Plasmaspheric plasma density and the ionospheric resonance width estimated by the improved hodograph method and the APGM method

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There exist methods called the improved hodograph method (IHM below) and the amplitude-phase gradient method (APGM below) which are used to obtain the latitudinal profiles of the field-line-resonance (FLR) frequency, from which we can estimate the plasmaspheric plasma density, and the ionospheric resonance width, by using data from two ground magnetometers latitudinally separated by ˜100km. The both methods apply FFT to the two magnetometers' data, and calculate the amplitude ratio and the cross phase from the two stations' data as functions of the frequency. From there the two methods use different approaches: IHM fits a curve to the obtained ratio (as a complex number including both the amplitude ratio and the cross phase) on the complex plane to separate out the non-FLR signal in the data, while APGM assumes that the obtained amplitude ratio and cross phase include FLR signal only and obtains the FLR frequency and the resonance width in an algebraic manner. In this paper we apply the two methods to the Scandinavian BEAR stations and a station pair of Wadena (belonging to MAGDAS) and Weyburn (belonging to CARISMA), show that IHM can properly estimate the latitudinal profile of the resonance width (which is the improved point of IHM over the original hodograph method), compare the results of applying IHM and APGM, and see how the latitudinal profile of the resonance width differs between geomagnetically quiet times and active times.