

GOES-R GLM Lightning-Aviation Applications

- GOES-R GLM instrument will provide unique total lightning data products on the location and intensity of thunderstorms.
 - E.g., demonstrated capability for enhancing the situational awareness and forecasting skill of deep convection, tornadoes severe weather.
 - anticipate similar utility of GLM lightning data and products for aviation applications related to thunderstorms (convection and turbulence requirements).
- R3/AWG GLM team sees excellent opportunity to partner with AWG Aviation Team.
- GLM team is just getting started on Aviation...
 - Dedicated UAH GLM R3-funded GRA (Erica Hill) just started Fall 2009. Advisor: Larry Carey; Committee Chair: John Mecikalski.
 - GOES-R3 Visiting Science Program (VSP) Award. Carey will visit Wayne Feltz and collaborators at U. Wisconsin-Madison CIMSS for 1-week during FY10.

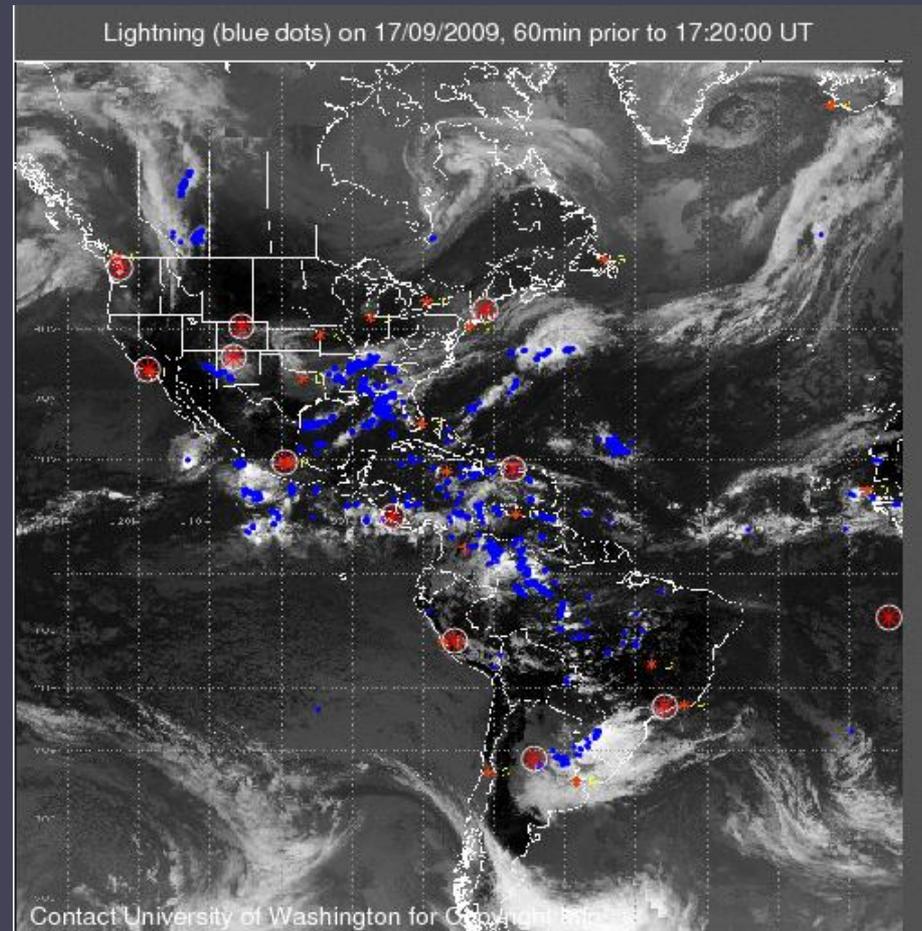
GOES-R3 Visiting Science Program (VSP)

- over-arching goals of Carey's visit to CIMSS will be to
 - 1) *foster collaborative ties* between the GOES-R R3/AWG Lightning and Aviation Teams,
 - 2) *exchange information and share expertise* on the potential use of GLM total lightning data and products in aviation applications and
 - 3) *develop critical concepts for potential algorithms and products* utilizing GLM lightning data (alone or in combination with other GOES-R instruments such as the ABI) for aviation convection and turbulence requirements.
- outcome of one-week visit will be a *white paper* on “*The Potential Use of GOES-R GLM Lightning Data in Aviation Algorithms*” to
 - 1) provide necessary background on cloud electrification, lightning and relevant aviation requirements related to thunderstorms,
 - 2) summarize key GOES-R instruments and (proxy) data (GLM and ABI),
 - 3) outline existing aviation algorithms,
 - 4) develop ideas for integrating GLM lightning into existing aviation algorithms, and
 - 5) motivate and develop key concepts for potential new aviation products and algorithms using GLM-only and GLM-ABI data.
- white paper will form the basis for collaborative partnership between the Aviation and Lightning Teams and potential future proposal(s).

Preliminary Plans and Points of Discussion

- Potential initial foci
 - Terminal Operations
 - *Enroute Aviation*
 - *Oceanic: maximum benefit using GLM.*
- Suitable source of lightning flash data over open oceans (or even coastal)?
 - What is the definition of a “GLM proxy” dataset in this context?
 - Different Approaches
 - Model Inferred: indirect based on physics and statistical correlations.
 - **Observations**: direct but have limitations

WWLLN Lightning: Hourly from
09/18/2009 1720 to 09/19/2009 1720 UTC

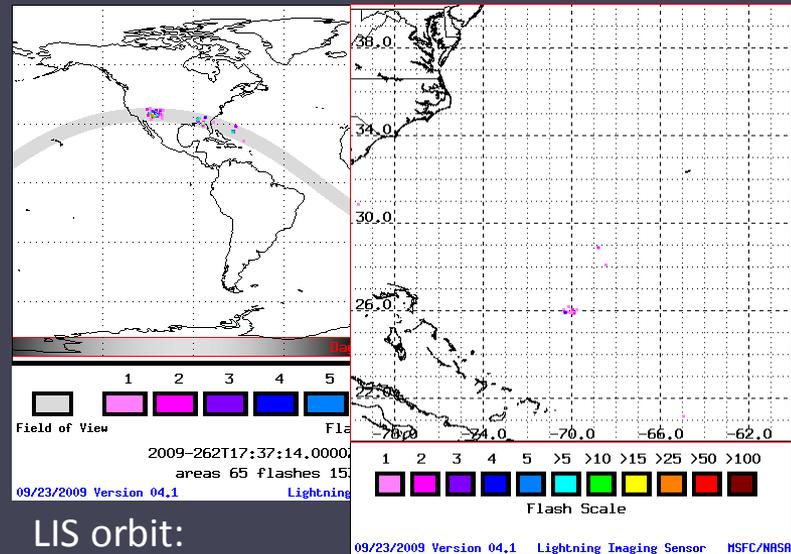


Source: WWLLN, University of Washington
<http://webflash.ess.washington.edu/>

Lightning Data for Enroute Aviation

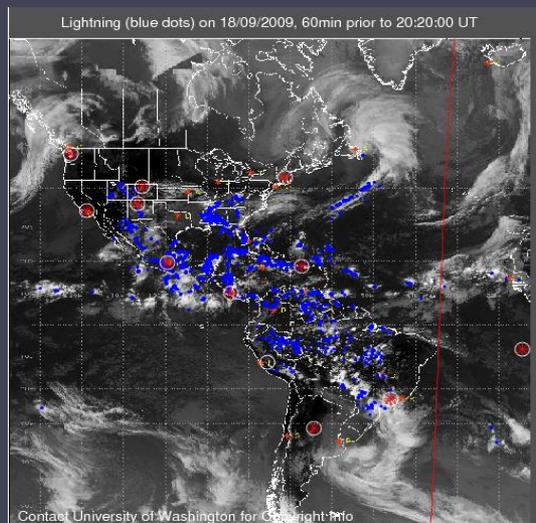
- LMA VHF-based networks have been used historically to develop total lightning GLM-proxies and algorithms (e.g., lightning jump for severe weather)
 - Small spatial scale ($R < 150$ km) does not lend LMA to enroute aviation applications.
 - LMA data is not available in remote locations (open ocean) where GLM lightning will likely have largest impact on aviation applications (i.e., devoid of ground-based radar).
- Although an ideal proxy (optical, large spatial domain), LEO TRMM LIS only provides brief temporal snapshots (~ 80 sec).
- Vaisala NLDN and WSI USPLN provide continuous mostly CG lightning (high CG DE and very low IC DE) at high temporal and spatial resolution but only over CONUS or nearby coastal region.
 - NLDN is well characterized in research community while USPLN is relatively new.
- Weatherbug lightning network provides continuous total (CG and IC) lightning at high temporal and spatial resolution over CONUS and nearby coastal region.
 - New so performance (e.g., IC DE) is untested in research community
- WWLLN and Vaisala GLD-360 provide continuous global lightning coverage of primarily CG flashes. Location accuracy and detection efficiency are likely less than above and must be studied and verified. GLD-360 is brand new.

- Potential VLF-based observations for continuous global oceanic CG (not total) lightning are the UW WWLLN and Vaisala GLD-360.
- GLD-360 performance is encouraging but network is new and therefore relatively unknown.
 - detection efficiency (DE): 60% to 70% (initial estimate)
 - location accuracy (LA): 5 - 10 km (initial estimate)
- WWLLN is more mature and better characterized.
 - DE: 30% (> 30 kA)
 - LA: 15 - 30 km
- Need comparisons to LIS (statistical global tropics/sub-tropics) and LMAs (storm life-cycle) for relative DE and LA performance.
- Inter-comparison among networks (GLD-360, NLDN, USPLN, Weatherbug, and WWLLN) could also be useful.

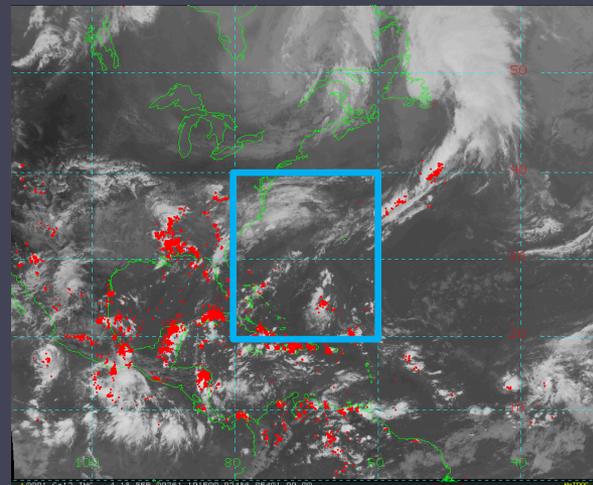


LIS orbit:
09/18/2009
1737z – 1911z

LIS orbit zoom
~ 1832z – 1837z



WWLLN 9/18/2009
1920z – 2020z



Vaisala GLD360 9/18/2009
1815z – 1915z

Source: <http://www.soest.hawaii.edu/cgi-bin/pacnet/images.pl>