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Photochemistry of the Martian atmosphere: Pathway analysis of ozone formation and destruction

J.W Stock (1), C.S. Boxe (2), R. Lehmann (3), J.L. Grenfell (4), A.B.C. Patzer (4), H. Rauer (1,4), and Y.L. Yung (5)

(1) DLR, Institut für Planetenforschung, Berlin, Germany (joachim.stock@dlr.de), (2) Megar Evers-City University, New York, NY, United States of America, (3) AWI, Alfred-Wegener-Institut, Potsdam, Germany, (4) Zentrum für Astronomie und Astrophysik, Technische Universität Berlin, Berlin, Germany, (5) Division of Geological and Planetary Sciences, Caltech, Pasadena, CA, United States of America

Ozone is of central importance for the Martian atmosphere, because e.g. it is related to the photochemical stability of the main atmospheric constituent, CO_2. Furthermore, ozone is relatively easy to observe, since it exhibits strong spectral features. The concentration of ozone is influenced by chemical trace species (mainly from the O_x- and HO_x-family) acting as catalysts in chemical pathways. It is therefore desirable to identify those pathways and quantify their efficiency by calculating pathway rates. Finding chemical pathways in complex reaction networks is in general challenging. Therefore, automated computer algorithms are useful to address such problems. In order to investigate the Martian atmospheric ozone photochemistry, we apply the PAP (Pathway Analysis Program) algorithm to the results of the updated JPL/Caltech photochemical column model of the Martian atmosphere. Rates of individual ozone production and destruction pathways are computed for different altitudes, by applying the algorithm to each vertical layer of the column model separately. Our findings show, that ozone is primarily produced by a Chapman-like mechanism involving CO_2 photolysis products as source for atomic oxygen. Ozone destruction proceeds mainly via photolysis except for a layer around 42km where the reaction with atomic hydrogen become more important.