The interactive simulation of Mars dust storms with the Mars General Circulation Model MarsWRF, at the resolution of 7.5°×9° (latitude×longitude)

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This presentation adds to recent interactive dust cycle simulations by the MarsWRF model at horizontal resolutions of 2°×2° and 5°×5° (latitude×longitude) [1,2]. The latter are repeated here at the classical resolution of 7.5°×9° (latitude×longitude). More information on the model resolution of 7.5°×9° can be found in Toigo et al.(2012) [3]. Our results for 7.5°×9° are compared with higher resolution of 5°×5° simulations by Gebhardt et al. (2020), JGR Planets [1]. Of particular interest are dust storms and surface dust lifting characteristics.

The interactive-dust-lifting-technique means that the MarsWRF model runs without being constrained by any external data on the Mars dust cycle. The model allows the model user to specify different parameters to simulate Mars dust storms and dust devils. This is based on two model parametrization schemes. These schemes account for surface dust lifting by dust devils and surface wind stress. Dust devils are convective vortices which form when air, heated by the ground, rises. This is illustrated in **Figure 1.** The other model scheme is for surface wind stress which depends on the wind speed and air density. The amount of lifted surface dust depends on the below wind stress lifting threshold and the wind stress lifting rate constant. The latter is a constant of proportionality between the horizontal and vertical flux of dust, which are shown in **Figure 2.**

The three parameters are:

1. AlphaD (α_D): dust devil lifting rate constant (kg J^{-1})
2. AlphaN (α_N): wind stress lifting rate constant
3. Tau (τ): wind stress lifting threshold (Pa)

The model is calibrated to produce global dust storm events in few Martian Years but not in others. This requires model calibration by trial and error. A particular focus of this presentation will be the formation of global dust storm events. **Figure 3.** shows curves of the MarsWRF predicted global atmospheric midlevel temperature, or T15 temperature, for 20 Martian Years in the 7.5° × 9° model run.

This modelling approach characterizes processes such as surface dust loss, atmospheric dust transport, and deposition of dust onto the surface, including regional-to-global dust storms. Thus, it contributes to the Emirates Mars Mission (EMM) science objective on the lower atmosphere, and also the objective of correlating the lower and upper atmosphere [4,5].

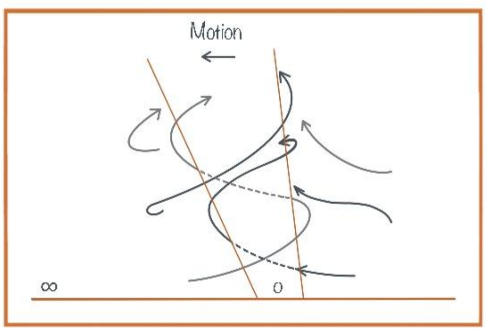

Figure 1. Surface Dust lifting by dust devils

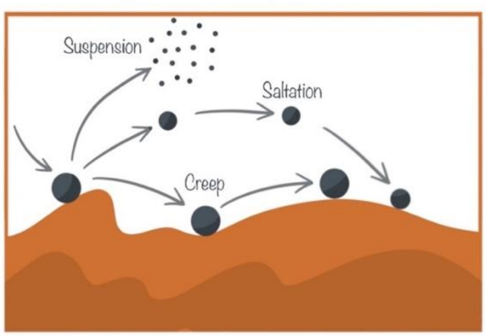

Figure 2 . Surface Dust lifting by wind stress.

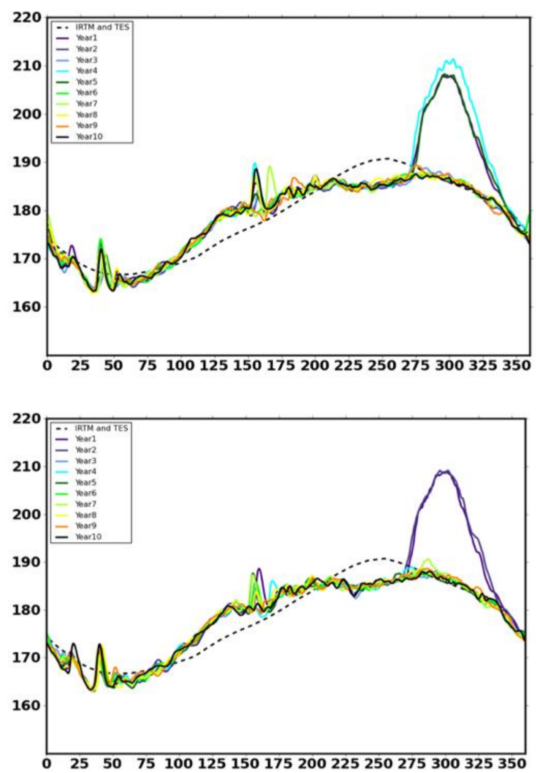

Figure 3. MarsWRF predicted curves of the global T15 temperature for the 7.5° × 9° model run

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