DEVELOPMENT OF A SURFACE-TO-EXOSPHERE MARS ATMOSPHERE MODEL. G. Crowley¹, M. A. Bullock¹, C. Freitas¹, Sidney Chocron¹, C. Hackert¹, D. Boice¹, L. Young¹, D. H. Grinspoon¹, R. Gladstone¹, W. Huebner¹, G. Wene² and M. Westerhoff² (¹Southwest Research Institute, San Antonio, Texas, 78238-5166; 210-522-3475; gcrowley@swri.org; ²Department of Mathematics, University of Texas at San Antonio, 6900 North Loop1604 West, San Antonio, TX 78249-0616)

Introduction: Understanding of the diurnal, seasonal and epochal water transport and volatile loss on Mars is of major scientific interest. Volatile loss is a cornerstone of a number of important science questions because it must be understood to help explain the current atmospheric state and the relative lack of water on the planet. A new ground-to-exosphere GCM is needed which considers volatile loss processes and must include explicit ground interaction with the lower atmosphere, vertical transport of H₂O, and enough chemistry to reasonably represent the loss of H and H₂ (and heavier species) from the upper atmosphere and exosphere. Including these regions in a Mars GCM allows for the estimation of global escape fluxes for the present time, which can then be extrapolated backward in time to post-cast the atmospheric state at significantly earlier time periods with different orbital elements.

We are in the process of creating a new Mars GCM that will extend from the planetary surface to altitudes of about 500km, thus coupling the lower and upper atmospheres. It will explicitly include interactions between the ground and the atmosphere, such as gas phase and dust particle exchange between the two regions, and the effects of topography. Volatile transport will be simulated over both short (daily) and geological timescales to study the water distribution and to predict the D/H ratio of the present day atmosphere, thereby helping to constrain the history of water on the planet.

The new Mars GCM will include simulations of the transfer of water from the planetary regolith into the atmosphere through boundary layer processes. We will also explore the role that mesoscale dynamical processes play in lofting dust into the atmosphere. The role of the dust and clouds in the planetary heat budget will be included through the use of specific microphysical and radiative transfer modules. The Mars ionosphere will be simulated with a detailed suite of chemical reactions, and over the long-term, the evolution of the D/H ratio will be predicted.

Figure 1. Major components of the new Mars GCM.