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Determining Catalytic Cycles in the Martian Atmosphere

Joachim Stock (1), Christopher Boxe (2), Lee Grenfell (3), Ralph Lehmann (4), Beate Patzer (3), Heike Rauer (1,3), and Yuk Yung (5)

(1) Institut für Planetenforschung, DLR, Berlin, Germany (joachim.stock@dlr.de), (2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA, (3) Zentrum für Astronomie und Astrophysik, Technische Universität Berlin, Berlin, Germany, (4) Alfred-Wegener-Institut für Polar- und Meeresforschung, AWI, Potsdam, Germany, (5) Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, USA

Chemical trace species play an important role in the chemical composition of terrestrial planetary atmospheres. These species can operate in catalytic cycles, which critically affect the concentrations of major chemical constituents and hence the whole structure of the atmosphere itself. The determination of chemical pathways in such complex systems is generally a challenging task, so effective methods are desirable for the investigation of such problems.

In order to address this question to the chemical catalytic cycles in the atmosphere of Mars, we use a new analysis tool (Pathway Analysis Program - PAP), which was originally developed and applied to automatically identify and quantify ozone and methane cycles in Earth's stratosphere. The implemented algorithm determines and quantifies all significant pathways by treating each species one after the other as a branching point. Pathways are formed by connecting shorter pathways producing those branching point species with pathways consuming them. Reaction rates are assigned to the pathways proportional to the branching probabilities.

In order to identify and analyze the dominant chemical processes in the Martian atmosphere, we apply PAP to the CalTech photochemical column model. The methodology of the algorithm is presented and first results of our analysis are discussed in view of the relevant chemical trace species.