Dual-Frequency Profiler Vertical Air Motions Retrieved during TWP-ICE

Christopher Williams[1,2], Scott Collis[3], Peter May[3] and Alain Protat[3]

[1]CIRES, University of Colorado, [2]NOAA ESRL Physical Sciences Division, Boulder CO

[3]Centre for Australian Weather and Climate Research (CAWCR), a joint centre between the CSIRO and Australian Bureau of Meteorology, Melbourne, Australia

Basis of Dual-Frequency Vertical Air Motion Technique

VHF (50-MHz) profilers are sensitive to both Bragg and Rayleigh scattering.

Bragg scattering corresponds to vertical air motions

Rayleigh scattering corresponds to hydrometeor motion

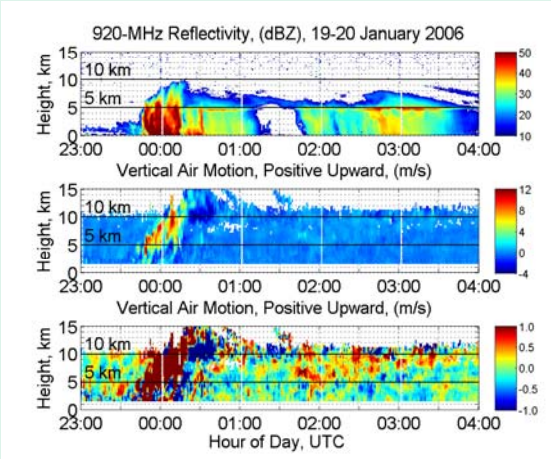
UHF (920-MHz) profilers are sensitive to Rayleigh scattering

Goal: *Use the 920-MHz profiler spectra to mask out the hydrometeor motion in the 50-MHz profiler spectra and estimate the vertical air motion from the residual.*

Simplified Description

1. Reduce the 920-MHz profiler spectra vertical resolution (100 m) to match the 50-MHz profiler resolution (500 m).
2. At each range gate, estimate Probability of Rayleigh scattering ($P_{Rayleigh}$) using 920-MHz profiler spectra.
   $P_{Rayleigh} = 0 \longrightarrow$ hydrometeors are not present
   $P_{Rayleigh} = 1 \longrightarrow$ hydrometeors are present
3. Calculate Probability of Bragg Scattering:
   $P_{Bragg} = 1 - P_{Rayleigh}$
4. Filter 50-MHz profiler spectra using P_{Bragg}:
   $S_{Filter}(v_i) = P_{Bragg}(v_i) * S_{50\text{-}MHz}(v_i)$
5. Find valid integration limits using S_{Filter}
6. Find moments using original 50-MHz profiler spectra.

Vertical Air Motion Estimates

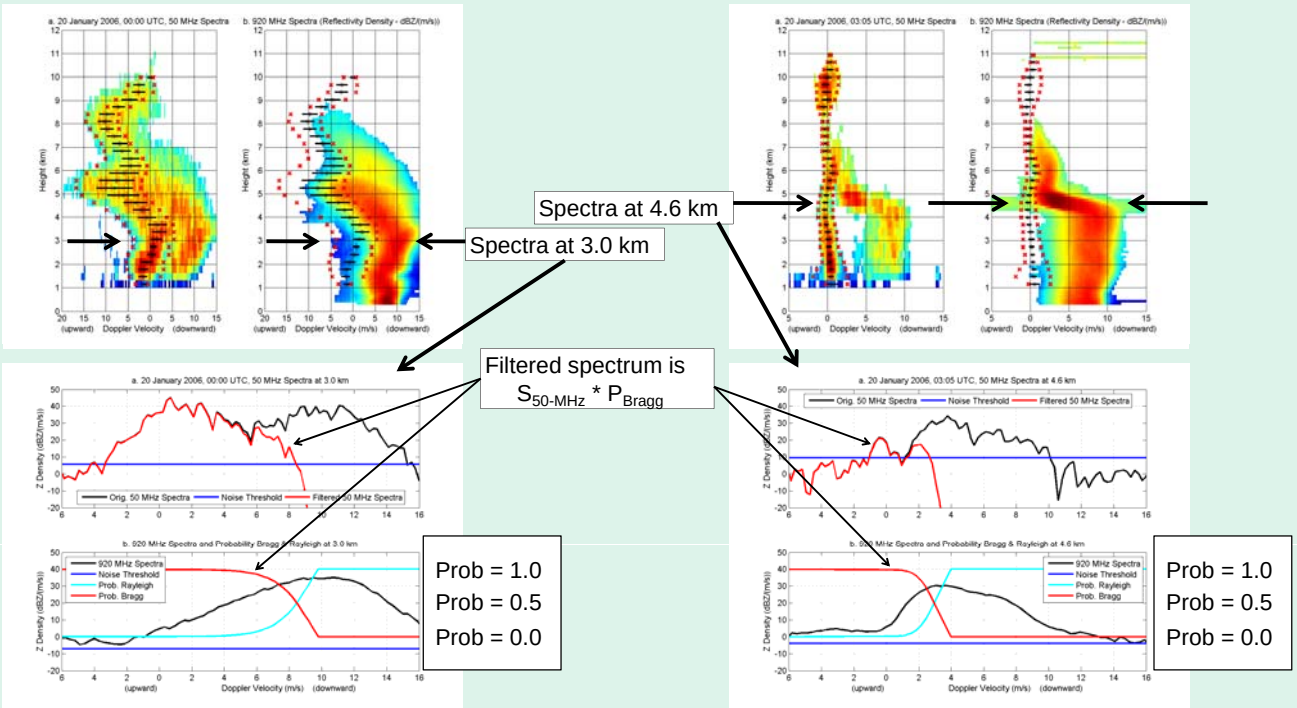


These columnar vertical air motion estimates provide a reference measurement for dual-Doppler scanning radar vertical air motion estimates (See Collis et al. poster).

Examples from Tropical Warm Pool – International Cloud Experiment

Convective Event – 00:00 UTC on 20 January 2006

Stratiform Event – 03:05 UTC on 20 January 2006



Planned Application in MC³E

This dual-frequency vertical air motion technique can be applied to 449-MHz and 2.8-GHz profiler spectra which will be deployed in MC3E (May-June 2011 – SGP).

Example spectra from the NAME campaign.