

## Interactive comment on "Climatology of Lyapunov exponents: The influence of atmospheric rivers on large-scale mixing variability" by Daniel Garaboa-Paz et al.

## Anonymous Referee #1

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This paper studies mixing and Lagrangian transport properties for a period of 35 years, 1979-2014, of the wind field reanalysis from the ECMRWF by computing trajectories of a large number of tracers placed in a grid of 0.35 degrees. Lagrangian simulations are carried out using the wind data as input and FTLEs are calculated for each tracer on a time horizon  $\tau$ . Potential connections of FTLEs maps with baroclinic instability, ENSO, storm tracks, etc are discussed. Some of these connections/correlations are clearer than others, some are put in firmer grounds than others, and some are no more than a conjecture, but the paper has potential to be interesting.

The paper has however some scientific issues that should be addressed:

1) The FTLE definition in Eq.(2) cannot be correct. The deformation tensor C must

C1

depend on  $t_0$  and  $\tau$  explicitly. I guess the authors mean C is the product of deformation tensors evaluated along the trajectory of the tracer from  $t_0$  up to  $t_0 + \tau$  at every time step in the integration. Ideally, one should write the explicit equations that go from the motion equations to  $\lambda$  to make the paper accessible to a wider audience– namely, those who are not specialists in Lagrangian flows. In any case, the formula (2) must be corrected and the correct meaning for C must be given.

2) Below line 25, the paragraph that begins: "Figure 4 ..." discusses ARs (atmospheric Rivers) the authors mention they use some detection criteria by Guan and Waliser and nothing else is explained. Well, I don't think this method is that well known to a general audience so that everyone should know how ARs were actually detected. One does not know why this method is used and no others or how would that change detection. The explicit details of how this detection works, why is favoured by the authors here, etc should be provided.

3) I do not know how periods with land falling ARs are calculated and I fail to fully appreciate the validity of Fig. 4. What does it mean  $\lambda_{AR}$ ? You mean the FTLE is only computed during those episodes of AR events? Does this mean the whole interval  $(t_0, t_0 + \tau)$  must be within the event? Or only the starting time  $t_0$ ?

4) The last sentence of the paper is intriguing. When the authors say: "... and could be used forecast precipitation events in those regions where persistence of coherent transport structures has a great impact", do they really mean to say FTLEs can be used to *forecast precipitation events*?

Typos:

1) In the first sentence of the paper I think "the conversion of" is better than "the conversion between"

2) In Page 3, line 8: It should be Eq.(1) instead of (2)

3) Page 3, line 18: "stable (unstable)" shouldn't it be "unstable (stable)"?

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