

OVERVIEW OF TOA SYSTEMS, INC.

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Lightning Physics
April 16, 2016

WHAT IS TOA?



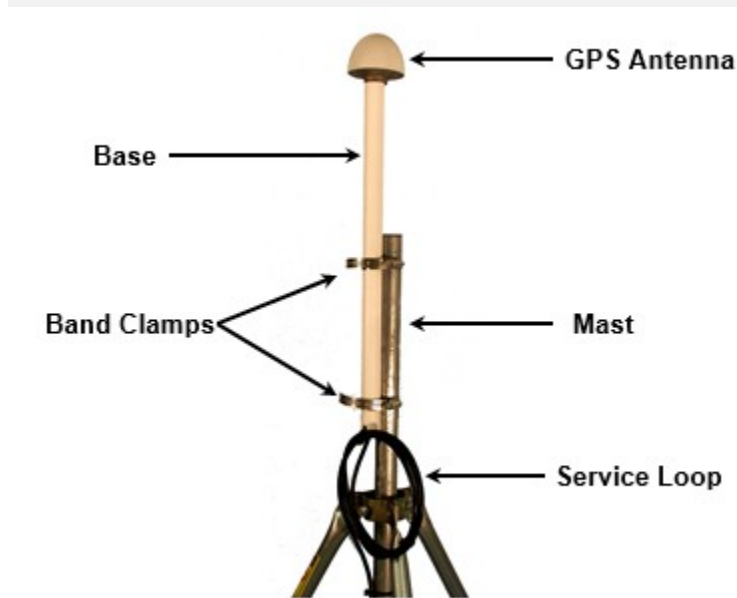
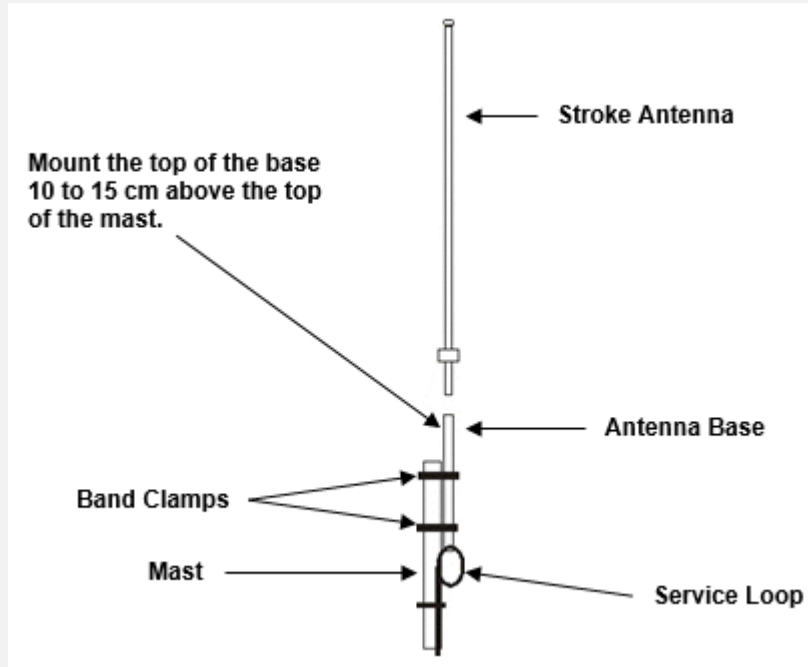
Primary lightning processing hub for USPLN, NAPLN, and GLN.

LIGHTNING DETECTION SENSORS

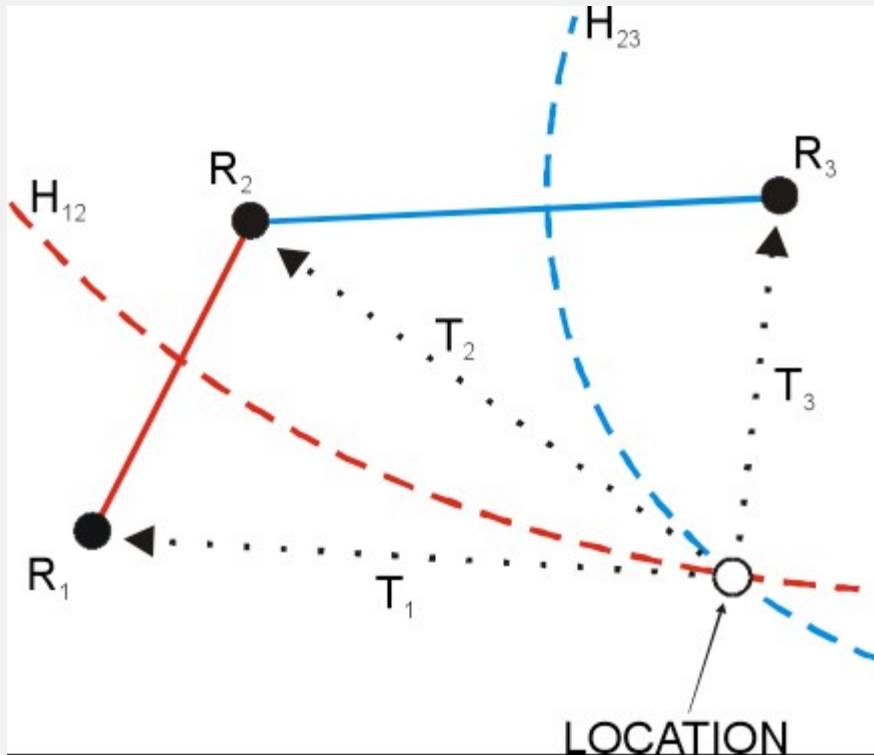


- Detects Cloud-to-Ground (CG) and Cloud (CL) lightning events
- RF Frequencies: LF/VLF - 1.5 kHz to 400 kHz, VHF available via expansion card

ANTENNAS

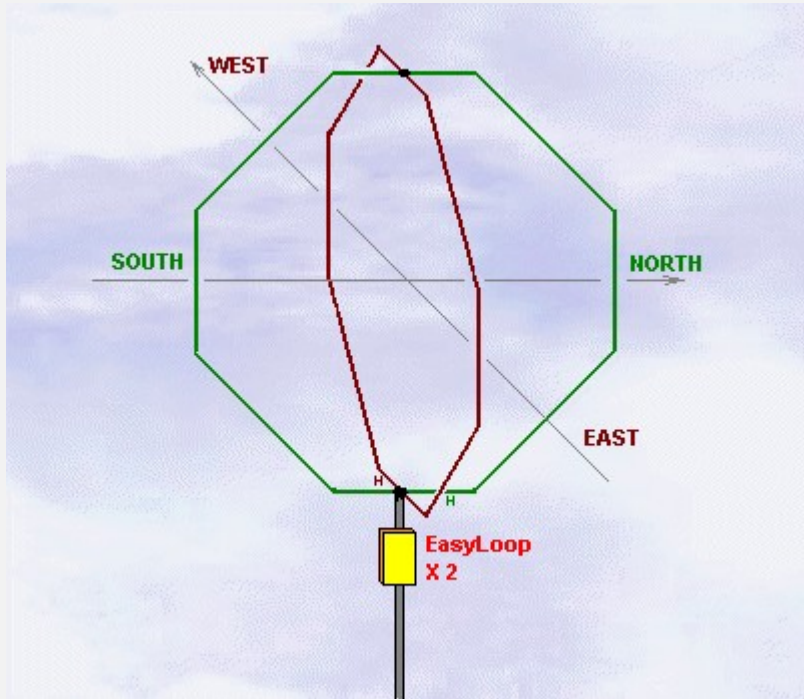


TIME OF ARRIVAL TECHNOLOGY



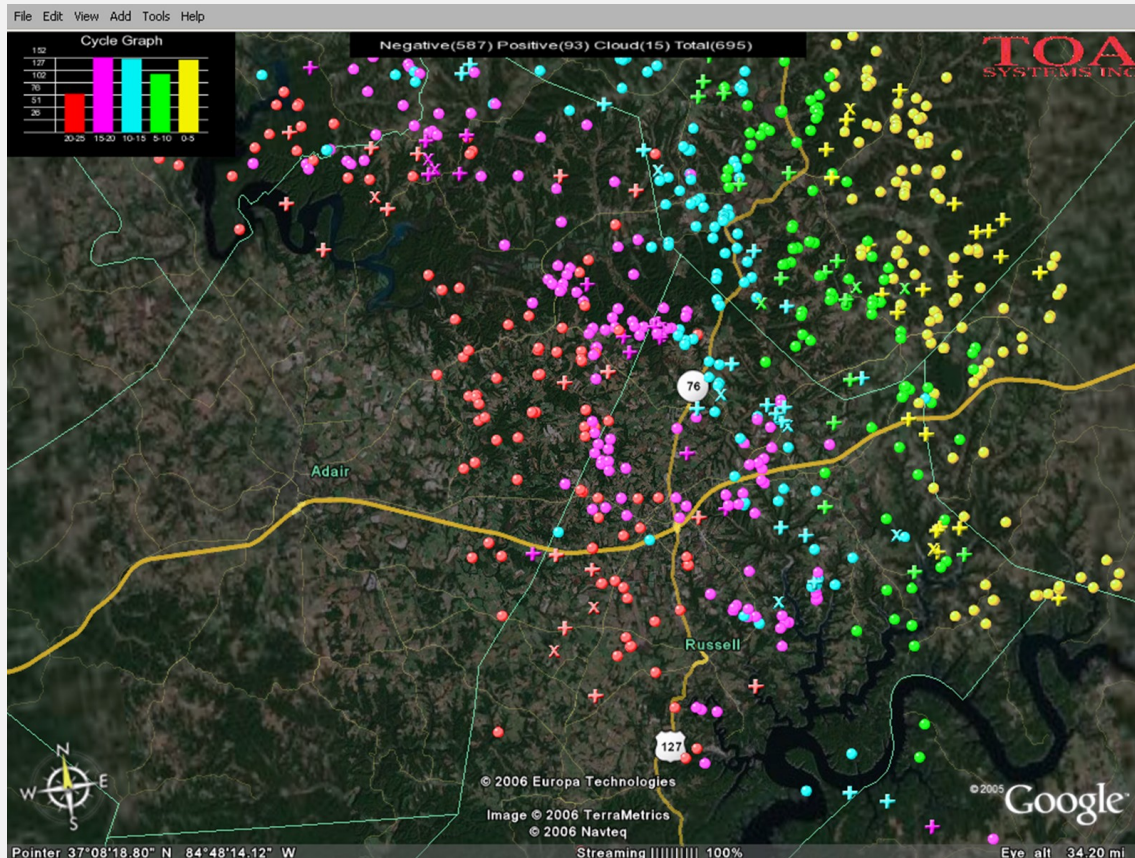
- Sensor picks up radio signal (R_1 , R_2 , R_3).
- Each signal is time-stamped at the sensor (T_1 , T_2 , T_3).
- Time-stamp differences used in hyperbolic curve generation calculations to locate source of signal (H_{12} , H_{23}).
- Point of intersection of two hyperbolic curves defines location of source (LOCATION).

WHY TIME OF ARRIVAL?

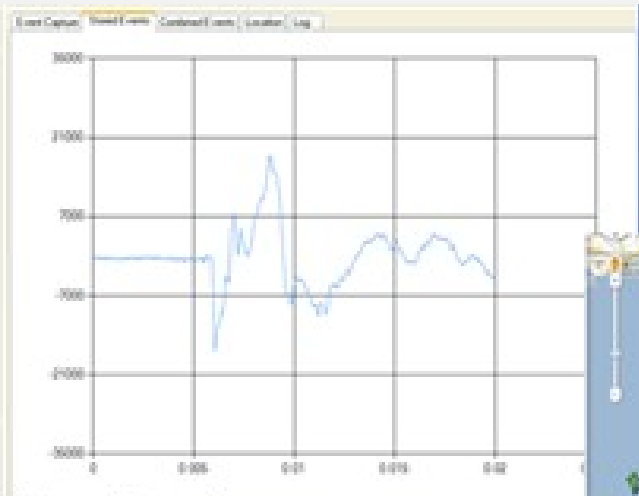


- Magnetic direction finding (MDF) technique has more errors.
 - If the flash is not vertical, the non-vertical component of the strong will induce errors in the voltage record.
 - Errors will occur where mountains are in the direct path of lightning and the stroke is received by dispersion.
 - Mismatches between receivers occur.

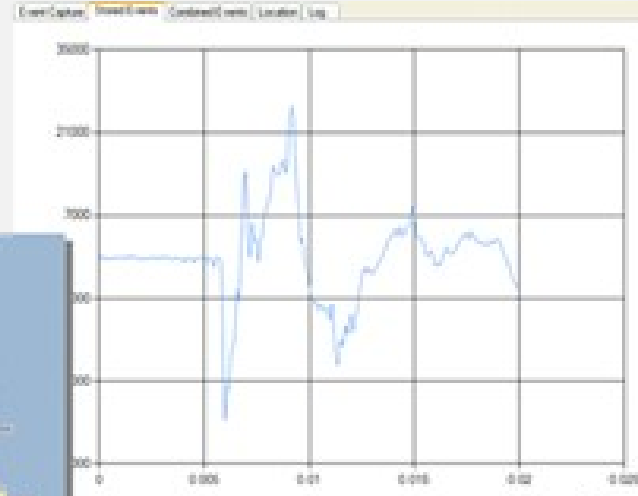
DATA PROCESSING



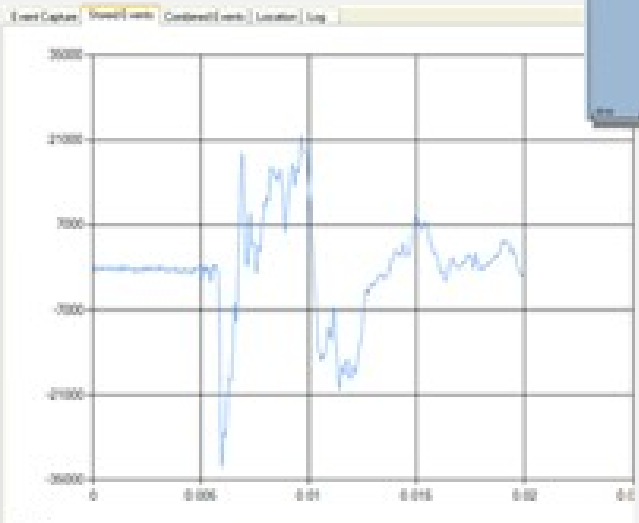
- Central Analyzer Processor (CAP)
 - Computes and displays real-time lightning location information.
 - Archives data for historical analysis.
 - Allows remote configuration of sensors.



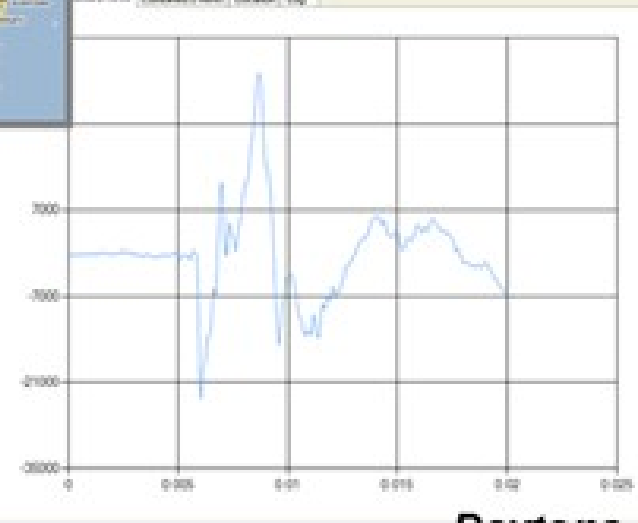
Key West



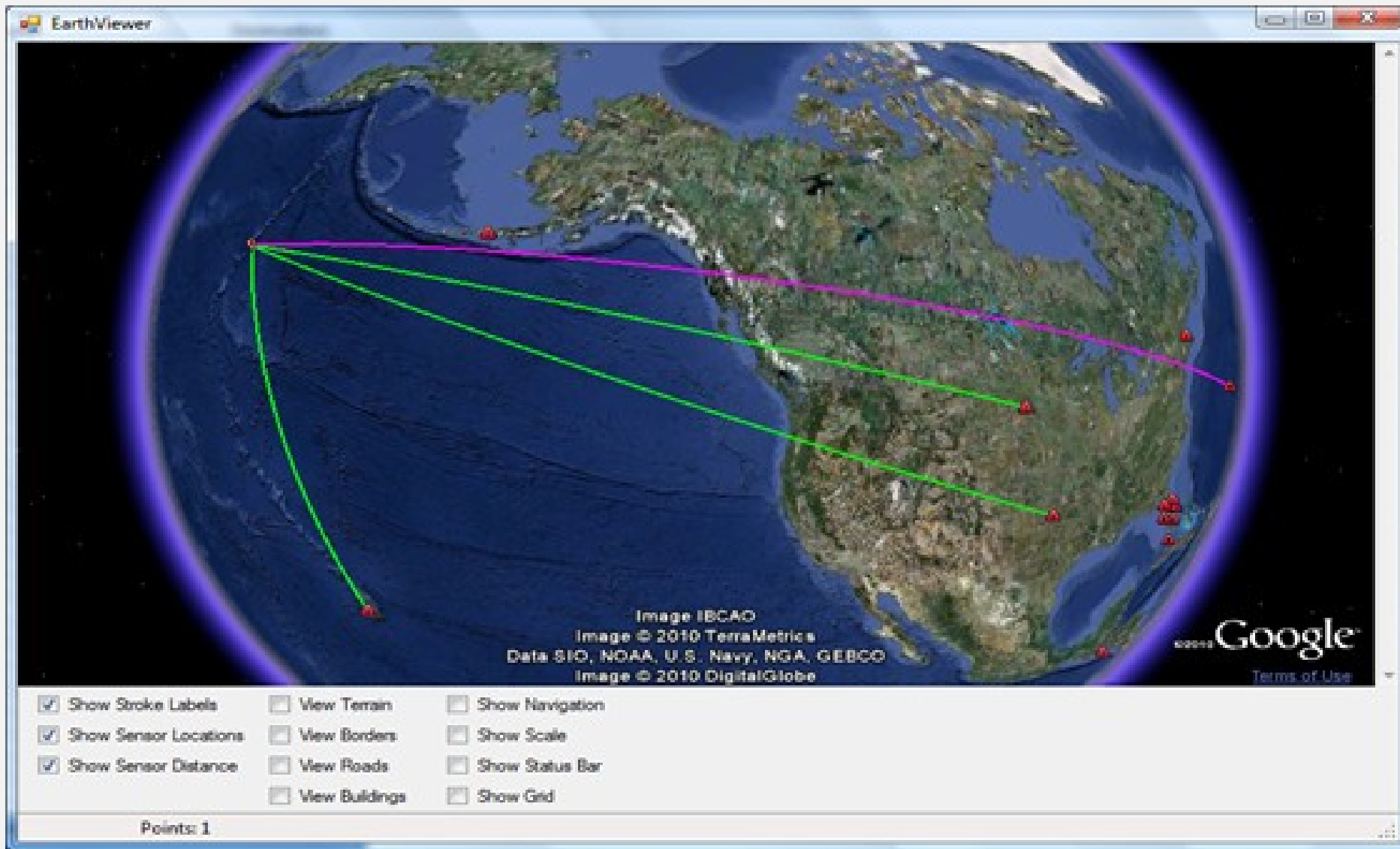
Ocala



Clearwater



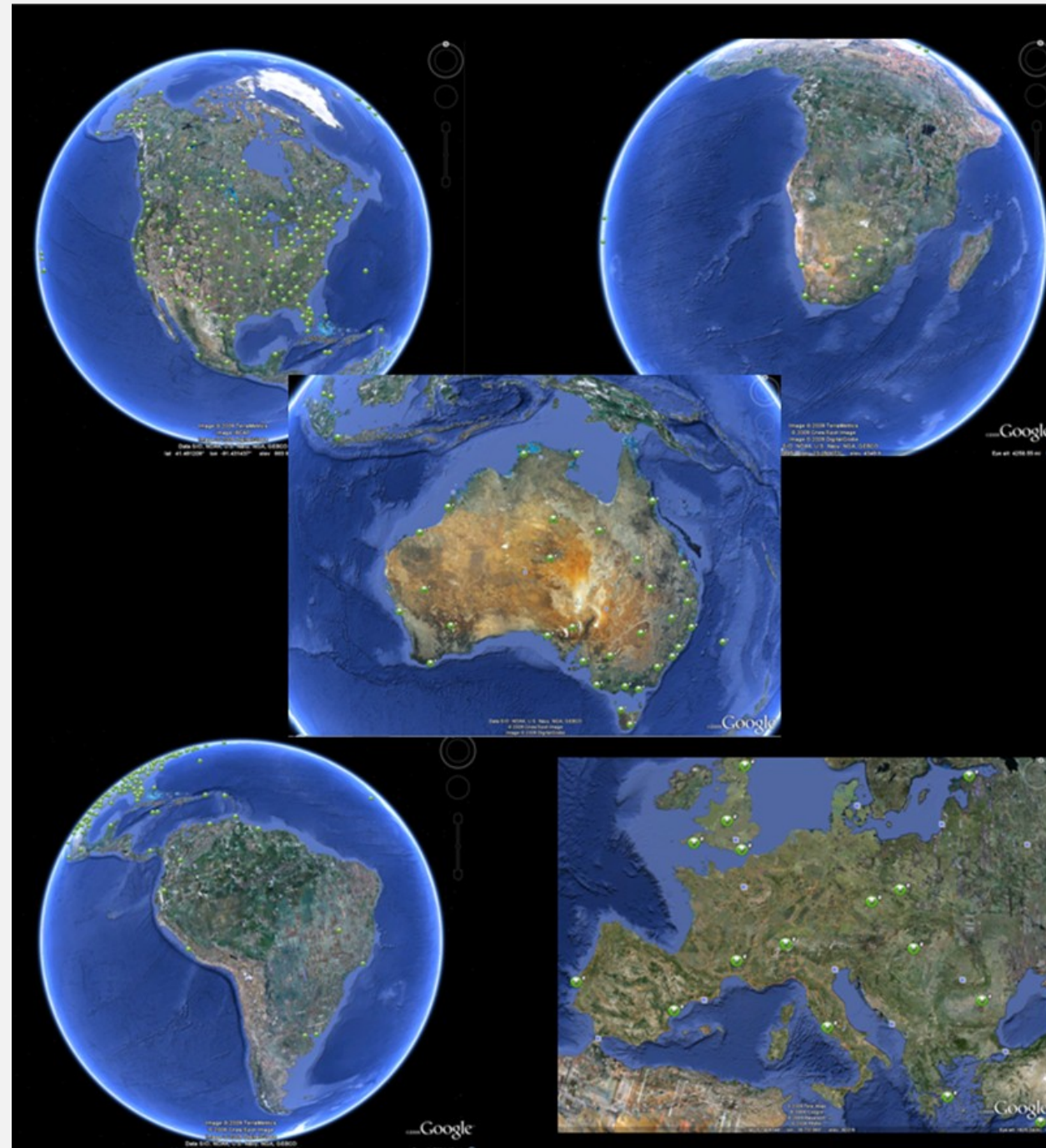
Daytona

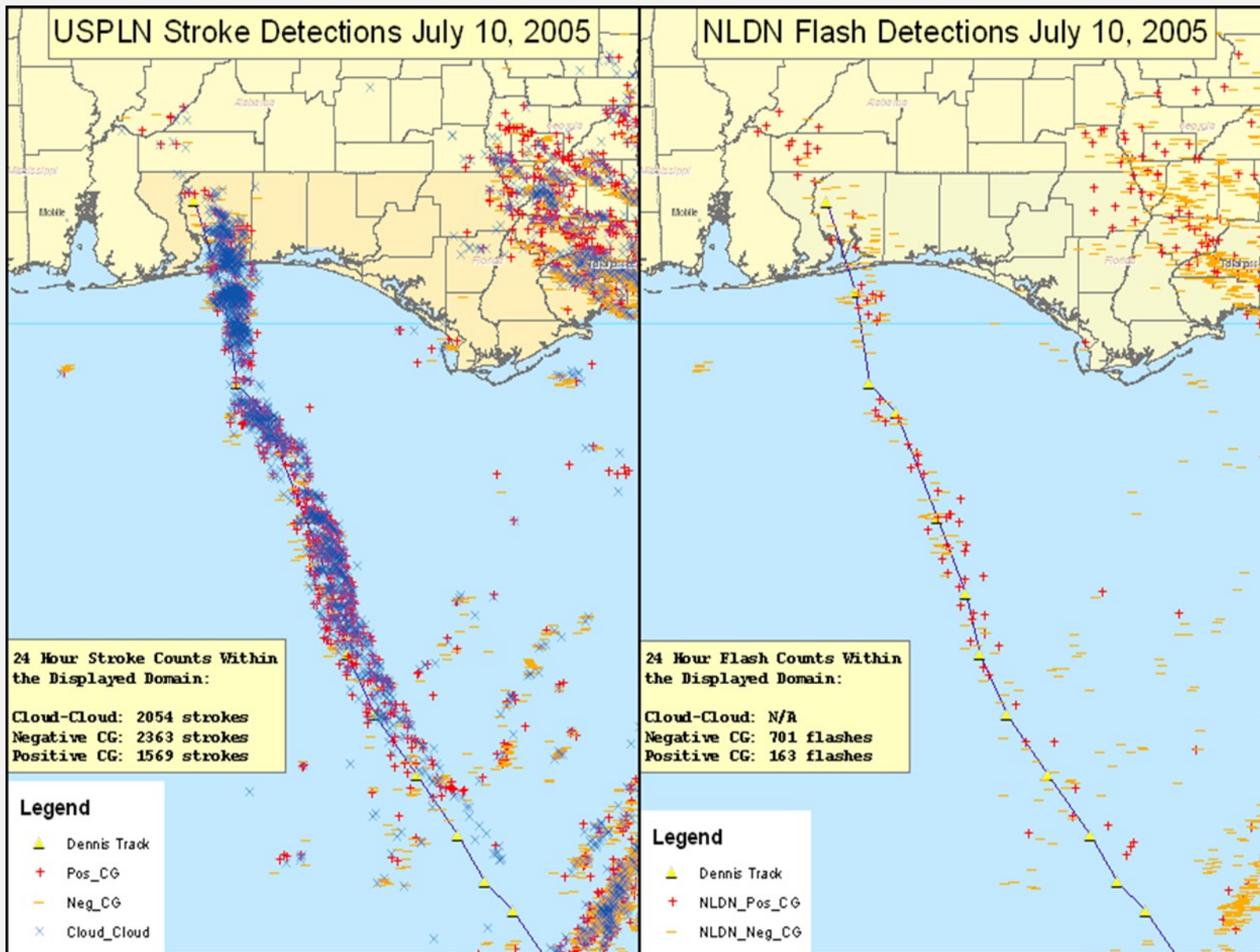


USPLN –
United States
Precision
Lightning
Network
NAPLN –
North
American
Precision
Lightning
Network



GPATS -
Global Position
and Tracking
Systems
GLN -
Global
Lightning
Network





Distance between multiple time-consecutive strokes in independent flashes

Date	Time	Latitude	Longitude	Sensor 1	Sensor 2	Sensor 3	Separation between one stroke in a flash and the next one (meters)
Fri Sep 09 2011	22:02:58	28.4503	-81.3674	Daytona, FL (DSP)	Sebastian, FL, US	Williston, FL, USA	
Fri Sep 09 2011	22:02:58	28.4502	-81.3674	Daytona, FL (DSP)	Sebastian, FL, US	Williston, FL, USA	5
Fri Sep 09 2011	22:02:59	28.4499	-81.3675	Daytona, FL (DSP)	Sebastian, FL, US	Williston, FL, USA	39
Fri Sep 09 2011	22:04:50	28.2472	-81.1701	Moore Haven, FL, USA	Daytona, FL (DSP)	Williston, FL, USA	
Fri Sep 09 2011	22:04:50	28.2474	-81.1191	Clearwater, FL, USA	Moore Haven, FL, USA	Williston, FL, USA	4995
Fri Sep 09 2011	22:04:51	28.2475	-81.1192	Moore Haven, FL, USA	Daytona, FL (DSP)	Williston, FL, USA	
Fri Sep 09 2011	22:04:51	28.2475	-81.1195	Moore Haven, FL, USA	Daytona, FL (DSP)	Williston, FL, USA	24
Fri Sep 09 2011	22:04:54	28.5140	-81.4516	Daytona, FL (DSP)	Sebastian, FL, US	Williston, FL, USA	
Fri Sep 09 2011	22:04:54	28.5150	-81.4506	Clearwater, FL, USA	Melbourne, FL, US (DSP)	Williston, FL, USA	142
Fri Sep 09 2011	22:04:54	28.5144	-81.4513	Daytona, FL (DSP)	Sebastian, FL, US	Williston, FL, USA	95
Fri Sep 09 2011	22:04:54	28.5149	-81.4506	Clearwater, FL, USA	Sebastian, FL, US	Williston, FL, USA	93
Fri Sep 09 2011	22:04:54	28.5149	-81.4506	Clearwater, FL, USA	Sebastian, FL, US	Williston, FL, USA	4
Fri Sep 09 2011	22:06:20	28.4706	-81.2291	Daytona, FL (DSP)	Melbourne, FL, US (DSP)	Williston, FL, USA	
Fri Sep 09 2011	22:06:20	28.4704	-81.2292	Daytona, FL (DSP)	Melbourne, FL, US (DSP)	Williston, FL, USA	18
Fri Sep 09 2011	22:06:20	28.4706	-81.2292	Daytona, FL (DSP)	Melbourne, FL, US (DSP)	Williston, FL, USA	12
Fri Sep 09 2011	22:06:20	28.4706	-81.2292	Daytona, FL (DSP)	Melbourne, FL, US (DSP)	Williston, FL, USA	4
Fri Sep 09 2011	22:06:20	28.4705	-81.2292	Daytona, FL (DSP)	Melbourne, FL, US (DSP)	Williston, FL, USA	7
Fri Sep 09 2011	22:10:45	28.2166	-81.0414	Clearwater, FL, USA	Moore Haven, FL, USA	Williston, FL, USA	
Fri Sep 09 2011	22:10:45	28.2163	-81.0407	Clearwater, FL, USA	Moore Haven, FL, USA	Williston, FL, USA	71
Fri Sep 09 2011	22:10:45	28.2164	-81.0406	Clearwater, FL, USA	Moore Haven, FL, USA	Williston, FL, USA	11

REAL-TIME LIGHTNING DATA

TOA/GPATS
World Lightning

REAL-TIME LIGHTNING DATA

- <http://toasystems.com/products-technology/technology/n-american-data-feed>
- <http://toasystems.com/products-technology/technology/australian-data-feed>