Point-to-point response to reviewers' comments

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1. *The biggest deficiency in the approach is clearly the failure to include a mechanism for irrigation. This is mentioned in the process description only briefly on 4663. It would benefit the paper if this could be expanded somewhat to describe why irrigation was not included. Irrigation is not generally considered to be a difficult thing to include in a process model, with most models using simple rules where additional water is applied if topsoil moisture falls below some threshold. Given that water cycles and especially large-scale irrigation patterns have been shown to have significant impacts on regional climate in several recent studies, this seems like a surprising oversight in what is otherwise a very comprehensive treatment of crops in a land-surface scheme.*

   Response: Thank you Joshua for your valuable comments. ORCHIDEE-crop is built by integrating the detailed crop development and carbon allocation processes of STICS, a generic crop model, into the DGVM ORCHIDEE. There are two modules in the stardard ORCHIDEE (version Tag196): SECHIBA (simulating energy and water dynamics within the SPA continuum and plant photosynthesis, etc) and STOMATE (simulating carbon allocation, decomposition, vegetation dynamics, etc.). In ORCHIDEE-crop (V0 version), the crop development is driven by the thermal-hydro variables (e.g., soil temperature, water infiltration, soil moisture conditions, etc.) simulated in SECHIBA module. Both managed and natural vegetation share the same thermal-hydro dynamics within the same mosaic (something like a pixel with different vegetation types mixed together). Therefore, we did not change the generic energy and water processes in our first version of ORCHIDEE-crop (V0). But in an updated version of ORCHIDEE-crop, we modify some specific processes of thermal-hydro dynamics for crop PFTs in SECHIBA, and effects of the imposed irrigation on soil water conditions for crops are now considered. We will put this information into the following publications of ORCHIDEE-crop simulations.

2. *I also have some further questions about the root distribution. Root biomass is accrued dynamically but as stated it seems that root depth and distribution is static, with 65% in the top 20cm. Is that correct?*

   Response: I agree with you that root dynamic is a key process for better representing the crop development and its interaction with water conditions. The water limitation effects on crop growth is estimated by the mean water condition within the root zone. In the current version, we did not consider the dynamic of root growth, but with a static distribution of root during the whole growing season, with 65% in the top 20 cm.

3. *Since the model considers winter wheat, it would be good to comment on whether/how cold temperature effects (leaf kill and full plant kill) are considered and (in the case where leaves are killed but he plant survives) whether/how this*

effects allocation during subsequent growth.

Response: Yes, you are right. Cold temperature during growing season (from planting to harvest) has important impacts on winter wheat growth. In ORCHIDEE-crop, the effects of cold temperature on winter wheat growth are different in different development stages. From planting to emergence, the cold temperature can impact the crop seeding emergence by both vernalization and thermal accumulation effect. Since emergence, the cold temperature can reduce or even stop (the cold temperature can lead to a no increment in daily LAI) the increment of LAI on a daily step and thus lead to changes in daily leaf growth (leaf growth is determined by both leaf growth increment and daily senescence dynamic) and hence other processes (e.g., photosynthesis, carbon allocations, etc.).

4. *It may not be in the scope of this paper, but I'm certainly very curious to know also how different the new scheme is in terms of large-scale factors that could affect climate feedbacks. Some integrated measure of surface albedo, total carbon budgets, etc. if possible, it would be good to add to the conclusion some statement about this. Does it greatly increase or decrease the land-surface climate feedback in any way that you expect to have implications for future IPSL coupled runs?*

   Response: This is really an important issue within the terrestrial-atmosphere interactions. As illustrated in previous literatures that the standard ORCHIDEE simulated crops (C3 and C4) as "super grass", with same phenology routines as grasses but different photosynthesis abilities. However, in ORCHIDEE-crop we integrated a generic crop module into ORCHIDEE and it simulated the crop phenology, development and carbon allocations based on explicit processes of crop development. The ORCHIDEE-crop can at least improve both the seasonality and magnitudes of LAI for different crops (as illustrated in our manuscript). Thus, ORCHIDEE-crop can improve the simulations of surface roughness, surface albedo, water, energy and carbon budgets for land surface (mixed with both natural and managed vegetation types). Therefore, an improvement in the land-surface climate feedbacks is reasonably expected for the future IPSL coupling.

5. *Small things. Some editorial work is needed to improve readability. For example, page 4659 line 10 "in the crop module same to STICS".*

   Response: We went through the manuscript carefully and made our presentation much clearer.