Optical and SuperDARN radar observations of shock aurora over Zhongshan station in Antarctica

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We present two case studies of ground-based aurora and ionospheric plasma convection responses to interplanetary (IP) shock compression. During the geomagnetic sudden commencement (SC) event caused by IP shock impact, Zhongshan station (ZHS) was located in the postnoon sector of the auroral oval. Optical auroral data observed by an all-sky camera at ZHS showed decrease intensity promptly during the preliminary impulse (PI) of the SC, and the SuperDARN radar at Syowa station scanning over zenith of ZHS observed plasma flow reversal from sunward to antisunward. Decrease of auroral intensity and reversal of the associated plasma convection in response to a sudden increase of the solar wind dynamic pressure has never been reported before. We suggest that these observational results were generated by a downward field-aligned current (FAC) and are consistent with a physical model of SC after examining the global geomagnetic variation. During the main impulse (MI) of the SC, new thin aurora arc with relatively brighter emissions was formed. One of signature of the ionospheric convection was the periodical oscillation of the flow direction characterizing ultra-low-frequency (ULF) waves during the shock compression. We suggest that the new discrete auroral arc may be associated with the field-aligned acceleration process in the region of the MI-related upward FACs. The ground magnetometer observations suggest that the oscillation of the ionospheric convection in duskside was associated with the field line resonance activity.