

Satellite radio observations of lightning

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Outline

- FORTE Satellite Radio Observations
- Los Alamos Sferic Array (LASA)
 - Ground Truth
 - Results
- The VGLASS Proposal
- What lightning do we see at VHF from space?
- Using LASA to validate VGLASS

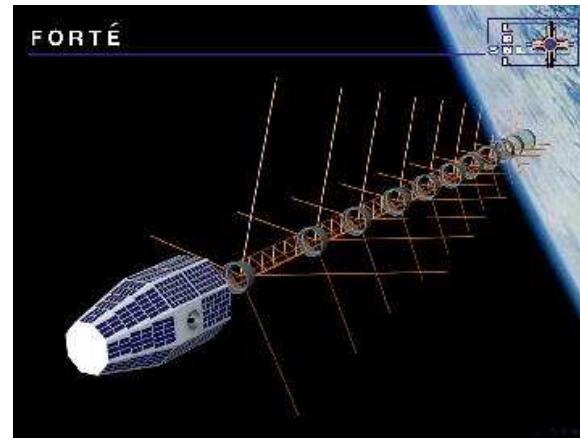


Fast On-board Recording of Transient Events

- FORTE Satellite
 - 70° inclination
 - 825 km altitude
 - 100 min. period

- Optical Package
 - Photodiode Detector (PDD)
 - 80° FOV (~ 1200 km dia.)
 - unfiltered (visible - NIR)
 - 15 μ s sample rate
 - Lightning Locator Subsystem
 - 128 x 128 CCD
 - square 'inset' in PDD FOV
 - 770 nm filtered

- Radio Package
 - 3 dB 'FOV' ~ 80°
 - Medium-Band Receivers
 - 2 x 22 MHz w/in 20-300 MHz
 - 20 ns resolution (50 MSa/s)
 - 8 sub-band triggering system
 - Wideband Receiver
 - 100 MHz analog bandwidth
 - 300 MSa/s

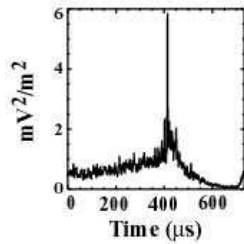




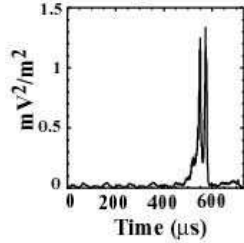
FORTE Lightning Observations

Cloud-to-Ground (CG) Lightning

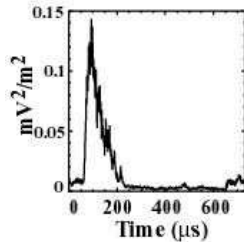
Stepped leader, 1st-RS



Subsequent-RS

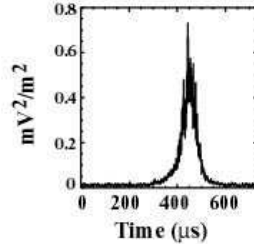


1st +RS

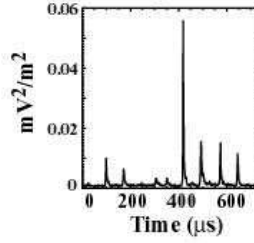


Intracloud (IC) Lightning

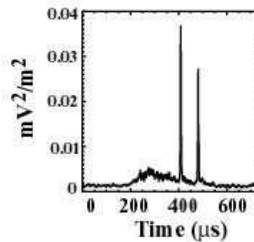
Non-impulsive



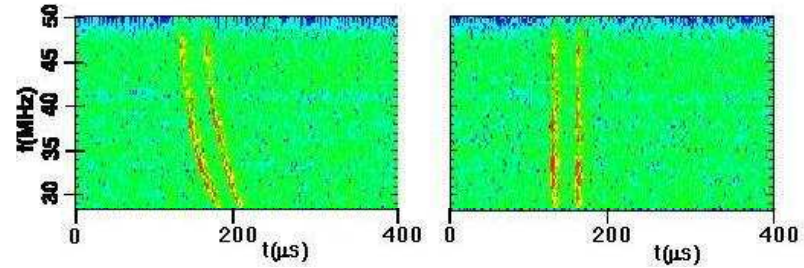
Impulsive



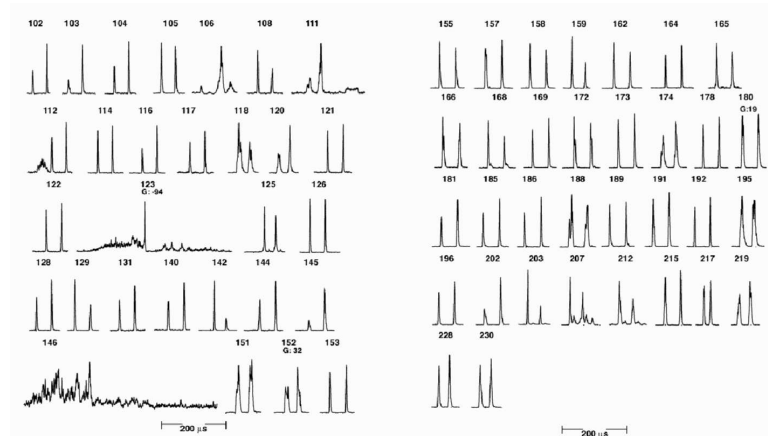
Mixed



• De-chirping



• Storm





Los Alamos Sferic Array

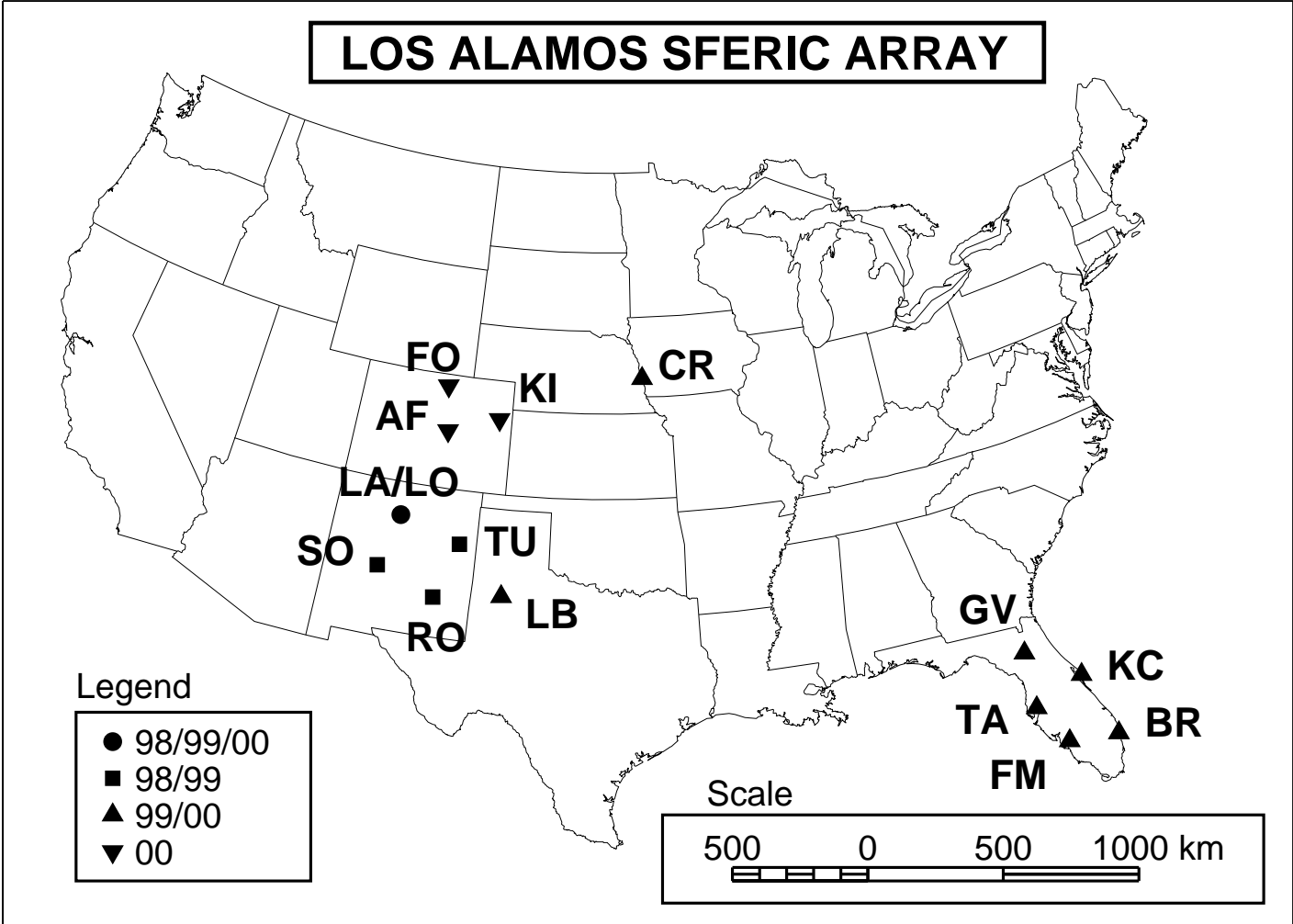
- FORTE ground truth
- Ground array of 11 FCM
 - Detect, record and time tag
VLF (300 Hz - 500 kHz)
EM emissions from lightning
 - DTOA system for geolocation
 - Ionospheric Reflection
for source height





LASA Operations

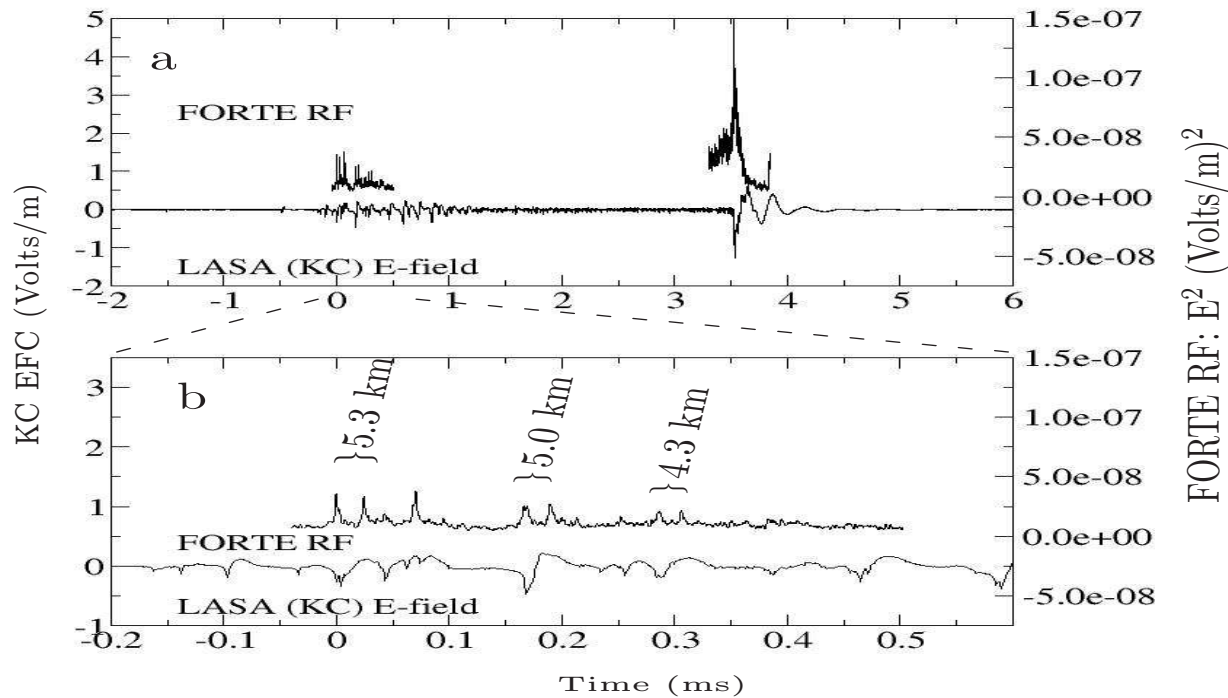
- Stations independently detect sferics 24 hr/day
 - Record waveform and time tag
- Time tag files are transferred to LANL daily
- Time tags compared daily to id coincidences
 - 3-Stations required for geolocation
 - Local (site) noise filter
- Coincident waveforms transferred to LANL
- Waveform cross-correlation provides timing correction
- DTOA to locate events
- FORTE overpass thresholding
- NBE's automatically classified and tagged
- NBE's height determined via ionospheric reflection





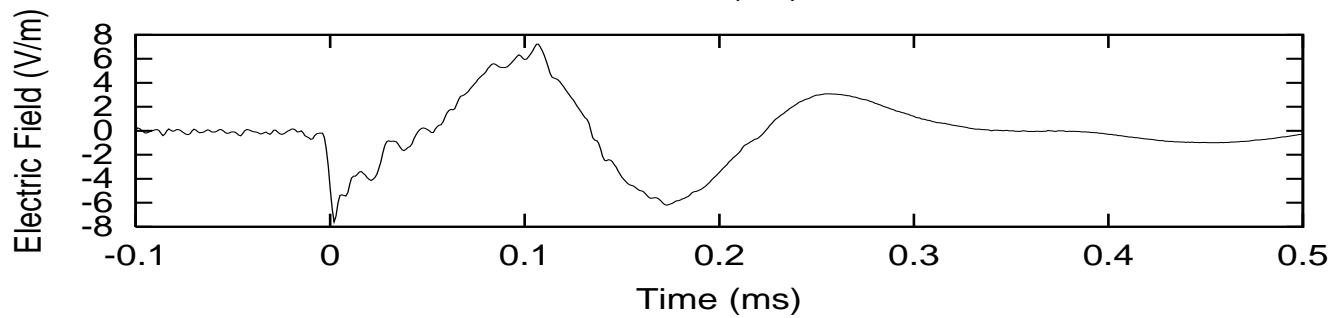
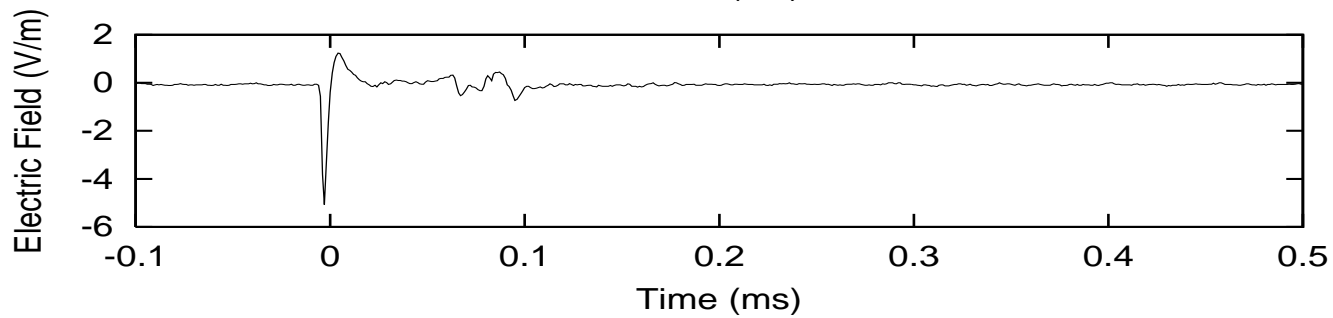
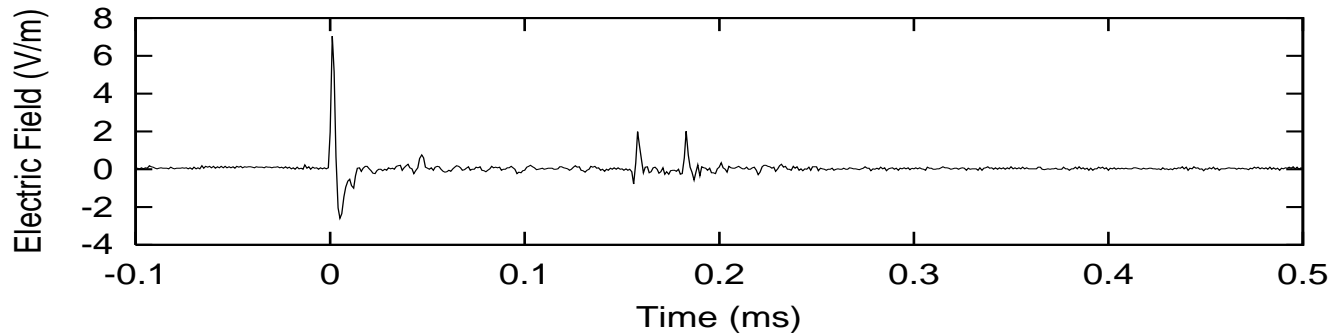
LASA as ground truth for FORTE

- Event Location
- Event Classification
- Event Height
- Other Event Characteristics
- Storm Environment



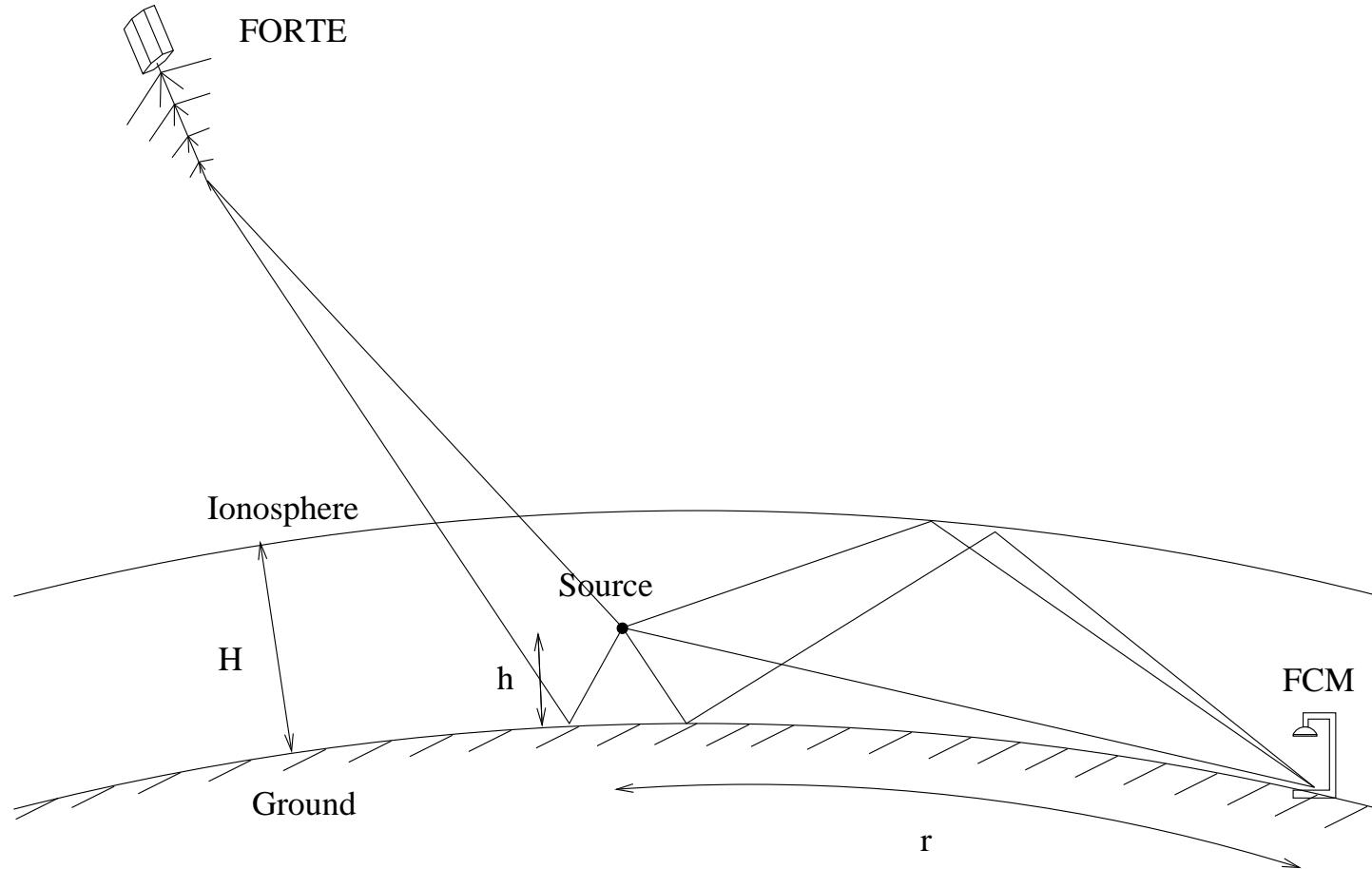


LASA Lightning Observations



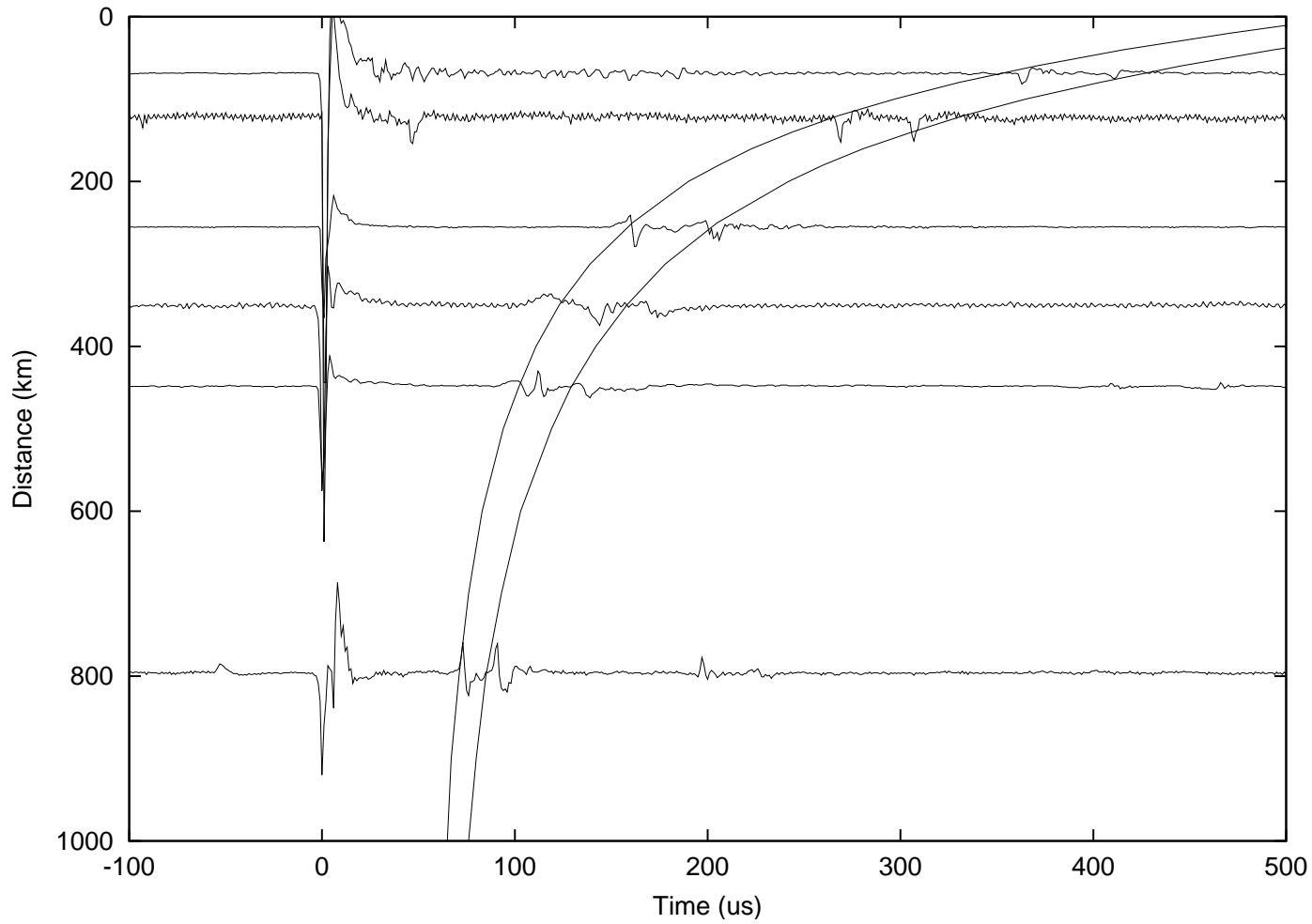


LASA NBE Height Determination



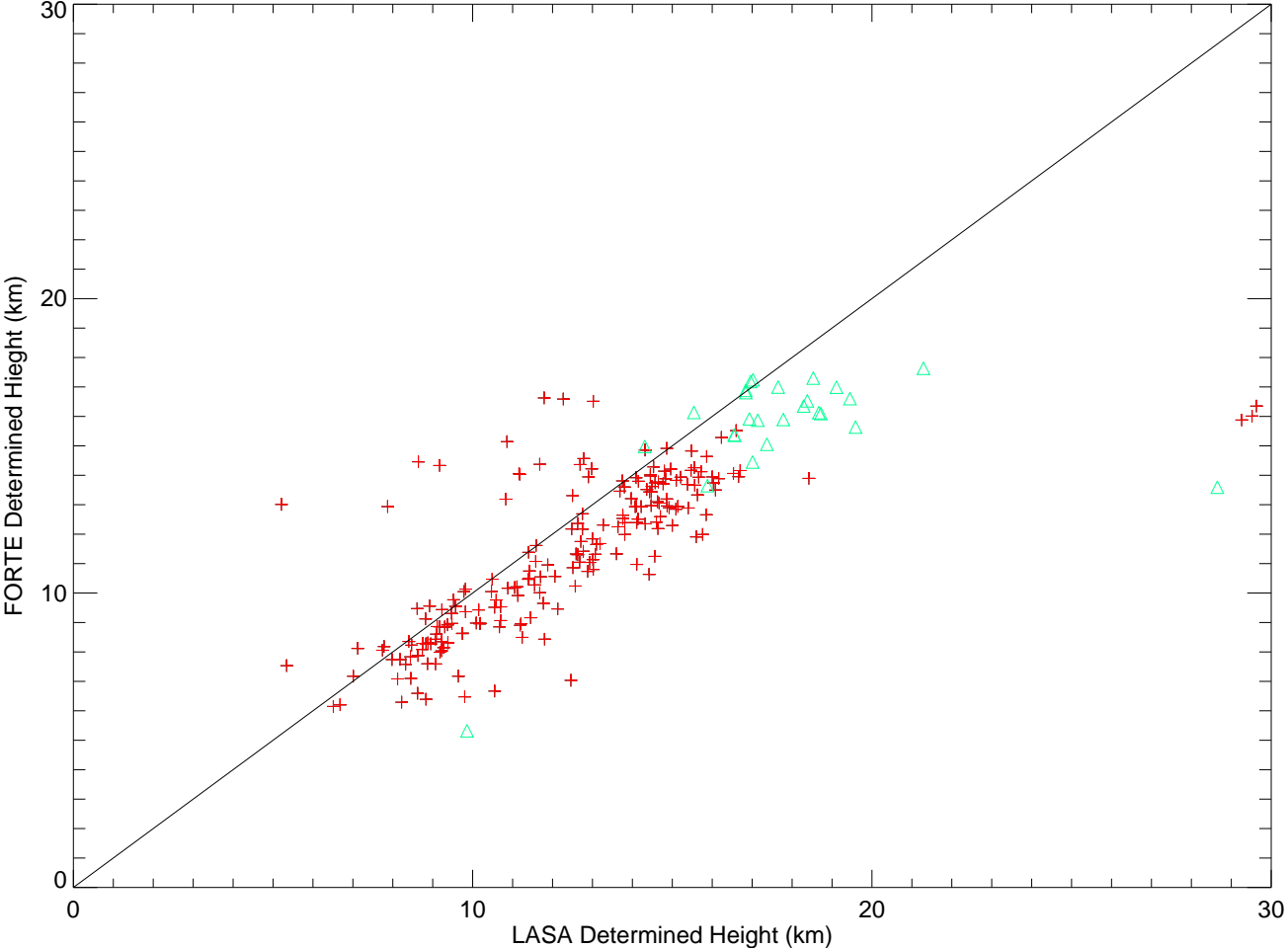


LASA Distance vs. Delay



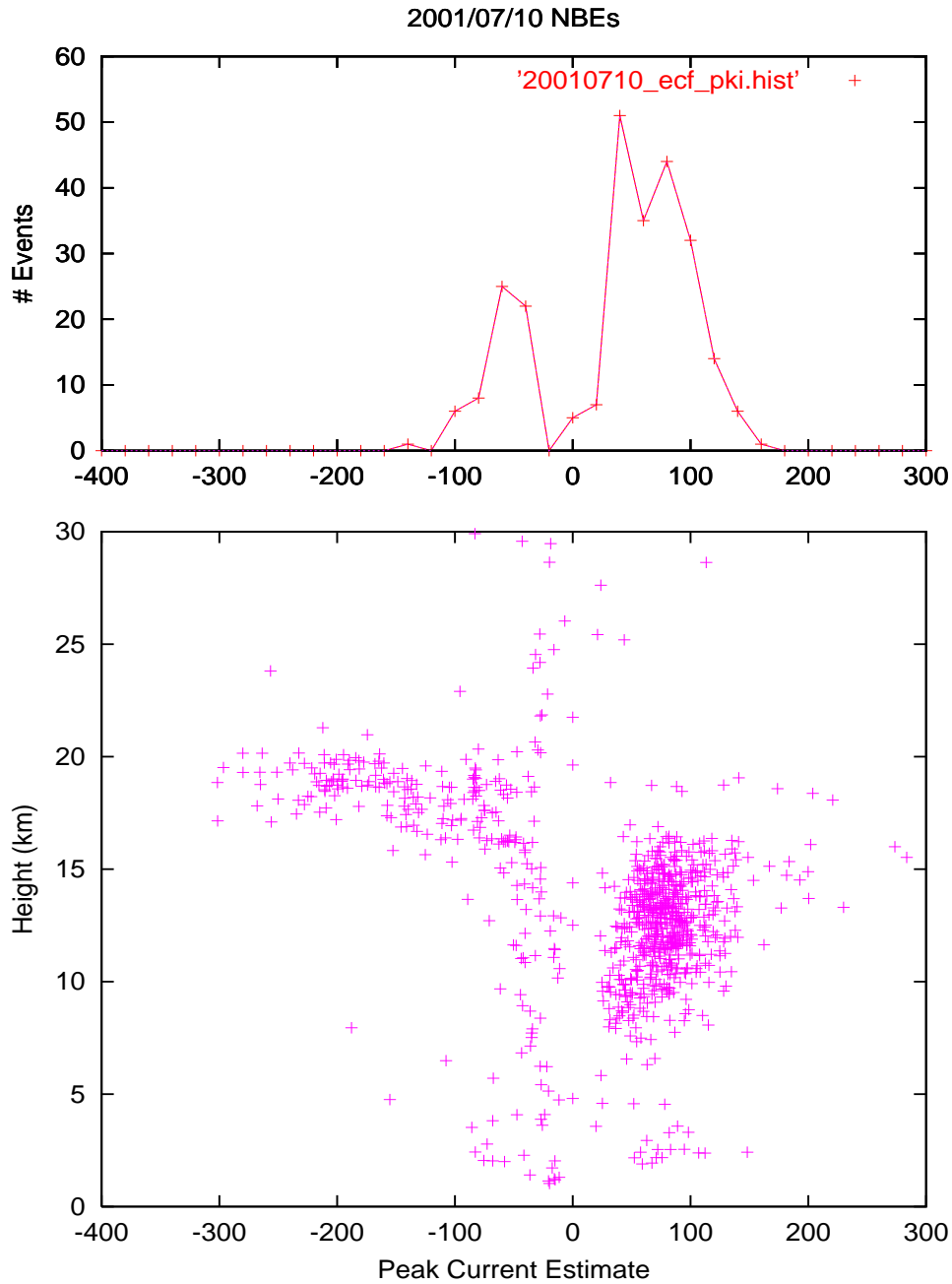


LASA/FORTE Heights





LASA Peak Current vs Height





LASA/Sat. Peak Current Comparison

