Statistical study of ion upflow and downflow observed with EISCAT Svalbard radar

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We have investigated how geomagnetic activity, the solar wind (SW), and the Interplanetary Magnetic Field (IMF) influence the occurrence of F-region/topside ionospheric ion upflow and downflow. Occurrence of dayside ion upflow observed with the European Incoherent Scatter (EISCAT) Svalbard radar (ESR) at 75.2 deg magnetic latitude is highly correlated with: the SW density and the SW dynamic pressure, as well as the strength of the IMF By component. We suggest that this correlation is because the region where ion upflow occurs becomes larger with SW density, pressure, and with IMF By magnitude, but does not move significantly in geomagnetic latitude. The occurrence frequency of dayside ion upflow has a peak concerning the variations of the geomagnetic activity index (Kp), SW velocity, and negative IMF Bz component. i.e. ion upflow is relatively less frequently seen at very higher values of these parameters. Dayside ion downflow in the F-region/topside ionosphere occurs only when the Kp index and/or SW velocity are high, or IMF Bz is largely negative. The ion downflow is likely due to ballistic return of the ion upflow. We suggest that the region of ion upflow not only becomes larger, but also moves equatorward with increasing Kp, SW velocity, and negative IMF Bz. Then the ESR is likely to move out of the upflow region, but can see some of the ions convecting poleward and returning ballistically downward.