The accurate projections of future climate change impacts on land surface carbon cycles are key to understand the climate change carbon cycle feedback and to mitigate climate change. This paper provides a way by using the observational-constraints of the optimal temperature and the emergent relationship between optimal temperature and atmospheric CO2 changes to narrow the uncertainty in the projected future CO2 changes. This method combined the short-term optimization with the long-term climate-carbon feedback and provided a new way of understanding the climate change.

I enjoyed reading the manucript in its novel idea. While before it can be accepted for publication, I have some questions on its suitability for application to broader model groups.

1. This study used the relationship between Topt and atmospheric CO2 changes, over the tropics for the broadleaf forests. I was wondering about the atmospheric CO2 used for the global mean or the tropical regions? Since the global CO2 can also be mediated by other vegetation types.

2. This study used the adjoint of JULES, which happened to be of the land component of the Earth system model that is used for projections. I wonder how can this relationship be transferred to other models, such as the CMIP5/6 models?

3. Data assimilation is a good tool for optimizing parameters from different processes. The nonlinearity of the terrestrial ecosystem models can have few parameters that are interacted and this would result in the joint-distributions of parameters from different processes. While in the data assimilation we seldom considered that or put little focus on the parameter interactions. So how can we properly obtain the relationships between paramters and variables that can be projected to futures? As the authors mentioned soil moisture and other variables. Why do not we use the emergent relationships between optimized variables instead?