Toward magnetospheric region identification from the SuperDARN data by using FLR signals identified in the data by the gradient method

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Geomagnetic pulsations include field-line eigen-oscillations generated by the field-line resonance (FLR). The FLR can be identified from the unique manner of change in the amplitude and the phase of the FLR-related waves across the resonant point. Their frequencies depend on the plasma density along the field line. The FLR frequency is expected to change sharply across the plasmapause, because of the sharp density change there. Since the pulsations oscillate the ionospheric plasma, too, there could exist cases in which SuperDARN radars monitor the two-dimensional (2D) distribution of the FLR frequency, from which we can estimate 2D plasma-density distribution on the magnetospheric equatorial plane, including the 2D location of the plasmapause. We have been looking for such cases in the data from the SuperDARN radars, and have been analyzing an event near the occurrence time of a Sudden Commencements (SC); the event is likely to have been caussed by the SC.

The analysis results so far are as follows:

(1) Wavy perturbations were identified in the line-of-sight plasma velocity (Vlos) data along the SuperDARN HAN (Hankasalmi, Finland) and PYK (Pykkvibaer, Iceland) radar's beams.

(2) The wavy event's location was embedded in the ground/sea backscatter area. However, in this paper we have identified the echoes as the ionospheric echoes, because they frequently had |Vlos| larger than 100m/s.

(3) Many wavy perturbations had features typically seen at FLR, but, near the noon, there was a large area with wavy perturbations which did not show clear FLR features.

(4) The density estimated from the FLR frequency appears to have decreased with increasing distance from the noon meridian; this feature needs more thorough analysis, though, because of the item (3).

We think there could be a possibility that the near-noon area of the item (3) included FLR but they were masked by a larger-amplitude global oscillation. To address this issue and, in the more general sense, to identify as many as possible FLR events for the purpose of making a 2D map ot the plasma density, it could be useful to use the so-called gradient method which has been applied to ground magnetometer data; this method cancels out the overwrapping non-FLR signals by dividing the data from a magnetometer by the data from another magnetometer having an adequate distance from the other along the same meridian. This method is effective since the FLR frequency tends to depend on the latitude more strongly than the overwrapping signals.

The gradient method is also applicable to the Vlos data from the SuperDARN radar; we have made initial analyses, which have led to the identification of the FLR from Vlos's at adequately separated two Range Gates. More details will be presented at the meeting.