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Interactive comment on "The Fate of a Southwest Pacific Bloom: Gauging the impact of submesoscale vs. mesoscale circulation on biological gradients in the subtropics" *by* Alain de Verneil et al.

Anonymous Referee #2

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In this manuscript, the authors use hydrographic data as well as remotely sensed data to describe the evolution of a phytoplankton bloom which was observed during an oceanographic cruise. In-situ data used in this study comes from 3 stations, S12, LDB and SD13, which were taken from Mar 11 thru Mar 21 2015. The authors conclude that the mesoscale eddy field is responsible for the horizontal advection of the bloom and do not find submesoscale motions to be relevant in the study region during that period, as diagnosed from the gradient and the balanced Richardson number.

The manuscript is well written and describes in detail the analysis and how the authors

base their conclusions. At times, though, it reads much like a cruise report. I believe the authors could be more concise and to the point.

My main concern about the manuscript is what is exactly new in this study. The authors rule out the role of submesoscale motions in the horizontal distribution of the bloom. However, the main role of such motions in oligotrophic regions would be to ignite surface chlorophyll blooms by supplying limiting nutrients to the surface. This would occur, by definition, at the onset of the blooms. The in-situ sampling in the study took place from Mar 11 to Mar 25, when the bloom, as seen from the satellite images (Fig. 6) was relatively mature.

The authors point out that it probably started on the previous December in the vicinity of an island. They are probably correct that some type of island-induced fertilization occurred, thus alleviating nutrient limitation (Dore et al. 2008), with chaotic advection transporting material over long distances, as shown previously (Rypina et al 2010). However, with the evidence shown it is not possible to infer if submesoscale processes were at work at the beginning of the bloom. Also, Law et al. 2011 report high rates of nitrogen fixation in an oligotrophic region after the passage of a tropical cyclone, which supposedly fertilized the ocean prior to a bloom. Strong winds may or may not be important for the ignition of the observed bloom, but the authors do not mention anything about it. The horizontal evolution of the bloom is most likely controlled by mesoscale currents, as shown in previous studies (Calil et al. 2011).

The authors claim to use a formulation from Thomas et al. 2013, based on the balanced Richardson number, to determine "how submesoscale the observed velocity shear is". However, the criteria described in Thomas et al. 2013, as seen by the pie chart in their Fig. 1, characterizes the flow as stable or unstable to a number of instabilities. Moreover, it considers the relative vorticity of the flow field. Therefore, while I don't think submesoscale processes were at play during the survey, this diagnostic by itself is not fully accurate for the purposes intended in this study and may be misleading for readers.

As a general comment, it has long been recognized that subtropical gyres, despite their low biomass, are far from being “oceanic deserts” (Emerson et al. 1997) as they are responsible for approximately half of the export of organic carbon of the oceans.

An additional comment: the authors tend to use sentences such as “investigators often espouse the assumption that” or “which are what most investigators focus on”. These sentences, without specific references are vague and unfit for a scientific paper. The authors should explicitly cite the works or assumptions they are supposedly challenging or simply remove these sentences.

References

Calil, P. H. R., S. C. Doney, K. Yumimoto, K. Eguchi, and T. Takemura (2011), Episodic upwelling and dust deposition as bloom triggers in lowâĂŘnutrient, lowâĂŘchlorophyll regions, J. Geophys. Res., 116, C06030, doi:10.1029/2010JC006704

Dore, J., R. Letelier, M. Church, R. Lukas, and D. Karl (2008), Summer phytoplankton blooms in the oligotrophic North Pacific Subtropical Gyre: Historical perspective and recent observations, Prog. Oceanogr., 76, 2–38.

Emerson, S., P. Quay, D. Karl, C. Winn, L. Tupas, and Mo Landry. "Experimental determination of the organic carbon flux from open-ocean surface waters." Nature 389, no. 6654 (1997): 951-954.

Law C.S. , Woodward E. M. S. , Ellwood M. J. , Marriner A. , Bury S. J. , Safic K. A. , (2011), Response of surface nutrient inventories and nitrogen fixation to a tropical cyclone in the southwest Pacific, Limnology and Oceanography, 56, doi: 10.4319/lo.2011.56.4.1372.

Rypina, Irina I., Lawrence J. Pratt, Julie Pullen, Julia Levin, and Arnold L. Gordon. "Chaotic advection in an archipelago." Journal of Physical Oceanography 40, no. 9 (2010): 1988-2006.

Thomas, L. N., Taylor, J. R., Ferrari, R., and Joyce, T. M.: Symmetric instability in

the Gulf Stream, Deep Sea Research Part II: Topical Studies in Oceanography, 91, 96–110, 2013.

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