Improving models of the Martian surface

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Large dust storms dominate the Mars climate in northern fall and are driven by a seasonal cycle that sees 30% of the atmosphere condense onto, and sublimate from, the polar ice caps every year. In this project, you would use recent observations to improve the accuracy of numerical models of these processes by extending a climate model of the Mars atmosphere.

Lee et al. (2018) showed that dust and water interact in the Martian atmosphere to produce the global planet-encircling storms observed by satellites. Lee, Richardson, and Newman (2021) showed that the distribution of dust on the surface of Mars could also control the timing and location of dust storms throughout the year. However, the strength and decay of the storms are not controlled by the current models of dust lifting or water ice growth, so these current models do not accurately simulate the later phases of large dust storms.

In this project you will extend the existing models of surface dust in a Mars Climate Model (MarsWRF). First, you will develop an analytical model of dust on the surface based on the relevant literature. You will then adapt this analytical model into a numerical model to simulate dust lifting on the surface of Mars. Finally, you will be able to test your model alongside the current MarsWRF climate model to produce more realistic simulations of the dust storms that encircle the planet (Smith and Guzewich, 2019).

The project requires strong mathematical-modelling skills and programming experience. Som knowledge of atmospheric physics is recommended.

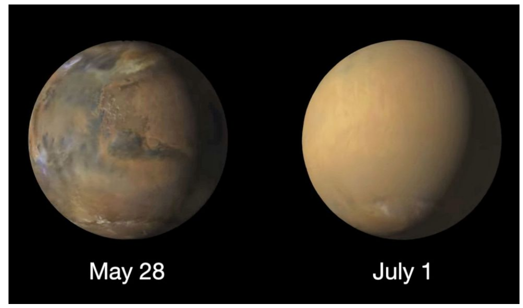

Figure 1: *The largest dust storm recorded covers the surface of Mars in the space of 1 month in June 2018. The storm blocked sunlight from the surface ending the Mars Opportunity Rover mission, and lasted for more than 90 days. Image from NASA/JPL-Caltech/MSSS.*

For more information, please feel free to contact me by email: `clee@atmosp.physics.utoronto.ca`

Bibliography

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