

# Venus Express: Results, Status and Future Plans

Håkan Svedhem  
ESA/ESTEC

# Present Status

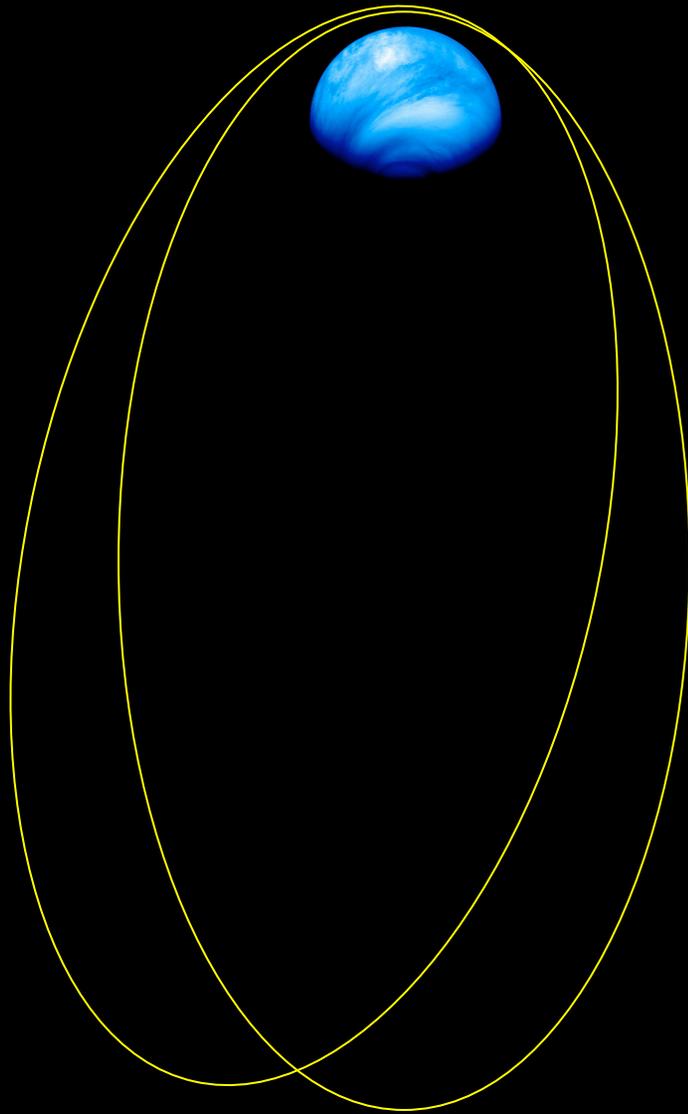
- The spacecraft and its payload in general is in a good condition, with the following remarks:
  - One of the two coolers of the VIRTIS instrument is no longer operational. This concerns the mapping IR channel which therefore is not presently being operated. The UV-Vis channel and the high spectral resolution channel operate as nominal.
  - The PFS remains out of operation.
  - One of the four reaction wheels is showing an excess friction torque. The level of friction seems to have stabilized and a correlation with the temperature of the unit has been found. This enables predictions of future performance to be made. If a further degradation occurs we may need to switch it off and operate on three wheels only. This will result in a slight loss of flexibility in the operations.
  - The S-band chain still has a large loss and is only used occasionally for some of the radio science experiments.

## Status cont.

- The mission is very robust with respect to margins for power, fuel and thermal control.
  - In the present orbit the fuel will run out at end of 2013.
- The spacecraft has experienced six safe mode transitions, all understood and recovered smoothly by VMOC.
  - No safe mode during the last year.
- Presently more than 2 Tbits of science data has been downlinked to ground.
  - This is more than all previous missions together, excluding Magellan.

# Mission Life

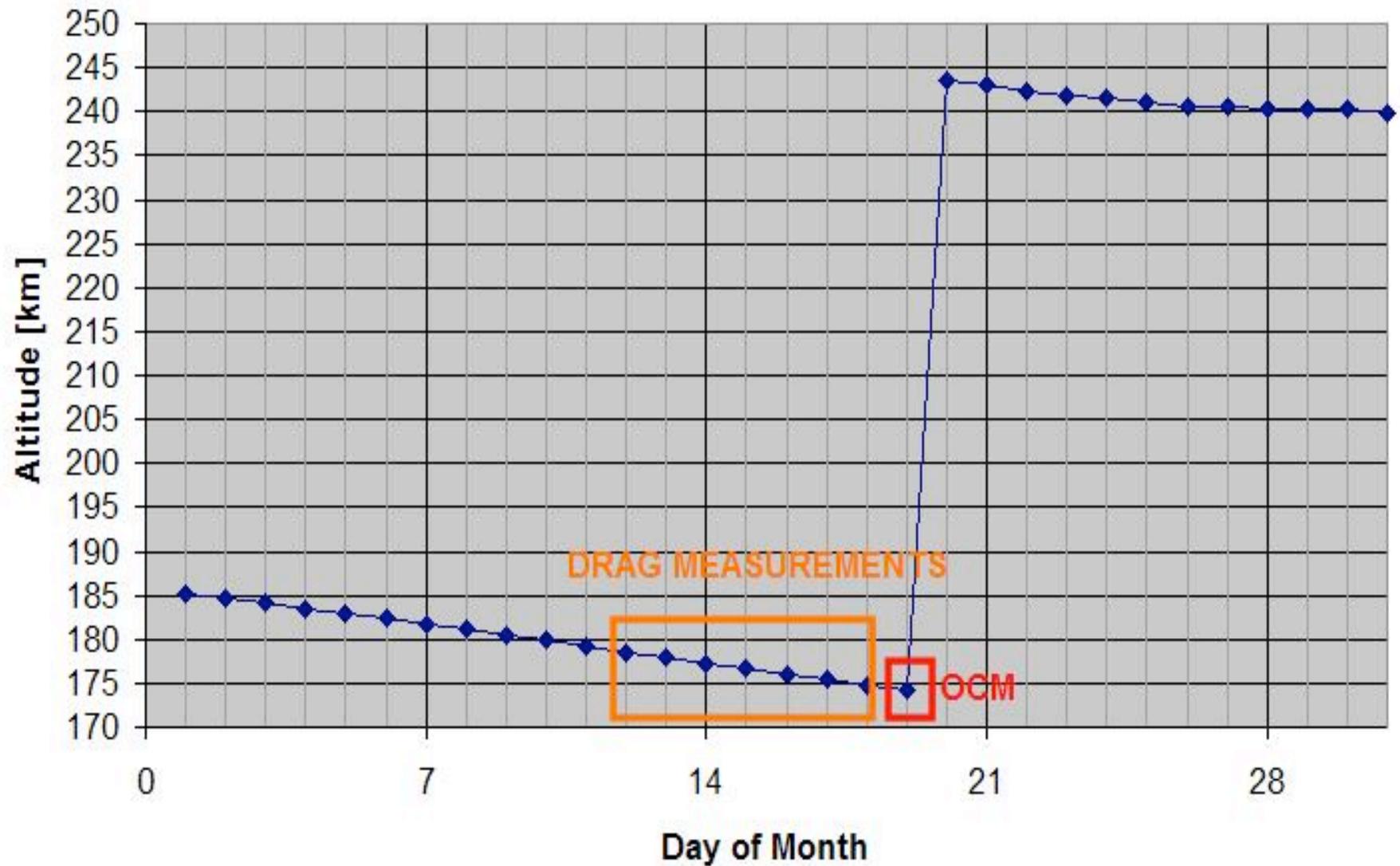
- The primary mission ran for 500 days from arrival at Venus in April 2006 until October 2007
- The first extension ended in May 2009
- Last Friday (October 2) the Science Programme Committee of ESA approved a further extension of the operation to end 2012!

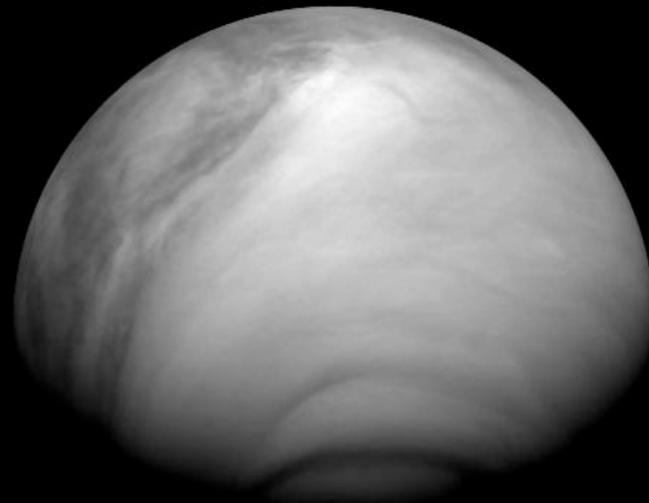
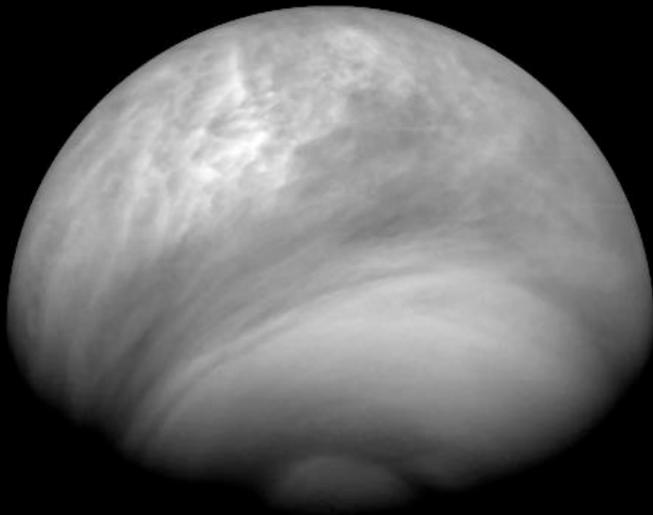
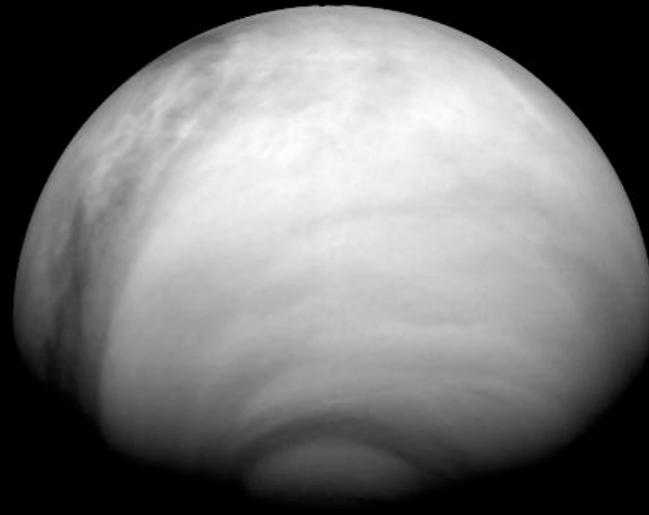
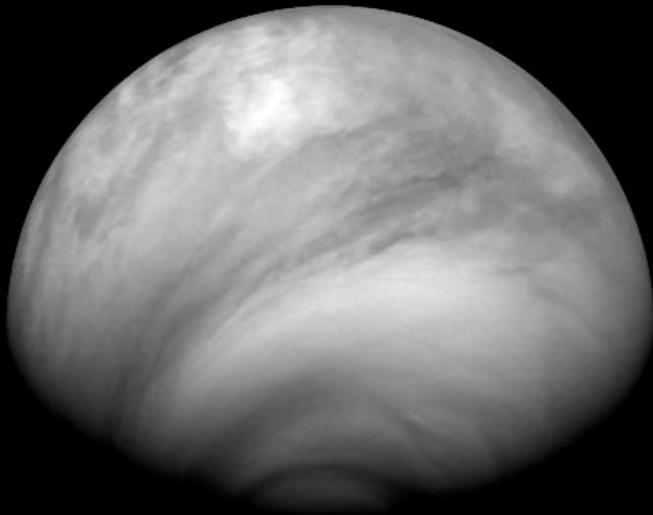


## *Orbit*

- *Polar orbit*
- *24 h period*
- *66000km apocentre height*
- *250-400km original pericentre height control band*
- *Latitude of pc drifting slowly from 78 deg N at arrival to 90 deg N mid 2009*
- *Pericentre height control band reduced to 175-275km late 2008*

### OCTOBER VEX altitude





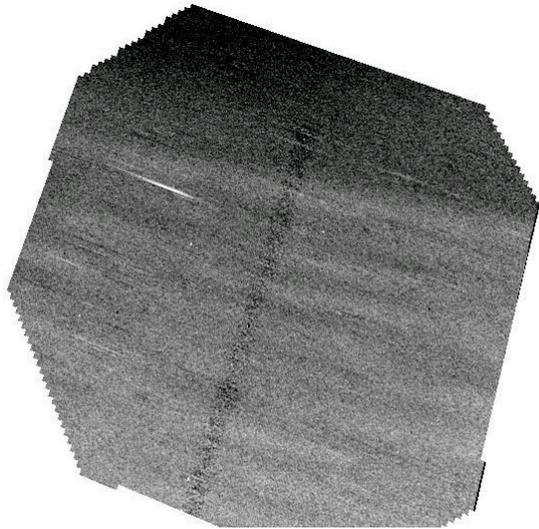
VMC images demonstrate a living planet with large scale variations at different time scales.

Reflected sunlight at 365nm.

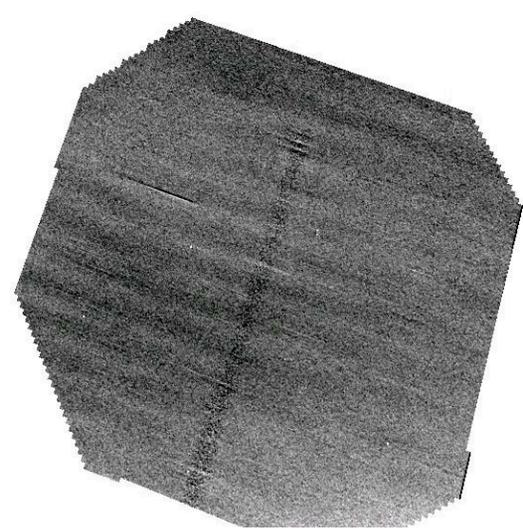
Possible relation to solar activity.

# High latitude waves by VMC @365nm, ~65-70km altitude

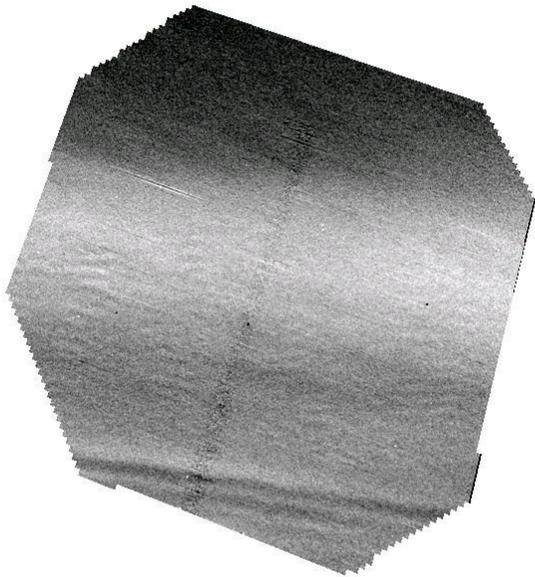
70.1°N



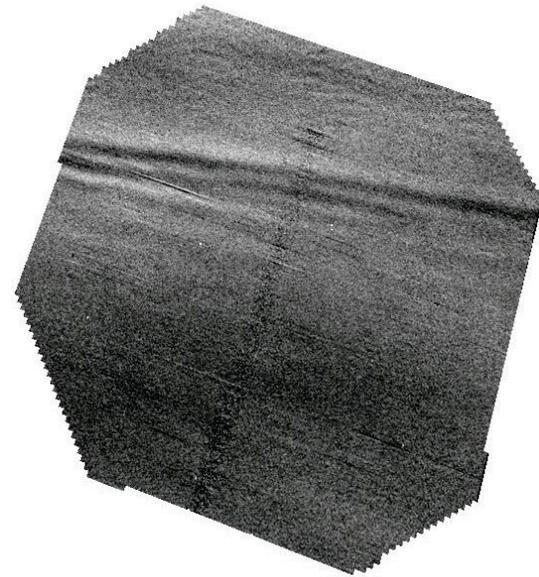
69.2°N



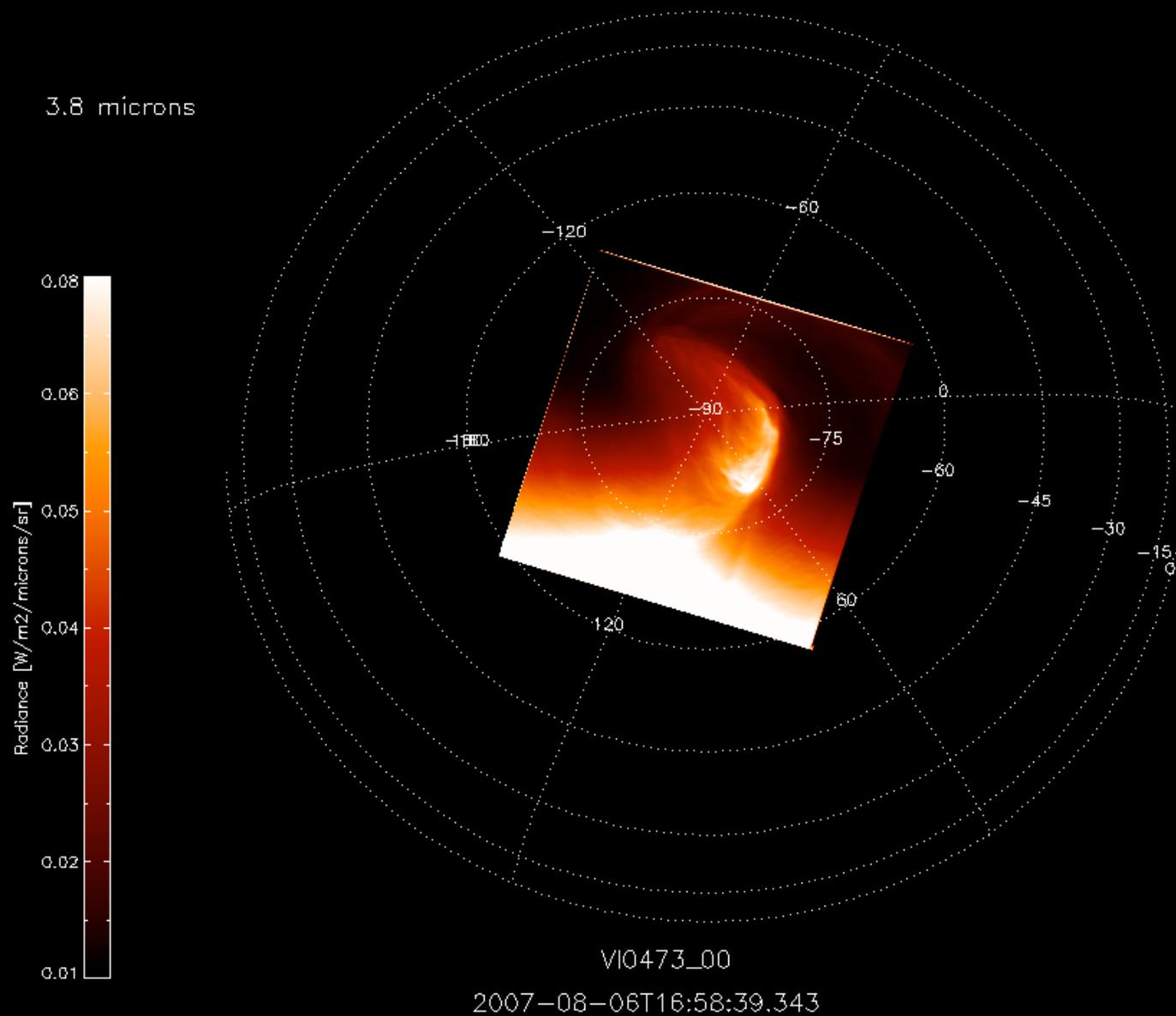
68.3°N



67.4°N

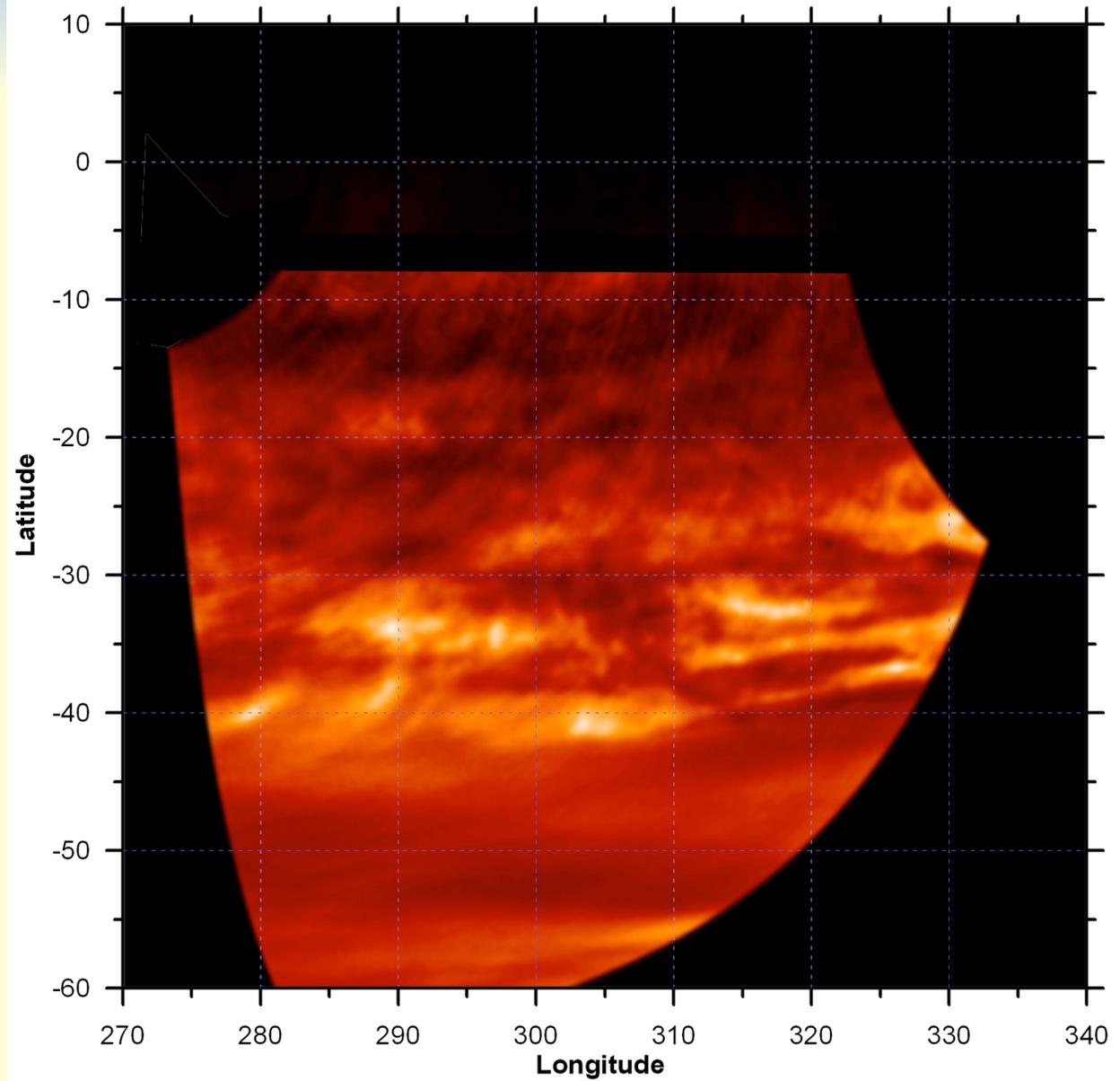


# South polar vortex at 3.8 $\mu\text{m}$

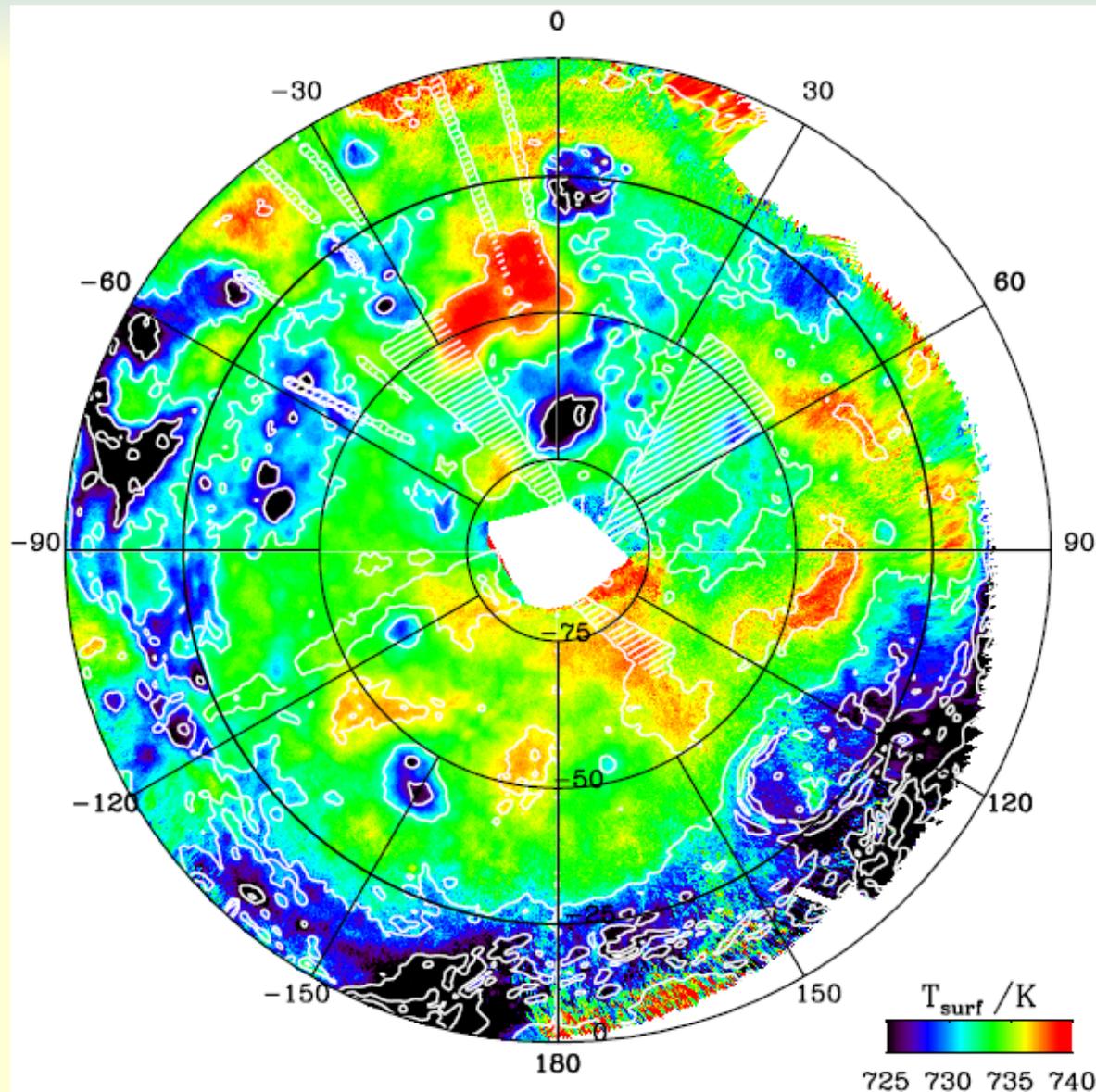


# Atmospheric dynamics and wave phenomena

*VIRTIS near-IR movie*



# Southern hemisphere surface temperature



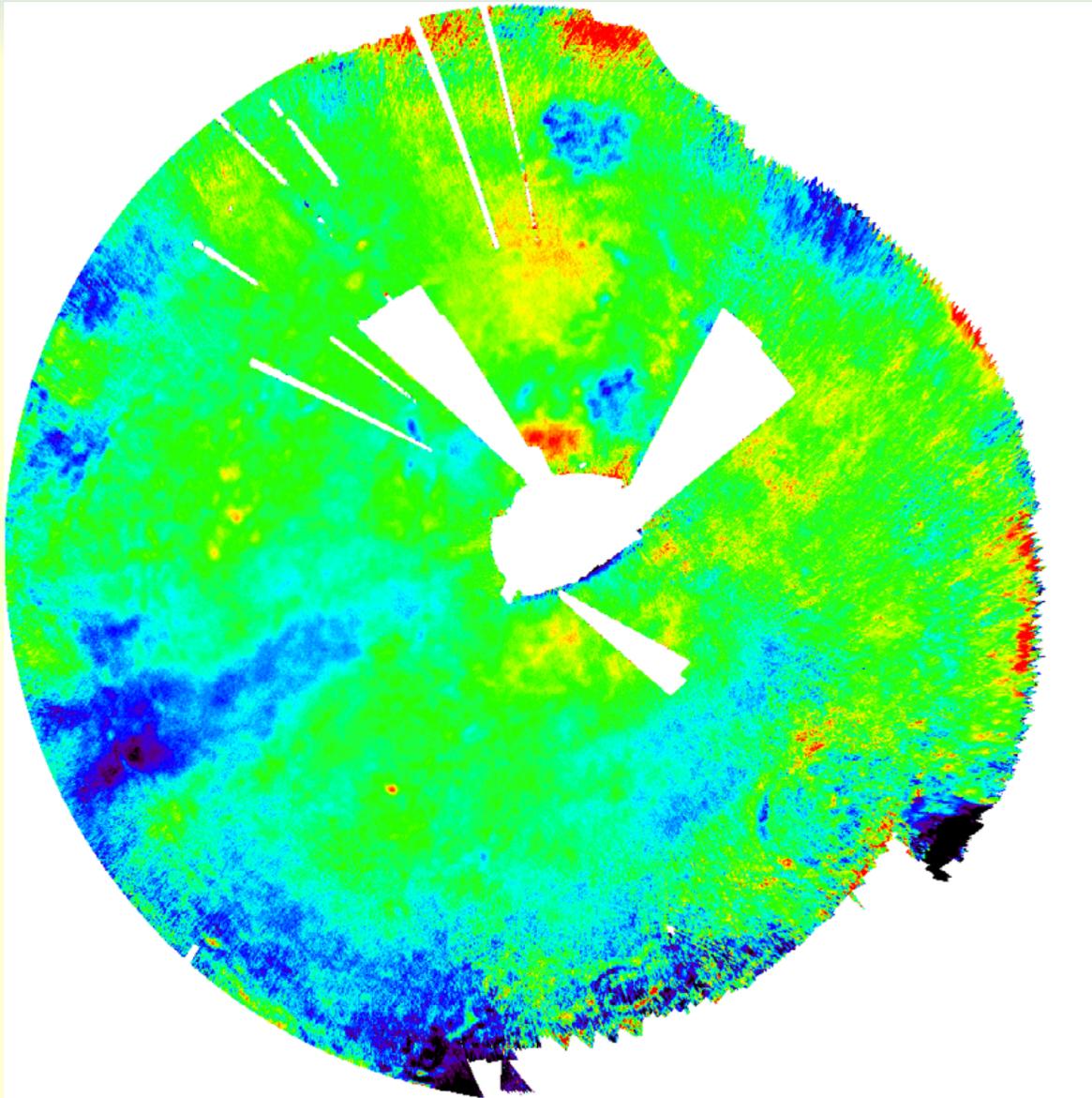
Data derived from ~700 VIRTIS images at  $1.0 \mu\text{m}$  using additional images in the band  $1-3 \mu\text{m}$  for removing cloud effects

A constant emissivity (0.8) is assumed

Hatched areas indicate regions without Magellan altimetry data

Müller et al. JGR 2008

# Southern hemisphere thermal anomalies



# More results

- **ASPERA**
  - Escape of H, O and He
- **Spicav**
  - Detection of Ozone, D/H profiles, Oxygen airglow...
- **MAG**
  - Characterizing the full induced magnetosphere
  - Detection of lightning (whistler waves)
- **Radio Science**
  - >250 Thermal and density profiles + ion density
- **And much much more...**

## Future plans

- The next few years will provide extended coverage in latitude and local time for the atmospheric measurements and better surface coverage of the surface temperature and emissivity maps.
- At the time of the lowest pericentre altitude, atmospheric drag will be monitored by measuring the orbital decay.
- A further pericentre altitude reduction will allow atmospheric drag measurements by on-board accelerometers that should give very high precision data on the density and temperature in the 150-200 km altitude range.
- Joint operations with the Japanese Venus Climate Orbiter in 2011 will enable simultaneous observations from different positions and provide improved temporal coverage. A joint Science Working Team meeting was held in Japan in July 2009.
- Preparations for aerobraking in order to reach a new orbit have started. A modification to an orbit with a shorter period will provide new science opportunities and will significantly extend the mission life.

## Conclusion

- Venus Express spacecraft is in a good health and very productive, but shows limited signs of ageing.
- The data analysis is in full progress but most teams are still limited in manpower.
- The archive is slowly getting populated with data from all instruments.
- The mission has been extended until end of 2012, pending a delta review in late 2010.
- Joint operations with the Japanese planet-C will take place in 2011