

Interactive comment on “Fast thermistor string observations at the slope of Great Meteor Seamount” by H. van Haren et al.

H. van Haren et al.

Received and published: 3 February 2005

Reply to Referee #3 commenting on manuscript OSD-2004-0003

We thank the reviewer for the comments raised, some of which are helpful to improve the message that we try to convey. We agree with most what is said in the evaluation at the end. Before answering the comments raised we would like to point out the following: - the thermistor string is NOT inaccurate. In fact, it is a quite accurate thermistor string. General thermistor strings available on the market are accurate to within about 0.1°C, whilst custom-made (towed) thermistor strings general have accuracies of about 0.01°C (e.g. Marmorino et al. JGR1987, Selschopp DSRI1997). Our thermistor string is nearly one decade more accurate when properly calibrated! However, calibration is not an easy task, as outlined in our paper. - The paper is about the technique of the thermistor string with examples of its performance given from ocean observations. The ADCP data are only supportive, and the emphasis of the comments

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

of the referee on all of the details of the large-scale circulation are somewhat out-of-place. We agree with one of the final comments of the referee that the paper describes a novel tool and that such tool must be developed [, and therefore must be described in open literature!].

Reply to specific comments:

1. The thermistors used in the sensors of the T-string are in fact temperature sensitive semiconductors, that electrically may be considered as variable resistors. There are many ways to convert this electrical temperature effect into a digital number representing a temperature. In the NIOZ1 string this was done using 2 matched thermistors that were both the R-parts of a certain type of RC-oscillator, a so-called Wien(bridge)oscillator. This makes the temperature measurement actually to become a frequency measurement, or, in this case, the reciprocal: a period ($T=1/f$) measurement. The resolution of such a measurement can be made very high and is independent of cable losses, as frequency always remains frequency. The Wien-oscillator can run at a very low voltage, which greatly reduces the amount of electrical energy dissipated in the thermistors, and therefore limits the selfheating of these sensors. In the NIOZ2 string another concept was used, that (by design) is less good than the NIOZ1 model, but much more compact, simpler and faster to process, thus allowing for a much larger number of sensors. Here a traditional DC-Wheatstone bridge, feeding into a 24-bit A/D-converter, is used. 1. 2. OK, can be moved to the calibration section. 3. Yes, we can omit, but we note that the reviewer is certainly right in his/her assertion that 'this is the case for nearly all new instrumentation..', which is however seldomly mentioned! 4. We will go through the text and remove unnecessary remarks, when apparent. 5. For the physics we are not necessarily interested in the few m horizontal scales, as the vertical range we cover is about 80 m and a typical vertical scale of the sloping bottom boundary layer is ~50 m. Hard to say what the aspect ratio is in the bottom boundary layer, certainly larger than the deep-ocean ratio of 1/1000 and generally less than 1/1 in full turbulence under homogeneous conditions. Taking

a value of 1/10 seems reasonable (large already, with a possible observed extreme of 1/3 at the leading edge of the bore in Fig. 5 we should resolve horizontal variations of about 150-500 m. We note that at 500 m waterdepth the footprint of the echosounder is about 170 m. For comparison, the horizontal scale of the ADCP, of which the observations are averaged over the beam spread, is several tens of meters given the vertical range and the 20 degree beam angle inclination. So, the tilt information may not be relevant when one side of the lander is stuck on a boulder, for example. 6. We have fixed the ADCP in its frame to assure that it's view is never obstructed by the frame. As the thermistor string is directly attached to the frame, we cannot afford to have the head of the ADCP stick out of the frame. Thus, if it were gimballed, one of its beams can easily hit the frame on a steep slope. So the measurements would be worthless then. 7. OK 8. Yes and no. The reviewer is right that (Fig. 2) can be somewhat more focused on the range 450-550 m; but, for proper calibration we need a wider range than that, say between 200-800 m. 9. No, disagree with the assertion by the referee, with is speculative (too). The profile near GMS shows typical boundary layer characteristics. The natural variability as determined from other CTD profiles in the CB are less. But we will weaken our point as it is not relevant for the paper. 10. Error bars will be given to substantiate our results. 11. OK salinity can be given, including some work on the possible errors with respect to natural variability (assuming the reviewer means internal wave and finestructure activity with this). 12. OK could be done, but we note that we cannot say much about this still water, other than a very speculative remark (that we assume that flushing is reasonable through the gaps between the cables; and that we see not much trend at a particular depth greater than the noise level (of about ± 0.0005 - 0.001 degree C). We disagree that there is a relatively large noise level. The noise level is only 1/3 of the value of the Seabird T-sensor (see new Fig. 3 attached; during the prep. of these replies we found that standard CTD processing involved the application of a low-pass filter, even for the 24 Hz ASCII data. This filter is removed from the processing procedure now). 13. The reviewers' scepticism about the linearity is misplaced. The present cal-

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Discussion Paper](#)

ibration is only valid between 11-14 degree C; the deviation at 17-19 degree C just demonstrates the non-linearity! We will more clearly mention this. A polynomial fit can be given, but we wonder what extra information that would give. As clearly stated, the thermistors are glass embedded and totally pressure insensitive (except for pressures >600 Bar, when the glass may break at some point). 14. Values of the buoyancy period can be inferred from the buoyancy frequency, but we will give them. Polynomial fit is by computer. The output of the sensors has to be transferred to engineering units; (in degrees C or K), which is achieved by a calibration and a polynomial fit. As the reviewer apparently does not understand what is done, following the rather outplaced remark that the reviewer's feeling is that the thermistors are not accurate;, which is not unjustified as it all depends on the calibration and the stability of the sensors. We will rewrite this section where necessary. 15. Fig.5b and 5c are exclusively on thermistor string temperatures. Fig 5a gives an overview of the entire record, and as the current meters were above and below the the thermistor string there T-records were chosen for the overview as they span a larger vertical range than the thermistor string. These are standard temperature sensors, well-known, and indeed far less accurate and slower than the thermistor strings, but that is not really important for an overview. 16. Because the current is up the slope. 17. See reply under 5. Also, we are discussing primarily a thermistor string here, not an ADCP. The ADCP data are mainly used for support and we consider further remarks less relevant. (No, it is not possible to have the manufacturer of ADCP; modify their software as suggested).(Yes, but that implies that the error velocity also contains the difference between horizontal current components from each pair!). (It is well known that acoustic backscatter is not just affected by suspended material but also on stratified layers, modified but small-scale (turbulent) motions). 18. Yes, the measured tidal current. We should have mentioned that u is only slightly larger than v . True, but we perhaps one should talk about the seamount here, not its slope. We do not see why we could not refer to the slope; that is highly relevant for the short-term bottom boundary layer processes! By the way, the (internal?) tidal current

ellipses having large ellipticity are very comparable to those observed and modeled in the same area (e.g. Mohn and Beckmann, Ocean Dyn. 2002). For the bottom-normal vs vertical discussion we refer the reviewer to van Haren et al., JMR 1994. 19. TN 7.5 min is not for the present data but for those observed in the North Sea, as mentioned, (further refer to van Haren et al. 2001). 20. Could mention K-H upfront, as a possible mechanism, no problem. No, periods of 1 min are very well resolved by the T-string, as it measures at 1 Hz. The ADCP measures at once per 30 s. But, to our taste the reviewer focuses too much on the ADCP and its data, whilst the paper is on the much faster sampling T-string! For illustration we attach an additional figure including Fig. 8c with the u-component ADCP-data for the same window. The tremendous difference in details is not just attributable to the 30-fold difference in sampling rate, but also to the horizontal smoothing of the ADCP (due to its beam spread). Similarly more detail is obtained using scientific echo-sounders in the near-surface waters (e.g. Moum et al, 2003; Orr et al., 2003) 21. These questions will be answered in the revision. 22. We do not understand the first remark. The instrument was in the water for ‘only’ 5 days, because we ran out of shiptime. We disagree that we cannot compare the performance of the T-string with CTD. No, the T-string is not inaccurate! 23. Yearday was used throughout because then one can reference the different figures directly. But, although it is matter of getting used to the fact that 0.001 day = 1.44 minutes (or 86.4 seconds) we will use different time axes (with the reference in the caption, alas). Fig.1. General circulation information is not very informative as we are interested in the performance of a thermistor string in the first place, that, in the second place, measures fast processes that have very little to do with the general circulation. Fig. 2. We will modify this figure. Fig. 3. No!, the calibration is not meant to be accurate near 18 degrees, due to the non-linearity. No. No. Time is the only common ref in both CTD and T-string (not pressure!). Impossible: CTD is measured at 24 Hz, T-string at 1 Hz, and not in degrees (but in large electronic numbers). Fig.4. Disagree. This figure is highly necessary to demonstrate that this procedure is a prerequisite PART OF the calibration and secondly to demonstrate the large stability of the

sensors. Again, accuracy exclusively depends on the calibration and on the stability! No, additional sensors are not needed! Fig. 5. and 8. We will look into modification. But they describe different parts.

Technical aspects. -will be modified accordingly

Resume of evaluation: 1.,2,3. Thank you 4. Can be outlined more, but we stress that this is a paper about the instrument with some examples of its capabilities in the ocean. See a similar recent paper on a similar instrument (Selschopp, DSR1997). 5. Perhaps some, although we find this remark open for discussion. 6. That is a matter of taste. 7. Thank you. 8.9. Yes, the reviewer is right, of course the instrumentation can be used above flat bottoms; but our present specific aim with this instrument is to study short-term processes above sloping bottoms. 10. Disagree, because this paper is in the first place about the instrument. 11. Agree and disagree. 12.13. We will go through the paper. 14.15. OK

Interactive comment on Ocean Science Discussions, 1, 37, 2004.

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Discussion Paper](#)