

The Venus Climate Database

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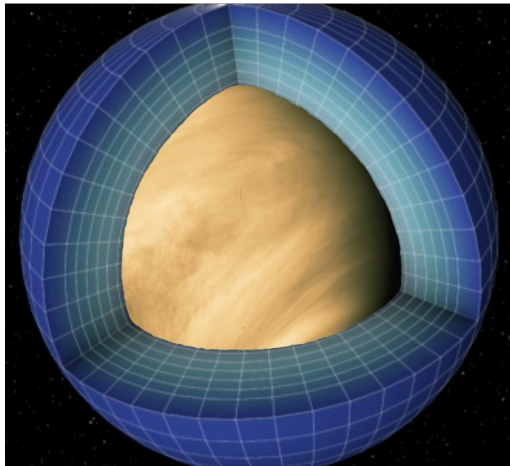
ESTEC, ESA, Noordwijk, The Netherlands



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The IPSL Venus GCM



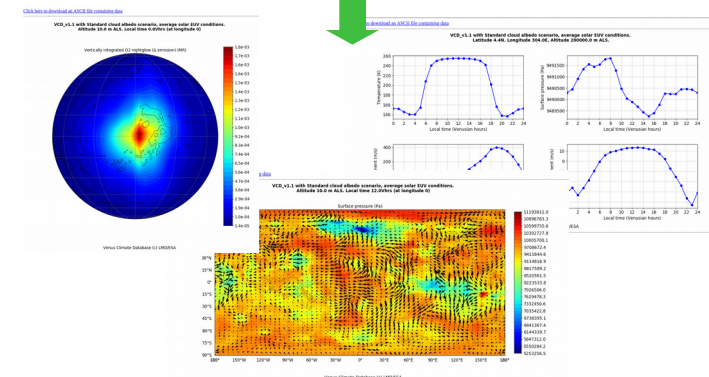
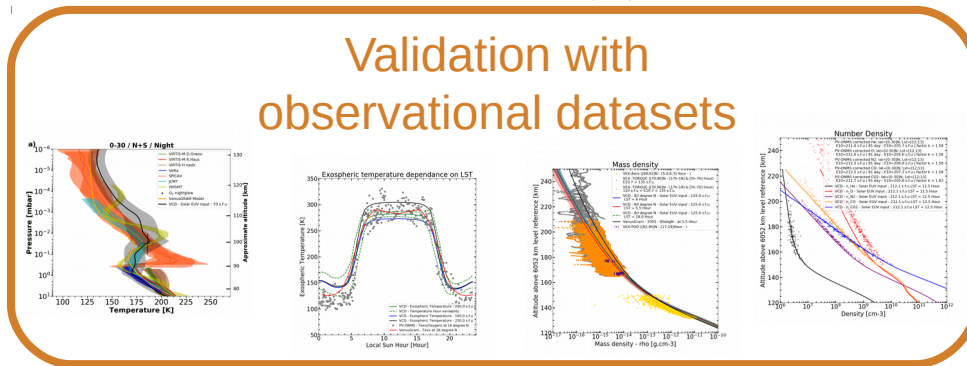
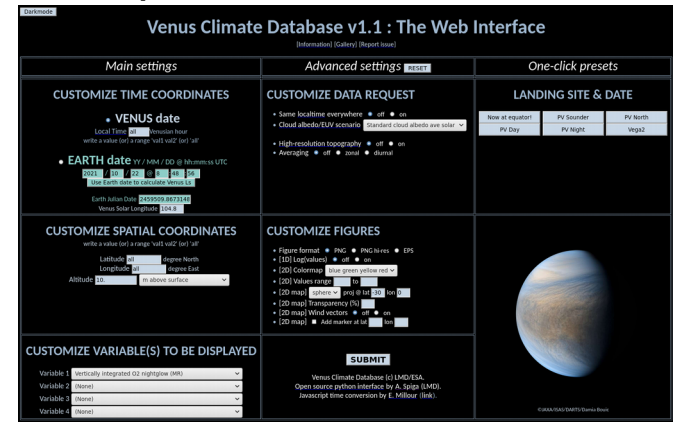
From surface to 250 km

VCD
 routine suite
`call_vcd(z_key,z,lon,lat,...,
 T,p,dens,zonwind,...)`

Direct use in users' codes

Various language interfaces

Simple web interface use



The IPSL Venus GCM

- Three-dimensional: 96x96x
[50 (0~95 km) / 78 (0~150 km) / 90 (0~250 km)]
- Vertical coordinates: hybrid (sigma/pressure)
- Dynamical core, transport of tracers
- Specific physics:
 - Radiative transfer: Infrared Net Exchange Rates matrix
Solar heating rates: tables
 - Thermosphere: Non-LTE processes
EUV heating
molecular diffusion
 - Parameterizations of sub-grid processes:
boundary layer (Mellor&Yamada 1982), convection
non-orographic gravity waves
orographic gravity waves
 - Topography
- Photochemistry implemented (PhD of Aurélien Stolzenbach)

The Venus Climate Database

- Based on the same principles as the well-known Mars Climate Database (MCD)
- The Venus Climate Database (VCD) is a database **derived from Global Climate Model (GCM) simulations**, using the IPSL Venus GCM.
- **ESA is funding the project**, in relation with the EnVision M5 mission
- The VCD is intended to be useful for **engineering applications** (e.g. Aerobraking studies, Entry Descent & Landing studies) and **scientific work** which require accurate knowledge of the Venusian atmosphere (e.g. analysis of observations).
- The VCD is **freely available**
 - <http://www-venus.lmd.jussieu.fr>
light online access for moderate needs (**web interface**)
 - **full version** : includes advanced post-processing software (Fortran subroutine **call_vcd**; examples of C, C++, IDL, MATLAB, SCILAB, Python interfaces are provided).
Please contact ehouarn.millour@lmd.ipsl.fr

VCD content and main features

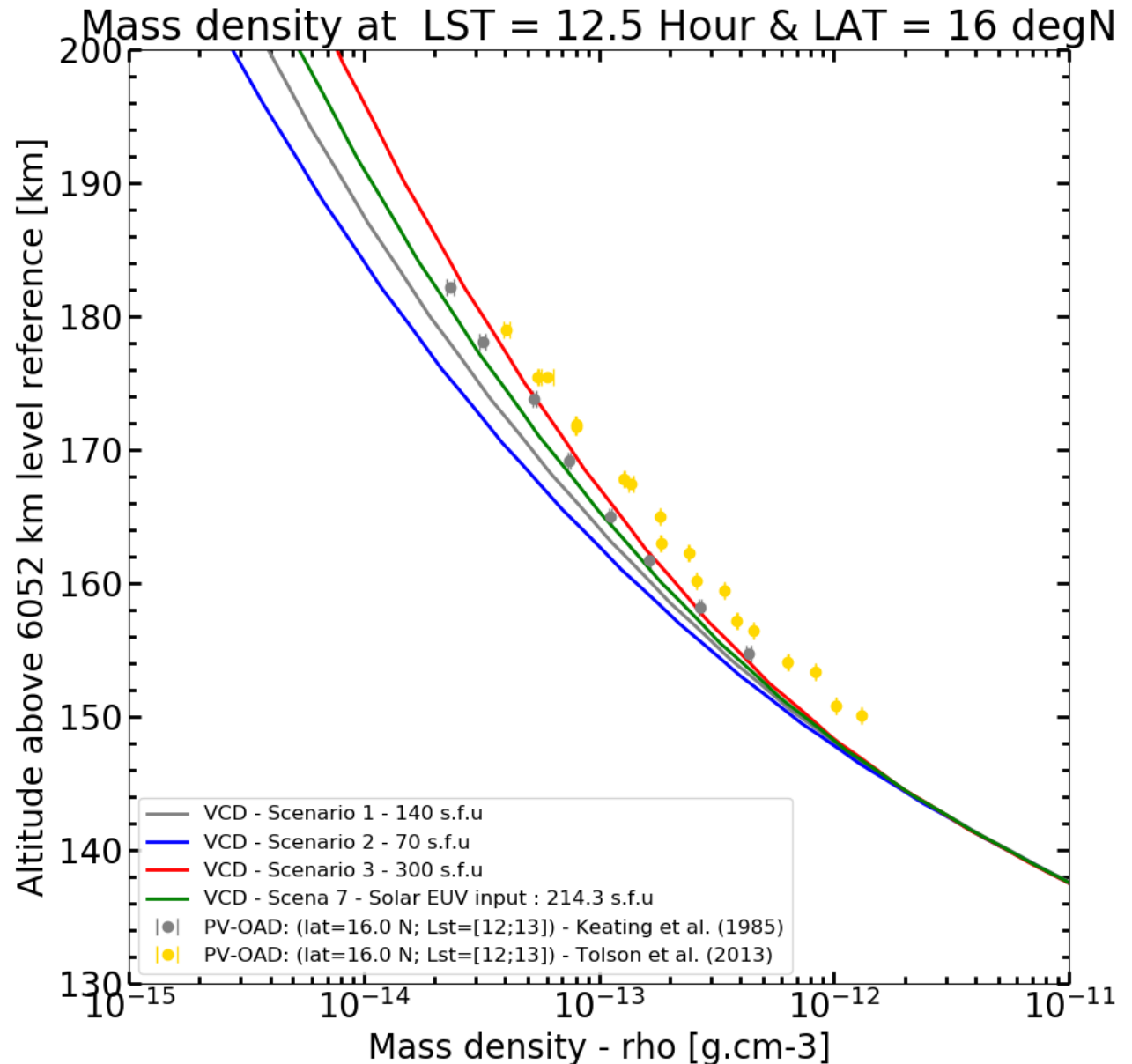
Main access software (**call_vcd**):

- Primarily composed of a **Fortran subroutine** (benefit from MCD heritage) designed to provide access, with adequate interpolations, to fields and variables as a result of a **point-wise** (in location and time) **query**.
- Enabling the user to query along the **time dimension** either by specifying an **Earth date** or a **Venus Local Time**.
- The VCD dataset includes **one full climatological Venus day** built using 10 Venus days of computations, sampled at 1/24th of a Venusian day to accurately represent the diurnal cycle

Example of the VCD Density profile

VCD vs density measurements

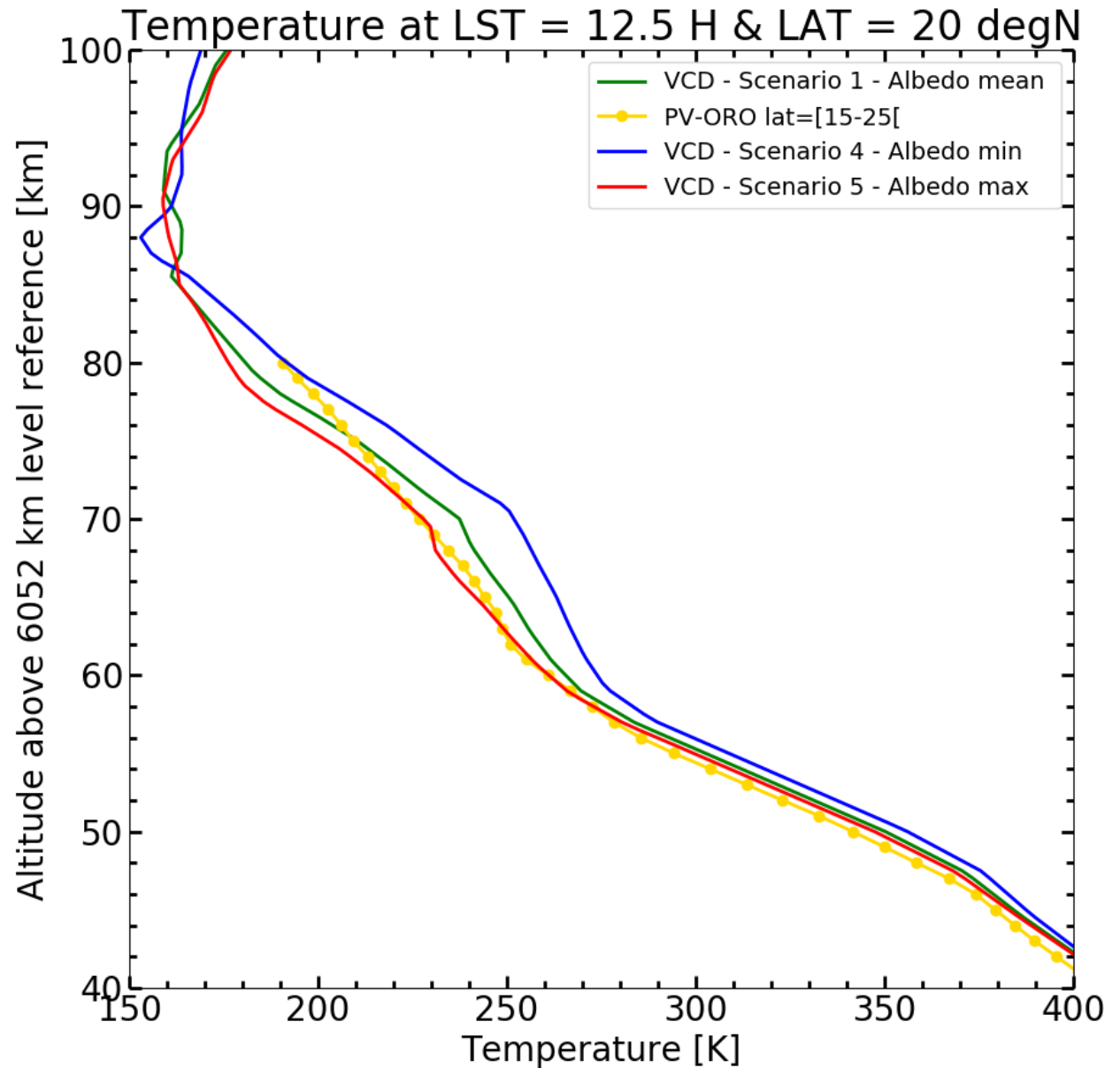
- The **EUUV scenarios** of the VCD allow to bracket reality
- The comparison can be more accurate using a **specific EUV with scenario 7**
- PV-OAD: Pioneer Venus Orbiter Atmospheric Drag



Example of the VCD Temperature profile

VCD vs temperature measurements

- The **cloud albedo scenarios** allow to bracket reality
- PV-ORO: Pioneer Venus Orbiter Radio Occultation

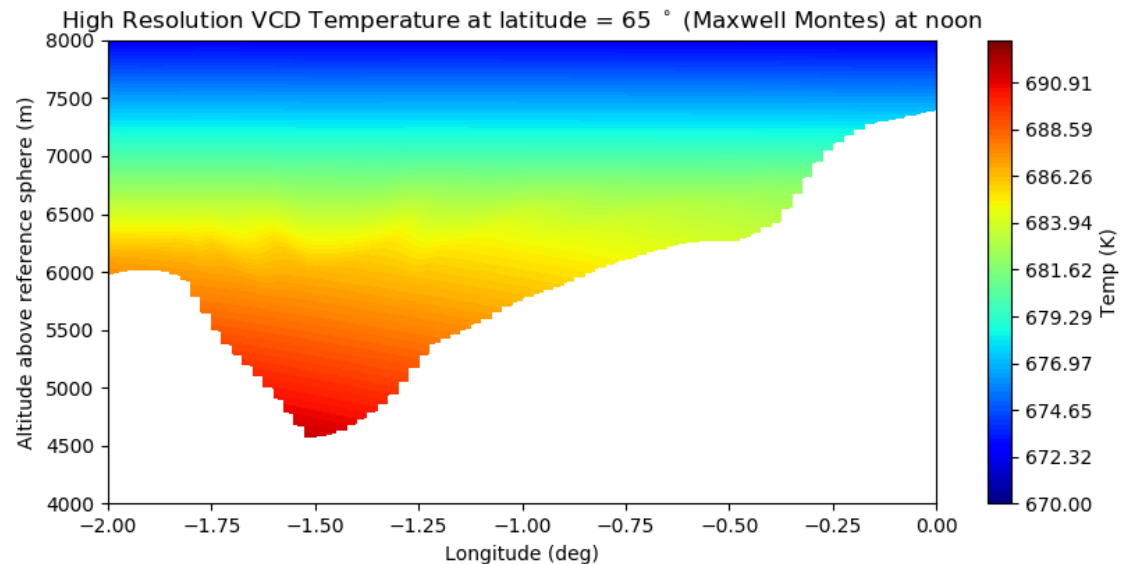
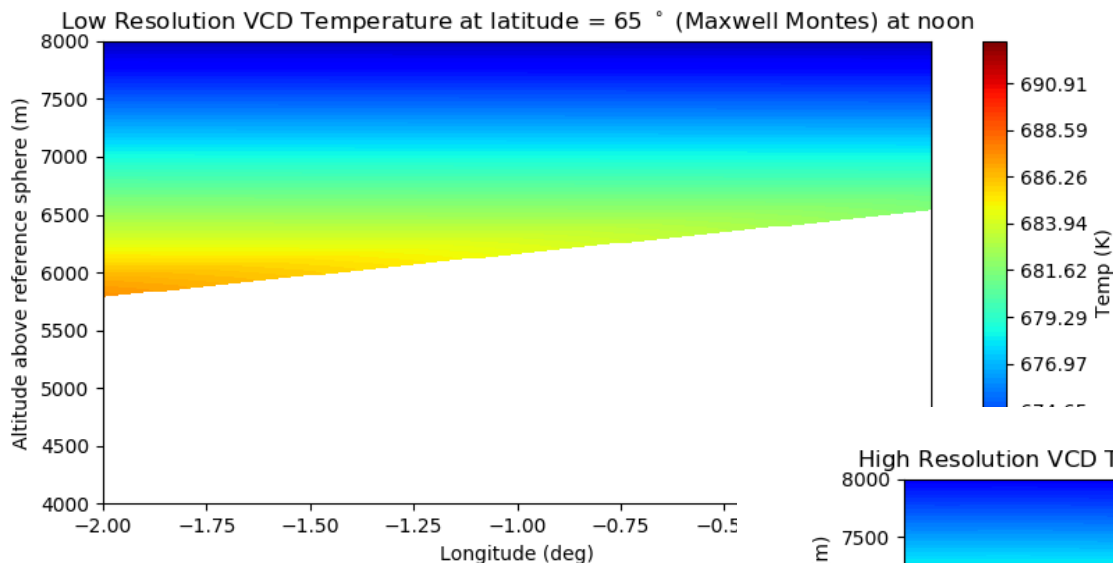


VCD available scenarios

1. Standard cloud albedo and average solar EUV input ($E_{10.7}=140$ sfu)
2. Minimum solar EUV input ($E_{10.7}=70$ sfu) and standard cloud albedo
3. Maximum solar EUV input ($E_{10.7}=300$ sfu) and standard cloud albedo
4. Low cloud albedo and average solar EUV input
5. High cloud albedo and average solar EUV input
6. EUV input as deduced from the input Earth date (Julian date)
7. EUV input as specified by the user

VCD high resolution mode

The access software includes a **high resolution mode** with a 23 pixel/deg topography measured with Magellan radar altimeter (combined with a few topography measurements from Pioneer Venus to fulfill the holes)

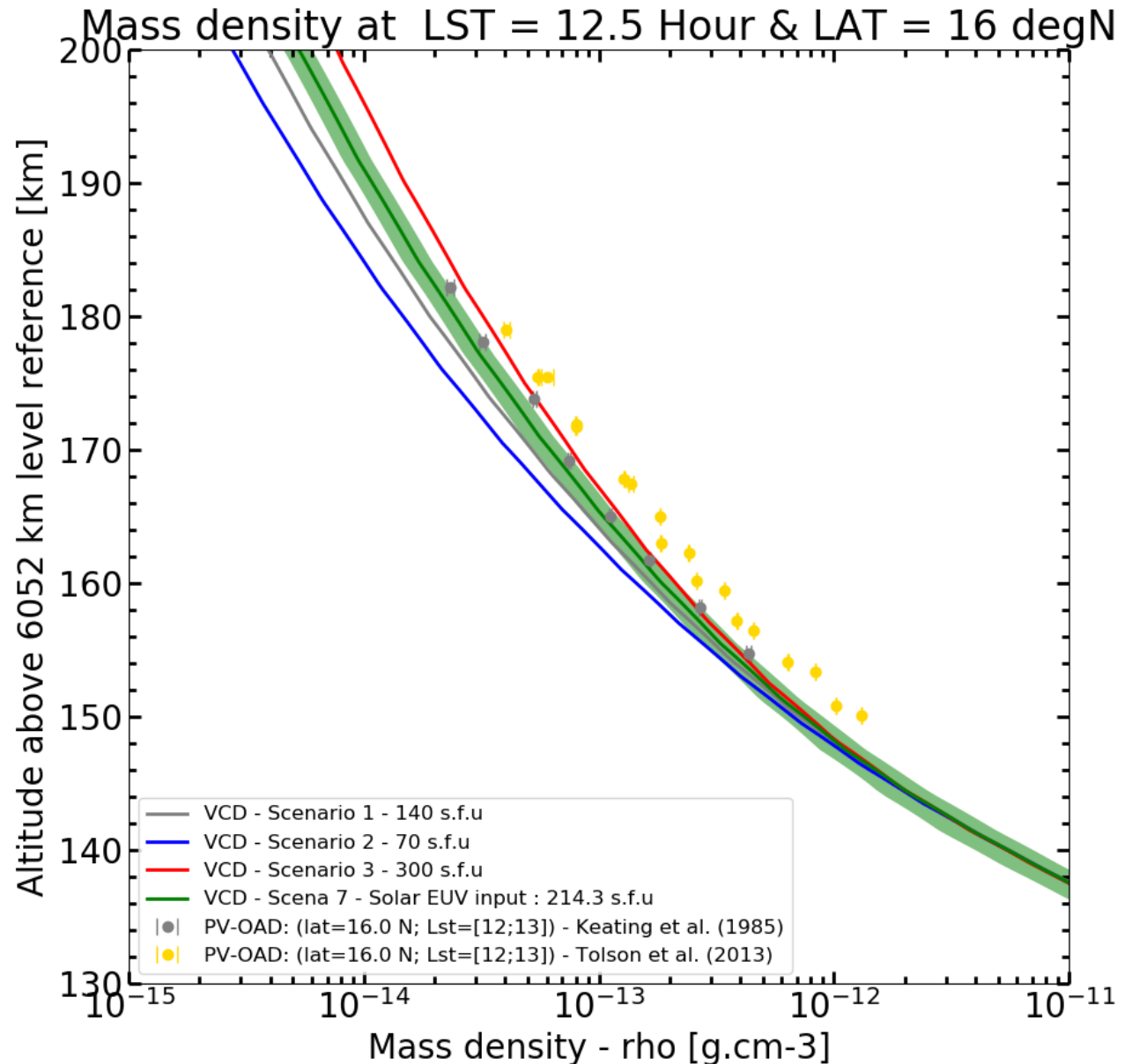


Variability in the VCD

Day-to-day and V-hourly RMS

VCD vs density measurements

- The **V-hourly RMS** (shaded green area) represents the variability within one venusian hour
- The **day-to-day RMS** represents the variability of the hourly averaged value from one Venus day to the next
- PV-OAD: Pioneer Venus Orbiter Atmospheric Drag

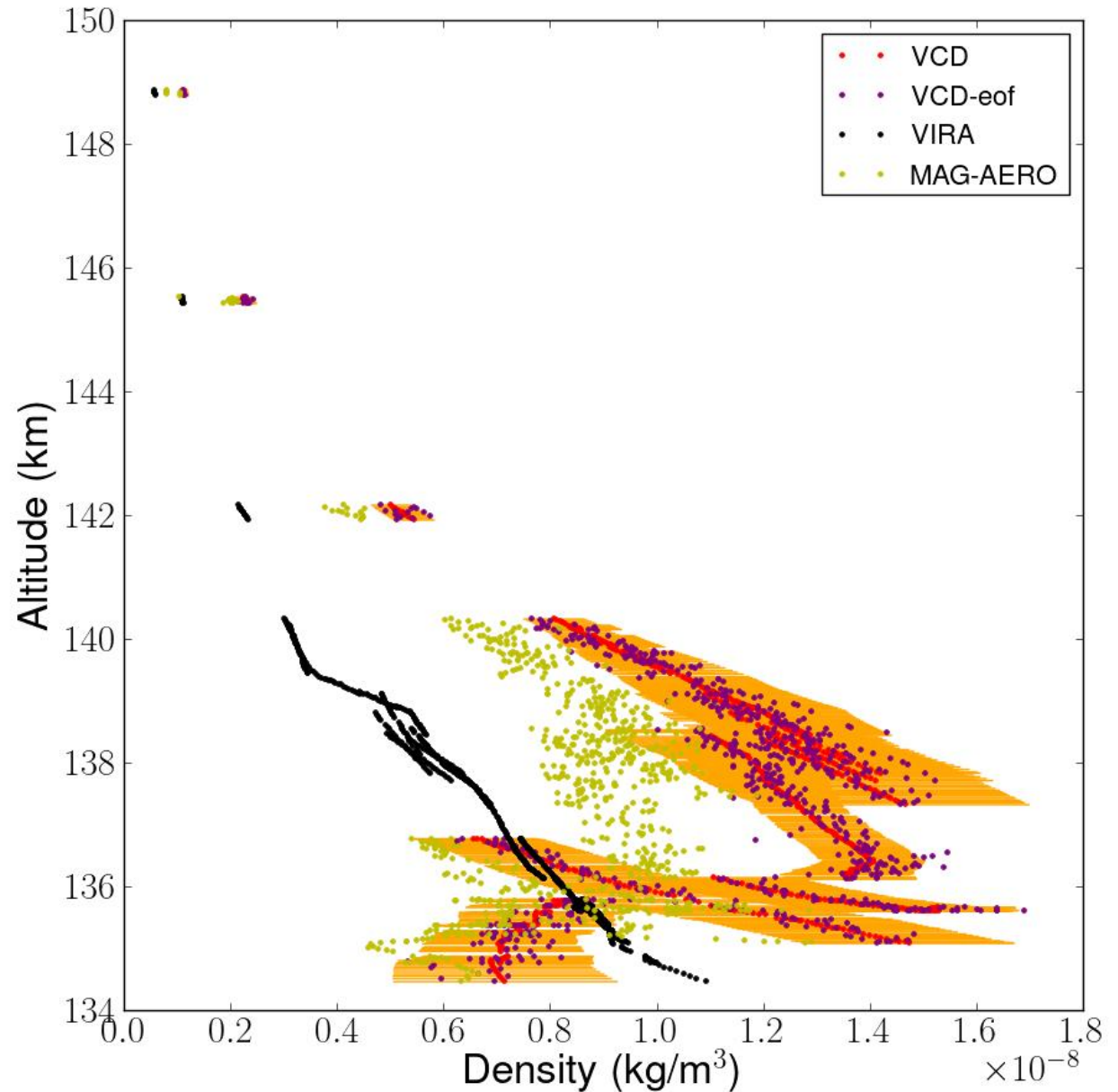


Variability in the VCD

EOF-reconstructed perturbations

VCD vs density measurements

- In addition to the climatology (red dots), the VCD allows to add **perturbations** to reconstruct meteorology, using **EOFs of high temporal resolution GCM simulations** (purple dots)
- MAG-AERO: Magellan aerobraking dataset (yellow dots)
- Orange area: previously mentioned RMS (V-hourly + day-to-day)

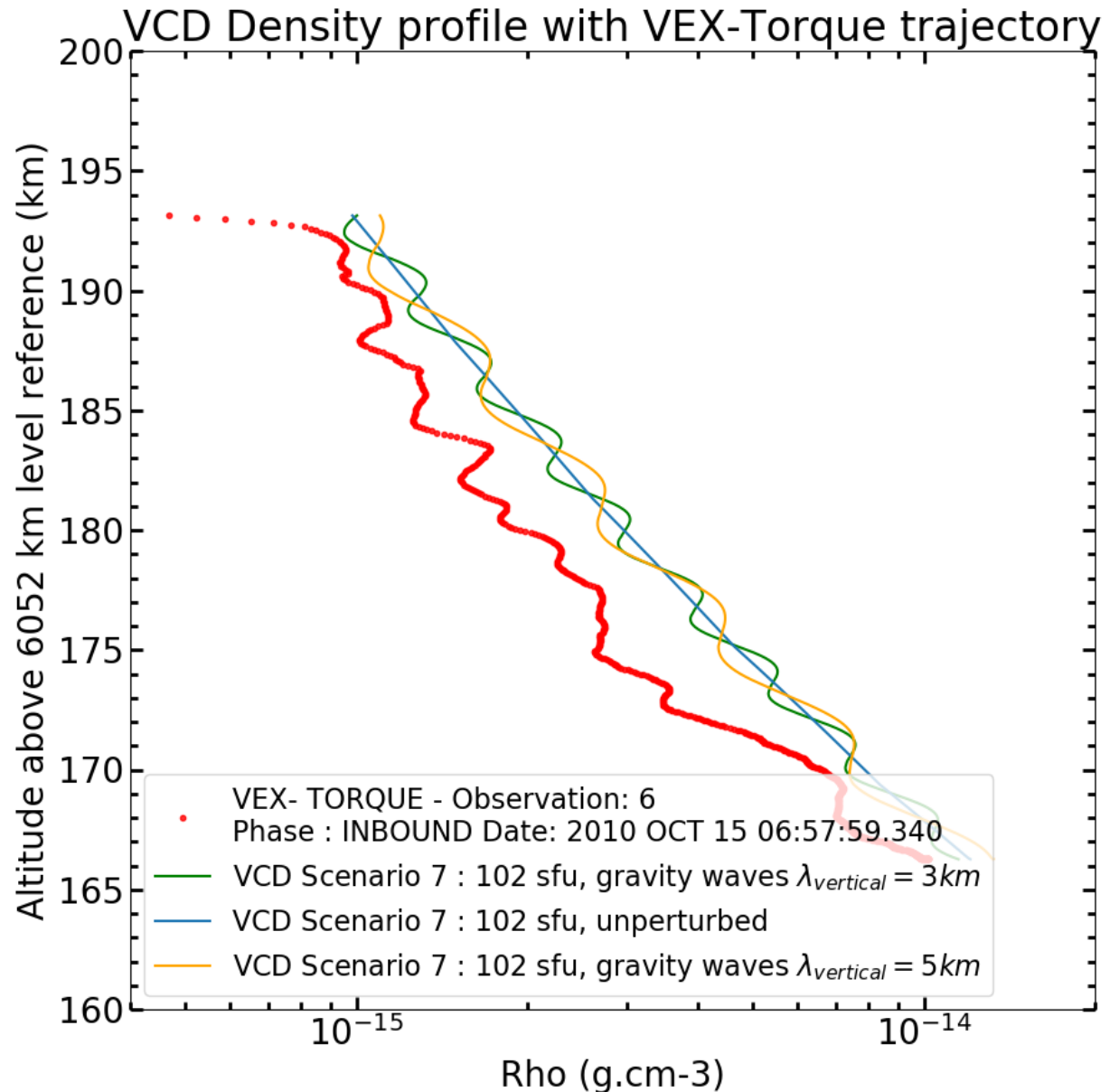


Variability in the VCD

Small-scale gravity waves perturbations

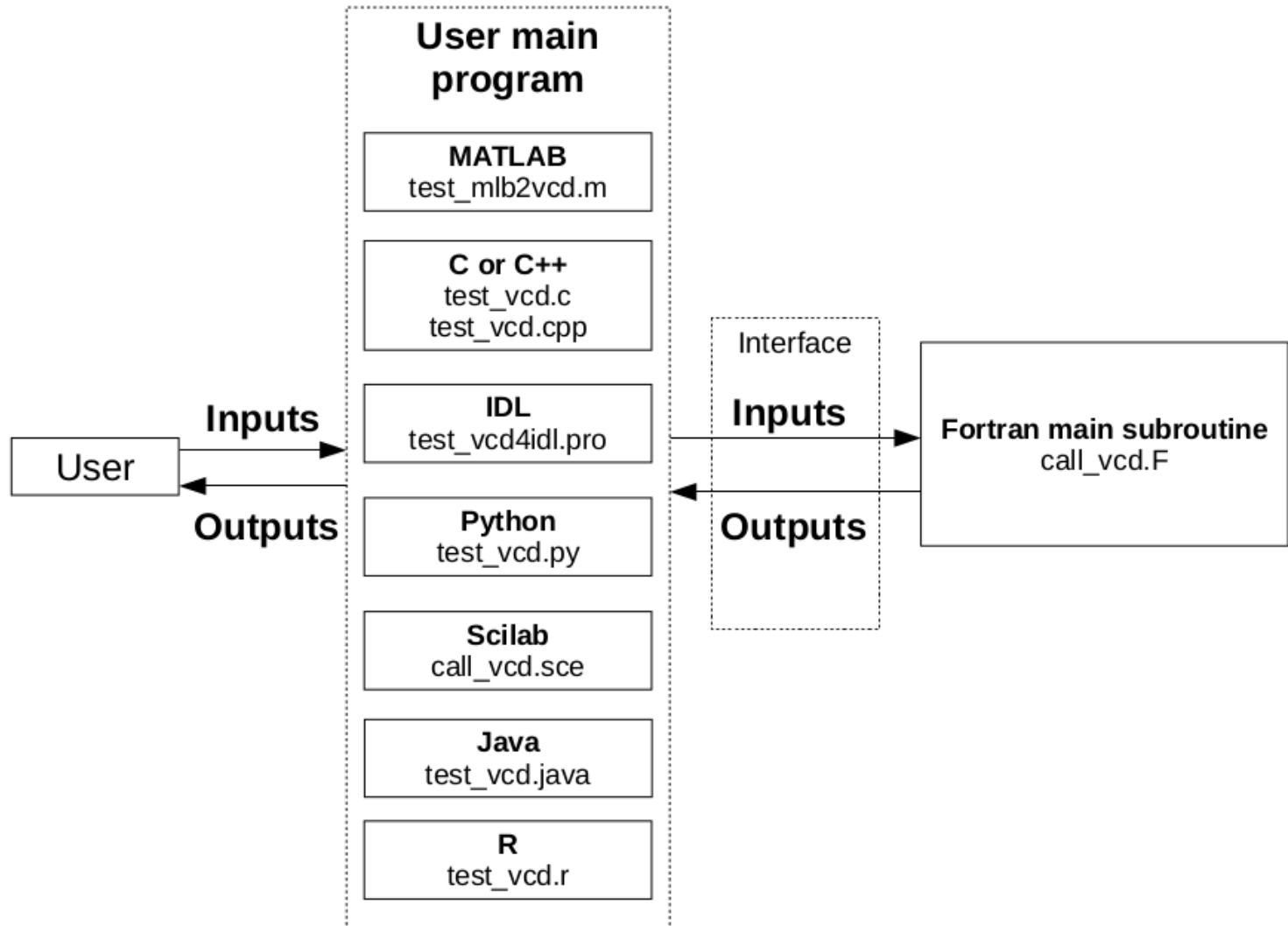
VCD vs density measurements

- In addition to the climatology (blue), the VCD allows to add **small-scale gravity wave perturbations**
- The vertical wavelength is specified by the user (green:3km /yellow:5km)
- VEX-TORQUE: Venus Express Torque experiment (red)



Interfaces to access the VCD

Interfaces with **other programming languages** (e.g. C, C++, IDL, Matlab, Python3, ...) is also provided.




Interfaces to access the VCD

A web interface for quick-looks and plots : www-venus.lmd.jussieu.fr

Darkmode

Venus Climate Database v1.1 : The Web Interface

[\[Information\]](#) [\[Gallery\]](#) [\[Report issue\]](#)

Main settings	Advanced settings <input type="button" value="RESET"/>	One-click presets						
<h3>CUSTOMIZE TIME COORDINATES</h3> <ul style="list-style-type: none">• VENUS date Local Time <input type="text" value="all"/> Venusian hour write a value (or) a range 'val1 val2' (or) 'all'• EARTH date YY / MM / DD @ hh:mm:ss UTC <input type="text" value="2021"/> / <input type="text" value="10"/> / <input type="text" value="22"/> @ <input type="text" value="8"/> : <input type="text" value="48"/> : <input type="text" value="56"/> <input type="checkbox"/> Use Earth date to calculate Venus LsEarth Julian Date <input type="text" value="2459509.8673148"/> Venus Solar Longitude <input type="text" value="104.8"/>	<h3>CUSTOMIZE DATA REQUEST</h3> <ul style="list-style-type: none">Same localtime everywhere <input checked="" type="radio"/> off <input type="radio"/> onCloud albedo/EUV scenario <input type="text" value="Standard cloud albedo ave solar"/>High-resolution topography <input checked="" type="radio"/> off <input type="radio"/> onAveraging <input checked="" type="radio"/> off <input type="radio"/> zonal <input type="radio"/> diurnal	<h3>LANDING SITE & DATE</h3> <table border="1"><tr><td><input type="button" value="Now at equator!"/></td><td><input type="button" value="PV Sounder"/></td><td><input type="button" value="PV North"/></td></tr><tr><td><input type="button" value="PV Day"/></td><td><input type="button" value="PV Night"/></td><td><input type="button" value="Vega2"/></td></tr></table>	<input type="button" value="Now at equator!"/>	<input type="button" value="PV Sounder"/>	<input type="button" value="PV North"/>	<input type="button" value="PV Day"/>	<input type="button" value="PV Night"/>	<input type="button" value="Vega2"/>
<input type="button" value="Now at equator!"/>	<input type="button" value="PV Sounder"/>	<input type="button" value="PV North"/>						
<input type="button" value="PV Day"/>	<input type="button" value="PV Night"/>	<input type="button" value="Vega2"/>						
<h3>CUSTOMIZE SPATIAL COORDINATES</h3> <p>write a value (or) a range 'val1 val2' (or) 'all'</p> <p>Latitude <input type="text" value="all"/> degree North Longitude <input type="text" value="all"/> degree East Altitude <input type="text" value="10."/> m above surface</p>	<h3>CUSTOMIZE FIGURES</h3> <ul style="list-style-type: none">Figure format <input checked="" type="radio"/> PNG <input type="radio"/> PNG hi-res <input type="radio"/> EPS[1D] Log(values) <input checked="" type="radio"/> off <input type="radio"/> on[2D] Colormap <input type="text" value="blue green yellow red"/>[2D] Values range <input type="text"/> to <input type="text"/>[2D map] <input type="text" value="sphere"/> proj @ lat <input type="text" value="-30"/> lon <input type="text" value="0"/>[2D map] Transparency (%) <input type="text"/>[2D map] Wind vectors <input checked="" type="radio"/> off <input type="radio"/> on[2D map] <input type="checkbox"/> Add marker at lat <input type="text"/> lon <input type="text"/>							
<h3>CUSTOMIZE VARIABLE(S) TO BE DISPLAYED</h3> <p>Variable 1 <input type="text" value="Vertically integrated O2 nightglow (MR)"/></p> <p>Variable 2 <input type="text" value="(None)"/></p> <p>Variable 3 <input type="text" value="(None)"/></p> <p>Variable 4 <input type="text" value="(None)"/></p>	<p><input type="button" value="SUBMIT"/></p> <p>Venus Climate Database (c) LMD/ESA. Open source python interface by A. Spiga (LMD). Javascript time conversion by E. Millour (link).</p>							

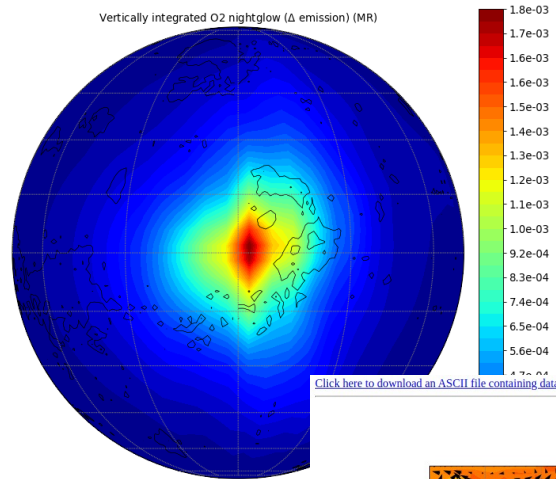
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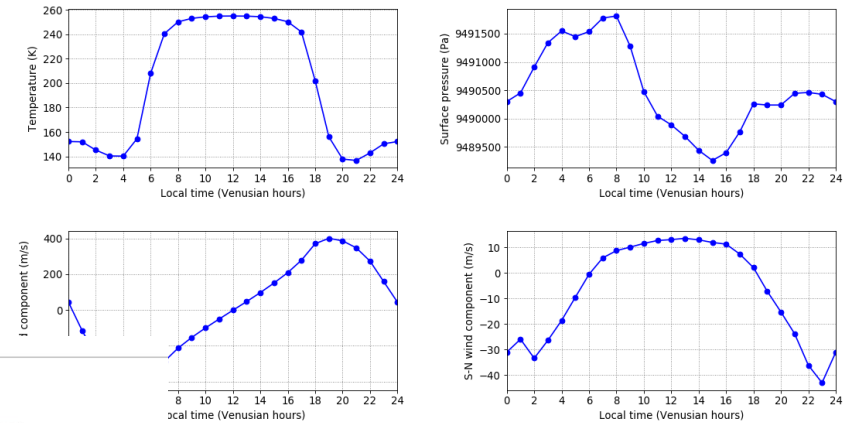
[Click here to download an ASCII file containing data](#)

VCD_v1.1 with Standard cloud albedo scenario, average solar EUV conditions.
Altitude 10.0 m ALS. Local time 0.0Vhrs (at longitude 0)



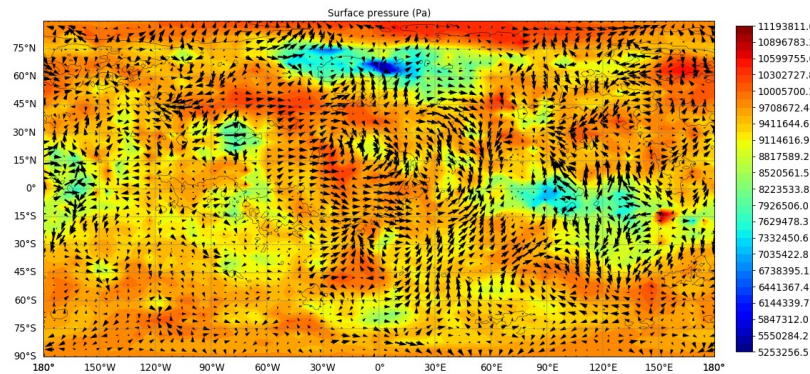
[Click here to download an ASCII file containing data](#)

VCD_v1.1 with Standard cloud albedo scenario, average solar EUV conditions.
Latitude 4.4N. Longitude 304.0E. Altitude 200000.0 m ALS.



VCD_v1.1 with Standard cloud albedo scenario, average solar EUV conditions.
Altitude 10.0 m ALS. Local time 12.0Vhrs (at longitude 0)

Venus Climate Database (c) L



Venus Climate Database (c) LMD/ESA

We are also very much interested in the possibility of distributing the VCD as a **virtual observatory** in the frame of the Virtual European Solar and Planetary Access (VESPA) Europlanet 2020 Research Infrastructure program <http://www.europlanet-vespa.eu>