Training Quick Guide for the Earth Networks Total Lightning Network (ENTLN)

Operational Use and Benefits

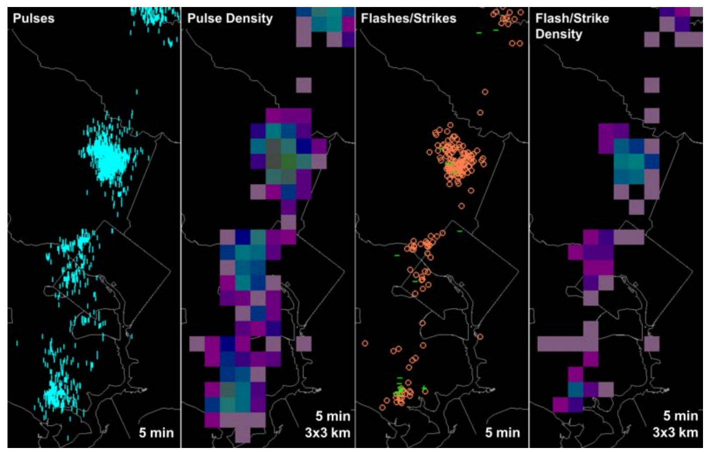
- Detect electrically active storms – IC precedes CG
- Determine the areal extent of the lightning threat
- Track convective cells embedded in larger features
- Identify strengthening and weakening storms
- Monitor convective mode and storm evolution
- Supplement radar data where coverage is poor
- Prepare for the Geostationary Lightning Mapper

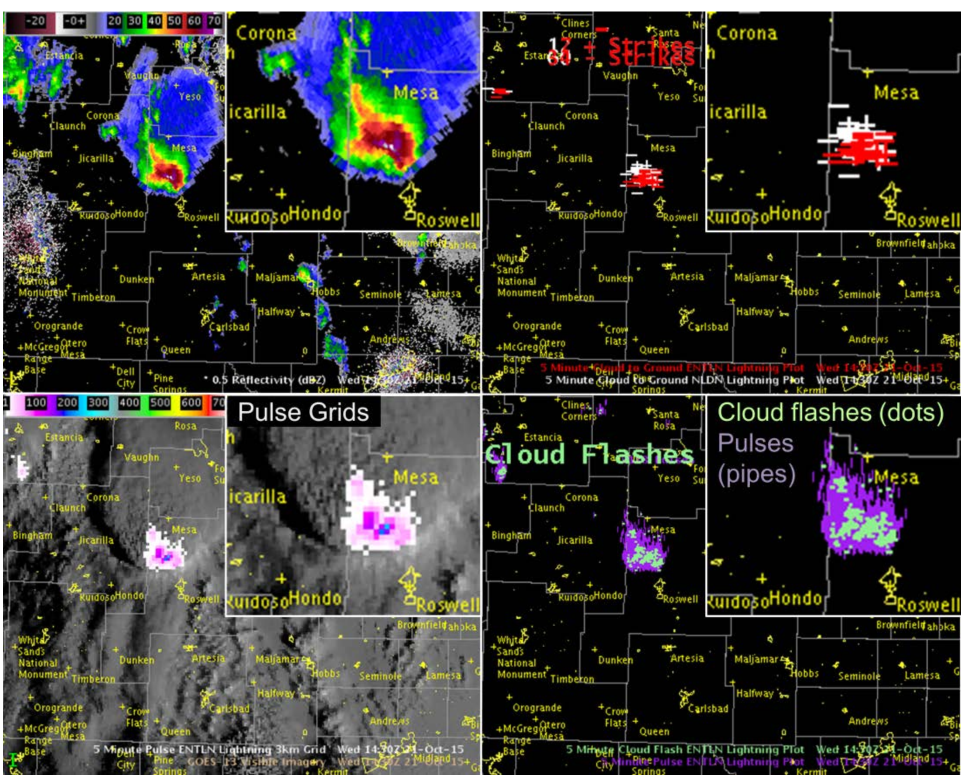
Gridded ENTLN Products

- ENTLN pulse and flash density grids in AWIPS-II simply report the pulse/flash counts within grid cells of varying size over varying periods of time
- Grids are provided at different spatial and temporal resolutions to accommodate a variety of users
- The frequency of lightning flashes often indicates updraft/storm intensity (especially cloud flashes)
- Spatial interpolation can enhance the gridded display

Pulses, Strokes, and Flashes

- The ENTLN detects the components of both intra-cloud (IC) and cloud-to-ground (CG) flashes, and algorithms use waveform shapes to differentiate between the IC pulses and CG strokes
- The IC pulses and CG strokes (both termed pulses in AWIPS-II) are combined into IC and CG flashes using space (10 km) and time (0.7 sec) criteria
- A typical CG flash contains many IC pulses and one or more CG strokes, but the number of components observed per flash varies regionally





AWIPS-II Display

- Positive (negative) CG flashes are depicted by + (-) symbols (labeled strikes)
- Default cloud flash symbol recently changed from circles (above) to dots (left)
- The magnification can be manually increased to better view the cloud flash symbols
- IC pulses and CG strokes are indicated by pipe (|) symbols (both labeled pulses)
- Pulse grids better depict the spatial extent, while flash counts are more indicative of updraft intensity
- ENTLN grids are most often used to create procedures for 1) convective initiation and 2) severe weather

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Contributions from Jason Jordan, Tiffany Meyer, Brian Motta, and Matthew Elliott *2 November 2015*

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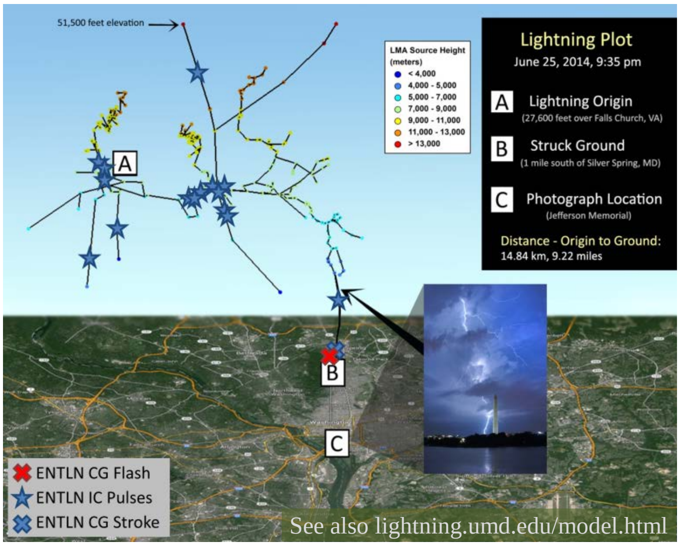


ENTLN Detection Method

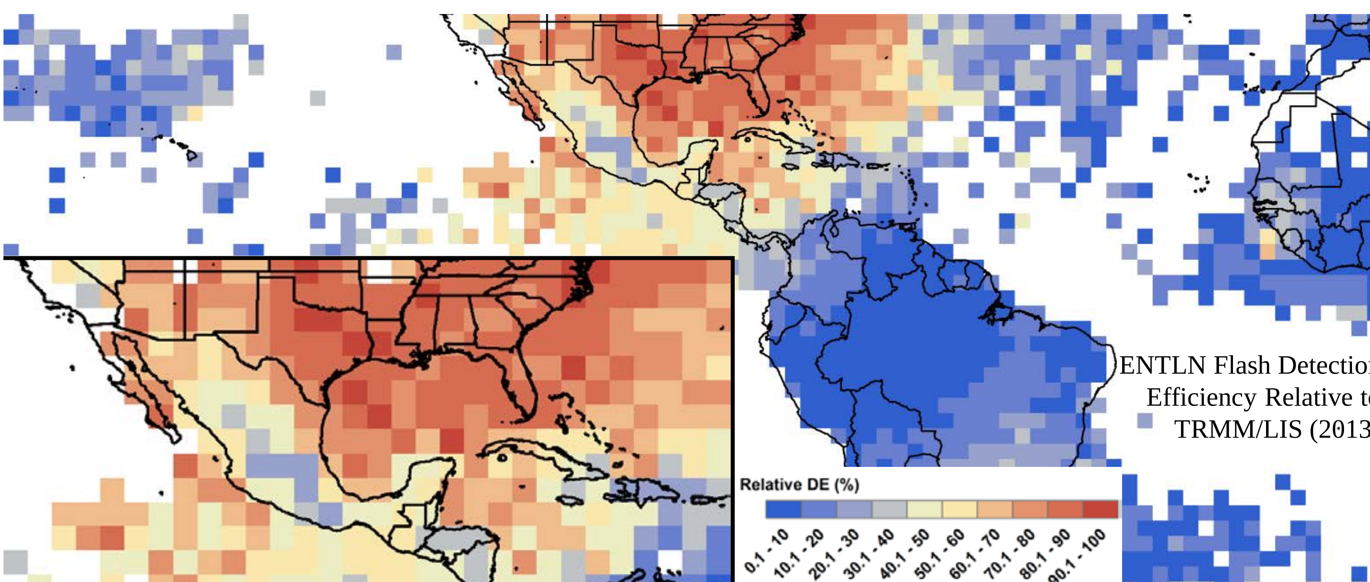
- The ENTLN monitors total lightning activity using wideband sensors with detection frequencies ranging from 1 Hz to 12 MHz (i.e., VLF to HF)
- The wide frequency range enables sensors to detect CG strokes, as well as typically weaker IC pulses
- The ENTLN employs a blended technique to provide a degree of global CG coverage with better performance (i.e., IC and CG lightning detection) in regions with greater sensor density
- The expanding high density network presently covers CONUS, Alaska, Hawaii, the Caribbean basin, Europe, Australia, Turkey, SE Brazil, Guinea, SE Africa (e.g., Kenya), Japan, and SE Asia

Total Lightning Conceptual Model

- The CG lightning flash depicted above originated ~27,000 feet AGL, covered nearly 150 square miles, and struck ground 10 miles to the northeast, well outside the parent thunderstorm
- The Washington D.C. Lightning Mapping Array observed nearly the entire channel, along which the ENTLN reported 15 IC pulses and 1 CG stroke
- In AWIPS-II, the ENTLN reports one CG strike where the flash connects to ground, while the cloud pulses better depict the spatial extent (see page 1)
- The ENTLN does not always report the full spatial extent of lightning flashes due to the varying separation distances between its sensors

ENTLN is Not the GOES-R GLM

- ENTLN detects radio waves emitted by lightning, GLM detects optical pulses from lightning
- ENTLN reports lightning as point observations, the GLM will report lightning on a 8×8 km grid
- The GLM will detect more than 70% of all flashes within its field of view, while the ENTLN detection efficiency varies spatially
- During 2013, the ENTLN detected 31.4% (79.7%) of all TRMM Lightning Imaging Sensor (LIS) flashes in the W. Hemisphere (Southern CONUS)
- The map below displays the fraction of all LIS flashes that were detected by the ENTLN during 2013 (white grid cells have less than 30 LIS flashes)



ENTLN Flash Detection Efficiency Relative to TRMM/LIS (2013)