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# *Interactive comment on* "Validation of the Thorpe scale-derived vertical diffusivities against microstructure measurements in the Kerguelen region" *by* Y.-H. Park et al.

**Anonymous Referee #2**

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General comments

This is a well written paper describing an interesting analysis and comparison of methods on how to estimate mixing intensities indirectly from density observations using Thorpe scales. The topic of mixing and mixing estimates in the oceans has been particularly researched in the past 20 years as one of the key challenge remaining in oceanography. It is vital that any progress in this field by passed on to concerned fields of research, in this case biogeoscience. The methods are detailed and clearly outlined, the results are strong and the supported conclusions provide clear advice on how to achieve best mixing estimates from density profiles in the Southern ocean, near the Polar Front. A good description with a small discussion is also given of the mixing



intensity and distribution east of the Kerguelen Islands. Overall the manuscript is well presented and and well structured. We suggest some additional references to support the discussion and some minor technical corrections.

Specific comments

1) Additional references:

- In section 2, page 12141 line 5: For the thermal mass correction, 'typical' values of alpha and beta are used as 'recommended'. Can you please provide a reference or some details as to where those correction values come from?

- Section 4, page 12147 line 10: When describing the diffusivity distribution, can you please provide some references of previous estimates of mixing in the Kerguelen Plateau area or southern Ocean for comparison. Eg Waterman et al 2014, Wu et al, 2011, Thompson et al 2007, St Laurent et al 2012...

- Section 4, page 12147 line 20: When talking about strong mixing found over the Plateau and close to the Polar front, can you refer recent work on mixing showing similar results or providing discussions on the matter? Eg Waterman et al 2014, Wu et al, 2011, Thompson et al 2007, Whalen et al 2012, Waterhous et al 2014, Sloyan 2005...

- Section 4, page 12148, line 3-4: You mention that the diffusion rate is quite 'low' throughout the upper 400 m and talk about a background level. The way it is written, one might think the background level is your mean mixing estimate. Some details and maybe reference about what you mean by background level, if not mentioned earlier, would be fitting here.

2) Additional discussion:

- Section 4, page 12147 line 25: When you mention that the diffusivity estimates this time are less intense than those from the 2005 campaign, it would be nice to add a couple of sentences with some ideas about why that is.

- Section 4, page 12147 line 25: You mention an exception at TNS 5 where a local minimum in chlorophyll is observed in conjuncture with elevated diffusivities. Are you able to provide any comments or theories on why that is?

3) Page 12145, line 8: what is the minimum value of the TurboMAp derived diffusivities?

4) Page 12147, line 2: You have not shown that this last sentence applies to any study or data set. Maybe add that 'is highly desirable in the estimation of vertical diffusivities for this data set'.

Technical corrections

Below corrections are suggestions only.

1) Page 12138, line 6: Change to 'These diffusivities are validated' for clarity.

2) Throughout the paper, change numerals between 1-10 to the written form (one to ten).

3) Page 12138, line 17-18: Clarify what is attached, the polar front or the acc surface water? The text as is is not clear.

4) Page 12139 line 23-24: Re phrase to 'Shih et al recently proposed a new param for the energetic turbulent regime based on the lab and numerical experiments as...' for clarity.

5) Page 12140, line 6: add 'a total of four kinds of K estimates at ...' to help the reader follow the story.

6) Page 12140, line 23: rephrase to 'while the TurboMAP measurements from the surface to about 400 m...' for consistency.

7) Page 12140, line 24: Change 'top' to 'upper'.

8) Page 12141, line 12: change to 'there was' for tense consistency.

9) Recurring use of 'On the other hand': Either just remove or use something else. It is



quite an outdated English expression in this setting.

10) Page 12142, line 21: Change 'as' to 'that' for clarity.

11) Page 12143, line 27: Replace 'Shortly speaking' with 'In short'.

12) Page 12144, line 21 and after: Change 'most apparent' to 'clear'.

13) Page 12145, line 3: For ease of reading, rephrase to 'from the Osborn parameterizations and from the Shih parameterizations...' otherwise, it sounds like you are talking about an Osborn & Shih parameterization.

14) Page 12145, line 24: add 'appears to be a tendency...'

15) Page 12148, line 17: Change to 'of the Kerguelen Islands using more direct estimates...'

16) Page 12149, line 3: remove 'still' as it makes it sound like the Thorpe scale method was considered at some point as a non useful tool. If that is the case, explain this in the introduction somewhere with references.

17) Throughout the paper, there is the use of 'We make here' or 'We do here'... This could be changed to 'Here we make' for reading fluidity.

18) Title: I m not sure that the 'the' is needed before 'Thorpe scale-derived vertical diffusivities'. Maybe worse checking with an English grammar specialist...

Figures:

1) Page 12152 Fig 1: Provide source for the chlorophyll satellite image. Also, explain where the location of the PF comes from... your data, previous papers...?

2) Page 12153 Fig 2: Add 'density noise (0,0007) used is...'

3) Page 12154 fig 3 and other figures: Add 'depth' on the y-axis or explain in caption that z is depth.

4) Page 12156 Fig 5: In caption add 'but for the mean (in black) and standard deviation (in grey) ratios of all stations.'

5) Page 12157 Fig 6: What data is used for the seabed profiles? Add source or ref please.

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