

Meteorological pressure at Gale crater

from a comparison of REMS/MSL data and MCD modelling: effects of dust storms

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Grupo de Ciencias Planetarias

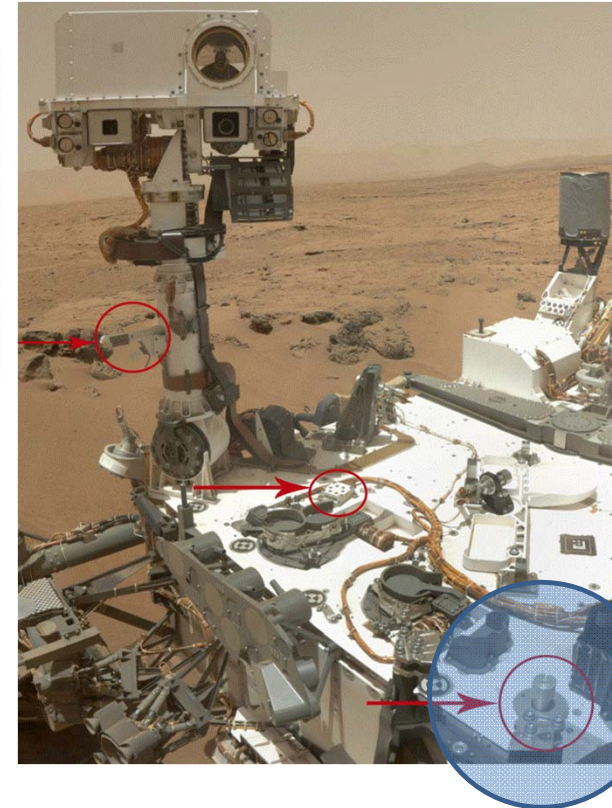
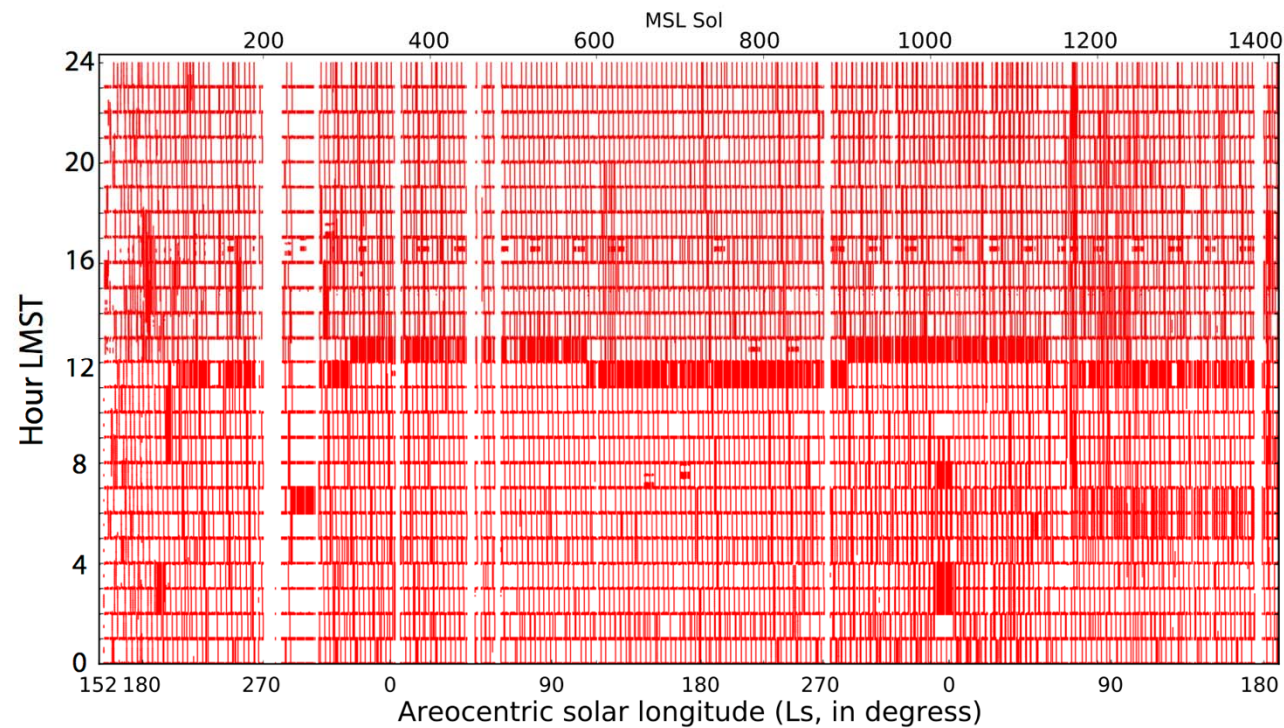


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REMS pressure data



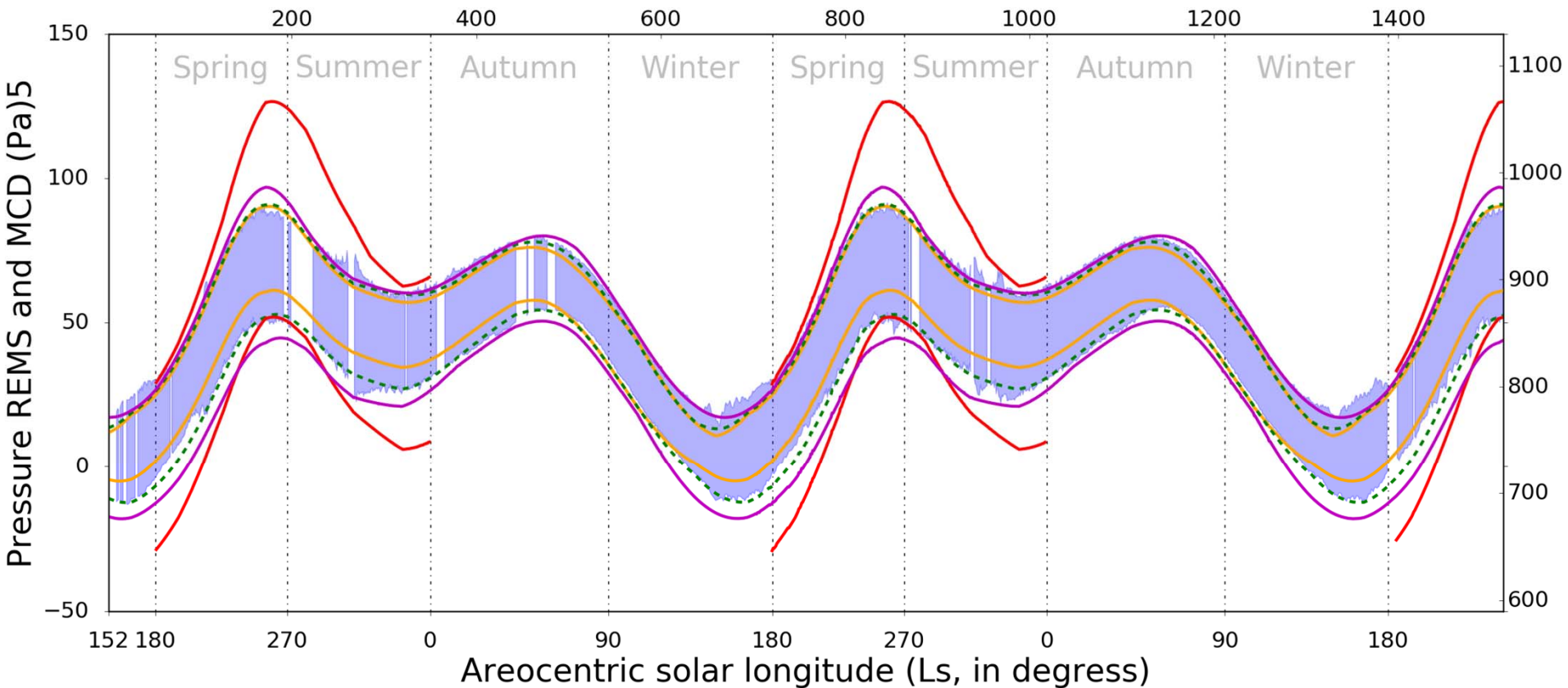
Mars Climate Database v5.2

- Our aim: to detect and characterize local meteorological events that last for a few sols.
- We compare REMS data with the Mars Climate Database (MCD) (Forget et al., 1999 and Millour et al., 2015)
- MCD: Atmospheric parameters computed from the average of several runs of a Global Climate Model

Mars Climate Database v5.2: The Web Interface

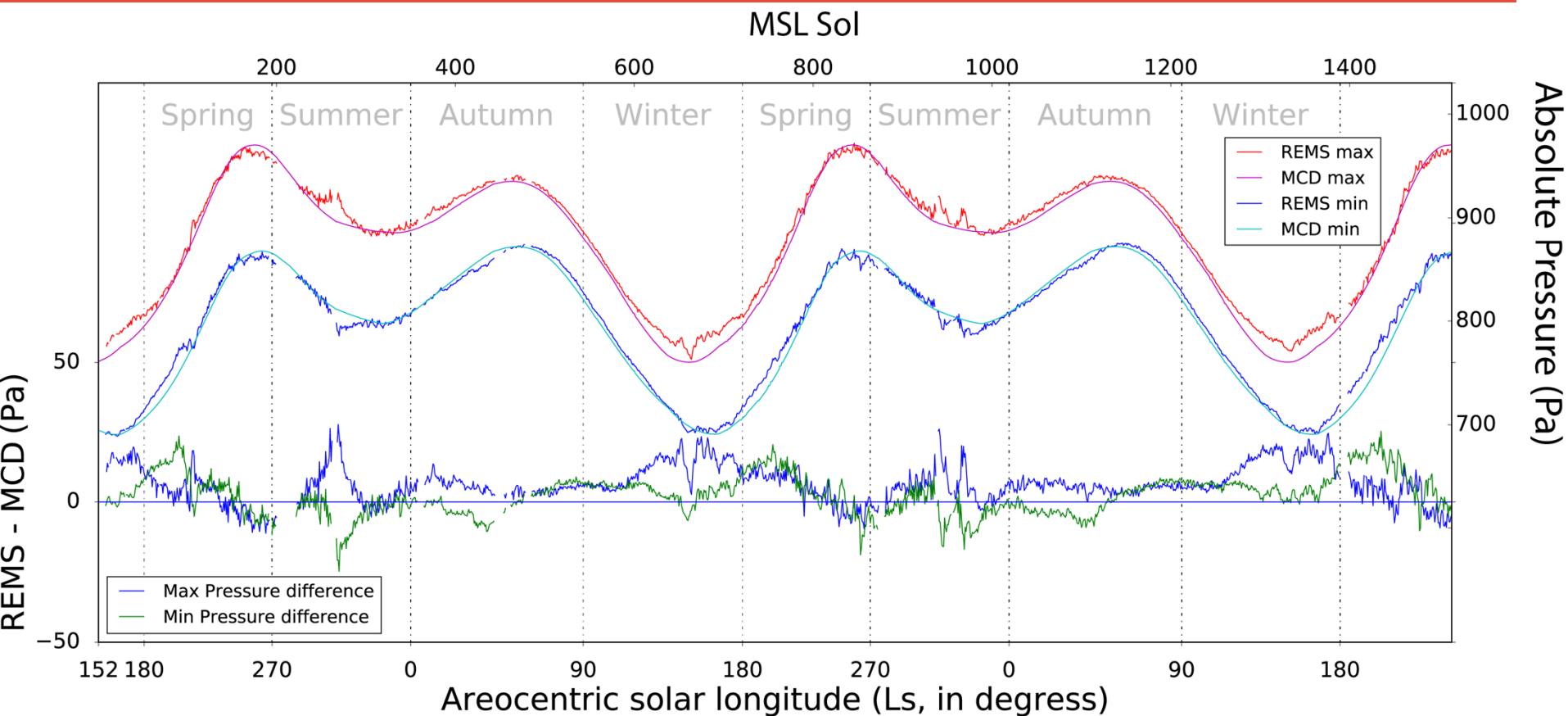
One-click presets	Main settings (reset)	Advanced settings and information
LANDING SITE & DATE Land now at equator! InSight Curiosity Phoenix Opportunity Spirit Pathfinder Viking 1 Viking 2	<input checked="" type="radio"/> MARS date Solar longitude (Ls) 93.6 degrees Local Time 0. Martian hour write a value (or) a range 'val1 val2' (or) 'all' <input type="radio"/> EARTH date YY / MM / DD @ hh:mm:ss UTC 2017 / 11 / 28 @ 9 : 12 : 24	If longitude is a free dimension, local time value is <input checked="" type="radio"/> at longitude 0 <input type="radio"/> fixed for the whole planet Earth Julian Date [2458085.88361] Mars MY [34] - MM [4] / 12 - sol [202] / 669 EARTH DATE >>> MARS DATE
TIME OF DAY Morning Afternoon Evening Night ALTITUDE Near surface Boundary layer Troposphere Mesosphere Thermosphere	CUSTOMIZE COORDINATES ON MARS write a value (or) a range 'val1 val2' (or) 'all' <ul style="list-style-type: none">• Latitude all degree North• Longitude all degree East• Altitude 10. m above surface	<ul style="list-style-type: none">• Dust/EUV scenario climatology ave solar• Use high-resolution topography <input type="radio"/> off <input checked="" type="radio"/> on• Zonal averaging (only lat/alt plot) <input checked="" type="radio"/> off <input type="radio"/> on• Figure format <input checked="" type="radio"/> PNG <input type="radio"/> PNG hi-res <input type="radio"/> EPS
INTEREST Atmosphere Winds Weather Water cycle Chemistry Landing engineering Glaciology Surface meteorology Radiative balance	CUSTOMIZE VARIABLE(S) TO BE DISPLAYED Variable 1 Temperature (K) Variable 2 (None) Variable 3 (None) Variable 4 (None)	<ul style="list-style-type: none">• [1D] Log(values) <input checked="" type="radio"/> off <input type="radio"/> on• [2D] Colormap blue green yellow red• [2D] Values range to• [2D map] flat lat lon• [2D map] Transparency (%)• [2D map] Wind vectors <input checked="" type="radio"/> off <input type="radio"/> on• [2D map] <input type="checkbox"/> Point at lat lon
PLOT REQUEST Daily cycle Vertical profile Altitude/time plot Global map Sphere	SUBMIT	Mars Climate Database (c) LMD/OU/IAA/ESA /CNES. Open source python interface by A. Spiga (LMD). Javascript time conversion by E. Millour (link).

Comparison of REMS/MSL data and MCD modelling

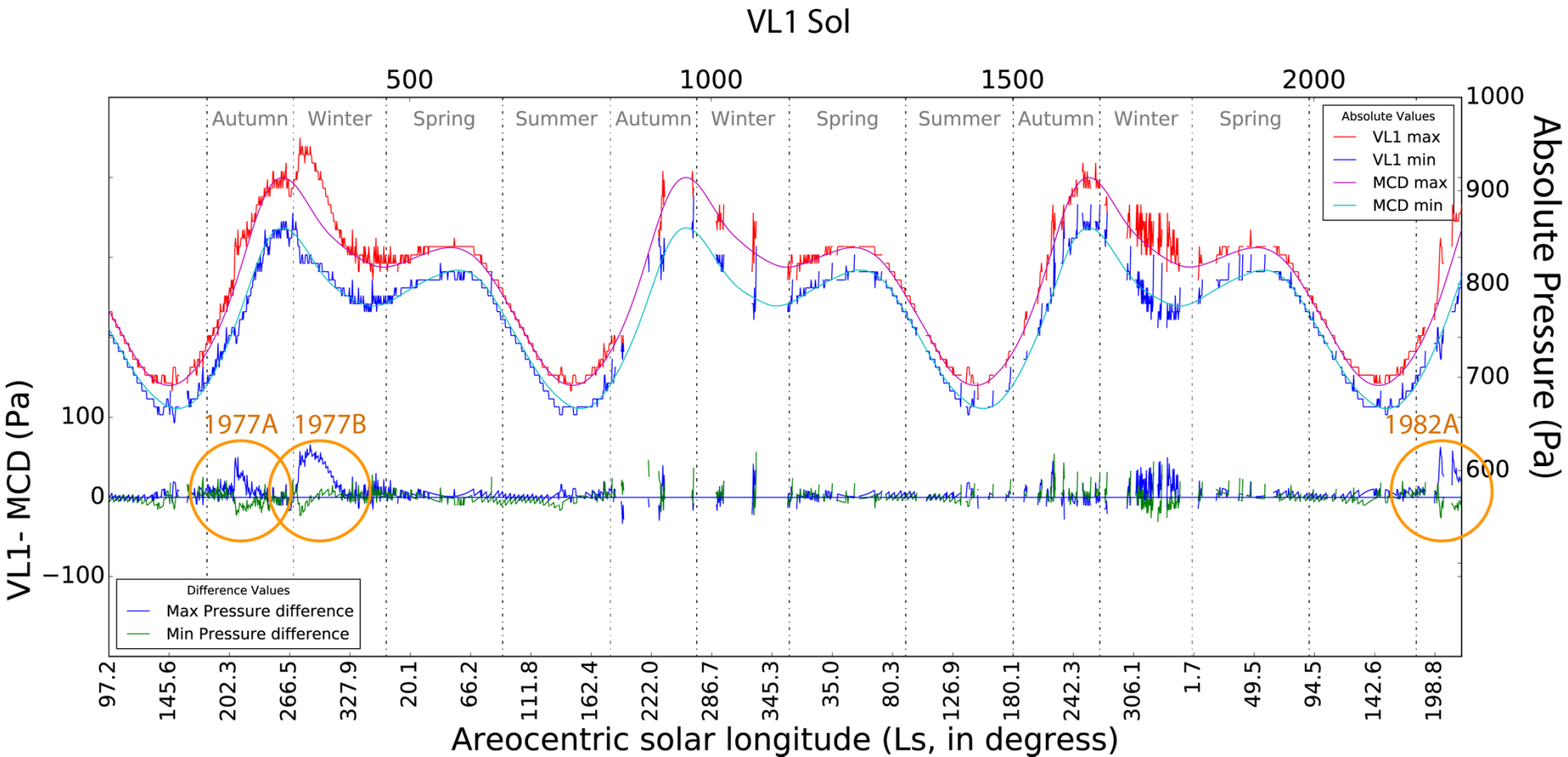


REMS data (violet shaded region) has been corrected from elevation effects as explained in the text. Solid lines correspond to different MCD scenarios: The climatology average scenario data (green dashed line), dust storm scenario (red line) which is only computed in the dust storms season ($L_s = 180-360$), warm scenario (magenta line) and cold scenario (orange line). Seasons are marked for the southern hemisphere.

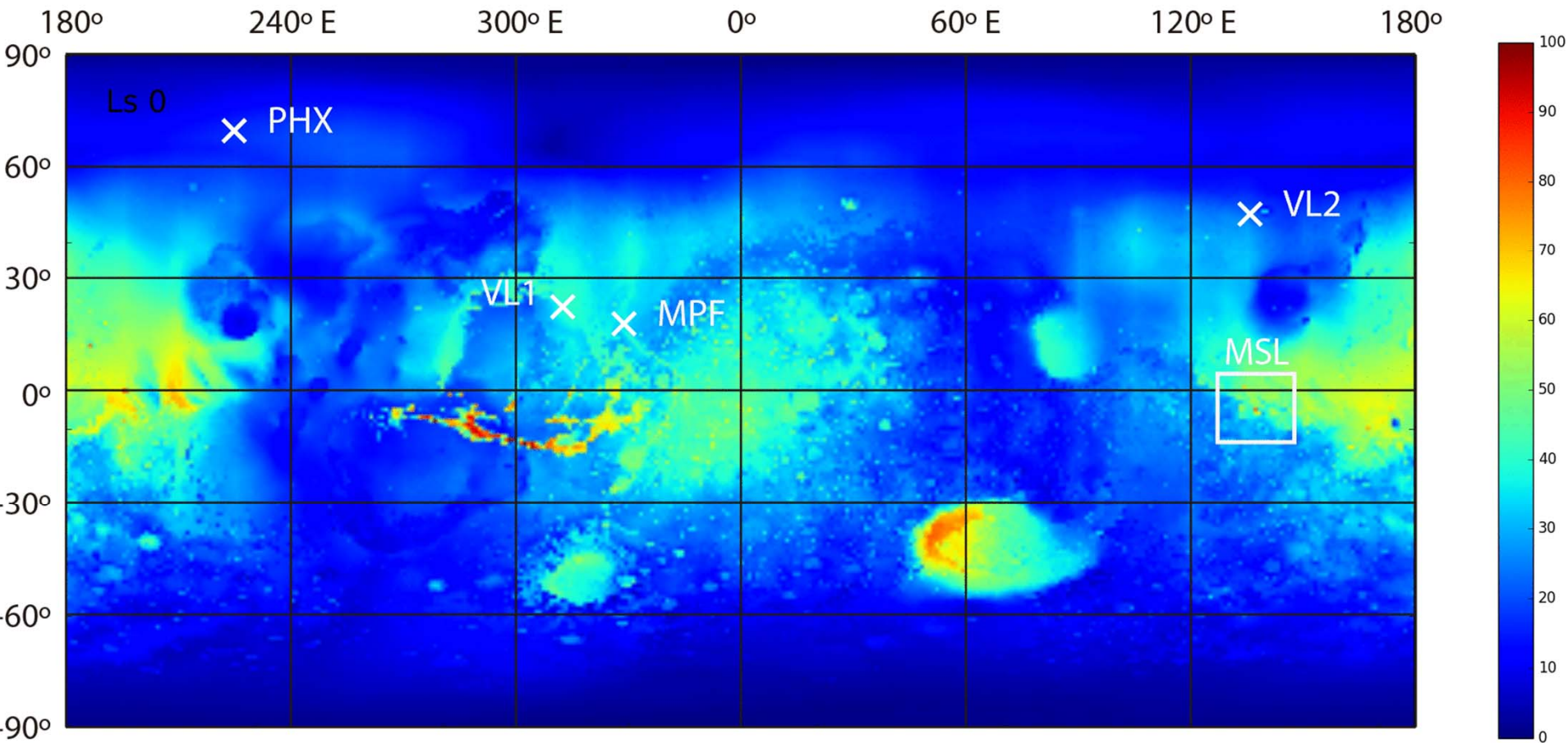
Comparison of REMS/MSL data and MCD modelling



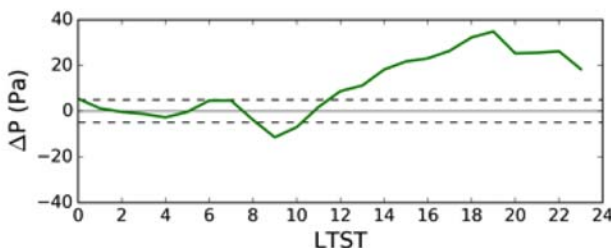
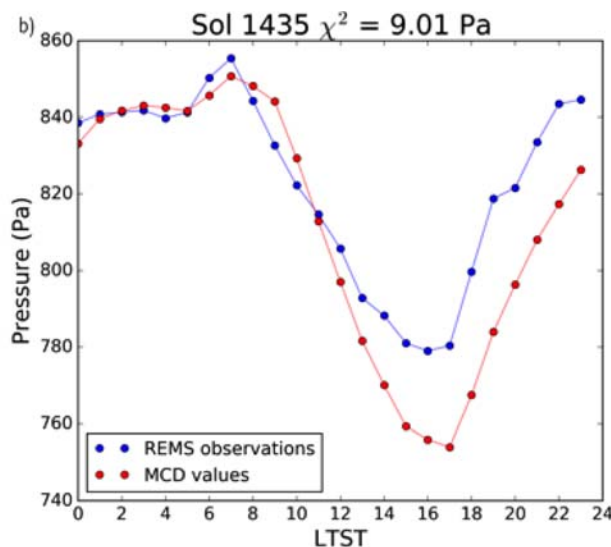
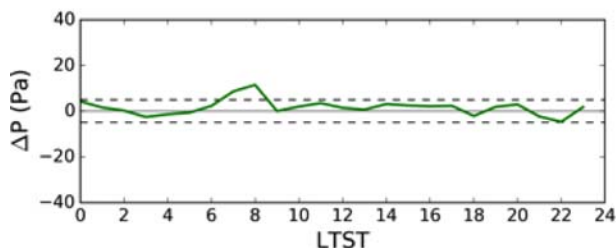
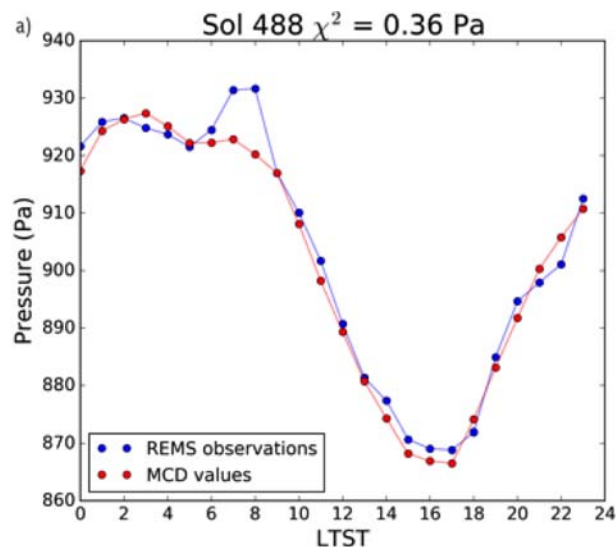
Validation with Viking Lander 1 pressure data



Amplitude of the daily pressure variation from the MCD



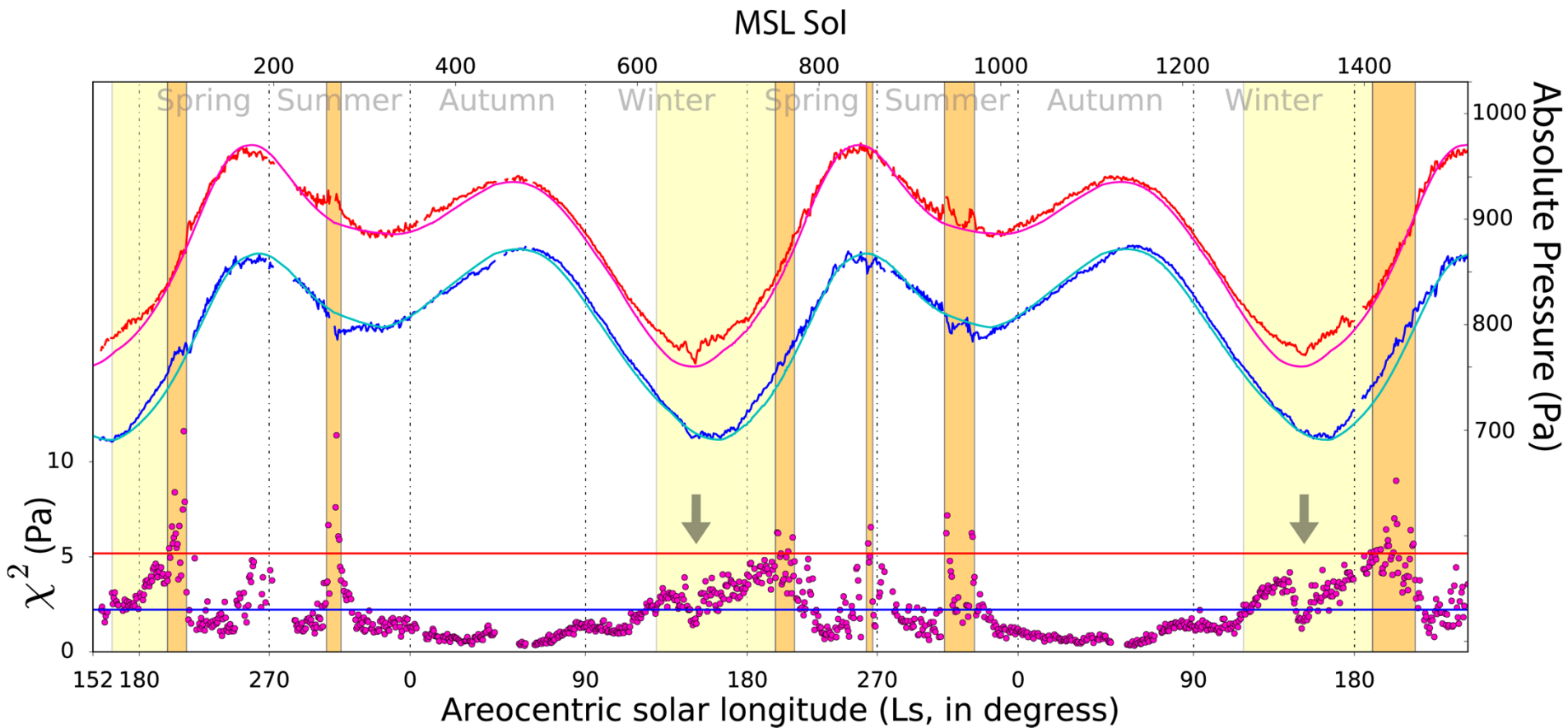
Daily global differences and selection of anomalous groups of sols



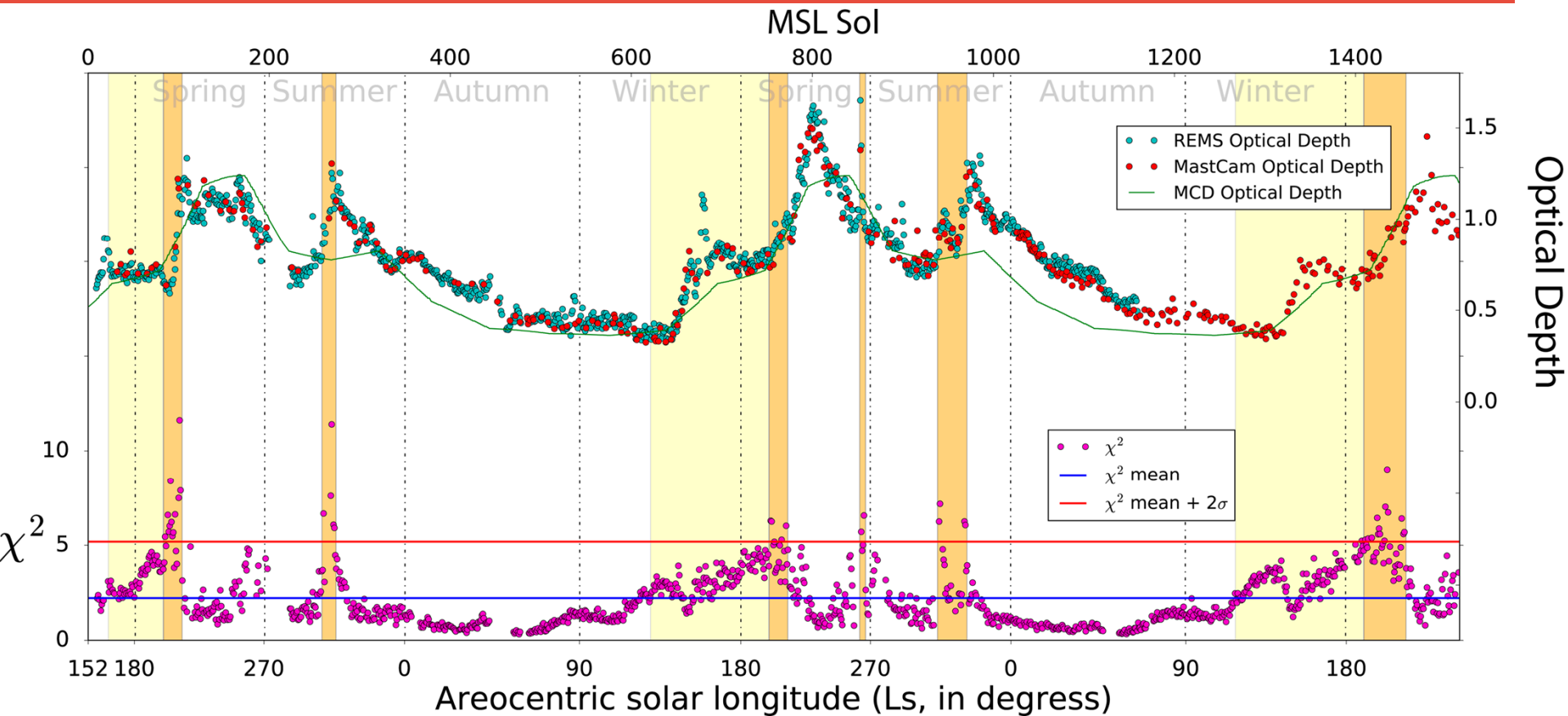
$$\chi^2 = \sum_i \frac{(P_i^{REMS} - P_i^{MCD})^2}{P_i^{MCD}}$$

P^{REMS} corresponds to the REMS average observations for each hour, and P^{MCD} to the pressure data from MCD at the same L_s and LTST

Selection of anomalous groups of sols



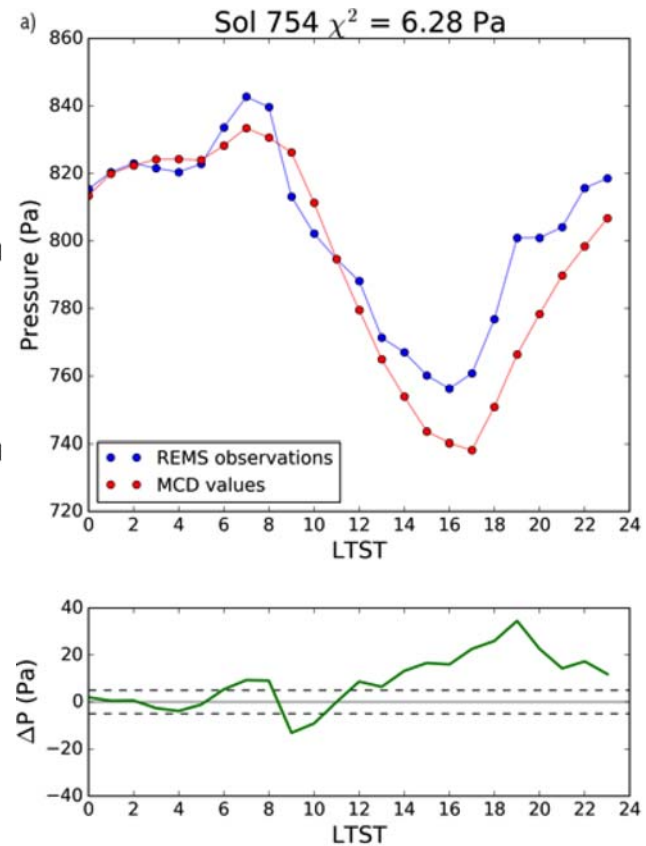
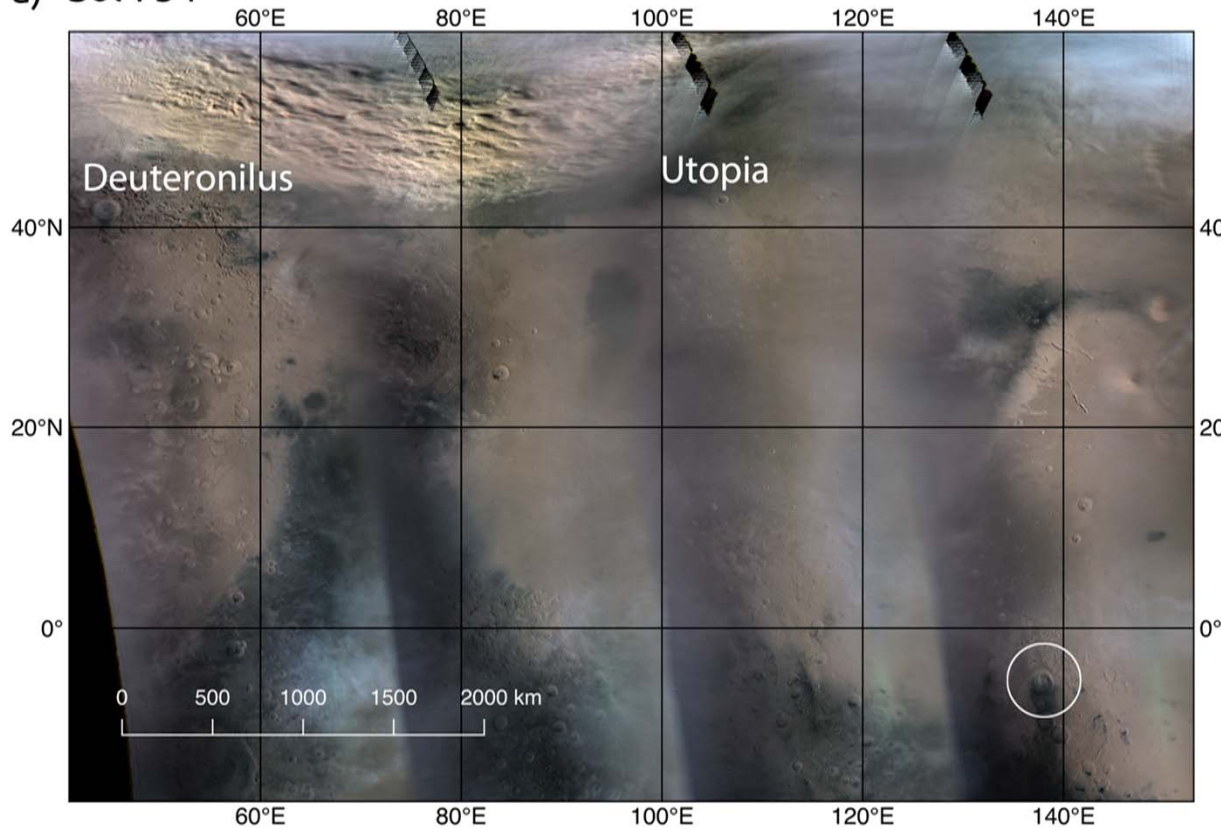
Dust opacity



Smith et al., 2016. Aerosol optical depth as observed by the Mars Science Laboratory REMS UV photodiodes. *Icarus*, 280, 234–248, doi: 10.1016/j.icarus.2016.07.012.

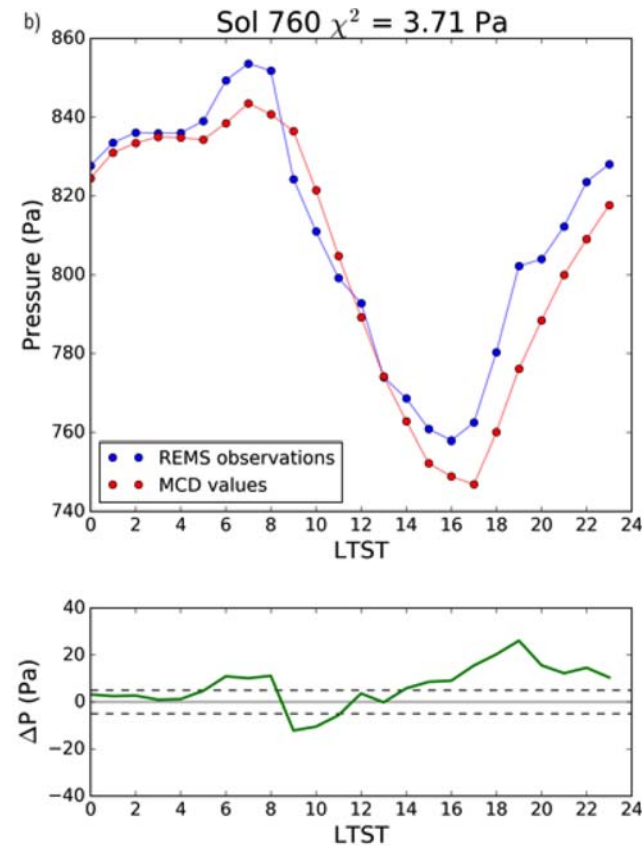
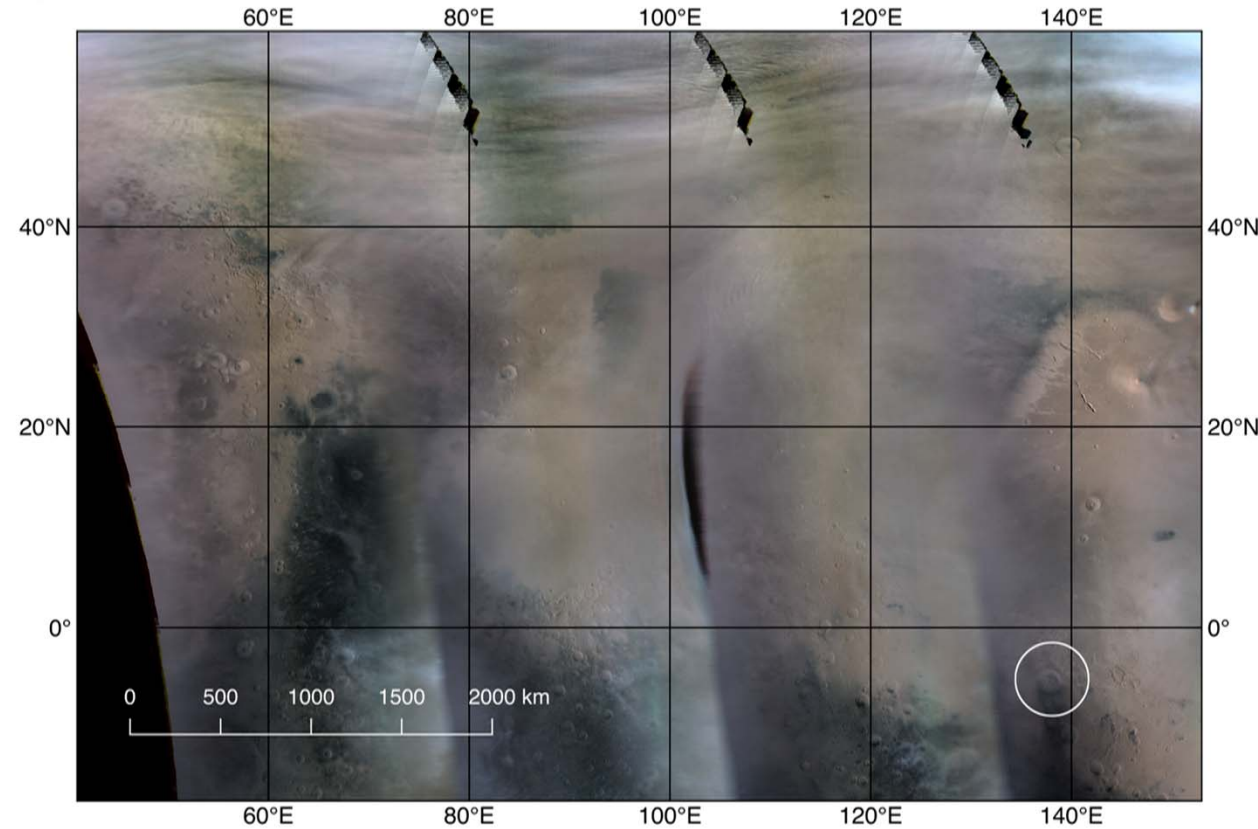
Early Spring events

a) Sol 754

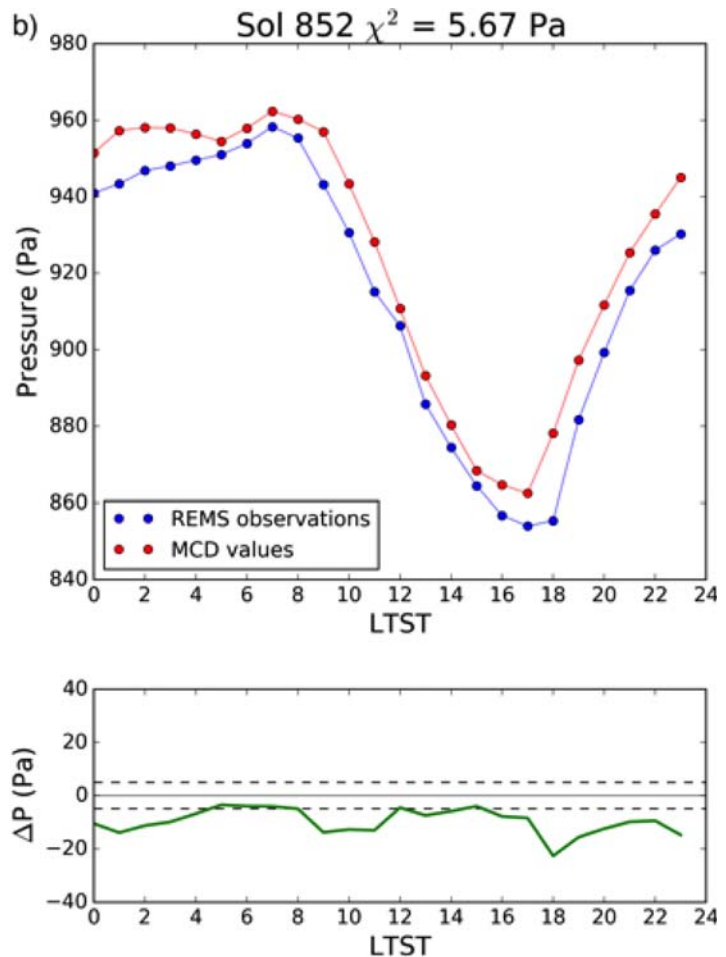
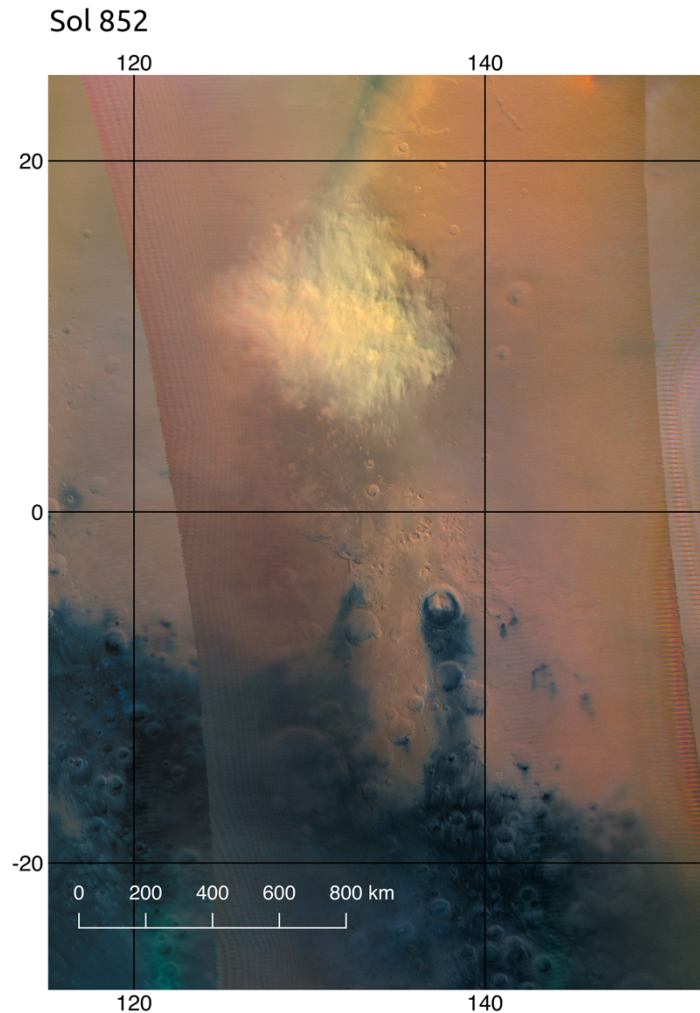


Early Spring events

b) Sol 760

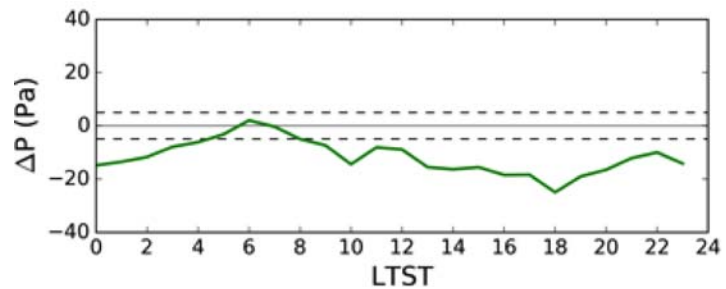
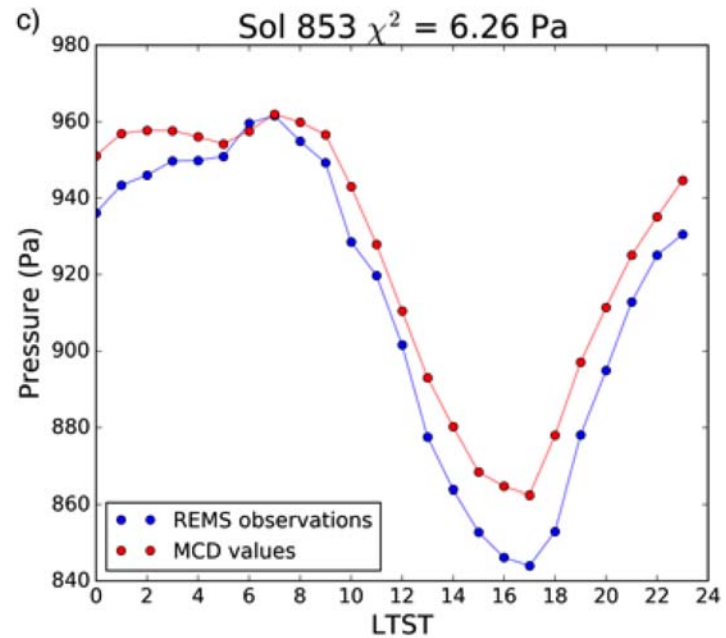
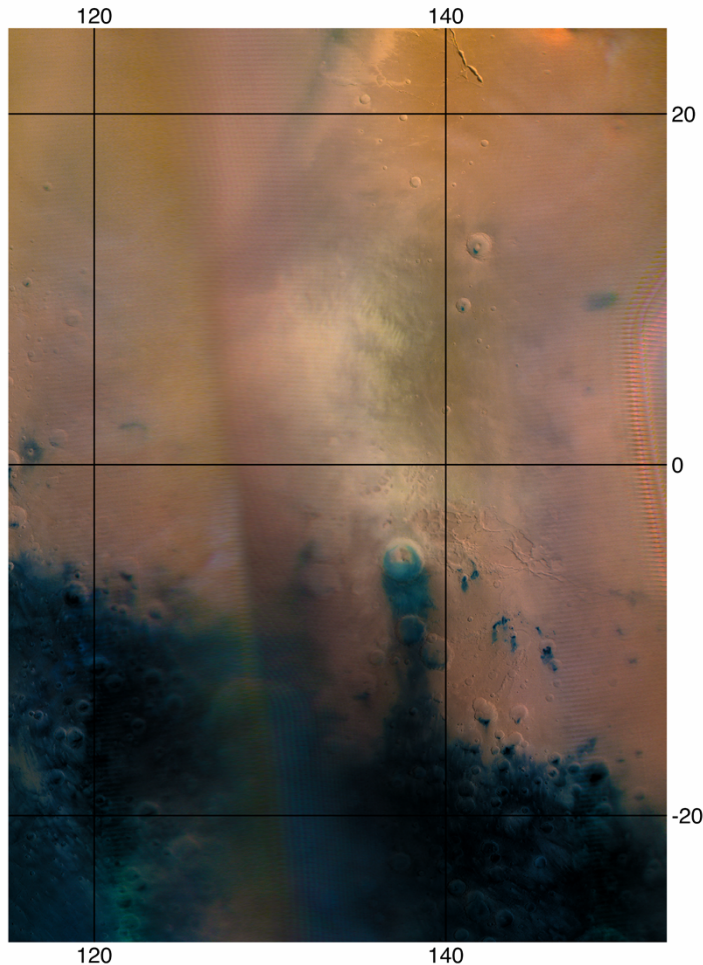


A localized small and nearby dust storm



A localized small and nearby dust storm

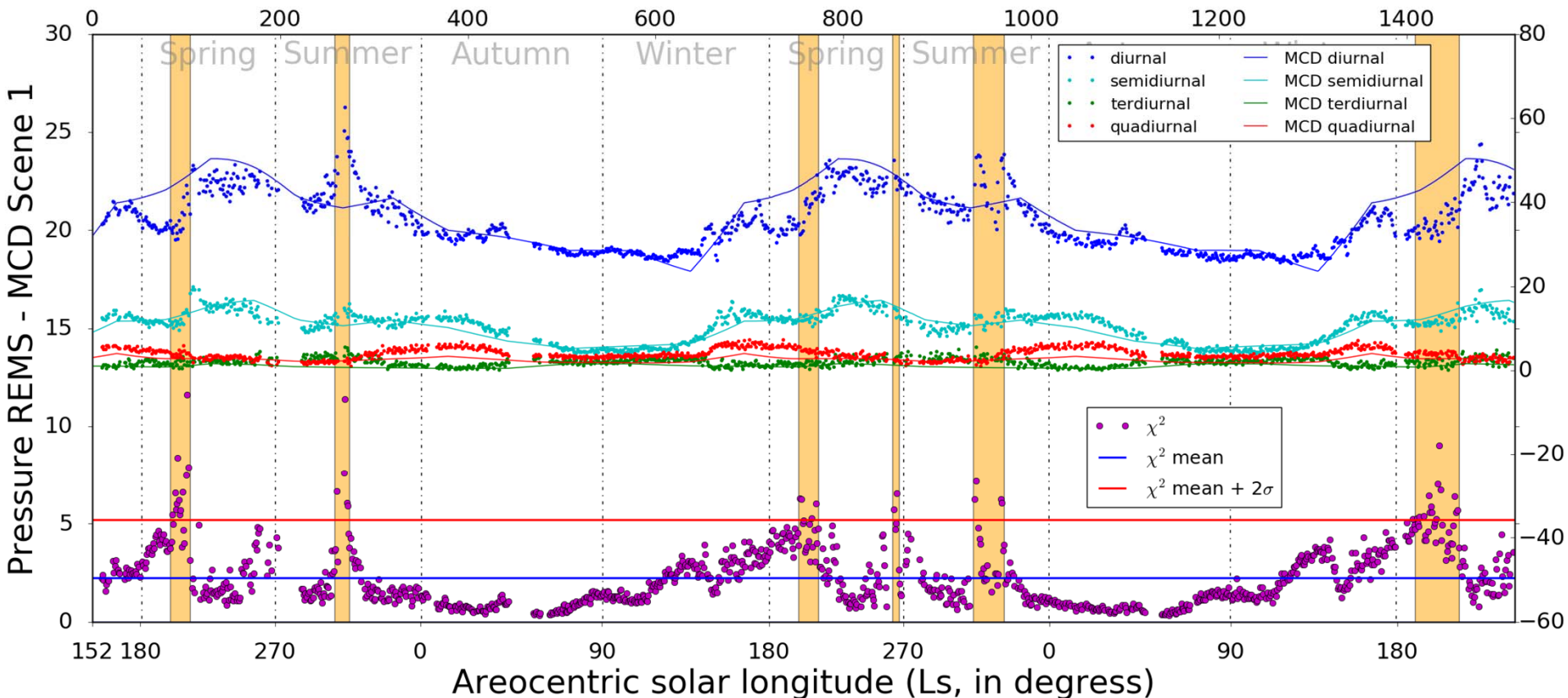
Sol 853



Summary and conclusions

- REMS pressure data is globally well reproduced by the MCD operating in standard conditions.
- Differences between REMS and MCD pressures are found in sols where the dust abundance is affected by the development of dust storms.
- Surface pressures are affected by the development of regional dust storms even at distances as large as 10,000 km.
- An examination of pressure data on MCD at different locations might be relevant for future pressure sensors on Mars.

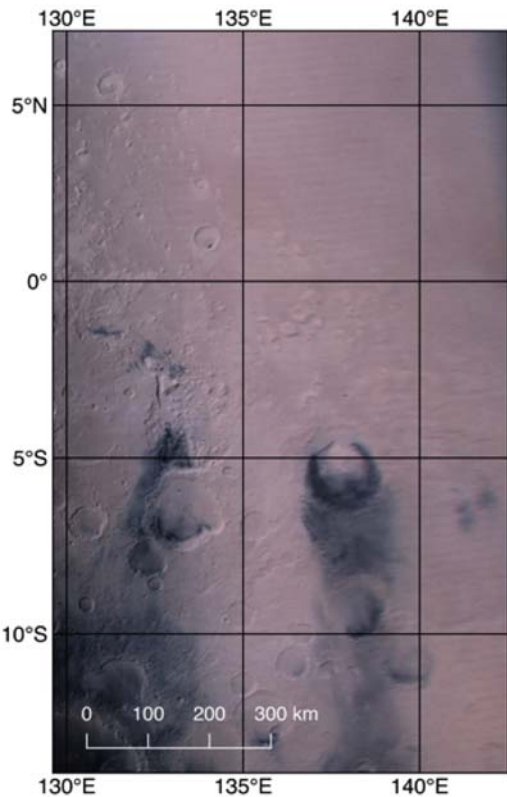
Tidal components of REMS and MCD pressure variations



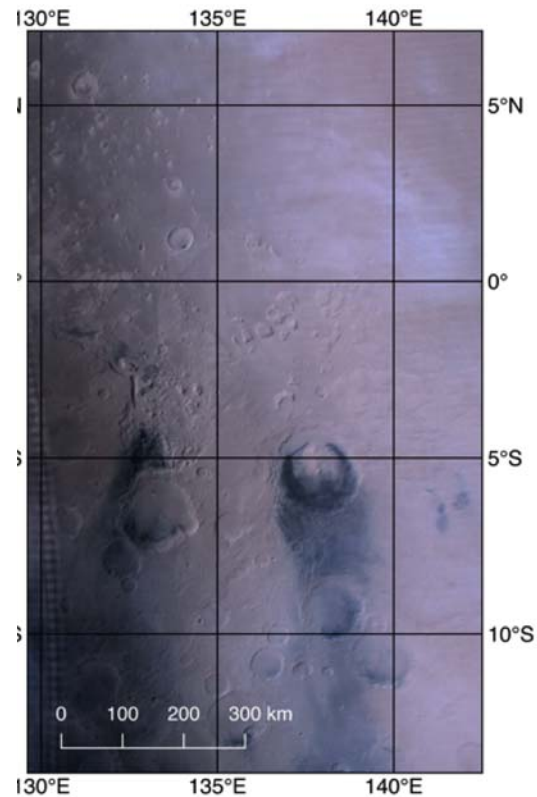
Guzewich et al., 2016. Atmospheric tides in Gale Crater, Mars. *Icarus*, 268, 37–49.

Water clouds - Winter Events

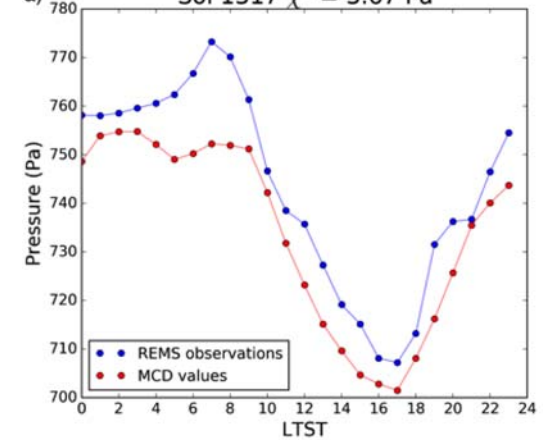
a) Sol 1317



b) Sol 1334



a) Sol 1317 $\chi^2 = 3.67$ Pa



b) Sol 1334 $\chi^2 = 1.71$ Pa

