Special application of polarimetric phased array weather surveillance radar

*Dusan Zrnic[1], S. Koch[1], V. Melnikov[2], R. Rabin[1], P. Zhang[2]

1. NOAA/NSSL, 2. CIMMS/OU

Flexibility of the polarimetric phased array radar offers opportunities to observe characteristics of the atmosphere that are typically not required from weather surveillance radars. Among these are the growth of the PBL and location where water vapor penetrates deeper into the free atmosphere. Within these areas, preferential spots where convective clouds are more likely to form can be identified and the vertical growth rate of these clouds can be determined. This information supplemented with satellite observations could help forecasters or models to locate storms genesis. Increase in radar sensitivity can facilitates detection of boundaries which may trigger convection. It is hypothesized that with sufficient sensitivity, the environmental winds around storm may be quantified. Thus, it should be possible to determine how the interaction of storms with the environmental winds affects subsequent evolution of convection. Also, wind profiling in clear air may be possible through and above the planetary boundary layer.

Besides the kinematics of the boundary layer it may be possible to quantify the humidity near the interface with the free atmosphere (capping inversion). This may be achieved from measurements of the refractive index structure parameter $(C_n)^2$. Assuming the vertical gradients of the structure parameter are dominant and the parameter is locally homogeneous it should be possible to obtain the horizontal distribution of the height of the max$[(C_n)^2]$. Typically the maximum is at the top of the boundary. To identify the radar returns are caused by turbulent eddies, polarimetric information is needed. The $(C_n)^2$ strongly depends on turbulence dissipation rate and gradients of humidity while it is much less affected by gradients of temperature. The dissipation rate of turbulent eddies can be estimated from the Doppler spectrum width and accounted for in the values of $(C_n)^2$. Then it is in principle possible to estimate the vertical gradients of humidity. But, to retrieve humidity at the top of the boundary layer constraining parameters are needed. These could be surface measurements of humidity or model estimates of humidity.

Keywords: Winds near storms and boundary layer, Refractive index structure parameter, Measurement of humidity