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Oral
Low-charge-state heavy ions in Earth's magnetosphere were thought to originate from the ionosphere. However, Observations from the Geotail mission have detected the presence of singly charged metallic ions, such as Fe+, whose abundances vary depending on the Moon's location, alongside their density ratios to O+. Additionally, research conducted using the Lunar Atmosphere and Dust Environment Explorer (LADEE) and the Acceleration, Reconnection, Turbulence, and Electrodynamics of the Moon's Interaction with the Sun (ARTEMIS) missions suggests that these metallic ions are significant components of the lunar pickup ion population, which originates from the Moon's neutral exosphere. These observational studies prompt an evaluation of the contributions from lunar plasma and its transport pathways.
This study employed a particle-tracing model with time-dependent electromagnetic fields from an OpenGGCM global magnetosphere simulation to investigate metallic Fe+ ions transport from the Moon to the inner magnetosphere when the Moon crosses the magnetotail. Five idealized six-hour simulations across various Interplanetary Magnetic Field (IMF) configurations are conducted. The results demonstrate that lunar pickup ions can be transported back to the inner magnetosphere specifically during northward IMF periods. Under idealized northward conditions, this transport optimally occurs at angles between 2 o and 5 o from the midnight plane. While the overall probability of this transport is limited, this study highlights a potential pathway from the Moon to the inner magnetosphere, suggesting that the metallic ions observed by Geotail likely include contributions from lunar sources.
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