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Interactive Comment

Interactive comment on "Variability of phenology and fluxes of water and carbon with observed and simulated soil moisture in the Ent Terrestrial Biosphere Model (Ent TBM version 1.0.1.0.0)" *by* Y. Kim et al.

Anonymous Referee #1

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General comments

This paper describes the leaf phenology scheme of the Ent model and aims to identify sources of error in the model structure and parametrisation through a number of experiments. This is an interesting and timely question as phenology is a key component of land surface models which is as yet not well represented in any of the existing models. Furthermore, identifying sources of error in complex vegetation models is often difficult so the experimental approach taken by the authors is a very useful tool and should be

employed in more modelling studies. The discussion of errors created by both phenology and biomass allocation is valuable as timing of growth and pattern of growth are often discussed separately despite the obvious close link between them.

The phenology scheme used by Kim et al aims to capture cold deciduous phenology, seasonally dry phenology and cold evergreen photosynthesis seasonality. The three components are a combination of parametrisations from other studies and it is not clear to me why the authors did not choose to use either a new parametrisation or a whole scheme from another study such as Jolly et al. (2005) or Caldararu et al. (2014). Having said that, the entire Ent model appears to be made out of components of other models and studies so maybe this is a larger question, not specific to this paper.

The idea behind the phenology scheme appears to be that we do not have a mechanistic understanding of phenology and cannot therefore build a process based model (p. 5819, line 25). This is not strictly true as a large number of plant sciences studies as well as some biogeosciences ones more recently, have tried to understand the physiological drivers behind leaf seasonality. In addition, recent modelling studies are trying to move towards models that incorporate our understanding of plant and ecosystem processes (Prentice et al., 2015; Norby et al., 2015).

The paper is generally well written, with the exception of the introduction, which is lengthy and a bit sloppy. Some of the introduction material can be found in the methods, while some of the methods material can, mysteriously, be found in the results section.

Overall, the Ent phenology model is correct and the results revealed by the experiments undertaken in this paper are interesting and should be applied more widely in the modelling community but the introduction needs re-writing and some of the model assumptions need clarification and justification.

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Specific comments

p 5810 line 23 The first sentence seems incomplete. Saying "these models" implies to me that there is maybe a sentence missing

p 5811 line 17 I would suggest deleting or shortening this paragraph, there are a lot of examples here in addition to the ones in the previous paragraph.

p 5812 line 13 This sentence suggests that the main purpose of coupling DGVMs with GCMs is to represent phenology...

p 5813 line 12 Again, you might want to shorten this paragraph, the introduction is meant to set the stage for the model, not provide a full review of the Richardson papers.

p 5814 line 2 You might want to move the version enumeration to either the methods or the footnote with the wonderful Tolkien comment, which made me laugh.

p 5819 line 24 - p 5821 line 18 All this material belongs in the introduction and might need shortening.

p 5819 line 24 As I said above, this statement is not strictly true and since it forms the basis of the chosen phenology scheme you should at least justify it a bit more.

p 5820 line 15 You might want to mention that the Jolly et al. (2005) scheme has been implemented into a DGVM with good results by Forkel et al. (2014).

p 5820 line 21 See Caldararu et al. (2014) for a globally applicable phenology model

p 5821 line 19 What is the relationship between Phenostatus and the various ϕ factors? Are they the same thing? How do you put everything together? A master equation at this stage would be very helpful.

p 5822 line 10 Generally, it is considered that photoperiod plays a much bigger role in leaf phenology, especially in spring and this simple approach you have chosen needs to be justified more.

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p 5822 line 20 How did you choose the 5^{o}C base temperature? What about the 10 day running average?

p 5822 eq. 1 This equation does not make any sense. Do you mean sum of maximum? Also, the sum must be from something to something. Do you actually mean:

$$GDD(t) = \sum_{t=1}^{t} max(0, T_{10} - T_{base}) \quad (1)$$

p 5822 eq. 2 You probably want to format this as above and get rid of the if.

p 5823 eq. 4 Do you mean GDD higher than GDD$_{crit}$? Otherwise your index goes from -1 to zero.

p 5825 section 2.4.4 What are the drivers for leaf on in seasonally dry systems?

p 5828 line 18 I do not understand how in your allocation scheme when the leaves have just started growing so that the LAI is very low, there is enough carbon available for a sudden jump to maximum LAI

p 5830 line 5 Information about the sites belongs in the methods section

p 5832 line 12 Again, this belongs in the methods

p 5835 line 12 This last sentence on PFT level parameters is out of place here, either delete it or create a new paragraph.

p 5835 section 5.2 This part of the discussion is somewhat general. I would be interested to see a discussion of the phenological parameters chosen and assumptions made. Is only using daylength as a senescence trigger a correct assumption? Do all sites have the same sensitivity to temperature and/or water? How sensitive are your predictions to the parameter values chosen?

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Technical comments

p 5813 line 25 "... a range of success" Rephrase

p 5814 line 1 "This is..." This paper is?

p 5814 line 14 "a synthesis a variety" Delete one of your choice

p 5823 eq. 3 Write this as e to the power of rather than exp(..)

p 5823 eq. 4 Equations of this type are commonly formatted as:

$$\phi_{GDD} = \begin{cases} \frac{GDD - GDD_{crit}}{GDD_{crit}}, & GDD > GDD_{crit} \\ 0, & GDD < GDD_{crit} \end{cases} \quad (2)$$

This applies to equations 5-7 too.

p 5829 line 5 "the partitioning... were both larger" clumsy sentence

p 5834 line 28 "VPD may not a good indicator" missing "be"

References

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