An Integrated 0-1 hour First-Flash Lightning Nowcasting, Lightning Amount and Lightning Jump Warning Capability

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Project Goals
- Using satellite-based methods that provide accurate 0-1 hour convective initiation (CI) nowcasts, and rely on proven success coupling satellite and radar fields in the Corridor Integrated Weather System (CWS; operated and developed at MIT Lincoln Laboratory), to subsequently monitor first-lightning initiation (LI) and later period lightning trends as storms evolve.
- Enhance IR-based methods within the GOES-R CI Algorithm (that must meet specific thresholds for a given cumulus cloud before the cloud is considered to have an increased likelihood of producing lightning next 90 min) that forecast LI.
- Integrate GOES-R CI and LI fields with radar thresholds (e.g., first ≥240 dBZ echo at the −10 °C altitude) and NWP model data within the WDDSS-I system for LI-events from new convective storms. Track ongoing lightning using Lightning Mapping Array (LMA) and pseudo-stationary Lightning Mapper (GLM) data to assess per-storm lightning trends (e.g., as tied to lightning jumps) and outline threat regions.
- Evaluate the ability to produce LI nowcasts through a “lightning threat” product, and obtain feedback from National Weather Service forecasters on its value as a decision support tool.

Proof of Concept
- Satellite-based information has been shown to aid in the realtime nowcasting of CI and LI, as already demonstrated within CWS for improved 0-2 hour CI and LI nowcasts. CWS is an integral part of CoSPA, for NWS. Satellite-based lightning forecast products have been initially formed, and can be useful given that lightning is a serious hazards to airports and terminal operations, outdoor activities, construction personnel, and events.

Expected Outcomes
- Prior research (Harris et al. 2010; Matte and Meckalski 2013) have developed understanding of how specific satellite and channel time and channel trends influence growing cumulus clouds that later go on to produce lightning.
- Construct a “detector” based upon GOES LI indicators.

Lightning Initiation Interest Fields
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Immediate Plans
- Develop Lightning Threat (WDSS-II) system to be semi-real-time by summer 2015.
- Optimize use of radar and GOES infrared indicators toward predicting first-flash LI.
- Develop threat cone within WDSS-II as cloud objects evolve to radar objects with accompanying LMA flash density data.
- Move to fully integrate High Resolution Rapid Refresh (HRRR) model LFA forecasts into the WDSS-II system.
- Collect performance statistics and demonstrate with NWS Forecasts for Lightning Threat product design.
- Develop a statistical model (with a training database) toward optimizing the skill of the Lightning Threat 0-60 min forecast product.

Processing Methodology & Data
- Identify date over the North Alabama Lightning Mapping Array (LMA) domain that LI occurred, which is typical of many days during summer (May–September).
- Collect GOES infrared (and 3.9 µm reflectance) fields.
- Focus on LI indicators that highlight non-injunctive charging (strong updrafts within mixed phase region of cloud), and therefore highlight where lightning can occur.
- Incorporate Multi Radar Multi Sensor (MRMS; Zhang et al. 2011) generated field of reflectivity at −10 °C altitude and GOES-based objects of growing convective clouds from GOES-R CI Algorithm into the WDSS-II tracking system.
- (1) Set 60-75 min LI predictions for GOES objects. (2) Track cloud objects to the point in time when a radar echo at −10 °C appears. (3) Once a ≥40 dBZ echo appears at −10 °C, then update the LI prediction (the 20-30 min lead-time period). (4) Associate a LI-object with LMA data once lightning occurs. (5) Project a “Lightning Threat” forward/downstream in a “warning cone”.

1800–1955 UTC 31 May 2014

This first case example occurred with NASA support (since July 2014) through grant NNX14AG23G. PI John R. Meckalski/UArHuntville

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