Decrease of IMF strength on the lunar dayside and above the polar region observed by Kaguya

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Direct interaction between the lunar surface and incident solar wind is one of the crucial phenomena of the planetary plasma sciences. Recent observations by lunar orbiters revealed that strength of the interplanetary magnetic field (IMF) at spacecraft altitude often increases over crustal magnetic fields on the dayside. In addition, variations of the IMF in the lunar wake have been reported in the viewpoint of diamagnetic effect. However, few studies have been performed for the IMF over non-magnetized regions on the dayside. Here we show events where the IMF strength decreases at ˜100 km altitude on the lunar dayside and over the polar region, comparing the upstream solar wind data from ACE with Kaguya data. (Note that we focus on the magnetic field reduction observed above non-magnetized regions (or very weakly magnetized regions)).

In one event when the IMF is roughly anti-parallel to the solar wind flow, the magnetic field reduction is detected in the dayside northern hemisphere. We estimate that the decrease in the magnetic pressure is partly compensated by the thermal pressure of the back-scattered protons. In another event the IMF reduction is continuously detected from the northern polar region to the dayside mid-latitude region. The Kaguya LRS/WFC data show a slight increase in the electron density around the northern pole, which suggests an increase in the positive ion density. The density increase might be attributed to the back-/forward-scattered solar wind protons as well as heavy ions originating from the lunar surface and/or exosphere, while the heavy ions may not contribute to an increase in the thermal pressure because their temperature is very low.

The observed magnetic field reduction is interpreted as diamagnetic effect by the scattered solar wind protons. We also discuss the diamagnetic current system on the lunar dayside that is added to the wake current system.