RoadMap – from Lab to Space: Applying an updated dust lifting equation in the GEM-Mars GCM

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Introduction: The aim of the Horizon 2020 RoadMap project (http://roadmap.aeronomie.be) is to better understand the role and impact of dust and clouds on the Martian atmosphere through an integrated approach involving lab measurements, micro-modelling, global climate modelling and remote sensing observations.

One of the specific goals set out for the project is to improve our understanding of the mechanisms responsible for dust lifting and transport. When dust is lifted from the surface and transported aloft, it has a significant effect on the temperature and circulation of the atmosphere. Several processes can lift dust from the surface, including saltation and dust devils.

Martian analogue soil: Three samples are used in the RoadMap project to provide a wide range of spectral and compositional variability. These are JSC Mars-1 (Johnson Space Center regolith simulant) in 2 different particle sizes, MMS-2 (Mojave Mars Simulant) and MGS-1 (Mars Global Simulant). The analogues were received, prepared and characterized at CSIC-ICV, then provided to the labs at CSIC-IAA, AU and UDE.

Figure 1 Martian dust analogues from left to right: JSC1-Mars < 1 mm, JSC1-Mars < 250 µm, MMS-2 and MGS-1.

Lab measurements: Preliminary lab measurements at AU and UDE using the Martian analogue soils were performed to investigate dust resuspension/aerolization and saltation. At AU, a narrow dust resuspension wind tunnel was constructed within their AWTSII chamber and preliminary experiments of saltation induced and direct wind driven dust resuspension were performed. At UDE, a setup for impact experiments has been developed.

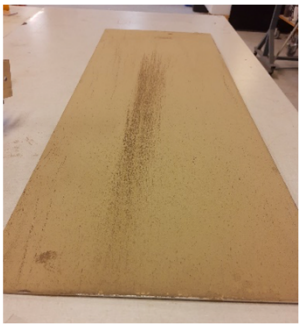

Figure 2 The AU sand bed with JSC-1 dust after wind exposure.

These experiments have contributed to an updated formulation of threshold wind stress to describe when lifting may occur. As more experiments are performed, the parameters used can be updated.

GCM Modelling: We test the new formulation for threshold wind stress in a three-dimensional Global Climate Model (GCM) for the atmosphere of Mars, GEM-Mars [1-2]. GEM-Mars has been evaluated and applied to several recent science investigations including [3-5]. The impacts of the 2018 global dust storm on the Martian atmosphere was explored in [6-8].

The current formulation for dust lifting from the surface in GEM-Mars includes the effects of saltation and dust devils. We update this implementation with new terms derived from the lab experiments and examine the impact on the representation of the global dust cycle in the GCM.

Acknowledgements: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004052.

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