**VALIDATION OF VAISALA’S GLOBAL LIGHTNING DATASET (GLD360) OVER THE CONTINENTAL UNITED** [**https://www.vaisala.com/sites/default/files/documents/6.Demetriades%2C%20Murphy%2C%20Cramer.pdf**](https://www.vaisala.com/sites/default/files/documents/6.Demetriades%2C%20Murphy%2C%20Cramer.pdf)

* Launched sept 2009
* GLD360- first ground based lightning detection network capable of providing worldwide coverage and uniform, high performance without differences btw nighttime/daytime conditions
* Expected
  + Detection efficiency: 70%
  + 5-10 km median cloud-to-ground stroke location accuracy
* Vaisala’s US National Lightning Detection Network (NLDN) used as ground truth for validation of GLD360
  + Undergone expensive independent validation over 20 year period
  + NLDN has detection efficiency of 90-95% for CG flashes
  + Median location accuracy of 300-500 meters
* Implicit assumption that NLDN is perfect for location accuracy
* Flash efficiency of GLD360 calculated by dividing number of matched NLDN CG flashes by the total number of NLDN CG flashes
* Findings:
  + GLD360 flash detection efficiency ranged from 86% to 92% through the 24 UTC day, exceeded the expected 70%
  + Median location accuracy was 10.8 km, slightly larger than the expected

**Highly intense lightning over the oceans: Estimated peak currents from global GLD360 observations**

[**https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/jgrd.50508**](https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/jgrd.50508)

* GLD360 performance is validated against NLDN data using one year of data
  + Compared the average estimated peak current in neg. lightning flashes
  + Data set composed of 353 million flashes was compared with NLDN for peak current accuracy, location accuracy, and detection efficiency
* Validation results
  + demonstrated mean peak current magnitude error of 26%,  a median location accuracy of 2.5 km, and a relative ground flash detection efficiency of 57%
  + detection efficiency and peak current were 22-88% and 65-121% higher respectively for negative CG flashes
* Majority of all negative flashes with estimated peak current magnitude above 75 kA occur over the ocean.
* On average measured peak currents for negative flashes are higher over the ocean
* Intro:
  + CG (cloud-to-ground) lightning is significant weather hazard
  + Well known cause of damage to electrical systems/power transmission lines
    - Airports continuously monitor nearby thunderstorm activity in order to cease outdoor operations (aircraft refueling)
    - Space launch criteria are also limited to lightning activity
  + Lightning Location Sytems (LLS) are deployed around the world to monitor thunderstorms to mitigate hazards posed
    - Established large databases that can be used to monitor historical lightning patterns
  + Peak current is not well correlated with total charge transferred during a return stroke
    - Currents continue to flow between cloud to the ground between strokes
    - Lightning Process
      * A negatively charged channel between the cloud and the ground called a “stepped leader” emerges and propagates toward the ground
      * Once it connects with the ground then there is a electric current wave (return stroke) that shoots up the channel and produces the visible lightning flash that can be seen
      * Return stroke: the visible lightning moving from ground to cloud

**GLD360 Upgrade: Performance Analysis and Applications**

* GLD360 dataset is generated by a long-range network that employs both Time-Of-Arrival (TOA) and Magnetic Direction Finding (MDF)
* Sensors are very sensitive to the VLF (very low frequency, 500 Hz-50 kHz) range
  + They use waveform recognition algorithm to identify features in radio atmospherics
  + Propagation correction is applied to the time delay of each feature in order to recover more consistent arrival time
  + Attenuation model is applied to the amplitude of the waveform, used to recover an estimate of peak current
* 2015 Vaisala released update to location algorithm that generates GLD dataset
  + Contained enhancements to improve network performance
  + Primary change includes more refined propagation model, improved sensor ….
* Long-range terrestrial lightning location systems (LLS) provide near real-time lightning data
  + They use receivers sensitive to the VLF (very low frequency) range
* Summary/conclusion:
  + the analysis of the performance of GLD360 network after 2015 software upgrade showed increase in CG flash DE (density efficiency) ~55%-75%to ~75-85%
  + One month of NLDN data was used as reference in evaluating multiple performance metrics
  + Relative IC pulse DE increased ….