Implementing northern peatlands in global land surface mode: description and evaluation in the ORCHIDEE high latitude version model (ORC-HL-PEAT).

This paper discusses the addition of peatlands into ORCHIDEE. There are two components for this – a vegetation component and a hydrology component. The vegetation component is mainly a modification of parameters. However the hydrology component involves the addition of some processes. These need to be described in more detail. I think more detail is required on the snow component which is frequently referred to in the results section but not discussed in the modelling section.

The vegetation is modified and there is a brief evaluation at the three FLUXNET sites. However it would be good to see the large scale effects of these changes. Also, since the snow seems to be a reason for many of the differences shown it would be good to maybe evaluate the snow component a little more.

It would be interesting to see a map of the observed peatlands and the different types.

I thin they authors should separate experimental design, observations used, model description and results more clearly. There are lots of slightly different experiments included, which is a bit confusing. There needs to be more consistency (particularly of terminology and experimental design) throughout the paper to make the story easier to understand.

Section 3.3.2 needs to be more focused on the key results given the question of how adding peatland affects the hydrology of northern high latitudes.

Minor comments

P2.L5 "The characteristics..." - sentence needs re writing.
P3. L14 What is the depth of the soil column and the approximate layer thicknesses?
P3. Section 2.2 – Paragraph 1 needs to go later. The first part of the section should discuss the site simulations, then the next part the large scale simulations. These should be more clearly separated. In addition and maybe more importantly, there is no experimental design for the large scale simulations despite several different experiments being included later.
P3. L1 There is no discussion of how the soil respiration is calcuated used for the NEE.
P6. L30 What hydraulic properties are used for peat soils?
P7. L3 – How much runoff from the other PFT soil columns?
P7. L7 How is the drainage blocked?
P7. Is there an equation or two that can be included to show how the hydrology was modified?
Fig 1. What is the depth of the soil?
P8. L1– Please rephrase this first sentence.
P8, L13 – any tests of the calibration of R for other sites? Maybe more details?
Fig 2. Looks a bit weird. In terms of the x-axis – there seems to be two days in a month. Results look very comparable though! The peatland pft has made a good change,
Fig 2. Do the observed NEE represent 100% peatland?
P9. L19. This says despite the missing processes we are getting the right answers? Surely this is unexpected?
P9. L22. Now it says Degero WTD is underestimated.....
Fig 3. Does Degero really have no winter precipitation? Maybe it is just too small to see? The axes could be adjusted?
Fig 3. I think these WTD results look pretty good for the summer. I think the winter differences need clear justification, see next comment.
Fig 3. Does the standard version of ORCHIDEE simulate a water table depth? If it does it would be

good to see how the improved representation of peatland affects this.

P10. L2. We have learned very little about snow up to now. Why cant the infiltration of snow occur?

Fig 4. How does this compare with observations?

Fig 5. How much does lack of snow infiltration affect things?

Section 3.2 This is a long section. Maybe I am missing the point but it seems to be telling us that minerotrophic peatlands are more sensitive to precipitation than ombrotrophic peatlands. This is expected? Is it the ability of the model to determine the difference between the two the novel result here? How much is this affected by the lack of representation of snow infiltration? It would be good to explicitly state the usefulness of these results for other applications.

P13. L10 This first paragraph is model description.

Fig 7. These subplots need a title. STD runoff is missing.

Fig 7. there is an interesting timing difference on the peaks between the observations and the model.

P14. L1 – Why is the STD version not the HL version aha it is (confusing!)?

P14. L3. This is the first time PEAT-LOWET has been introduced. It needs to go in the experimental design.

P14. L6 to P15. L5. This information can also go in the experimental design.

P15. L30 GRACE should be discussed earlier in a "materials and methods" section.

Fig 8 – What is HIGHLAT representative of – is this the same as STD? GRACE needs to be the same in each subplot. What do we learn from Fig 8a?

Fig 8. Do we learn anything from such a long time series or would a climatology for 1 year be better?

P16. L4 We have no "top panel" in fig 8.

Fig 9. I don't understand the units?

Serction 3.4 In section 3.2 there is quite a discussion of bog vs fen. Can this be referred back to in this section? How well does the model represent the flooded areas of bog vs fen? This would tie the relevant sections together.

Fig 10 – it seems the differences in timing in Figure 10 are caused by the snow. It might be good to show some snow results to demonstrate this?