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Geoscientific
Model Development
Discussions

Interactive comment on "The Joint UK Land Environment Simulator (JULES), Model description – Part 2: Carbon fluxes and vegetation" *by* D. B. Clark et al.

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Response prepared by D.B. Clark, L.M Mercado, S. Sitch and C.D. Jones.

The authors thank the referee for providing a thorough review, and agree that some changes and clarification would improve the manuscript. We would propose to make the revisions outlined below for submission to Geoscientific Model Development. Each item starts with the reviewer's comment.

1. *Overall: It would be useful to add a table for list of variables including units.*

   While preparing the manuscript the authors discussed the question of whether

to include units with the definition of all variables, and concluded that we would follow a pragmatic approach and provide units where it was felt useful. Each variable used is introduced in the text. At this stage we are not in favour of introducing an exhaustive table of variables, definitions and units, in which respect we follow common practice in the literature. We will however review this position and consider how we can clarify the presentation in any subsequent GMD paper.

2. *Page 653: Equation (20): Is this equation delivered from the equation (17)? If so, the incident direct radiation 'Ib0' should be multiplied to the right side.*

   Equation 20 is correct because it is calculating a fraction of the flux (and so does not need to be multiplied by the incident flux), but we agree that the text was somewhat ambiguous in this area (i.e. the word 'fraction' in p652 Line 21 was intended to apply to all terms, not just the sunlit leaves). We have rewritten this section of the manuscript in an attempt to remove this and other ambiguities and we include the revised version as an attachment to this comment (document revised_photosynthesis_text.pdf).

3. *Page 656: Lines 9: Authors could state shortly underlying mechanism that improved the simulation output.*

   We propose to augment P656 Line 11 with the following:

   > Simulated photosynthesis using the big leaf approach shows light saturation at low levels of radiation (left panels) and a 'flat' response around midday (right panels), unlike the observations. This is because with the big leaf approach simulated photosynthesis is light-limited with very low levels of radiation and thereafter is limited by carboxylation of Rubisco. With the multilayer approach for light interception and photosynthesis, JULES simulates competition between light-limited and Rubisco-limited photosynthesis at each canopy layer, resulting in increased Rubisco limitation towards the top of the canopy and increased light limi-

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tation lower in the canopy. In addition to a better representation of light response and diurnal cycles of canopy photosynthesis (Fig. 1), the multi-layer approach also leads to improved simulation of stomatal and canopy conductance (not shown).

4. *Page 660: Line 11: A phrase 'respiring root and stem' should be changed to 'root and respiring stem'.*

   We agree (note this is actually page 659).

5. *Page 660: Line 16: Please add a citation for the pipe-model.*

   The references are:

   Shinozaki K, Yoda K, Hozumi K et al., (1964a), A quantitative analysis of plant form - the pipe model theory I. Japanese Journal of Ecology, 14, 97-105.

   Shinozaki K, Yoda K, Hozumi K et al., (1964b), A quantitative analysis of plant form - the pipe model theory II further evidence of the theory and its application in forest ecology. Japanese Journal of Ecology, 14, 133-139.

6. *Page 661: Section 5: I feel section 5 and section 6 should be exchanged. Otherwise, equation (45) in the section 5 is not understandable in the first look.*

   We agree that these sections should be swapped.

7. *Page 663: Equation (49): A variable 'f_theta' should be capitalized as was first presented in the equation (46). In addition , a symbol 'S' is already used as respiring-stem carbon in the equation (39). Authors should use different symbol for soil moisture.*

   We agree with both points.

8. *Page 664: Line 3: The phrase "Carbon from decomposition of all 4 carbon pools is partly released to the atmosphere and partly feeds the BIO and HUM pools"*

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should be moved before presenting equations (51) to (54). Otherwise, these equations seem to be very odd at the first look.

We agree.

9. *Page 664: Line 2: I understand that the variable alpha_dr is a fraction, which varies from 0.0 to 1.0. If so, why alpha_dr for crops is more than 1.0?*

   The reviewer has identified a mistake in our presentation. α_{dr} is the ratio of decomposable to resistant plant material in the litter. In Equations 51 and 52, α_{dr} should be replaced by f_{dpm}, where $f_{dpm} = \alpha_{dr}/(1+\alpha_{dr})$ is the fraction of litter that is decomposable plant material:

$$d(DPM)/dt = f_{dpm}\Lambda_c - R_{DPM} \quad (51)$$

$$d(RPM)/dt = (1-f_{dpm})\Lambda_c - R_{RPM} \quad (52)$$

10. *Page 668: Line 11: The equation (67) cannot be obtained from equations (64) and (39) as is mentioned here.*

    We agree. In fact some of the terms in Eq.67 were replaced by numerical values in earlier equations. If the constant 0.01 in Eq.39 is replaced by η_{sl}, and the exponent 5/3 in Eq.64 is replaced with b_{wl}, the derivation can be followed.

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/4/C324/2011/gmdd-4-C324-2011-supplement.pdf

Interactive comment on Geosci. Model Dev. Discuss., 4, 641, 2011.