Control of Solar Wind on Magnetic Field Fluctuations in the Subsolar Magnetosheath

Ying Zou*[1], Brian Walsh[2], Yuxi Chen[3], Hongyang Zhou[2], and Savvas Raptis[1]

[1]JHU-APL – United States
[2]Boston University – United States
[3]University of Michigan – United States

Abstract

The magnetosheath modifies the solar wind and IMF before they reach Earth's magnetosphere, and hence plays a crucial role in regulating the solar wind-magnetosphere interaction. Although the steady component of the magnetosheath magnetic field has been reasonably well reproduced, the fluctuating component has been less accounted for despite its significant amplitude. This paper empirically determines the mean characteristics of the ultra-low-frequency magnetic field fluctuations, and constructs a functional form using solar wind parameters. We use 15 years of THEMIS data for magnetosheath, and OMNI for the upstream solar wind conditions. Qualitatively, fluctuations are negatively correlated with the IMF cone angles, and positively with the solar wind speed and dynamic pressure. Some fluctuations are correlated with the IMF strength but not all. The level of fluctuations in the IMF is positively correlated with < 0.01-Hz fluctuations in the magnetosheath. A higher Mach number is associated with a larger fraction of compressional versus transverse fluctuations in the magnetosheath. Quantitatively, the correlation between magnetosheath fluctuations and individual solar wind parameters is weak, correlation magnitude being < 0.5. However, by performing a multiple linear regression fit of the solar wind parameters to magnetosheath fluctuations, a reasonably good prediction can be achieved with correlation magnitude in the range of 0.5-0.7, except for the parallel magnetosheath fluctuations in the 0.01-0.1 Hz frequency range. Our results are overall consistent with earlier studies, but our quantitative approach further permits forecast of how much the IMF changes inside magnetosheath which is beneficial for scientific understanding and space weather forecasts.

*Speaker