Preparing for the GOES-R Era: The Geostationary Lightning Mapper (GLM) Perspective

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Outline and Overview

1) Lightning Observations
   - Multi-scale lightning observations
   - Ground-based network performance
   - GLM specifications and benefits

2) Storm Warning Applications
   - Lightning jumps and severe weather
   - Improving precipitation estimates
   - Data assimilation (modeling efforts)
   - Improving hurricane intensity forecasts
   - Ocean Prediction Center evaluation

3) Public Safety Applications
   - Washington D.C. Lightning Mapping Array (DCLMA) and the outreach opportunities it provides

The Many Types of Lightning
Multi-Scale Lightning Observations

- **“Regional” Networks**
  - Continental Scale
  - Lightning Mapping Arrays (LMA)

- **“Global” Networks**
  - Long-Range, ground-based
  - Observations from space

Long-range networks leverage ionospheric reflections

Right: Comparison of TRMM and LMA Observations (from Carey and Schultz)
Ground-Based Lightning Network Performance

“Evaluating WWLLN Performance Relative to TRMM/LIS”

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Earth Networks Total Lightning Network (ENTLN)

Worldwide Lightning Location Network (WWLLN)

Above: Coincidence fraction and seasonal variability plots courtesy of Kelsey Thompson/UAH and Monte Bateman/USRA

Rudlosky and Shea 2013
Geophys. Res. Letters
GOES-R Geostationary Lightning Mapper (GLM)

- Nearly uniform performance in both space and time
- GLM will observe intra-cloud (IC) and cloud-to-ground (CG) lightning
- The first flash in a storm is almost always IC (and most flashes are IC)
- Spatial and temporal resolutions that are currently unavailable
- Must use existing networks to simulate future capabilities
May 3 1999 Oklahoma Tornado Outbreak

1-minute of observations from TRMM/LIS
GOES-14 Super-Rapid Scan (SRSOR) Experiment
SRSOR plus DCLMA Observations

13 Jun 2013: 1801Z
GLM Mission Benefits

- Lightning Jumps in Severe Storms
- Improving Satellite Precipitation Estimates
- Lightning Data Assimilation (Modeling Efforts)
- Improving Tropical Cyclone Intensity Forecasts
- Evaluation at NWS Ocean Prediction Center (OPC)
Lightning Jumps and Severe Storms

Improved situational awareness and forecaster confidence results in more accurate severe storm warnings (i.e., improved lead times and reduced false alarms)

Schultz et al. 2011
- Using lightning data alone, predicted severe weather with 20.65 min lead time
- 79% probability of detection (POD)
- 36% false alarm rate (FAR)

Rudlosky et al. 2013
- Severe = 1.44 jumps h⁻¹; Non-severe = 0.92 jumps h⁻¹
- Adding a 10 mm Maximum Expected Size of Hail (MESH) threshold:
  - Severe = 1.25 jumps h⁻¹; Non-severe = 0.61 jumps h⁻¹
Adler et al. – Convective Stratiform Technique (CST) is confused by thick cirrus, thick anvil debris, or large Mesoscale Convective System (MCS) cloud shields.

- Lightning information consistently improved convective detection (POD) by 8% and lowered false alarm rate (FAR) by 30%.
Lightning Data Assimilation (Modeling Efforts)

OBSERVED

CONTROL

LIGHTNING

 Courtesy of A. Fierro, CIMSS/NOAA
Improving Tropical Cyclone Intensity Forecasts
Lightning Product Evaluation at OPC

- **GOES-R Proving Ground Project**
  - Create flash density grids at GLM resolution using a ground-based network (i.e., GLD360)

- **Evaluation during Summer 2013**
  - Develop training materials, shadow forecasters, and compose report

- **Expand to additional NWS Centers**

**Flash Locations**

**Flash Density Grids**

**Collaborators**
Joe Sienkiewicz
Greg McFadden
Michael Folmer
Scott Rudlosky
Dustin Shea
Hurricanes Ingrid and Manuel (14-15 September)

Vaisala GLD-360

GLD-360 Lightning Density
Summary

- The GLM will provide total lightning observations at spatial and temporal scales that are currently unavailable.
- Presently using ground-based networks to prepare forecasters and the general public for the GOES-R era.
- Many applications will benefit from GLM operations:
  - Lightning jumps and severe weather
  - Improving precipitation estimates
  - Data assimilation (modeling efforts)
  - Hurricane Intensity Forecasts
  - National Weather Service Operations