

## Comparing lightning activities with climatic reanalysis parameters

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Area around the Maritime Continent (MC) is one of the most important regions for lightning and convection activities in the world. Therefore, detail research in this area leads to understanding of climate change. GEON, Global ELF observation Network, provides information including energy of individual lightning stroke which occur anywhere in the world. We compared GEON data with Outgoing Longwave Radiation (OLR) as a kind of proxy of cloud amount or strength of atmospheric convection. In the initial analysis areas of MC, Western Pacific Warm Pool (WPWP) and Eastern Indian Ocean (EIO) are examined from August 2003 to July 2004. It is found that lightning activities shows ~30 day periodicity while convective activities ~40 day periodicity. And cross spectrum of these data have ~30 day periodicity. In this presentation, we will show detailed results and comparative results of lightning activities and climatic reanalysis parameters.

### 1. Introduction

The atmospheric convection is activated by the updraft associated with the heating of the surface by insolation. This convection carries water vapor and heat to higher altitudes. MC is one of the most important regions for convection and lightning activity in the world, which is related to the global climatic phenomena including El Nino, Madden-Julian oscillation (MJO) and Asian monsoon. Therefore, detail research in this area leads to better understandings of the global climate change.

### 2. Data

#### 2.1. Lightning activities

Until now only a few statistical studies on the lightning activity with energy information of individual discharge have been made for global scale since there have been no lightning observation network with world-wide uniform sensitivity. GEON, Global ELF observation Network, constructed and operated by Hokkaido University, provides information including energy of individual lightning stroke which occur anywhere in the world. GEON consists of four observation sites and detects electromagnetic waves in the frequency range of 1-100 Hz, radiated from cloud-to-ground lightning discharges, with a detection threshold of 950 C-km. The estimated average error in geolocation is about 600 km.

#### 2.2. Convective activities

OLR are a kind of proxy of cloud amount or strength of atmospheric convection. Negative OLR are indicative of enhanced convection. In contrast, positive OLR are indicative of suppressed convection. We used OLR and climatic reanalysis parameters.

### 3. Initial results

We compared GEON data with OLR. In the initial analysis areas of MC, WPWP and EIO are examined from August 2003 to July 2004. It is found based on frequency analysis that lightning activities shows ~30 day periodicity while convective activities ~40 day periodicity. And cross spectrum of these data have ~30 day periodicity.

### 3. References

- [1] Christian, H. J., Blakeslee, R. J., Boccippio, D. J.: Global frequency and distribution of lightning as observed from space by the Optical Transient Detector, *J. Geophys. Res.*, 108, D4005, doi: 10.1029/2002JD002347, 2003
- [2] Eldo, E. Á., Rodrigo, E. B., Nesvit, E.C., Andrew, B. C., Rosa, H. C. and Arthur, R. W. H.: Correlations between deep convective and lightning activity on a global scale, *Journal of Atmospheric and Solar-Terrestrial Physics*, 72(2010), 1114-1121, 2010
- [3] Hartmut, H. A., David, T. G., Steven, E. B. and Denis, A. E.: Seasonal correlations of SST, water vapor, and convective activity in tropical oceans: A new hyperspectral data set for climate model testing, *Geophys. Res. Lett.*, 34, L15813, doi: 10.1029/2006GL029191, 2007
- [4] Hartmut, H. A., Ruzmaikin, A.:

CORRELATION BETWEEN THE SEA SURFACE TEMPERATURE AND THE FREQUENCY OF SEVERE STORMS IN THE TROPICAL OCEANS USING SEVEN YEARS OF AIRS DATA, IGARSS 2010, Honolulu, Hawaii, Paper number 1474, 2010

[5] Kase, H.: M. Thesis, 2010

[6] National Oceanic & Atmospheric Administration: <http://www.noaa.gov/>

[7] Price, C. and Asfur, M.: Can Lightning Observations be Used as an Indicator of Upper-Tropospheric Water Vapor Variability?, American Meteorological Society, doi: 10.1175/BAMS – 87 – 3 - 291 ,2006.

[8] Takahashi, Y., Okazaki, Y., Sato, M., Miyahara, H., Sakanoi, K., Hong, P. K. and Hoshino, N.: 27- day variation in cloud amount in the Western Pacific warm pool region and relationship to the solar cycle, Atmos. Chem. Phys., 10, 1577-1584, 2010

[9] Yamashita, K.: D. Thesis,2011