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Interactive comment on "Water masses and mixing processes in the Southern Caribbean upwelling system off Colombia" *by* Marco Correa-Ramirez et al.

Anonymous Referee #1

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This manuscript presents a study of the Caribbean upwelling system based on four cruises as well as the analysis of outputs from numerical simulations performed with the Mercator model. There are two main objectivesÂă: the first one is to determine the origin of the upwelled waters and the second one is to characterize mixing processes that may influence biological productivity. The upwelled waters, that are mainly constituted of Subtropical Water Mass (SUW), are characterized by a local salinity maximum. This salinity maximum presents a strong seasonal variability and is significantly smaller than that of the SUW, as inferred from in-situ data. The pathway of these upwelled waters is inferred from the Mercator modelÂăoutputs: they originate from the Western Caribbean Sea and are transported by the intense Caribbean coastal undercurrent

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Discussion paper

(CaCU). Mixing processes are estimated and shown to be significant with vertical diffusivities of 10-4m2s-1 for double diffusive processes and 10-3m2s-1 for mechanical mixing. This mixing impacts the salinity distribution of these coastal upwelled waters but the impact on the nutrient content in the upwelling region is to be determined.

The manuscript is generally well written and presented with clear figures. The topic is interesting and the questions adressed relevant though I don't know to which extent the results are new, not being a specialist of the watermasses and circulation in the area. Also I find a lack of convincing results with respect to the points adressed.

My major concern is on mixing processes, with estimates of diffusion by salt fingering (SF), active below the subsurface salinity maximum, and by turbulence (T). The SF diffusvity is derived from a formula (eq. (3)) with out any reference. I guess that this formulation is derived from Schmitt (1981), in any case it should be mentionned. I wonder about the ÂńÂăbackgroundÂăÂż constant value, which is large, as well as the maximum Ksf value, how were they prescribedÂă? The vertical eddy diffusivity, KT, is inferred from density overturns. The method is described with details except for the background value when no density overturns. Its application to in-situ data is not detailed. It would be interesting to know how the KT vertical sections shown in Figure 4 were obtainedÂă: indeed according to the N2 sections, the stratification is always stable, so one may wonder whether density overturns were resolved or not, how the computation for each individual vertical profile was performed (with or without a background value) and how the interpolation was perfomed for KT. It is also confusing to discuss the relative part of the salt fingering and turbulent mixing contribution to diffusive salt fluxes with a background Ksf taking into account other mixing processes (i.e. mechanically driven mixing, for instance by internal wave breaking). This analysis is not convincingÂă: this may result both from the lack of details provided and mostly from the inadequacy of the dataset to this aim.

In conclusion my advice would be to remove the part on mixing processes as it is not convincing(see details above). Also the objective is too ambitious owing to the data available, without current measurements and microstructure measurements. Regarding the water mass part and upwelled waters pathways, it should be strenghtened with further analysis. For instance a lagrangian analysis based on retro-trajectories may be helpful to this purpose for tracing water masses pathways and provide more convincing results.

My recommandation is to submit a new manuscript focused on the circulation and water masses excluding mixing processes.

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