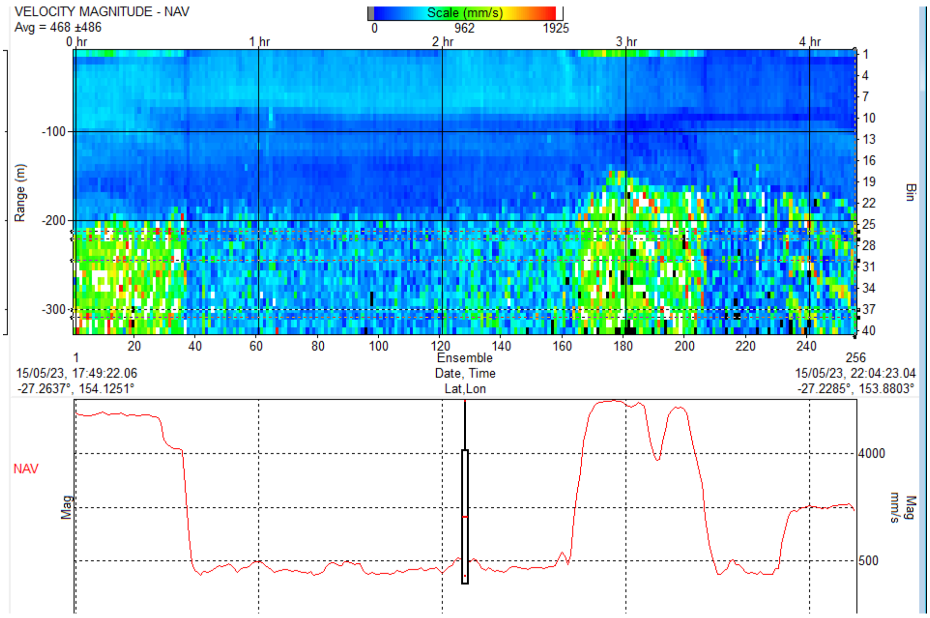


Figure 6 – example of OS150 BB output with dropkeep at 2m – bubble effect is weakened but is still there. Note the large drop in range due to switching to BB from NB. In2015_v020100

In summary, we found that in NB mode, the unrealistic shear affects less bins and that lowering the drop keep helps as well. We did not see any obvious difference between a 2m and 4m extension. We could not eliminate the bubble effect during steaming altogether. It will have to be edited out . This does lessen the value of the OS150, as its main advantage over the OS75 is a smaller blanking distance and resolution near the surface.

Issue 5: Interference from other Sonars (Gabriela Semolini-Pilo)

Based on plots of echo-amplitude in the OS150 beams, it was clear that interference was occurring from some other sonar. It took us some time to determine the source of the interference.

1. 150 kHz ADCP

We noted the presence of a recurrent interference on the 150 KhZ shipboard ADCP data (Figure 1). This interference does not occur in the earlier records of the EAC Mooring Array cruise (in2015_v02034_*.ENR), starting at the in2015_v02035_*.ENR record (Figure 2). The difference between these files is that the former ones where captured on shallow waters (depth < 200 m) and the ADCP was performing bottom tracking. On the later files, the ship left the continental shelf, navigating on deeper waters. The signal is strong on the beams echoes, but is not always considered as noise by the VmDAS qc (Figure 3). The interference pattern can change within a 1 hour record (Figure 4). Also, the interference pattern seems stronger in a later file (Figure 6).

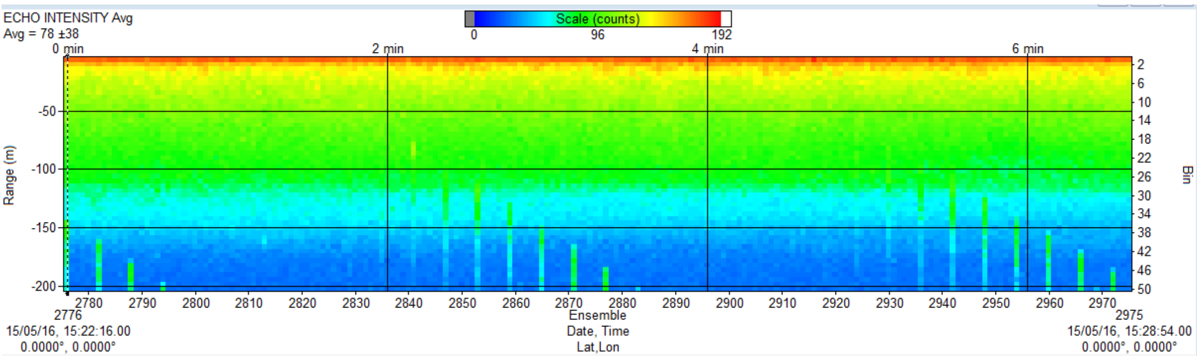


Figure 1: Interference identified in the 150 kHz ADCP files.

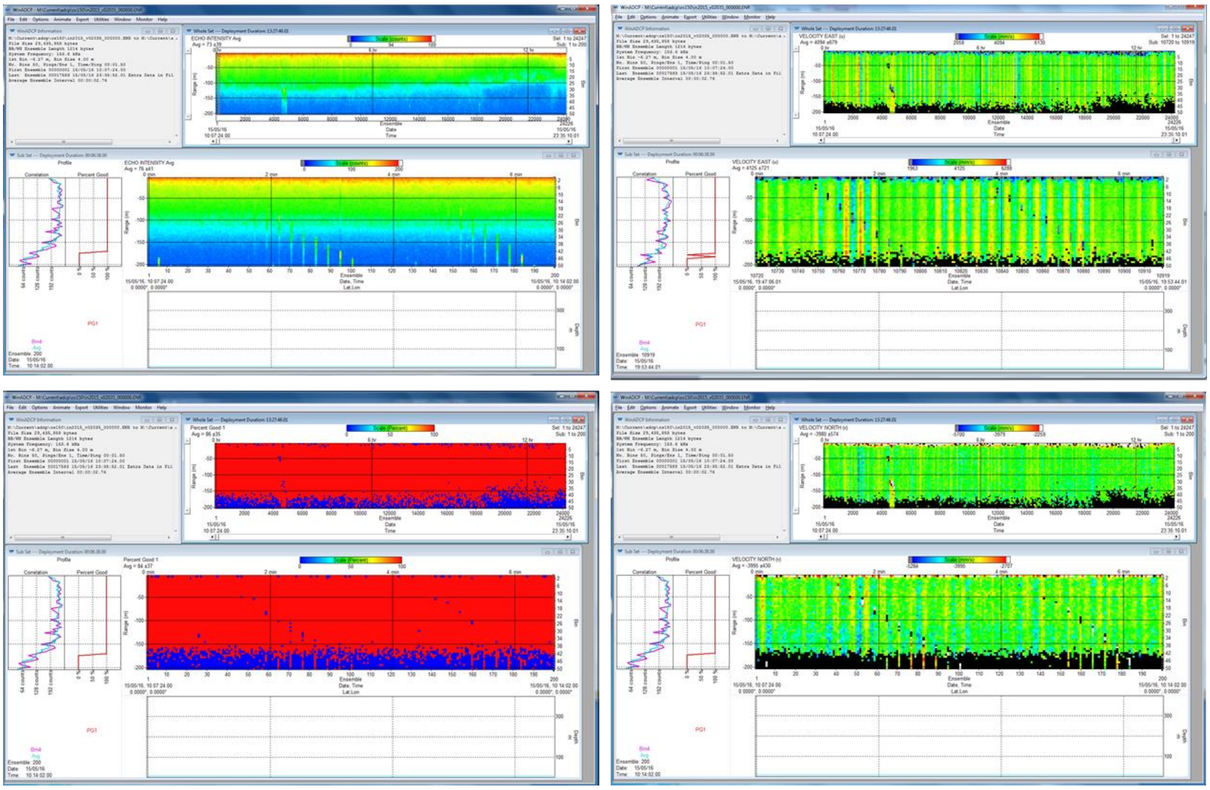


Figure 2: Snapshots from file 2015_v02035_000001.ENR; a) Beam Average Echo, showing the recurrent interference; b) Zonal component of velocity, without processing; c) Bean 1 Percent Good; and d) Meridional component of velocity, without processing.

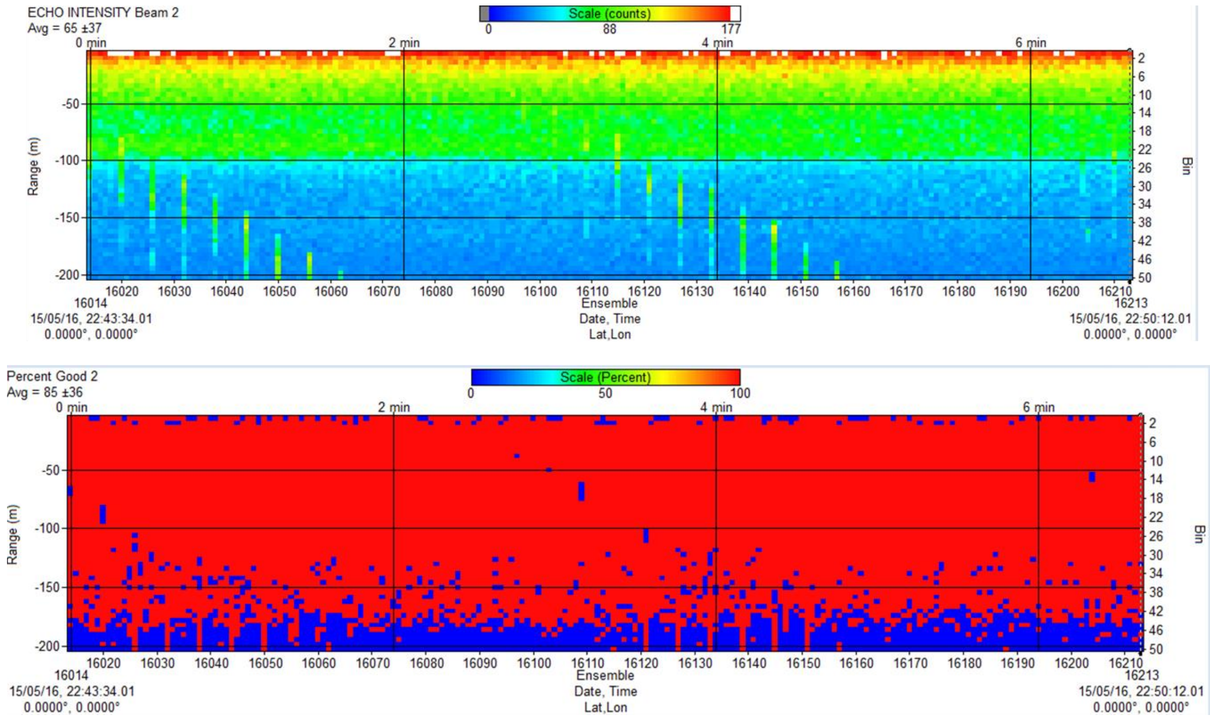


Figure 3: a) Echo intensity from Beam 2 and b) its respective percent good.

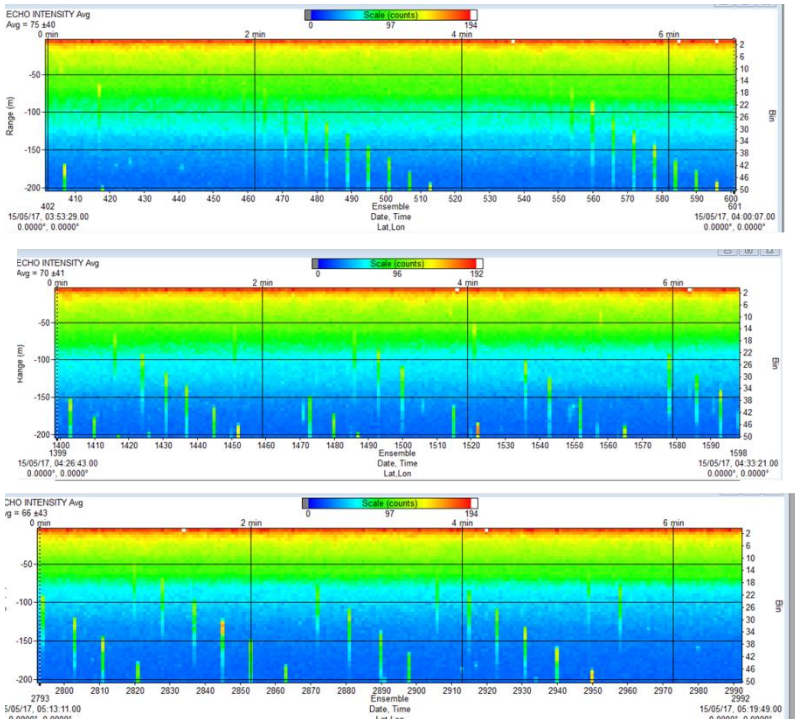


Figure 4: Changes in interference patter in file in2015_v02036_000000.ENR.

In the in2015_v02036_000000.ENR file at 17/May/2015, 19:18:33UTC the pattern changes (Figure 5), followed by an absence of the interference for 1 hour. The regular pattern (Figure 1) starts again at 20:18:37.

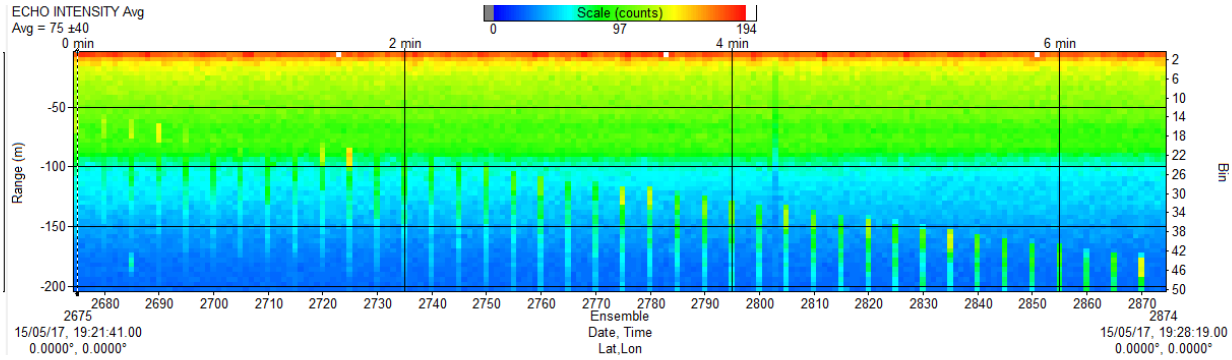


Figure 5: Change in interference pattern in file in2015_v02036_000000.ENR.

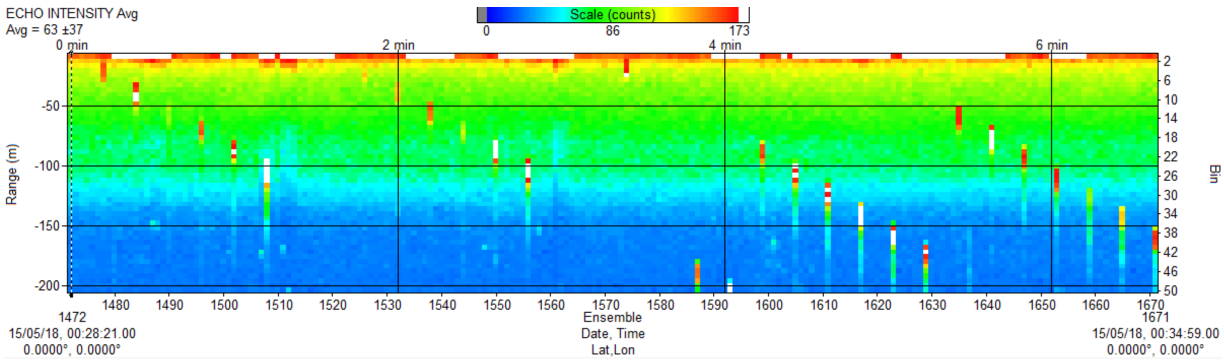


Figure 6: Interference pattern in file in2015_v02038_000000.ENR.

2. 75 kHz ADCP

The 75 kHz ADCP seem to feature similar interference as the OS 150 kHz in all files (Figures 7 and 8).

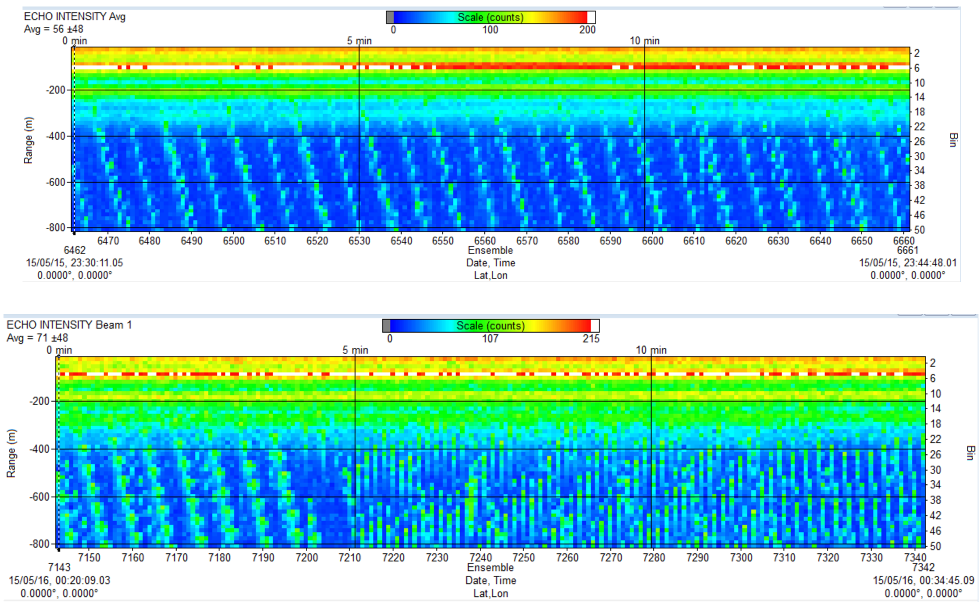


Figure 7: Snapshots from in2015_v02057_000000.ENR – shallow waters.

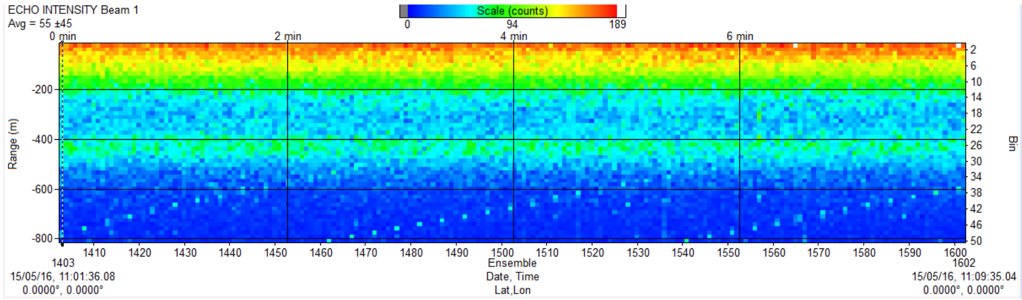


Figure 8: Snapshot in2015_v02059_000000.ENR – deep waters.

3. Tracking the source of the interference (SEW)

Using Gabi's notes we looked to see if the ships depth sounder was turned off during the period when the interference disappeared. Nina showed that is has been on continuously so we can rule that out as the source of interference.

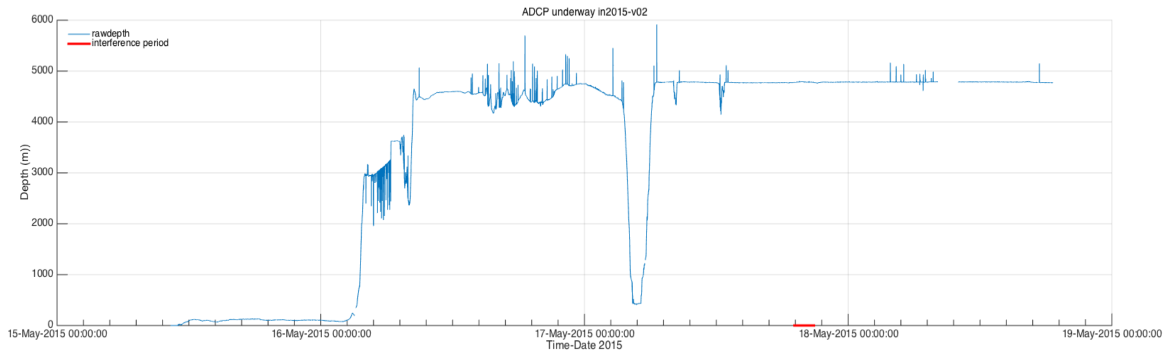


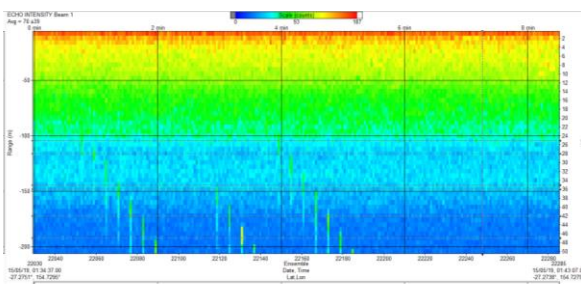
Figure 9: ships' sounder outputs showing it was on when the OS150 showed interference. The EK60 was turned of early in the voyage.

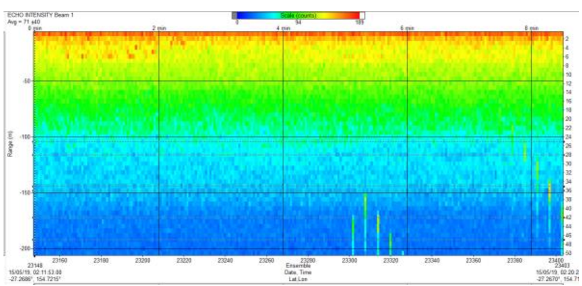
The next most likely candidates are that the ADCPs are interfering with each other or that the speed of sound monitor on the drop keel used to calibrate the swath, or the swath itself.

Interference test 1: 19/05/2015

Turned off the OS75 and see if interference disappears on OS150.

OS75 turned off at ~ 0139 UTC and turned back on at ~ 0217 UTC. Plotting beam EAs in winADCP (see below) showed clearly that the interference pattern disappeared when the OS75 was turned off and reappeared on its start up. This means that in the OS150, it is the OS75 that is causing interference. [file = M:\Current\adcp\os150\in2015_v02038_000006.ENX]





Summary: As documented in the RDI manual and noted in the UH Report by Jules Hammon on the *RV* Sikuliaq installation, the OS75 and OS150 interfere with each other. The UH expert group suggest that this is OK as the affected bins can be edited out ping by ping in CODAS. It does mean that the .STA and .LTA ensemble averages output by VmDAS are biased by this interference (use – beware). UH recommend letting the two OS ping as fast as possible and to avoid syncing them as this drastically reduces the number of water pings, and thus drives up the random error in the ensemble averages.

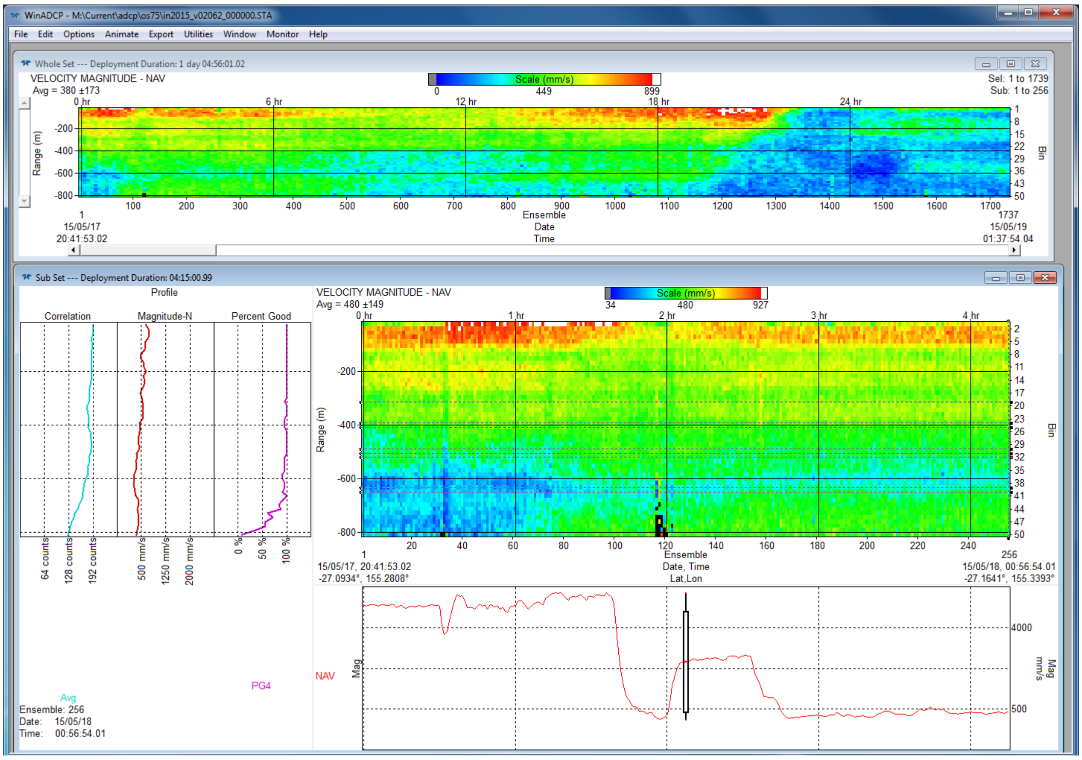
Other issues examined:

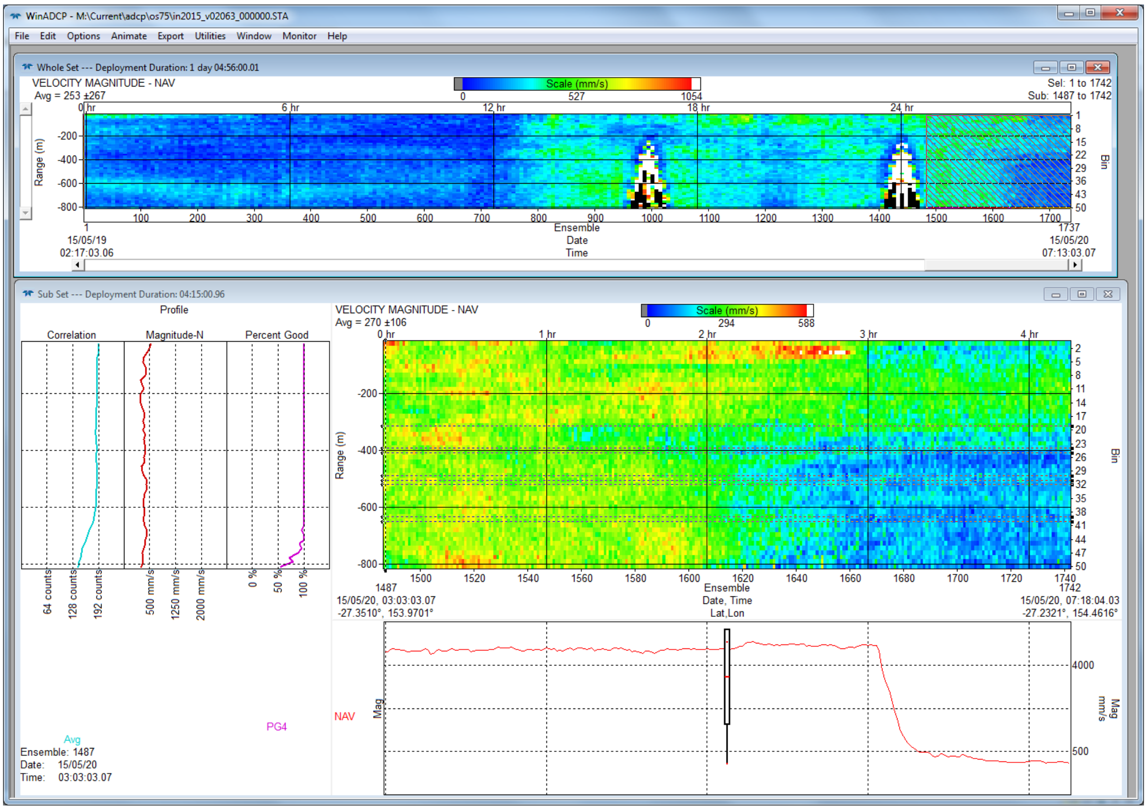
1. Possible impact of extending the drop keel on OS75 data quality due to vibration.

We tried to compare the impact of drop keel position on noise in OS75 NB mode.

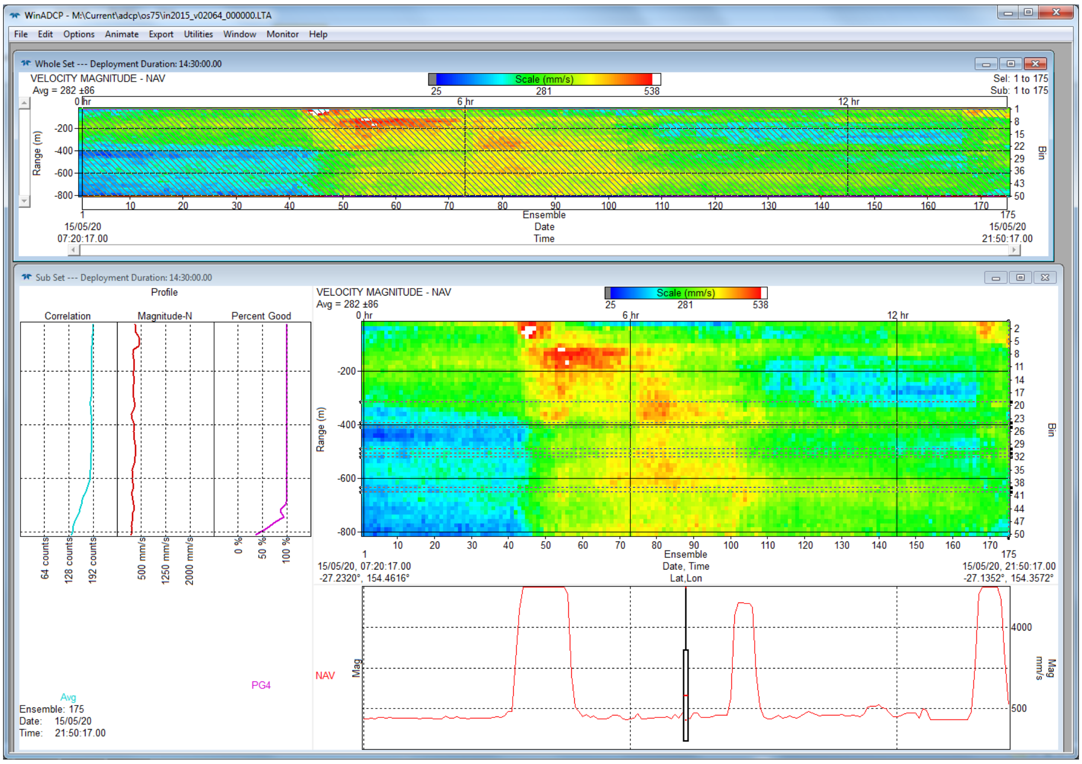
Drop keel was moved to full extension (4m below gondola) at 0717 20/05 UTC

Drop keel was moved to medium position (2m below gondola) at 2203 20/05/2015

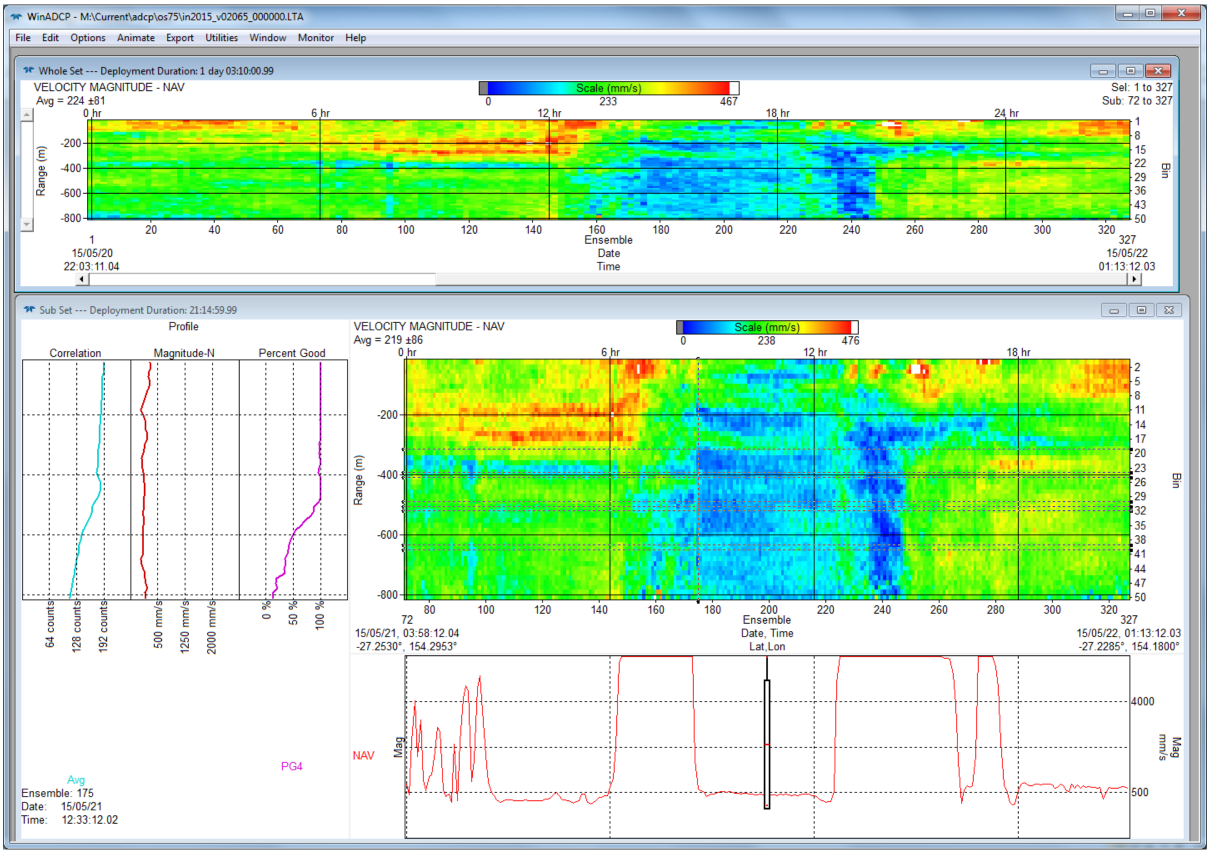




Above has drop keel flush with the gondola.



Above is with the drop keep fully extended.



Above is where the drop keel is half extended.

There appears to be no degradation of the OS75 by having the drop keel extended but this effect could be further check in post processing using CODAS.

Possible impact of use of the bow-thruster on data taken during CTD stations and mooring layouts.

Johan looked to see if there was any indication of impacts of use of the bow-thruster. He did not think any were clear. The times of deployments are listed below for comparison in post processing.

<u>Deployments of bow thruster from the bridge log</u>
19- May Local
0536 - Bt deployed
0635 - Bt home
0719 - Bt deployed
1615 - Bt home
1845 - Bt deployed
1929 - CTD in water
2309 - Bt housed

20- May Local
1622 - Bt deployed and running
1648 - CTD in water
1716 - Deploy port drop keel 4m down
2030 - CTD on board

2032 - Bt home
2040 - make way to next CTD site
2215 - Ready for CTD deployment
2355 - CTD on sea floor, comence retreiva

21- May
0127 - Bt home

Local	date	UTC	date	Difference
536	19-May	1936	18-May	-10
635	19-May	2035	18-May	
719	19-May	2119	18-May	
1615	19-May	615	19-May	
1845	19-May	845	19-May	
1929	19-May	829	19-May	
2309	19-May	1309	19-May	
1622	20-May	622	20-May	
1648	20-May	648	20-May	
1716	20-May	716	20-May	
2030	20-May	1030	20-May	
2032	20-May	1032	20-May	
2040	20-May	1040	20-May	
2215	20-May	1215	20-May	
2355	20-May	1355	20-May	
127	21-May	1527	20-May	