The exploration of dust storm events based on data products with sub-diurnal coverage, including the early Emirates Mars Mission science phase

Claus Gebhardt[1], Bijay K. Guha[1], Roland M. B. Young[1,2], Michael J. Wolff[3]. [1]United Arab Emirates University, National Space Science and Technology Center, Al Ain, United Arab Emirates, [2]United Arab Emirates University, College of Science, Department of Physics, Al Ain, United Arab Emirates, [3]Space Science Institute, Boulder, CO, USA. Contact: claus.gebhardt@uaeu.ac.ae

Mars dust storms are an interdisciplinary field of research. They have adverse effects for the entry-descent-landing operations of spacecraft, the energy production by the solar panels of Mars rovers and landers, and others. As can be foreseen, dust storms also have implications for the future human exploration of Mars. Dust storm research is directly aligned with the Emirates Mars Mission (EMM) science objective on the lower atmosphere, and also to the objective of correlating the lower and upper atmosphere [1,2].

The focus of this presentation is dust storm research related to EMM. Owing to its high-altitude orbit, the EMM instrumentation provides snapshots of the Mars atmosphere and surface at a near-hemispheric view. Moreover, EMM provides situational information on Mars dust storms at a sub-daily time step. In the standard science mode, the EMM instrument EXI (Emirates Exploration Imager, [3]) provides camera images each ~2-3 hours. Moreover, several image sequences with a time step of ca. 5 minutes are obtained per month. These are so-called high-cadence images. Both standard science products and high-cadence images are valuable for the detection and tracking of dust storms.

Based on EMM data products with sub-diurnal coverage, we will explore dust storms of particular interest. Any dust storm is relevant, if there are unique EXI images, in line with the spatial and temporal coverage of EMM. This will include, but is not limited to, large dust storm events and their impact. A recent example is the first large dust storm observed by EMM. Fig. 1 shows the situation shortly before this dust storm. Selected dust storm observations are provided in Figs. 2 and 3. This dust storm occurred in early January 2022 and impacted different spacecraft on the Mars surface, other than EMM.

The EMM science phase officially started on May 23rd, 2021 (Martian Year 36, LS49). The early EMM science phase is thus part of the low-dust-loading-season of Martian Year 36 (~LS10-140). The low-dust-loading-season (LDL) is generally known for the sparsity of dust storms at the low-to-midlatitudes. In few Martian Years, however, even unusual regional dust storms occur during the LDL [4]. As an integral part, this presentation will also cover the early EMM science phase, in the LDL of Martian Year 36. This will include some large local dust storm of particular interest.

Acknowledgements

The authors would like to acknowledge support by a Joint Research Agreement between the Mohammed Bin Rashid Space Centre (MBRSC) and the National Space Science and Technology Center (NSSTC), UAE University. This work was also supported by the UAE University research grant “Mars and Earth atmospheric science research at the National Space Science and Technology Center (NSSTC)”, 31R253.

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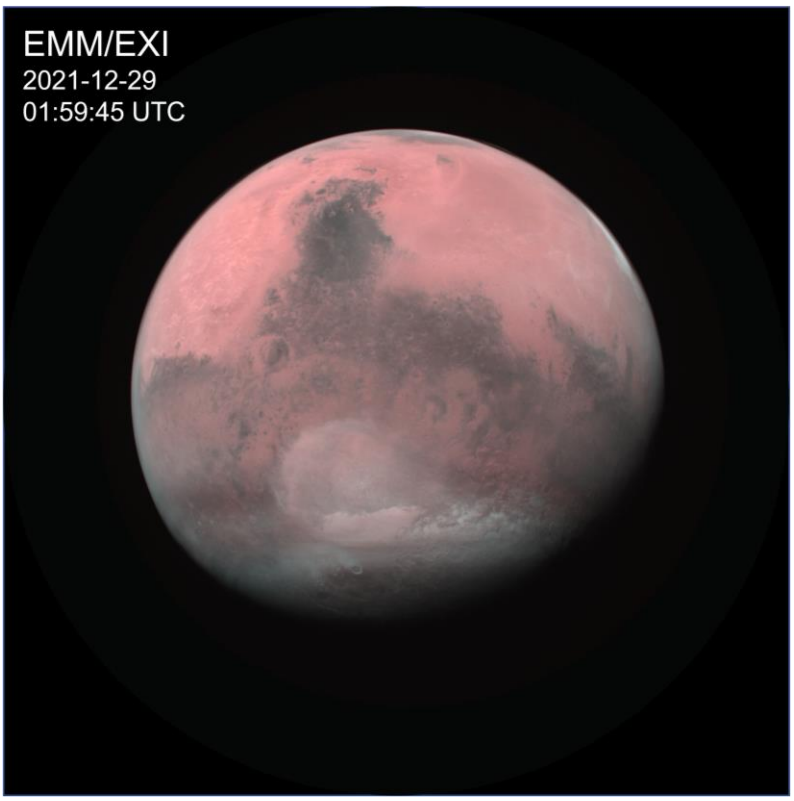

Fig. 1: This Mars image from the EMM instrument EXI was obtained on 2021-12-29 (L_S149). The image includes the Mars regions Syrtis Major and Hellas. At that time, the Mars atmosphere was relatively clear of dust. Few days later, EXI observed a large dust storm in this area. This is shown in the following Figs. 2 and 3.

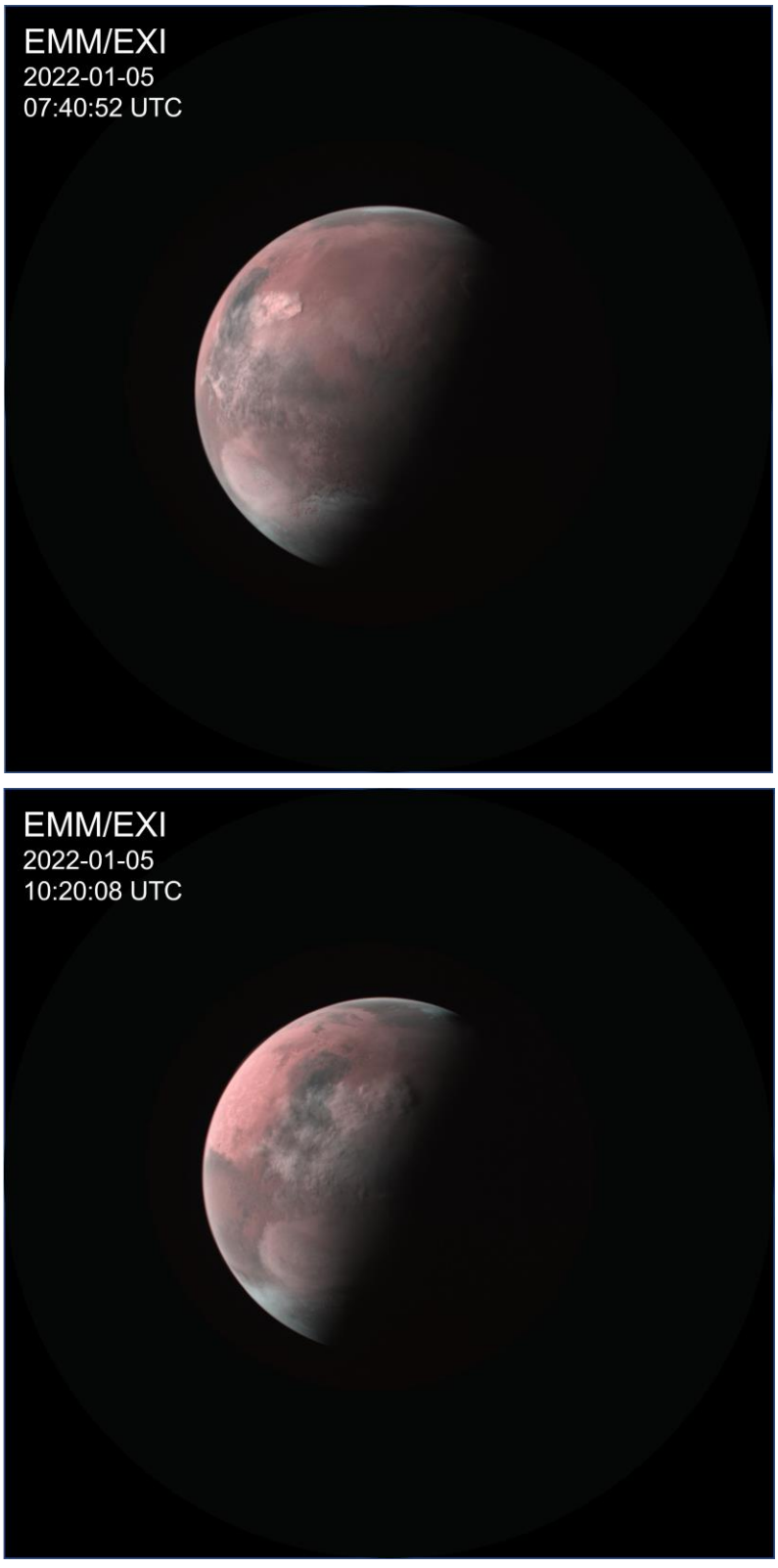

Fig. 2: These two EXI images were obtained on 2022-01-05 at a time difference of 2-3 hours. In both images, the Mars dayside is on the left and the nightside on the right. There is a large dust storm eastward from the Mars region Syrtis Major and northward from the Hellas region.

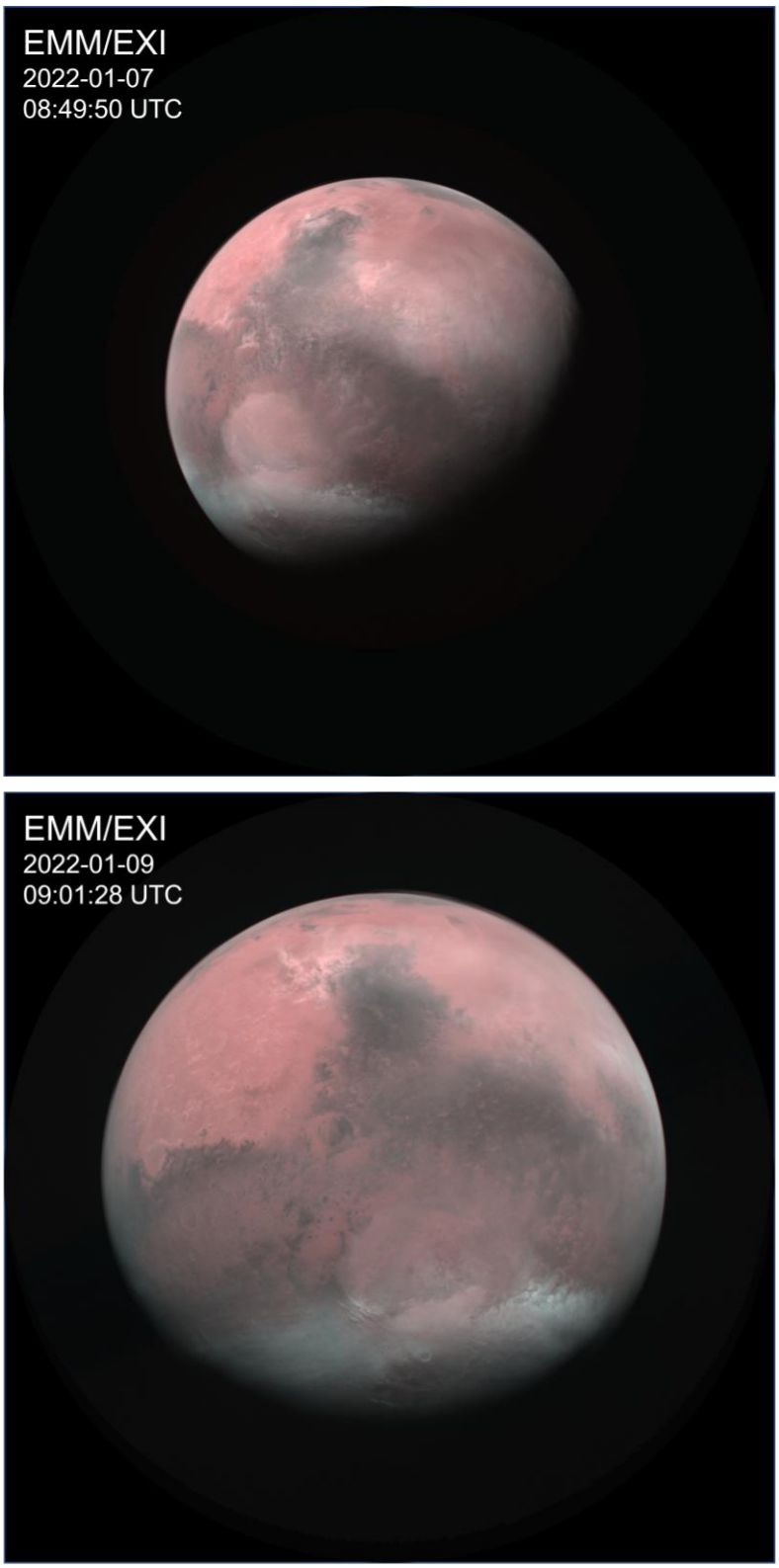

Fig. 3.: Same as Fig. 2, but the EXI images are from 2022-01-07 and 2022-01-09, respectively. Dust storm activity is ongoing around the Mars region Syrtis Major.