Development of a New Mars Atmosphere Model

G. Crowley, M. Bullock, C. Freitas, D. Boice, L. Young, D. Grinspoon, R. Gladstone, R. Link and W. Huebner
Southwest Research Institute

DPS 2002 Meeting

The exploration of Mars has been driven in recent times by the possibility that this planet was once more Earth-like than it is today. This possibility raises questions as to what processes and forces have modified the Martian environment and created the planet we observe today, and particularly what shaped the development of the present-day atmosphere and resulted in the presumed loss of water?

There are several key issues that are not addressed by existing models of the Martian atmosphere, and thus modeling of the Mars atmosphere remains a rich subject for investigation. Of major scientific interest is the understanding of diurnal, seasonal and epochal water transport and volatile loss. 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 complete GCM model which considers volatile loss processes must include explicit ground interaction with the lower atmosphere, vertical transport of H_2O, and enough chemistry to reasonably represent the loss of H and H_2 (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.

SwRI is in the process of creating a new model of the Martian atmosphere. The new Mars GCM will extend from the planetary surface to altitudes of about 500km, thus explicitly coupling the lower and upper atmospheres of Mars. It will include the interactions between the ground and the atmosphere: specifically gas phase and dust particle exchange between the two regions, and the effect of topography. The model will thus predict volatile loss, including the effect of ground interaction. The 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. An outline of the model will be presented, together with an update on its development.