Observations of a viable process for the loss to space of terrestrial atmospheric matter

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Earth’s atmosphere is protected from direct solar wind erosion by the geomagnetic field. Escape of atmospheric atoms to interplanetary space requires photoionization and subsequent upward ion acceleration to overcome Earth’s gravity. However, these ionospheric ions have not yet escaped the terrestrial environment because the Dungey circulation (convection) keeps most within the inner magnetosphere where they either remain or precipitate back into the atmosphere. Key problems in estimating isotopic loss rates on geological scales are quantifying the fluxes of source upflows and evaluating the fraction that subsequently returns to Earth. We present direct evidence of ionospheric ions making their way, via detached regions from the dusk plasmasphere, into the accelerated flows along the magnetopause generated by magnetic reconnection. Using recently developed techniques to find the transit time of open flux tubes across the polar cap, we show that they gain enough energy to escape from the terrestrial environment into interplanetary space.

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