

Interactive comment on “Intrusion of coastal waters into the pelagic Eastern Mediterranean: in situ and satellite-based characterization” by S. Efrati et al.

S. Efrati et al.

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We are thankful to the reviewer for the constructive remarks. Bellow are our replies to the reviewer comments point by point.

1. Comment: The use of altimetry derived velocities in near coastal applications should be discussed in the paper.

1. Reply: The following paragraph was added to the manuscript: “The use of satellite altimetry in the area close to the coast is difficult and may lead to errors in the calculated velocity field. Major obstacles are land contamination of the radar altimeter measurements, and the difficulty to accurately correct the effect of environmental

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factors as tides and atmospheric conditions”.

2. Comment: The authors should make a clear case for employing ridges of FSLE for identifying LCS, particularly given recent formal developments (Haller 2011; Haller and Beron-Vera 2012).

2. Reply: We agree with the reviewer about the importance to discuss the choice of employing FSLE for identifying LCS. The following paragraph was added to the manuscript:

“Transport barriers between fluid domains were delimited by identifying attracting Lagrangian coherent structures (LCS, Haller and Yuan, 2000), in the satellite derived surface velocity field. In recent years, novel approaches for locating material transport barriers in two-dimensional flows were introduced (Haller 2011; Haller and Beron-Vera 2012). Here, the barriers are identified as ridges of local maxima in the field of finite size Lyapunov exponents (FSLE) (Boffetta et al., 2001). This method was shown to be efficient in detecting transport barriers that delimit the spatial distribution of oceanic tracers as surface chlorophyll (d’Ovidio et al., 2004, 2010; Lehahn et al. 2007).”.

The following references were added accordingly: Haller, G. A variational theory of hyperbolic Lagrangian Coherent Structures. *Physica D* 240: 574–598, 2011. Haller, G., and F. J. Beron-Vera, Geodesic theory of transport barriers in two-dimensional flows, *Physica D* 241: 1680–1702, 2012.

Furthermore, following the reviewer comment, we have replaced the term “FSLE” with the term “attracting LCS” at several locations throughout the manuscript.

3. Comment: I find it difficult to see any correlation between the overall structures revealed in the FSLE plot and those in the chlorophyll and SST pictures in Fig. 2. This makes me wonder about the validity of the explanation provided for the intrusion.

3. Reply: We agree with the reviewer that the overall structure of FSLE distribution over the basin do not fully coincide with that of chlorophyll and SST. We note however that

such correlation is only expected under specific conditions. Most importantly, FSLE and scalars as SST or chlorophyll are likely to correlate when spatial variability is first introduced due to environmental factors (e.g. large scale gradients or local injection of nutrients), and when the scalar is a tracer whose spatial distribution is controlled by horizontal advection. We argue that such conditions are met in the case of the patch studied here. As mentioned explicitly in the text, this notion is based on a number of complimentary evidences, mainly the good agreement between the FSLE and southern SST and fluorescence fronts (Fig. 4), and the westward patch propagation speed, which is in the order of the surface velocities (Fig. 6).

4. Comment: The authors speculate on several possible sources of nutrient rich coastal water. I wonder if (numerical) tracer release experiments can help elucidate the most likely nutrient source as done, for instance, in Olascoaga et al. (2008).

4: reply: Indeed, as suggested by the reviewer, we have conducted numerical tracer release experiments. Unfortunately, these experiments did not contribute to identifying the exact sources of enriched waters. The main reason for that is the relatively coarse resolution of the satellite altimetry data, which is not sufficient to resolve the exact pathways of particles as they are advected by the surface currents.

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