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METEOROLOGICAL PREDICTIONS FOR MARS 2020 EXPLORATION ROVER HIGH-PRIORITY LANDING SITES

Abstract

The Mars Regional Atmospheric Modeling System (MRAMS) is used to predict meteorological conditions that are likely to be encountered by the Mars 2020 Rover at several proposed landing sites during entry, descent, and landing (EDL). The meteorology during the EDL window at most of the sites is dynamic. The intense heating of the lower atmosphere drives intense thermals and mesoscale thermal circulations. Moderate mean winds, wind shear, turbulence, and vertical air currents associated with convection are present and potentially hazardous to EDL. Nine areas with specific high-priority landing ellipses of the 2020 Rover, are investigated: NE Syrtis, Nili Fossae, Nili Fossae Carbonates, Jezero Crater Delta, Holden Crater, McLaughlin Crater, Southwest Melas Basin, Mawrth Vallis and East Margaritifer Chloride. MRAMS was applied to the landing site regions using nested grids with a spacing of 330 meters on the innermost grid that is centered over each landing site. MRAMS is ideally suited for this investigation; the model is explicitly designed to simulate Mars' atmospheric thermal circulations at the mesoscale and smaller with realistic, high-resolution surface properties. Horizontal wind speeds, both vertical profiles and vertical cross-sections, are studied. For some landing sites simulations, two example configurations –including or not Hellas basin in the mother domain- were generated, in order to study how the basin affects the innermost grids circulations. Afternoon circulations at all sites pose some risk entry, descent, and landing. Most of the atmospheric hazards are not evident in current observational data and general circulation model simulations and can only be ascertained through mesoscale modeling of the region. Decide where to go first and then design a system that can tolerate the environment with passive landing systems would greatly minimize risk.