Passive Microwave Observations during Strong Convection

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A cluster of tornadoes with winds up to 180 mph killed one person and destroyed 50 homes in northern Colorado on 22 May, 2008. Large temperature and humidity variations caused by convective updrafts and downdrafts were observed by a microwave radiometer profiler at Boulder, Colorado, 40 km southwest of an F-3 tornado. The radiometer also observed dramatic water vapor to liquid transitions. The 1-mile diameter tornado crossed an interstate highway and a railroad, rolling tractor trailers and railcars along a 30 km northward path to Windsor, Colorado, where most of the homes were destroyed.

Convective Available Potential Energy (CAPE) from radiometric data peaked at 2,519 joules/m^3 one half hour before the tornado struck Windsor (CAPE is the energy source for convection). A special NWS radiosonde launched at Denver, 50 km south of the tornado, 15 min after it touched down, showed 1,500 joules/m^3 CAPE. Doppler radar images showed 180 mph vortex winds at Windsor. Radiometer, wind profiler and radiosonde skew-T plots showed CAPE and other forecast indices during the regional strong convection.

Liquid feature winds were derived from north-south radiometer observations at 30 degrees elevation, similar to the way cloud top winds are obtained from time-sequenced satellite observations. Temperature and water vapor feature winds can also be obtained from profile cross-correlation at various heights from opposite off-zenith radiometer observations.

This severe weather case demonstrates that radiometric sensing of upper-air thermodynamics in early stage convection can improve short term convective forecasting. The authors are evaluation the impact of radiometer and wind profiler data on convective prediction by numerical weather models.