SuperDARN near range echoes and higher resolution measurement - recent improvement and future

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SuperDARN (Super Dual Auroral Radar Network) is an international high-frequency radar network originally intended to cover a wide range of polar ionosphere in both hemispheres by its fields-of-view and to monitor global ionospheric plasma convection in high temporal resolution of about 1-2 minitues in quasi real time mainly for space weather research. It can observe not only basic and important ionospheric plasma Doppler velocity and electric field, a variety of geomagnetic waves, ionospheric disturbances and irregularities, but also properties of neutral atmosphere, e.g., traveling ionospheric disturbances (TIDs), mesoepheric echoes like PMSEs and neutral wind around mesopause region. As it is originally designed to measure global large-scale ionospheric plasma parameters, the spatial resolution has been rather coarse, and it was originally difficult to obtain height information of echoes, high temporal resolution less than 1 second, and high spatial resolution of less than 15km in radial direction. Echo height information is very important especially to distinguish those among D, E and F regions as the properties of plasma among them are considerably different and also to obtain precise altitude of meteor echoes around mesopause due to existence of thin layers of neutral wind shear. Recent development in calibrating radar interferometry in SuperDARN community is an important step to improve much the reliability of height information especially in near range echoes and also of region identification for further echoes as well. Combining raw I/Q time series analysis method (Yukimatu and Tsutsumi, GRL, 2002) to be applied to extract underdense meteor echoes precisely, frequency domain interferometry (FDI) and/or over-sampling technique (Tsutsumi et al., 2009) with the appropriate interferometer calibration will improve the reliability and height resolution of the neutral wind measurement possibly leading to global neutral wind observing network around mesopause region with SuperDARN which will contribute to many studies on mesosphere-lower-thermosphere (MLT) or mesoephere-thermosphere-ionosphere (MTI) region dynamics and vertical coupling between ionosphere and neutral upper atmosphere. Another issue possibly critical for some specific studies, e.g., on short period electro-magnetic waves is possibility to achieve higher temporal resolution within a second as well as higher spatial resolution in range direction. (Higher spatial resolution in azimuth direction has been already tried and achieved by some radars using general imaging or spatial domain interferometry (SDI) technique.) There have been some trial against these possibilities with some success depending on the cases of the applied phenomena and the conditions of echoes, but have still been thought to be difficult to be overcome. This presentation will describe the evolution of SuperDARN near range echo measurement after last JpGU meeting, and will also discuss about the reliability of high temporal resolution measurement and the possible method to obtain reliable high temporal resolution data to extend the ability of SuperDARN.

Keywords: SuperDARN, near range echoes, electromagnetic waves, high temporal resolution

