Development of a Meteor observation radar system using radio forward scattering and interferometry technique

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Meteor radar has been used for the last five decades to observe meteors activity and atmospheres characteristics continuously even at day time and cloudy nights when optical observation is impossible. Forward scattering radar rely on the ionization of the upper atmospheric plasma resulted from meteors entry into the atmosphere. Interferometry improves the observation by superimposing received waves on multiple antennas and detecting phase difference between them.

Since 2005 a meteor radar observation system has been developed at Kochi University of Technology based on radio forward scattering and interferometry technique. The system utilizes the VHF band (53.75 MHz) beacon waves emitted from Sabae station at Fukui National College of Technology, Fukui prefecture as a source of radio beacon signals. The receiver is formed of five channel antennas with cross arrangement at a distance of 340 km from the transmitter. A PC with a sound card and an AD board are connected to the receiver for data output. Optical observation is performed in parallel at night and comparison with radio observations is presented.

Received meteor echoes are counted using the software application 'HROFFT' (Ham-band Radio meteor Observation Fast Fourier Transform). HROFFT generates a PNG image every 10 minute period summing 144 images per day. The software meteor echo counter developed at KUT analyzes the images generated then produce information on the meteors detection time, duration time, and location. Phase difference between received waves is then extracted to detect meteors direction. Based on the meteor parameters obtained it is possible to observe the effect of Ozone content at the mesosphere level by comparing the number of counted meteor echoes observed and the duration time of each echo. The Ozone layer impact statistically appears in less number of meteors counted having certain echo duration times (Cevolani et al., 2003).

Improvements to the existing HRO-IF system are in progress. A plan to develop the system capabilities by adding 2 remote receiving antennas at a distance not less than 15 km from the radar site will be implemented. This can allow measurement of meteors speed and display their trajectory. A transmitter antenna also is planned to be installed at a later stage to provide better control of the system end to end. Research on other meteor characteristics such as mass and upper wind velocity will be conducted at a later stage using the developed system.

Reference G. CEVOLANI and G.PUPILLO (2003) Ground-based radio observations to probe the ozone content in the meteor region, Annals of Geophysics, 46, 247-258