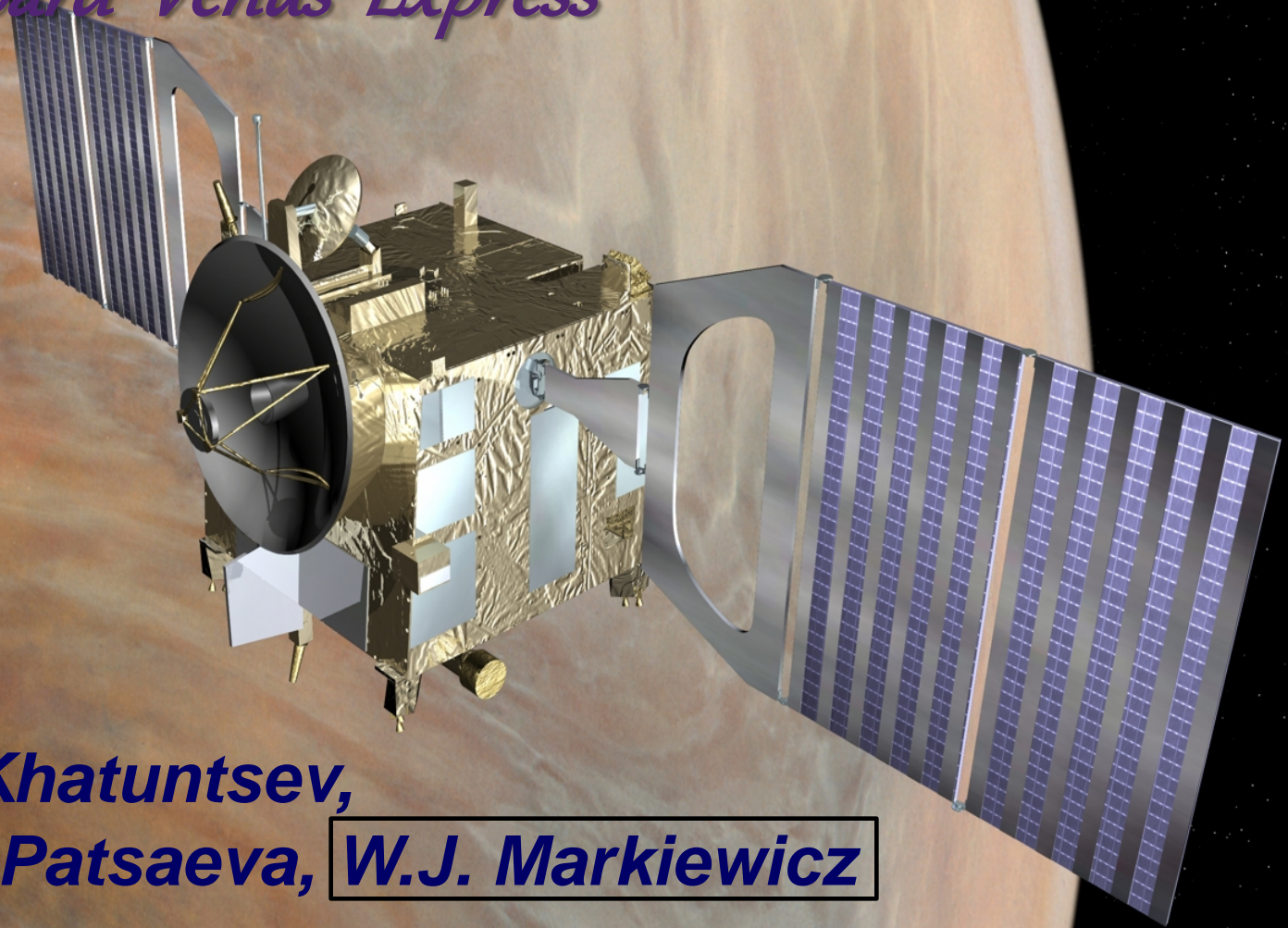


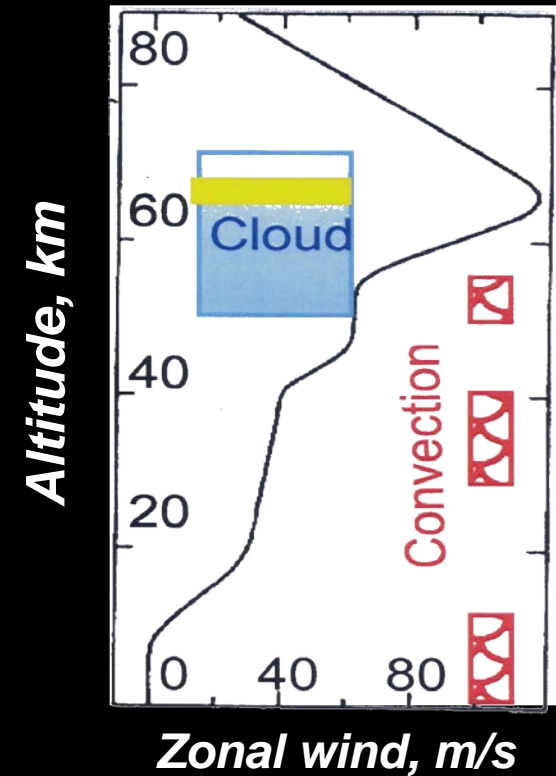
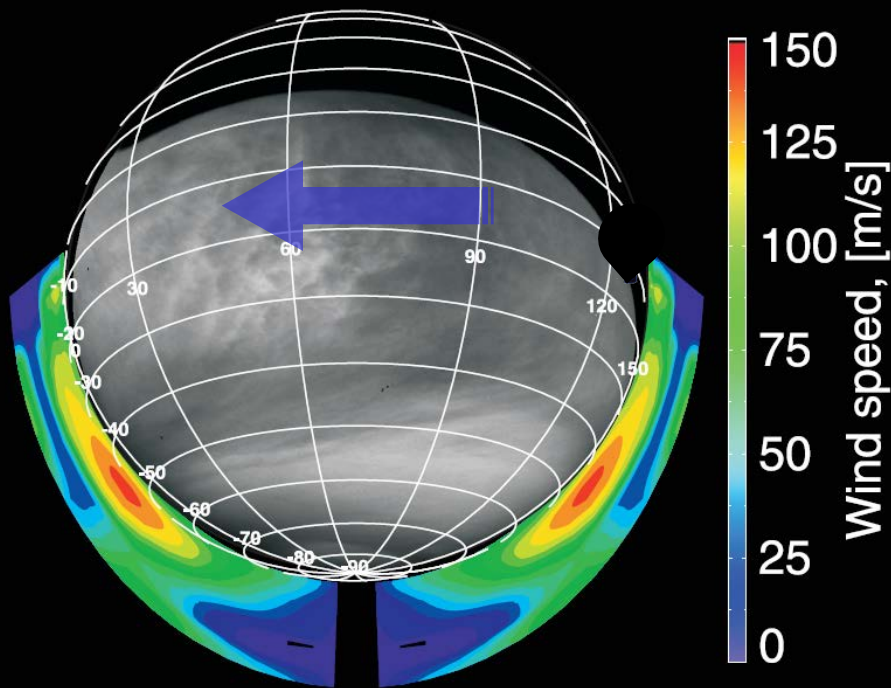
*Dynamics of the Venus atmosphere from  
the imaging by Venus Monitoring Camera  
onboard Venus Express*



***D. Titov, I. Khatuntsev,  
M. Patsaeva, W.J. Markiewicz***

***SSW10 Science Workshop, 13-15 November 2017, Aranjuez***

# Venus circulation - a continuing enigma



Venus Express science goal:

Characterization of the atmospheric circulation  
at the cloud level from equator to pole

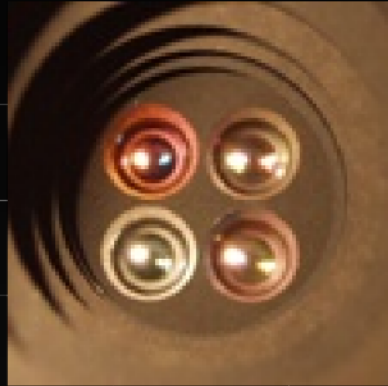
# Venus Monitoring Camera

## Science Goals

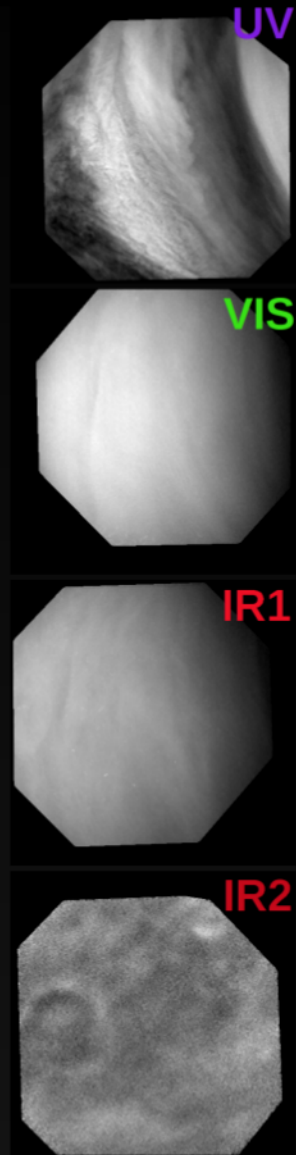
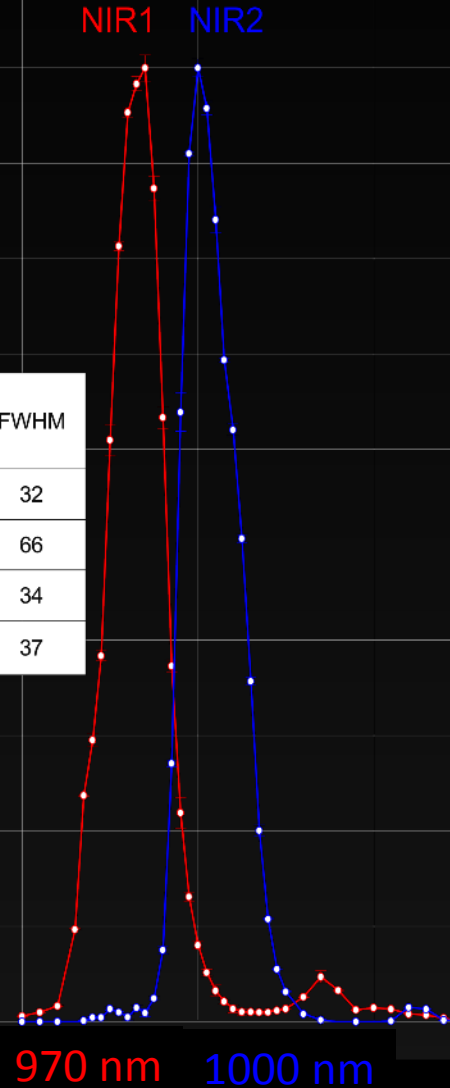
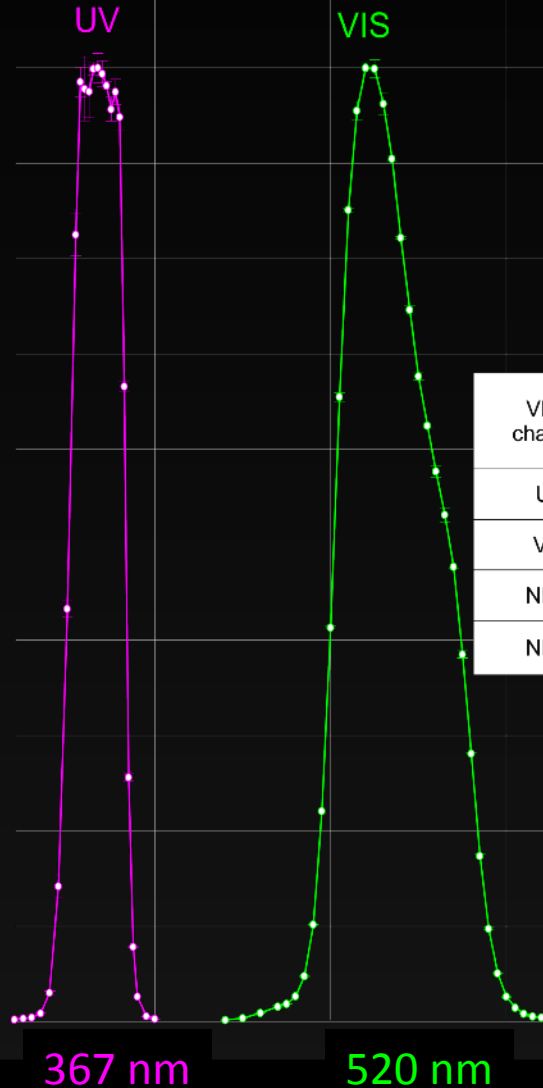
Dynamics

Airglow

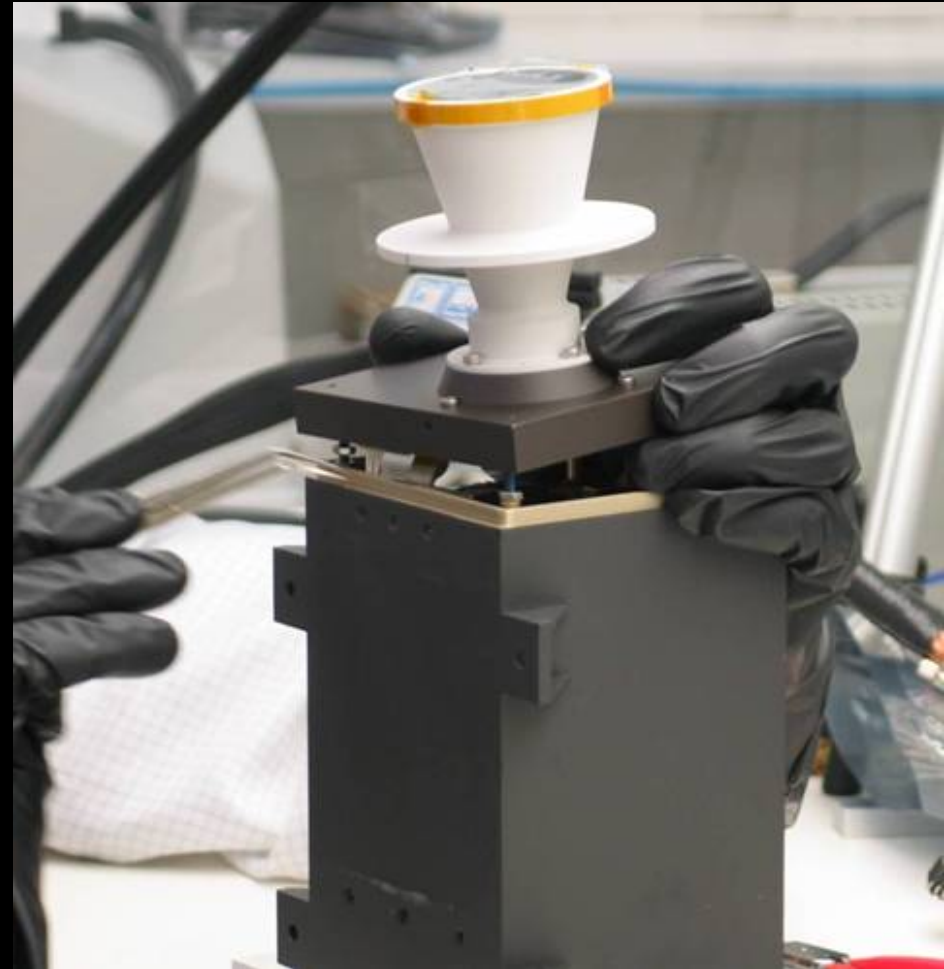
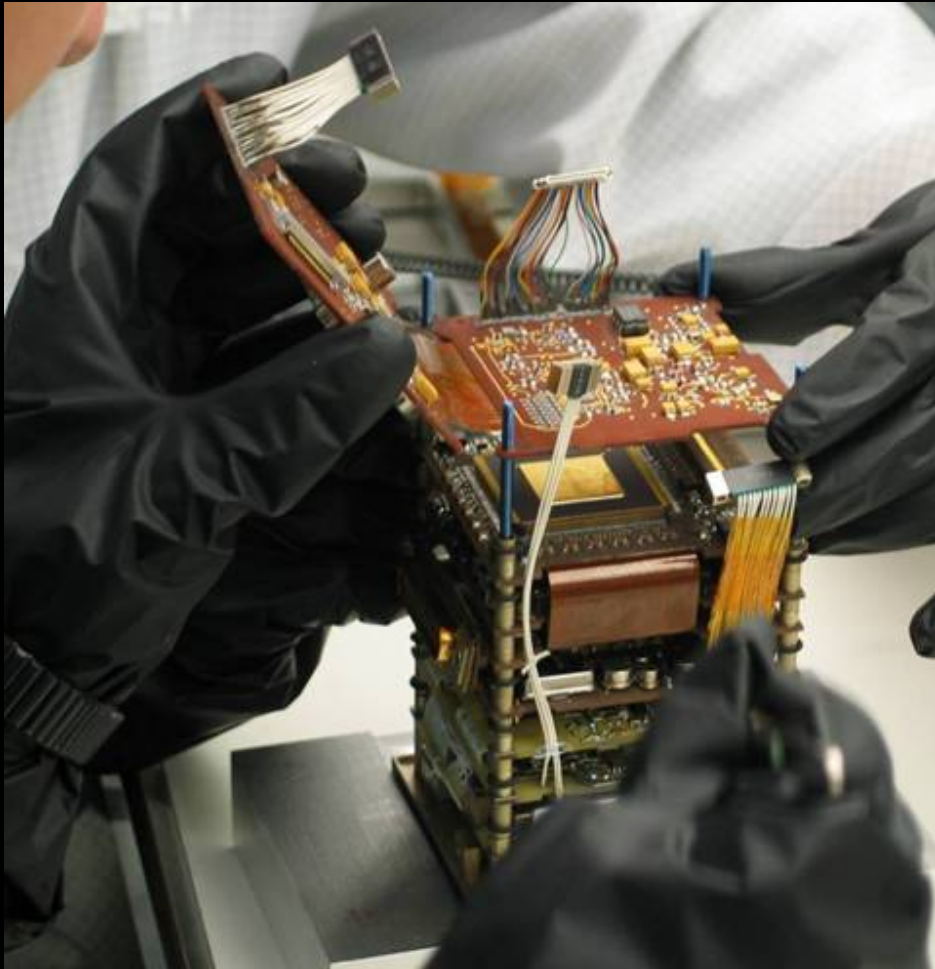
Dynamics Surface



VMC channel	Spectral range (½ max), nm	Maximum of sensitivity	FWHM
UV	351 – 383	367	32
VIS	502 – 568	520	66
NIR1	948 – 982	970	34
NIR2	988 – 1025	1000	37

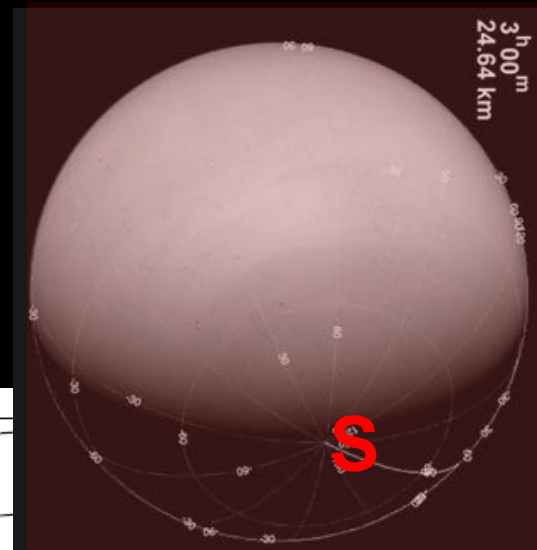
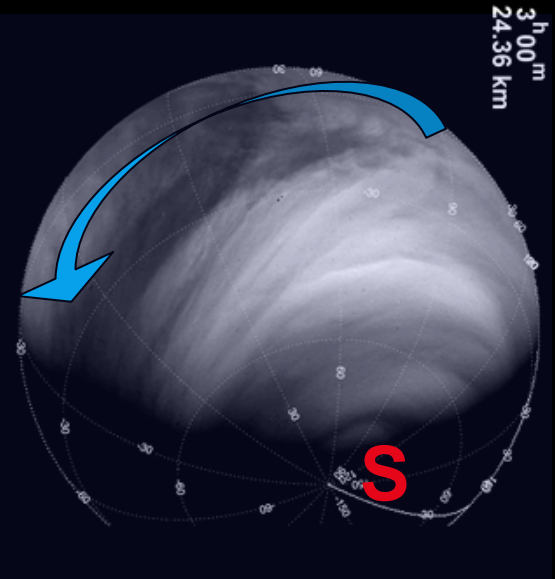


# Venus Monitoring Camera

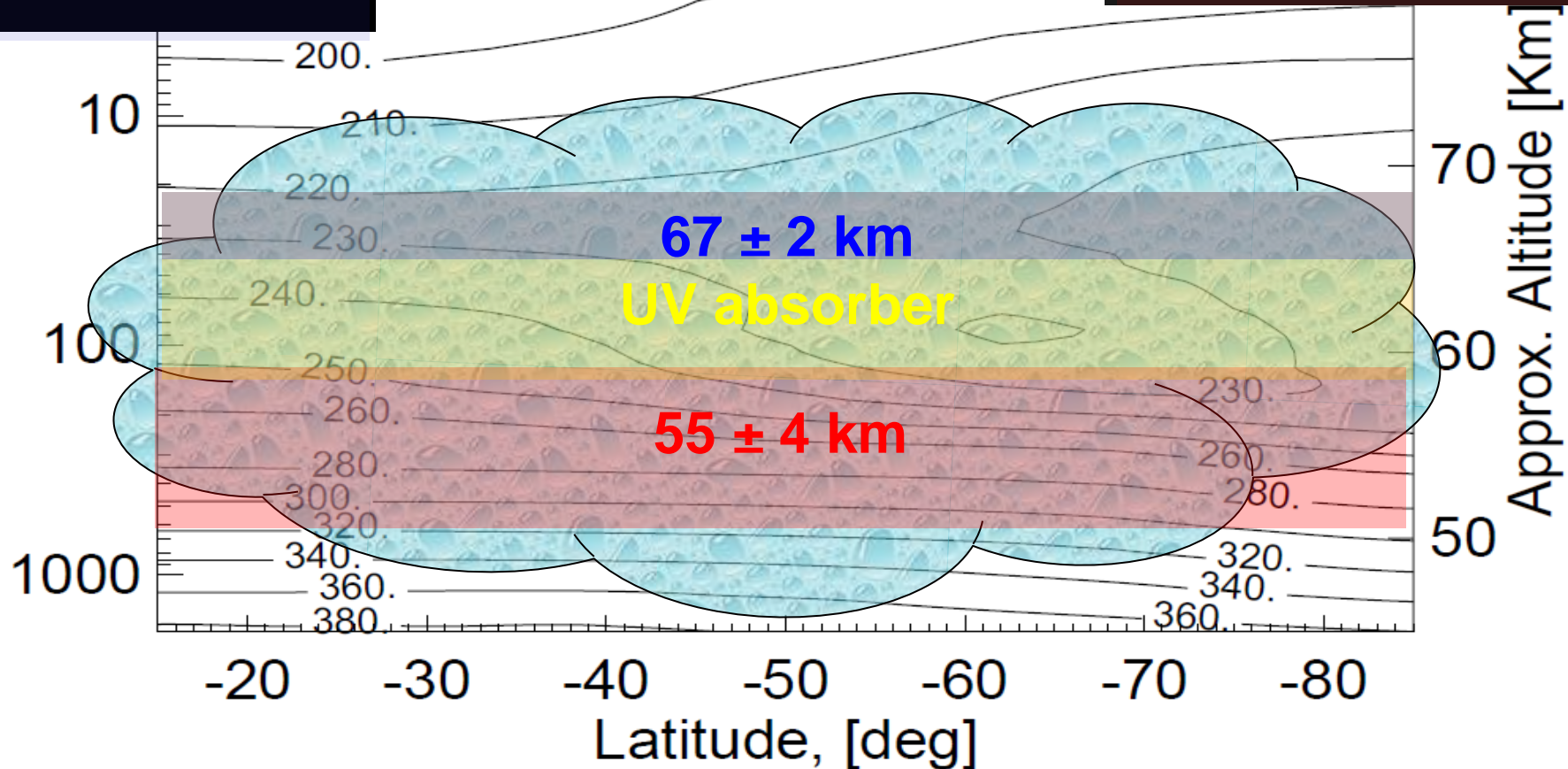


*VMC was designed and manufactured by consortium of MPS (Katlenburg-Lindau), IPF-DLR (Berlin) and IDA (Braunschweig)*

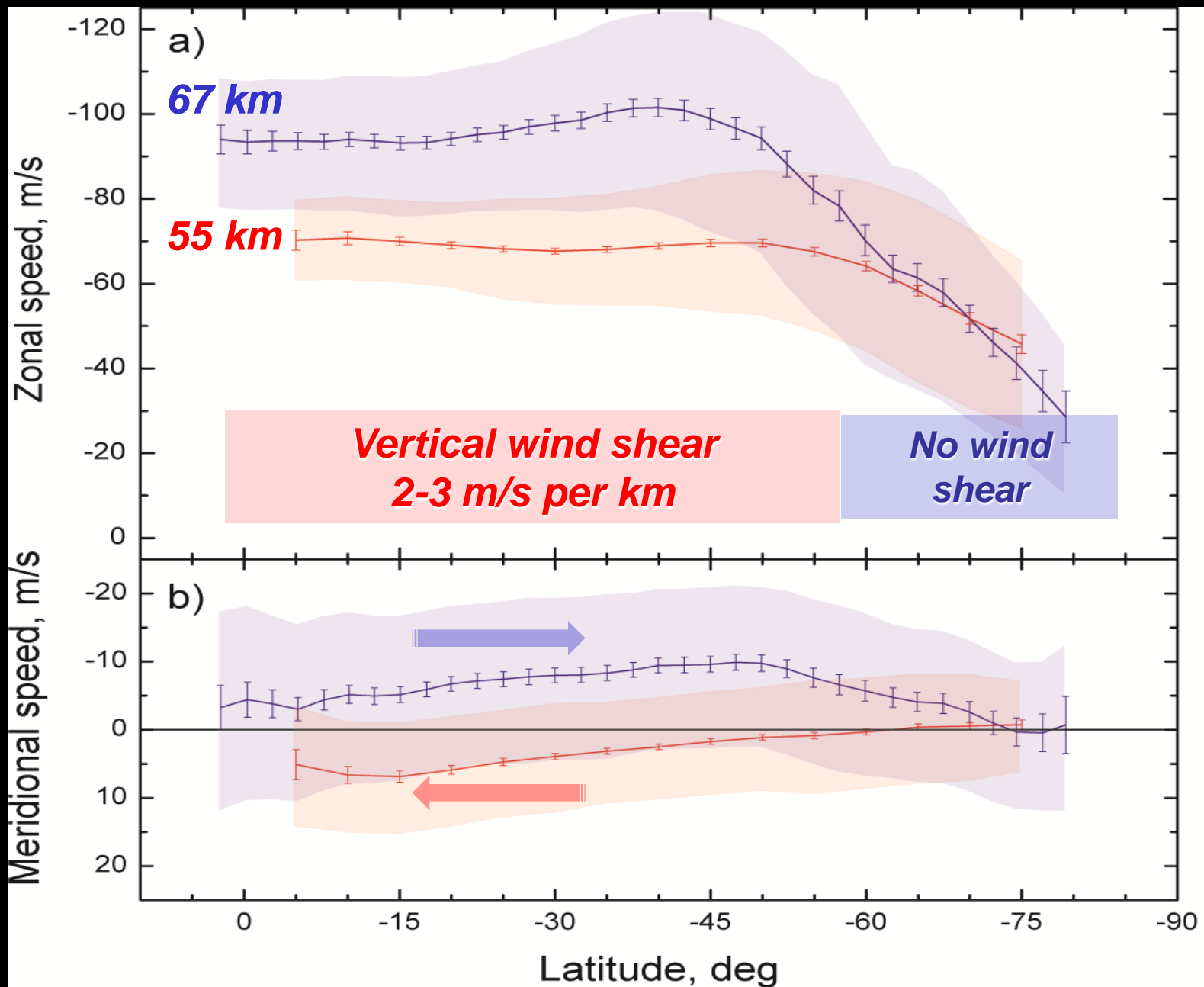
# VMC wind tracking



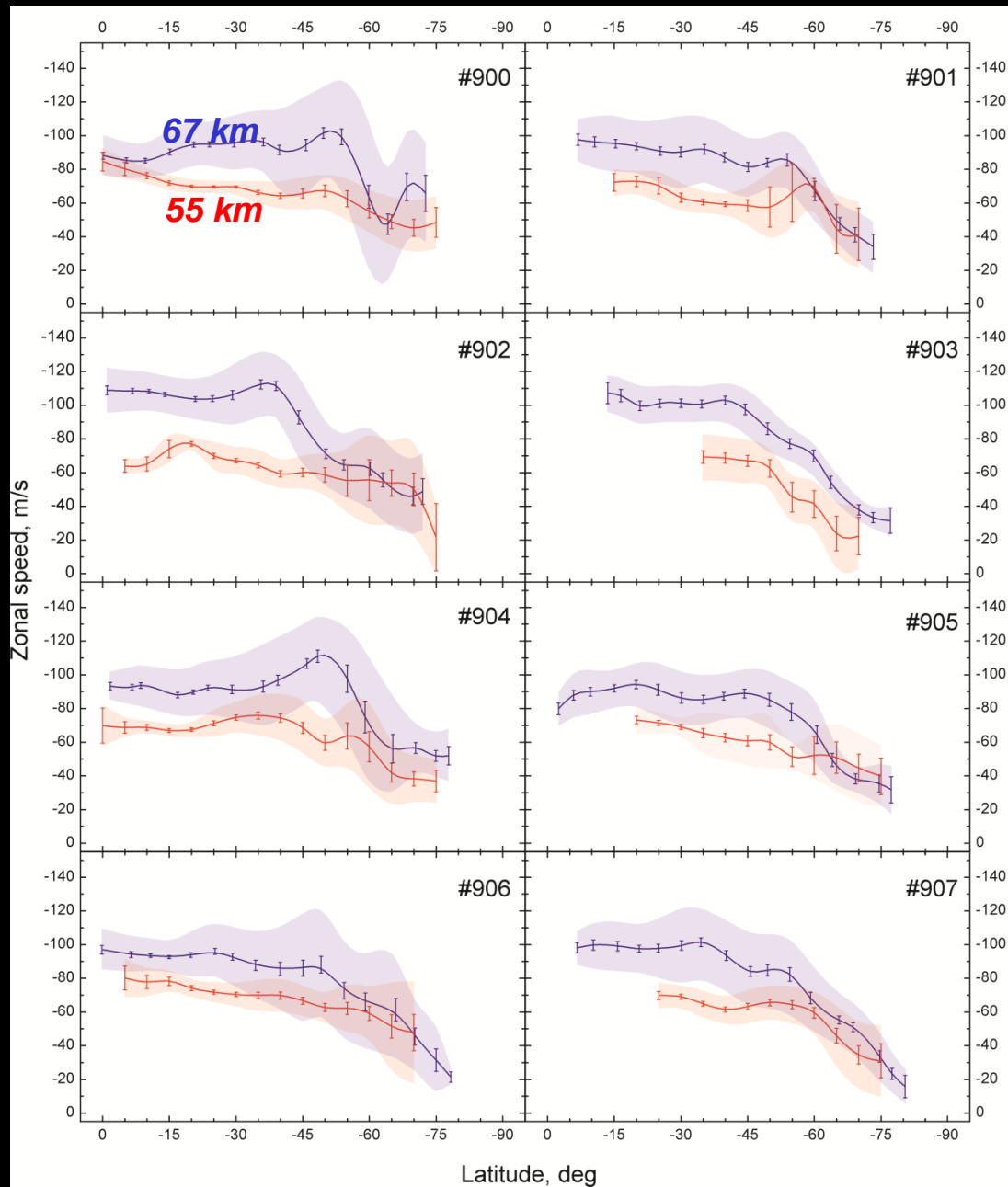
Pressure, [mbar]



# Zonal and meridional winds

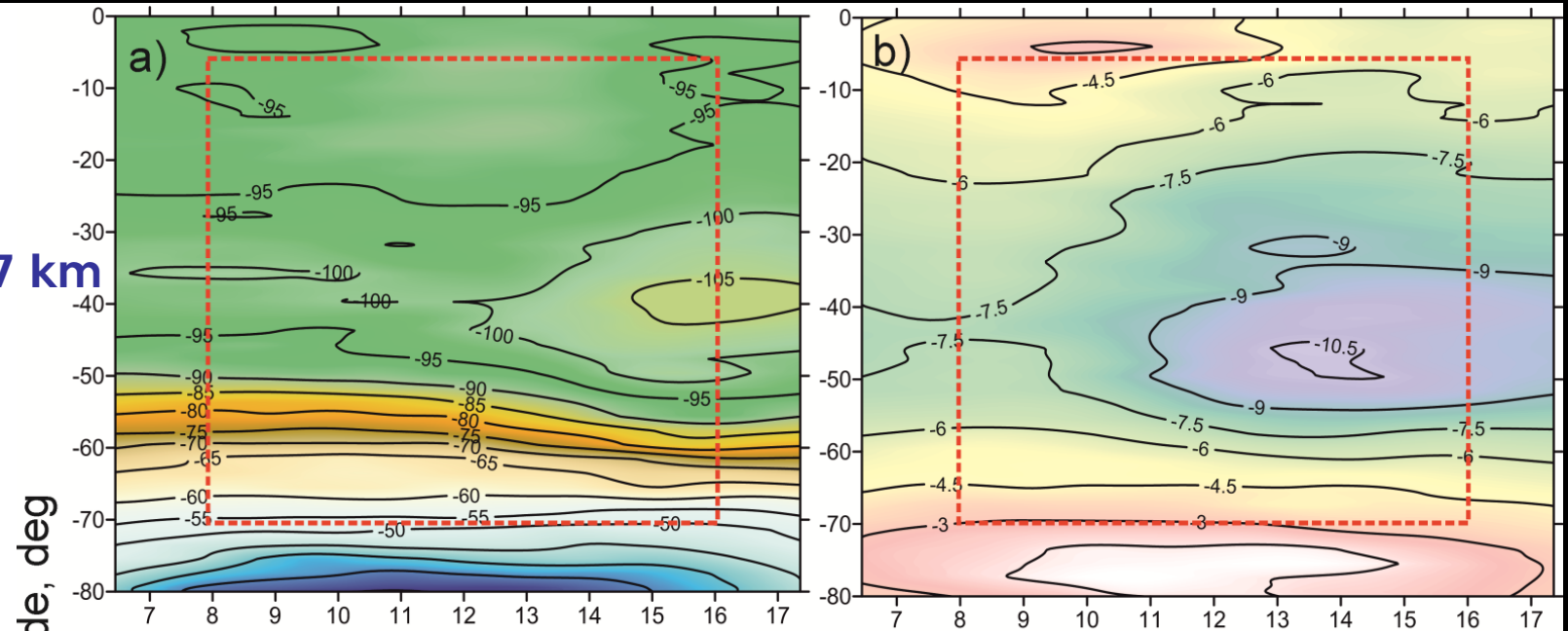


# Orbit-to-orbit variability

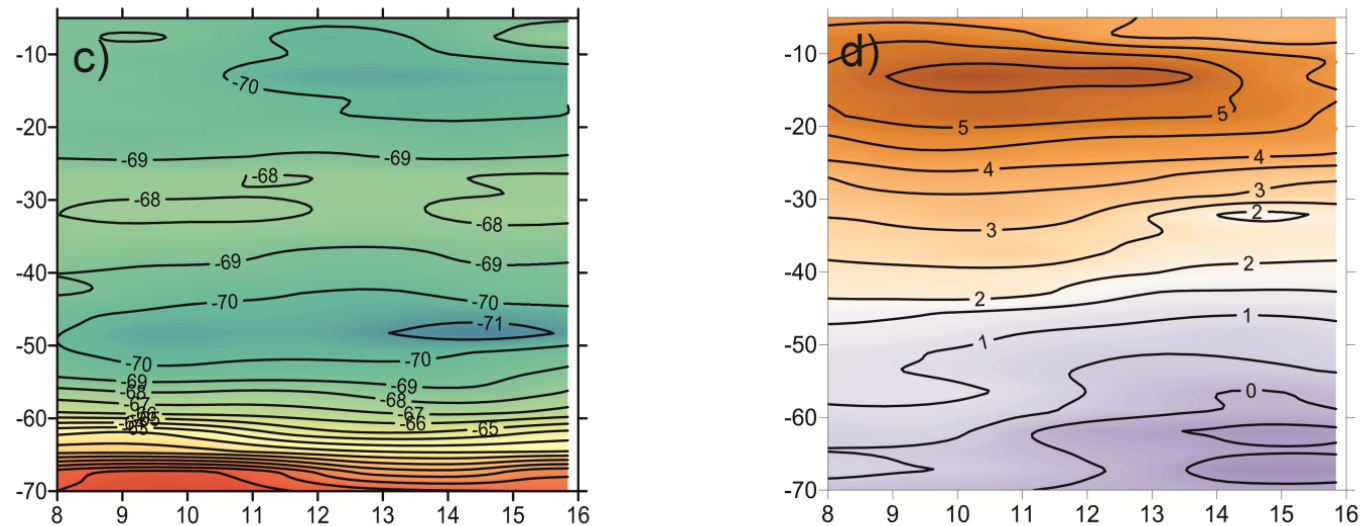


# Diurnal variations of winds

67 km

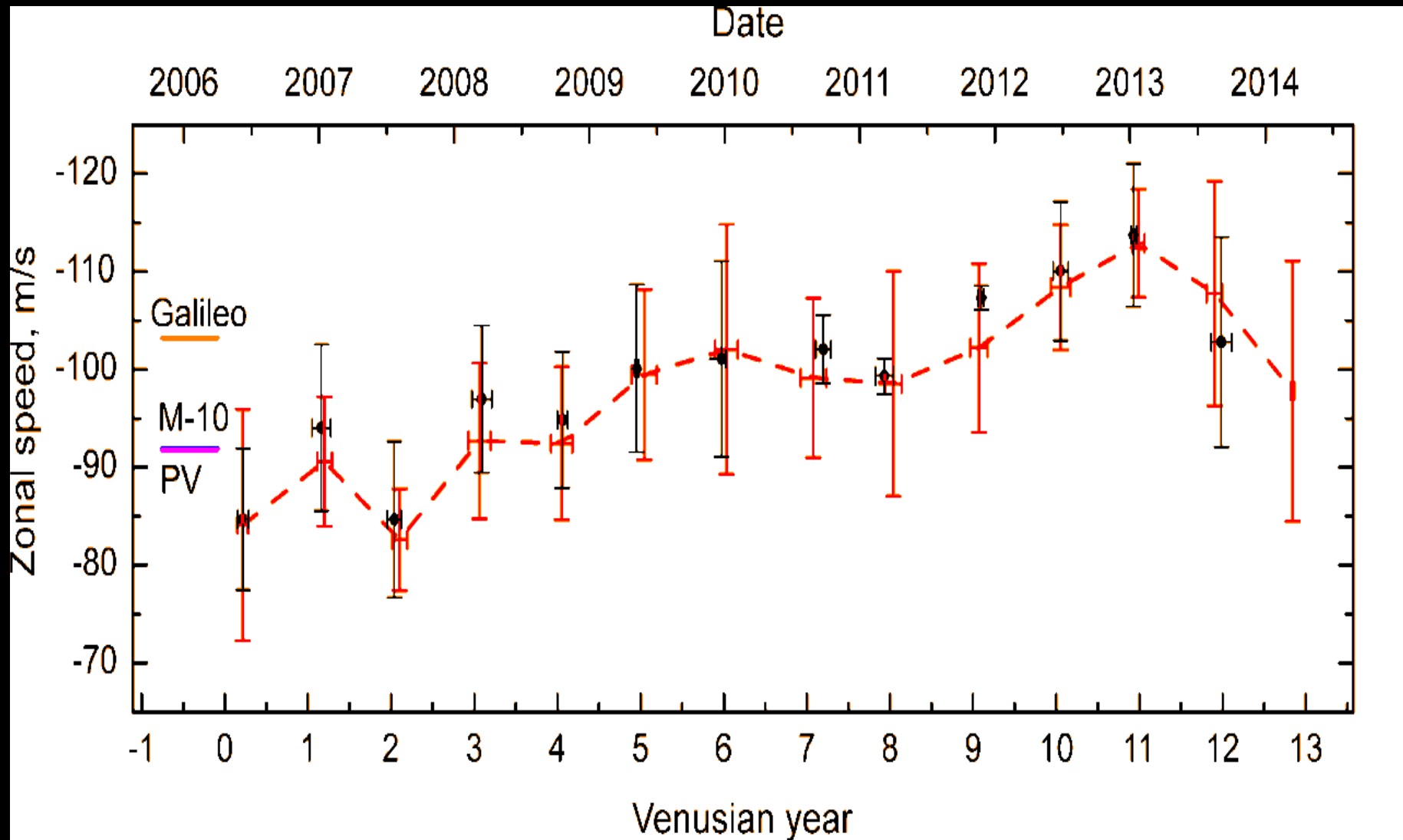


55 km

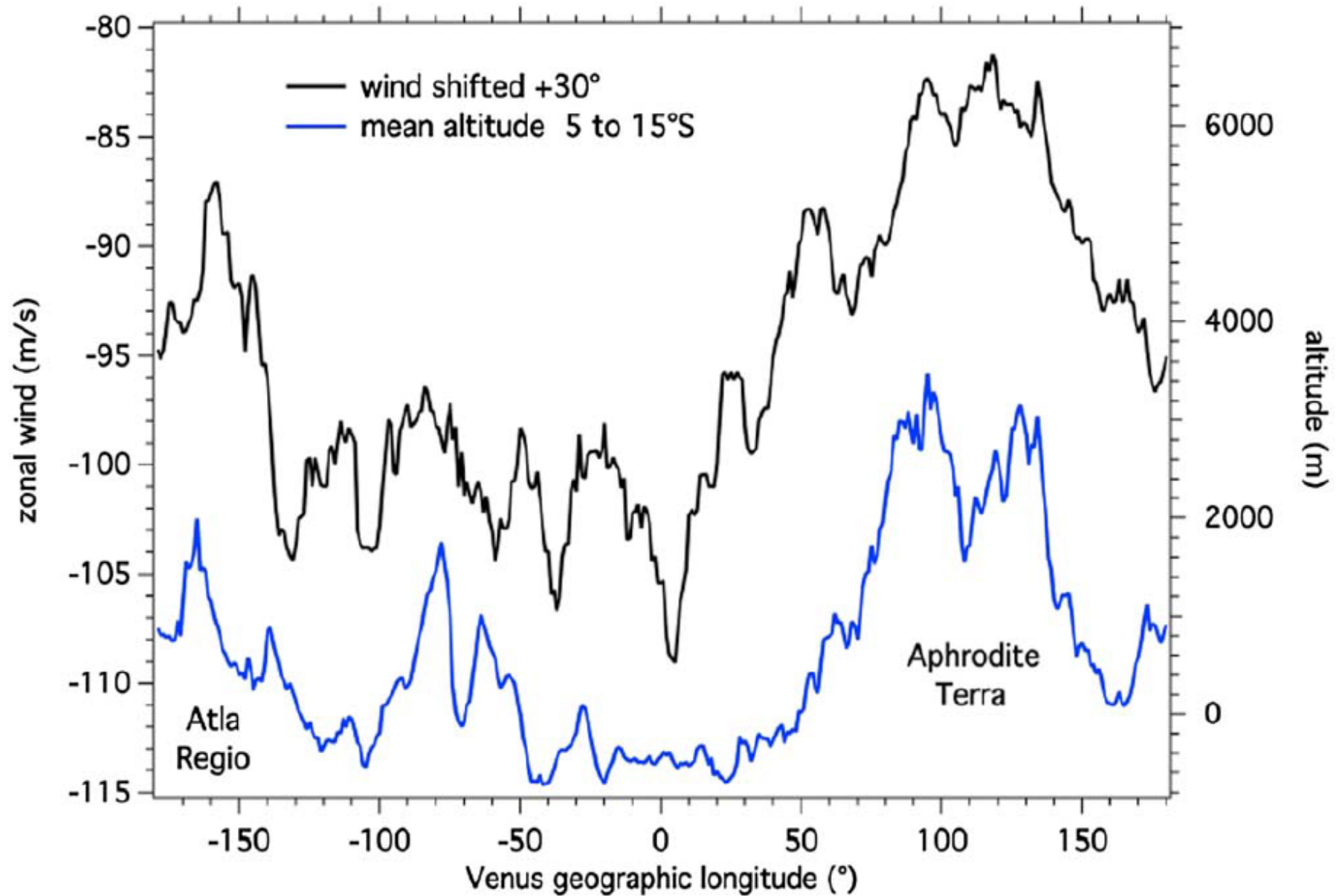


Local time, hrs

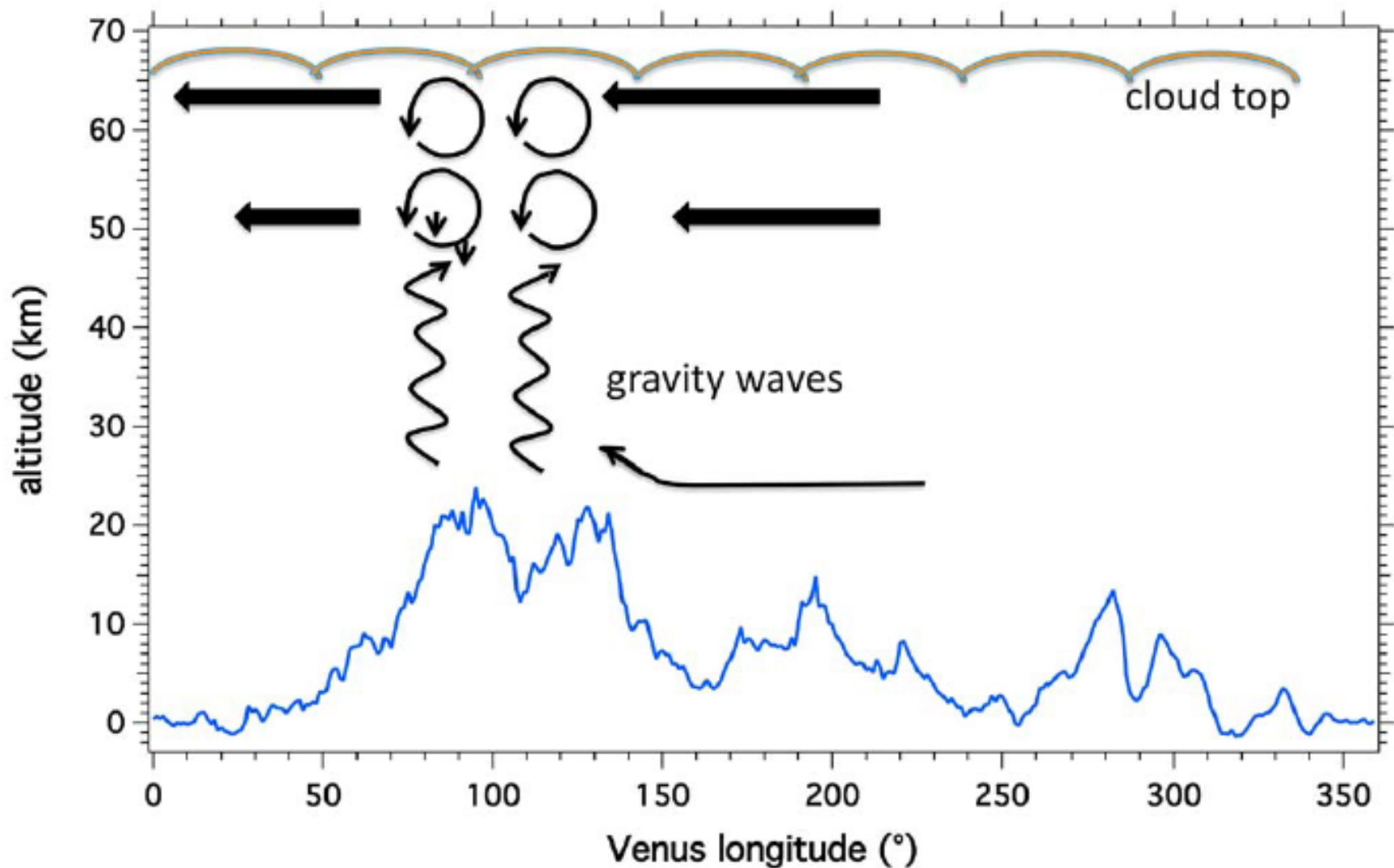
# Long-term trend of the mean zonal wind ?



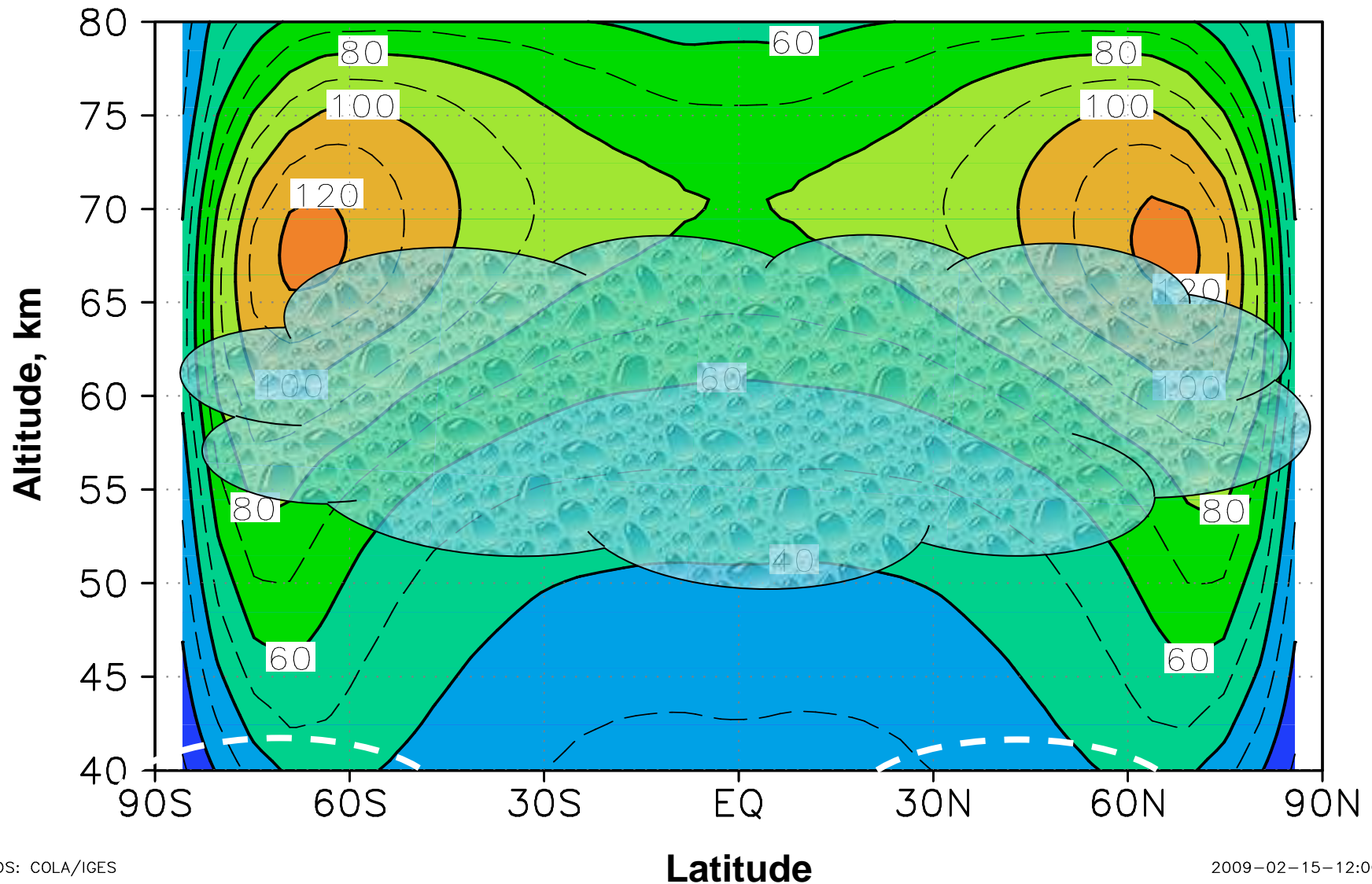
# Correlation of the zonal wind with topography



# Gravity waves decelerate the zonal flow



# General circulation modelling



GrADS: COLA/IGES

2009-02-15-12:00

***Yamamoto & Takahashi***



# Summary and conclusions

- ✓ 12 Venus years of continuous imaging of the planet
- ✓ 500,000+ wind vectors at the cloud top and in the deep cloud
- ✓ Latitudinal and vertical structure of the mean circulation
- ✓ Characterization of variabilities of the circulation
- ✓ Discovery of the return branch of the Hadley cell
- ✓ Discovery of orographic effect on the cloud top circulation

## Zonal winds at the cloud tops

