First observations of ionospheric O\(^+\) ion outflow “off the beaten path”

Due to a geomagnetic substorm, electromagnetic energy from the Earth’s nightside magnetosphere was transferred along the magnetic field lines and hit the ionosphere, causing the extraction of low-energy O\(^+\) ions from mid-to-low latitudes. Such outflow path is different from the “beaten” one, which would require O\(^+\) ions to escape from the dayside cusp. As Van Allen Probe B was moving deep into the inner magnetosphere (inside 4 Earth radii) towards its perigee, it observed the electromagnetic energy fluctuations along with multiple O\(^+\) ion band structures, which can be explained by the subsequent bouncing motion of the ions that just escaped the ionosphere along the magnetic field lines.

**First observations of ionospheric O\(^+\) ion outflow directly into the nightside inner magnetosphere from an equatorial vantage point.**