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A statistical test of the Cooling model of reconnected field line motion

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The simple model of reconnected field line motion developed by Cooling et al. (2001) has been used in several recent case studies to explain the motion of flux transfer events (signatures of transient magnetopause reconnection known as FTEs) across the magnetopause. We extend a previous study to 213 FTEs observed by all four Cluster spacecraft between November 2002 and June 2003, when the spacecraft tetrahedron separation was $\sim$5000 km. Observed velocities were calculated from multi-spacecraft timing analysis, and compared with the velocities predicted by the Cooling model in order to check the validity of the model. After excluding three categories of FTEs (events with poorly defined velocities, a significant velocity component out of the magnetopause surface, or a scale size of less than 5000 km), we were left with a sample of 118 events. 78% of these events were consistent in both direction of motion and speed with one of the two model de Hoffmann-Teller (dHT) velocities calculated from the Cooling model. A further 13% were consistent in direction only. As two sets of open field lines are formed by reconnection, there is an ambiguity in the model of two model dHT velocities. This ambiguity can be removed by examining the plasma signature of magnetosheath events. Out of the 17 events which were consistent with only one model velocity and for which there was a clear directionality in the electron signature, 14 had electron signatures which were consistent with the hemisphere of connection indicated by the Cooling model. This indicates that although the model is a simple one, it is a useful tool for identifying the source regions of FTEs.