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Interactive comment on "Abyssal plain hills and internal wave turbulence" *by* Hans van Haren

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Review to Hans van Haren Abyssal plain hills and internal wave turbulence Biogeosciences Discussions

Thank you for reporting on this interesting data set. The paper deals with an observed high-resolution temperature timeseries above an abyssal hill region. It describes internal wave, stratification, overturn, and estimated mixing aspects, as derived by frequency spectra, Thorpe scales, and exemplary showcases. Important points of outcome are a diagnosed relatively intense mixing, particularly in the bottom boundary layer (BBL), as well as a proposed mechanism causing this (internal waves propagating from above into a marginal stable bottom boundary layer and triggering instability). The data set is unique and from an interesting setting between steep and smooth topography, and away from mainstream focus. It merits to be publicly visible, although in the present form I would not recommend to publish the paper. The two main reasons for that are reproducibility, and a possible flaw in the Thorpe scale analysis that would

depreciate major results of the paper.

Reproducibility: a range of results which are specified in the abstract and conclusions sections are not based on data analysis by objective methods or are not treated in the results or discussion sections (a methods part is entirely missing). E.g.: - The coupling mechanism/interaction/interplay between internal waves above the bottom boundary layer and their effects within the BBL. - Sediment resuspension. - Internal wave breaking to be the dominant cause for forming the BBL. - Evidence for the occurrence of fronts and solitary internal waves. - Asymmetric turbulent erosion of stratified layers. - Abundances of overturns. - Turbulence to be caused by both shear instability and convection alike.

Thorpe scale analysis: There is a striking pattern in the calculated Thorpe displacements, indicating a very frequent and long-lasting 50m overturn at the lowest 50m. I assume this is an artefact, because the temperature gradient is often at or below 0.5mK/50m, and sensor noise and uncertainty are comparatively high. In such a constellation of a very low density gradient like in the BBL, noise/uncertainty will cause spurious overturns and overestimated displacements, leading to overestimated mixing through Thorpe scale analysis [Piera et al., 2002; Johnson and Garrett, 2004]. The diagnosed intense mixing in the bottom 50m is at the base of major results of the paper: the increasing turbulence with depth, intense near-bottom mixing, and the explanation for the intense near-bottom mixing by internal waves which trigger overturns in a marginal stable regime. Given the importance of the intense bottom boundary layer mixing for the paper, a critical review of the appropriateness of the used Thorpe scale processing should be a central part of the methods. If the existence of a quasi-permanently overturning 50m-bottom-layer should prove true, this as well should be a central part of the discussions.

Further remarks: - Given the reported numbers N = 5.5 * 10 ˆ -4, S = 1.6 * 10 ˆ -4 (lines 254 to 258), the average Richardson number in the BBL seems rather 10 than unity. This would not support the assumption of the BBL being systematically marginally stable. - Can you make clearly understandable why the given arguments (lines 189 to 192) allow to choose a mixing efficiency parameter m of 0.2? - I'd propose to more prominently place the particular results for the abyssal hill region in the larger context of the limiting cases 'steep topography' and 'smooth abyssal plain' - data availability is not stated

References:

Piera, Roget, Catalan (2002): Turbulent patch identification in microstructure profiles: a method based on wavelet denoising and Thorpe displacement analysis, J. Atm. Oceanic Tech., 19, 1390-1402

Johnson and Garrett (2004): Effects of noise on Thorpe scales and run lengths, J. Phys. Oceanogr., 34, 2359-2372

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