A MODERN-DAY MARS CLIMATE IN THE MET OFFICE UNIFIED MODEL: DRY SIMULATIONS

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Introduction:

Mars atmospheric modelling has come far in the past two decades, with increased missions expanding our observational capabilities drastically. These observations are allowing us to develop increasingly accurate Martian Global Climate Models (hereafter; GCMs) [1, 2, 3]. There are currently several well-established GCMs that already model Mars' atmosphere, including (but not limited to) the LMDs Mars GCM, NASAs AMES Mars model and OpenMARS.

Here we describe the usage and first climate results from our adaptation of the Met Offices Unified Model (hereafter; UM), one of the most sophisticated Earth GCMs already used for modelling exoplanets, for a Martian climate. By adapting established climate schemes used for the study of Earth within the GCM (e.g. atmospheric dust, wind, atmospheric composition, etc.) to Mars' characteristics, we can create a highly sophisticated Mars model (e.g. high spatial resolution, dynamic dust scheme). Our simulations will be verified by comparison with existing Mars GCMs. The key parameters incorporated into our GCM will include:

- Radiatively active dust
- Orography and surface roughness [4]
- Martian orbital parameters
- Atmospheric composition and pressure
- Atmospheric H_2O
- CO_2 ice

In this presentation I will detail the different schemes incorporated into the UM key to simulating a Mars climate, then describe the processes used to implement them into the UM. We will then showcase the different scenarios of Mars' climate we have introduced and their subsequent effects on other climate parameters (e.g. increased pressure and how it changes temperature). I will finish by showing the verification process we used and comparisons to other existing models.

Future of the project:

A verified Mars-UM will then be used to investigate the relationship that key climate variables have to each other. By forcing exaggerated changes in targeted key parameters (e.g. doubling average surface pressure or increasing atmospheric moisture content), we can then investigate the secondary effects these changes have on other parameters in the Martian climate (e.g. change in temperature or dust mixing ratios). This study will help discern the importance and relative influence of Mars' key parameters, this will in-turn provide insight for future areas of research and development.

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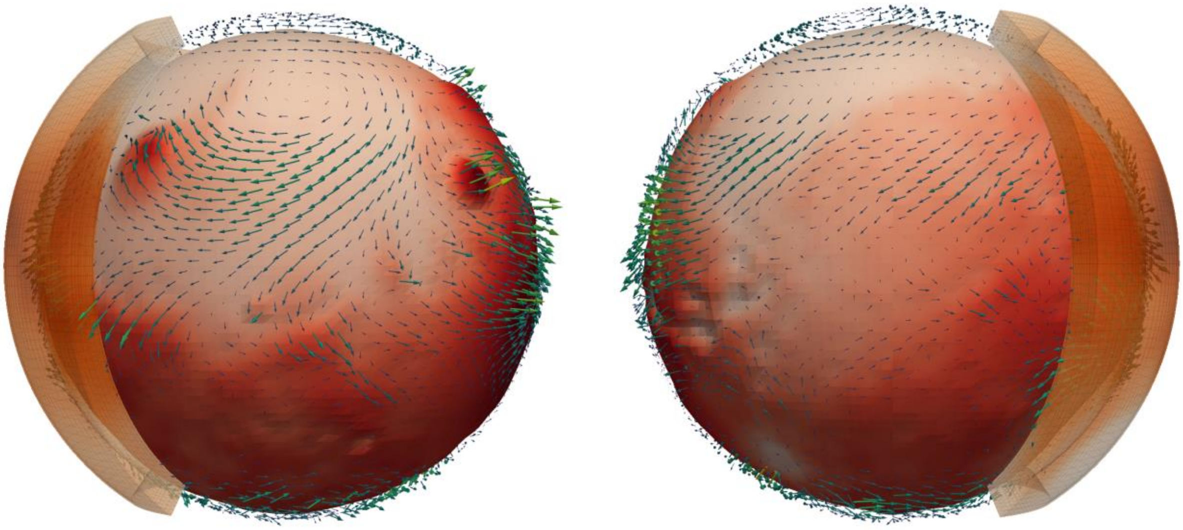

Overview 3D plot of an example output during Southern summer (Ls=260°). Included is an extracted regional dust layer as an isosurface, free wind vectors at 1km height (arrows) and an exaggerated orography (scaled up in this image by a factor of 30 to highlight extremities). Higher resolution GIF and code available at https://github.com/dannymcculloch