Responses to comments from Reviewer 2 (comments in bold italics, responses in regular font):

Rev: This manuscript investigates thermodynamic soundings for premonsoon and monsoon seasons from the Indian subcontinent are analyzed to document differences between convective environments. Pre-monsoon environment features more variability for both near- surface moisture and free-tropospheric temperature and moisture profiles. As a result, level of neutral buoyancy (LNB) and pseudo-adiabatic Convective Available Potential Energy (CAPE) vary more for the pre-monsoon environment. The authors argue that the key element is the partitioning of surface energy flux into its sensible and latent components, that is, the surface Bowen ratio, and the way Bowen ratio affects surface buoyancy flux.

Overall, the manuscript is well written. It is obviously beneficial to have detailed analyses of observation data on the Indian monsoon. Idealized simulations are well setup.

We thank the reviewer for the useful comments.

Rev: This reviewer, however, feel that the findings from the analyses are plain instead of new insights on the atmospheric physics related to Indian monsoon. For instance, it is very obvious to see that LCL heights are shown to depend on the availability of surface moisture, with low LCLs corresponding to high surface humidity arguably because of the availability of soil moisture.

We realize that our findings are not ground-breaking as they highlight relatively-well understood impacts of surface moisture on Bowen ratio and cloud base height. However, we are not aware of any studies of these impacts on the convection over the Indian subcontinent and the difference between premonsoon and monsoon convection, especially with high resolution radiosonde observations for a long period.

Rev: 1) The argument with observations of changes in the Bowen ratio and LCL height around the monsoon onset is clear. But, in other sense, the Bowen ratio is a resulting parameter instead of a controlling variable. The authors need to be careful in describing the analyses.

We are not sure what the reviewer has in mind here. Perhaps the issue is that monsoon precipitation causes the Bowen ratio to change and in this way the Bowen ratio is both the effect (say, on longer time scale) and the cause (say, on daily time scale) of the differences in convection and precipitation. Such thinking indeed brings the soil moisture – precipitation feedback. We revised the manuscript following such an argument and added a more detailed discussion below.

Rev: 2) Regarding the soil moisture feedback, there are numerous literature that describes the soil-moisture-precipitation feedback processes (e.g., Asharaf et al. 2012, Soil Moisture–Precipitation Feedback Processes in the Indian Summer Monsoon Season). It is recommended to cite these papers in explaining the physical mechanism, and an addition of a new insight from the previous literature.

We agree that a feedback mechanism exists between LCL heights and surface energy balance partitioning. However, land surface parameters such as soil moisture, vegetation cover etc., collectively determine energy balance partitioning, which then influences turbulent motions and boundary layer depth (Jones et al, 2009). Arguably, of all the surface properties, soil moisture has the largest impact on Bowen ratio. Soil moisture has the memory of atmospheric processes (Orlowsky et al, 2009); it responds to precipitation variability and affects precipitation through evaporation (Douville et al, 2010). This soil moisture – precipitation (S-P) feedback has been extensively studied in the past. Asharaf et al, 2011 studied the S-P feedback for the Indian summer monsoon and found that premonsoon soil moisture has a significant influence on the monsoonal precipitation.

Arguably, the memory effect dominates on a scale of several days. But for a single day, Bowen ratio can act as the controlling factor rather than the consequence. This has been demonstrated in several studies. Rabin et al (1990) studied the observed variability of clouds over a landscape using a one dimensional parcel model, attributing it to the changes in Bowen ratio. This study points to a previous finding by Rabin (1977) which states that on moist days clouds develop earlier over places with low Bowen ratio, and on dry days convection occurs sooner over regions with higher Bowen ratio. Lewellen et al (1996) studied the role of Bowen ratio in determining the structure of boundary layer clouds using Large Eddy Simulations (LES). The study suggests lower cloud ceilings for low values of Bowen ratio. Schar et al, 1998 conducted simulations using a regional climate model on S-P feedback and stated that wet soils with small Bowen ratio produces shallow BL where the fluxes of heat and moisture are concentrated in a small volume of air. This leads to the build-up of high levels of moist entropy and provides a source for convective instability. Simulations also suggested that level of free convection was lower over wet soils.

As stated above, we included elements of this discussion and selected references into the revised manuscript.

References mentioned above:

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