Modelling the evolution of CMEs and their shocks through different solar wind structures

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The evolution of coronal mass ejections (CMEs) as they travel away from the Sun is one of the major issues in heliophysics and space weather. After erupting, CMEs propagate outwards through the background solar wind flow, which in turn may significantly affect CME evolution by means of e.g. acceleration, deflection, and/or rotation. In order to determine to which extent the ambient wind can alter the speed, trajectory, and orientation of a CME, we run a series of 3D magnetohydrodynamics simulations (using the coupled solar–heliospheric WSA–Enlil model) to conduct a multi-vantage point study of the radial and longitudinal evolution of CME structures as they propagate up to Earth’s (1 AU) and Mars’ (1.5 AU) orbits. We explore a broad range of input CME parameters (initial radial speed, angular width) and ambient solar wind conditions (slow versus fast wind) to investigate the different evolutionary behaviours of CMEs and their driven shocks and sheath regions. To study the radial and longitudinal evolution for the modelled CME ejecta and shock events, we examine the resulting magnetic field and plasma time series at different heliocentric distances (0.5 AU, 1 AU, and 1.5 AU) and heliolongitudes (in 30° increments). This work will help establish a set of expected CME behaviours at Earth’s and Mars’ radial distances, which can be used for analysing real CME events.