We would like to thank the reviewer for the time and effort spent reading our manuscript and for the useful comments and suggestions. A detailed response to all comments can be found below, where the black text indicates comments of the reviewer. The blue text denotes our response to these comments; line numbers refer to the revised version of the paper.

Comments by the reviewer:

General Comments: Excellent work, taking into account that the diapygnal fluxes at the interfaces of the stepped structures are considered comparable to those of the surface fluxes. The further use of the current results (in a next paper) can provide at global scale the contribution of the stepped structure diapygnal fluxes.

We indeed are working on a next paper where we compute the contribution of double-diffusive processes to the global mechanical energy budget. Furthermore, we noticed that 'interfaces' is a more widely accepted term than gradient layers. Therefore, we replaced all mentions of 'gradient layers' by 'interfaces' throughout the manuscript. This included replacements in Figure 4, 5, 6, and 8.

Specific Comments: A sentence is needed why only Argo floats and ice tethered profilers were used. Why not the high vertical resolution of the CTD profiles, which in most cases the vertical profiles are deeper than those of the floats.

We limited ourselves to Argo floats and Ice-Tethered Profilers, because they have a global coverage and we could use them to show that the algorithm performs its task well. However, we agree with the reviewer that it would be interesting to extend the dataset with more data in the future. We also added a sentence to the conclusions to highlight this possibility.

> *Lines 266-268:*
> *'Therefore, when considering an individual staircase region, we recommend optimizing the input variables of the algorithm for that specific region and applying the algorithm on additional data, for example high-resolution CTD or microstructure profiles, where available.'*

Furthermore, we added additional information about the original vertical resolution of the profiles used in this study (Fig. 1 and Table 1). We added the Figure and Table at the end of this response.

> *Lines 54-58:*
> *'Details on the origin and vertical resolution of the profiles are depicted in Table 1 and Figure 1, in which Figure 1b confirms that all profiles have observations deeper than 500 dbar. Furthermore, the average vertical resolution of the profiles indicates the average resolution is well below the 5 dbar that was used as a threshold (Fig. 1c). After this quality control, 487,493 vertical temperature and salinity profiles remain.'*

Before or after the Figure 6, add a sentence about the depth the stepped structures were detected, i.e. diffusive convection mostly was detected at depths between 300-400 m, while the salt finger between 400-700 m.

We rewrote the paragraph to clarify that we selected the staircases with most steps. In addition, we indicated the water masses between which these staircases are found (and provided references):

> *Lines 164-167:*
> *'In line with previous results (Rudels, 2015), staircases in the diffusive-convective regime (Fig. 7a) are mainly detected on the thermocline with the conservative temperature increasing with depth. These staircases are predominantly located in the Arctic Ocean at a depth between 300-400 m, which is between the warm and saline Atlantic Water and cold and fresh surface waters (Rudels, 2015)'*
>
> *Lines 175-178:*
> *'Thermohaline staircases with a high number of steps in the salt-finger regime are detected on the main thermocline where the conservative temperature decreases with depth (Fig. 7b). Compared to the staircases in the diffusive-convective regime, these staircases are located slightly deeper at 400-700 m. While the locations of these staircases vary, they are located above the cold and fresh Antarctic Intermediate Water, which is observed below 700 m (Tsuchiya, 1989; Fine, 1993; Talley, 1996).*

Will be of interesting to see in a new paper using the CTD data from the SeaDataNetand or EMODNET portals applying the same technology of this ms to reveal the deepest stepped structures, as well as the fluxes estimates.

We agree with the reviewer that it would be interesting to use the algorithm on different datasets as well, but this is outside the scope of the present paper. No changes in text.

Table 1 Number of floats and profiles in the global dataset. Profiles taken with Argo floats are categorised by the Data Assembly Center (DAC). Profiles taken with Ice-Tethered Profilers are categorised as ITP. The percentage between brackets indicates the relative contribution to the total number of profiles in the global dataset (487,493 profiles). More details on abbreviations of DAC can be found in Argo (2019)

DAC	Number of floats	profiles
aoml	2692	312,285 (64.1%)
bodc	93	11,092 (2.3%)
coriolis	347	27,134 (5.6%)
csio	81	15,099 (3.1%)
csiro	378	42,942 (8.8%)
incois	65	4,363 (0.9%)
jma	205	22,919 (4.7%)
kma	1	1 (0.0%)
kordi	0	0 (0.0%)
meds	145	9,285 (1.9%)
nmdis	0	0 (0.0%)
ITP	82	42,373 (8.7%)

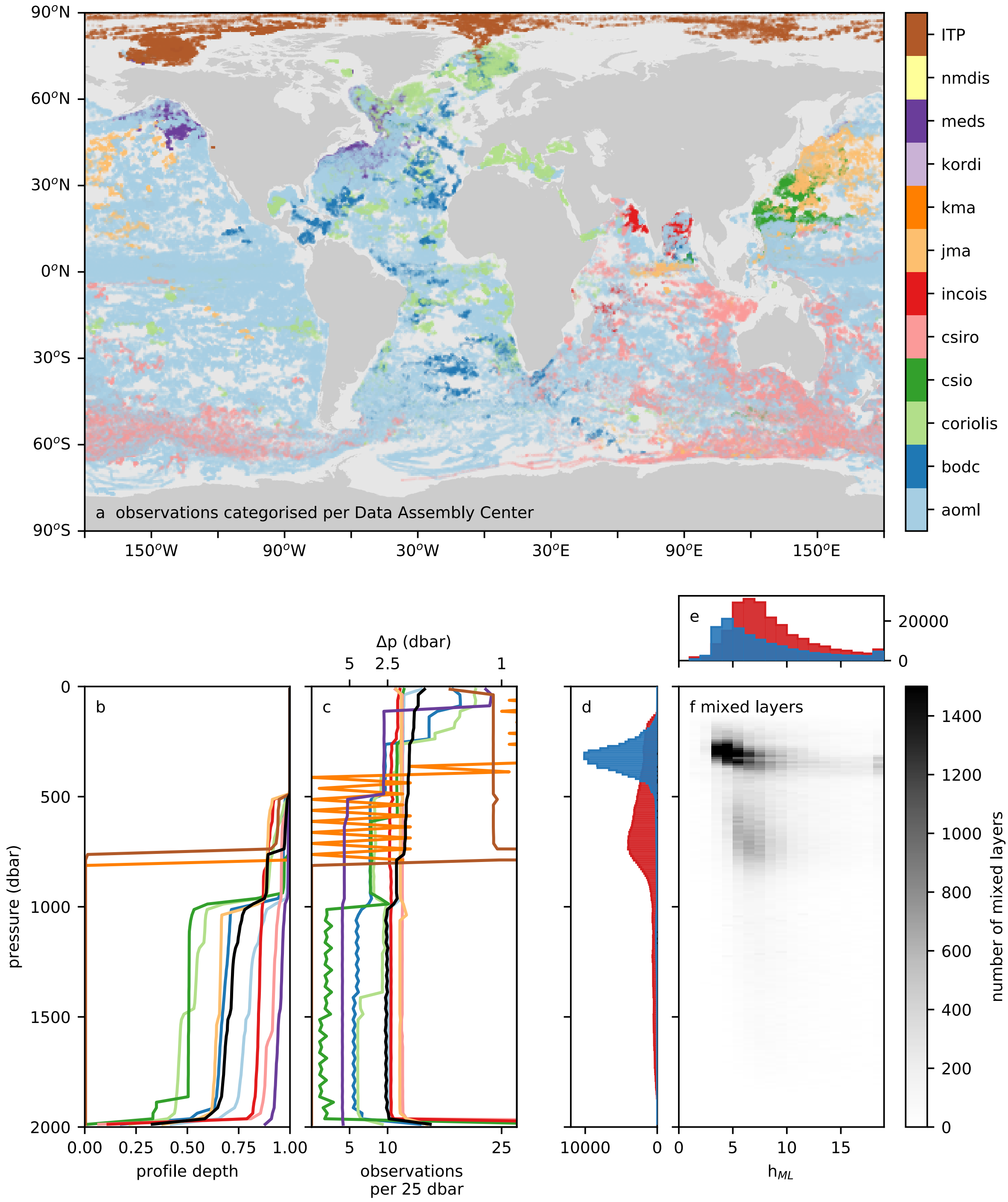

Figure 1 (a) Locations of observations categorised by Data Assembly Centers (DAC) when obtained by an Argo float. Profiles obtained with Ice-Tethered Profilers are indicated with ITP. (b) Cumulative fraction of profiles that reached a given pressure in 25-dbar intervals from 0 to 2,000 dbar per DAC. (c) Average number of observations in 25-dbar intervals from 0 to 2,000 dbar. (d) Distribution of detected mixed layer pressures in the salt-finger (red histogram) or diffusive-convective (blue histogram) regime. (e) Number of detected mixed layers height in the salt-finger (red histogram) or diffusive-convective (blue histogram) regime. (f) Distribution of detected mixed layer heights in thermohaline staircases per pressure level. Panels (b) and (c) were obtained following Wong et al. (2020). Black lines indicate the averages in total global dataset. More details on abbreviations of DAC can be found in Argo (2019)