

Simulation study to detect Mars atmosphere by satellite gravimetry

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On many planets, like the Earth, the atmosphere plays an important role in regulating the surface environment of the planet. Atmospheric circulation accompanies the movement of mass on the planet's surface and therefore can be detected as a temporal variation of the gravity field. In this study, we focus on the circulation of the Martian atmosphere and discuss the possibility of detecting it by satellite gravimetry. To evaluate whether the magnitude of surface mass variations due to Martian atmosphere are detectable by satellite gravimetry, we investigated the magnitude and spatiotemporal properties of the mass variations caused by Martian atmosphere and other potentially detectable mass variable components (CO₂ ice, dust, H₂O ice), using Mars Climate Database (MCD) 5.3. Based on the obtained results, we discussed the required sensitivity, number, observation period, and orbit design of the spacecraft to detect each signal effectively. We also discussed the possibility to estimate the Mars' load Love numbers by detecting temporal mass and volume changes of the surface CO₂ ice, combining satellite gravimetry and altimetry.

Keywords: satellite gravimetry, Mars