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COMPARATIVE MESOSCALE METEOROLOGY : THE CASE OF MARS AND THE EARTH.

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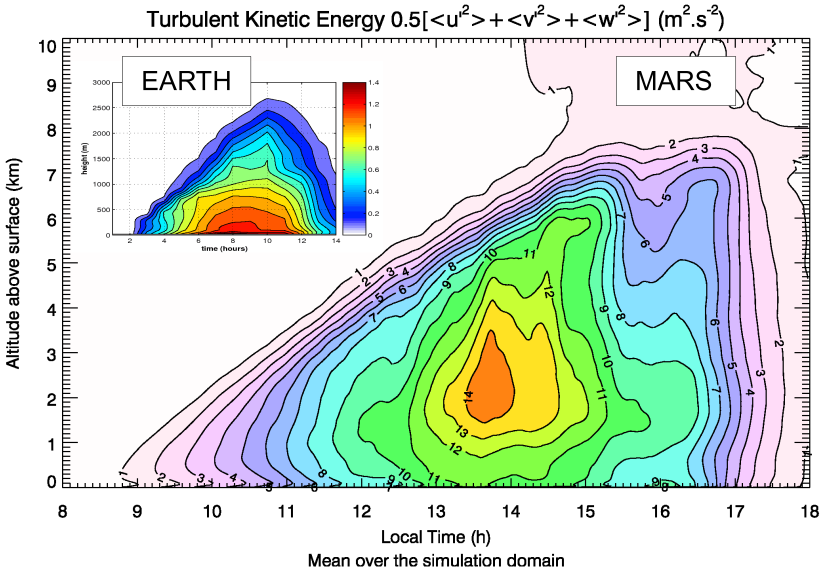

Figure 1 : Altitude vs. local time plots of T.K.E. computed by Large-Eddy Simulations. The main plot shows the very deep growth of the Martian afternoon convective boundary layer, compared to the terrestrial case (small plot, courtesy of A. Catarino, LMD).

Background: Atmospheric dynamical phenomena are known to occur at various spatial scales : synoptic (> 100/1000 km), mesoscale (100/1 km), microscale (< 1 km). Since the 60s, terrestrial general circulation models have been adapted to Mars, Titan, Venus to study and compare the synoptic circulation of the atmospheres of these environments [1]. More recently, following the high-resolution measurements of MGS [2], Mex [3], and MRO [4], the adaptation of sophisticated terrestrial mesoscale/microscale solvers to Mars gave birth to new models resolving smaller-scale phenomena, such as the mesoscale and microscale model we recently developed at LMD [5] to complement the LMD Martian GCM [6]. These new models offer unprecedented perspectives of comparative meteorology.

Boundary layers: Large-Eddy Simulations, which spatial resolution is the order of 10-100 m, enables an in-depth assessment of the 3D properties of the planetary boundary layers. In addition to such numerical microscale tools, recent in-situ [7] or remote-sensing measurements [8] gave new ground-truth references for the Martian case. We will discuss this Martian case in the light of the comparison with the terrestrial environnement, as illustrated in *Figure 1* : height of the afternoon convective PBL, energy transfers in the PBL, convective vortices...

Slope winds: We showed with our new LMD Martian Mesoscale Model, as other authors also did [2], how deep circulations in the vicinity of the giant Martian topographical obstacles might develop and lead to strong meteorological signatures e.g. in the temperature field. Slope winds are known to be far less intense in most terrestrial environments, except above the vast ice sheets at the surface of Earth. We would discuss the fundamental properties of slope winds in the light of various examples on Martian and terrestrial terrains and compare the main differences between both planetary environments.

Gravity waves: Gravity waves are perhaps the most ubiquitous mesoscale phenomena in planetary atmospheres [3]. We will discuss the possible sources in action on Mars and the Earth and review the recent detections in other planetary environments (Venus, Giant Planets) [9,10]. We will illustrate some differences between gravity waves on Mars and the Earth by referring to the well-known case of waves generated by an atmospheric flow impinging on a topographical obstacle.

Deep convection: High-altitude CO_2 clouds were detected by OMEGA, some of which of possible deep convective origin [11]. We had conducted simulations to infer the convective nature of such clouds, and would present how these could be related to terrestrial convective towers driven by the condensation of water vapor in the atmosphere. Our idealized approach is potentially applicable to other convective clouds in the Solar System (CH_4 Titan, H_2SO_4 Venus, H_2O Jupiter).

References: [1] Lebonnois et al. this issue [2] Rafkin et al. Nature02 [3] Spiga et al. JGR07 [4] Malin et al. Icarus08 [5] Spiga & Forget JGR09 [6] Forget et al. JGR99 [7] Smith et al., JGR06 [8] Hinson et al. Icarus08 [9] Peralta et al. JGR08 [10] Reuter et al. Science07 [11] Montmessin et al. JGR07