Ocean Sci. Discuss., 8, C612–C614, 2011
www.ocean-sci-discuss.net/8/C612/2011/

Ocean Science Discussions

Interactive comment on "A computational method for determining XBT depths" *by* J. Stark et al.

Anonymous Referee #2

Received and published: 6 September 2011

This paper presents a new calculation for XBT depths based on fluid dynamics principals and numerical modeling. This is similar to the approach used by Green (1984), but using a more advanced technique. The topic is of great interest and the methods appear sound. However, the authors main real world result is that the depths calculated from application of the model are very similar to results using the manufacturers fall-rate equation. This is not a satisfactory result given than the manufacturers fall-rate equations are not considered accurate enough for climate research. What is the point of the theoretical exercise if it simply duplicates already existing questionable results? And the authors, in the conclusion are suggesting applying the present technique to historical data. More examination of the results are necessary before such a suggestion can be justified. I would recomend that major revisions be made to the paper. Specific points are detailed below.

Assuming that CTD depth-temperature measurements are ground truth, rather than

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show the numerical model depths match the manufacturers fall-rate equation depths, it would be better to show that the numerical model can reliably calculate depths from time since drop of an XBT which then match the CTD depth-temperature pairs from a CTD dropped at the same time as the XBT. Can this be done? Were CTDs dropped at the same time as the XBTs in the Mediterranean experiment? If this was not done, what did the Mediterranean XBT drops add to the paper? What was unique about these drops which made them preferable for comparison to historical data?

Why were T5s used? T5s have been the subject of a very few studies examining fall-rate, and these studies have produced varied results, from no problem with the manufactures equation, to fairly significant changes to that equation. T5s are also not a very large subset of XBT data, most are T4s, T7s, or Deep Blues.

The author lumps together T4/T6/T7/DB XBT probes with regards to fall-rate. However, many studies such as Heinmiller et al (1983) and Wijffels et al. 2008 show that there is a difference between the drop rate of at least the T4 and T7. Can this be accounted for in the numerical model? Are the mass/shape/surface parameters of each probe different enough to distinguish velocities of each in the numerical model?

There are many other factors aside from fall-rate which may affect XBT depth-temperature pairs including angle of entry, height of drop, temperature bias due to the thermistor or some part of the recording system. The authors should address some of these issues and their bearing both on the real-world velocity of the probes and on the numerical model.

The authors do note that the depths from the T5s in the Mediterranean experiment match better deeper down in the water column between manufacture fall-rate and numerical experiment. Why? And is this an expected result? Figure 6 would be more helpful (maybe a figure 6b) showing the difference in meters between the numerical model and the manufacturers fall-rate for each time step. What does this difference mean for climate studies (ocean heat content)?

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Does the wire connection from the XBT to the ship above have any significant effect on the drag on the probe? Is there a pull there?

In the introduction the authors state that "the water column measurements are most commonly made by expendable bathythermographs (XBT), conductivity/temperature/depth probes (CTD) or Argo floats and gliders." Argo floats and gliders both use CTD sensors. Maybe the last part of the sentence "(CTD) from ships, Argo floats, and gliders" or similar.

The very next sentence calls the XBT the oldest of the devices. That is not correct. CTDs and their predecessors STDs were developed earlier than XBTs.

It makes some sense that a constant density is used in the calculations since XBTs dont measure salinity. What error is introduced by using a constant density? Would it be better to use some type of synthetic salinity to better estimate the true density? In general how much more accurate is the depth/temperature pair given the temperature dependence of the model?

How easy would it be for someone to implement the numerical model scheme (either in the XBT software itself or for someone intending to recalculate depths from the historic data)? Do the authors have software they would be able to share?

Interactive comment on Ocean Sci. Discuss., 8, 1777, 2011.