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# The World Wide Lightning Location Network (WWLLN): Update on new dataset and improved detection efficiencies

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## 1. Extended Abstract

Powerful lightning flashes with large return stroke peak currents induce energetic and electrical coupling between the troposphere, the upper atmosphere and near-Earth space via the quasi-electrostatic and/or the radiated electromagnetic pulse (EMP) which leaks into space as whistler waves. Global lightning observations provide context on the activity levels of thunderstorm systems, assisting studies into whistler activity, Transient Luminous Events, Terrestrial Gamma-ray Flashes, meteorology and atmospheric electricity in general. One of the few scientific experiments which can currently provide such observations is the multi-station World Wide Lightning Location Network (WWLLN). The World Wide Lightning Location Network (WWLLN), provides low-cost, real-time global lightning coverage. The network stations measure the very low frequency (VLF; 3-30 kHz) radiation emanating from lightning discharges. Propagation at these very long electromagnetic wavelengths (up to 100 km) allows lightning strokes to be located in real time at up to 10,000 km from the receivers with a location accuracy that is estimated to be a few kilometres. True global mapping of lightning from widely spaced (a few Mm) ground-based receivers requires the use of frequencies below about 30 kHz. Lightning impulses in this frequency range suffer low propagation attenuation, and hence propagation in the Earth-ionosphere waveguide is possible over global distances [1, 2].

In the last few years WWLLN was enhanced to allow for the measurement of the stroke energy for each WWLLN-detected stroke. This allows for the roughly 65 station network to measure the stroke energy to a 17% uncertainty alongside the location and timing accuracies of ~10 km and <30 μs [3]. This is now an operational WWLLN-produced dataset, with historic energy values available from mid-April 2009. We have compared the WWLLN-energy values for the New Zealand region with the return stroke peak current estimates provided by the New Zealand Lightning Detection Network (NZLDN). On the basis of this comparison, we find the best results are found when a quality filter is placed on the WWLLN energy data we recommend that WWLLN energy values should be used only when the number of stations contributing to that energy value is ≥3 and the WWLLN estimated relative error is ≤70%.

Recently, a new collaboration has been struck up between WWLLN and Earth Networks WeatherBug Total Lightning Network WTLN, where some WTLN receivers are being analyzed in real time to calculate the time of group arrival (TOGA) to provide WWLLN-like observations. The combined WTLN and WWLLN TOGA form an impoved global network of over 200 receivers. The combined global lightning network shows marked improvement over the WWLLN-only data set in regions such as central and southern Africa, and over the Indian subcontinent. It is normal for the WWLLN+WTLN dataset to include >100% additional lightning locations than the WWLLN only observations.

## 2. References

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