# Vertical Velocities in Continental Boundary Layer Stratocumulus Clouds

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## 1. Introduction:

Continental boundary Layer (BL) stratocumulus (Scu) clouds are not only important due to their impact on radiation budget but also due to their close coupling with the turbulence in the BL. They are fundamental in regulating the vertical structure of water vapor and entropy and also affect the local weather. In this study an attempt is made to characterize the vertical velocity (w) in these clouds, using the high resolution (4 sec; 45 m) data from the Millimeter Cloud Radar (MMCR) at the Southern Great Plains (SGP) site. Eleven cases of non-precipitating BL Scu clouds are analyzed to get pdf of w and its representative parameters like the variance, skewness, updraft and downdraft fraction for each 30 min period. Fig. 1 shows the parameters and Fig. 2 show the mass-flux averaged from all 11 cases.

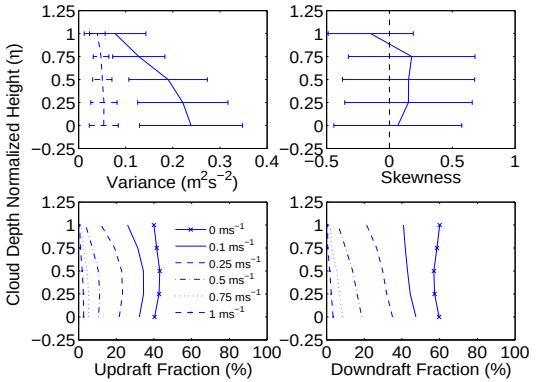


Fig 1: Vertical velocity variance (top left), skewness (top right), updraft fraction (bottom left) and downdraft fraction (bottom right) as a function of cloud depth normalized height (η) derived from half hour statistics from 11 cases.

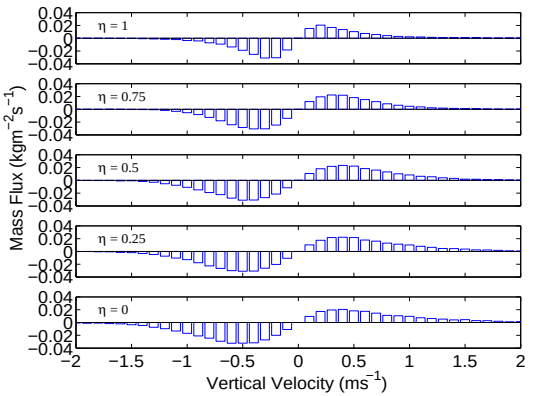


Fig 2: Averaged mass-flux as a function of w from all the 11 cases. The panels show the mass-flux at five different cloud depth normalized heights (η) with top panel with η=1 for cloud top and bottom panel with η=0 for cloud base.

## 2. Case Classification:

The 141 half-hour periods from the 11 cases were then classified based on certain criteria. Shown here are the results when the cases were classified based on the surface buoyancy flux (VHF). Periods with the surface buoyancy flux less than 10 $Wm^{-2}$ were labeled as "Stable" while with surface buoyancy flux greater than 60 $Wm^{-2}$ were labeled as "Unstable". 50 stable and 44 unstable half-hour periods were obtained based on this classification. Shown in Fig 3 are the averaged variance and skewness for the stable and unstable periods. The conditionally sampled updraft fraction and downdraft fraction for six different thresholds for this classification are shown in Fig 4. Fig. 5 shows the mass-flux as a function of velocity at five different cloud depth normalized levels.

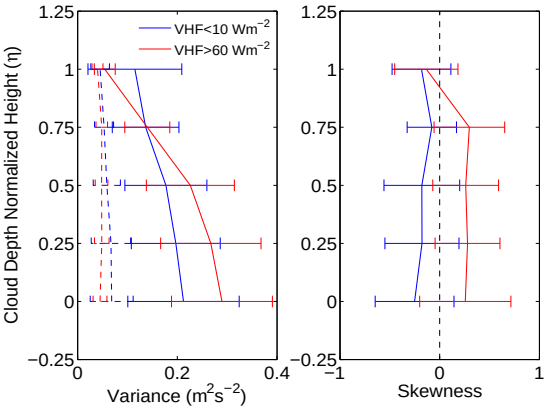


Fig 3: W variance and skewness as a function of cloud depth normalized height (η) averaged for periods with surface buoyancy flux less than 10 $Wm^{-2}$ (blue) and greater than 60 $Wm^{-2}$ (red).

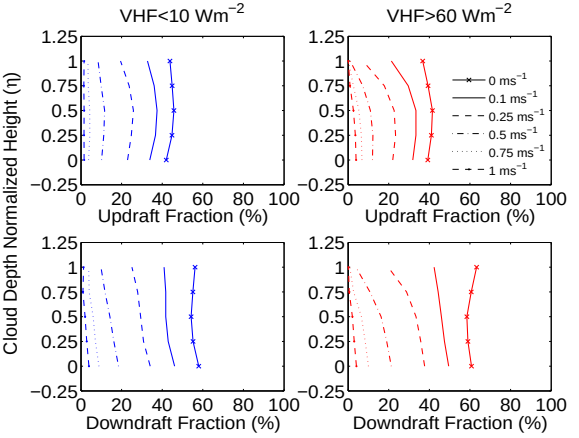


Fig 4: Conditionally sampled updraft fraction (top panels) and downdraft fraction (bottom panels) averaged for periods with surface buoyancy flux less than 10 $Wm^{-2}$ (left panels) and greater than 60 $Wm^{-2}$ (right panels) as a function of cloud depth normalized height (η).

## 3. Summary & Future Work:

ARM observing facilities offer unique dataset to study continental BL Scu clouds. The high resolution MMCR data from 11 cases of nonprecipitating Scu clouds was used to develop half-hourly vertical velocity statistics. The measurements from other instruments like radiosondes, radiometer, surface met. station, flux suite were used to map the BL structure. The half-hour periods were then classified based on certain criteria and the variations in the pdf of w for the classification were studied. The future work will focus on relating the dynamical parameters like the variance and skewness of w with cloud microphysical parameters to study the complex interaction between dynamics and cloud microphysics.

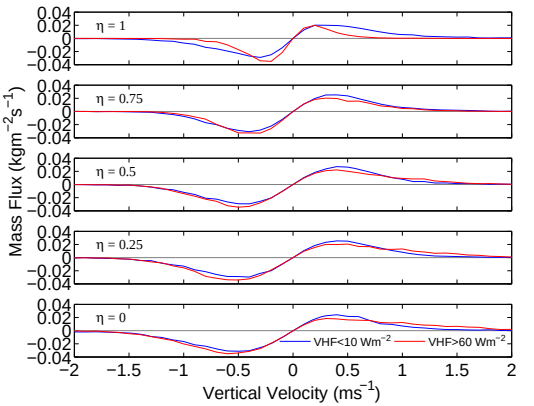


Fig 5: Averaged mass-flux as a function of w for periods with surface buoyancy flux less than 10 $Wm^{-2}$ (blue) and surface buoyancy flux greater than 60 $Wm^{-2}$ (red). The panels correspond to five different cloud depth normalized heights (η) with top panel with η=1 for cloud top and bottom panel η=0 for cloud base.

## References:

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