A Case Study Based on Ground Observations of the Conjugate Ionospheric Response to Interplanetary Shock in Polar Regions

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This study uses data acquired by an imaging riometer, an ionosphere total electron content (TEC) monitor, and three specific wavelength auroral imagers at the conjugate Antarctic Zhongshan (ZHS) and Arctic Yellow River (YRS) stations to investigate the response of the polar ionosphere to a space weather event induced by solar flare activity on July 14, 2012. After the geomagnetic storm suddenly commenced and a magnetospheric substorm was triggered by the arrival of an interplanetary shock wave and its interaction with the magnetosphere at 18:10 UT, significantly enhanced auroral activity was observed by the auroral imagers at the ZHS. Meanwhile, the polar conjugate observation stations in the two hemispheres recorded notable growth of the two-dimensional cosmic noise adsorption and similar motion tendencies. According to our analysis and comparison of the ionospheric TEC data acquired by the conjugate stations, the TEC at both locations presented a considerable growth tendency after the interplanetary shock wave arrived, although the two stations experienced different sunlight conditions (polar night in the Antarctic region and polar day in the Arctic region). However, a comparison with high-frequency radar data demonstrated that different sources were responsible for the electron density enhancement of the ionosphere. In the Arctic polar day region, the increased electron density may have been caused by anti-sunward convection of the plasma irregularity, whereas in the Antarctic polar night region, the increased electron density may have been caused by energetic particle precipitation at the magnetospheric tail. Different physical processes might be the cause of the differential responses of the ionosphere at the two studied geomagnetic conjugate stations in the same solar activity event due to different local photoionization conditions.

Keywords: polar ionosphere, conjugate, substorm, response, irregularity

