Inferring the parametric location of the magnetopause reconnection X-Line from in situ measurements

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Résumé

Magnetic reconnection is a key plasma process leading to the reconfiguration of magnetic field lines, during which magnetic energy is transferred to the plasma as kinetic and thermal energy. A paradigm, supported by evidence in simulations and in-situ data, is that magnetic reconnection happens along a global line called the X line. On the Earth's magnetopause, reconnection events have been identified locally, but until now, the global position and shape of the X line were accessible from global simulations only. This work presents a method to locate the X line from ion flow maps of the boundary layer, built from large amounts of boundary layer data selected automatically with a machine learning algorithm on multiple satellites. This allows the study of the position of the X line for different conditions. Notably, the rotation of the X line with IMF clock angle and its vertical shift with dipole tilt have been evidenced with unprecedented precision. Finally, a comparison between the measured X line and the ones predicted by different models is possible, which eventually should give us more insight about which physical parameters control where magnetic reconnection occurs.

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