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Which direction does the interplanetary magnetic field point at Mars? A clustering study of the Mars Global Surveyor magnetometer data

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Abstract

Constant improvements in computing power have made data science techniques more accessible than ever to scientific researchers. However, these ideas have rarely been applied in the space science field, particularly in regards to clustering and data mining. This study presents the results of applying data science ideas to solar wind magnetic field and plasma data from the near-Mars environment, with the aim of bringing better understanding to the Sun-Mars magnetic interaction. Mixture modelling and clustering methods are applied to Mars Global Surveyor (MGS) magnetometer and electron reflectometer data in an attempt to classify typical magnetic field signatures within the data. Focusing on intervals when the MGS spacecraft was located within the solar wind, this study finds clustered groups of magnetic field measurements that could represent energetic events found within the interplanetary magnetic field (IMF), and assesses how suitable the assumption of a weak slow-changing IMF is at Mars. The properties of these groups and the events that they may represent are discussed.