Authors' response (AR) to Reviewers' comments (RC) on manuscript OS-2017-58 "Quantifying thermohaline circulations: seawater isotopic compositions and salinity as proxies of the ratio between advection time and evaporation time" by Berman, H., N. paldor and B. Lazar

General

Both reviewers raised a number of issues that are totally acceptable to us and which we intend to address in the revised version of the manuscript. These comments entail re-focusing the manuscript on semi-enclosed basins and eliminating the use of the term thermo-haline circulation (which will be changed in the revised manuscript to evaporation-driven circulation) since this term is presently used in the context of the global circulation in the Atlantic. As part of the change in focus, we intend to include in the revised version an analysis of surface salinity snapshots in the Mediterranean that bolster our use of the proposed new non-dimensional parameter. We thank the reviewers for their insightful review that helped us better clarify the points we are trying to make.

Our response to each of the particular points raised by the reviewers is listed below.

<u>Reviewer 2</u>

1. The term "strength" will not be used in the revised version. Instead γ will be called the index of evaporation driven circulation (EDC index). The magnitude of γ (<1) determines the fraction of the mixed layer (mean depth *h*) that evaporated during the time when the water moved a distance *x* at a speed *u*. Thus, the larger the γ, the larger the contribution of the evaporation-driven circulation to the actual circulation. The highest EDC index (measured in the extremely arid semi-enclosed Red Sea) is ~0.1. This will be explained in the revised version.
2. While the flow we have in mind is driven by excess evaporation, changes in SSS are inherent to the circulation (in fact, the change in surface salinity is the main indicator of our proposed theory). The term "thermohaline" will be replaced by the term evaporation-driven circulation in the revised version.
3. Diffusion is indeed ignored in our theory which focuses on Evaporation-driven flows. In the context of our gross estimates, molecular diffusion is entirely negligible on the O(1000) km length scale, while no data can be invoked to estimate the eddy diffusion in these flows. A mean value of mixed layer depth (*h*) is used throughout even though mixing processes change it as time goes by.
4. Additional data from the Mediterranean (including seasonal changes) will be added in the revised version (see Fig. 1 below).
5. The title will be modified to: "Circulation in semi-enclosed basins: Quantifying the fraction of the mixed layer that evaporates during the horizontal flow"

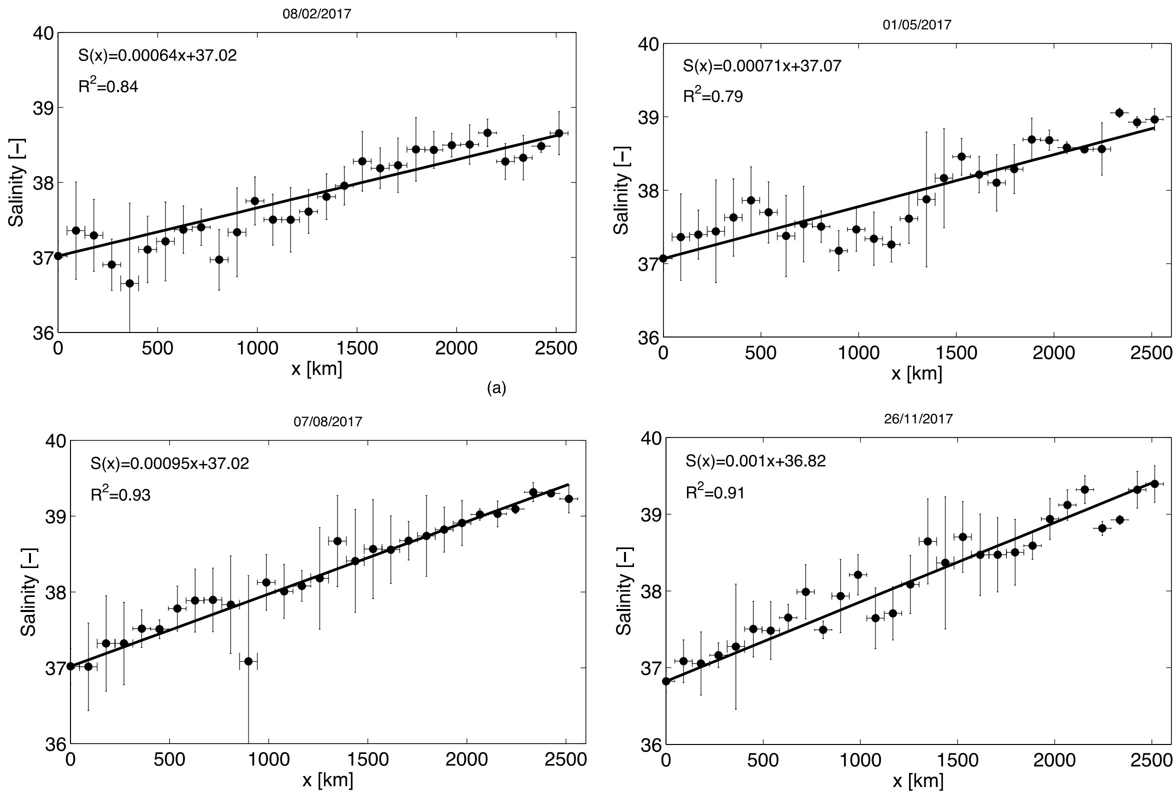

Figure 1: Meridionally averaged sea surface salinity in Mediterranean Sea as a function of distance from the Straits of Gibraltar (*x*) every 3 months during the year 2017. Data is taken from the SMAP (Soil Moisture Active Passive) Sea Surface Salinity (SSS) level 3 8-day running average[1]. The slopes of the trend lines are the highest during August and November (when precipitation is minimal, i.e. excess evaporation is maximal) and lowest in February and May when precipitation is largest (i.e. excess evaporation is lowest). The resulting values of γ vary between 0.06-0.07 in August and November, and are ~0.04 in February and May (only ~60 % of summer γ). These values are consistent with our claim that high γ values reflect higher contribution of evaporation driven circulation. It is also consistent with the highest value of γ= of 0.09-0.12 we estimated for the Red Sea, which is located in an extremely arid desert region with virtually no freshwater input and hence evaporation driven circulation is high there.

1 Meissner, T. and F. J. Wentz, 2016: Remote Sensing Systems SMAP Ocean Surface Salinities [Level 2C, Level 3 Running 8-day, Level 3 Monthly], Version 2.0 validated release. Remote Sensing Systems, Santa Rosa, CA, USA. Available online at www.remss.com/missions/smap, doi: 10.5067/SMP20-3SPCS.