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Discussions

Interactive comment on "Relative dispersion in the South Western Mediterranean as derived from satellite-tracked surface drifting buoys" *by* Maher Bouzaiene et al.

Anonymous Referee #1

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Review of the manuscript: "Relative dispersion in the South Western Mediterranean as derived from satellite-tracked surface drifting buoys", by Maher Bouzaiene, Milena Menna, Pierre-Marie Poulain and Dalila Elhmaidi.

General considerations: This work appears rather superficial and fragmentary, without a clear guiding line. The kind of data analysis proposed and the presentation of the results do not respect, in my opinion, the minimal requirements to consider this manuscript for publication. The Authors should decide if – in their opinion – it is better to separate the relative dispersion regimes they claim to observe in the time domain or as function of the separation scale. Physical arguments demand a description of the relative dispersion regimes in function of the separation scale, not in function of time.

This fact has been established, and repeatedly confirmed, by many papers published in the last 20 years about which the Authors seem to be totally unaware. For example, at Page 2, Line 20: "In the last decades several studies have been focused on the relative dispersion in many parts of the World Ocean. . .." That's true. Unfortunately, the Authors seem to ignore several works that could have been useful to know before undertaking a study like this. For example, I would like to suggest a paper like this one: "General characteristic of relative dispersion in the ocean", Corrado et al., Nature Sci. Rep. 2017, and references therein, where it is explained how to measure the physical characteristics of the relative dispersion process in the correct way, what is the optimal indicator of relative dispersion and how to interpret the results in a global theoretical picture. If this paper may seem too recent to be cited (in the present version of this manuscript), there is for example a very good review about Lagrangian statistics in ocean and atmosphere by LaCasce, "Statistics from Lagrangian observations", Progr. in Oceanogr., 2008, that could have been included in the bibliography. It is not necessary to go into a detailed list of remarks. Just some further considerations. Fig. 2. Diffusion is an asymptotic regime, i.e. it holds in the limit of t $\rightarrow$ infinity, or better for infinitely large separation distance. That's true that the diffusive regime may exist far before these limits are reached, namely, it can occur right after the spatial correlations between trajectories have decayed. Of course, it is simpler to look at single trajectory autocorrelations. In that case, velocity autocorrelation functions could help to see on what time scale the autocorrelations decay. By the way, it is singular that the d) panel shows apparently no correlation decay since particles having a large initial separation should reach the diffusive regime (if any) presumably earlier than pairs starting from much smaller initial separations. Fig. 4. It is supposed that the mean square relative velocity should converge to some constant value for any initial separation, and this is clearly not the case shown in the figure. What is the meaning of the vertical line and how it is related to the vertical lines shown in Fig. 2 ? Fig. 6. The Authors have discovered that the mean square relative dispersion depends significantly on the initial separation, if measured as function of the time. . . see for example: "Nonasymptotic properties of transport and mixing", Boffetta et al., Chaos, 2000. That's why some people have introduced and developed the so-called scale-dependent analysis of relative dispersion in terms of the indicator known as Finite-Scale Lyapunov Exponent, or FSLE. The Authors might not recognize or might underestimate the value of this innovation but scientists are supposed to be open to welcome new instrumentation or new analysis techniques that could help them to do their work better than in the past. Fig. 7. Where the vertical lines come from, and for what reason pair velocities should be uncorrelated during a Richardson's regime ? Velocities become uncorrelated only in the standard diffusion regime. Before diffusion, any other pre-asymptotic regime is characterized by the persistence of spatial and temporal correlations. When all correlations decay, relative dispersion tends to a standard diffusive regime (constant diffusivity). Fig. 8. Again, if the vertical lines actually indicate the separation after which the pair velocities become uncorrelated (let us assume this is true), I don't understand why the characteristic dispersion time doesn't seem to scale as D2 (as in a diffusive regime), first of all. Second, it does not make sense to look for a D2/3 fit (as in a Richardson scaling) at scales larger than the presumed spatial correlation length (panels b, c and d), since in a Richardson turbulent dispersion regime particle pairs are still correlated by the presence of eddies at the same scale of the particle separation (locality property).

I cannot recommend publication of this manuscript. I invite the Authors to pay much more attention to the writing of the text and, above all, to the presentation and the discussion of the results in more rigorous terms. Some fundamental literature is missing from the reference list and this explains, in part, why a study on Lagrangian relative dispersion of ocean drifters, submitted in 2017, looks so out of date and surprisingly superficial.

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