

## ***Interactive comment on “Sea surface salinity variability from a simplified mixed layer model of the global ocean” by S. Michel et al.***

### **Anonymous Referee #5**

Received and published: 13 February 2007

Title: Sea Surface Salinity Variability from a Simplified Mixed Layer Model of the Global Ocean by: S. Michel, B. Chapron, J. Tournadre, and N. Reul

### **GENERAL COMMENTS**

This manuscript deals about the reconstruction of balanced SSS fields in order to evaluate the importance of different mechanisms affecting the evolution of SSS at a global scale. This is done via a two step process: First, they invert the ocean’s MLD from heat fluxes, the Ekman and Geostrophic components of ocean currents and observed SST and thus, they use freshwater fluxes, ocean currents and the MLD to evaluate the terms of an equation of conservation of SSS. Understanding of the sources of salinity variability is of great interest in ocean sciences (ocean dynamics, ocean biology, and

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climate studies).

However, the authors fail on several issues. The one this reviewer is concerned the most is the fact that the inversion process focuses on reconstructing and validating the MLD. But one of the processes affecting the most the variability of SSS is advection. There is no validation at all about the quality of the velocity fields used in this study. Without validation of the currents, the results lack of robustness. On the other hand, the equatorial regions are not considered here. A global study should really consider these regions. The authors recognize the possibility of extending their work to these regions (see for example Durand and Lagerloef, JPO, 2002). Including the equatorial region will clearly differentiate this work from the previous works that have used the same model as, for example Mignot and Frankignoul (2003). Moreover, when applying the model on the equatorial region, the model has to take into account the penetration of light, as the equator is one of the regions where the correct heat balance requires the explicit consideration of the attenuation of solar radiation (Murtugudde et al., JCLI, 2002).

Because of the lack of the validation of ocean currents affecting SSS balances, the lack of equatorial regions, and the numerous editing problems of the manuscript lead this reviewer to suggest the editor not to consider this manuscript for publication in its current form but strongly encourages the authors to resubmit a more complete version of this work because of its intrinsic interest.

#### ADDITIONAL COMMENTS

Page 41. The time scales at which this manuscript refers should appear on the title of the manuscript.

Page 42. Sentence “The model is based on the ..., which allows many simplifications in the vertical mixing representation”. The question: Who is first the model or the simplifications ? The validity of the model depends on the validity of these simplifications.

Page 43. Sentence “As CO<sub>2</sub> solubility ... “. Make that statement clear.

Page 43. Change “The present knowledge of global SSS is limited ...” to become “Present knowledge of SSS has been limited ...” . The manuscript says nothing about the new source of knowledge of salinity as are Argo floats.

Page 44. Sentence “the estimation of uncertainties (for the error covariance ...)”. Is it “for” or “from”?

Page 44. Change “larger uncertainties” to become “large uncertainties”.

Page 44. Change “forced continuously” to become “continuously forced”.

Page 44. Last paragraph. This is the place where the GOAL of the manuscript appears. Question: What is the goal of the manuscript? To introduce the MLD model (already used by other authors) or to get new knowledge about salinity (in that case, what are the novelties by respect what is discussed by Mignot and Frankignoul (2003) ?)

Page 45. The horizontal scale of 1 degree is said to be “rather fine”. Previously the same resolution is hinted to be coarse. In page 48 it is said, about the same resolution, “relatively coarse”.

Page 45. “This study focuses on the SSS variability ... time scales from days to years.” The manuscript does not deal with interannual variability.

Page 45. Change “Which processes dominate ...” to become “What processes dominate ...”.

Page 45. About the question “What is the relative importance of surface forcing and deep processes?” Is your subsurface data good enough to answer this question?

Page 45. Where in the manuscript it is discussed the “poorly sampled regions”?

Page 46. Mignot and Frankignou reference missing.

Page 46. From the sentence “The equations governing T and S evolutions ...” remove

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“evolutions”.

Page 47. There are regions of the oceans where the dept of attenuation of radiatin compares with the depth of the mixed layer.

Pag 47. The horizontal advection is separated on two components (Ekman and geostrophic). In the OSCAR ocean current product, there are four components (Ekman, geostrophic, Stommel and horizontal buoyancy gradient). Discuss.

Page 47. Density appears sometime as  $\rho$  and sometimes as  $\rho_o$ . Unify notation.

Page 49. The statement “Another important characteristic of the model is that it does not require a turbulent closure equation”. Equations (1) and (2) contain an explicit turbulent closure approach.

Page 49. “By definition, variation in thermohaline properties ... are ... small”. Are you talking about vertical variations?

Page 51. What equation refers to the time step of h?

Page 53. Explain how can you get unstable stratification with your model?. Are you fixing a deep density or a deep temperature and salinity?

Page 54. Even if reconstructed fields have the same order of magnitude, that does not mean that errors can be as large as the signal !

Page 56. The results presented here are, sometimes, referred as “model” and sometimes as “simulation”. Unify notation.

Page 78. Change “missing process” to become “missing processes”.

Page 78. Change “strong salinity decrease” to become “strong freshening”.

Page 79. After “ECMWF model, caused”, remove the dot

Page 86. The term  $\partial_T h$  should be  $\partial_t T$

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Page 86. %delta\_x should be replaced by %Delta x.

Page 90. The reference Pavia and Chassignet should be for year 2001.

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