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**MCD : Mars Climate Database
Virtual Observatory service in VESPA**

User Manual

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This document aims to explain quickly how the service MCD on VESPA is build and how to interrogate it on VESPA query interface. It will detail the most useful query criteria of the service and the data content.



Chapter 1

Service content

The Virtual Observatory access to the Mars Climate Database (MCD)¹ is an alternative way to use the MCD in selecting sets of profiles matching queries. It give access to the simulated profiles of various parameters in Mars atmosphere in VOTable² format for 51 points of altitude between 0 and 249.5 km (altitude from Mars areoid). Those profiles depends on solar longitude, local time, latitude, longitude and the scenario of the database. These input parameters have been sampled (see Table 1.1) to be integrated on a VESPA service.

1.1 Mars Climate Database

There are two categories of scenarios provided by MCD : Scenarios characterized by a set of meaningful dust and solar conditions and scenarios based on Mars Years 24 to 32 dust and solar conditions.

- The first is composed by 8 combinations of dust and solar scenarios:
 - 3 Solar conditions are implemented: Solar Maximum, Average and Minimum;
 - 5 Kinds of dust scenarios are implemented, but not necessarily available for all solar condition :
 1. The "Climatology" (clim) scenario, representative of a standard Martian year. Climatology dust scenario is provided with the 3 solar EUV conditions (**climavr**, **climmin**, **climax**)
 2. The Cold scenario corresponds to an extremely clear atmosphere ("Low dust scenario"). It is provided for a solar EUV minimum (**coldmin**).
 3. The Warm scenario corresponds to "dusty atmosphere" conditions, but nonetheless non-dust storm conditions, with a solar maximum thermosphere (**warmmax**).
 4. The Dust Storm scenario represents Mars during a global dust storm, during northern fall and winter (Ls=180-360), with the 3 cases of solar EUV inputs: (**stormmin**, **stormavr**, **stormmax**).
- The 10 Mars Years scenarios (**MY24**, ..., **MY33**) corresponds to the best representation of these specific years, both in terms of daily atmospheric dust loading and daily solar EUV input.

¹http://vespa.obspm.fr/planetary/data/display/?&service_id=ivo://lmd.jussieu/mcd/q/epn_core&service_type=epn

²VOTable Standard Format Definition : <https://www.ivoa.net/documents/VOTable/>

Parameter name	Content	Range of values
solar_conditions	Solar conditions of the MCD scenario	Maximum Average Minimum Mars Year
dust_conditions	Dust conditions of the MCD scenario	Climatology Cold Storm Warm Mars Year
granule_gid	MCD scenario	climavrEUV climmaxEUV climminEUV coldmaxEUV strmavrEUV strmmaxEUV strmminEUV warmmaxEUV MY24 ... MY33
solar_longitude_{min max}	Solar longitude in degrees	From 15 to 345 or 195 to 345 (storm scenarios) by step of 30°
local_time_{min max}	Local time in hours	From 0 to 24 by step of 2 h
c1_{min max}	Longitude in degrees	From 0 to 360 by step of 5°
c2_{min max}	Latitude in degrees	From -90 to 90 by step of 5°
c3_{min max}	{min max} altitude above areoid in the profile (km)	c3.min=0 and c3.max=249.5 km
time_{min max}	Earth date YYYY-MM-DDThh-mm-sss	From 2004-01-13 to 2017-04-15
obs_id	SL{solar_longitude}_H{local_time}_LAT{c2}_LON{c1}	
granule_uid	{granule_gid}_{obs_id}	

Table 1.1: Principal research parameters on MCD service

See the MCD 5.3 user manual³ and the webpage dedicated to the project⁴ for more information.

1.2 Parameter description

The MCD VO service for VESPA is searchable using query parameters. Main query parameters of the service are reported Table 1.1 and corresponds to the MCD inputs. Each granule of the service links to a VOTable file containing the profile of numerous MCD outputs (see Table 1.2).

³MCD 5.3 user manual : http://www-mars.lmd.jussieu.fr/mars/info_web/user_manual_5.3.pdf

⁴<http://www-mars.lmd.jussieu.fr>

Altitude :
Altitude above Mars Zero Datum (km)
Altitude above the local surface (km)
Radial Distance from center of the planet (km)
Altitude of the surface with respect to the areoid (km)
Temperature/Pressure :
Atmospheric Temperature (K)
RMS day to day variations of Atmospheric Temperature (K)
Atmospheric Pressure (Pa)
RMS day to day variation of Atmospheric Pressure (Pa)
Surface Temperature (K)
RMS day to day variations of Mars Surface Temperature (K)
Surface Pressure (high resolution) (Pa)
RMS day to day variations of Surface Pressure (Pa)
Winds :
Zonal component of wind (positive if eastward) (m/s)
RMS day to day variations of Zonal component of wind (positive if eastward) (m/s)
Meridional component of wind (positive if northward) (m/s)
RMS day to day variations of Meridional component of wind (positive if northward) (m/s)
Composition :
Atmospheric Density (kg.m-3)
RMS day to day variation of density (kg.m-3)
Dust column visible optical depth
RMS day to day variation of Dust column visible optical depth
Dust mass mixing ratio (kg_dust/kg_air)
Dust effective radius: Dust particle size (m)
Water vapor column (kg.m-2)
Water vapor column Volume Mixing Ratio (mol_water_vapor/mol_air)
Water ice column (kg.m-2)
Water Ice column Volume Mixing Ratio (mol_water_ice/mol_air)
Water ice effective radius : Water ice cloud particle size (m)
Carbon Dioxide Volume Mixing Ratio (mol_co2/mol_air)
Dinitrogen Volume Mixing Ratio (mol_N2/mol_air)
Argon Volume Mixing Ratio (mol_Ar/mol_air)
Carbon monoxide Volume Mixing Ratio (mol_CO/mol_air)
Oxygen Volume Mixing Ratio (mol_O/mol_air)
Dioxygen Volume Mixing Ratio (mol_O2/mol_air)
Ozone Volume Mixing Ratio (mol_o3/mol_air)
Hydrogen Volume Mixing Ratio (mol_H/mol_air)
Dihydrogen Volume Mixing Ratio (mol_H2/mol_air)
Electron number density (cm-3)
Carbon dioxide column (kg.m-2)
Dinitrogen column (kg.m-2)
Argon column (kg.m-2)
Carbon monoxide column (kg.m-2)
Oxygen column (kg.m-2)
Dioxygen column (kg.m-2)
Ozone column (kg.m-2)
Hydrogen column (kg.m-2)
Dihydrogen column (kg.m-2)
Total Electronic Content (kg.m-2)
Helium column (kg.m-2)
Helium Volume Mixing ratio (mol_H2/mol_air)

Table 1.2: Content of the profiles provided in the VOTables of the MCD service
Parameters which do not change with altitude (Surface Pressure, Surface Temperature, RMS Surface Pressure, RMS Surface Temperature) are provided as *param* tags of the VOTable. Other parameters are provided as *field* tags.