A Polar Mars Climate Database built on Mesoscale Simulations
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An interest for Martian geologists and glaciologists
Martian polar regions are, meteorologically speaking, very active regions. This activity is evidenced by numerous surface morphologic features, from frost streaks to dune fields, which putative inferred direction is roughly compatible with directions obtained by mesoscale models [1]. The varying spectral signatures (H\textsubscript{2}O or CO\textsubscript{2}) over polar slopes during seasonal retreat have been possibly ascribed to winds too [2]. The occurrence of trough clouds has possibly been linked to the migration of spiral troughs thanks to mesoscale modeling of polar katabatic winds, both over the northern polar cap [3] and the southern polar cap [4]. Furthermore, smaller-scale sedimentation waves than troughs over the Martian polar caps are thought to be controlled by katabatic winds [5]. The control of surface morphology by winds might even be extended to the paleo-topography revealed by radar imagery [6].

An interest for Martian climate scientists
The interest for Martian polar regions is not restricted to surface-atmosphere interactions. Studying the meteorology of the Martian polar regions is a means to address key questions for the Martian climate at all scales. The fact that many flushing storms originate from the Martian polar regions [7] indicates that the mesoscale wind activity in polar regions is likely to play a decisive role [8, 9]. At the same time, the wind variability itself in the polar regions is a matter of active research to disentangle the combined influence of katabatic acceleration [10, 11], sea-breeze circulations caused by the ice-soil contrasts [8], polar transients [9], and, last but not least, the large-scale polar vortex [12, 13]. Polar regions also play a key role as a seasonal source/sink for the water annual cycle, where mesoscale transport processes [14] and cloud formation with radiatively-induced effect [15] play a crucial role. As far as the upper troposphere / lower mesosphere is concerned, the polar atmosphere is also prone to a particularly strong mesoscale activity with the frequent occurrence of gravity waves [16].

Why use mesoscale simulations for polar regions?
Mesoscale models are well-suited to get insights into atmospheric and surface processes in polar regions. Contrary to global circulations models [GCMs], mesoscale models integrate the atmospheric dynamics at high resolution in a specific region of interest on the planet with

Figure 1: The retreat of the seasonal CO\textsubscript{2} cap is the primary driver of the variability of the surface wind speeds in spring. Results of a \(dx = 18\) km mesoscale simulation (nested domain in a \(dx = 54\) km mother domain) at \(L_s = 60, 75, 90^\circ\) (northern spring) in the northern polar region. Wind vectors in m s\textsuperscript{-1} are shown each 3 grid points. Surface temperature is contoured. An albedo map of the Martian northern polar region is included in the background to provide context.
an adapted map projection. Polar mesoscale domains are defined through stereographic projections, hence devoid of the “pole singularity” present in most GCMs. In addition, high-resolution surface thermophysical properties (albedo, thermal inertia) are used in mesoscale modeling.

A better seasonal coverage for polar mesoscale simulations As is detailed in the previous paragraphs, understanding the diurnal, seasonal, and even interannual variability of temperature, winds, water vapor & clouds, ... in Martian polar regions is an important step to understanding both surface and atmosphere processes. Our idea is that, since existing published mesoscale simulations focused on a specific season of interest, it is now time to attempt a full annual coverage of polar mesoscale simulations. We performed test mesoscale simulations with the LMD Martian Mesoscale model [17, 10] over a wide range of seasons to demonstrate the potentialities of this concept and offer a first (and quite unprecedented yet) discussion on the seasonal variability of winds in the northern and southern regions of Mars. For instance, for North pole, we provide simulations for each 5-10° of solar longitude (Ls) beginning at northern vernal equinox (Ls 0°) and ending at northern autumnal equinox (Ls 180°) [18]. Those simulations allow us to explore the Martian polar meteorological variability: we show an example of wind changes associated with the CO2 cap retreat in Figure 1.

Building a Polar Mars Climate Database Our proposal is to build an online interface to map (and more generally extract) the atmospheric predictions from the LMD Martian Mesoscale Model in the Martian polar regions, following the example of both the online Mars Climate database [http://www-mars.lmd.jussieu.fr/mcd_python], and similar online database for terrestrial polar regions [19]. The Mars Polar Conference will be an excellent vector to discuss with the community to determine the most relevant parameters and fields for the various studies undertaken, as well as to define an infrastructure of the database which will optimize the scientific return of the simulations.

References