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# ***Interactive comment on “The ecological module of BOATS-1.0: a bioenergetically-constrained model of marine upper trophic levels suitable for studies of fisheries and ocean biogeochemistry” by D. A. Carozza et al.***

## **Anonymous Referee #1**

Received and published: 24 December 2015

**General Comments** This paper documents a new, computationally efficient, global-scale model of fishery biomass. The model allows fishery scientists to evaluate the impacts of climate change and fishing on commercially valuable fish biomass at a global scale. Model structure is well detailed and the parameters are both well defined and sufficiently supported. The model is size structured and resolves three groups of commercially available biomass. Growth and mortality are based on life history traits. The model is driven by the two factors that most directly influence marine biomass and growth, food availability (here, net primary productivity) and temperature, thus captur-

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ing the major influences while avoiding being overly complex. The input can be either empirical (e.g., satellite remotely-sensed) or modeled (e.g., climate model) data. The ecological component of the BOATS model is discussed in this paper, though the full BOATS model includes economics and fishing mortality. Though not discussed in this paper, these features (and most specifically the economic component) contribute to the novelty of the model.

As with any model, a number of simplifying assumptions are made in constructing BOATS. These assumptions are discussed in detail throughout the paper and supported, where possible, by the literature. A number of assumptions are made in an effort to avoid over parameterizing the model, which seems reasonable. There are a few aspects of the model that I have questions about, as well as a few minor technical corrections. These questions and corrections are detailed below.

Overall, this contribution is well presented and is of high scientific quality and significance. The authors provide a link to the model code allowing others to reproduce their results and use the model for their own research.

Specific Comments -The introduction provides a good background and motivation for developing the model. It also clarifies the novel aspects of this approach (computationally efficient, includes an economic component, requires minimal inputs and parameters, global scale).

-The spatial scale (1 deg x 1 deg) aligns well with climate model output, which adds to the model's utility. The use of mass rather than length to determine organism size also adds to the model's utility as fishery catch is most often reported by weight.

-Page 10147, line 19: Consider rewording "has the potential to transform" to something more definite as we're already seeing impacts of climate change on temperature distribution (e.g., Pinsky et al. 2013 Science, Walsh et al. 2015 PLoS ONE).

-Page 10150, lines 24 – 26: Consider stating that these three groups are independent

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Interactive Discussion

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“species groups” and that fish don’t grow into the next larger size spectrum. In other words, “small” consists of fish that remain small throughout their life history and not the juveniles of “medium” and “large”. This becomes clear later in the paper, but it would eliminate confusion by clarifying early on.

-Page 10152, first paragraph: I have trouble seeing where this paragraph is going. Is it providing support for making biomass a function of net primary production? Please clarify.

-Section 2.1: Why is the time increment per second? This seems quite fast.

-Page 10154, lines 11 – 13: What specifically prevents a buildup of biomass at the largest sizes in each spectrum? Also, would fishing mortality come into this mortality term, or would it be an additional term in eq. (1)? You don’t need to go into detail about how fishing mortality is included, but it would be helpful just to note where it enters.

-Section 2.5: I’m unclear whether phytoplankton size structure influences fish size structure. How would a shift towards smaller or larger phytoplankton impact the fish spectra?

-Section 2.6, final two paragraphs: I have a hard time with the lack of predation-dependent mortality, especially in a model that aims to investigate fisheries. It doesn’t sound like the model is able to capture top-down impacts. For example, if there’s a heavy removal of larger sizes (say, though fishing) would smaller sizes increase in abundance as a result of reduced predation? Maybe this is captured through the mechanism discussed on page 10158, lines 1 – 4? Also, the final sentence of this section seems to contradict the rest of the paragraph. Please clarify the example you’re giving with a bit more detail.

-Page 10169, lines 2 – 29 and page 10170, lines 1 – 4: Consider condensing these paragraphs considerably. I don’t think it’s necessary to delve this far into the details of satellite estimates of NPP in this paper. After all, as you state, you could force the

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Interactive Discussion

Discussion Paper



model with some other source. It seems sufficient to treat discussion of your NPP input as you do your discussion of temperature input.

-Page 10173, line 11: Your definition of the intercept here is different from that on page 10172, line 1. Is this intentional? If so, why use two different definitions?

-Page 10174, lines 1 – 3: The sentence beginning, “Overall...” is a nice summary of the influences of NPP and temperature on the biomass spectra.

Technical Corrections -Throughout the paper equations are mentioned out of order. I can see why this is done in some cases, but if it's possible to address it would aid the reader. It's not critical, though.

-Page 10146, line 19: I think this should read, “determine how they change...”, not “determine how the change”.

-Page 10149, final sentence: Fragment, but would be fixed by removing the word “which”.

-Page 10154, line 4: The closing parenthesis is missing before the period.

-Page 10154, line 13 and page 10164, line 22: Consider replacing “old age” with “senescence”.

-Page 10155, lines 17 – 18: Consider omitting “more than” for tone.

-Page 10162, lines 7 – 9: I don't think Blanchard et al. (2009) model the dynamics of the phytoplankton spectrum, but rather assume constant conditions.

-Page 10163, lines 24 – 25: Please state how carbon is converted to wet weight, either here in the text or in Table 1.

-Page 10168, final sentence: Consider replacing “ocean general circulation model including a lower trophic level model” with “earth system model”.

-Page 10174, line 17: Insert “such as” before “for use in...”.

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Interactive Discussion

Discussion Paper



-Page 19175, line 2: Convert “10 cm” to mass to be consistent with the body of the paper. This could be a parenthetical after the length if it’s desirable to have both measures.

-Figure 5c: Are groups 1, 2, and 3 the same as small, medium, large in the other figures? If so, please change the legend for consistency.

-This is a somewhat picky suggestion, but blue-green-red color scheme could be hard for color-blind folks to distinguish. An easy solution would be solid, dashed, and dotted lines, differently shaded lines, or some combination thereof.

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Interactive comment on Geosci. Model Dev. Discuss., 8, 10145, 2015.

## GMDD

8, C3471–C3475, 2015

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