Biogeosciences Discuss., 7, C4172–C4176, 2010
www.biogeosciences-discuss.net/7/C4172/2010/

Biogeosciences Discussions

Interactive comment on "Silicate:nitrate ratios of upwelled waters control the phytoplankton community sustained by mesoscale eddies in sub-tropical North Atlantic and Pacific" *by* T. S. Bibby and C. M. Moore

Anonymous Referee #1

Received and published: 3 December 2010

General comments

Many studies in the past have provided evidences that mesoscale and submesoscale turbulence influences marine biogeochemistry on a wide range of timescales. In the Sargasso Sea, cyclones and mode-water eddies (MWE) have been hypothesized to stimulate a biological response. However, recent studies indicate that only MWE can sustain large-diatom communities. In contrast to the pattern observed in the North Atlantic Subtropical Gyre (NASG), high abundance of large diatoms has been described in cyclonic eddies studied in the North Pacific Subtropical Gyre (NPSG). The reason

for the different phytoplankton communities observed in cyclonic mesoscale features in NASG and NPSG remains enigmatic so far.

This paper hypothesizes that the phytoplankton community structure in mesoscale eddies is predetermined by the relative abundance of silicate over nitrate (Si*) in the upwelled waters. According to the authors, MWE in NASG and cyclonic eddies in NPSG upwell Subtropical Mode Water (STMW) and North Pacific Intermediate Water (NPIW), respectively, both characterized by relatively high Si*. In contrast to the Pacific, cyclonic eddies in the Sargasso Sea upwell Sub-Antartic Mode Water (SAMW) characterized by negative values of Si*. In order to verify their hypothesis, the authors analyze nutrients and pigments data from specific cruises carried out in NPSG (E-Flux) and NASG (EDDIES) to investigate mesoscale physical–biological–biogeochemical linkages. Finally, in order to verify the pattern described from the EDDIES data, they analyse nutrients distribution at eddy features affecting the BATS site for the period 1993-2002.

My main concern about the paper is that the authors have not performed any water masses analysis and therefore they have not provided evidences for the type of water mass being uplifted in each eddy type. As far as I know the water mass of Hawaiian lee eddies consists mainly of Subtropical subsurface waters (STSW) that are uplifted into the surface (Kuwahara et al. 2008), whereas NPIW resides deeper on the isopycnal surfaces of ïĄşïĄś = 26.7-26.9. Moreover the authors indicate that the analysis of BATS data confirm the trend observed during the EDDIES cruises (Figure 3). However, higher Si* in MWE is only observed below 200 m, which is deeper than the deep chlorophyll maximum, and therefore is not affecting the phytoplankton communities at this depth.

I considered that they authors have proposed an interesting hypothesis to explain the different biological responses that characterized each eddy type. This point is crucial to understand the role that these features play in the marine global biogeochemical cycles. However, in order to verify their hypothesis they need to identify and characterize the different water masses upwelled by each eddy type. In general the paper is

well-written and the information well organized.

Detailed comments

Page 7506, lines 5-6. Many evidences indicate that mesoscale eddies stimulate phytoplankton communities, however their role in export fluxes is controversial.

Page 7506, line 9. BATS is Bermuda Atlantic Time-series Study.

Page 7507, lines 8-10 "...estimates of export flux made locally are in excess of geochemical estimates (Jenkins et al., 1988). " I believe that it is the other way (geochemical estimates higher than in situ measurements).

Page 7507, line 10 "...Three main types of mesoscale eddies have been studied..." (indicate in the Sargasso Sea)

Page 7507, line 12 exchange "nutricline" by "seasonal thermocline"

Page 7507, lines 13-15 "MWE and cyclonic mesoscale eddies can lift macronutrients into the euphotic zone and stimulate a biological response in the phytoplankton community, leading to enhanced export (McGillicuddy et al., 1999).". No enhanced in export is shown in McGillicuddy et al. (1999).

Page 7508, lines 19-21 "A potential mechanism that has been proposed to account for the magnitude of biological response between MWE and cyclonic eddy communities in the Sargasso Sea involves the effects of wind stress." modify to "A potential mechanism that has been proposed to account for the different biological response in MWE and cyclonic eddy communities in the Sargasso Sea involves the effects of wind stress."

Page 7509, lines 3-8 "The global distribution of Si* indicates that Sub-Antarctic Mode Water (SAMW) acts as a significant source of nutrients to the thermocline in the North Atlantic, whereas North Pacific Intermediate Waters (NPIW) play a more important role in thermocline nutrient supply in the Pacific (Sarmiento et al., 2004); recent modelling studies further support this suggestion (Palter et al., 2010)." Here and though the ms

try to shorten sentences.

Page 7511, lines 8 "...contribution of diatoms to total phytoplankton community...âĂć

Pages 7511, "Only eddy features that exhibited a strong signal, that affected the BATS site for relatively long periods of time, and were influenced by the centre of the eddy features were used in this previous analysis (Mourino-Carballido, 2009).". Eddy features reported in Mouriño-Carballido (2009) include BATS samplings affected by the centre of the eddy features but also those samplings affected by eddy features but not located at the eddy centre. The source for the eddy features used in this study should be clarified.

Pages 7512, lines 12-14. These are approximate locations, do not use four decimal units for latitude and longitude. Why using cyclonic eddy C5 as a representative feature instead of cyclonic eddy C1 that was intensively investigated in summer 2004?

Page 7513, lines 5-9. Shorten sentence. Is phytoplankton biomass at C5 in excess of what is normally measured at BATS?

Page 7514, lines 13-15 "Anti-cyclonic eddies, although not considered in this paper, generally support low biomass phytoplankton communities dominated by Prochlorococcus ecotypes." Include reference for this.

Page 7514, lines 24-25. In order to probe that cyclones and MWE upwell different water masses the authors need to perform a water mass analysis.

Page 7514, lines 26-27. The influence of eddies at BATS is inferred from altimetry and hydrographic data.

Page 7514-7515, lines 29-2. Indicate the criterion used to define the nutracline. Why Si* at surface waters in the Pacific is lower than Si* at the waters upwelled by the eddies.

Page 7515, lines 2-6 "At depths below 100 m, Si* becomes negative (Si*=0 is shown in

Fig. 3a and d as a vertical dotted line), and from the nutracline to ïĄ¿500m Si* is more negative in cyclonic features than MWE features, indicating that the trend observed in the EDDIES program (Fig. 1) is consistent with mesoscale features sampled over the past decade at the BATS site."

Figure 3 shows that Si* became clearly negative below 200 m what is deeper than the DCM. Which is the criterion used to define the nutracline? Below 200 m, the pattern of Si* being more negative in cyclones than MWE extends deeper than 500 m.

Page 7515, line 13 "While this is clearly the case..." explain what this sentence refers to.

Page 7515, line 22 "a mechanism of enhanced nutrient..."

Page 7516, lines 5. Nitrate concentration are detectable in the euphotic layer, indicate what surface layer refers to.

Page 7516, line 20 "Moreover, cyclonic eddies in the NPSG have a higher Si*". Higher than what? Specify.

Page 7517, line 14. Give a better reference for this.

Page 7517, line 25 Krause et al, 2010

Page 7521, line 12 BATS (instead of bats)

Figure 1d. High surface values shown in this plot contradict the pattern shown in Bibby et al (2008). I recommend not to show chla in a log scale.

Legend: "Cyclonic eddy Opal was sampled close to Hawai'i in the NPSG, while cyclonic eddy C5 and MWE A4 were sampled in the Sargasso Sea NASG, at similar times of year." Similar for the three eddies?

Interactive comment on Biogeosciences Discuss., 7, 7505, 2010.