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## ***Interactive comment on “Impact of dust deposition on Fe biogeochemistry at the Tropical Eastern North Atlantic Time-series Observatory site” by Y. Ye et al.***

### **Anonymous Referee #2**

Received and published: 22 June 2009

This is an interesting paper and should be published, however some reorganization and editing of the text would make the paper easier to read and therefore higher impact.

1. Please include all model description and sensitivity study descriptions in the methodology section.
2. Please be clear about when and how you are comparing to observations, and make these comparisons easier to follow.
3. Please be clear about what are new model elements and results in this paper, compared to previous papers.

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Your abstract really only talks about the model, and perhaps that's all you can talk about. But if you can show that your model represents reality, then you can infer something about the real world. So showing more obs/model comparison is very important.

Also, please think about demonstrating more clearly that your hypotheses are the BEST hypotheses: e.g. other hypotheses contradict the few observations we have. This is not always argued very clearly in the text. I try to highlight below where I see obvious improvements can be made.

sentence fragment: "To provide a better understanding of this complex, several numerical models"

"by choosing a slightly different turbulence parameter-isation, and a slightly different time/space discretization.": . It makes sense to do this, but please just describe better: either the basis of these changes (more mixing because we know there's more mixing based on study blah), and/or the exact values.

1st paragraph, section 2.2: you describe 5 different iron species: please tell us, are these the standard species? Are these the ones measured in the field? Are these similar or dissimilar to obs?

"Here we chose the rate for colloid re-dissolution from Rose and Waite (2003b) ( $k_{cd}=0.41 \text{ d}^{-1}$ ) and assumed a rate for re-dissolution of particulate iron to ensure that the flux from particulate to colloidal pool is in the same order of magnitude as colloidal aggregation ( $k_{pd}=1.5 \text{ d}^{-1}$ )."

Is this a new value or a new process? Please tell us why are changing things.

"1% solubility (Johansen et al., 2000; Spokes and Jickells, 1996; Baker et al., 2006a,b)." 1 % solubility is good for close to dust regions, as you are here: please indicate that you are reasonable for this reason.

"Particles in our model are split into four classes by their composition and size: 1) 20 small detritus; 2) fine terrigenous material deposited by Saharan dust events; 3) large,

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pure organic aggregates and organic material in mixed aggregates; and 4) terrigenous material in mixed aggregates. This classification is based on the size distribution of sinking particles at the TENATSO site (see Sect. 4.4 Removal of dissolved iron). Two different settling velocities are assumed for the small organic and inorganic particles (1) 25 and 2), and the aggregates (3) + 4), respectively. Particle aggregation is described as coagulation between small particles. Parameterisation and choosing of the rates and constants are explained in detail in Sect. 4.4. “ why is the model description in a results section? It makes much more sense to put it in the model description section.

“The modelled chlorophyll a concentration in surface waters is between 0.2 to 0.45  $\mu\text{g L}^{-1}$  and consistent with the observations at the TENATSO site or during cruises past the Cape Verde Islands, which vary from 0.06 to 0.7  $\mu\text{g L}^{-1}$  (Cruise data of POS 320/1, POS 332, Meteor 68/3, POS 348/2, Merian, 20 April 2008, L. Cotrim da Cunha, personal communication). Between March and November, a deep chlorophyll maximum with values around 0.4  $\mu\text{g L}^{-1}$  develops at the depth of nutricline near 70m. Primary production in the model shows a strong daily, but only a weak seasonal variation, with an annual average of 660  $\text{mgCm}^{-2} \text{day}^{-1}$ . Primary production estimated from MODIS data, using the algorithm by Behrenfeld and Falkowski (1997) averages to 470  $\text{mgCm}^{-2} \text{day}^{-1}$  for the  $1 \times 1$  square around the TENATSO station and the period 5 from July 2002 to December 2007. Phytoplankton growth is limited by nitrogen rather than iron from surface to the depth of the deep chlorophyll maximum. The lowest value of the nitrogen limiting factor  $f_N$  is around 0.3 found in surface waters during phytoplankton blooms in summer and autumn.” Here you are showing that your biological model has some validity. It’s probably worth a figure or two, to show what you are doing. Also, is the model N limited? Is that consistent with obs?

What is equation 2? Is this a model equation or observed equation? If it is a model equation, please put it in the model description. Please be sure to define all the terms in the equation, and tell us why you are showing the equation – I’m a bit lost here.

“The modelled DFe concentration ranges in the same order as observations (Fig. 3).”

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Is some of this scatter due to seasonal variability? It would seem better to show us seasonal variability of both models and obs, or is it not variable? This, especially, would seem to be an important figure to compare in detail to the very limited observations.

Section 4.2: if CDOM is important, could you make sure you indicate whether your CDOM amounts match obs?

“We considered the role of copper in the same way like Weber et al. (2005).” Replace like with as.

Section 4.2: Does the inclusion of Cu improve your model? Or do you not know because you have not enough obs? Please indicate in the text what the conclusions are from these sensitivity tests.

“Our modelled concentration of total strong ligands (Fig. 7) is close to the measured 20 data by Rue and Bruland (1995).” Please put their data on the plot.

“Contrary to the observations, modelled weak ligands decrease exponentially with depth below its maximum at 90m and reach a relatively low concentration below 300m ( $\sim 0.4 \text{ nmol L}^{-1}$ ).” Which obs? Please indicate on plot, if possible. The readers need to know also how many/few obs we are talking about, and where they are from.

“For further sensitivity studies of our model we have therefore introduced a restoring of the concentration of total weak ligands towards  $2 \text{ nmol L}^{-1}$ , a commonly observed value in the deep ocean, throughout the water column with a rate of  $0.1 \text{ d}^{-1}$ , in order not to affect iron speciation and losses by too little complexation. This restoring is weak enough so that loss processes near the surface (biological uptake and photochemical decay) still lead to the observed vertical gradient of total weak ligand concentration there.” What is the result of these sensitivity studies? Usually sensitivity studies are described in the model methodology section, and the results are described in the results section.

Most of section 4.4.1 should be in the methods section: only the results should be in

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the results section.

Figure 15 should be referenced after Figures 12-14.

Maybe you should make a table of the sensitivity studies, so that it is clear what you have looked at in more detail?

“Despite the simplicity of the NPZD-type ecosystem model, observed chlorophyll a concentration and seasonality of primary production at the TENATSO site are well 20 reproduced.” If this is in the conclusions, you definitely need to show it in the paper.

“This double role of dust deposition should be taken into account in investigating the impact of varying dust deposition on Fe speciation and biogeochemistry.” Is this the first paper to argue this?

In the conclusions, please be sure to differentiate new results from this study, from previously found results.

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**BGD**

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