Accurate Lightning Detection Near and Far

/ VAISALA GLOBAL LIGHTNING DETECTION NETWORK GLD360 DETECTS METEOROLOGICAL ACTIVITY AROUND THE WORLD

VAISALA

The Network You Can Rely On

Vaisala Global Lightning Dataset GLD360 is the top performing worldwide lightning dataset in existence today. With very low frequency long-range sensors operating all over the world, GLD360 is able to accurately detect up to 70% of lightning worldwide and locate with accuracy up to 5km. GLD360 is ideal for improving weather analyses and forecasts, as well as early warnings for aviation, defense, shipping, the general public, as well as others who need a more complete picture of the weather anywhere in the world.

The following examples show you the GLD360 in action through some past weather phenomena. Whatever the weather or the location, the Vaisala Global Lightning Dataset has the lightning data covered.

GLD360 Identifies Lightning in Australian Cyclone Yasi

Cyclone Yasi, one of the strongest tropical cyclones to hit Australia in many years, came inland on February 2, 2011, striking the northeast coast, near Cairns, North Queensland. Lightning data from Vaisala's GLD360 show 76,437 strokes over the map area during the 24-hour period ending at 2000 UTC on February 2.

Four features of the cyclone become apparent when the image above is compared with the satellite image at 1123 UTC on February 2.

- First, there are several small clusters of strokes located within 100 km of the eyewall, along the later portion of the track, at 0000 and 1200 UTC, as found in studies by Nick Demetriades and Ron Holle of Vaisala's Development Center for Meteorology.
- Second, there are curved lines in the top-center of the image that are feeder bands flowing toward the center of the cyclone as it moved to the west-southwest.
- Third, there is almost no lightning along the path. This is consistent with past studies, which have shown an almost complete lack of lightning in the large central dense overcast shield (which contains the strongest winds of a tropical cyclone) that is not undergoing any rapid changes.
- Finally, there are several large clusters over Australia that experience very frequent lightning, northwest through southwest of the center as the cyclone makes landfall just after 1200 UTC. These clusters are located on the western edge of the thick upper clouds from the outflow of Yasi, in the humid air where thunderstorms developed during daytime heating.

The GLD360 data are able to identify all four of these features – eyewall, feeder bands, lightning-free central dense overcast shield, and the outer edge of the cyclone. In one seamless view, GLD360 identifies the locations and times of strong updrafts throughout the region, and associated convective weather threats.

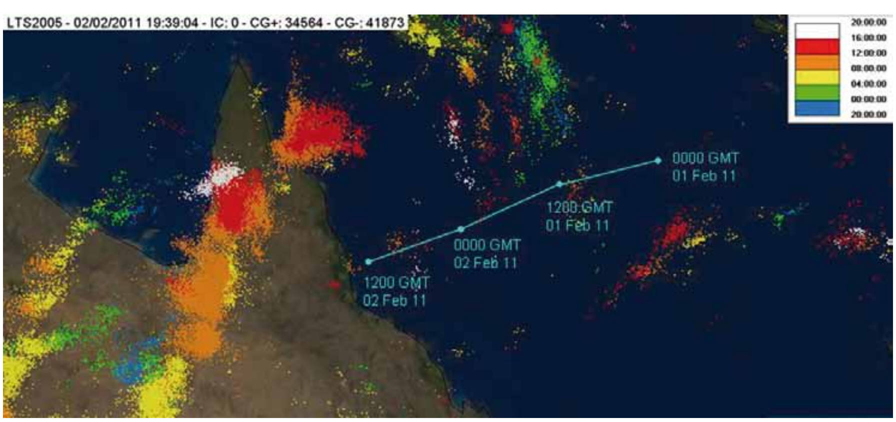

Figure 1. The path of tropical cyclone Yasi is shown in light blue as it moved from east-northeast to west-southwest, with locations at 0000 and 1200 UTC on February 1 and 2 pinpointed.

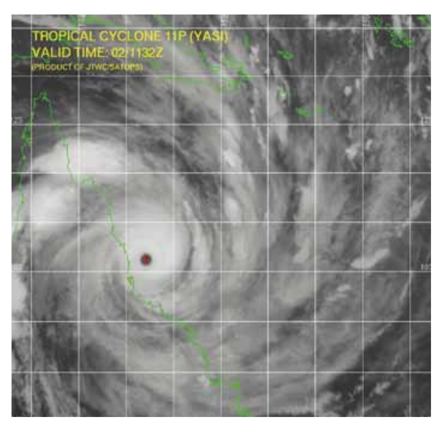

Figure 2. Infrared satellite image of tropical cyclone Yasi at 1130 UTC on February 2, 2011. The eye location is indicated with a red plus sign.

GLD360 Detects Lightning Increases in South American Summer

During the past few months, the number and areal coverage of lightning strokes over South America has increased significantly. Vaisala's Global Lightning Dataset GLD360 has detected this interesting development.

Lightning in South America persists all year in equatorial regions and the northern Amazon basin. In the southern regions of the continent, however, cold fronts bring cooler and drier air from the south in the winter months. As spring arrives, lightning activity expands steadily southwards. Figure 3 shows this steady monthly progression across the continent during 2010, from the middle of the Southern Hemisphere's winter (June) to late spring (October).

Lightning activity has continued in the regions featured in the October map, as indicated by recent flooding in the Rio de Janeiro region.

An interesting feature appears as the summertime's warmer, moister, low-level air spreads across South America. Figure 4 shows lightning over the Amazon basin and other regions, as well as a separate line along the west coast on December 6 and 7. On both days, there is a tell-tale pattern of orographic lifting with the existing low-level moisture being pulled westward toward higher elevations to become the fuel for thunderstorms on the mountains and their eastern slopes. This mountainous region is not covered by meteorological radars, highlighting the effectiveness of GLD360 in identifying lightning in the world's most remote locations.

GLD360 depicts a lack of coastal lightning due to the cool to cold water on the western side of continents at low latitudes. This feature is common worldwide, and prohibits deep convection from forming due to subsiding air aloft. In this situation, the GLD360 data accurately plot this well-known meteorological feature.

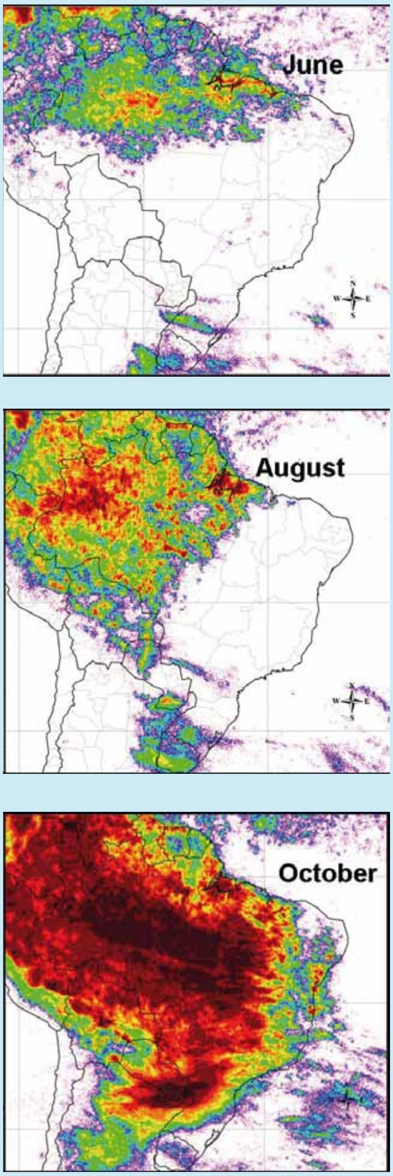

Figure 3. The number of GLD360 strokes increased from 1.1 million in June to 3.4 million in August, before a tenfold increase to 32.0 million in October as summer arrived.

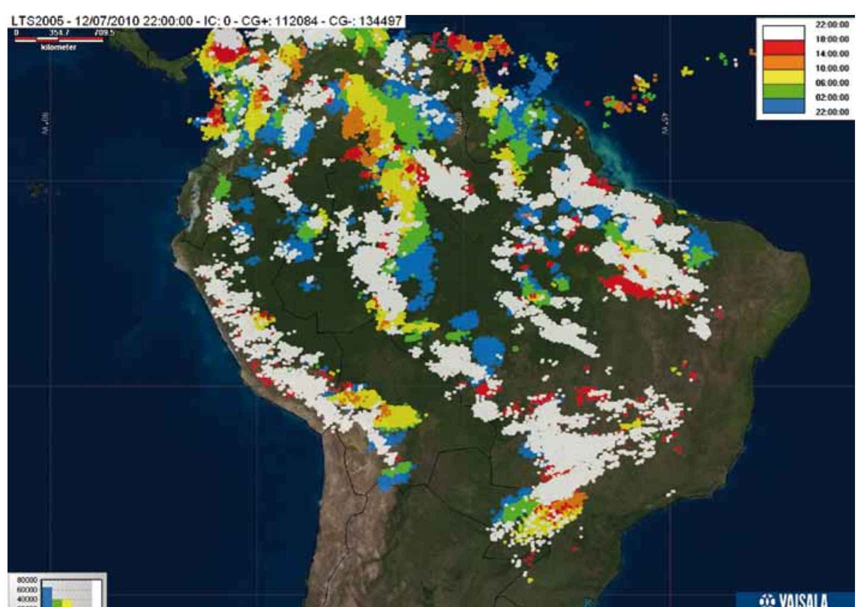

Figure 4. Frequent lightning is detected by GLD360 over some of the most remote locations in the world, in northern and central South America, on December 6 and 7, 2010.

GLD360 Detects Lightning in European Winter Storms

In 2010, much of Europe experienced strong early winter storms. Vaisala's Global Lightning Dataset GLD360 detected a significant amount of lightning during some of these storms.

On December 2, 2010, GLD360 showed extensive lightning over the seas and oceans surrounding southern Europe (see Figure 5). This situation indicates very cold air over relatively warm oceans, resulting in strong vertical instability. Further west over the North Atlantic, a strong cyclone traveling in the Westerlies is producing frequent lightning. More than 160,000 strokes were detected during this 24-hour period.

One week earlier, on November 26, 2010, GLD360 detected frequent flashes over the central North Atlantic (see Figure 6), where flashes are overlaid onto infrared satellite data. Lightning indicates regions of strong vertical motion that pose a hazard to aviation and maritime interests. Flashes are apparent in clusters within the large band of high clouds extending from south to north, as well as in the cold pool shown by scattered flashes and clouds west of the main cloud band.

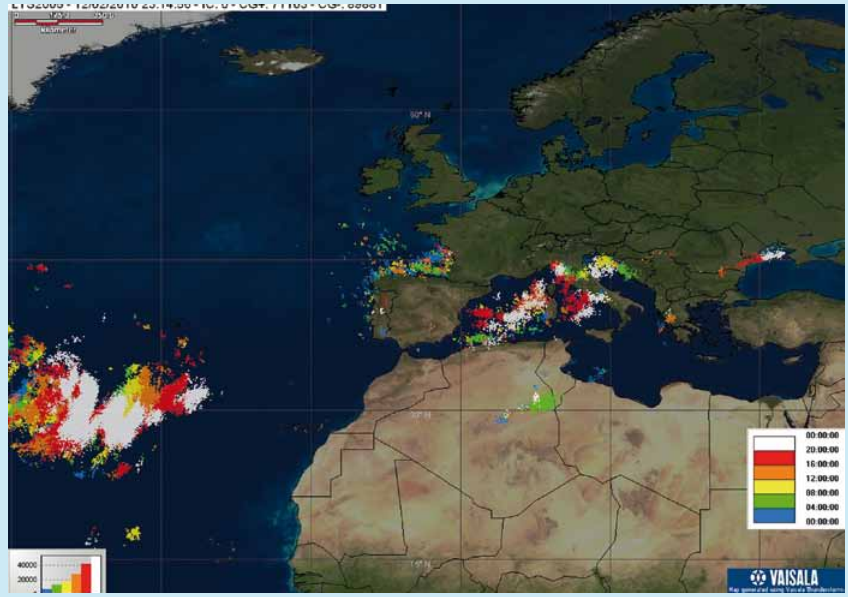

Figure 5. Extensive lightning can be seen over the seas in southern Europe as well as a strong cyclone traveling over the North Atlantic.

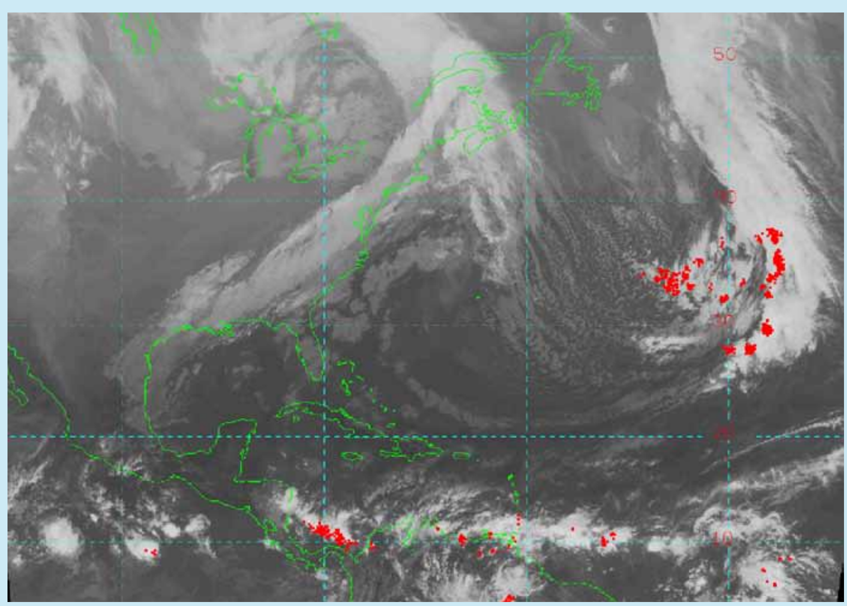

Figure 6. A composite of lightning and satellite data on November 26, 2010 provided by the University of Hawaii.

GLD360 Accurately Locates Lightning in Remote Areas

Vaisala's Global Lightning Dataset GLD360 is able to locate lightning in areas of the world where meteorological observations may be partially lacking. Among the most difficult areas are islands that may not have local meteorological radar or have radar with limited range over the land area. Since meteorological satellite data is not usually available at high temporal and spatial sampling rates in such areas, updates on convection and thunderstorms are often unavailable. Two examples are considered with GLD360 data below.

The island of New Guinea, divided between the nations of Papua New Guinea and Indonesia, is near the Equator, surrounded by warm oceans and mountains. All of these factors result in a strong lightning maximum over the island during the daytime, when the land is heated relative to the surrounding oceans.

The lightning frequencies over higher terrain on the main island for these four months indicate that the annual total probably equals or exceeds the annual stroke frequency in Florida. In the absence of information from radar and other sensors in this developing country, GLD360 lightning data can be used to identify areas of concern for aviation, defense, maritime, and other interests.

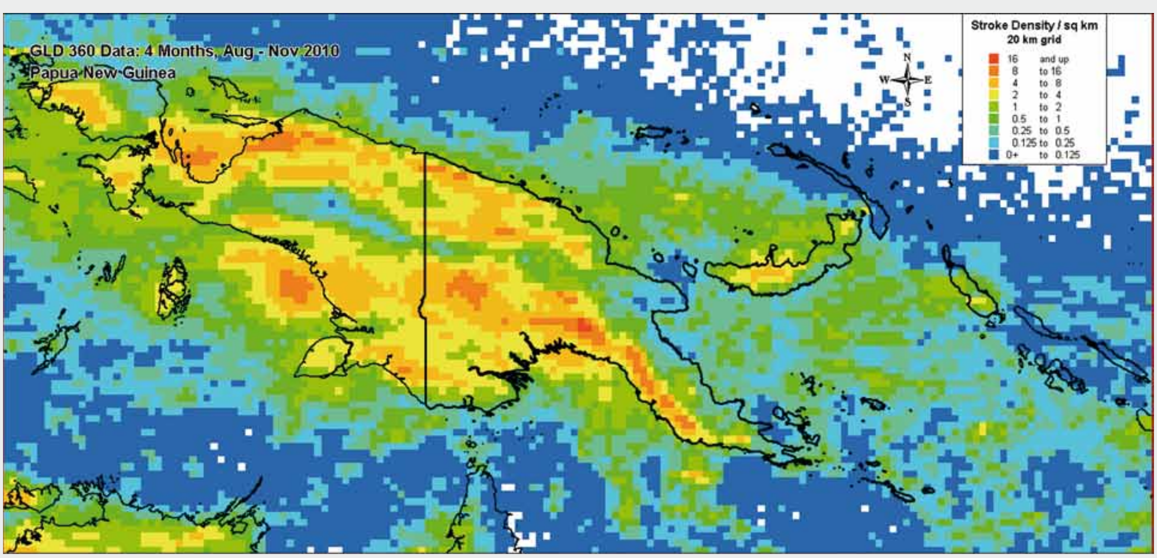

Figure 7 shows how GLD360 data, from August through to November 2010, effectively locates the high frequency of strikes over the main island, and captures the much lower stroke frequency over the water. The map also shows maxima over nearby islands to the northeast.

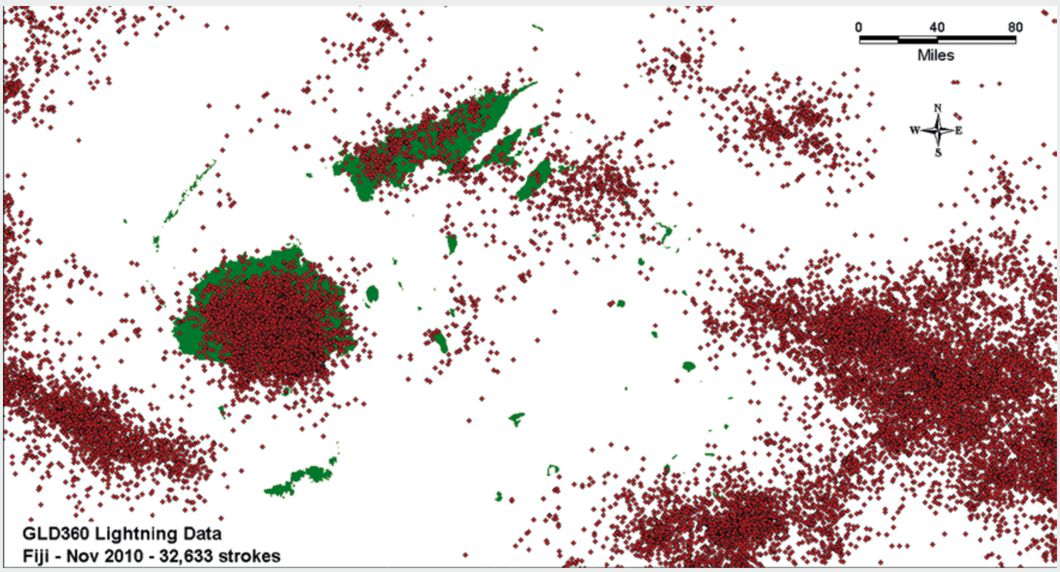

Figure 8. The lightning (in green) is concentrated over the two largest islands of Fiji in November 2010.

Fiji is a geographically remote and isolated nation comprised of a group of islands that is covered by a stronger meteorological infrastructure than New Guinea.

In Figure 8, GLD360 shows a concentration of lightning over the two largest islands in November 2010.

While the number of strokes is not especially large, the position of the strokes over the two islands shows that GLD360 is able to locate them effectively. Additional thunderstorms occur over oceanic areas in the regions to the southwest and southeast. Locating such lightning with GLD360 over these distant oceanic regions is valuable for operational applications in the area.

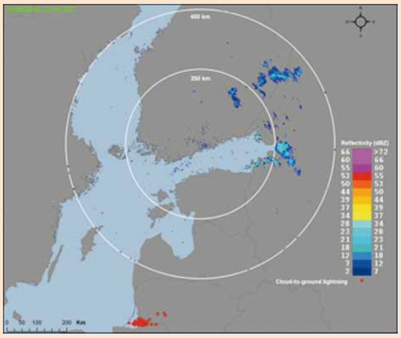

Figure 9. Reflectivity measured by the Vaisala Weather Radar WRM200 combined with lightning strikes of 15 minute segments measured by the Vaisala Global Lightning Dataset GLD360. The first detection of the storm (shown at the bottom of the image) approaching Scandinavia was provided by the GLD360.

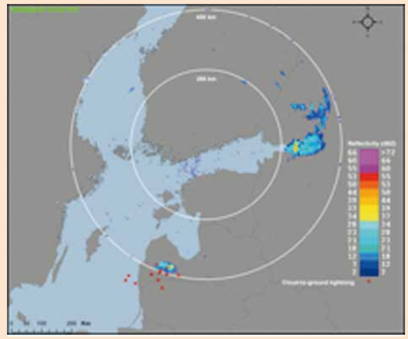

Figure 10. Reflectivity measured by the Vaisala Weather Radar WRM200, combined with lightning strikes of 15 minute segments, measured by the Vaisala Global Lightning Dataset GLD360 two hours after the observations shown in Figure 9.

GLD360 Tracks Storms Both Outside and Within Radar Range

This example shows Vaisala's Global Lightning Dataset GLD360 detecting lightning before the thunderstorm enters the radar's range. At the center of Figure 9 is a Vaisala radar north of Helsinki, Finland covering the Baltic Sea region and the surrounding nations. The radar in the center is sensing reflectivities at a distance of up to 450 km, but then the curvature of the earth places the radar beam too high to detect the top of the thunderstorm below it.

Vaisala's Global Lightning Dataset GLD360 detects lightning without such a distance boundary. Figure 9 shows a lightning storm over Lithuania, southwest of the radar, with strokes indicated in red. At first, the cluster of GLD360-detected strokes is not accompanied by radar returns outside the 450 km range, but the storm then moves within radar range, over Latvia and Lithuania, as shown in Figure 10. As a result, GLD360 data provide up to two hours more lead time for detecting thunderstorms of interest within the radar's range. Strokes in other storms are apparent in these 15-minute time segments. Since lightning does not always directly correspond with radar reflectivity, the thunderstorm lifecycle and threat information from the combined dataset is greater than either dataset shown separately.

Radar echoes beyond radar range have long been used along national borders and offshore, such as in the case of Vaisala's National Lightning Detection Network in the U.S. In this case, GLD360 demonstrates the ability to track thunderstorms uniformly in any area, providing the opportunity for meteorological, forestry, aviation, defense, and other applications in remote regions.

Detecting precipitation at a range of 450 km in a cold climate such as Finland's is extremely rare. An exceptionally warm air mass in Finland in summer 2010, which saw some of the highest temperatures in over a hundred years, led to some heavy thunderstorms.

In a cold climate, radar measurements do not usually exceed 250 km. Precipitation height is relatively low and everything beyond the 250 km range falls beneath the lowest measurement angle of the radar. At a range of 450 km, the center of the lowest weather radar beam is at an altitude of 18 km and is several kilometers wide.

For more information about Vaisala Global Lightning Detection Network GLD360 and to find your local contact point, please visit www.vaisala.com/GLD360.

Vaisala in Brief

Vaisala is a global leader in environmental and industrial measurement. Building on more than 70 years of experience, Vaisala contributes to a better quality of life by providing a comprehensive range of innovative observation and measurement products and services for meteorology, weather critical operations and controlled environments. The company serves customers in over 100 countries.

Headquartered in Finland, the Group employs over 1400 professionals worldwide.
The company has offices and operations in Finland, North America, France, United Kingdom, Germany, India, China, Sweden, United Arab Emirates, Malaysia, Japan and Australia.

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For more information, visit www.vaisala.com or contact us at sales@vaisala.com

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