The South African Lightning Detection Network

MTG LI Mission Advisory Group Meeting

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South African Weather Service

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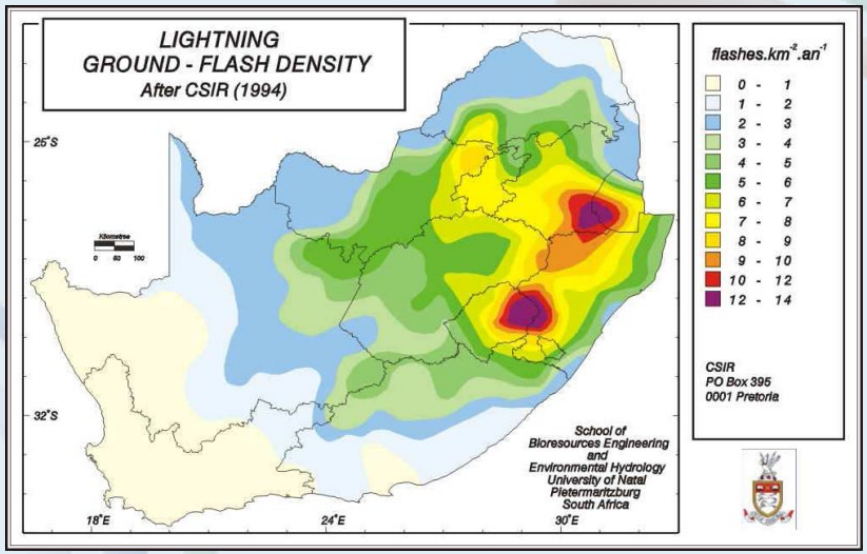
History

- For many years South Africa had no observations of lightning.
- In the 1980's to early 1990' the Council for Scientific and Industrial Research (CSIR) operated a network of lightning flash counters across the country.



- In the 1990's, Eskom, the power utility in South Africa operated LPATS sensors to monitor lightning strikes to their distribution lines.

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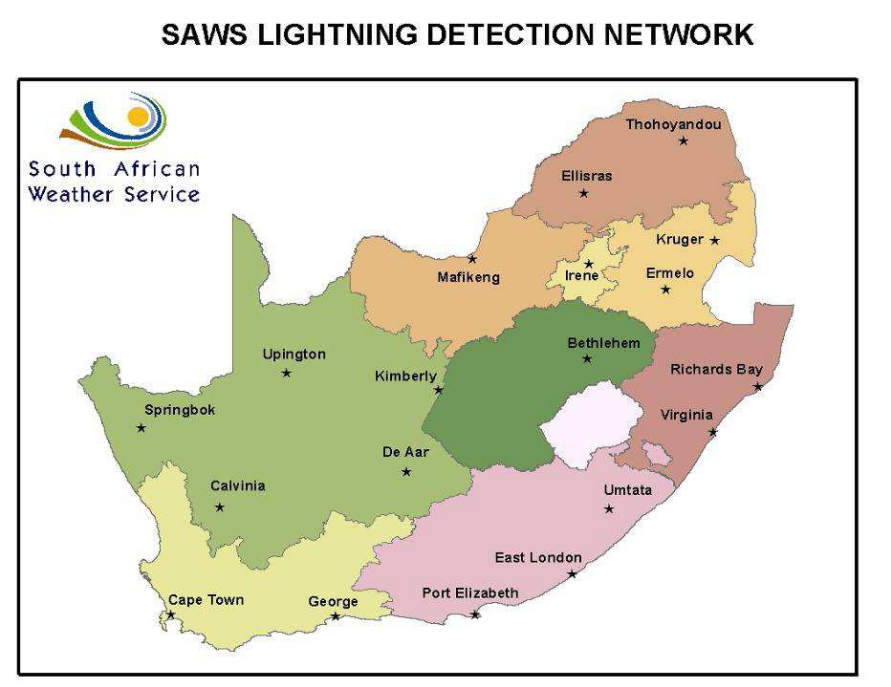
History

- In 2005, the South African Weather Service started installing a lightning detection network over the country.
- A Network of Vaisala sensors
- Original network consisted of 19 LS7000 sensors
- Fully operational in 2006.

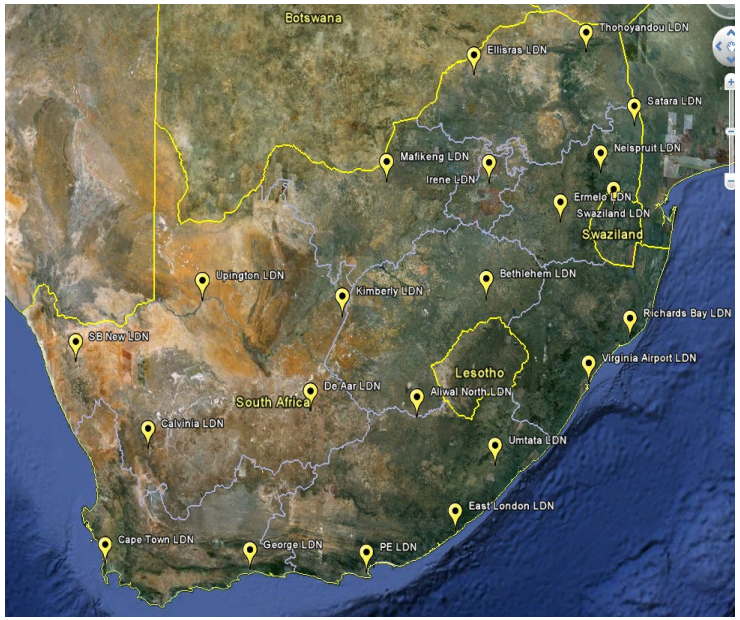


Upgrades

- The network has undergone regular upgrades throughout the years.

2009/10 upgrade

- Three new LS7001 sensors were added
- One sensor replaced with a LS7001 sensor
- 22 sensors



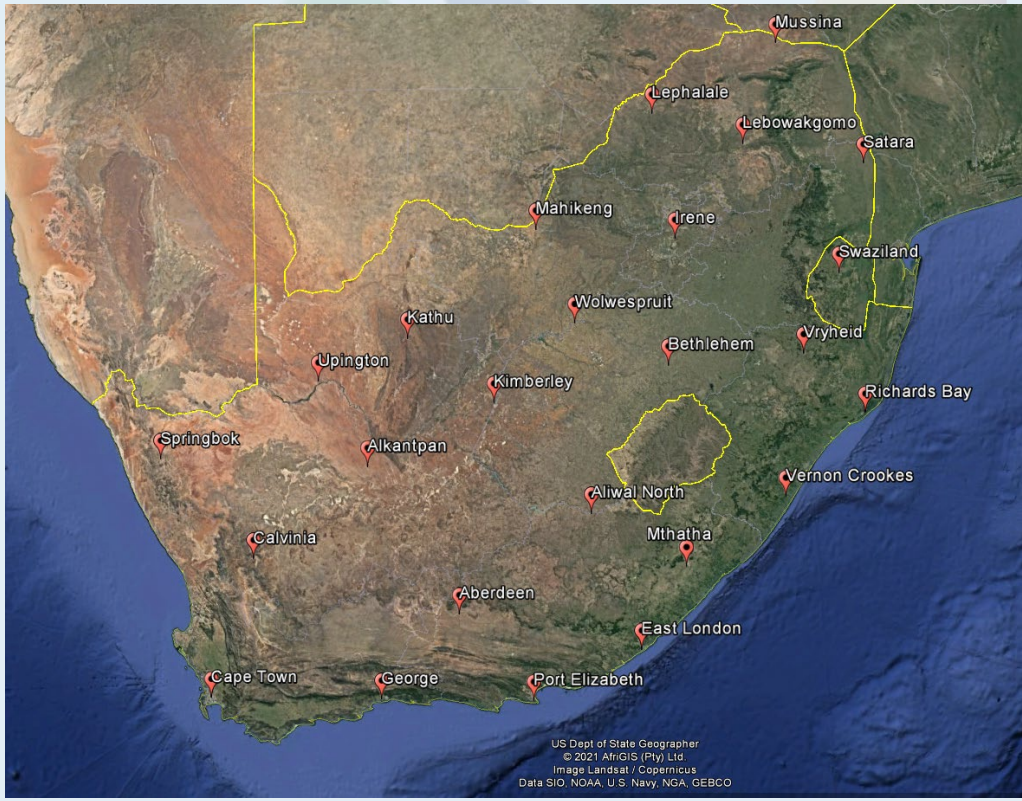
2011 upgrade

- Four sensors relocated to new sites
- One new LS7001 sensors were added
- One old LS7000 sensor added
- 24 sensors

Upgrades

- In 2015 one new sensor was added to give a network of 25 sensors.
- We also frequently upgrade the Vaisala processing software.

- Currently in the process of upgrading sensors to LS7002
- Three sensors were upgraded in 2020
- Additional two in 2021
- Procure a further 10 in 2021
- The remaining sensors to follow.
- Currently:
  - 18 LS7000 sensors
  - 4 LS7001 sensors
  - 3 LS7002 sensors



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Network

- Sensors operate in the VLF/LF frequency ranges.
- Designed for cloud-to-ground lightning.
- Also detect a percentage of cloud lightning (30-50%).
- Sensors make use of both time-of-arrival and magnetic direction-finding principles.
  - Minimum of two sensors required to locate a lightning discharge (instead of 3).
  - Improved detection of low amplitude pulses in CG
  - Improved detection of cloud pulses
  - Magnetic field measurements improve peak field measurements
  - Improved overall accuracy

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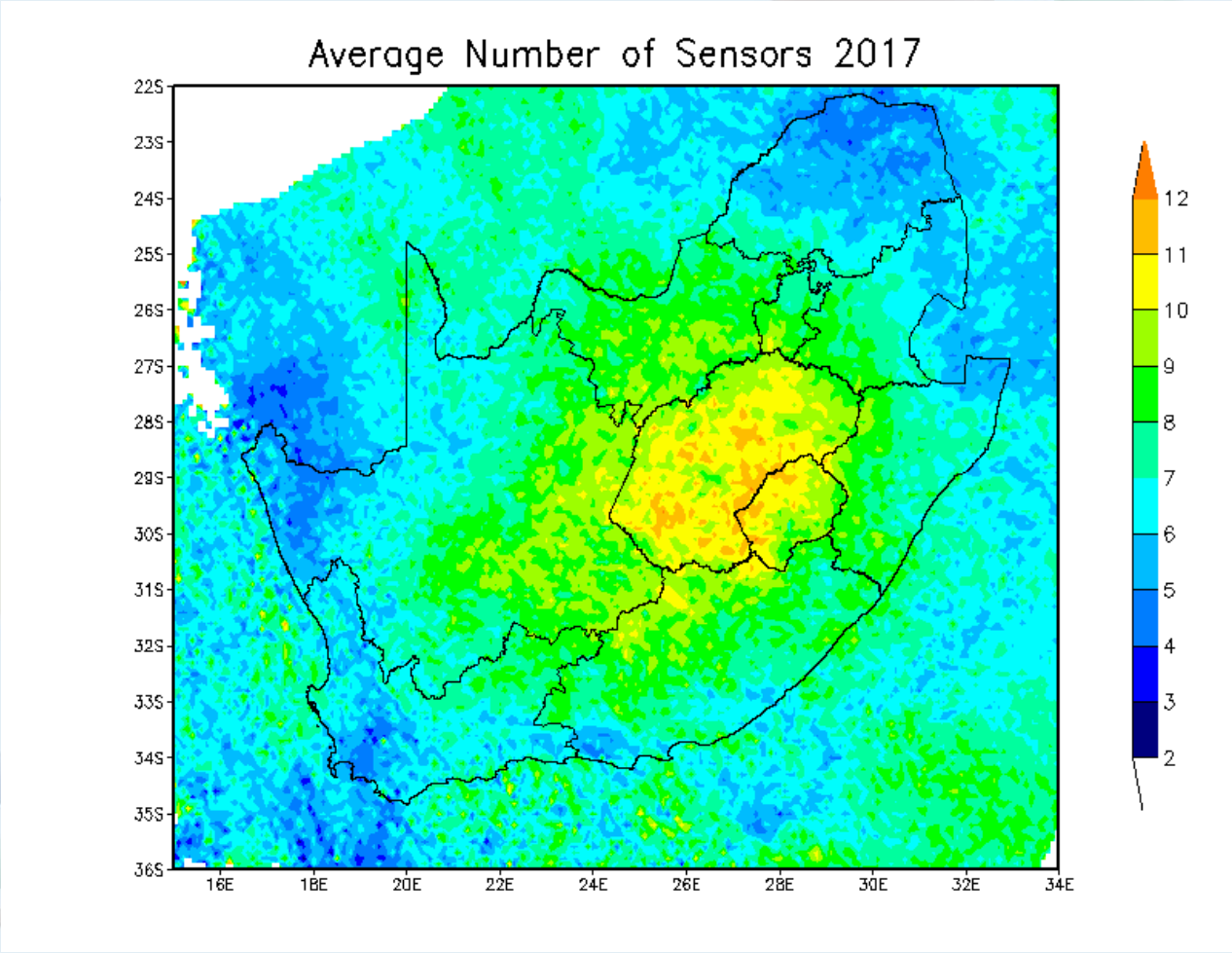
Network

- Several sensors participate in the detection of lightning.
- The more sensors participating to produce a lightning solution, the more accurate the solution.



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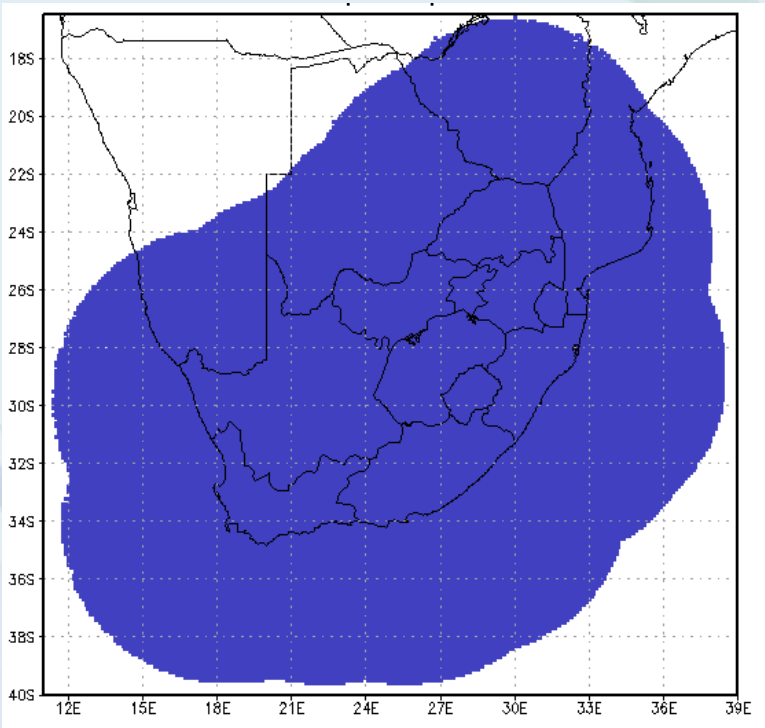
Network

- Maximum range we produce solutions for:



- Outside network accuracy and efficiency decreases.

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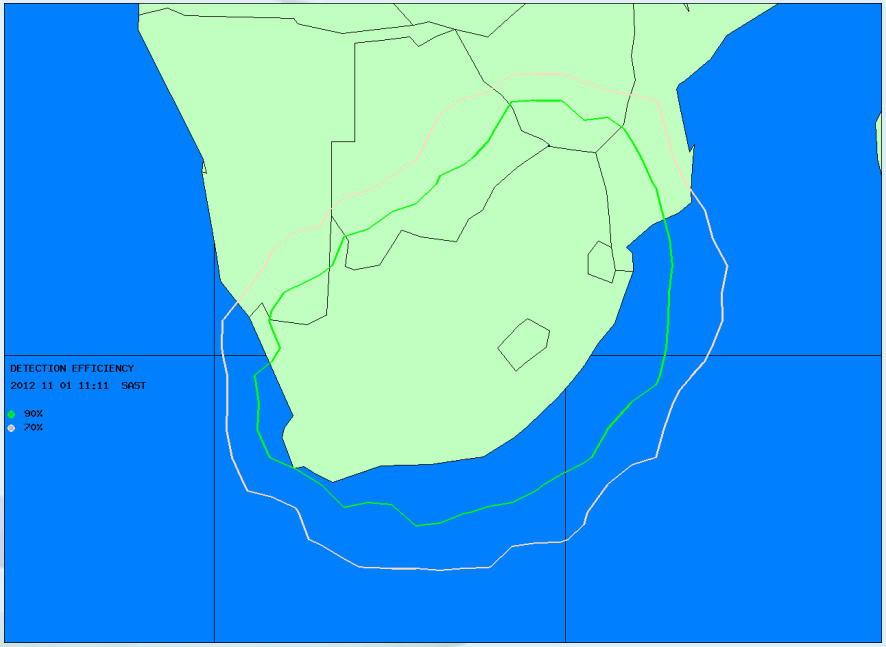
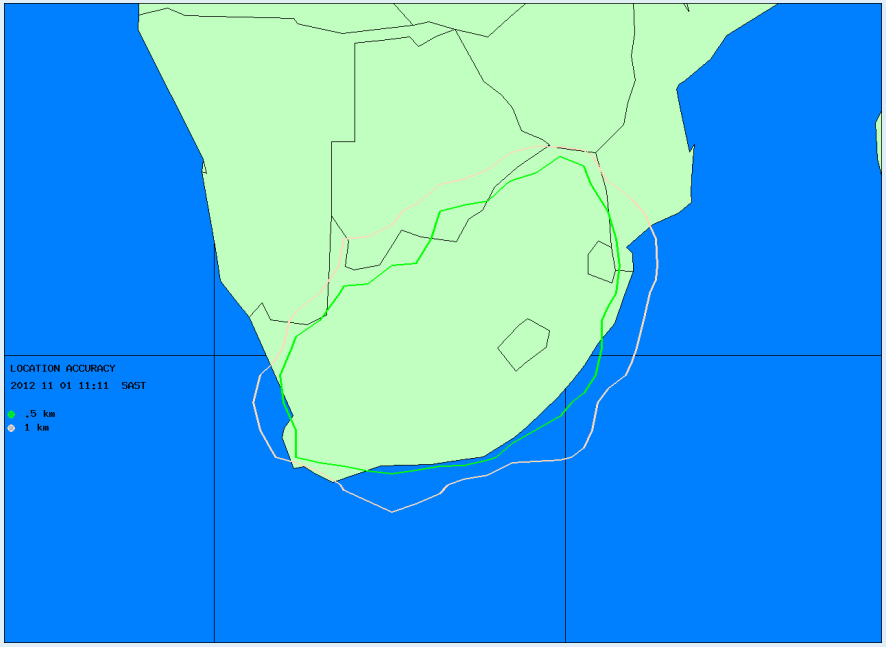
Performance

- Validation of the performance of the network is complicated due to the lack of ground-truth observations.
- High-speed camera footage or rocket-triggered lightning needed.
- Modelled projections of Detection Efficiency and Location Accuracy:

Detection Efficiency

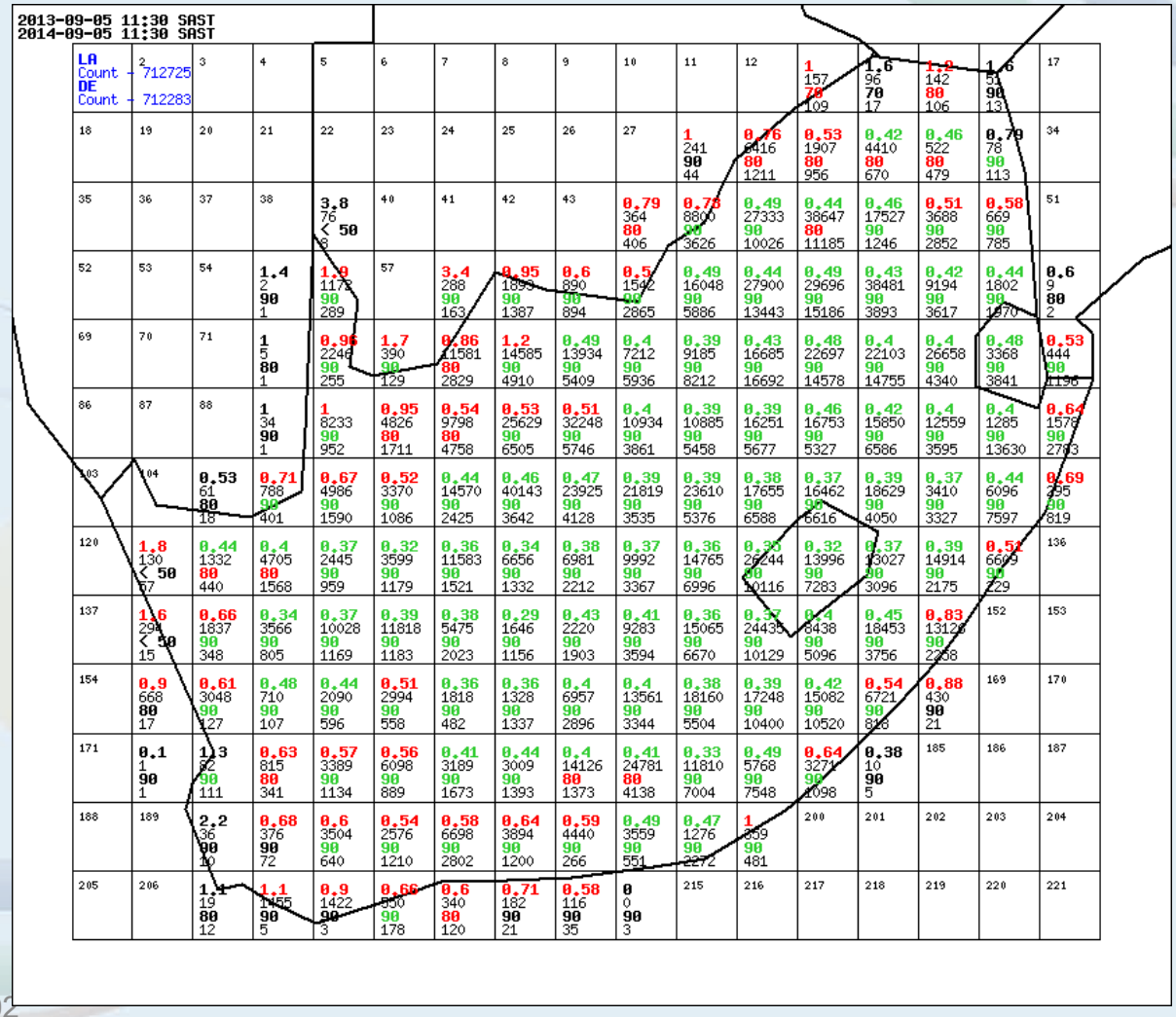


Location Accuracy



Performance

Dynamic projections of Detection Efficiency and Location Accuracy



Performance

- Recent performance evaluation was performed using high-speed camera footage of lightning to two towers in Johannesburg.
- Flash Detection Efficiency (128 flashes):
  - Detection Efficiency of downward flashes (101) = 94%
  - Detection Efficiency of upward flashes (27) = 66.7%
  - Overall Flash Detection Efficiency = 88.3%
- Stroke Detection Efficiency (466 strokes from upward and negative flashes):
  - Overall Stroke Detection Efficiency = 72.1%
- Median Location Accuracy (71 events) = 68.5 meters
- Not representative of entire country and all events

Fensham H.G., Shumann C., Hunt H.G.P., Tasman J.D, Nixon K.J., Warner T.A., & Gijben M., 2018: Performance evaluation of the SALDN using high-speed camera footage of ground truth lightning events over Johannesburg, South Africa. Presentation presented at the 34th International Conference on Lightning Protection, 2-7 September 2018, Rzeszow, Poland. 978-1-5386-6635-7/18/$31.00 ©2018 IEEE

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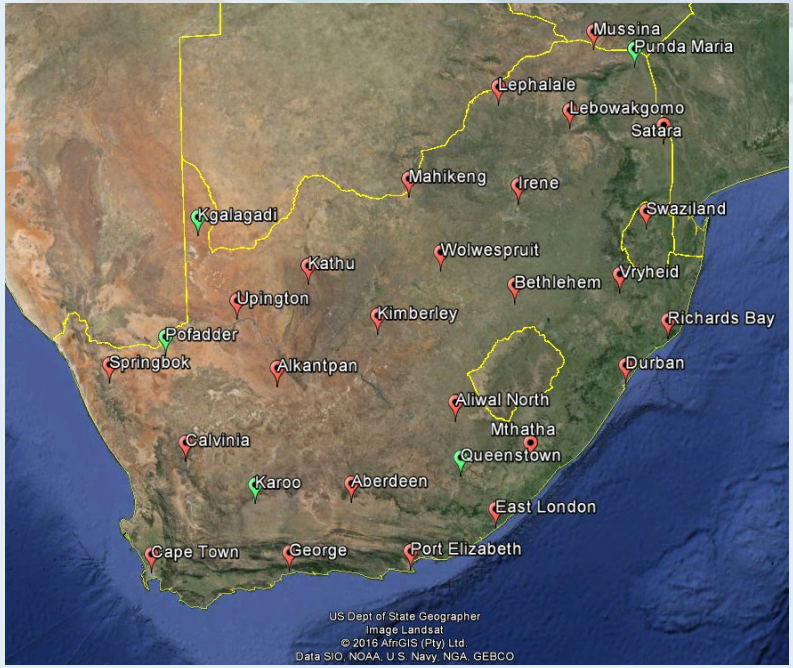
Plans for network

- We recently upgraded the Vaisala TLP processing software.
- New software + upgrade of sensors should improve performance of network.

- We also want to add more sensors in South Africa (especially on the edges) – At least 5 to start, more later.
- Extend network into neighbouring countries.



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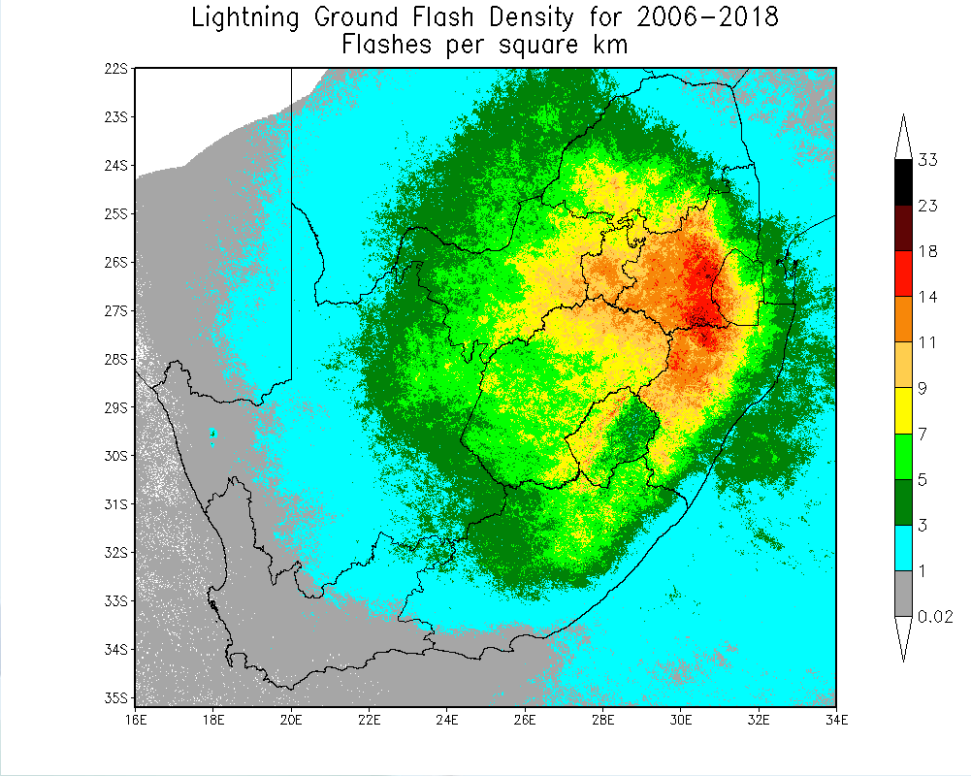
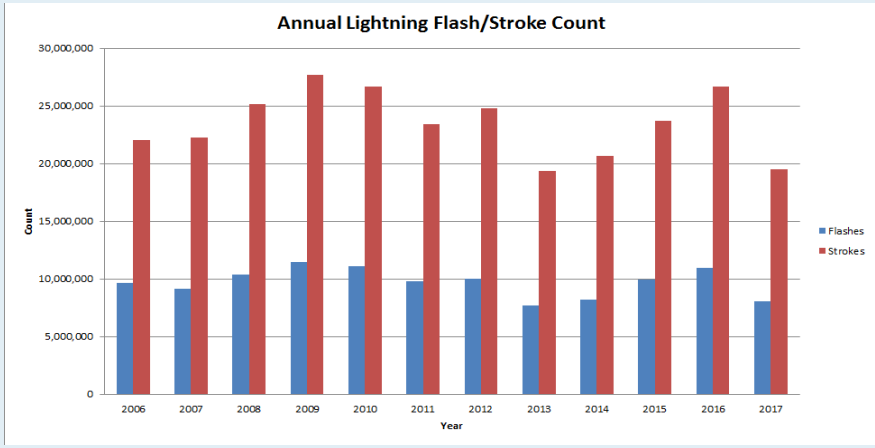
Data

- We have a data archive from March 2006 to present available.
- Data for lightning flashes and strokes available.
- Data for real-time and reprocessed flashes/strokes available.





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Uses

- Monitoring of thunderstorms
- Nowcasting
- Input to systems
- Research
- Product development
- Product validation
- Climatology
- Lightning verification (e.g. insurance sector)
- Clients (e.g. power utility)
- Etc.

- We will be happy to assist with data comparisons between the Lightning Imager onboard MTG and the SAWS LDN.

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Thank you

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