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Solar wind propagation by magnetic lasso

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Concerning the increasing number of heliospheric space missions it is a key issue to foresee space weather conditions in the spacecraft's and the target object's neighborhood. Solar wind parameters are propagated to outer orbits by several ballistic and magnetohydrodynamic (MHD) methods. MHD models describe the underlying physical processes more realistic, but computations are time-demanding. Ballistic models are simple, computationally fast and need only input data. They work quite well closer to the Sun, where MHD effects have smaller amplitudes. The ballistic model presented here is enhanced by adjusting for the target movement during the propagation time through the following method: First, a dataring is created around the Sun containing solar wind parameters for each Carrington longitude, based on ACE data. It is assumed that solar wind parameters from the same source are constant for one solar rotation. The second step is the actual propagation where we are trying to find the exact magnetic field line connecting the target object with a certain longitude of the source surface at the Sun. This is carried out by a minimum variance analysis. By this step a correction is applied for the movement of the target object during solar wind travel time. Once the proper magnetic field line is found, solar wind velocity and magnetic field polarity is propagated assuming no change during travel time. The method was tested successfully during the Rosetta mission. While the spacecraft was investigating the close environment of the comet Churyumov-Gerasimenko it was necessary to know the properties of the ambient solar wind in order to evaluate data and account for the dynamic changes.