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Observations of plasma bubbles using HF trans-equatorial propagation by digital radio receiver

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Plasma bubble is a disturbance in the magnetic equatorial and low latitude and equatorial ionosphere. Studying the plasma bubble is important in both scientific and engineering aspects. Coupling processes between low and upper atmosphere or large scale plasma waves in the ionosphere are suggested to be closely related to the plasma bubble. Ionospheric irregularities associated with the plasma bubble is a problem in satellite communication or satellite navigation and its occurrence and motion is needed to be monitored and predicted.

Trans-equatorial propagation of HF radio waves has been used to study the equatorial ionospheric structure for long time. It is useful to observe a wide area at the same time. The recent study with a latest HF direction finder showed that the off-great-circle propagations in the night correspond to plasma bubbles and zonal velocities of plasma bubbles can be estimated. However, the estimated positions and velocities were less accurate because of scattered arrival directions.

This study aims at improving the accuracy of the position and velocity measurements by measuring the propagation path length by a passive radar technique utilizing digital radio receiver. The observation system consists of two sets of digital receiver system. One of the receiver is placed near a radio source such as a radio broadcast station, and the other is placed far away from the source. By simultaneously measuring the same radio wave and measuring delays between the two recorded waves, propagation path lengths can be estimated.

At the conference, our observation system and initial results using HF radio stations in Japan will be presented. Planned observations using HF radio stations abroad will also be introduced. Any cooperations with our observation are welcome.

Keywords: plasma bubble, equatorial ionosphere, HF trans-equatorial propagation, digital radio receiver, passive radar, GNSS