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Interactive comment on “A generic approach to explicit simulation of uncertainty in the NEMO ocean model” by J.-M. Brankart et al.

J.-M. Brankart et al.

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Received and published: 26 March 2015

We thank the reviewer for his/her careful reading of our paper, and for his constructive suggestions to improve the quality of the manuscript. They have been carefully taken into account as explained below.

Concerning comments 1 and 5 by reviewer #1, please see our answers to his/her comments.

Thank you also for the additional literature, they have been added in the paper as a complement information. In particular, the reference to Palmer et al. (2014) has been used to answer to the first comment of reviewer 1; the reference to Palmer et

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al. (2001) has been used as an additional reference to the development of stochastic parameterization in meteorology; and the reference to Palmer et al. (2008) has been used as an additional reference to the implementation of stochastic parameterization at ECMWF.

Concerning the stochastically perturbed backscatter of kinetic energy, we agree that it should be mentioned in the paper, and that there could be some ways of using it in ocean models (even if we have not investigated this possibility). The following text has been added at the end of section 2.3: “Before concluding this section, it is important to remember that the above discussion only provides one possible framework for simulating the effect of unresolved fluctuations, and that other approaches can be imagined. For instance, a specific stochastic parameterization is already routinely applied at ECMWF to simulate the backscatter of kinetic energy from unresolved scales to the smaller scales that are resolved by the model (Shutts, 2005). This scheme has been developed for atmospheric applications but might also be applicable to ocean models.(...)”

Concerning unresolved biologic diversity, we have tried to give more background information, with an additional reference (see also answer to comment 5 by reviewer 1). The following text has been added to the paper: “On the one hand, the most common simplification in biogeochemical model (Le Quéré et al., 2005) is to aggregate the biogeochemical components of the ocean in a limited number of categories (defining system $\mathcal{A}$ in Fig. 1). This reduces the number of state variables and parameters, and introduces uncertainties in the model equations since the various components included in one single category (unresolved diversity, in system $\mathcal{B}$) do not usually display the

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same dynamical behaviour. To simulate this first class of uncertainty, we will use (...)”.

Typos have been corrected. Thanks.

Additional references:

Le Quéré C., S. P. Harrison, I. C. Prentice, E. T. Buitenhuis, O. Aumont, et al. (2005). Ecosystem dynamics based on plankton functional types for global ocean biogeochemistry models. *Global Change Biology*, 11 (11), 2016–2040.

Palmer, T. N. (2001). A nonlinear dynamical perspective on model error: A proposal for non-local stochastic-dynamic parametrization in weather and climate prediction models. *Q.J.R. Meteorol. Soc.*, 127: 279–304. doi: 10.1002/qj.49712757202.

Palmer, T. N., R. Buizza, F. Doblas-Reyes, T. Jung, M. Leutbecher, G.J. Shutts, M. Steinheimer and A. Weisheimer (2009). Stochastic parametrization and model uncertainty. ECMWF Tech. Memo. 598, 42pp.

Palmer, T. N. P. Düben , H. McNamara (2014). Stochastic modelling and energy-efficient computing for weather and climate prediction, *Phil. Trans. A*, 372, issue 2018.

Shutts, G. (2005). A kinetic energy backscatter algorithm for use in ensemble prediction systems. *Q.J.R. Meteorol. Soc.*, 131: 3079–3102.

Interactive comment on Geosci. Model Dev. Discuss., 8, 615, 2015.