Seasonal snowfall on Mars

Identification, characterization and monitoring of CO_2 snow formation in the martian atmosphere is critical for determining the energy budget of the polar regions of Mars. Routine and targeted mid-infrared measurements collected during winter seasons by the Mars Climate Sounder (MCS) on the Mars Reconnaissance Orbiter (MRO) over five Mars years have confirmed conditions consistent with significant CO_2 snowfall and accumulation in both polar regions of the planet. Snow accumulation in the 70-90 degree S latitude zone may contribute up to 3-20% of the seasonal mass. Orographic (mountain-initiated) or convergent (air masses meeting horizontally) lift is probably required to initiate nucleation and snowfall in the 60-80 degree S latitude zone. Differences in the character of accumulation (frost vs. slab) may cause surface modification on dune crests and other surface types (see entry on surface changes triggered by CO_2 frost). High cadence monitoring of snow clouds in these regions reveals information on the highly temporal nature of the clouds and particle sizes, which are determined to be in the 10-100 μm size range. Differences in snowfall rates between the two hemispheres may reveal underlying climatic processes: the much snowier northern hemisphere winter occurs near Mars' perihelion dust storm season, when condensation nuclei are available to form snow clouds. This timing may lead to observable differences in CO_2 and H_2O ice accumulation rates, affecting the planetary climate on multi-year timescales. In addition to CO_2 snow, atmospheric measurements collected at the martian surface by LIDAR on the Phoenix lander at 532 nm confirmed that frostpoint conditions develop overnight which produce H_2O precipitation and permit downward transport.

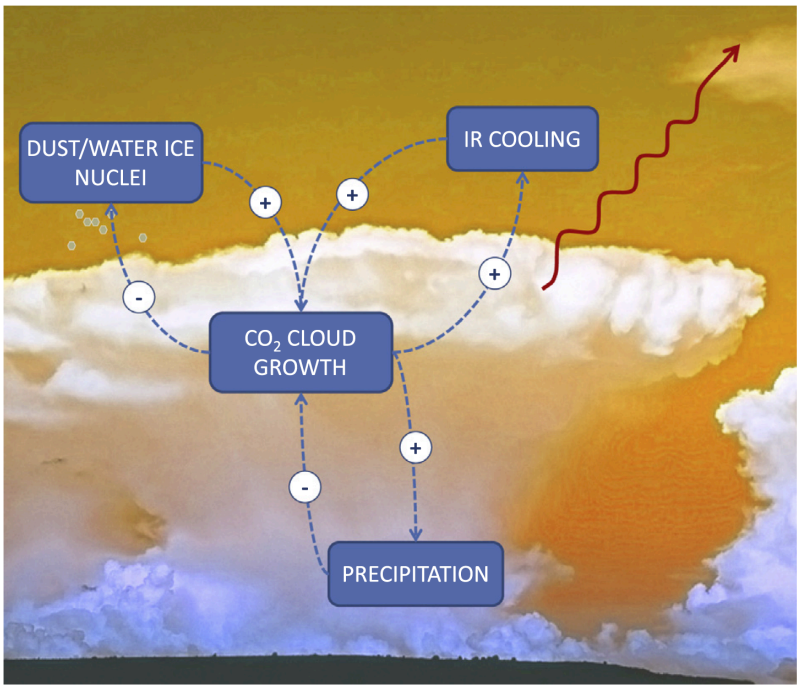

Fig. 6. A schematic representation of the feedbacks involved in forming CO_2 snow clouds on Mars. Positive and negative feedbacks are indicated by the circles on each arrow.

Figure and caption from Hayne et al., (2014); see below.

Relevant references:

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