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Analysis of Atmospheric Entry Decent Landing profiles of Mars by a General Circulation Model

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The entry, descent, and landing (EDL) sequences of Mars entry probes are rare opportunities to investigate the Mars atmosphere in situ, over a wide altitude range, as has been done only a few times. Atmospheric profiles based on ED: flight data typically cover altitudes from about 120 km down to the surface. These high resolution observations of the atmospheric structure from surface to thermosphere, which reveal the atmospheric structure and allows for the characterization of a wide variety of phenomena including atmospheric waves, large scale atmospheric tides, and small scale gravity waves.

In this study, atmospheric profiles from different Mars EDL missions are compared with the predicted atmospheric structure and dynamics from a global circulation model (GCM). The missions include the Viking landers, Pathfinder, Phoenix, Mars Exploration Rovers, and Mars Science Laboratory, covering different seasons and latitudes on Mars. The prediction capabilities of the MarsWRF model, which is an extended version of the Weather Research and Forecasting (WRF) model, is investigated by using avaibale EDL profiles of density, pressure, and temperature. Important modeling parameters are the solar longitude, local time, altitude and latitude, and the assumed dust opacity of the Mars atmosphere. Discrepancies between the model and the situ observations are discussed, including possible reconciliation by adjustment/improvements of of model parameters.