R009-01 **会場: B** **時間: 11月21日 11:10-11:25**

DRAMATIC MGCMを用いた現在の火星環境における水循環のシミュレーション

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Simulation of the water cycle on the present Martian environment using DRAMATIC MGCM

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The spacecrafts on the Mars orbit, such as Mars Global Surveyor, Mars Odyssey, Mars Express and Mars Reconnaisance Orbiter, have continuously observed the global distributions of water vapor and water ice clouds for these 17 years. Simulating the water cycle on Mars consistently with those observations using Martian General Circulation Models (MGCMs) is a challenging topic, as the required physical processes are not well known.

First simulations of the Martian water cycle which incorporated the observations were made by Richardson and Wilson [2002, JGR] and Richardson et al. [2002, JGR], assuming the prescribed ice cloud radius of 2 um to determine the sedimentation velocity. Montmessin et al. [2004, JGR] first introduced the cloud microphysics which was substantially important for the reproduction of the realistic seasonal and latitudinal variances of the water ice opacity. In those studies the radiative effects of water ice clouds were missing, but later Wilson et al. [2008, GRL] first showed the importance of them on the temperature fields. The development of a model which consistently reproduces the water cycle with radiatively-active water ice clouds has been difficult [e.g. Haberle et al., 2011, Paris workshop], although Navarro et al. [2014, JGR] indicated that the scavenging of dust particles due to the condensation ice also plays a significant role.

In this context, we are also starting to simulate the water cycle of the present Martian environment using the DRAMATIC (Dynamics, RAdiation, MAterial Transport and their mutual InteraCtions) MGCM whose dynamical core is based on the CCSR/NIES/FRCGC MIROC model, for the further investigations of the water cycle system and related material transport on Mars. The model has a spectral solver for the three-dimensional primitive equations, with the horizontal resolution of T21 (about 5.6^ox5.6^o, ˜333 km at equator) and vertical 59 sigma-levels up to ˜100 km. Realistic topography, albedo, thermal inertia and roughness data for the Mars surface are introduced. Radiative effects of CO_2 gas (considering only LTE) and dust are taken into account, and radiative effects of water ice clouds can also be included. The standard seasonal and latitudinal changes of dust opacity are defined externally, with the vertical distribution of so-called ’Conrath profile’ [Conrath, 1975]. In the formation of water ice clouds, the cloud microphysics process following Montmessin et al. [2004] is implemented, setting a part of airborne dust as nuclei. In the cloud formation scheme, the water ice cloud radius inside each grid and layer is set to be constant. The sedimentation of water ice clouds, accumulation on the surface and sublimation of water ice from the surface are implemented.

Our results show the consistent seasonal and latitudinal changes of zonal-mean water vapor column density and ice opacity with observations in the run without the radiative effects of water ice clouds and adjusting the number of nuclei to be 5-10 um of the ice cloud radius in maximum at the equatorial cloud belt in northern summer. With the radiative effects of water ice clouds, the altitude of equatorial cloud belt becomes ˜20 km higher and the ice opacity there becomes much smaller. Also the radiatively-active water ice clouds largely change the temperature fields, increasing up to ˜50 K at equatorial cloud belt and ˜30 K in winter polar regions. Then, our results indicate that taking interactive dust transport including scavenging into consideration would be important for the consistent simulations with the radiatively-active water ice clouds.

The isotopic fractionations for HDO and H_2O are already implemented into our model [Kuroda et al., 2012, NASA workshop], and further developments for the water cycle would contribute to support the future missions such as ExoMars Trace Gas Orbiter which targets to observe the isotopic ratios of water vapor.