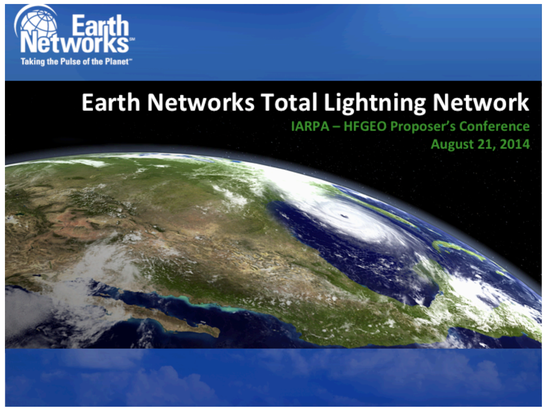
# Ionosphere Inversion using Lightning

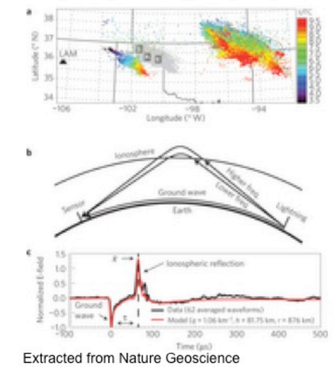



## ENTLN – Overview

- Total lightning network
- Global capability (dense networks in CONUS and other areas)
- Time Of Arrival based
- Broadband, dual digital signal processors cover LF and HF ranges
- Digital signal processing to automatically reduce local noise sources
- Very high performance metrics…detects nearly all CG and very high percentage of CF at continental scales
- Enables longer lead times for early warning storm detection

## Applied Physical Sciences — Application of ENTLN to HFGEO

- Lightning sources provide oblique measures of ionosphere interaction
- Lighting EMPs interact with local ionosphere to affect the TEC observed in the neighborhood of the storm
- Each observation can enable a bottom-side ionosphere height estimate for propagation prediction
- ENTLN provides ionosphere estimates precisely where the IRI models are mis-matched

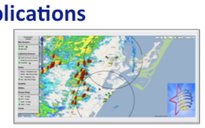


Extracted from Nature Geoscience Letters 16 December 2012
Xuan-Min Shao, Erin H. Lay and Abram R Jacobson

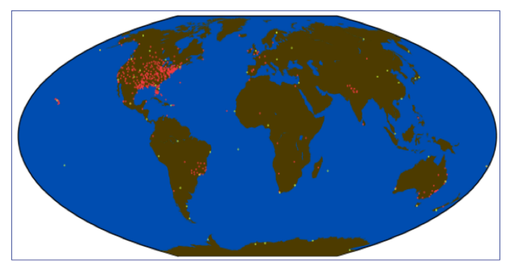
Slide 3

## Total Lightning Applications

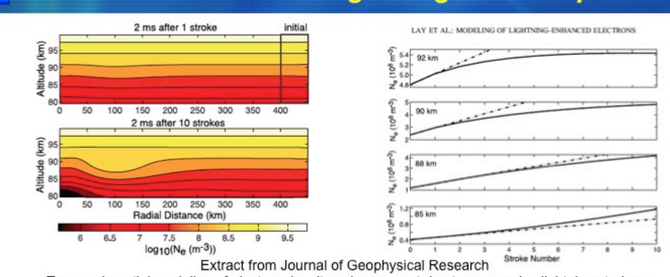
- Flash Visualizations / Overlays
  - Workstations (AWIPS): Lightning over radar
  - Proximity Notifications
- Model Assimilation
  - Currently happening at NSSL and GSD
- Derivative Products
  - Cell Tracking Alerts: Dangerous Thunderstorm Alerts (DTA's)
  - PulseRad (Proxy Radar)



## 750+ Global ENTLN Sensor Installations

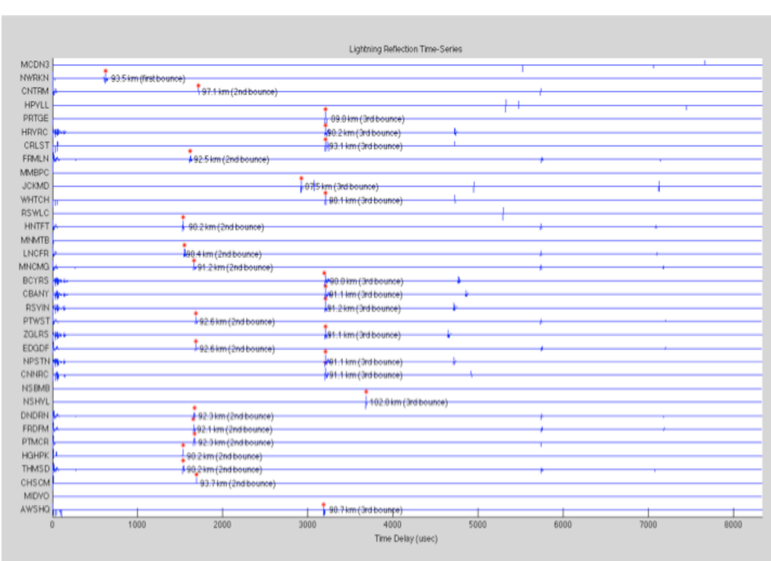


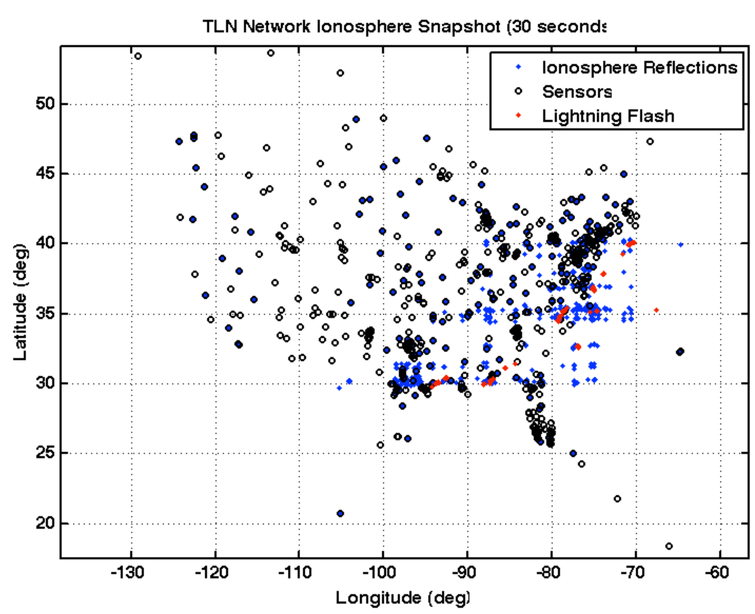
## Applied Physical Sciences — Effect of Lightning on Ionosphere

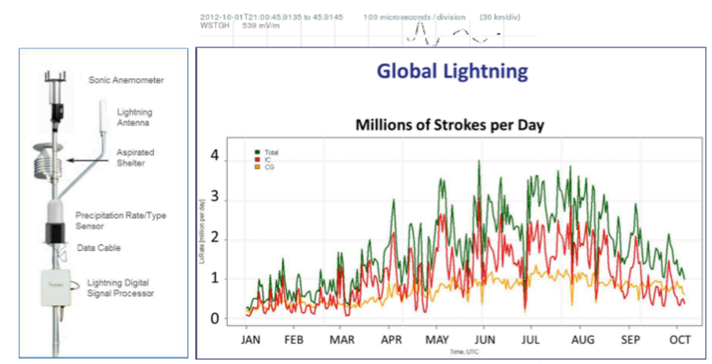



Extract from Journal of Geophysical Research
Temporal-spatial modeling of electron density enhancement due to successive lightning strokes
Erin H. Lay, Craig J. Rodger, Robert H. Holzworth, Mengu Cho, and Jeremy N. Thomas

- Lightning Strokes effect on ionosphere can be modeled effectively where localized
- Localized lightning strokes can provide input TEC model updates, as well as
- Enhance the effectiveness of propagation models




Slide 4

## How Is This Accomplished? Big Data!