## General Comments

This manuscript describes the new floodplain scheme implemented in ORCHDEE model, evaluate the validity of the new scheme, and analyzed its impact on other land surface variables. Even though it's still a case study simulation over Pantanal, I feel the paper very carefully analyzed how floodplain is important for land surface modelling.

The modeling strategy seems to be a bit complicated, while I feel the complexity is necessary given that the floodplain inundation itself is a complex physical process. I suggest the authors to provide more kind explanations about floodplain parameterization scheme, for example by using schematic figures, to help readers to understand how the proposed floodplain scheme works. However, the manuscript is overall well written, while minor revision is needed before acceptance.

## Major concerns

[1] I feel the manuscript is too long. It might be unavoidable as a model description paper, but readability might increase if not-so-important parts are moved to supplements.

[2] So many variables/symbols are used to parameterize proposed floodplain scheme, and I feel difficulty following the explanations and equations. I suggest to create one schematic figure which represents the parameterization concept of floodplain scheme (with explicit description of which symbols corresponds to which variables). Visual explanation must help readers to understand about the new floodplain scheme.

## Specific comments:

L193: whether the floodplains are activated or not.

This should be "regardless of whether …"

In addition, please explain what slow and fast reservoir represents. It is explained in results section that they represent aquifer and shallow groundwater, but this should be stated here. Otherwise, readers cannot know why they have limited relationship to floodplain scheme.

L235: The floodplains scheme allows a specific HTU to "overflow" the content of its floodplains reservoir into connected upstream HTUs with floodplains.

This is very interesting scheme. I wonder what is the impact of this overflow scheme on simulated water and energy budget. If space allows, please include some analysis.

L284 2.4.1: Case $S_{f,I} < S_{fmax,i}$

I recommend you to explain the case in plain language in the section title, not by the equation.

L285: height of the floodplain
This term is ambiguous. Do you mean “water surface elevation of the floodplain”?

L331: in order to define a mask of potentially flooded areas based on the following categories:
Could you please explain in which case this floodplain mask is required, and what is the impact of using this floodplain mask?

L355: before using the scheme over another region to evaluate if this parameterization is the more appropriate.
In many part of the world, there is no observation data for calibration. If possible, it’s better to perform some sensitivity tests of parameters (confirm results are not so sensitive to parameters, or specify which parameter has larger impact).

L360: Methodology of Validation and Analysis
Please also provide some description of the simulation domain. Probably, a figure showing the simulation domain (with location of the gauges) is better to be provided.

L419: forced with ERA5 re-analysis data.
I assume this is regional atmospheric simulation, and in that case ERA5 must be “boundary condition” rather than “forcing”.

Figure 2:
Could you please analyze the mechanics of river discharge delay? E.g. where water stays before reaching to the river gauge? Did they stay in floodplain as surface water? Or did they stay in soil by infiltration? Given that the difference between FP and NOFP simulation is large, it’s better to provide detailed analysis on the mechanism which cause the difference.

L507: soil moisture and in the stream reservoir increases slightly
Considering the magnitude of change, compared to other storage variables, I feel the soil moisture was “significantly” increased by floodplain scheme (it’s not slight increase).

L508: This increase is even more important in the fast and slow reservoirs.
Please also reconsider this statement. The relative increase could be large, but absolute change is larger in soil moisture.

Figure 3:
I suggest it's better to make some discussion on the water volume change and annual river discharge (by converting annual discharge to volume unit). How large the volumetric change in each reservoir is, compared to the annual discharge? This analysis must be essential to understand why discharge seasonality changed significantluy.

L551: divergent flows which very sensitive to the orography and cannot be represented in this model
Please explain why divergent flow cannot be represented. (i.e. because only one downstream is assumed for model's river network).

L639: vegetation fraction decrease
I think vegetation fraction can decrease also due to water logging along floodplains (too much water). It seems this impact is not considered in the proposed model, so better to be mentioned as limitation.

L816: . The divergent processes are not represented in the Hydrological DEM and, therefore, are not implemented in ORCHIDEE.
Divergent flow is represented in MGB-IPH and CaMa-Flood by analyzing high-resolution topography data (Pontes et al. 2017; Yamazaki et al 2014). Given that representation is possible, I think it's better to mention about the possibility.

L860: IMaps
What is IMaps? Please explain.