LAND-ATMOSPHERE INTERACTIONS AT A SEMI-ARID REGIONS IN THE DECCAN PLATEAU

The exchange of heat, moisture, and momentum between the Earth's surface and the atmosphere is commonly discussed under the climate jargon "land-atmosphere interactions". It is one of the most important parameters regulating the regional weather (at short time scales) and climate. Such interactions are essentially related to the dynamics of the atmospheric boundary layer (ABL), the region of the atmosphere in contact with the Earth's surface and extending to a few hundred meters to a few kilometres (depending on the time of the day and the season). The surface energy imbalance between the incoming solar radiation and the outgoing terrestrial radiation is manifested in various forms such as the evaporation of surface water/soil moisture, heating of the land surface and the soil layers beneath it, energy storage in the vegetation etc, and hence are specific to the surface type and the local meteorology. Accurate knowledge of land-atmosphere interactions and the role of ABL dynamics are essential inputs needed in closing the surface energy balance in high-resolution climate models. However, the lack of sufficient in-situ observations leads to large uncertainties in model simulations. Long-term energy and mass flux measurements over different environments and their time-series comparison with various data sets are required to resolve it.

Multi-year meso-meteorological data from the climate observatory set up in the second campus of IISc at Challakere, a semi-arid environment in the Deccan Plateau have been used by researchers from Divecha Centre for

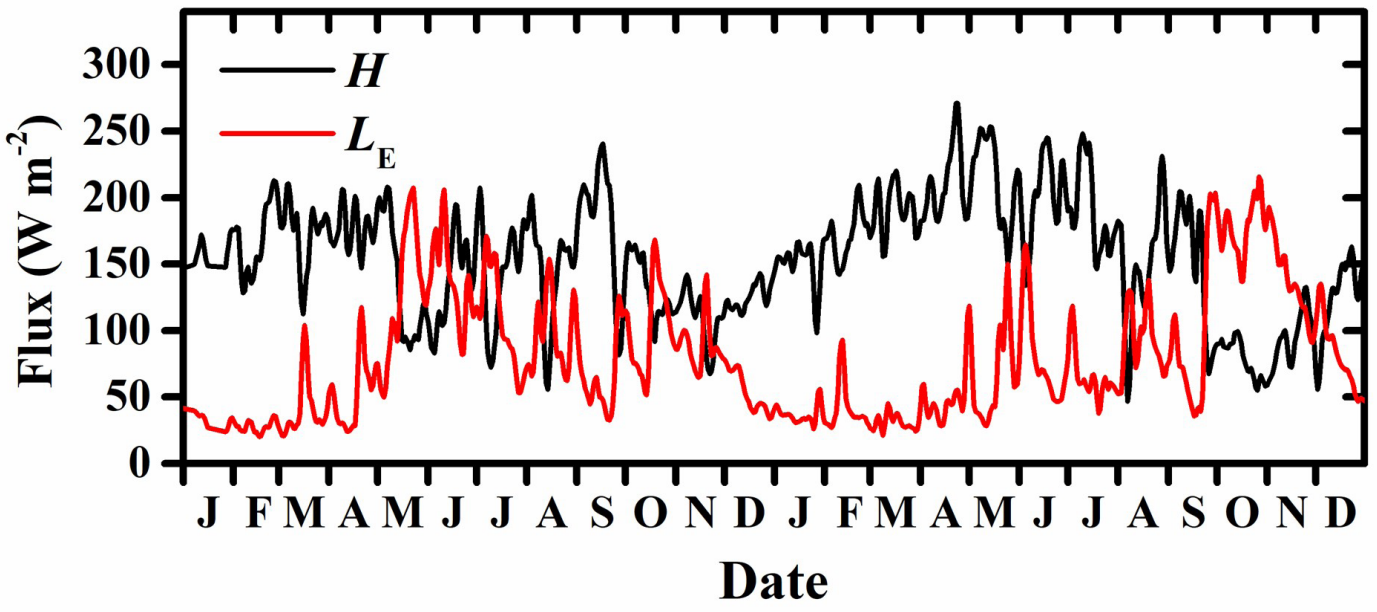

Figure 1: Time series of daily mean values of sensible heat flux (H, red lines) and latent heat flux (LE, black lines) obtained from the ground observations at Challakere. The x-axis label marks the first letters of the months during the measurement period, starting from January (J) 2018 through December (D) 2019

Climate Change, IISc and Indian Institute of Science Education and Research, Thiruvananthapuram for understanding these processes in detail. Two-year measurements of atmospheric and soil parameters using multiple sensors mounted on a 32-m tall meteorological tower as well as below the soil surface were analyzed, which revealed an anomalous partitioning of surface energy. Irrespective of the seasons, the soil moisture, and its response to rainfall, as well as the surface roughness drive the land-atmosphere interactions and along with the net radiation, play crucial roles in deciding the magnitude of surface fluxes. Contrary to the previously reported results over the Indian region, this study revealed that the surface energy fluxes are partitioned more to sensible heat rather than latent heat (see Fig. 1). Energy balance closure was observed to be inversely proportional to the height of the roughness elements and their scatter around the measurement site. The measurements also revealed large differences in the rainfall duration and intensity and land-atmosphere interactions compared to reanalysis data (Figure 2). These findings will improve the ABL schemes in climate model simulations over the dry regions in the tropics.

Reference:

Anand, N., Satheesh, S. K., & Moorthy, K. K. (2022). Land-atmosphere interactions at a semi-arid region in the Deccan Plateau. Journal of Geophysical Research: Atmospheres, e2022JD037211.

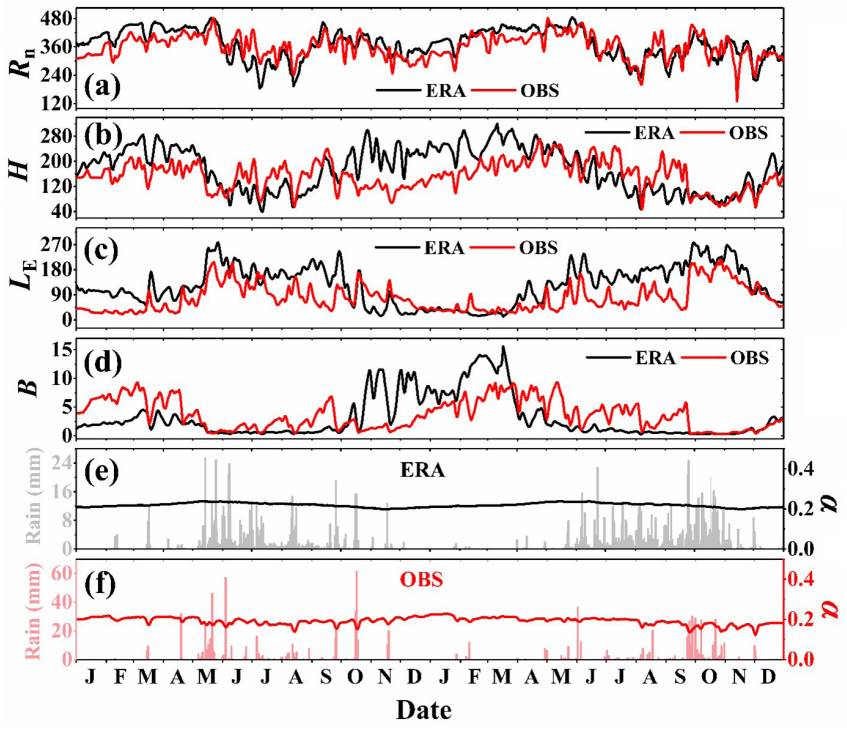

Figure 2: Daily time series of (a) net radiation (Rn), sensible heat flux (H), (c) latent heat flux (LE), (d) and Bowen ratio (B) from observations and ERA5 reanalysis; (e) rainfall and surface albedo (α) from (e) ERA5 reanalysis and (f) observations. All parameters except rainfall were subjected to 7-point moving average smoothing. ERA5 reanalysis data are marked using 'ERA' and observational data by 'OBS'. The x-axis label marks the first letters of the months during the measurement period, starting from January (J) 2018 through December (D) 2019