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Chemical Pathway Analysis of the lower Martian Atmosphere

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Abstract

The atmospheric composition of terrestrial planets is critically controlled by trace chemical species, which operate in catalytic cycles (e.g. [1, 2]). These cycles can provide more efficient routes for the production or consumption of highly abundant species (e.g. CO_2 on Mars [3, 4]). Identifying such cycles is in general a challenging task.

In order to investigate such chemical processes in the lower Martian atmosphere, we introduce a new analysis tool (Pathway Analysis Program - PAP), which was originally developed by Lehmann [5] and applied to determine ozone and methane cycles in Earth's stratosphere. The implemented algorithm determines and quantifies all significant pathways by treating each species one after another as a branching point. Pathways are formed by connecting shorter pathways producing those branching point species with pathways consuming it. Rates are assigned to the pathways proportional to the branching probabilities. Hence operating catalytic cycles can be identified automatically.

In this contribution, we will outline the methodology of the analysis program. By applying PAP to the CO_2 dominated atmospheric chemistry of Mars, important cycles affecting the chemical composition of the lower Martian atmosphere can be identified and discussed.

References

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