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Hydrology and Earth System Sciences Discussions

Interactive comment on "Modelling soil temperature and moisture and corresponding seasonality of photosynthesis and transpiration in a boreal spruce ecosystem" *by* S. H. Wu and P.-E. Jansson

Anonymous Referee #1

Received and published: 24 June 2012

Overview and major comments:

This is an interesting paper that addresses the issue of climate change on boreal forests, and importantly considers both air and soil temperatures which may respond differently and may have different effects on high latitude forests. The authors combine modeling with flux tower observations to describe energy balance components, water, and carbon fluxes at a site in Sweden, using model formulation developed for a site in Finland. The effort consists of four general model runs dry/moist with and without soil

temperature controls

Given the wide audience that may be interested in this paper I strongly suggest that you minimize jargon and phrasing that mean something to you and a small community, but not anyone else. An example from the abstract is “The parameter ranges obtained are probably valid to represent regional characteristics of boreal conifer forests, but were not easy to constrain to a smaller range than that produced by the assumed prior distributions.” Although generally correct, it does not convey nearly as much meaning as it could. For example, can you specify: what parameters, what ranges, what characteristics what assumptions, what distributions?

I am not a big fan of papers that show validity of a model, I prefer rather than showing that “we can make a model capture some response” that papers focus on questions about system response and what you learn from a model and what the limitations of the model may be. This fundamentally changes the flow of a paper from showing it works to showing what we learn about the system. Reading about behavioral models doesn’t tell the typical reader who may not be a modeler about the critical knowledge gaps that are filled but this exercise and the other questions or knowledge gaps that are identified. The goal should not be to “sell” the model, but to learn about the system.

My biggest concern, and one that clouds my review of the paper, is an apparent lack of energy balance closure that is not addressed clearly in the manuscript. I do not understand how the model can overestimate LE but not underestimate H when driven by same radiation and climate data. How can you close the local energy balance? Where is the energy coming from? Hopefully I misread this and it is only a simple misunderstanding.

General comments

A bit more detail on the sites would be useful rather than referring to other studies. This is especially true when you describe growing season length of 160 days, but clearly this varies interannually and may be due to air or soil conditions you address

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Similarly, what is the relative cover and spatial orientation of dry, mesic, and moist conditions at your site – especially within tower footprint? Is this variability due to convergent flow? Does it add to your story if you discount it as contributing to tower response? Is it reasonable to discount these areas? What data can you show to help convince the reader that your assumptions are correct about footprint characteristics?

Not clear how you deal with soil frost given the use of limited soil T data and an unclear, undefined soil water energy balance model

The section describing performance indices seems to contain results and I wonder if it is misplaced.

Need to show that the EC data cover the range of conditions relative to the inferences drawn from model.

Why add 2003 sensible heat without other energy balance terms? The ability to approximately close energy balance for a site is requisite for evaluating flux tower data

Specify how met data gaps were filled – were they replaced or was a regression developed?

It is unclear why use dry and moist soil data if the tower is mostly dry? What about mesic site? Can you learn anything from that data?

Given different soil moisture regimes and veg types it would be useful to quantify the contributing area to fluxes using footprint analysis to determine if the soil-veg combinations behave differently by using periods when one or another landscape type dominates footprint

How do you evaluate spatial variability in soil physical properties in the model if you only have one observation in each dry and moist soil plots?

Why are soils 11.3 m and 20 layers? Doesn't this go beyond GW depth? Do these trees access GW? If so how does one partition plant water use between vadose and

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GW?

Why is growing season defined as 5C? is this reasonable and realistic? I've seen a number of papers and presentations that suggest C uptake begins as soon as liquid water hits soil and temps are near 0C.

With only one plot each of dry and moist how do you assess spatial variability?

Need to separate spring vs growing season – the initiation of uptake vs seasonal uptake – the title suggests a focus on initiation but the paper blurs the two

I don't understand how total ecosystem biomass can be simulated with only a few years of data. This needs to be explained more clearly

Minor comments

Page 6420 Word missing on line 12-13

Page 6422 line 14 – here and elsewhere please be specific and say what direction and how small the change was, rather than saying only "small change"

6423 line 16-17 what is meant by high and low resolution data?

Page 6428 first paragraph – be consistent with plural and tense when describing climate – should be past tense and plural

Figure legends and figures in general are too small

In general, sentences like "The seasonal patterns of global radiation, air temperature and precipitation during 2001–2003 are shown in Fig. 1" do not add information to the text, but rather distract the reader and ask them to look at a figure without saying why. The next sentence describes what they will see in the figure and you could add (figure reference) at the end of this sentence. This shortens the text and focuses the reader

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 6419, 2012.