Geophysical Research Abstracts
Vol. 17, EGU2015-13075, 2015
EGU General Assembly 2015

An atmospheric process to explain the formation of the detached layers of dust on Mars: GCM modelling, validation and comparison with observations

Chao Wang (1,2), Tanguy Bertrand (1), François Forget (1), Aymeric Spiga (1), and Ehouarn Millour (1)
(1) LMD, Université Paris 6, Paris, France (cwang@lmd.jussieu.fr), (2) East China Normal University, Shanghai, China

Dust is the crucial component of the Martian atmosphere. Its motion, horizontal and vertical transportation, is of great importance to Martian meteorology and climate. Recently, detached layers of dust are confirmed by the observations of the Mars Climate Sounder (MCS) as well as the Thermal Emission Spectrometer (TES). The origin of the detached layers has remained debated. They cannot be reproduced by traditional Global Climate Models (GCM) including a dust cycle.

Several possible interpretations were proposed to explain the origins of the detached layers of dust, such as small-scale dust lifting, upslope topographic winds, scavenging by water ice clouds, dust storms... Scavenging has been shown to be unable to form of dust detached layer through the simulations using the GCM developed at the Laboratoire de Météorologie Dynamique (LMD).

In the present study, a new parameterization called "rocket dust storms" in the LMD Martian GCM were implemented on the basis of mesoscale model simulations. The parameterization works like this: In the GCM, when a strong dust opacity gradient is observed, a local (subgrid scale) dust storm will be produced. Because of the difference of radiative heating rates between inside and outside of the dust storm, the dust particles inside the dust storm will be transported to high altitudes due to the vertical velocity of the dust which is directly deduced from the extra dust radiative heating, since we have found that this heating is almost integrally converted to adiabatic heating . The dust particles injected in the high layers are then horizontally transported by the large scale winds in the GCM.

In the present study, the validation of the "rocket dust storm" parameterization and the comparison between model outputs and MCS observations is implemented. To do so, case studies of the dust storm are performed to see how the dust were lifted and transported and how the detached layers formed in the upper atmosphere. We find that the detached layers of dust can be easily recognized in the model outputs. This illustrates that the "rocket dust storms" parameterization yields satisfying results in the GCM and it could be the origin of the formation of detached layers of dust on Mars. The diurnal and seasonal variations between model and MCS observations are also compared. The detached layers of dust obtained by the model reach an agreement with the MCS observations.