Extraction of polarization field and magnetospheric impedance from the M-I coupled system via shear Alfven wave

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Formation of field-aligned current (FAC) coupling to the ionospheric current via shear Alfven wave is a key element to understand magnetosphere-ionosphere (M-I) system. Especially clarification of generation process of secondary electric field is very important. Because the secondary electric field is an indispensable factor for formation of self-consistent M-I coupled current system via excitation of feedback FAC to the magnetosphere. Alternatively difference between ionospheric (F-layer) convection and magnetospheric convection mapped on the ionosphere is also produced by the secondary electric field. However relation between generation process of secondary electric field and formation process of total electric field in the ionosphere is not yet fully understood.

The purpose of this paper is to establish the methodology that identify the secondary field from total observed electric field generated by elementary processes of M-I coupling such as direct reflection process by the impedance mismatching between magnetosphere and ionosphere, polarization process due to the Hall and Pedersen conductivity gradient and feedback process due to the generation of inductive divergent Hall current.

In this paper, we develop the theoretical framework that describes the secondary electric field in the context of current conservation law under the separated elementary M-I coupling processes via shear Alfven wave. Using this formulation, we found the confinement ratio of curl-free ionospheric current inside the ionosphere due to the elementary processes of M-I coupling. We also propose an identification method of Alfven wave conductance and/or magnetospheric impedance from observational data of ionospheric conductivity and electric field distribution, which controls above confinement ratio of curl-free ionospheric current.