THE MARS CLIMATE DATABASE (VERSION 5.3)

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Introduction: The Mars Climate Database (MCD) is a database of meteorological fields derived from General Circulation Model (GCM) numerical simulations of the Martian atmosphere and validated using available observational data. The MCD includes complementary post-processing schemes such as high spatial resolution interpolation of environmental data and means of reconstructing the variability thereof.

The GCM that is used to create the MCD data is developed at Laboratoire de Météorologie Dynamique du CNRS (Paris, France) [1-3] in collaboration with LATMOS (Paris, France), the Open University (UK), the Oxford University (UK) and the Instituto de Astrofisica de Andalucia (Spain) with support from the European Space Agency (ESA) and the Centre National d'Etudes Spatiales (CNES).

The MCD is freely available upon request (contact millour@lmd.jussieu.fr or forget@lmd.jussieu.fr); a simplified web interface for quick browsing at MCD outputs is available on http://www-mars.lmd.jussieu.fr

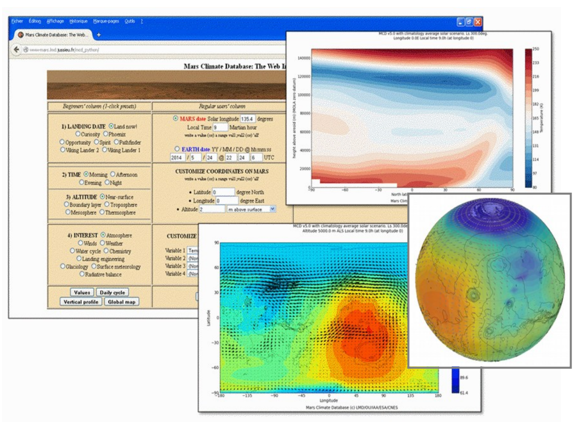

Figure 1 : Illustrative example of the online Mars Climate Database web interface and its plotting capabilities.

Overview of MCD contents: The MCD provides mean values and statistics of the main meteorological variables (atmospheric temperature, density, pressure and winds) as well as atmospheric composition (including dust and water vapor and ice content), as the GCM from which the datasets are obtained includes water cycle [4,5], chemistry [6], and ionosphere [7,8] models. The database extends up to and including the thermosphere [9,10] (~350km). Since the influence of Extreme Ultra Violet (EUV) input from the sun is significant in the latter, 3 EUV scenarios (solar minimum, average and maximum inputs) account for the impact of the various states of the solar cycle.

As the main driver of the Martian climate is the dust loading of the atmosphere, the MCD provides climatologies over a series of **dust scenarios** : **standard year** (a.k.a. **climatology**) , **cold** (i.e: low dust), **warm** (i.e: dusty atmosphere) and **dust storm**, These are derived from home-made, instrument-derived (TES, THEMIS, MCS, MERs), dust climatology of the last 8 Martian years [11]. In addition, we also provide additional "add-on" scenarios which focus on individual Martian Years (MY 24 to 32) for users more interested in specific climatologies than the MCD baseline scenarios designed to bracket reality,

Provided outputs: The MCD provides users with:

- Mean values and statistics of main meteorological variables (atmospheric temperature, density, pressure and winds), as well as surface pressure and temperature, CO_2 ice cover, thermal and solar radiative fluxes, dust column opacity and mixing ratio, [$H_2$0] vapour and ice concentrations, along with concentrations of many species: [CO], [O_2], [O], [N_2], [Ar], [H_2], [O_3], [H] ..., as well as electrons mixing ratios. Column densities of these species are also given.

- Dust mass mixing ratio, along with estimated dust effective radius and dust deposition rate on the surface are provided.
- Physical processes in the Planetary Boundary Layer (PBL) [12], such as PBL height, minimum and maximum vertical convective winds in the PBL, surface wind stress and sensible heat flux.
- A high resolution mode which combines high resolution (32 pixel/degree) MOLA topography records and Viking Lander 1 pressure records with raw lower resolution GCM results to yield, within the restriction of the procedure, high resolution values of atmospheric variables.
- The possibility to reconstruct realistic conditions by combining the provided climatology with additional large scale (derived from Empirical Orthogonal Functions extracted from the GCM runs) and small scale perturbations (gravity waves), a scheme which has been greatly improved for MCDv5.3.

Improvements in MCDv5.3: This new version of the MCD includes the following additions and upgrades:

- Better documentation on guidelines for the integration of the MCD on Windows operating systems.
- Improved interfaces with Matlab, Scilab and IDL which are now fully interactive with the MCD (Fortran) software
- Improved computation of some of the trace species column densities when in MCD "high resolution" mode.
- An improved gravity waves schemes, which accounts for both horizontal and vertical propagation of these.
- Improved extrapolation around the MCD "model top" (~10^{-8} Pa, i.e. ~250km) to better represent the exosphere where species evolve with their own distinct scale heights. In practice this means that provided compositions and densities should be trusted up to ~500km.
- The Mars Year 32 dust scenario has been added.
- Updated Extreme UV scenarios to better bracket the latest observed solar cycle (see figures 2 and 3).

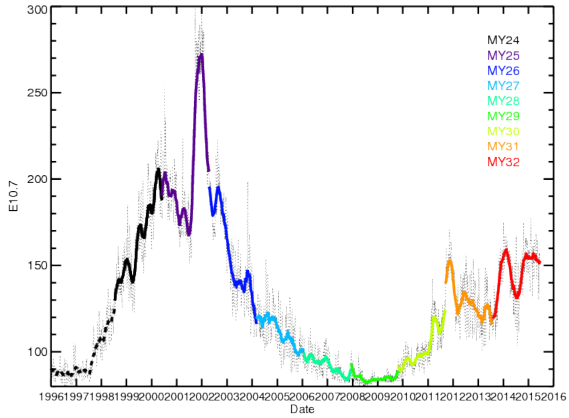

Figure 2: Solar EUV cycle (in terms of E10.7 proxy) over the last Mars Years. The MCD5.3 EUV minimum, average and maximum cases respectively correspond to E10.7 values of 80, 140 and 320.

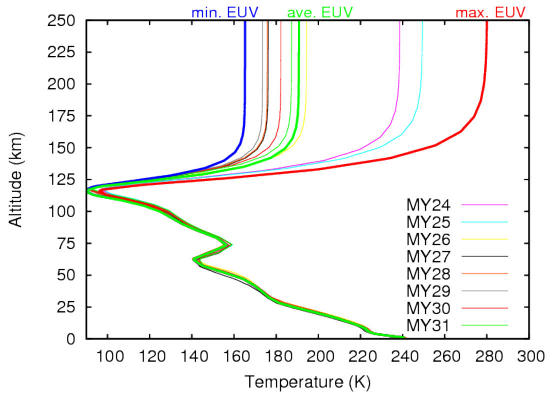

Figure 3: MCDv5.3 temperature profiles extending into the thermosphere using the three synthetic EUV (minimum, average and maximum) forcings (with the climatology dust scenario), along with the realistic cases obtained at same location and time of year when using the MY24 to MY32 scenarios.

References:

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