Geophysical Research Abstracts, Vol. 7, 02875, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02875

Introduction to the World Wide Lightning Location Network (WWLLN)

E. H. Lay (1), C. J. Rodger (2), R. H. Holzworth (1), and R. L. Dowden (2)

1. Department of Earth and Space Science, University of Washington, Seattle, WA, USA, (2) Department of Physics, University of Otago, Dunedin, New Zealand, (3) Low Freqency Electromagnetic Research, Ltd., Dunedin, New Zealand (erinlay@u.washington.edu)

BACKGROUND

An experimental lightning detection network, the World Wide Lightning Location Network (WWLLN) [Dowden et al., 2002], is being developed to provide low-cost, real-time global lightning coverage with 10 km location accuracy and at least 50% detection efficiency. While still growing, the network currently consists of 20 stations which 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.

OPERATIONAL STATUS

As part of the initial testing phase of the WWLLN the network operated in a simple mode sending the station trigger times into a central processing point rather than making use of the sferic Time of Group Arrival (TOGA). The introduction of the TOGA algorithm significantly improved the location accuracies, as expected. The global location accuracy ranges from ∼2-20 km, with the global median being ∼3 km, and the global mean ∼3.5 km [Rodger et al. 2005]. Regional case studies have shown that WWLLN detection efficiency depends on peak current, with a larger efficiency for strokes with high peak currents than with low peak currents [Lay et al. 2004; Rodger et al. 2004].

Based on a comparison between all WWLLN good lightning locations in February-April 2004, and the activity levels expected from satellite observations we estimate that the WWLLN is currently detecting ∼2% of the global total lightning, providing good locations for ∼5% of global CG activity [Rodger et al. 2005]. The currently low global efficiency is due to the difficulty of determining which lightning impulses ("sferics") have a common lightning stroke. A new algorithm, which largely resolves this, will be in use from early 2005. However, in a region of Australia where comparisons could be made with commercial lightning detection data, the WWLLN detected ∼13% of the total lightning, suggesting a ∼26% CG detection efficiency and a ∼10% IC detection efficiency.

SUMMARY

For many scientific applications, the benefits of a global overview in real time can outweigh the very low total lightning detection. It has been shown that the WWLLN network data can provide spatial resolution on the order of magnitude of an isolated thunderstorm even at >7 Mm from the receiver locations allowing an indication of global lightning activity in real time (if not individual flashes) [Lay et al. 2004]. Observations of red sprites undertaken from the space shuttle Columbia during the ill-fated STS107 mission used WWLLN activity maps available from the internet to orientate the shuttle [Yair et al., 2004], allowing some predication of where active thunderstorms containing the large lightning events which produce red sprites would be located. Even in its experimental state, WWLLN is already being used by many research groups to monitor global lightning activity.

REFERENCES

Dowden, R. L., J. B. Brundell, and C. J. Rodger, VLF lightning location by time of group arrival (TOGA) at multiple sites, J. Atmos. Sol. Terr. Phys., 64, 817-830, 2002.

Lay, E. H., R. H. Holzworth, C. J. Rodger, J. N. Thomas, O. Pinto, and R. L. Dowden, WWLL Global Lightning Detection System: Regional Validation Study in Brazil, Geophys. Res. Lett., 31(3), L03102, 10.1029/2003GL018882, 2004.

Rodger, C. J., J. B. Brundell, R. L. Dowden, and N. R. Thomson, Location accuracy of long distance VLF lightning location network, Ann. Geophys., 22(3), 747-758, 2004.

Rodger, C. J., J. B. Brundell, and R. L. Dowden, Location accuracy of long distance VLF lightning location network: Post algorithm upgrade, Ann. Geophys., (in press) 2005.

Yair Y., P. Israelevich, A. D. Devir, M. Moalem, C. Price, J. H. Joseph, Z. Levin, B. Ziv, A. Sternlieb, and A. Teller, New observations of sprites from the space shuttle, J. Geophys. Res., 109, D15201, doi:10.1029/2003JD004497, 2004