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Development of a detailed microphysical model for Martian dust and ice clouds

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Although water vapor is a minor constituent in the composition of the Martian atmosphere, water ice clouds have been observed for more than thirty years. They seem to play an important role in the atmospheric transport of water and dust. A careful and detailed modeling study of these clouds is therefore important to better understand the Martian climate.

Marsbox is a new microphysical boxmodel for the dust and water ice clouds on Mars. This model has been adapted from PSCbox, a detailed model for polar stratospheric clouds in the Earth's atmosphere which has been developed at the Danish Meteorological Institute [1, 2].

Marsbox takes into account the following processes:

- heterogeneous nucleation of ice particles by water vapor deposition on dust particles,
- condensation and evaporation of water vapor to and from the ice particles, causing growth and shrinking of the particles,
- gravitational sedimentation of the cloud particles,
- eddy diffusion, which describes the vertical mixing of the cloud particles and the water vapor.

Each particle type is described by a binned size distribution for the number density and composition. The model calculates the evolution in time of these size distributions, of the mixing ratio of water vapor, and of the mass of condensed water. The model uses the ambient air temperature and pressure and the partial pressure of water vapor as input. The initial size distribution of the cloud particles is assumed to follow a lognormal distribution. The model has a variable internal timestep because the microphysical processes may require computational timescales much smaller than the driver's timestep.

We present the first simulations with this new model using input fields from GEM-Mars (or GM3), a recently developed global circulations model (GCM) for the Martian atmosphere which has been developed at York University, Toronto, Canada [3]. These first results will be compared to cloud retrievals from the SPICAM instrument on Mars Express [4].

References

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