Ground based radar detection of the inner boundary of the ion plasma sheet and it's response to the changes in the interplanetary magnetic field

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Abstract

SuperDARN is an array of HF radars, which covers most of the northern and southern high-latitude regions. The primary goal of this array is to study the dynamics of the large-scale convection pattern in order to understand the Solar wind – Magnetosphere-Ionosphere coupling (SW-M-I). Wide area coverage of the SuperDARN radars made it possible to detect some of the proxies for the magnetospheric land marks and boundaries on a global scale and shed some light on the on the some of the fundamental problems in the SW-M-I coupling process. One of the recent discoveries is that SuperDARN radar E region backscatter boundary in the dusk-midnight sector can be used as a proxy for the inner boundary of the ion plasma sheet. This discovery made it possible to study the boundary dynamics on a more global scale for the fist time. The boundary undergoes seasonal, diurnal, and substorm associated variations. One of the outstanding questions in the SW-M-I coupling research is how fast Magnetosphere-Ionosphere system reacts to the changes in the Interplanetary – Magnetic –Field (IMF). There are two schools of thoughts with regards to the changes in the ionospheric convection one being instantaneous and the other being delayed response. In this paper we present a study of the response of the equatorward boundary of the ion auroral oval on a global scale to the changes in the IMF. We have used the wide area coverage of the SuperDARN radar to investigate the response of the boundary to the changes in the upstream IMF. Estimation of the delay from the changes in the solar wind and IMF from an upstream satellite to the ionosphere is sometimes ambiguous. In order to avoid this ambiguity we have also used the changes in the central polar cap convection (both direction and speed) related to the changes in the IMF. This method also helps to precisely test the hypothesis of the fast and or slow changes. We will also compare the response of the ion auroral oval and the open/closed field line boundary detected using the ground based photometers in order to better understand the sequence of response from the changes in IMF to the changes in the polar cap convection, to the open/closed field line boundary and the equatorward boundary of the ion auroral oval. The implication of these results in the SW-M-I coupling will be discussed.