Analysis of Equatorial Atmosphere Radar (EAR) Spaced-Antenna Performance from Multiple Orientation of the Receiving Antennas

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Equatorial Atmosphere Radar (EAR) is a very high frequency (VHF) Doppler radar operated with an active phased-array antenna system at 47 MHz. It had originally been equipped with a single receiving channel system since its establishment in 2001 at the equator in Kototabang, West Sumatra, Indonesia (0.20°S, 100.32°E). An effort has been carried out recently to enable spaced-antenna capability for the EAR with the development of software-defined multi-channel receiver.

We have developed multi-channel receiver system for the EAR using the combination of Universal Software Radio Peripheral X300 (USRP X300) series and GNU Radio. Two USRP X300 devices corresponding to four receiving channels are synchronized using 10 MHz reference clock and 1 pulse per second (PPS) signal. Received signals are collected by the existing EAR antennas and fed to the USRPs for digital conversion and then stored in Hard Disk Drive (HDD). Offline signal processing is carried out to obtain the Doppler spectra and Full Correlation Analysis from Spaced-Antenna method is carried out for the measurement of zonal and meridional wind speed.

Initial configuration uses three non-collinear receiving antennas where the size of each antenna is approximately one twelfth of the whole antenna size. Noticeable limitations in term of maximum observable height and fluctuating estimated horizontal wind appear which could be due to several factors such as low signal to noise ratio (SNR) and high separation distance between the receiving antennas, thus, the configuration of the receiving antennas required to be modified. Here, we present an analysis of spaced-antenna method with multiple orientations that taken into consideration the size of receiving antenna and its separation distance where significant performance improvement is expected to be achieved.

Keywords: Spaced-antenna, Full correlation analysis, Software-defined radio, Equatorial