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Reconstruction of time-varying reconnection rate and X-line location

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We present a remote-sensing technique specially designed for magnetospheric applications and allowing to reconstruct reconnection rate and X-line location from single-spacecraft magnetic data. The technique was developed on the basis of analytical time-dependent Petschek-type reconnection model, which generalizes the classic Petschek's mechanism for an unsteady regime. The unsteady solution allows to simulate different reconnection regimes (impulsive, quasi-stationary, intermittent) and to investigate dynamics of the reconnection process depending on a variable reconnection rate. In the frame of this model a current sheet decays into a system of MHD discontinuities and shocks, which form two outflow bulges, containing accelerated plasma. Time-varying rate results in a curved shape of the outflow bulges - unlike the original Petschek's model, where the rate is constant and the outflows are bounded by straight shocks. Once reconnection ceases, the outflow bulges detach themselves from the X-line and move in opposite directions along the current sheet. External perturbations are caused by field line bending around the moving bulges and, naturally, they reflect all time variation of the reconnection rate. The model predicts signatures typical for such observational magnetospheric phenomena (which are believed to be associated with reconnection) like FTEs (Flux Transfer Events) and TCRs (Traveling Compression Regions): An asymmetric bipolar variation in the Bz-component, a simultaneous deflection in the Bx-component (x, z are directions tangential and normal to the current sheet, respectively), and a change from upward (away from the current sheet) to downward flow in the Vz-component of plasma bulk velocity. A good agreement between model predictions and spacecraft observations gave rise to an idea of developing remote-sensing technique for reconstruction of reconnection rate and X-line location.