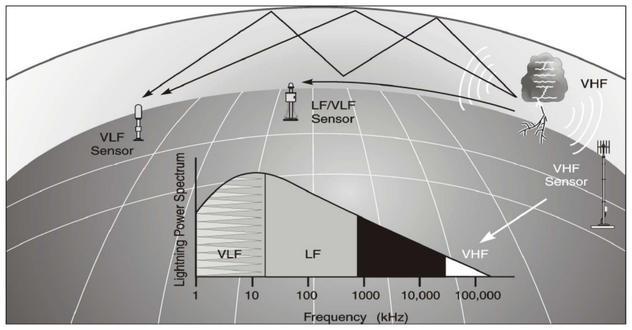
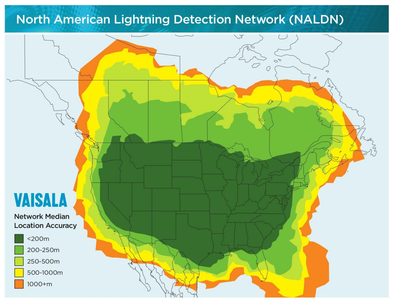
Vaisala Lightning Data is the foundation of new non-invasive tool for natural resources exploration.

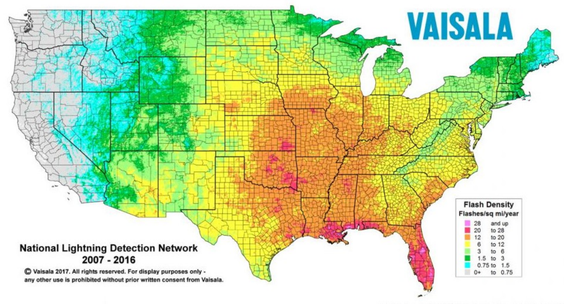
Images from Vaisala

Vaisala Lightning Detector





Strike Location Accuracy
Dark Green < 200 m / 656 ft



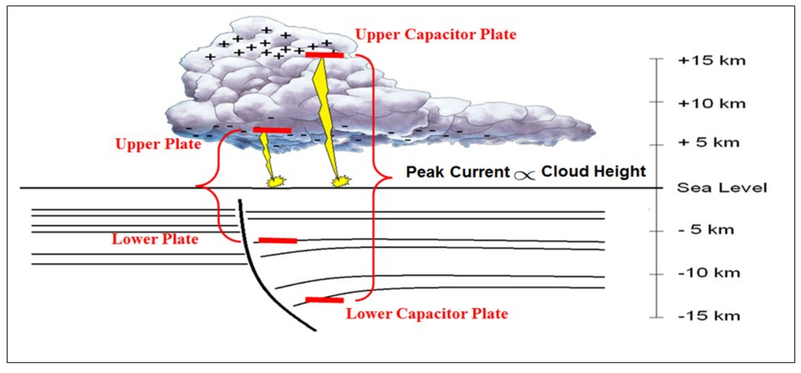
2007-2016 Flash Density Flashes / sq mi / year
yellow area: 6 to 12 strikes / sq mi /year

Lightning Data in 4 Dimensions

Rock Property & Attribute Maps & Volumes

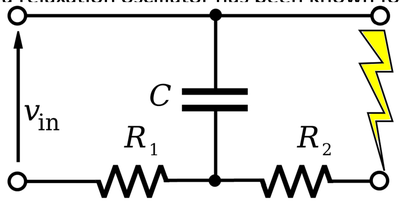
Key Assumptions:

1. Lightning occurs when there is sufficient charge to bridge the capacitor.
2. Lightning is affected by geology to a depth proportional to cloud height, as derived from Peak Current



Calculating Resistivity

- The physics of a relaxation oscillator has been known for decades.
- The atmosphe capacitor.
- The difference current.



- R_2 is the resistance between the lightning strike point and the bottom plate of the capacitor, i.e. the resistance of the rocks and the fluids in the rocks.
- Calculating R2 provides values for resistivity maps & volumes.

EM technologies provide linkages between electrical and magnetic earth currents, atmospheric currents, and acoustic waves in various ways.

Conductivity surveys record near surface conditions, induction well logging tools image near boreholes, some image DHIs by blending electrical signals and acoustic seismic wave responses (generates DHIs), some map shallow features with currents and magnetics (flow paths of water), and lightning attributes provide information on apparent resistivity and structure at depth.

Skin Effect

We've all seen fulgurites – melted silica from lightning strikes that can extend a few tens of meters into the ground. However, there is more to this earth/atmosphere relationship.

Meteorologists:

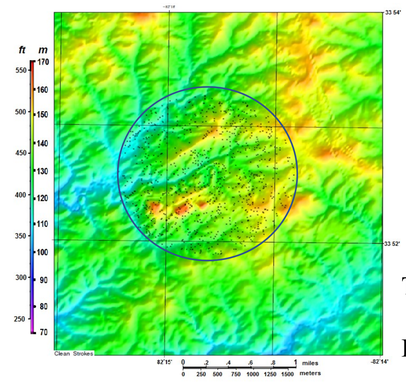
- See lightning as an atmospheric event with little interaction with geology.

Geophysicists:

- See lightning as a primary charging source of telluric (earth) currents.
- Skin Effect is the depth the current is reduced to 1/e (~0.37 of surface current).

- Given δ is skin depth in meters, μ_r is relative magnetic permeability of the medium, ρ is the resistivity of the medium in ohm-meters, and f is the frequency of the current in kilo-hertz. 503 is the product of constants.
- At 2,000 meters current density is still about 2% of near-surface value.
- A 20 kA Peak Current strike effects an area of 0.01 m^2, with a current density of 2,000 kA/m^2. At 2% of the initial value, it will still be 40,000 A/m^2. Lightning, like current along a wire, induces a magnetic field, which could interact with telluric currents to as much as 12,000 m/40,000 foot depths.
- Telluric currents likely play a significant role in where lightning strikes.

Lightning Attribute Study Area Over Former Barite Hill Gold Mine



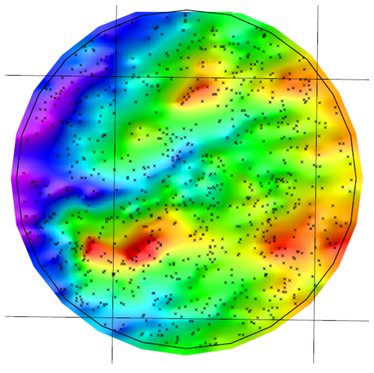
Topographic Map
Cloud to Ground
Lightning Strikes

Small black dots indicate lightning strike locations (over 1200 strikes; 760 used after data cleaning)

Total Circular Study Area:
1.99 sq mi/5.15 sq km
Diameter: 1.59 mi/2.56km

20 Years of Data - Cloud to Ground (CG) Strike Point Risk Probability Demonstrates Strikes Not Random

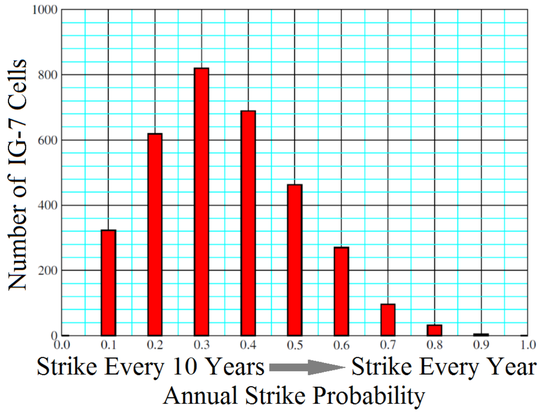
Distribution of CG Strikes over Barite Hill Study Area



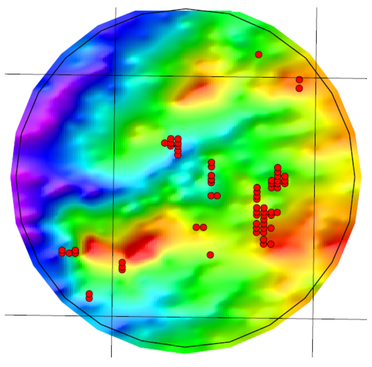
Topography
Red - High Blue - Low

Annual Strike Probability Per Cell

Cells = Rectangles 30x50 meters / approx. 98x164 ft



Distribution of Risk Points Over Barite Hill Study Area



Risk Points
Red Rectangles 30/50 m