

Super-rotation during the 2018 Martian Global Dust Storm



Open-access dataset

Dataset summary

This dataset contains information on the atmospheric fields of Mars, as generated by an assimilation of data from a Mars Global Circulation Model (MGCM) and observational data from two satellite instruments. The MGCM is the Mars atmospheric model used at the Open University, and the observational data are from: (a) the Mars Climate Sounder (MCS) instrument aboard the Mars Reconnaissance Orbiter (for Mars Years 33 and 34), and (b) the Atmospheric Chemistry Suite (ACS) aboard the ExoMars Trace Gas Orbiter (for Mars Year 34 only). Assimilation output data is provided over solar longitudes $L_S = 150^\circ\text{--}240^\circ$ for both years, as this is the time period covering the period of the global dust storm in MY 34.

Accessing the data

The data is provided in NetCDF format; sample Python scripts for access are available in the **OpenMars standard database** (<https://doi.org/10.21954/ou.rd.7352270.v1>; <https://doi.org/10.21954/ou.rd.7352579.v1>).

Structure of the data files

The filename convention for the general MGCM diagnostics from the reanalyses is as follows:

NAME_myMM_IsLLL_myMM_IsLLL.nc

where NAME indicates the variables contained in the file (NAME can be “diag”, or “wind”), MM (33 or 34) indicates the MY, and L (000 to 359) the start/end value of solar longitude (to the nearest integer) for the period covered.

Dimensions

The dimensions of all the data files are listed in Table 1. The MGCM was run at spectral resolution T42, which corresponds to approximately 3.75° grid spacing in both latitude and longitude on the physics grid. There are 55 vertical levels in these data files, extending to an altitude of approximately 105 km. Vertical coordinates in the model are terrain-following sigma levels $\sigma = p/p_s$, where p and p_s are the pressure and surface pressure respectively.

Table 1: Dimensions of data files (diag_*.nc, wind_*.nc)

Dimension	Number of values	Description
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lon	96	Longitude
lat	48	Latitude
lev	55	Vertical level
time	360	Time

Variables are output 12 times every martian Sol, which lasts 24 hours, 39 minutes, and 35.244 seconds, or 88775.244 seconds. Mars Years are defined according to the calendar introduced by R. Todd Clancy, where Mars Year 1 ($L_S = 0^\circ$) begins on April 11th, 1955 (Clancy et al., 2000). For ease of use, values of Sol, Solar longitude, and Mars Year are included in the dataset; these are listed in Table 2, together with the other spatial dimension variables.

Table 2: Dimension variables

Variable	Dimension	Description	Units
lon	lon	Longitude	Degrees East
lat	lat	Latitude	Degrees North
lev	lev	Model sigma level	-
time	time	Martian Sol	Sols since 0.0
Ls	time	Solar longitude	Degrees
MY	time	Mars Year	-

The field variables included in each data file are listed in Tables 3a and 3b.

Table 3a: Variables for MGCM diagnostics (diag_*.nc)

Variable	Dimension	Description	Units
ps	lon, lat, time	Surface pressure	Pa
tau	lon, lat, time	Column dust optical depth at 600 nm	-
temp	lon, lat, lev, time	Temperature	K
dust_mmr	lon, lat, lev, time	Dust mass mixing ratio	-

Table 3b: Variables for MGCM diagnostics (wind_*.nc)

Variable	Dimension	Description	Units
u	lon, lat, lev, time	Eastward wind speed	m/s

v	lon, lat, lev, time	Northward wind speed	m/s
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Details of model, MCS and ACS data, and assimilation scheme used

Details of the MGCM and assimilation scheme, as well as details on the MCS temperature profiles and dust columns, can be found in the OpenMARS MY28-32 reference manual (Holmes et al., 2019): <https://doi.org/10.21954/ou.rd.7352579.v1>.

Note that for the period of the 2018 GDS, the MCS data used in the assimilation is the v5.3.2 dataset, available at: https://mcs-ws1.jpl.nasa.gov/level_2_2d_v532/

Also note that for the period of the 2018 GDS, the usual filtering of equatorial dayside dust columns from MCS described in the **OpenMARS MY28-32 reference manual** was not performed.

Further details of the temperature profiles from the ACS instrument can be found in (Federova et al 2020).

For any queries regarding the dataset, contact kylash.rajendran@open.ac.uk.

References

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