Modeling turbulent flows in the atmospheric boundary layer of Mars: application to Gale crater, Mars, landing site of the *Curiosity* rover

*William Anderson[1]

1. University of Texas at Dallas

Mars is a dry planet with a thin atmosphere. Aeolian processes –wind-driven mobilization of sediment and dust –are the dominant mode of landscape variability on Mars. Craters are common topographic features on the surface of Mars, and many craters on Mars contain a prominent central mound (NASA's *Curiosity* rover was landed in Gale crater). Using density-normalized large-eddy simulations, we have modeled turbulent flows over crater-like topographies that feature a central mound. We have also run one simulation of flow over a digital elevation map of Gale crater. Resultant datasets suggest a deflationary mechanism wherein vortices shed from the upwind crater rim are realigned to conform to the crater profile via stretching and tilting. This was accomplished using three-dimensional datasets (momentum and vorticity) retrieved from LES. As a result, helical vortices occupy the inner region of the crater and, therefore, are primarily responsible for aeolian morphodynamics in the crater. We have also used the immersed-boundary method body force distribution to compute the aerodynamic surface stress on the crater. These results suggest that secondary flows –originating from flow separation at the crater –have played an important role in shaping landscape features observed in craters (including the dune fields observed on Mars, many of which are actively evolving).

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