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Martian Climate Dynamics and Paleoclimate

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Mars possesses a complex climate system involving water, carbon dioxide, and dust. Ample evidence exists that this climate system has been configured so as to yield a range of very different environmental conditions at various points in the Martian past (and will continue to do so in the future). This evidence largely takes the form of geological landforms suggestive of the action of wind and water in locations, phases, and/or strengths that are inconsistent with the current climate.

Uniquely in the solar system, Mars is in a similar dynamical regime as that of the Earth: the length of day is nearly identical, yielding a similar atmospheric dynamical and forcing regime; the obliquity of the planet is very similar, yielding a similar amplitude of seasonal cycles; and the temperature is such that cycling of water into and out of the atmosphere allows the formation of clouds and ice sheets. From simple energy balance models of ice albedo feedback to General Circulation Model (GCM)-based coupled climate system models, the same kinds of tools used to investigate terrestrial climate dynamics, climate change, and paleoclimate can most readily be adapted to Mars.

In this talk, the components of the climate system are described and their interactions examined, with the aid of spacecraft data and model simulations. The variation of the climate with changes in orbital elements and volatile inventory will be discussed.