

2016 Sikuliaq ADCP evaluation after moving transducers

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Revision History

05/03/16	Draft #1
06/03/16	Final

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1 Changes in 2016

Sikuliaq has had very bad luck with RDI's OS150. They finally got a replacement in early 2016. In an effort to improve the performance of both ADCPs, *Kongsberg* designed new wells, farther aft and inboard from the original wells. During this process, the OS75 was diagnosed with possible problems: electrical scoping of the cable did not meet specifications. The OS75 was returned to RDI for investigation. Both ADCPs were in place in the spring, and two cruises are evaluated in this short report. The two cruises are SKQ201604S and SKQ201605S. Differences between the two might include weather (or sea state) and the presence or absence of other sonars in use.

1.1 SKQ201604S overview

This cruise lasted 12 days, occasionally reaching depths beyond the range of either instrument. Steaming and on-station work gave a good sample of ship speed and range, so although there was no particular test run to look at the effect of speed and range, we can look at the cruise as a whole. Neither instrument was synced to another sonar on this cruise; both instruments (OS150 and OS75) ran free for the whole cruise with both broadband and narrowband modes running. EM302 and EK60 were secured. Apparently the weather was calm during this cruise.

Notes about calibrations:

1. OS150BB and OS150NB calibrations did not agree with each other (but they should)
 - OS150BB required 1.005 scale factor, OS150NB did not require anything
 - OS150BB required 0.2deg rotation more than OS150NB (usually closer than that)

2. An algorithm now in place allows us to account for the offset between the transducers and the GPS used; it looks like that is about 22m. In a future upgrade this will be put in place for the at-sea processing; in the meantime, it is available in postprocessing for anyone who cares to take that step

There were a few places where one of the 4 modes (OS150BB, OS150NB, OS75BB, OS75NB) did not agree with the rest. (Figures 1,2,3)

In general, range of the OS150BB or OS150NB, while not stellar, were not that different from each other and were pretty consistent throughout the cruise, regardless of ship speed (see Figure 4). In general, the same was true of the OS75, though the range was considerably better. Ship speed had essentially no effect on range. It has been noted that there is biofouling on the hull, which should be cleaned after the present cruise; that may help with range.

1.2 SKQ201605S overview

During the cruise, subsets of the processing directories were pulled off the ship in the dark of night, to allow analysis of the data and evaluate whether there were any changes in settings that would help, and to assess the effect of triggering on the OS75 (does not play well with the EM302).

Triggering experiments with Ksync, EM302, and OS75 included “ping together” and “ping in groups”. “Pinging together” means the long pulse of the EM302 decimates the top few hundred meters of the OS75. “Pinging in groups” means the OS75 is pinging with the EK60. There are some strange biases when the triggering is in place, but it is impossible to tell whether that is related to the EK60 or not.

The weather is variable on this cruise, with 25-30kt winds and hence oncoming swell, creating heading-dependent data quality. Data were negatively impacted when facing into the seas.

Notes about calibrations:

1. OS150BB and OS150NB calibrations were consistent with the previous cruise, in that:
 - OS150BB required 1.005 scale factor, OS150NB did not require anything
 - OS150BB required 0.2deg rotation more than OS150NB (usually closer than that)
2. BUT a comparison between OS75 and OS150 revealed an apparent and unexplained 1.01 scale factor and 0.75deg phase difference between the instruments. There is no immediate explanation for this.
3. OS75NB calibrations were consistent with the previous cruise (angle and scale factor were similar)

When the weather was good, OS150 range was dominated by the diurnal migration pattern of scatterers: daylight means better range (as the critters descend to hide from predators) and nighttime means decreased range (as the critters shoal for feeding). (Figure 5).

Bubbles from higher sea state decreased the range of both instruments. The OS150 Percent Good (percentage of pings used in the 5-minute average) was reduced, but not as much as the

OS75. However, apparently the OS75 was rejecting bad values, whereas the OS150 was keeping them. The resulting OS150BB and OS150NB datasets were badly affected by ringing, with some additional unexplained biases in the deeper ranges (Figure 6). A comparison of the OS150NB and OS75NB shows the difference in surface editing (ringing in OS150NB) and the difference in Percent Good for the two.

At 2200 UTC on May 4, air was vented from the OS150 well. Apparently a significant amount was released. It is impossible to tell whether the air in the well or the calming of the sea state reduced the ringing after May 4, since the sea state calmed down the previous day. After the cruise, the hull was scrubbed and the well was vented again. It remains to be seen whether the range will increase (from the scrubbed hull) or the ringing will continue to be a problem. This will be monitored.

Summary: Ranges of the OS150 and OS75 must be compared to other ships with ice-strengthened hulls and thick windows. The range of the OS75 is comparable to the range on Healy. The move to the new location seems to have improved at least the OS75 as it is able to return good data when underway in calm weather (not the case before). The OS150 well does not have any acoustic damping material. That is on the work list for the next major in-port period. Hopefully in the longer term, that will improve the ringing problem.

1.3 Figures:

Figure 1: unexplained bias in OS150BB (shown compared to OS150NB)

Figure 2: unexplained bias in OS75BB (shown compared to OS150NB)

Figure 3: SKQ201604S ship speed vs/ range for all 4 frequency+ping combinations

Figure 4: SKQ201605S range over time, showing diurnal migration and bad weather

Figure 5: SKQ201605S Percent Good for OS150NB and OS75NB

Figure 6: OS150BB and OS150NB: ringing in the upper 50m

Figure 7: OS150NB keeps bad data; OS75 tends to reject it

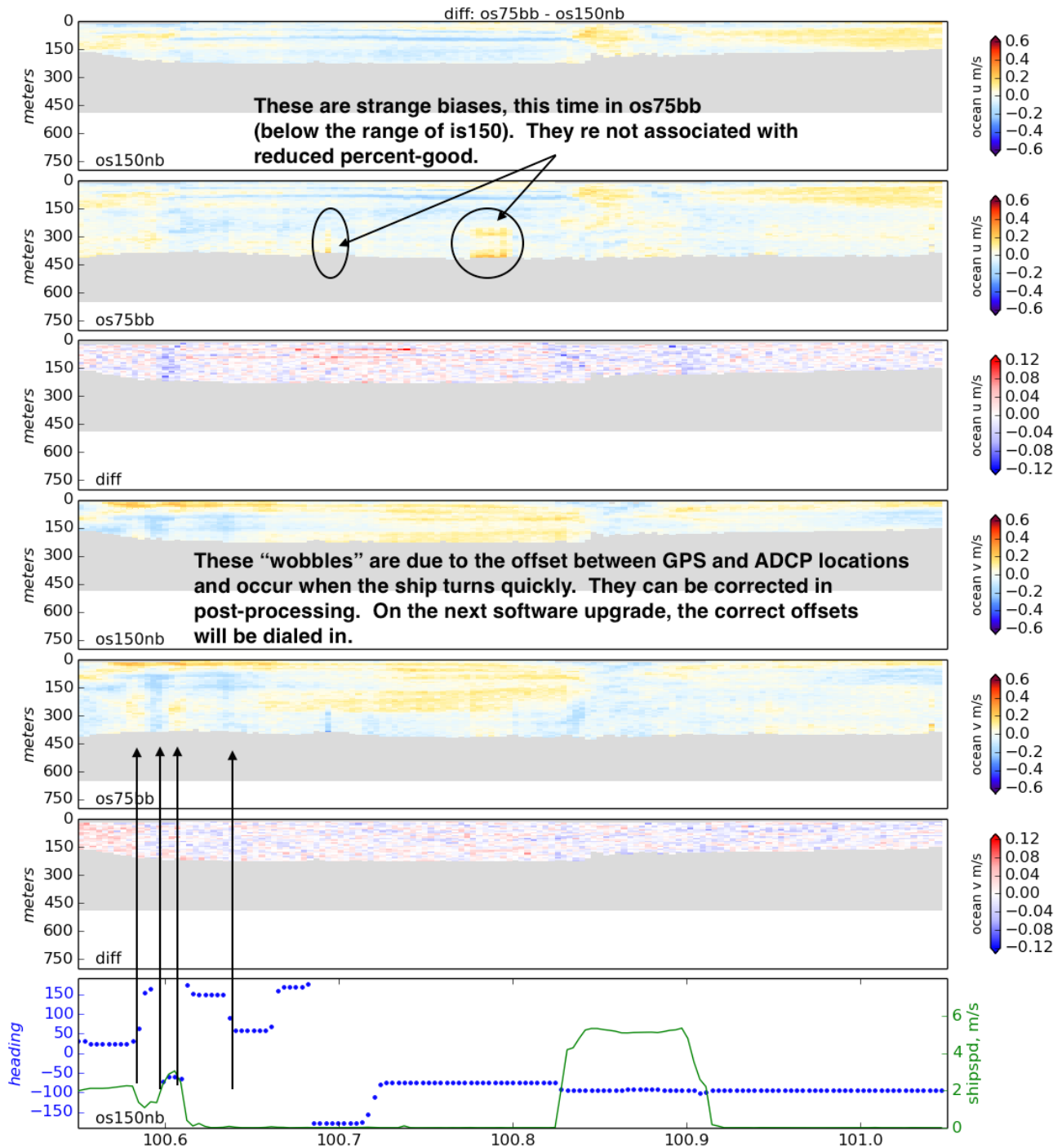


Figure 2: This figure shows an unexplained bias between OS75BB and OS150NB data, just before decimal day 100.8. It also illustrates the effect of the uncorrected offset between GPS and ADCP position, when the ship is maneuvering (around decimal day 100.6). The top two panels show eastward ocean velocity from OS150BB and OS150NB (respectively); the third panel is the difference between them: $OS150NB(u) - OS150BB(u)$. The fourth and fifth panels are northward ocean velocity for OS150BB and OS150NB, respectively; the sixth panel is the difference: $OS150NB(v) - OS150BB(v)$. The vertical axis is depth, for the top 6 panels. The bottom panel shows ship speed and direction. The horizontal axis is time, in decimal day.

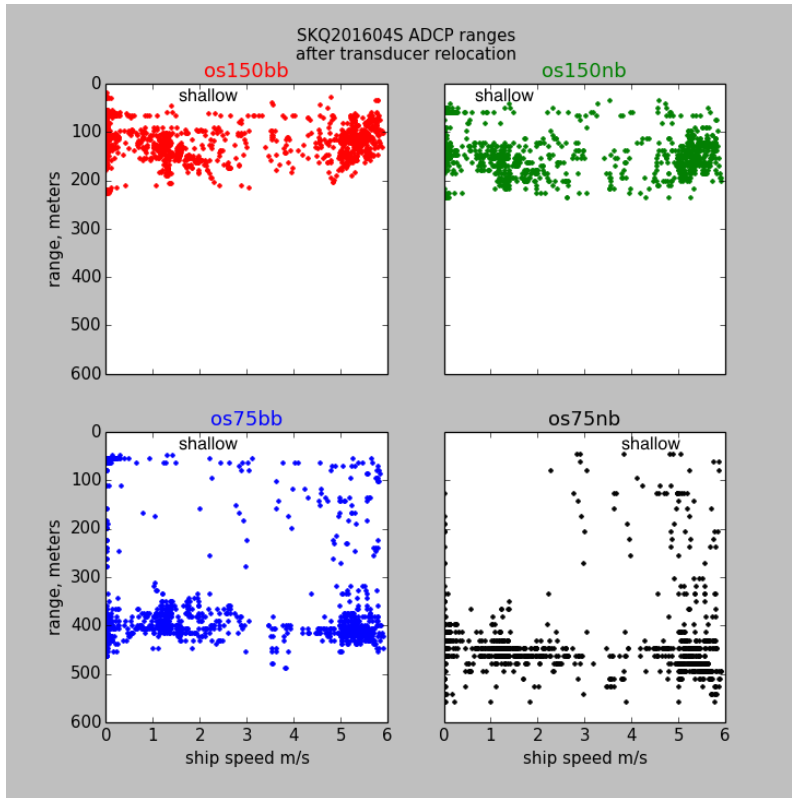


Figure 3: This figure shows the instrument range as a function of ship speed. The weather was good, and there is no particular correlation between ship speed and range

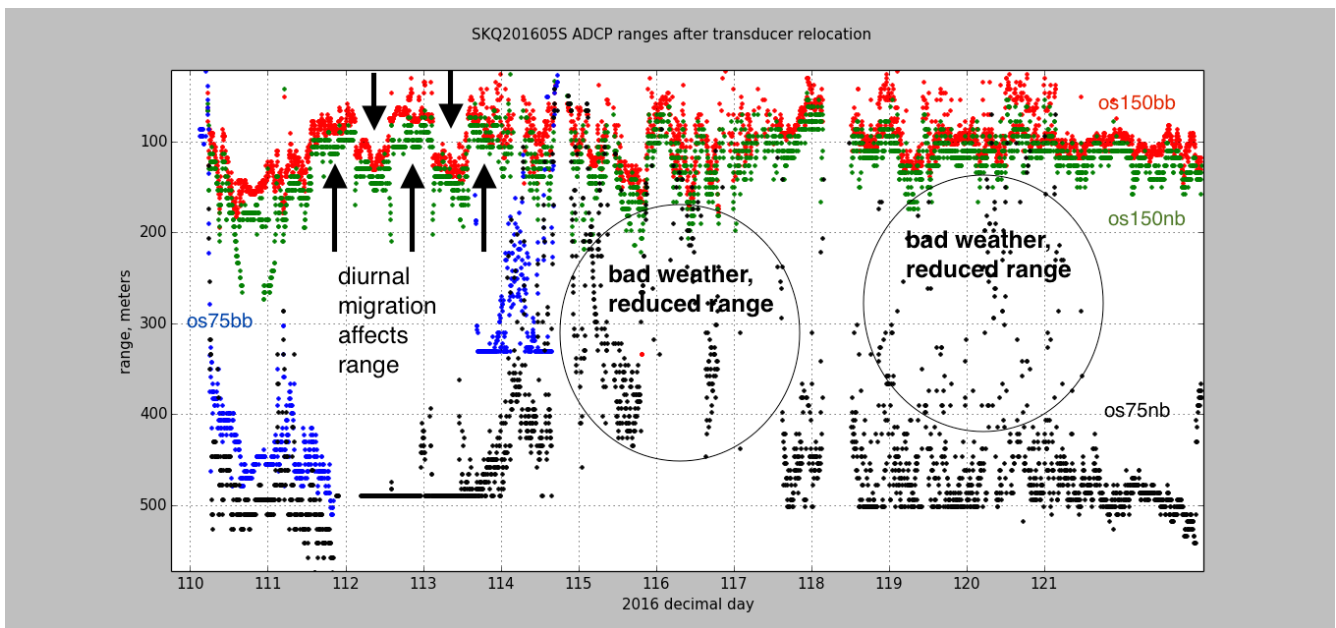


Figure 4: This figure shows a time series of ADCP range, with good weather in the early period (OS150 range dominated by diurnal migration and OS75 range at a maximum). The weather deteriorates and OS75 range is somewhat reduced. OS150 slightly reduced.

OS150 and OS75: effect of bad weather (bubbles from increased sea state)

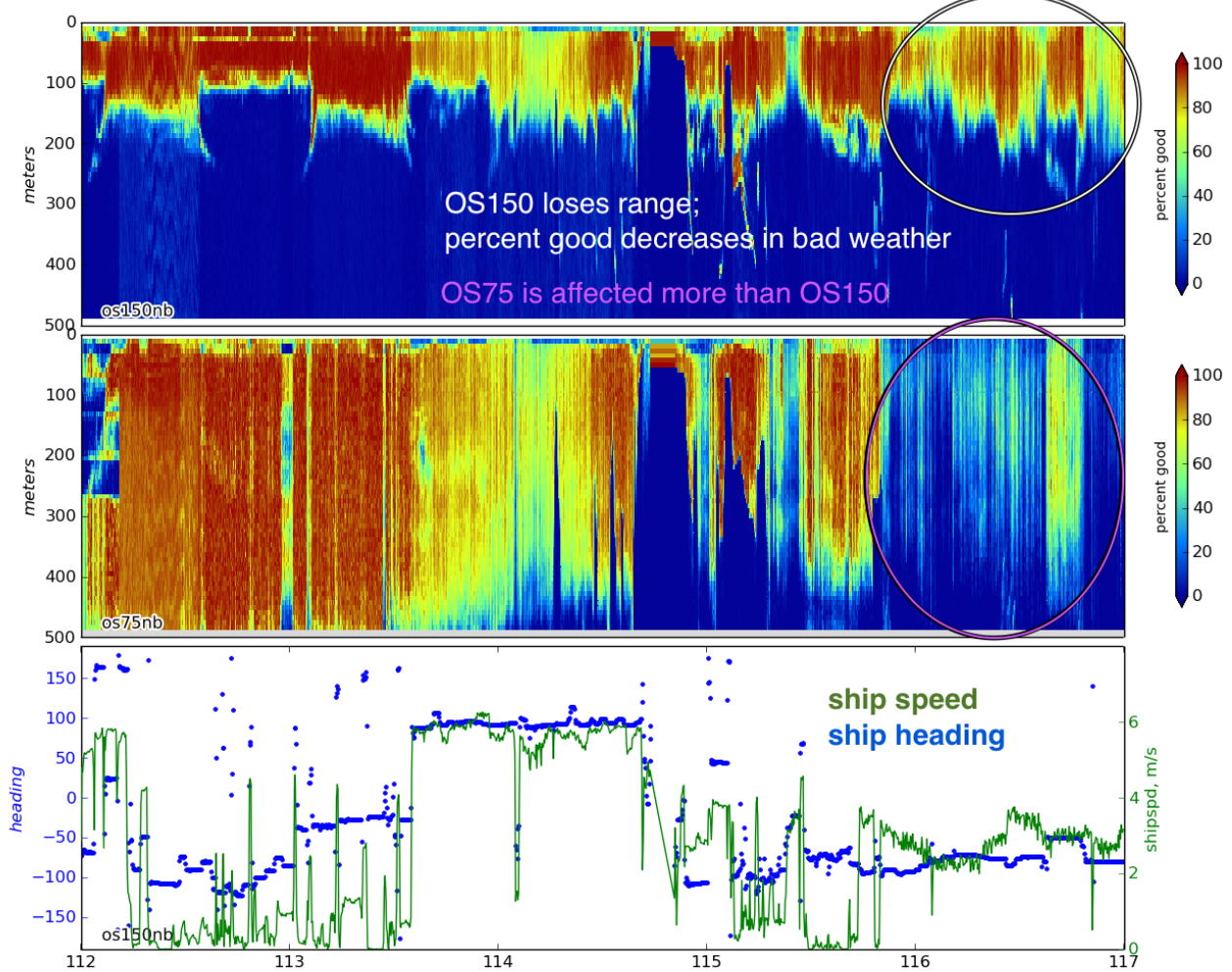


Figure 5: This figure illustrates the effect of bubbles on the Percent Good of the OS150 (top) and OS75 (center). The bottom panel is ship speed and direction. Note the reduced Percent Good near the surface of bot (as the upper bins are affected by ringing and single-ping editing attempts to remove them). The effect on OS150 is slightly-reduced values of Percent Good, hence slightly reduced range. The effect on OS75 is a greater reduction of Percent Good, then a total loss of data

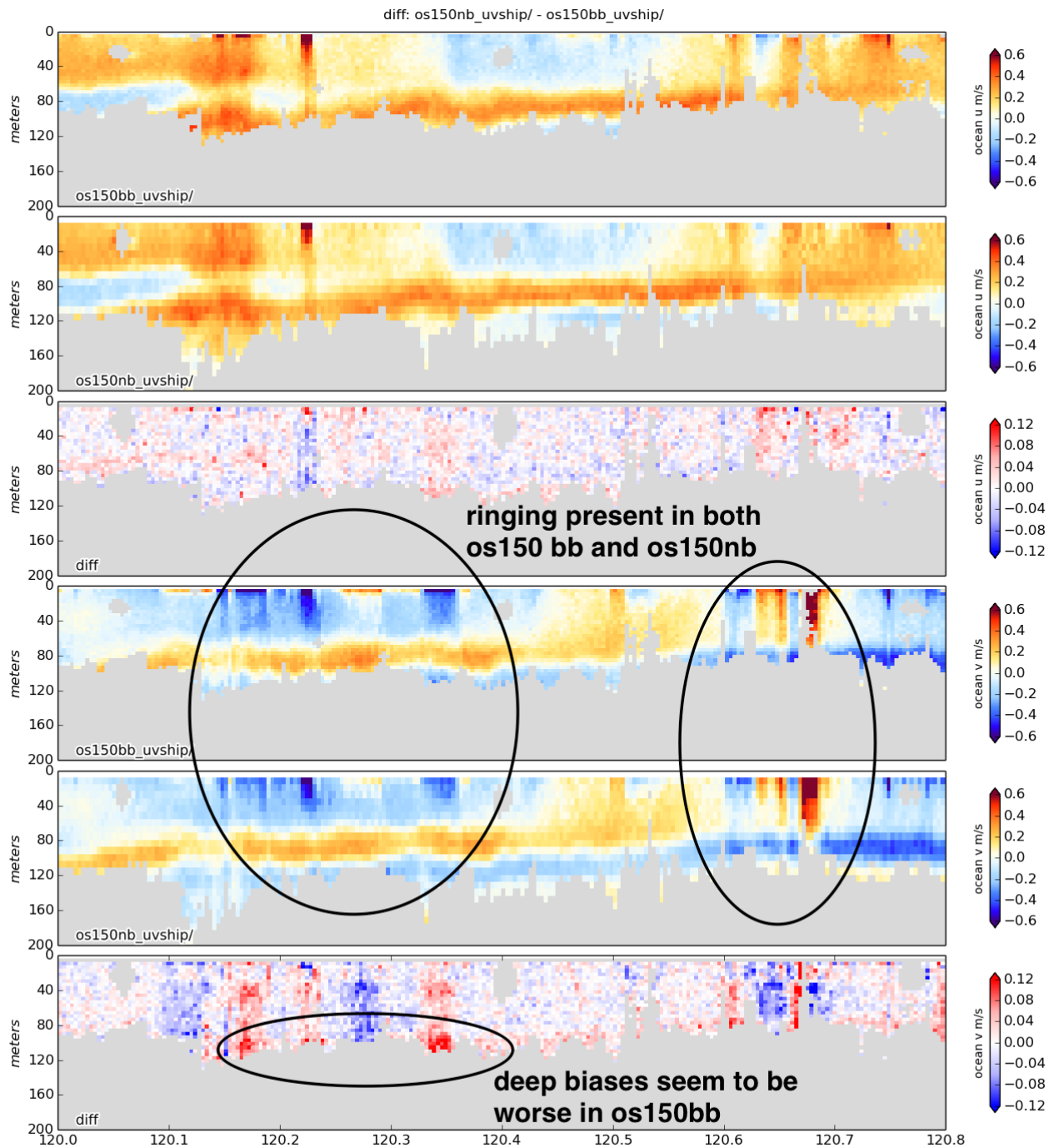


Figure 6: This figure illustrates the ringing in the OS150BB and OS150NB (biases in the upper 50m). In the deeper range of the pings, the OS150BB still seems to be worse than the OS150NB. The top two panels show eastward ocean velocity from OS150BB and OS150NB (respectively); the third panel is the difference between them: $OS150NB(u) - OS150BB(u)$. The fourth and fifth panels are northward ocean velocity for OS150BB and OS150NB, respectively; the sixth panel is the difference: $OS150NB(v) - OS150BB(v)$. The vertical axis is depth, in meters; the horizontal axis is time, in decimal day.

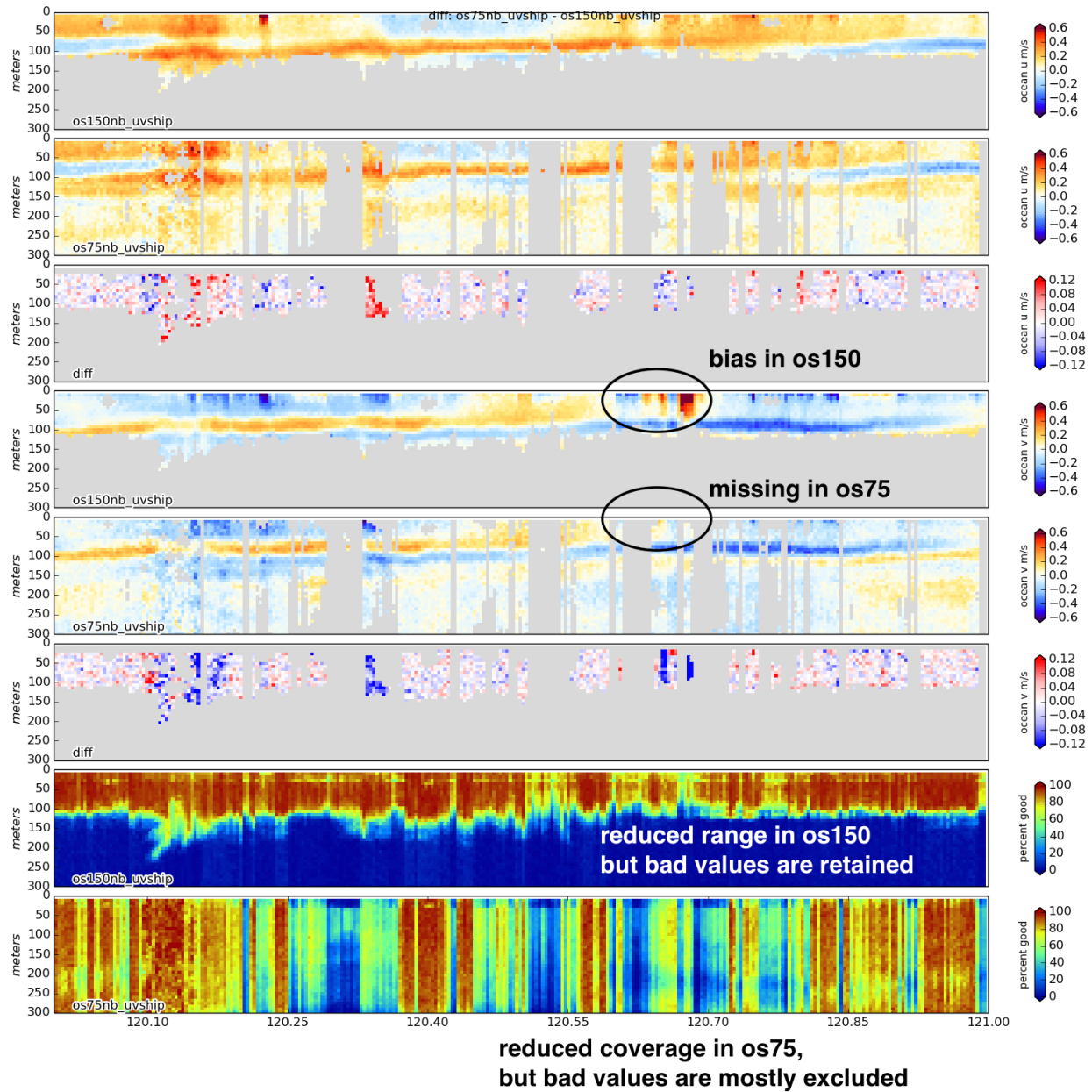


Figure 7: This figure illustrates the ringing in the OS1500NB (biases in the upper 50m) and compares it to the OS75NB. The OS75NB Percent Good is very poor in many areas, but the OS150NB still has data (bad data). The top two panels show eastward ocean velocity from OS150BB and OS75NB (respectively); the third panel is the difference between them: $OS75NB(u) - OS150NB(u)$. The fourth and fifth panels are northward ocean velocity for OS150nB and Os75NBN, respectively; the sixth panel is the difference: $OS75NB(v) - OS150NB(v)$. The last two panels are OS150NB Percent Good and OS75NB Percent Good. The vertical axis is depth, in meters; the horizontal axis is time, in decimal day.