

Interactive comment on “Isotope data improve the predictive capabilities of a marine biogeochemical model” by T. Van Engeland et al.

Anonymous Referee #3

Received and published: 20 September 2012

This manuscript describes methodology to analyze changes in model performance due to additional observational data, in this case stable isotope tracer data. The model is an extended NPZD model applied to a mesocosm experiment conducted to study the effects of ocean acidification on the planktonic ecosystem.

General comments:

The methodology is carefully and adequately presented. However, several issues were introduced in different sections and then not adequately followed up, with the overall impression of the authors not exploring in enough depth issues that had been raised.

Three examples:

- (i) In the Abstract, the authors state that "...overparameterisation ... led to uncon-
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strained fluxes through the zooplankton and detritus compartment, ...", yet this result is presented later with little elaboration. On p. 9468 we are referred to Fig. 5m,p and Table 4, yet I see nothing about zooplankton in either place. (ii) On p. 9458 (l. 22) the authors state that "Fixed C:N ratios (Redfield) are implemented" without further comment. It is well-known that under many conditions, C:N ratios vary over time. This is a usual assumption, but one would think that a mesocosm experiment might be a place where changing C:N could be explored, or at the very least previous studies might be cited to justify this assumption for mesocosm studies. (iii) With regard to Model Sensitivity, equation (1) on p. 9461 and the sentence on p. 9462 (lines 2-4) "The overall result of such a sensitivity analysis is a sensitivity matrix, in which each column represents the temporal evolution of all the variable sensitivities to a specific parameter." suggest intriguing results, i.e. under what conditions is the modelled system most sensitive to certain parameters and their values. However, the only result along this line is Figure 6, whereas it seems this is an area of results that should be presented and discussed in greater detail. So, overall I felt that the manuscript is technically adequate, but that several potentially interesting results are presented superficially.

I usually read a manuscript first without reading related manuscripts because I feel that each manuscript should stand on its own. So when I read the comments of Referee #2, the problem became clearer to me: this manuscript is meant to describe the methodology while the de Kluijver et al. manuscript elaborates on the scientific results. One additional comment supporting this statement is that the Conclusions are a general discussion of the philosophy of ecosystem modelling with essentially no reference to any specific results of this manuscript, suggesting again that it is basically a methodology description to support the de Kluijver manuscript. Referee #1 voices similar concerns: "The strength of the isotope data is that they contain information about the fluxes among different components of the plankton system, but this fact is only vaguely hinted at in the manuscript". Overall, I basically agree with Referee #2 in questioning whether this manuscript is adequately complete to stand on its own. If the two manuscripts are to remain separate, then I would recommend that this manuscript

(with corrections to the many minor technical issues) remain only as a Discussions contribution.

Specific comments:

p. 9455, l. 12 – 'the parameter values are modified until the model output matches the data'. This is not an accurate statement, since the process minimizes a 'cost function' which is a normalized measure of deviation from the data. In some cases, the parameters cannot be adjusted to get a 'close' fit to the data.

p. 9456, l. 3 – change 'amount' to 'number'

p. 9456, l. 10-15 – it is not clearly stated here what assumption about fractionation is being made.

p. 9456, l. 17 – change to 'Several deliberate tracer studies have shown ...'

p. 9457, l.3 – 'indistinguishable'

p. 9457, l.18 – this sentence restates what was said at the beginning of the previous paragraph (l.4)

p.9457, l.22 – change to '... were maintained at different pCO₂ levels, representing potential future ...'

p.9458, l.2 – please explain what you mean by 'at AN enrichment level of 100' ppt.

p.9458, l.11 – change 'obtained' to 'obtained'

p.9459, l. l. 17-18 – 'This implies that the phytoplankton mortality rate was strongly time dependent', but this issue is not really mentioned again. In Figs. 3 and 4, mortality is highly correlated with maximum growth rate for both groups (Fig. 4) and for group I only (Fig. 3). What does that mean – that maximum growth rate is also highly variable? The only other mention that I could find (p.9466, l.5) was that there was that a relatively weak correlation remained for group I between maximum growth rate and mortality.

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p.9460, l.7-9 – what is the justification for giving the different phyto groups different maximum growth rates but the same half saturation coefficient for DIN uptake? Usually the small phyto would have a smaller half saturation coefficient, so they out-compete for nutrients at low nutrient concentrations.

p.9460, l.10 – change 'split up over an input' to 'partitioned into an input ...'

p.9460, l. 16 – change 'subdivided over' to 'partitioned into'

p.9462, l. 11 – change 'we can ...data' to 'is it possible to change the parameter to improve the model fit to the data'

p.9463, l. 18-20 – it would help to include the mathematical expression for the cost function

p.9464, l. 1-2 – 'such that each parameter represented exactly one transformation in the model'. What do you mean by this? A mathematical transformation? Or do you mean a change in state or flux of an element between compartments, say DIN to cellular N in phytoplankton after photosynthesis? I am puzzled.

p.9466, l.1 – I am not clear what you mean by 'parameter randomisations'

p.9466, l. 5 – change 'week' to 'weak'

p.9467, l.1 – change 'out of ' to 'from'

p.9468, bottom – delete 'coloured'; 'solid' is sufficient and the blue is so dark as to be nearly black in my document.

p.9470, l.14 – change to 'data are', the singular form is 'datum'

Interactive comment on Biogeosciences Discuss., 9, 9453, 2012.

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