【Grant-in-Aid for Scientific Research(S)】

Integrated Science and Innovative Science (New multidisciplinary fields)

Title of Project：Development and deployment of the radar network at high resolution

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Research Area：New multidisciplinary fields

Keyword：Meteorological disasters

【Purpose and Background of the Research】

Social vulnerability has become a major concern in recent years for the modern highly sophisticated society, particularly in terms of natural disaster. In order to prevent the meteorological disaster, the radar system has been widely used and the most effective tool, because the system can remotely sense the meteorological targets over the wide area in a short time. Most conventional radars for both operation and research are S-, C-, and X-band radars covering 100–450 km in radius with a range resolution of more than 100 m and a time resolution of 5 min roughly, which are appropriate for the precipitation system of macro- or mesoscale. On the other hand, it is difficult for conventional radars to detect smaller scale weather phenomena such as localized scattered thunderstorms, tornadoes, and microbursts, which often damage our lives seriously. In addition to these, while the radar system can detect the motion of the hydrometors, it is not possible to detect the electrical signature of thunderstorms. In this project, using the recently developed small radar systems and lightning location system, the life cycle of the thunderstorm and lightning activity are observed with high resolution, and the way to predict the meteorological disaster will be developed.

【Research Methods】

In this research project, based on the developments of the 3 dimensional lightning mapping system and the broad band radar system, we are going to 1) develop the radar network and assess its effectiveness, 2) construct the data processing and distribution system, 3) analyze the thunderstorm behavior using both the broad band radar data and lightning location data from the digital broad band interferometer, and 4) develop the prediction model for meteorological disaster.

【Expected Research Achievements and Scientific Significance】

The two main instrument used in this research project, the broad band radar and the broad band digital interferometer, have been both developed in Osaka University. The Ku-band broadband radar (BBR), with fast scanning capability for meteorological application can accurately measure the radar reflectivity factor with a range resolution of several meters and a time resolution of 55 s per volume scan from the nearest range of 50 m to 15 km for 10-W power using pulse compression. On the other hand, the broad band digital interferometer is a system to locate sources of VHF impulses based on the digital interferometric technique. The basic idea of the technique is to estimate the phase differences between the EM pulses received by a pair of spatially separated broadband antennas at various frequencies. By doing so, the location of the VHF sources emitted by lightning is determined and the 3 dimensional structure of lightning progression is reconstructed with at least 2 sites. Using these instruments, the electrical and dynamical nature of storms are observed and analyzed to predict the natural disasters.

【Publications Relevant to the Project】

・Yoshida, S., C. J. Biagi, V. A. Rakov, J. D. Hill, M. V. Stapleton, D. M. Jordan, M. A. Uman, T. Morimoto, T. Ushio, Z-I. Kawasaki, Three-dimensional imaging of upward leaders in triggered lightning using VHF broadband digital interferometers, *Geophys. Res. Lett.*, VOL. 37, L05805, doi:10.1029/2009GL042065, 2010.3

・Yoshikawa, E., Tomoaki Mega, Takeshi Morimoto, Tomoo Ushio, Zen Kawasaki, Katsuyuki Imai, and Shin'ichiro Nagayama, Development and Initial Observation of High Resolution Volume Scanning Radar for Meteorological Application, *IEEE Trans. Geosci. Remote Sens.*, in press

【Term of Project】 FY2010-2014

【Budget Allocation】 77,600 Thousand Yen

【 Homepage Address and Other Contact Information】

http://www1a.comm.eng.osaka-u.ac.jp/index.html.ja