

Interactive comment on “Physical forcing and physical/biochemical variability of the Mediterranean Sea: a review of unresolved issues and directions for future research” by P. Malanotte-Rizzoli et al.

Anonymous Referee #3

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The authors draw a very extensive synthesis on current advances in the Mediterranean dynamics and enlighten the issues that have to be addressed for future research programs. The paper is well documented and clearly written. The strengths of the manuscripts are numerous : The scales of variability of Mediterranean circulation together with the spatial / temporal variability induced by EMT / WMT events are very well described and the authors have proposed many directions for both observing and modeling these changes. The same comment can be done for shelf/slope and open sea circulation and dense water formation. Several observational programs are on the way

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to be set in the Mediterranean Sea and converge with the views developed in this paper, which is particularly thrilling for most readers. The atmosphere – sea coupling though climatic forcing is also well documented in the manuscript and the key questions related to SST and salinity changes are addressed. This paper will help the Mediterranean scientific community to better define the needs for observations and models in resolution and frequency. For the above mentioned reasons, I would underline the importance of this paper and the need for its publication. However, I also have some concerns, that I suggest the authors to address. The main weakness lies in the references on the key interactions between physics and biogeochemistry in the Mediterranean Sea. No mention of MERMEX group paper was done (MerMex group, (2011). Marine Ecosystems Responses to climatic and anthropogenic forcings in the Mediterranean, Progress in Oceanography, 91 : 97-166.), and the paper would benefit from it, as one of the goal of this synthesis, as underlined in the conclusion, is to gather all the “Mediterranean” scientists together for multidisciplinary and multinational programs in order to better address the key questions for future research in the Mediterranean Sea. A few more comments are suggested in the next section. Specific comments Section 2.3. Forcing and variability in the stock of nutrients (p.1216-1219) I would suggest another specific issue regarding the changes in nutrient stocks : exchange flux between shelf (under high anthropogenic pressure, e.g. waste and industrial waters enhanced in nutrients) and open sea waters. These fluxes are strongly related to the shelf – open sea circulation, and represent an issue addressed by MERMEX/MISTRALS project. Section 2.4. Modeling and assessing ecosystems (p.1221) Point 4 of specific issue. I’m not sure that O₂ vertical structure, showing no real minimum is only related to a small export. I would suggest that a strong O₂ penetration led by anticyclonic meanders would explain it (as well as low nutrients in basin interior). Section 3.7. Carbonate system (p. 1247) 1) Another specific issue is related to surface pH. How CO₂ penetration affects surface pH with time ? And how pH changes, in turn, affect bioavailability of micronutrients, metal speciation and the related food webs ? 2) Ait-Ameur and Goyet (2006) have proposed an estimate of the anthropogenic carbon that outflow the Mediterranean Sea

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at Gibraltar strait. Although I agree that the physical-biochemical variability requires some kind of monitoring, this paper should be mentioned (Aït-Ameur and Goyet, 2006, Distribution and transport of natural and anthropogenic carbon in the Gulf of Cadiz, Deep-Sea Research II, 53, 1329-1343) 3) (p. 1249) Suggested specific issue: monitoring surface pH changes with current pH sensors in key Mediterranean ecosystems. Section 3 and 4. SOCIB observational system is mentioned p.1253. In no part of the manuscript, I have seen MOOSE observational system cited. It is an important program that aims at addressing most of the key issues that arise in your manuscript. It has been developed a few years ago and is now operational in the liguro-provençal basin (mio.pytheas.univ-amu.fr/moose/).

Technical comments: - P.1212 line 7 : Strait instead of Straits - P.1221 line 27 : syntax "surface waters both sub-basins" - P.1236 line 10 : EMed instead of EMED - P.1246 line 19 : cycle instead of cycles

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