

Small spatial scale field aligned currents in middle and low latitudes as observed by the CHAMP satellite

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The magnetic field observation by the CHAMP satellite shows the ubiquitous existence of small scale (1-5 nT) magnetic fluctuations with period around a few tens seconds along the satellites. From characteristics of the amplitude and period, 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 the following; first, the gravity waves generated by the lower atmospheric disturbance propagate to the ionosphere; the neutral winds oscillate, cause ionospheric dynamo and Pedersen and Hall currents flow; because the dynamo region is finite, the currents cause polarized electric fields; and the polarized electric fields propagate along the geomagnetic field as Alfvén waves accompanied by field-aligned currents, at the same time, the ionospheric currents divert to the field aligned currents; finally the CHAMP satellite observes the spatial structure of the field aligned currents generated in this way as a temporal change along the path, because the temporal variation of the gravity waves are slow enough, i.e., more than a few minutes, that is, that of field aligned current can be ignored and nearly constant for the satellite crossing the currents.

This time we analyze correlation relation of the two components perpendicular to the geomagnetic field to find the following tendencies. About the magnetic data at the observed point, 1) if inclination and declination are plus and plus respectively, a correlation coefficient tends to be minus; 2) if inclination and declination are plus and minus respectively, it tends to be plus; 3) if inclination and declination are minus and plus respectively, it tends to be plus; 4) if inclination and declination are minus and minus respectively, it tends to be minus.

We report the model of the current system consistent to the characteristics of the magnetic fluctuations including the tendency of the correlation relation.

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