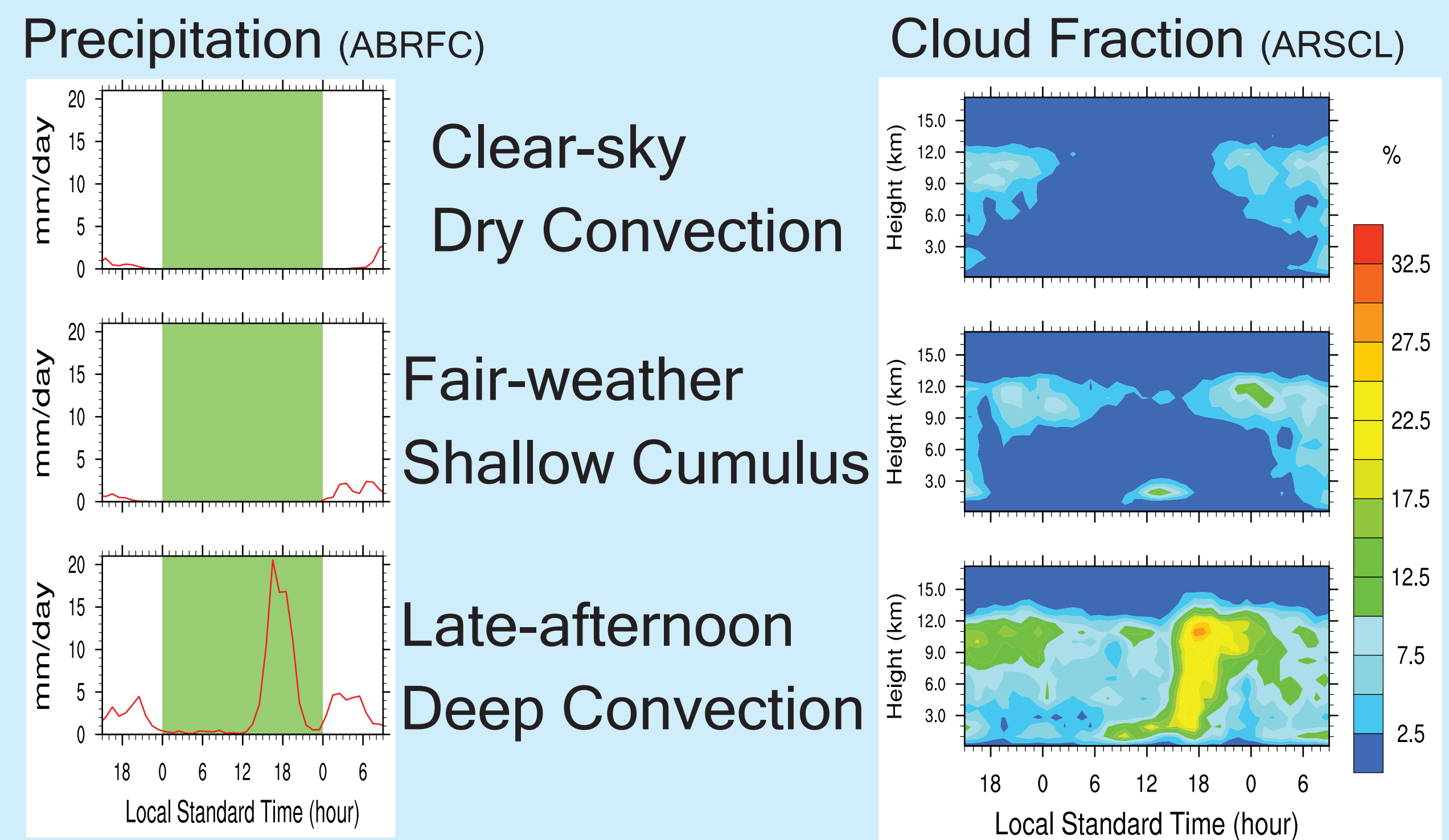
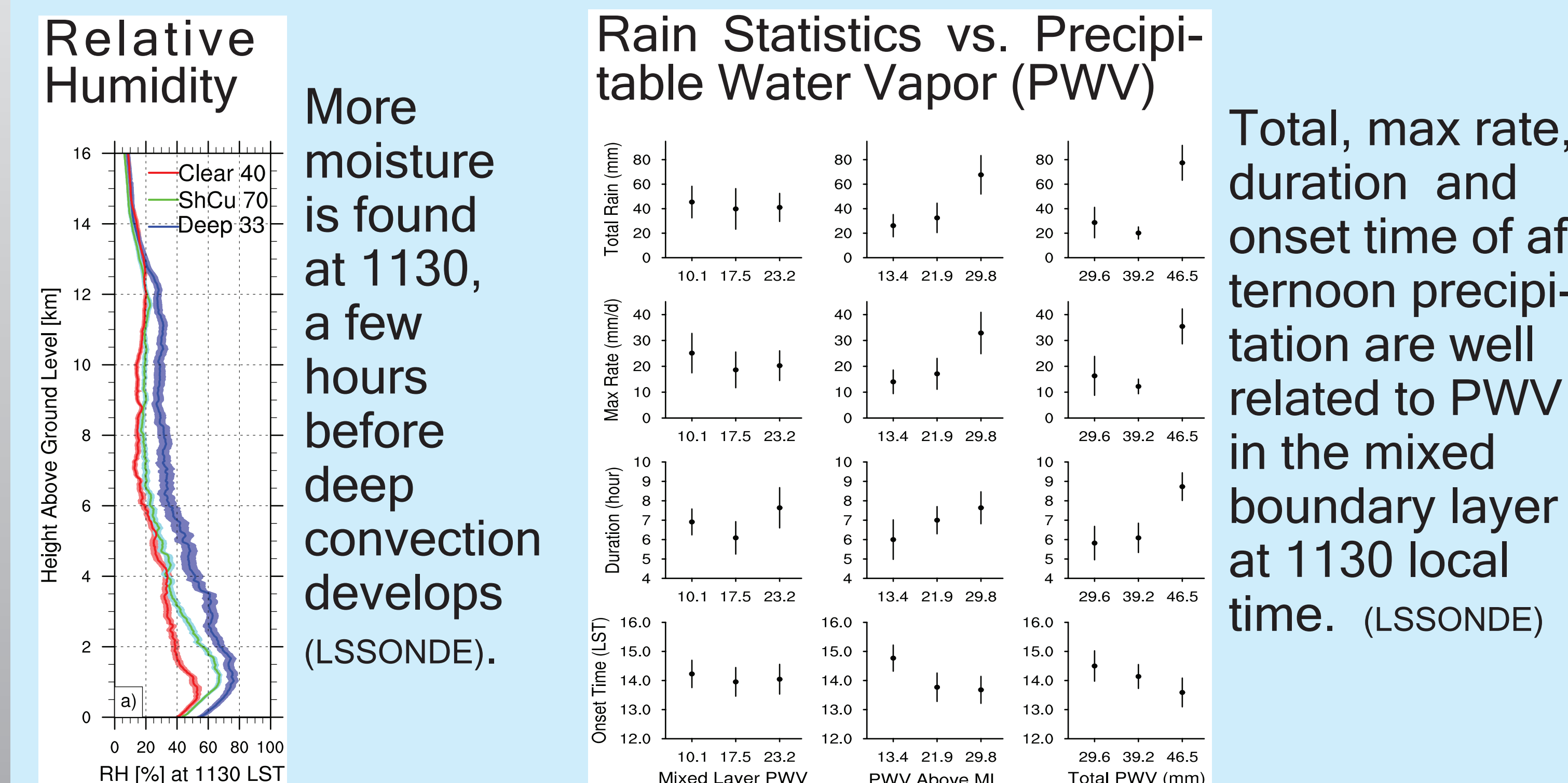


1. Diurnal Cycle Composites



4. Atmospheric Humidity

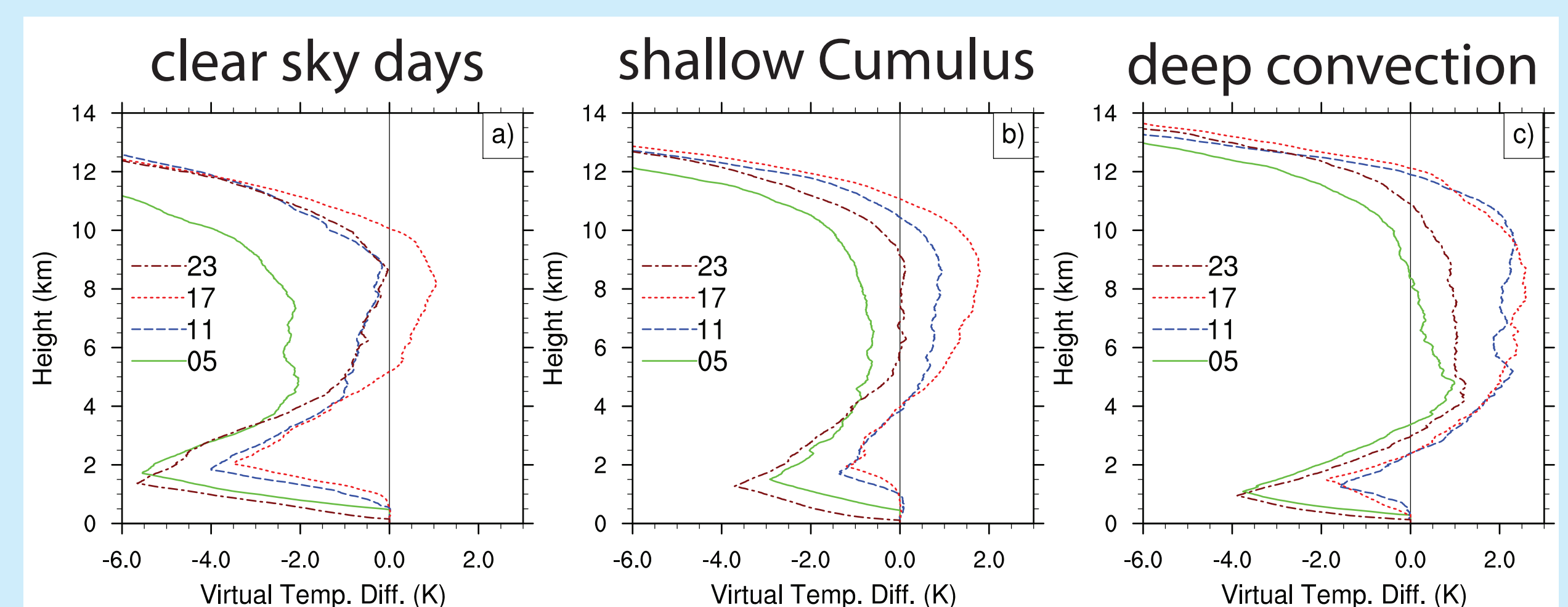


Message on Diurnal Cycle Analysis

We use ARM SGP long-term data to assess convection triggering and transition theories on stability, free-troposphere humidity and boundary layer inhomogeneity. Compared with clear-sky and fair-weather shallow cumulus days, in late-afternoon deep convection days, we found:

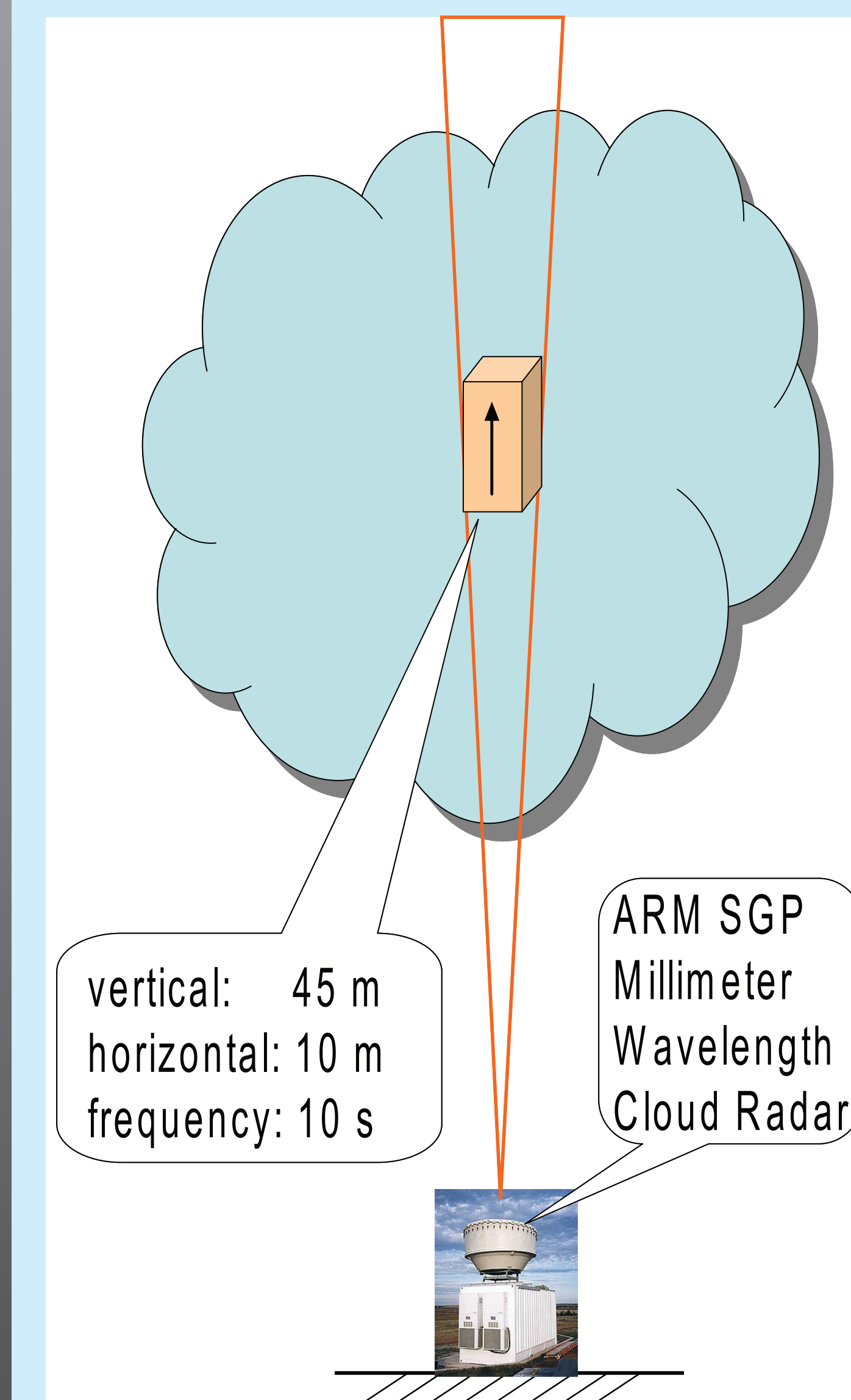
1. Stronger instability during the whole day;
2. Rain rate at the earlier stage of deep convection is weakly correlated with surface moist static energy standard deviation before the onset of the rain;
3. Larger humidity at all levels at 1130, a few hours before deep convections develop and rain statistics are correlated with moisture above boundary layer.

2. Atmospheric Stability



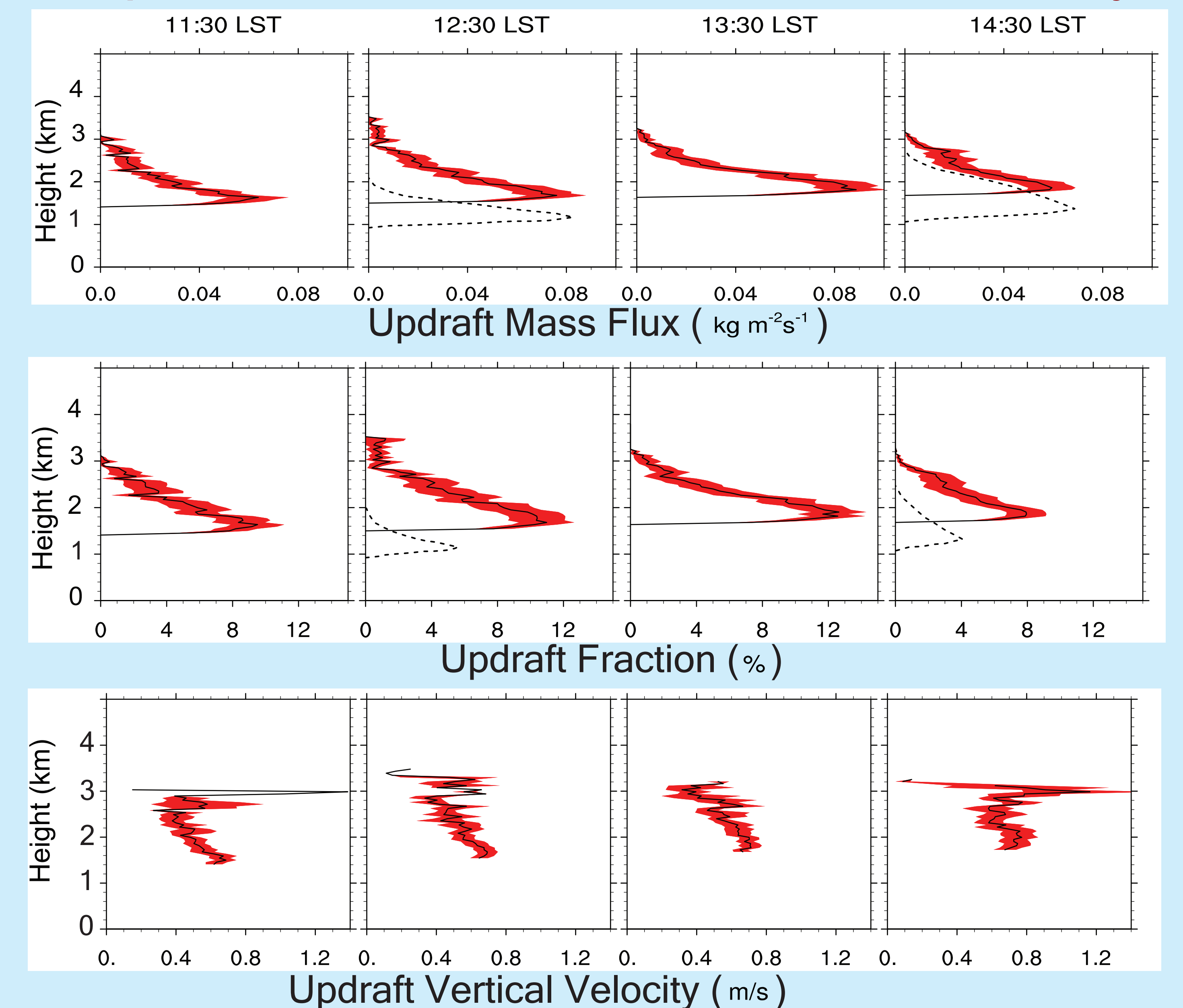
Virtual temp. difference between sounding and air parcel with maximum equivalent potential temperature in the lowest 0.5 km, lifted through reversible adiabatic processes (data from LSSOND)

5. Vertical Velocity in Fair-weather Non-precipitating Shallow Cumulus

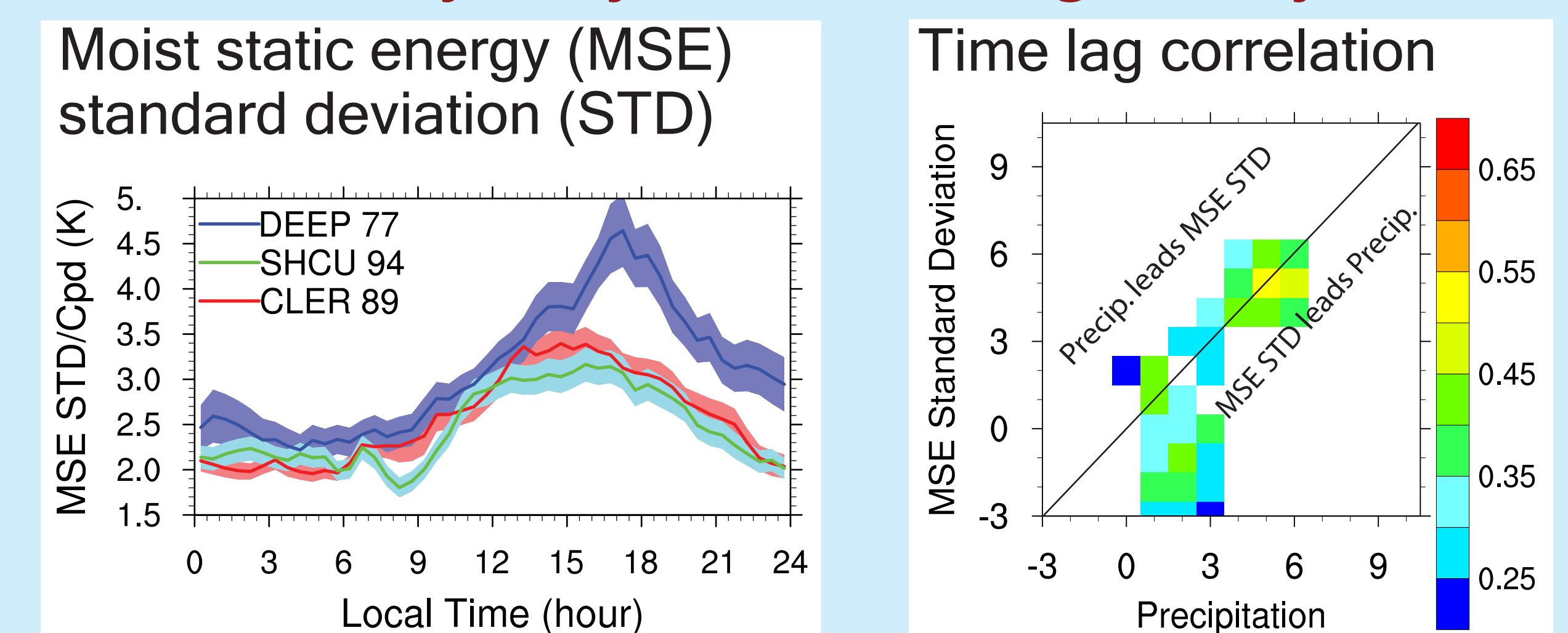


MilliMeter Wavelength Cloud Radar (MMCR) measures vertical velocity of cloud liquid droplets. The terminal velocity of a cloud droplet is small (\sim cm/s), thus the vertical velocity of cloud droplets is equal to the vertical velocity of air motion. There is NO retrieval in clear air NOR the precipitating part of the cloud; the retrieval is particularly good for non-precipitating liquid-phase shallow cumulus.

6. Updraft Mass Flux, Fraction, and Velocity



3. Boundary Layer Inhomogeneity



MSE STD is significantly larger in late-afternoon deep convection days and leads precipitation rate especially during the earlier stage of deep convection. (Data from SGP CF SMOS & 4 OK Mesonet)

Message on Vertical Velocity Data Analysis

1. The updraft mass flux and updraft fraction are comparable with LES results by Brown et al (2002)
2. The net mass flux, fluctuating around zero at all levels, is unexpected. This is caused by the similarity between updraft and downdraft, both in magnitude and the fraction in clouds.

We plan to perform LES for the composite case of fair-weather shallow cumulus and to sample the same way as observations do, so that we would investigate whether these observations on vertical velocity are specific feature of shallow cumulus over land or not.