SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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USING MARTIAN CLIMATE MODELS TO ASSESS THE POTENTIAL OF ARTIFICIAL GREENHOUSE GASES TO INCREASE MARTIAN SURFACE TEMPERATURES

Abstract

The study of planetary atmospheres such as the one of Mars offers valuable insights into the evolution and dynamics of atmospheres. The absence of oceans and biosphere on Mars allows the development of simple climate models compared to Earth's complex general circulation models The recent improvements of Martian global climate models combined with new data obtained from Mars exploration missions allows for a better understanding of climate systems and their internal feedbacks effects. It also provides a simple platform to explore theoretical options for active climate modifications such as ecopoiesis, defined as the fabrication of an uncontained biosphere on the surface of a sterile planet.

Ecopoiesis on Mars would require several environmental modifications, such as increasing its atmospheric content and mean surface temperatures. Specifically, models have shown that a relatively modest temperature increase of 20 K might trigger a runaway release of CO_2 gas sequestered in the polar caps or trapped in the Martian regolith. Among the several methods reported to achieve such a change, the release of artificial greenhouse gases in the Martian atmosphere is considered as one possible approach. Based on previous preliminary research, this paper assesses the warming potential of four artificial greenhouse gases (CF_4, C_2F_6, C_3F_8 and SF_6) in a Martian Global Climate Model. Key improvements include a better representation of the radiative properties of the greenhouse gases and water ice clouds. A critical discussion of the warming effect of the released gases is hereby presented.