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What can simulations of the Kelvin-Helmholtz instability tell us about coronal plasma parameters

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For space weather applications, computer simulations are extremely helpful for the analysis of detailed physical processes. Especially simulations of the dynamics of the chromosphere and corona become more and more important to understand the mechanisms that drive solar eruptions throughout the solar atmosphere and become geoeffective later on while others don't or dissipate already in the corona. All these simulations rely mainly on the determination of all necessary input parameters, but the limited observation capacities make it hard for modellers and forecasters to get a reliable set of boundary conditions and starting values for their models which impacts directly the reliability of their results. Recent studies of Kelvin-Helmholtz instabilities at coronal mass ejection (CME) boundary layers have shown that these instabilities can form under various conditions of the background plasma and magnetic fields. The presence or absence of this instabilities may be used to restrict the conditions of the local plasma parameters and local magnetic fields in the corona.

Therefore we performed parameter studies of the Kelvin-Helmholtz instability using 2.5D magnetohydrodynamics simulations of CME boundary layer dynamics, developed from the Total Variation Diminishing Lax-Friedrichs scheme. We used different plasma parameters, magnetic field values and orientations as input parameters to investigate how the instability properties change. The simulation code was also applied to two observations of eruptive events showing boundary layer instabilities under completely different conditions.