Assimilation of merged NLDN/GLD360 and GLM lightning data in the High Resolution Rapid Refresh (HRRR) and Rapid Refresh Forecast System (RRFS) weather prediction systems

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Abstract

The High Resolution Rapid Refresh (HRRR) is a convection-resolving hourly-updated model run operationally by NOAA to provide detailed forecast guidance for thunderstorms and other hazardous weather. Convective weather phenomena are initialized within the HRRR via a latent-heating scheme relying primarily on radar reflectivity observations, augmented by lightning observations from ground-based sensing networks (NLDN and GLD360) to enhance heating within convective cores and to supplement areas of low radar coverage.

The final operational implementation of the HRRR will occur in 2020, and development has commenced on its successor, the FV3-based Rapid Refresh Forecast System (RRFS), planned for implementation in 2023. For RRFS implementation, we will supplement assimilation of NLDN/GLD360 lightning data with observations provided by the Geostationary Lightning Mapper (GLM) instruments onboard the GOES-16 and GOES-17 satellites. These satellites provide continuous detection of total (in-cloud, cloud-to-cloud, and cloud-to-ground) lightning throughout the planned RRFS domain and with an approximate 10-km resolution. These satellite data complement ground-based observations for storms over data sparse regions (primarily oceanic regions adjacent to North America for the RRFS).

We combine the satellite and ground-based lightning data sets to create a lightning flash density field suitable for initializing rapidly updating models covering North America and adjacent oceanic regions and test various assimilation strategies for this combined data set. The assimilation strategies include our current method of specifying latent heating within the model in regions with observed lightning and more direct ensemble-based approaches. At the conference, we will describe the lightning dataset merging procedure and assimilation techniques and present case study results illustrating forecast skill from assimilation of these data. Our current testing still uses the HRRR system as a proxy for the RRFS, but as the RRFS model and assimilation procedures continue to mature, we will shift our efforts to test in the RRFS framework and expect to have preliminary RRFS-based lightning assimilation results at the conference.

Topic Areas

Meteorology: Numerical Modeling and Nowcasting

Submission Format

Oral