View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by NASA Technical Reports Server

Abstract for 36th AMS Conference on Radar Meteorology

Polarimetric and multi-Doppler radar observations of electrified and unelectrified wildfire smoke plumes

Timothy J. Lang[1*], Steven A. Rutledge[2], Brenda Dolan[2], Paul Krehbiel[3], William Rison[3], Daniel T. Lindsey[4]

[1]NASA Marshall Space Flight Center, (ZP11) Huntsville, AL 35812
[2]Colorado State University, Fort Collins, CO
[3]New Mexico Institute of Mining and Technology, Socorro, NM
[4]NOAA/NESDIS/STAR/RAMMB, Fort Collins, CO

[*]Presenting Author

Pyrocumulus clouds above three Colorado wildfires (Hewlett Gulch, High Park, and Waldo Canyon; all occurred during summer 2012) electrified and produced small intracloud discharges whenever the smoke plumes grew to high altitudes (over 10 km above mean sea level, or MSL). This occurred during periods of rapid wildfire growth, as indicated by the shortwave infrared channel on a geostationary satellite, as well as by incident reports. In the Hewlett Gulch case, the fire growth led to increased updrafts within the plume, as inferred by multiple-Doppler radar syntheses, which led to the vertical development and subsequent electrification - a life cycle as short as 30 minutes. The lightning, detected by a three-dimensional lightning mapping network, was favored in high-altitude regions (~10 km MSL) containing modest reflectivities (25 dBZ and lower), ~0 dB differential reflectivity, and reduced correlation coefficient (~0.6-0.7). This indicated the likely presence of ice particles (crystals and aggregates, possibly rimed) mixed with ash. Though neither multiple-Doppler nor polarimetric observations were available during the electrification of the High Park and Waldo Canyon plumes, their NEXRAD observations showed reflectivity structures consistent with Hewlett Gulch. In addition, polarimetric and multiple-Doppler scanning of unelectrified High Park plumes indicated only irregularly shaped ash, and not ice, was present (i.e., reflectivities < 25 dBZ , differential reflectivity > 5 dB, correlation < 0.4), and there was no broaching of the 10 km altitude. Based on these results, the electrification likely was caused by ice-based processes that did not involve significant amounts of graupel. The results demonstrate the scientific value of multiple-Doppler and polarimetric radar observations of wildfire smoke plumes - including the ability to distinguish between regions of pure hydrometeors, regions of pure ash, and mixtures of both - and also suggest a possible new application for lightning data in monitoring wildfires.