**Ocean Science
Discussions**

Interactive
Comment

Interactive comment on "Empirical correction of XBT fall rate and its impact on heat content analysis" *by* M. Hamon et al.

M. Hamon et al.

mathieu.hamon@ifremer.fr

Received and published: 31 March 2011

Dear reviewer,

Our XBT correction method builds on previous works, including the results of Gouretski and Koltermann (2007) , Wijffels et al (2008), Thadathil et al (2002) and Gouretski and Reseghetti (2010). We used a collocation method to compared XBT and CTD/OSD profiles. We highlight the need to separate deep and shallow XBT (Wijffels et al ,2008) and to take into account the water of the sea where the probe had been deployed (Thadathil et al ,2002). It is a combination of previous correction.

We chose to calculate for each year between 1968 and 2007 a parabolic correction because it provides a good fit with the calculated depth bias. In contrast to Gouretski

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

and Reseghetti (2010) we find a time-dependent depth correction (parabolic correction and offset). According to Gouretski and Reseghetti (2010) we also apply a pure thermal correction varying with years. Our correction is however smaller than the one they found. As mentioned in the paper, it can be explained by our more stringent criterion on collocated data. Moreover, we perform some further analysis and this is also partly related to the difference of bathymetry between collocated data. This will be discussed in the revised version of the paper.

The correction is fitted to the calculated depth bias (I attach an illustration).

When we say "more or less", our statements are supported by Figure 5 where is shown the different type of correction. However, we will remove this sentence of the revised manuscript.

Specific comments:

P. 3, Line 7: ". . . proposed a linear correction" . I suggest to change to "a yearly multiplicative correction factor.

-"Wijffels et al. (2008) proposed a yearly linear correction on the depth " will be changed by " Wijffels et al. (2008) proposed a yearly multiplicative correction factor".

P.3, Line 9 : ". . . bias compared on a CTD climatology". Obviously, " bias obtained by comparing with the CTD climatology" was meant.

- "the annual median temperature bias compared on a CTD climatology. " will be changed by "the annual median temperature bias obtained by comparing with the CTD climatology.".

P.3, Line 27: "distant from less than 15 days" – please, reformulate: "distant" is rather used for separations in space.

- "We selected all CTD and OSD (Ocean Station Data) geographically distant by less than 1 of latitude and 2 of longitude and temporarily distant from less than 15 days "

is changed by "We selected all CTD and OSD (Ocean Station Data) near from a XBT, geographically distant by less than 1 of latitude and 2 of longitude and a time lag below 15 days".

P-4, Line 5 : Why profiles shallow than 200 m were removed from the study?

-We exclude profiles shallower than 200m to exclude coastal regions. In other hand, we have shown that this can be a source of bias.

P.4, Line 24 : "The vertical median bias" : bad English, please, rewrite.

- "The vertical median bias" is changed by "The 1-year median bias function of depth"

Page 5, after line 2: Please, insert the reference to Gouretski and Reseghetti (2010), as they noted (and provided plots) inability of the depth-uniform correction factor to effectively reduce the bias throughout the water column.

- Ok

Page.5, Line 8: This observation agrees.. Change to "This agrees.."

- Ok

P.5, Line 14: "Our calculations. . .to several observations". The word "observations" is not a proper one here. Please, rewrite the sentence.

- "Our calculations of depth bias from collocated profiles points to several observations " is changed by "Our calculations of depth bias from collocated profiles lead to several comments".

P.6, Line 19-20: I do not understand the sentence.

-"Furthermore, we note that those probes need more different regimes of correction than the others." is changed by "Furthermore, we note that those probes need more different types of correction than the others (linear part>0, parabolic part>0, or linear part>parabolic part...).". As shown in figure 5, each sector represents a behavior of the

calculated median depth bias. We note that deep XBTs deployed at low temperature fill more sectors than the others categories of XBTs.

P.7, lines 13-14: "As we did not find significant differences between profiles. . ." I guess, the difference in terms of biases is meant?

-Yes we refer to differences in terms of bias.

P-7, line 22: "The parabolic character . . . is certainly due to a too simple approximation..". No! The parabolic character is simply YOUR choice of the approximation – nothing more.

- I agree with you. It is better to write "The parabolic character of the calculated depth bias..."

Page 8, L.9-18: I can not see why two temperature classes were selected? Do the probes have a different fall rate in different regions? – There are no further details. I also do not understand the last sentence about the application of depth corrections three times. Please, rewrite the section in a more understandable way, or remove it from the text.

We rewrote this to:

Following a global approach, we chose to differentiate several categories of profiles, XBTS and XBTD deployed in high or low temperatures (above or under 10 C) to optimally correct the database. The comparison suggested that fall rate depends on temperature (viscosity), and retaining only two temperature classes is a practical choice, as the computations require a sufficient number of profiles to be robust (Fig. 4). In practice, the two categories overlap to avoid discontinuities between profiles deployed in water close to 10 C . For the high temperatures class, we selected all XBTs deployed in water warmer than 8 C and for the low temperature class, we selected XBTs deployed in water colder than 12 C. Moreover, we estimate depth correction in an iterative process repeated three times because of subtle non-linearities when estimating

the correction: we first calculate the raw depth bias and the fitted correction using the local gradient of temperature observed by the CTD (Eq. 2). However, when we apply the correction to XBT, we use the uncorrected gradient observed by XBT (which is not equal to the one observed by the CTD),

Tcorr=T+dz(dT/dZ)xbt

Thus, there is a residual depth bias related to the difference of gradient between the uncorrected XBT and the CTD. It is necessary to start again the calculation of the depth bias until convergence when the corrected XBT gradients will be statistically similar to the one of the CTDs.

P.8, lines 20: There is no sense to speak about the correlation between the bias and its correction.

-The sentence will be removed from the text.

P.8, line 27: "The calculation of the drop height in board is very rough . . ." Bad English, please, rewrite. Moreover, the launch height is not calculated! It is known or (in most cases) unknown.

-I agree with you, we change it in "It is difficult to know the height at which the XBT is dropped because of movements on the ocean surface , estimation of the height of the deck..."

The section on heat content demonstrates the robustness of the correction based on collocated data (about 10%) on the entire database. it is an important check of the consistency of the corrections we applied compared to the ones done by other groups, on an integrated quantity for which the results should be rather similar.

Concerning the English, the text will be checked by a native English.

Yours sincerely,

Mathieu Hamon

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

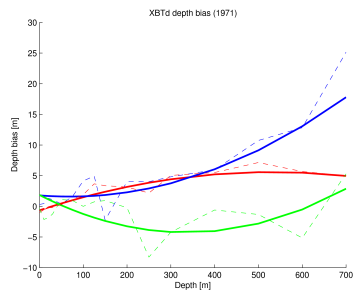Interactive Discussion

Discussion Paper

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

XBTD (deep) median depth bias (dotted line) and the fitted correction (full line) in 1971. The depth bias is shown for the 3 classes of XBTD. XBT deployed in western Pacic basin (green), XBT deployed in warm water (red) and deployed in cold water (blue).

Fig. 1.