

Title: Potential of using CO₂ observations over India in regional carbon budget estimation by improving the modelling system by Thilakan et al.

The authors have made substantial efforts to address the comments from the previous review, resulting in a manuscript that shows improvement compared to the earlier version, particularly with additional discussions on aspects related to seasonality and the diurnal cycle. However, before accepting this manuscript, I still have a few concerns that should be addressed during the revision process.

In general, the mismatches between observations and the model are influenced by emissions, encompassing both biospheric and anthropogenic sources, and uncertainties stemming from transport errors. How do you discern the variations in observations-model disparities under different environmental conditions? For instance, Mohali is influenced by anthropogenic sources, while Nainital, being a high-altitude background site, is influenced by biospheric emissions. Is there a transport-related role in the observational and model mismatches observed in Nainital? Understanding whether the errors or mismatches in the model are linked to emissions or transport is crucial.

In line 370: The authors have emphasized that the sharp decline in CO₂ concentrations is attributed to the uptake by Rabi crops. However, in certain instances, the authors underscore the insufficient representation of biospheric fluxes, particularly related to crops. Clarification on this statement would be beneficial.

The authors suggest an insufficient representation of biospheric fluxes in the model. It raises curiosity about what alternative biospheric fluxes might address this issue, considering that the VPRM biospheric fluxes have already been incorporated into the regional models.

Another crucial aspect to consider when simulating the model for the entire year is the significant role that the Planetary Boundary Layer (PBL) plays in the variability of observations. Was this considered in the design of the model experiments, such as incorporating a proper PBL scheme?