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Geoscientific Model Development Discussions
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Interactive comment on "EMPOWER-1.0: an Efficient Model of Planktonic ecOsystems WrittEn in R" *by* T. R. Anderson et al.

Anonymous Referee #1

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General Comments

Anderson et al. provide a detailed description of the two-layer slab model 'EMPOWER'. They also describe their parameter fitting methodology at four stations, as well as a structural sensitivity analysis, which assessed the calculation of daily depth integrated photosynthesis and the mortality terms used. In addition to providing a methodological framework for model testing that can be recreated by the modelling community, it is interesting that they find their model has a greater degree of sensitivity to the attenuation of light in the water column than the choice of P-I curve used in terms of calculating daily depth integrated photosynthesis.

The introduction is well written and well informed; however, I feel a comparative

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description of some 'competing' marine ecosystem models (e.g. Blackford et al., 2004; Le Quere et al., 2005) would strengthen the argument for using less-complicated models, such as the simple NPZD model implemented here. Elizabeth Fulton has published several papers regarding marine ecosystem model complexity (Fulton et al., 2003a; Fulton et al., 2003b; Fulton et al., 2004), which may contribute to the discussion about ecosystem model complexity here and in the final discussion.

The models mentioned above (Blackford et al., 2004; Le Quere et al., 2005) are cited in the discussion but are not compared to EMPOWER in terms of their research applications or skill in reproducing observed data, which would provide further justification for less complex models such as EMPOWER. Similarly, comparison to low complexity global models such as that of Tyrrell (1999) – which has been used for educational purposes and research (e.g. Chuck et al., 2005) – would add completeness to the discussion.

Model skill in reproducing observed chlorophyll and nitrate concentrations is not quantified and, although the description of 'fit' is detailed, it would certainly facilitate comparison of parameter sets and model setups. Lewis and Allen (2009) and Lewis et al. (2006) are examples of quantifying model skill that come to mind.

Although the majority of the paper is well referenced, there are a number of points throughout that would benefit from additional citations (for details see my specific comments below). The results section also has numerous qualitative statements that require quantification (again see my specific comments below).

Specific/Technical Comments

1) p. 55, lines 1–9 and p. 56, lines 11–15: No example studies are cited to support the statements made and direct further reading for those interested.

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2) p. 56, line 27: Are the models referred to reviewed by Gentleman (2002)?

3) p. 59, line 1: It would be helpful to know the location of George Bank.

4) p. 63, line 17: Pluralise station, i.e. "...(stations Papa in the north. . .".

5) p. 63, line 21 and forward: There are several versions of the World Ocean Atlas, it would be helpful to make the version used clearer (i.e. WOA 2009).

6) p. 64, lines 19–20: An explanation of why you focused on station India would be helpful.

7) p. 66, line 8: kPAR is not defined.

8) p. 66, line 20: I would find an example plot illustrating changes in surface irradiance throughout the day (both sinusoidal and triangular patterns) helpful.

9) p. 67, line 17: Explicitly stating the coefficients in question would simplify reading, i.e. ". . .polynomial coefficients (b0,i – b5,i) are listed in Table 2."

10) p. 68, lines 2–5: This sentence is repeated from p.66, lines 19–21.

11) p. 69, lines 21–24: Symbols 'φ' and 'ϕ' seem to be used interchangeably.

12) p. 70, line 13: Word order should presumably be "Regarding phytoplankton non-grazing mortality. . .".

13) p. 71, line 8: It would be helpful to direct the reader to the equations in

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which each term is used, as you have done for GGE (Eq. 13).

14) p. 71, lines 1–8 and p. 72, lines 10–23: Perhaps referring to Table 3 somewhere here would help the reader follow the variables being defined.

15) p. 75, lines 1–2: This sentence is repeated from p. 73, lines 13–14.

16) p. 75, line 5–15: Please state the equation numbers corresponding to the functions.

17) p. 75, line 18: I would find it helpful to have the state variables explicitly listed here.

18) p. 76, line 14–16: Perhaps the output files listed should be added to Figure 7.

19) p. 80, line 21: Possible typo of 'that' instead of 'than'.

20) p. 81, line 3–4: The way in which 2006 is a characteristic year is not explained.

21) p. 81, lines 6–10 and p. 82, line 23: Comparative statements are made in terms of model fit but these are not quantified. For example, how much 'too high' was predicted chlorophyll in spring and summer?

22) p. 82, lines 24–25: Why is low overwinter chlorophyll is a common feature in slab models?

23) p. 83, lines 23–27 and p. 84, line 2 and 18: Again comparative statements

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are made but not quantified.

24) p. 86, line 12: ‘A93’ does not seem to have been defined in the text.

25) p. 87, line 8–14: Please cite examples models and studies supporting the statements.

26) p. 87, line 14: Please quantify “too high”.

27) p. 89, lines 11–13: Please cite example of some of the pioneering work by Riley, Steele and Fasham.

28) p. 91, lines 12 and 14: It would be helpful to include the equation number for Beer’s Law and the piecewise Beer’s Law.

29) p.92, line 21: Please clarify the magnitude of nitrate drawdown that the following is being compared to: “. . .nitrate drawdown was slightly greater (0.5 mmol Nm^{-3}) with the MEDUSA parameterisation.”

30) p. 93, lines 7–8: Please cite examples.

31) p. 94, lines 6–8: Please provide supporting citation(s).

32) p. 95, line 17: On what basis do you recommend the equation for shortwave irradiance?

33) p. 103, line 10 and p. 104, line 7: Should it be ‘ASCII’ rather than ‘ASC II’?

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34) Table 1: Should the legend read: “Characteristics of published slab models?”

35) Table 2: Referring the reader to Eq. 10 would be helpful.

36) Figures 2 and 4: Would it be possible to combine these figures and give a more detailed description in the legend?

37) Figure 3: Use of ‘Biotrans’ and ‘NABE’ is inconsistent.

38) Figure 6: Units are not given on the colour bars.

39) Figure 7: Is there an over arching ‘main’ module or subroutine that contains the sections of code shown in this flow diagram? There is also repetition in the ‘Functions’ section – is this intended?

40) Figures 8 and 9: Could these be combined in the same way as for stations Papa and Kerfix (Figures 12 and 13)?

41) Figures 11, 12 and 13: Data shown are for 2008 or 2009 – the choice of these years (rather than 2006) is not explained in the text.

42) All figures displaying observational data do not cite its source.

43) Figure 17: ‘A93’ and ‘EP85’ are not defined.

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Blackford, J. C., Allen, J. I., and Gilbert, F. J.: Ecosystem dynamics at six contrasting sites: a generic modelling study, J. Mar. Syst., 52, 191-215, 2004.

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