Ground-based observations of Venus in near-infrared

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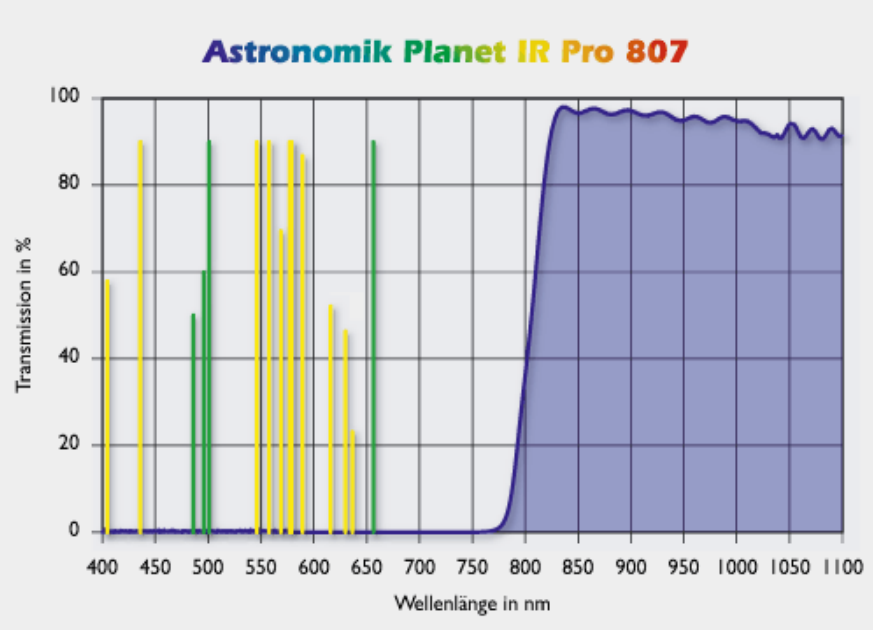
Working objectives

- Finding a value for the rotation of the planet in near IR: it is supposed to be slower than in UV, due to weaker winds found at a deeper atmospheric level (~10 km less), and increased cloud density
- Finding variation in speed with latitude
- For the thermal emission on the night side, correlating features with venusian relief

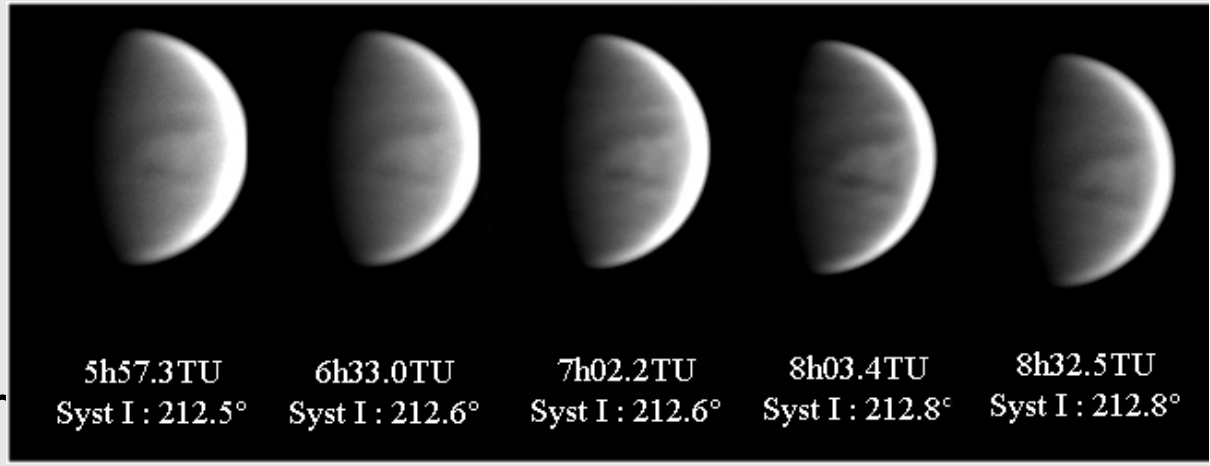
I – Current techniques to observe Venus from the ground in near IR: the equipment

- Observation of Venus in near IR is easy (bright planet, good seeing, cameras highly sensitive)
- After several years of Venus imaging, it is clear that filters having a cut-on near 800 nm bring noticeably more contrast than those with a cut-on near 700 nm.
- Amateur-sized telescopes are efficient in getting good images, but we have been using the 62 cm cassegrain telescope of Astroqueyras to try to get better data

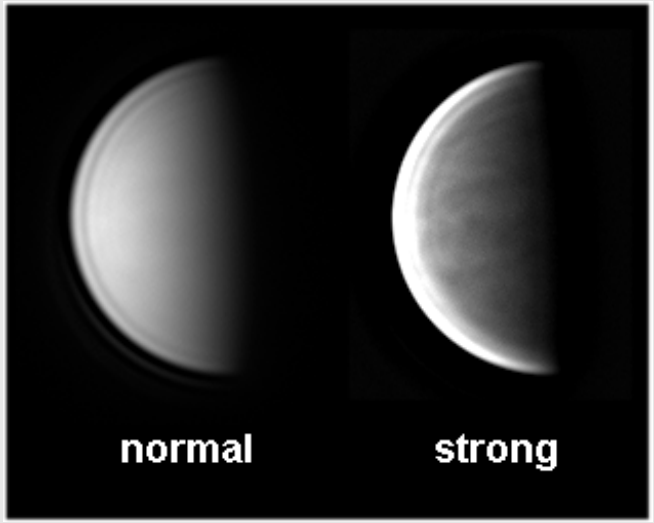


I – Current techniques to observe Venus from the ground in near IR: getting and processing images

- Videos of a few minutes will secure thousands of frames with excellent SNR: WinJupos derotation is not required
- Videos are grabbed during several hours, regularly spaced (30 mn). This asks the observer to find observing time long before or after sunset/sunrise. **This is better than trying to measure details on images separated by several days (they are hard to identify again)**
- The contrast of details observed in near-IR is extremely weak and requires very heavy sharpening (but the dynamic of images allows that)



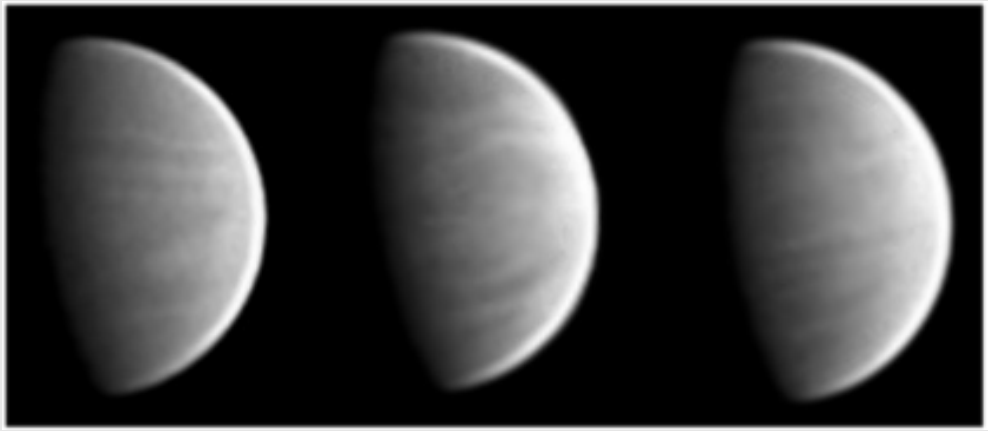
620 mm cassegrain, sept. 2012 – filter 830 nm.
Monachino/Astroqueyras



250 mm gregorian, march 2012 – filter 800 nm.
Pellier

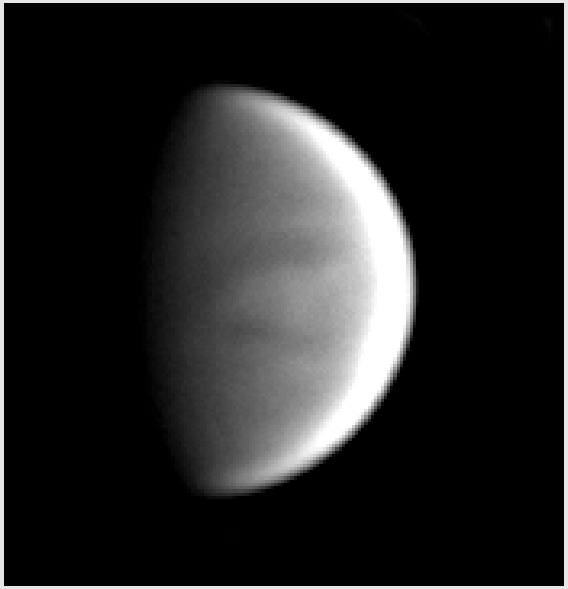
II – Analisis of images

Measurement of details is complicated: they are weakly contrasted, and we see longitudinal belts much more often than isolated spots



355 mm SCT, may 2007 – filter 780 nm. Peach

Animating the rotation of the planet is helped by the regular spacing of video recording and allows to detect interesting or spurious details more easily

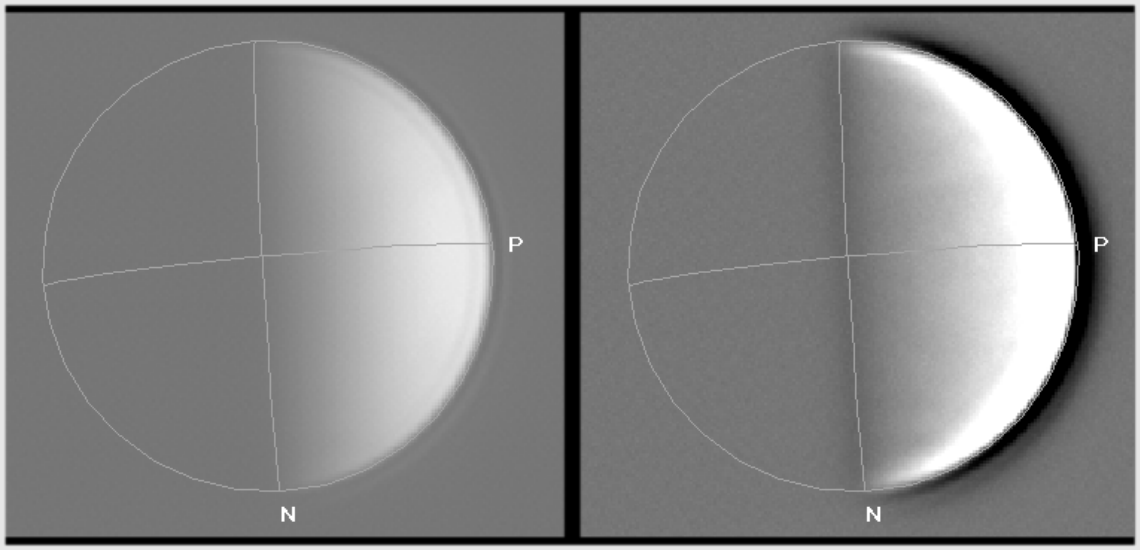


620 mm Cassegrain, Sept. 2012, 830 nm. Monachino

250 mm Gregorian, August 2012, 800 nm. Pellier

II – Analisis of images

- Winjupos is used to make the first measurements. We verified that the heavy processing do not affect the true position of the limb



- Details are recorded **in system I (surface)**. The surface is considered to be still for the period analysed
- A measurement file (.mea) is created with all recorded positions
- Or measurements are directly reported on an Excel sheet

Measurements Venus - venusIR_DS1

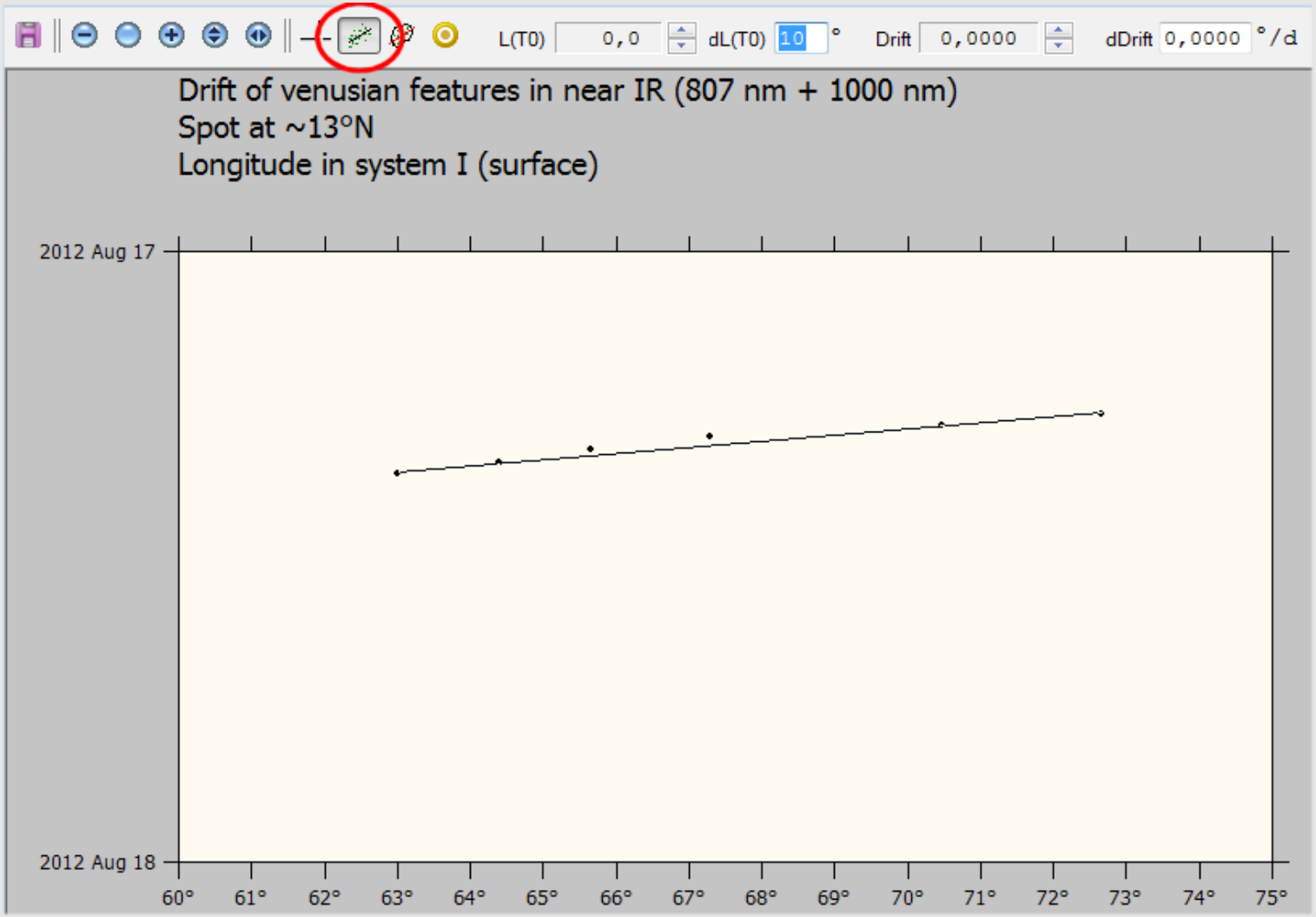
Record (F9) 6 Date (F10) 2012/08/17 [yyyy/mm/dd] File Selected record(s) Close Help

Record	Object	Date	UT	L1	L2	+/-	Sy.	B	+/-	Meas.	Chan.
1	DC1_SPOT	2012/08/17	06:22,0	72,6	**94,8**		2	**+12,2**			ired
2	DC1_SPOT	2012/08/17	06:52,0	70,5	**94,4**		2	**+13,0**			ired
3	DC1_SPOT	2012/08/17	07:17,1	67,3	**92,7**		2	**+13,2**			ired
4	DC1_SPOT	2012/08/17	07:46,3	65,7	**92,7**		2	**+13,2**			ired
5	DC1_SPOT	2012/08/17	08:16,3	64,4	**93,2**		2	**+12,5**			ired
6	DC1_SPOT	2012/08/17	08:46,2	63,0	**93,6**		2	**+13,1**			ired

Image	L°	I°	Heure	Dérive (°)	Δ t (s)	Rotation (s)	Rotation (j)
V1	75,5	11,8	5:57:15				
V6	74,4	12	6:32:00	1,1	2085	682363,636	7,89772727
V15	70,4	12,7	8:03:22	4	5482	493380	5,71041667
V18	68,4	12,6	8:32:31	2	1749	314820	3,64375
V21	67,1	13	9:02:37	1,3	1806	500123,077	5,78846154
V24	65,1	12,6	9:32:27	2	1790	322200	3,72916667
V27	62,2	12,5	10:01:44	2,9	1757	218110,345	2,52442529
V30	60,4	12,3	10:35:22	1,8	2018	403600	4,6712963
						Moyenne	4,85217768

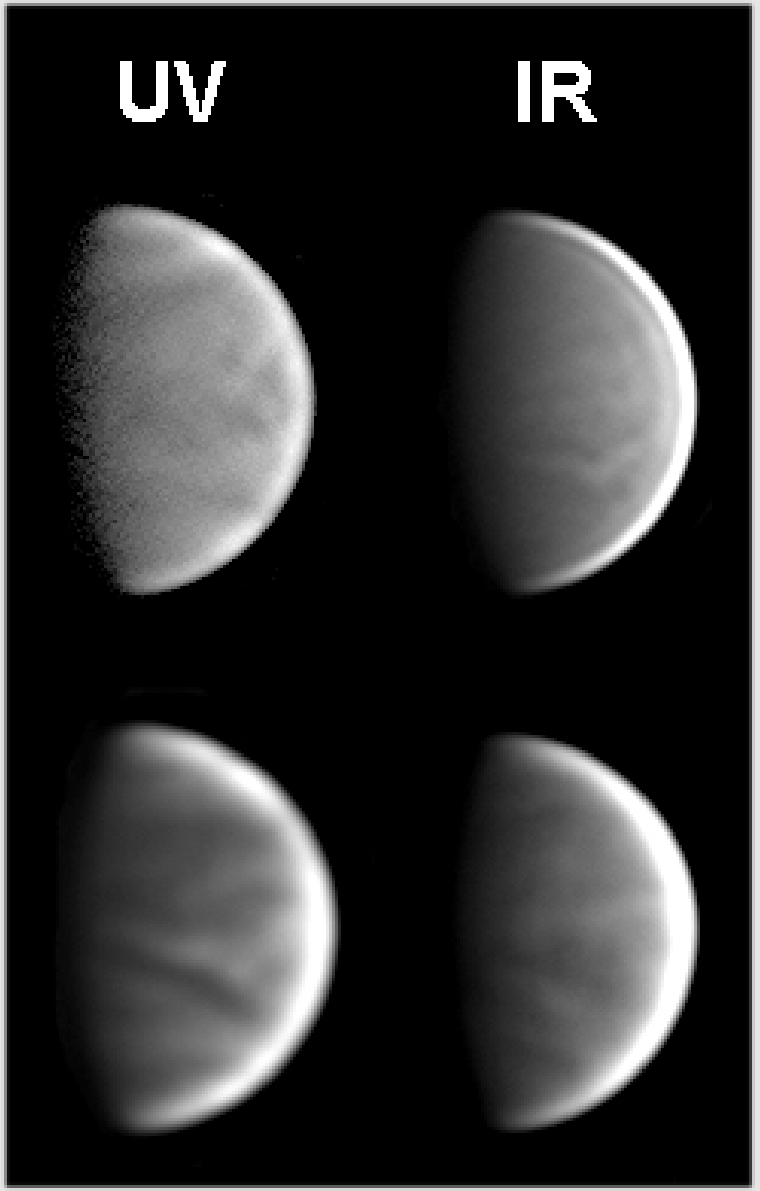
II – Analisis of images

- **However,** generating a WinJupos drift chart proved to be not precise enough to calculate the rotation of the planet with the tool "Measure object drift via two points"
- An excel sheet is better to finalyse the calculation



II – Results

- We find no correlation, at amateur-size level of resolution, between UV details and IR details (or a very weak one)
- For comparison, the rotation of clouds at UV level is coherently measured to be 3,8-3,9 days
- There are great variations in measurements, due either to imprecision or true variations

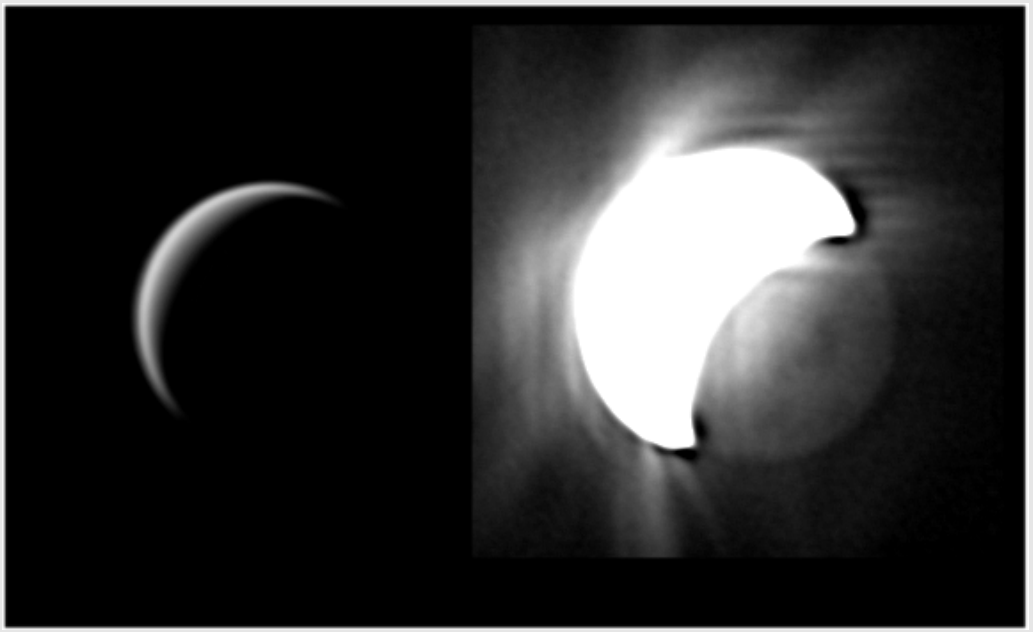


II – Results

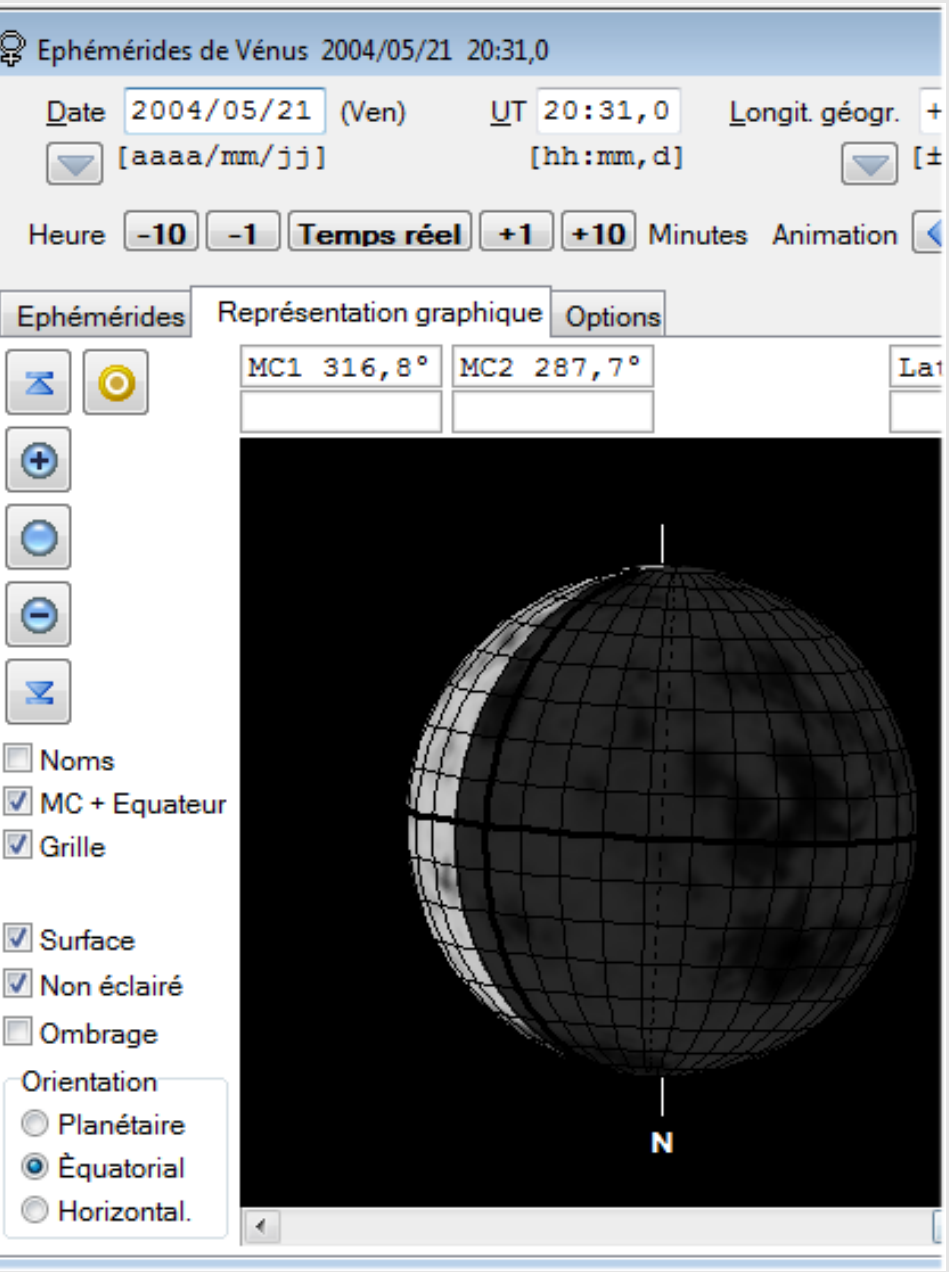
- **Despite the variations we repeatedly find an average value of <u>4,9 days</u> for the rotation of the atmosphere at near-IR level, one more than for UV**
- This is quite different from results obtained by Carbognani et al. (7,8 days, also with great variations)
- To the contrary we dot not put in evidence any coherent variation of speed with latitude but this is likely to be due either to the incertainty of measurements, or the lack of data. This is a possible area of further investigation.

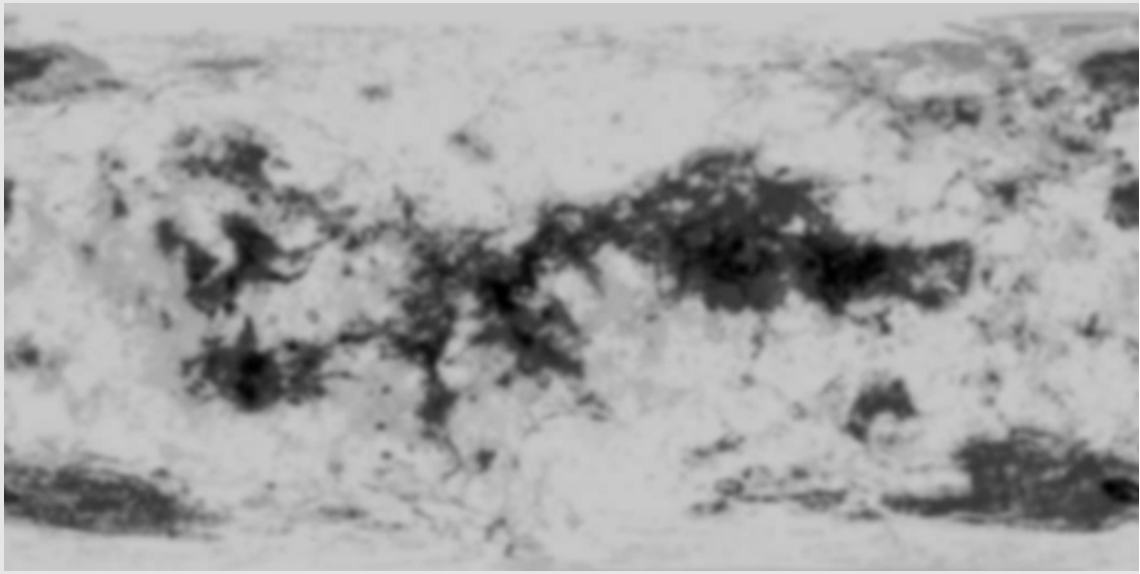
III – The thermal signal from the surface at 1 micron

- Since the end of 80's we know that the hot surface shines at 1 micron in the near IR, and can be detected from Earth in the venusian nightside due to a C02 emission band situated at the same wavelength
- From 2004, the observation is within easy reach of amateurs and has been made several time since then
- It requires a b&w camera and a 1000 nm IR-pass filter and several exposures of a around a few seconds



III – The thermal signal from the surface at 1 micron



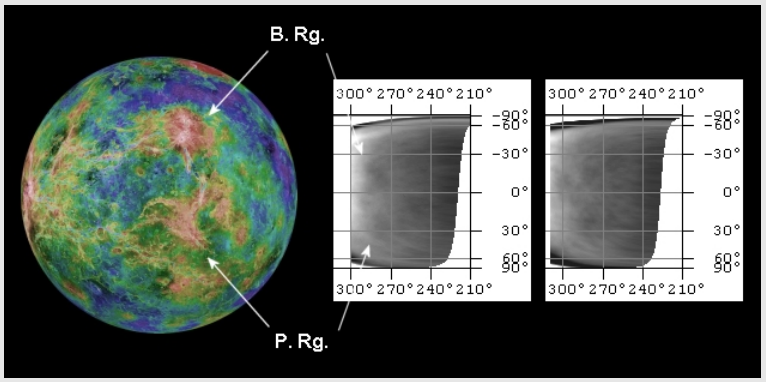


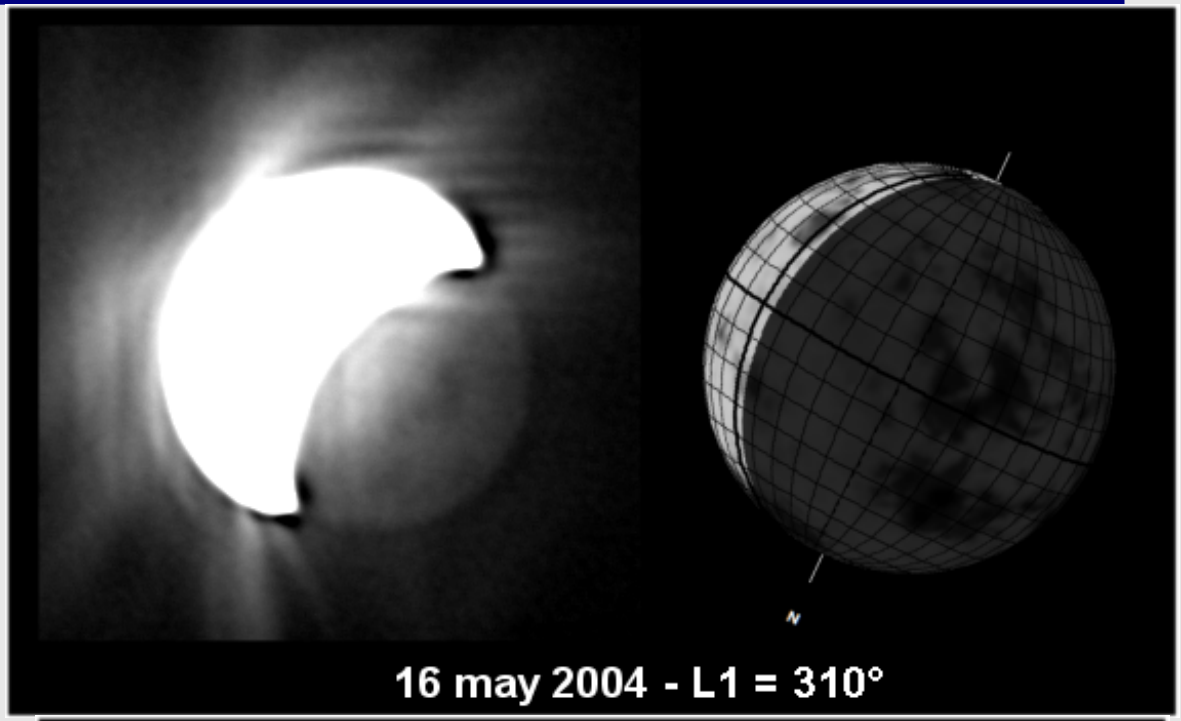
- A new tool has been developed under WinJupos following an idea of observer John Boudreau: a map of the theorical thermal signal built from an inverted relief Magellan map
- It allows easier comparison with direct images

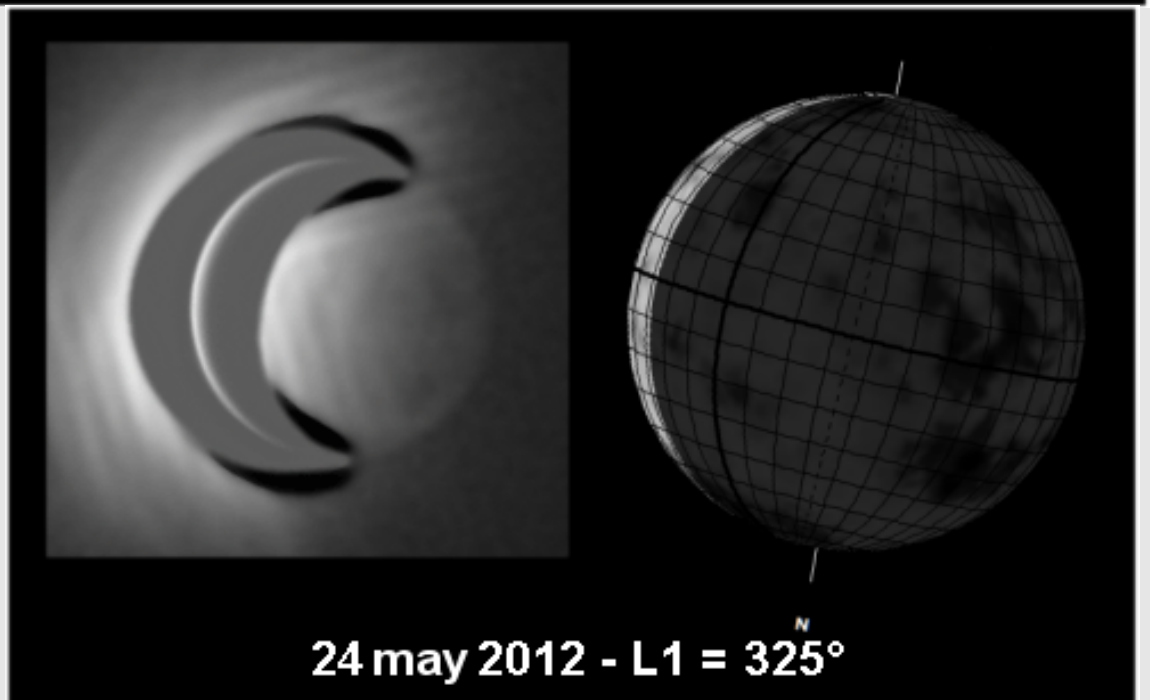
III – The thermal signal from the surface at 1 micron

- Analisis shows that at least the bigger dark patches imaged through the signal correspond to venusian mountains- higher in altitude, their thermal signal is weaker and then appears dark
- They are found again at same position in 2004 and 2012, eastern elongations that are equivalent in the 8 years cycle and correspond to Beta and Phoebe Regio

Images: Pellier (2004) Boudreau (2012)







III – The thermal signal from the surface at 1 micron

- Further studies would be required to improve correlation and find out if there is more than thermal shadow of mountains: low clouds masking the thermal signal ?
- **The next opportunity comes in next december (2013):** from mid december until the end of the year the venusian nightside will be again observable from Earth, for the last time until 2015 spring/summer.

Thank you...

Questions ?