

A model of small scale field aligned currents in the middle and low latitudes as observed by the CHAMP satellite

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We have reported that the magnetic field observation by the CHAMP satellite shows the ubiquitous existence of small scale (1 nT - 5 nT) magnetic fluctuations with period around a few tens seconds along the satellites orbit and they can be interpreted as the spatial structure of small scale field-aligned currents generated by the ionospheric dynamo driven by atmospheric gravity waves propagating from the lower atmosphere. The mechanism is as follows: First, the gravity waves generated by the lower atmospheric disturbance propagate to the ionosphere. Then the neutral winds oscillate causing the ionospheric dynamo, and the Pedersen and the Hall currents flow. Because the dynamo region is finite, the electric charge accumulates at the boundary of the finite dynamo region and causes polarized electric fields. The temporal change of the polarized electric fields makes them propagate along the geomagnetic field as the Alfvén wave, at the same time, the ionospheric currents divert to the field-aligned currents. The CHAMP satellite observes the spatial structure of the field-aligned currents generated in this way as a temporal change along the path.

We report a result of verification of the model compared with the observed data, in addition to physical quantities including the current and amplitude of the neutral wind oscillation estimated by the model using the data.

Keywords: spatial structure of field aligned currents, middle and low latitudes, the CHAMP satellite, atmospheric gravity wave, the lower atmospheric origin