11. Lowered Acoustic Doppler Current Profiler (LADCP)

11.1 Instrument Setup

The JC031 Drake Passage cruise began in Punta Arenas equipped with a compliment of 3 fully functioning LADCP's, all the same model (RDI Workhorse Monitor 300 kHz), two of which were comprised of a titanium casing and the other had an aluminium casing. The original LADCP was ready installed from the previous cruise (JC030), and was bolted securely to the CTD frame on the opposite side to the CTD fin. The battery life of the LADCP only held up deployment on the shallow stations, but disruption due to charging time was minimal. Between a deep station and a shallow station where the steaming time was only an hour the disruption caused by charging the LADCP was reported as approximately 15 minutes. The data was downloaded from the instrument by the CTD technicians. As with other NOCS cruises the LADCP's were configured to have a standard 10x16m bins, with one water track and one bottom track ping in a two second ensemble. There was also a 500cm blank at the surface.

11.2 LADCP Performance

Following the JC030 cruise the LADCP's were considered to be in good working order. On the test station that was performed at the beginning of the trip, the CTD along with the LADCP was lowered to a depth of 4409m to test the performance. The graphs produced from the processed data at this station demonstrated that the instrument was working correctly, and all the beams were shown to be aligned in terms of signal strength. No messages warning about weak or broken beams were produced.

Physical loss and damage forced the use of each of the spare instruments on board. The LADCP that had been attached since Punta Arenas was lost when an incident with the winch caused the whole package to be lost at Station 12. The other incident occurred during Station 34 when the wire slipped on the traction winch causing the CTD frame to fall from a height (a few inches). Unfortunately the LADCP bore the brunt of the impact with the metal fastening on the deck in the wetlab. The instrument was removed, tested and found to be functioning properly. As can be seen from Figure 40, the damage was localised to one area of the instrument. However, it was decided that continuing to use it would be unwise as the instrument could likely flood when submerged again, especially as the instrument would be subject to large pressures when lowered to depth. Consequently, the instrument was taken out of action and the final spare was deployed. In addition to these major impedances, several minor technical issues occurred throughout the cruise, but not of any real significance that affected the data collected. For example, on Station 24 the memory was erased because the LADCP ping could not be heard. Station 50 did not yield any LADCP data because the deploy command was not sent. Station 75 presented problems with downloading the data because a diode failed. This was replaced and there did not appear to be any problems with downloading data at subsequent stations.

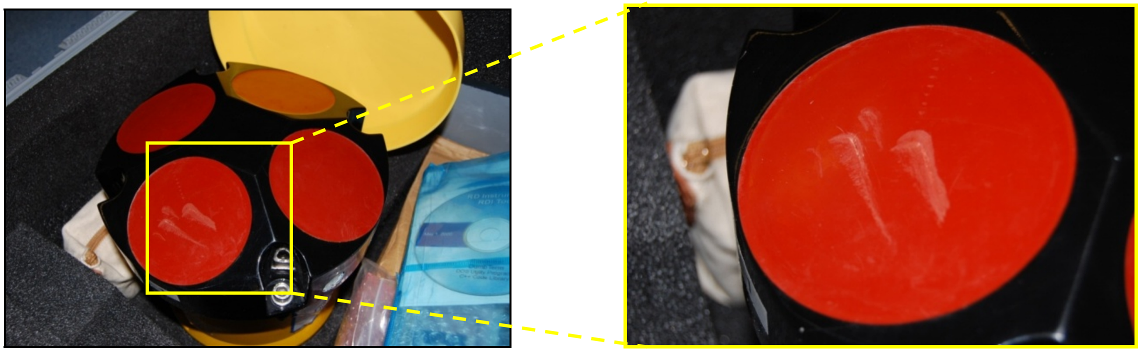

Figure 40: Damage to the LADCP

11.3 Data Processing

Data collected by the instrument was downloaded after each cast by the technician on watch. This data comprised of RDI binary .000 files and corresponding .txt files.

The data from the lowered Doppler was subject to two processing types; UH (University of Hawaii) and LDEO (Lamont-Doherty Earth Observation). Principally, the current velocities were calculated without the CTD data in order to gauge how the instrument was operating and also to identify what was happening in terms of current velocities. Once the CTD data had been processed by Mary Woodgate-Jones, the speed of sound corrections could be made to the LADCP data, giving a more accurate interpretation of the current velocities at each station. To accomplish this, an ascii version of the CTD 1Hz file was created using Matlab. Another program then checked that the vertical velocities for the CTD and LADCP agree. The CTD data is then incorporated into the LADCP soundings and the single pings are merged into corrected shear profiles.

11.3.1 UH Processing

The following graphs demonstrate the findings from the UH processing of the data from the test Station (001). The data used in these graphs has had the speed of sound corrections applied. By using the UH processing technique, information regarding the current velocities, CTD rotation and tilt, and shear are extracted.

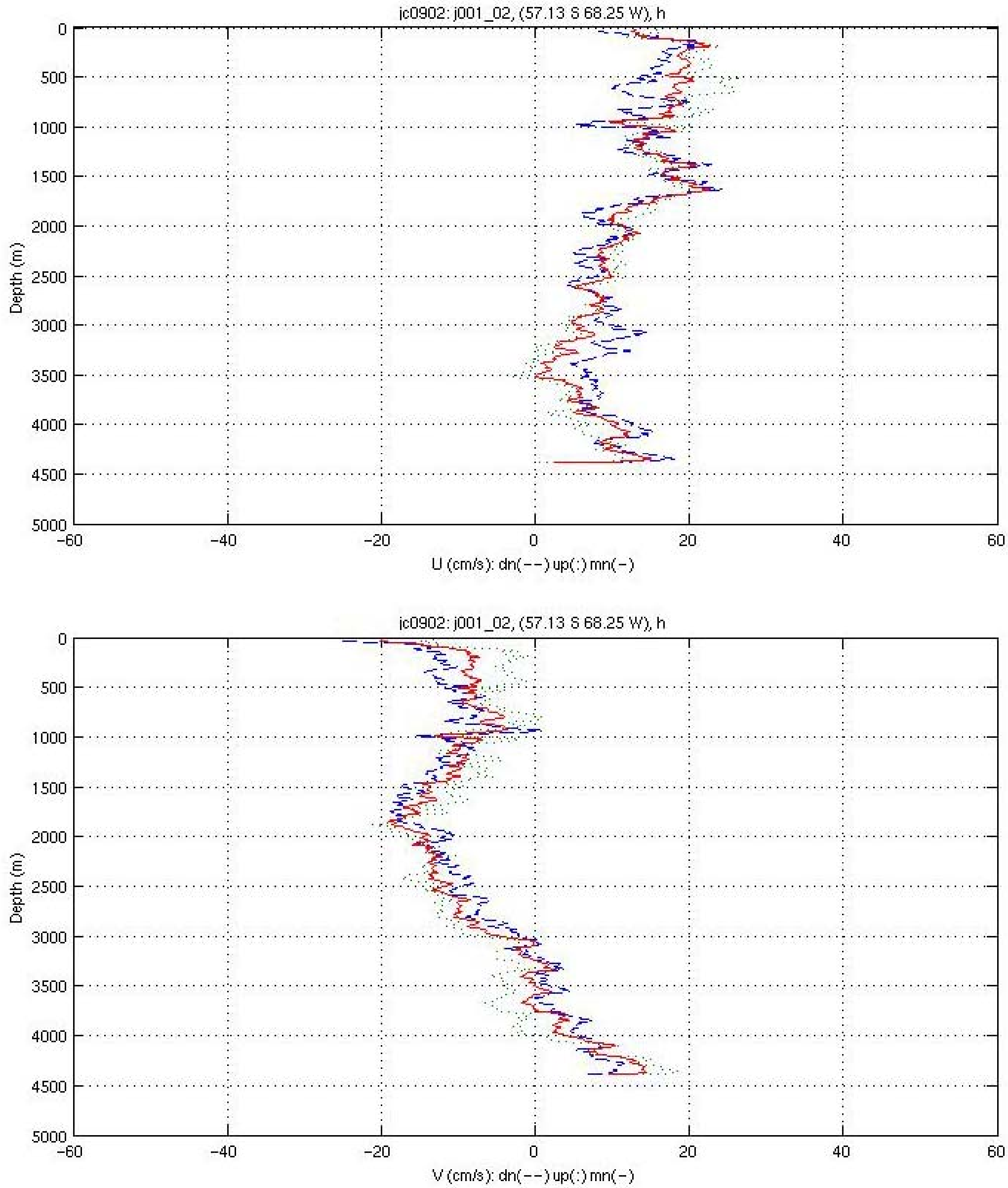

Figure 41: Example of a UH processing output of a U and V velocity profile.

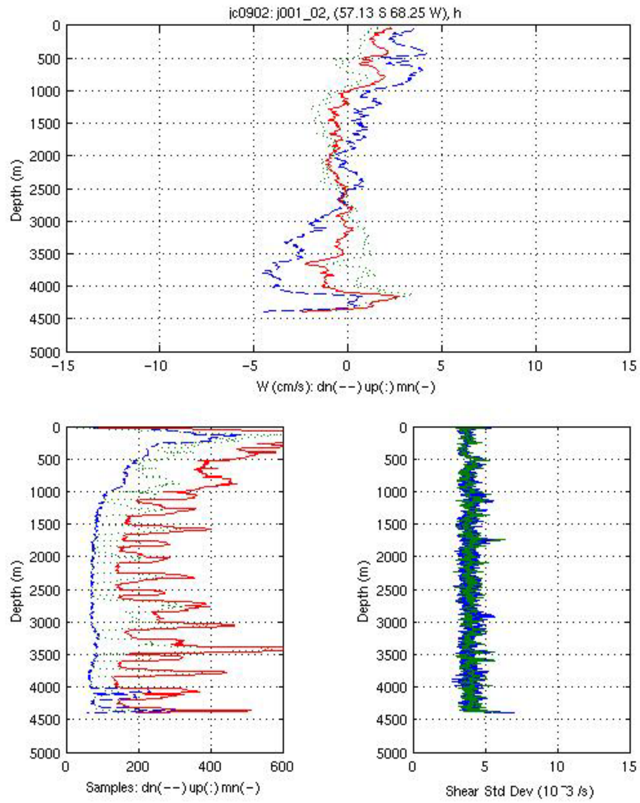

Figure 42: Example of UH processing output of processing velocity and also number of samples taken. Shear standard deviation is also taken.

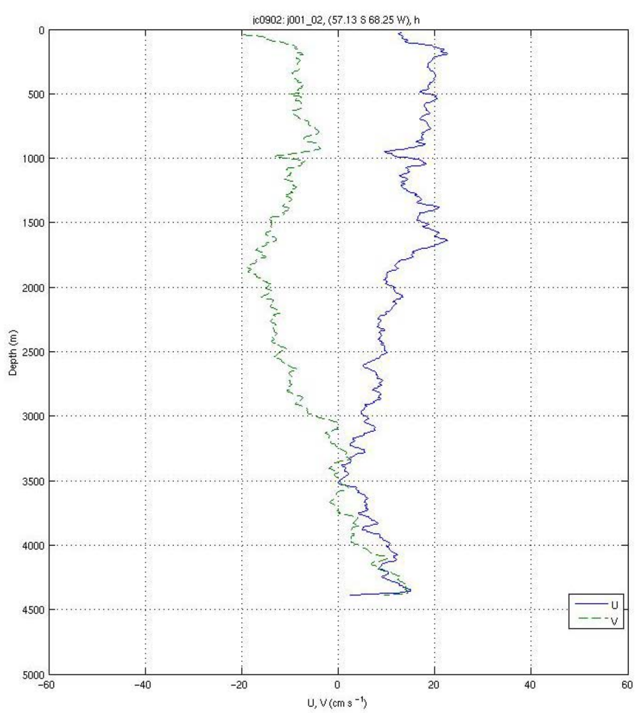

Figure 43: The mean values of the U and V components from the UH processing.

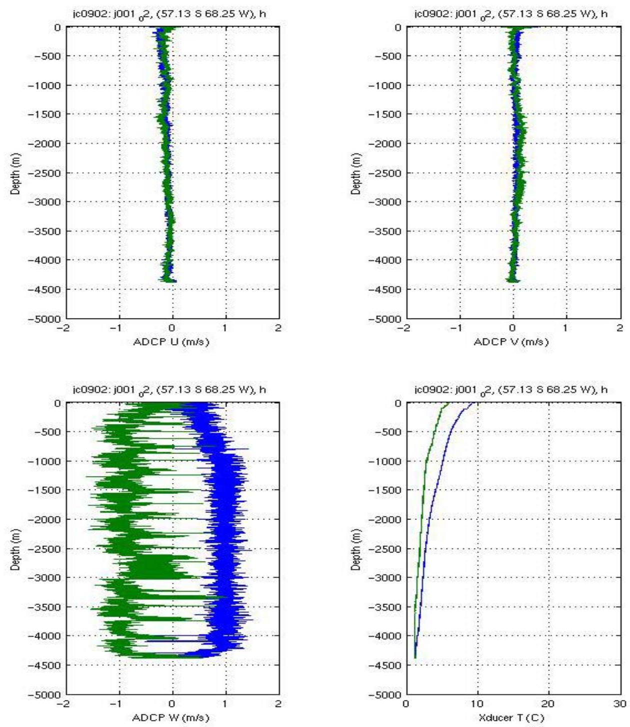

Figure 44: Example of Shear in the U and V components from the UH processing

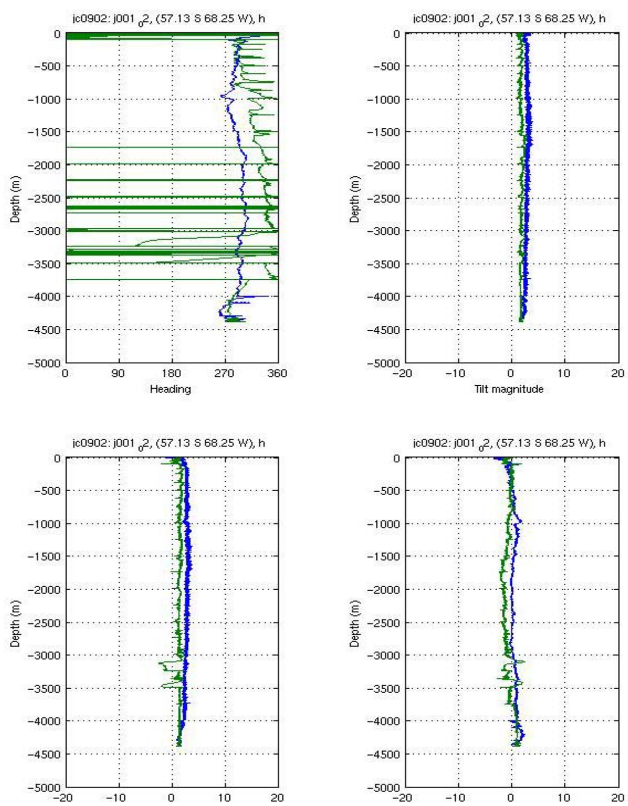

Figure 45: Example of the UH processing calculating the numbers of turns on the CTD wire.

At certain points during the cruise, especially around Station 67, the current velocities sensed by the LADCP were found to be in the order of 120-130 m/s near the surface, and accounted for the amount of drift experienced by the CTD package and the ship. It was considered that these strong currents were the result of an eddy that we encountered a few stations after Elephant Island whilst steaming northwards.

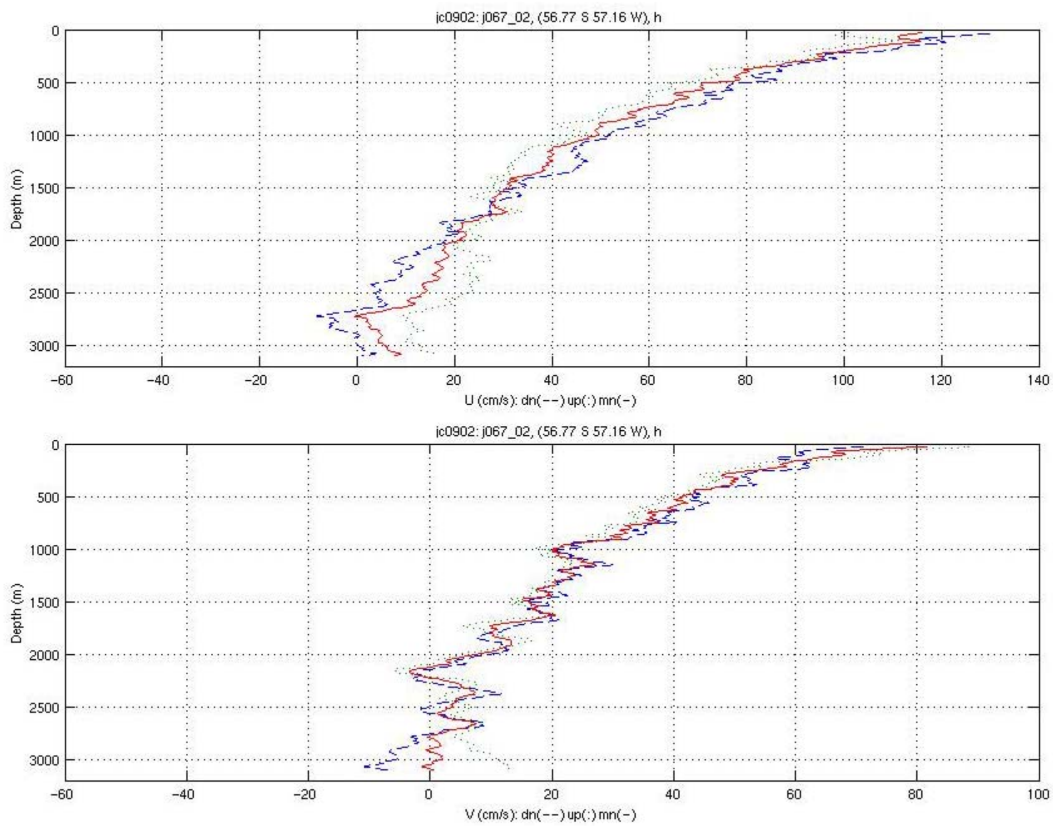

Figure 46: UH processing of Station 67

11.3.2 LDEO Processing

The LDEO processing technique offers similar current velocity plots to the UH processing technique, but one of the main reasons for doing this processing was to observe and monitor the condition of the beams. Very occasionally a weak beam signal was detected on the LADCP, but this seemed to improve and return to normal beam strength at the following station. This processing technique also offers the ability to observe the relative movements of the ship and the CTD package by connecting the two paths of movement with points of identical time.

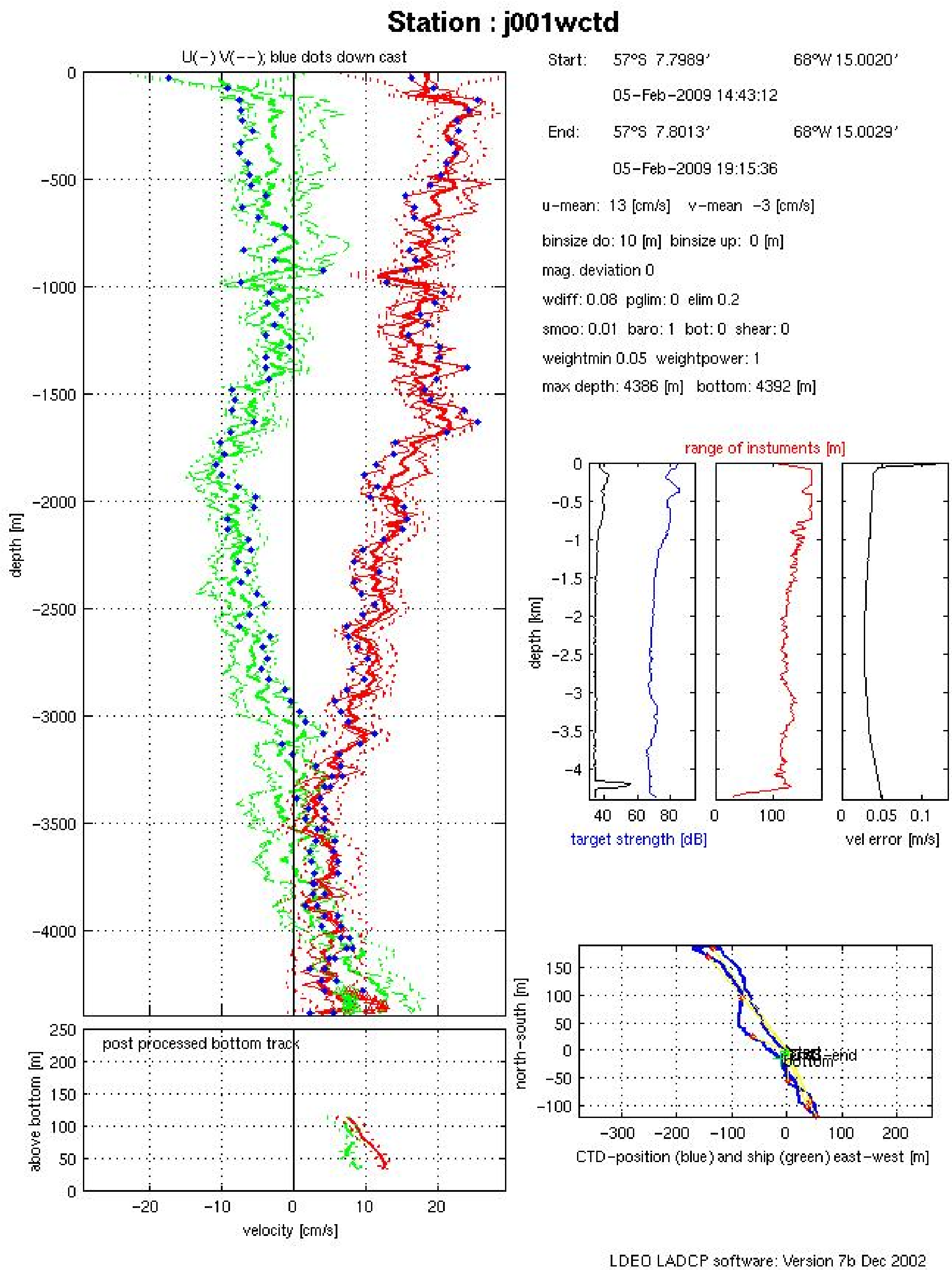

Figure 47: Example of LDEO processing

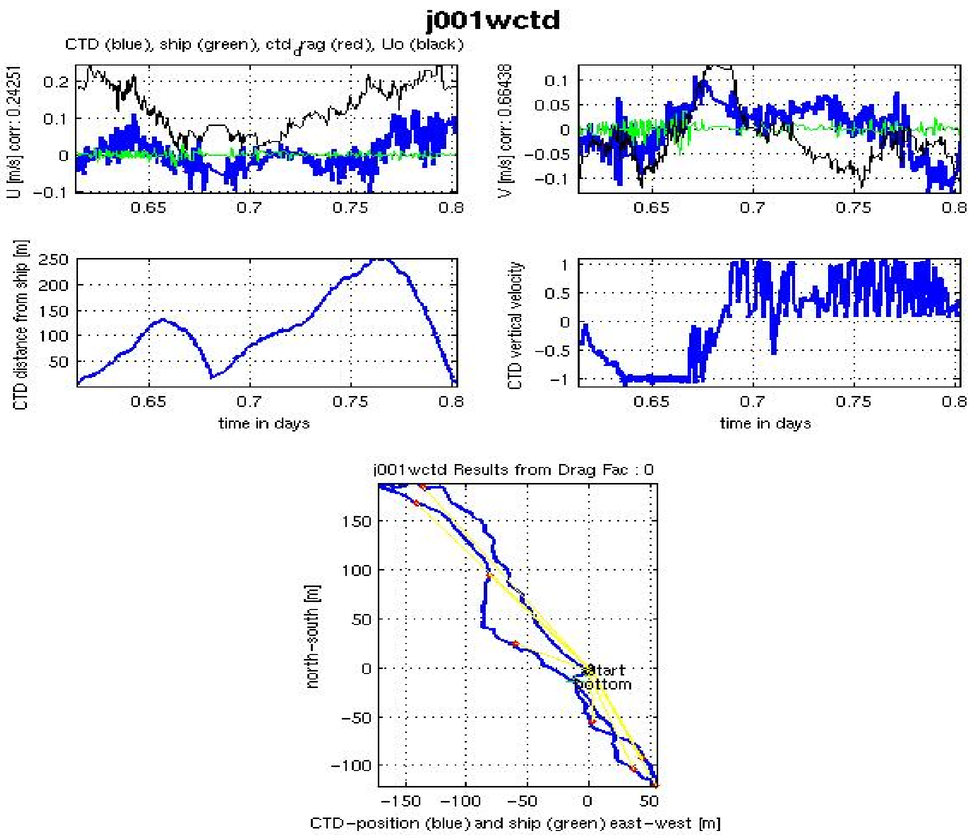

Figure 48: LDEO processing showing the CTD package motion relative to the ship

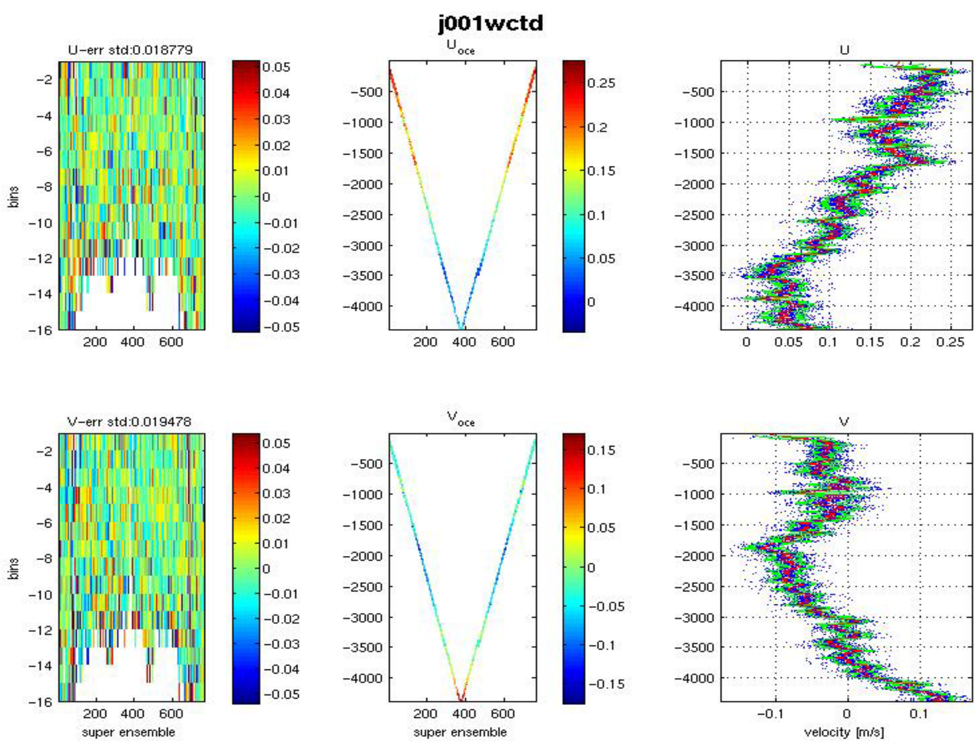

Figure 49: Super-ensemble grid

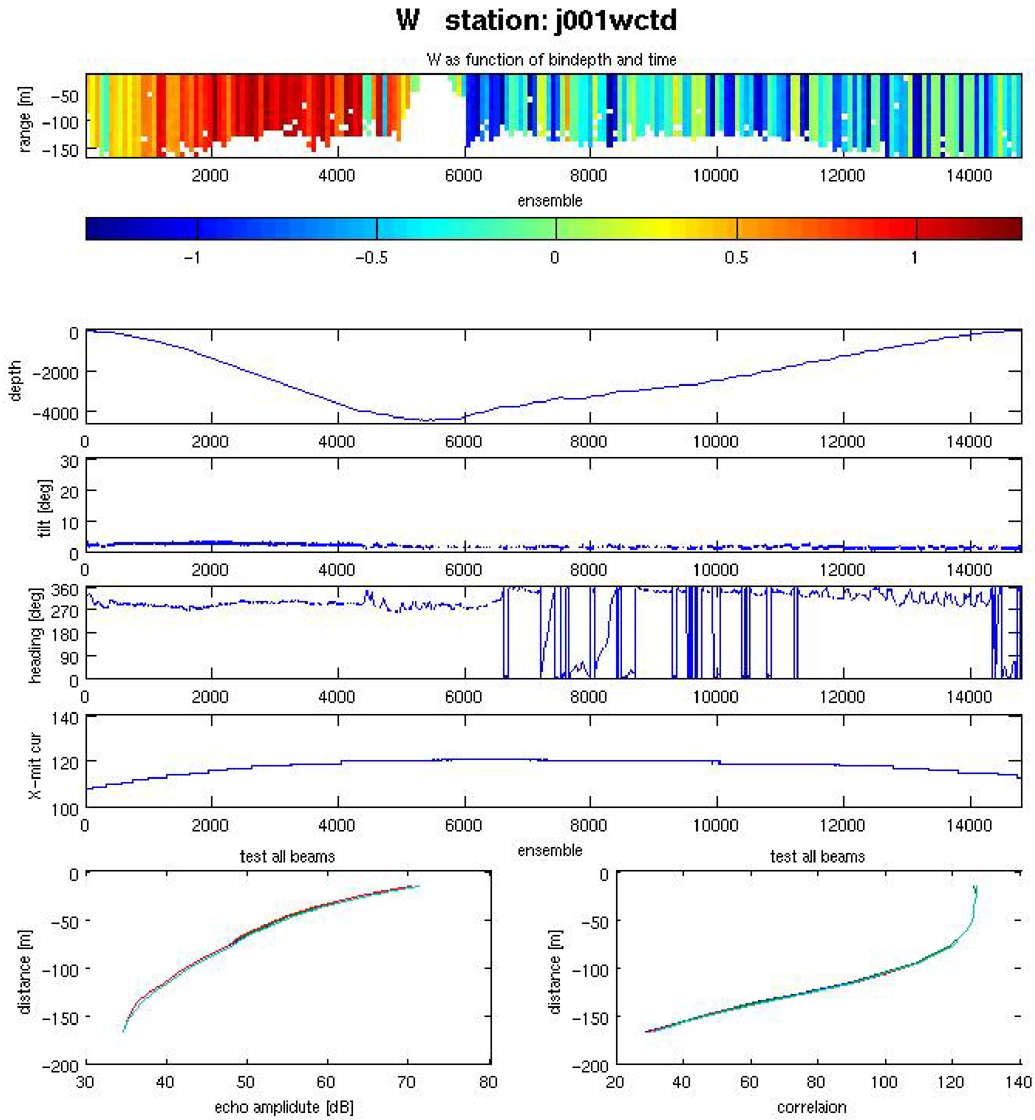

Figure 50: LDEO processing showing beam strength and sample collection with depth.

11.4 Data Comparison

The use of two different techniques to process identical data yielded the opportunity to observe how the interpretation of the data would vary. The U and V velocity profiles for each station were compared in the following ways; comparison between UH and LDEO, comparison between LDEO and bottom track data, comparison between UH and bottom track data and comparison between the LADCP and VMADCP. In order to do this a number of scripts were written in Matlab because it was necessary for the data to be put on the same depth grid. For each of the station comparisons the mean offset and the standard deviation was calculated and appended to the respective graph. Comparisons with bottom track data are particularly useful, because the bottom track is likely to be more accurate and reliable due to a fixed reference point.

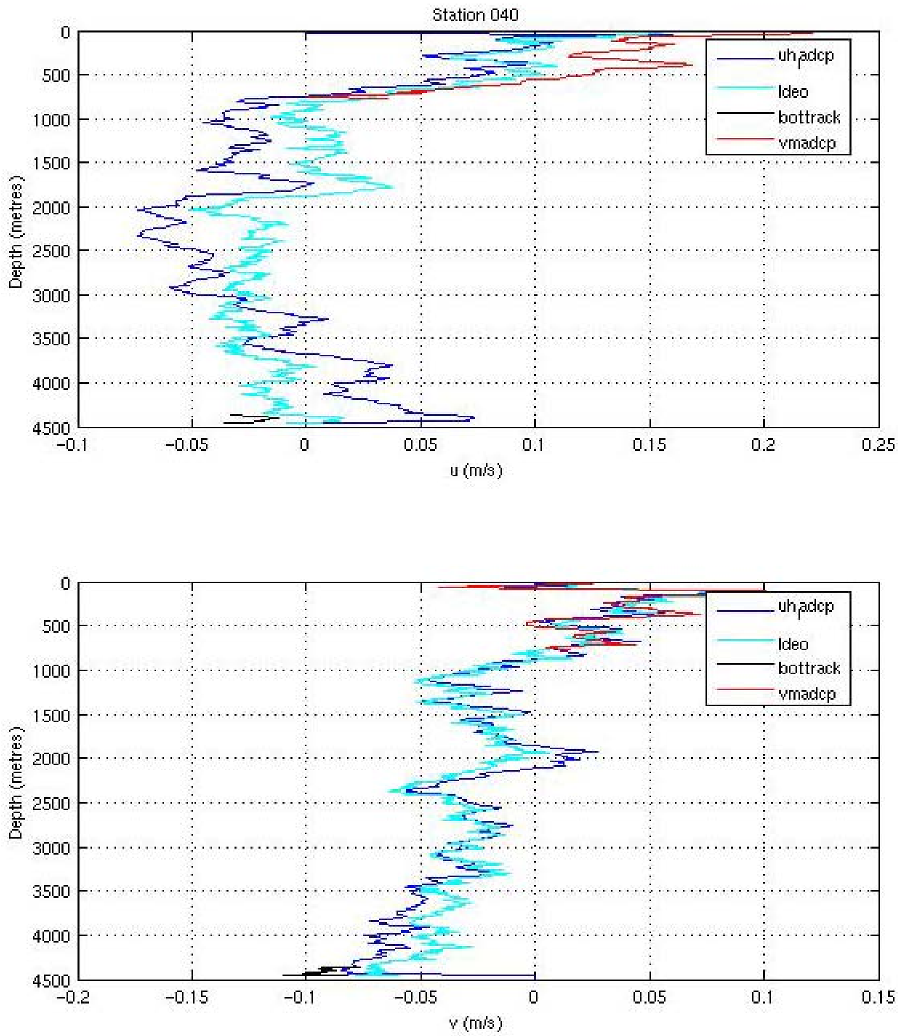

Figure 51: Velocity comparison of different instruments and processing types

Here is an example of one of the graphs that were created principally at the beginning of the data comparison exercise. For each station the UH, LDEO, bottom track and VMADCP data was plotted so as to achieve a simple visual comparison of the U and V components. As can be observed in this example there is a general agreement between the different techniques and data sources.

Below is one of the plots created from the calculation of velocity difference. It is evident from this plot that the difference in velocity between the LADCP and VMADCP and also the different processing techniques, is not stable with depth. In this particular graph (Figure 52), the velocity difference is minimal, but it must be noted that on some stations, a much higher degree of variation is found.

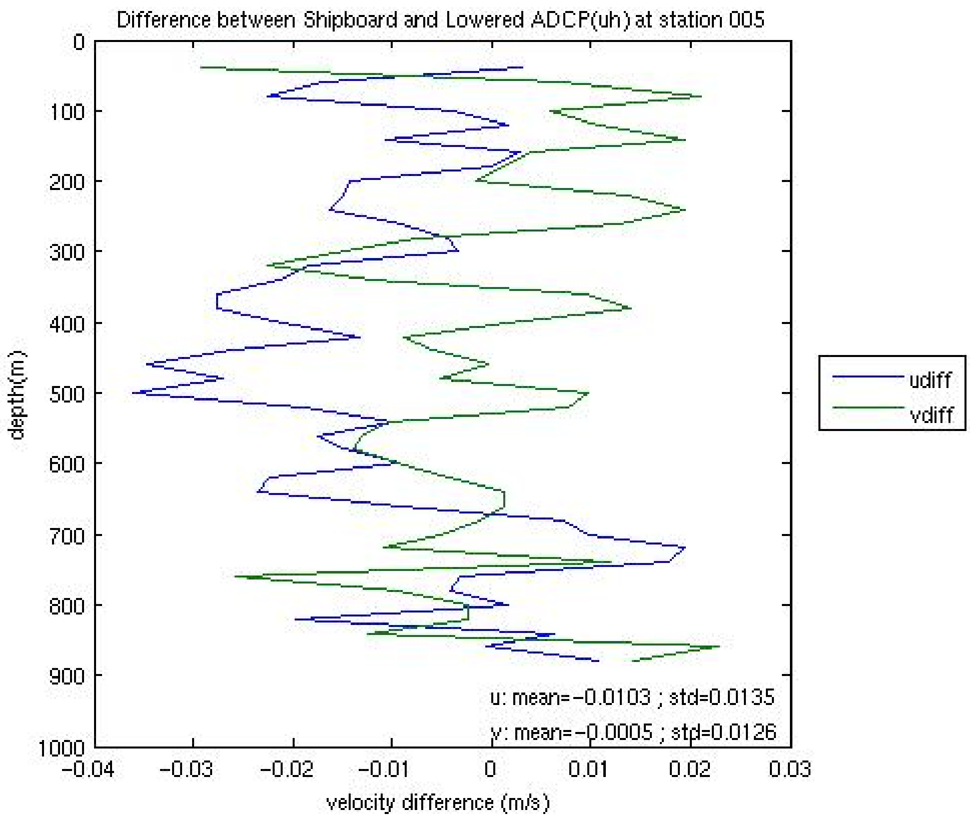

Figure 52: Calculated difference between different processing types. In this case the VMADCP and LADCP with UH processing.

11.5 Summary

- LADCP use was perturbed mainly by physical damage or loss.
- Any technical problems that were experienced were mostly minor, apart from at Stations 50 and 75.
- Two different processing techniques for the same data allowed the opportunity to observe how the different techniques interpreted the raw data.
- Additional comparisons were made between LADCP and bottom track data were the data sets overlapped.
- The damaged LADCP needs to be sent back to NOCS for repair.
- At the end of JC031 there is only one working LADCP remaining.

The LADCP beams were generally very stable in terms of amplitude. There were some decreases in beam strength at certain stations but these changes appeared to be anomalous each time as the beam strength would be shown to have improved at the next station.

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