Short-lived sub-auroral plasma flows observed by the SuperDARN Hokkaido radar during the magnetic storm of 14-15 December 2006

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The SuperDARN Hokkaido radar covers a wide range area including the sub-auroral and auroral regions. During the intense magnetic storm of 14-15 December 2006, the Hokkaido radar captured short-lived plasma flows at 45-55 MLAT equatorward of the auroral oval in the premidnight sector. The direction was predominantly westward, and the line-of-sight velocity reached about 300 m/s. These characteristics agree with those of the sub-auroral polarization stream (SAPS) which is a common term for enhanced plasma flows equatorward of the auroral oval. The IMF Bz was slightly negative during the period of three sub-auroral plasma flows, and no corresponding fluctuations corresponding to the subauroral flows were identified in the solar wind and IMF data. We performed a simulation of coupling between the ring current and the ionosphere. The sub-auroral electric potential was calculated solving Poisson's equation for the poleward boundary condition given by the Weimer-2001 empirical convection model. The field-aligned current driven by the ring current was also incorporated. The hot ion distribution in the inner magnetosphere was solved using bounce-averaged approximation with its boundary condition given by the hot ion measurements by four LANL satellites at 6.6 Re. The simulated line-of-slight velocity of the ionospheric plasma flows matched with the observation in terms of the three enhanced flows. It is concluded that the short-lived sub-auroral flows could have resulted from meso-scale structures of the field-aligned currents and the ring current in response to the changes in the convection electric field as well as plasma sheet density and temperature at 6.6 Re. Meso-scale structures with a length scale shorter than a half of Re in the equatorial plane could have been embedded in the storm-time ring current.