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Magnetic Local Time Variation of the Dynamics of the Poleward Auroral Luminosity Boundary and its Scaling

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The total net balance of dayside and nightside reconnection processes within the Earth's magnetosphere and their effect on the amount of open magnetic flux threading the ionosphere have been well studied through a number of case studies. The dynamical behaviour has usually been interpreted in the context of the expanding-contracting polar cap model. However, a systematic analysis of the multi-scale nature and character of magnetospheric reconnection in time and space has yet to be attempted. Here, we begin this by analysing the consequential fluctuations in the open-closed magnetic field line boundary inferred from the poleward boundary of auroral luminosity as measured by the FUV instruments on the IMAGE spacecraft. We have studied the motion of this boundary during a two year period across the complete range of magnetic local time. Using a structure function analysis, we quantify the auroral boundary dynamics in each MLT sector, and determine whether they demonstrate mono- or multi-fractal scaling. The dayside boundary dynamics are broadly self-similar (mono-fractal) on timescales up to 6 hours. On the nightside, there is clear evidence of a scaling break on the substorm timescale ($\sim$90 minutes) and the dynamics are suggestive of multi-fractality. We discuss how this behaviour may relate to the reconnection process, its solar wind driver, and the expanding-contracting polar cap model.