ALFVEN WAVES OF IONOSPHERIC ORIGIN AND THE ASSOCIATED PLASMA DYNAMICS AND ELECTRODYNAMICS

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ABSTRACT

In this presentation, we demonstrate how the temporal variations of the ionosphere generate the Alfven waves and show the quantitative results of these Alfven waves and the associated electrodynamics during solar eclipses. We also show how the spatial variations of the ionosphere lead to the Alfven waves representing the active role of the ionosphere in the M-I system and discuss why the field-aligned currents and structured electric field associated with these Alfven waves are of ionospheric origin. These Alfven waves of ionospheric origin are important for our understanding of the ionospheric dynamics and the M-I coupling processes.

INTRODUCTION

It is well known that the interactions between the solar wind and magnetosphere can generate Alfven waves in the magnetosphere. These Alfven waves carry the magnetospheric convection and field-aligned currents down to the ionosphere and drive the large-scale plasma dynamic and electrodynamic processes in the ionosphere. In the M-I system there also exist the Alfven waves that have the ionospheric origin and are determined by the characteristic spatial and temporal scales of the ionospheric processes. These Alfven waves are vital for our understanding of the small-scale plasma structures in the ionosphere and have drawn increasing attention in the space physics and ionospheric physics communities.

SIMULATION RESULTS

We developed an M-I coupling electrodynamic model and the model can be used to study the generation of the Alfven waves associated with various ionospheric processes and the associated plasma dynamics and electrodynamics.

Alfven Waves Generated by the Temporal Conductivity Variations During Solar Eclipses

Using the M-I coupling model, we performed the numerical study of the Alfven waves generated by the sudden change of the ionospheric conductance during solar eclipses and the associated electrodynamics. The main results include:
1) Strong Alfven waves can be generated in the solar eclipse regions and they cause significant distortion of the ionospheric electric field.
2) The field-aligned currents are associated with these Alfven waves and the current intensity can be as high as 13 $\mu A/m^2$

Field-Aligned Currents and Structured Electric Field of Ionospheric Origin

By using the M-I coupling model, we also conducted the numerical study of how the spatial variations of the ionosphere lead to the Alfven waves representing the active role of the ionosphere in the M-I system and the field-aligned currents and structured electric field of ionospheric origin. The main results include:
1) The spatial variations of the ionosphere can lead to the Alfven waves that do not mirror the magnetospheric drivers and generate their own structured field-aligned currents and electric field.
2) When the conductivity gradient is not aligned with the direction of the magnetospheric convection field, the resulted ionospheric convection field rotates, leading to more complicated field-aligned current structures of ionospheric origin.

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