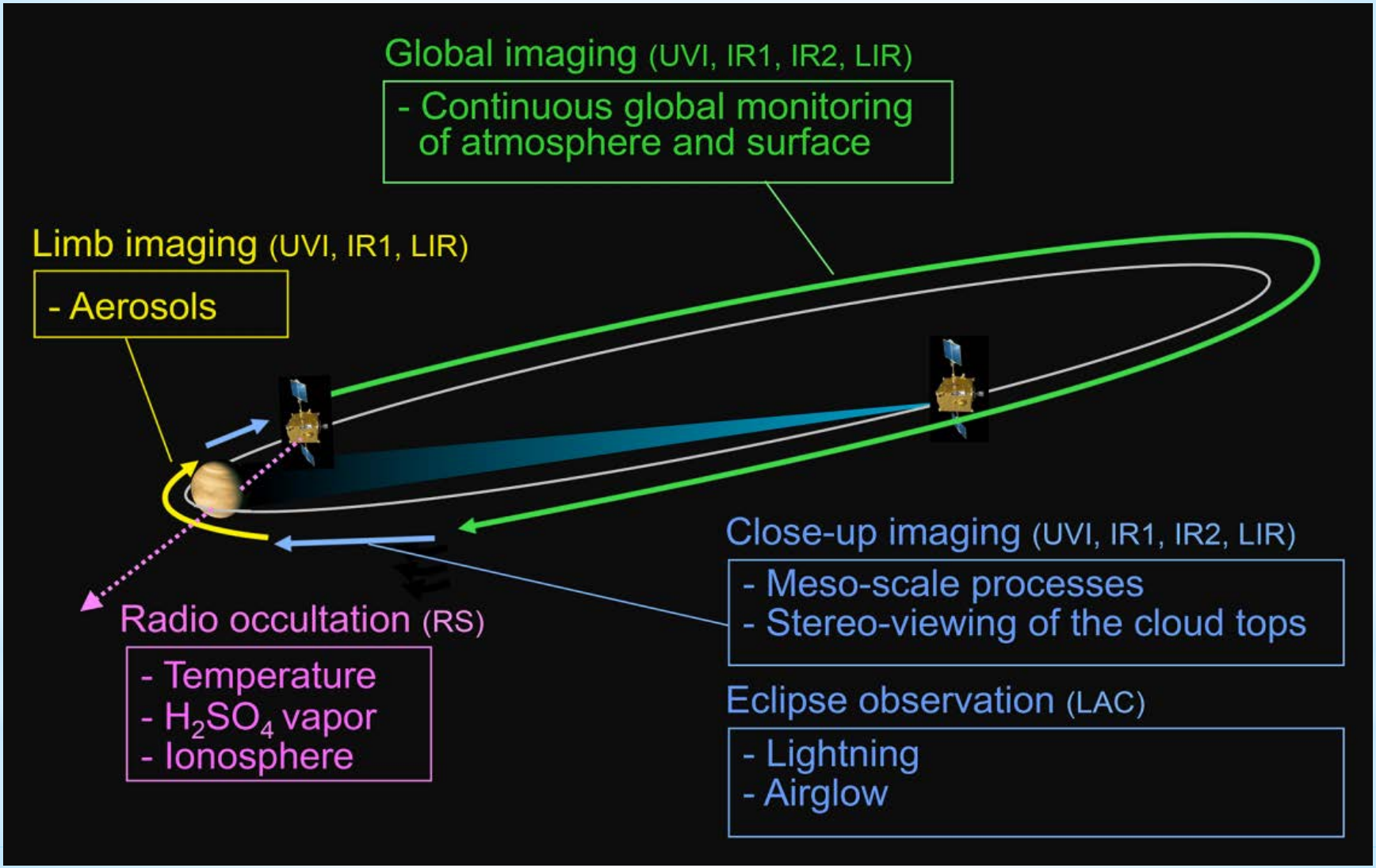
Multispectral Day and Night Cloud Morphology of Venus from Akatsuki Cameras

S.S. Limaye and the Akatsuki Team

Venera-D Modeling Workshop
Space Research Institute, Moscow
5-7 October 2017



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Camera	Channel Name	Band Center (µm)	Bandwidth (micron)	Transmittance	Pixel Size (mm)	# Lines	# Samples	Focal Length (mm)	Day/Night
IR1	090d	0.900	0.00910	0.0027	0.017	1024	1024	84.2	Day
	090n	0.898	0.02890	0.74	0.017	1024	1024	84.2	Night
	097	0.969	0.03860	0.78	0.017	1024	1024	84.2	Night
	101	1.009	0.03910	0.75	0.017	1024	1024	84.2	Night
IR2	174	1.735	0.041	0.85	0.017	1024	1024	85.41	Night
	226	2.26	0.052	0.67	0.017	1024	1024	85.44	Night
	232	2.32	0.036	0.67	0.017	1024	1024	85.41	Night
	202	2.02	0.039	0.06	0.017	1024	1024	85.50	Day
	165	1.65	0.283	0.93	0.034	520	520	85.35	-
UVI	283	0.283	0.014	0.280	0.013	1024	1024	63.3	Day
	365	0.365	0.014	0.509	0.013	1024	1024	63.3	Day
LIR		10.00	4.00	-	0.037	328	248	42.2	Day and Night

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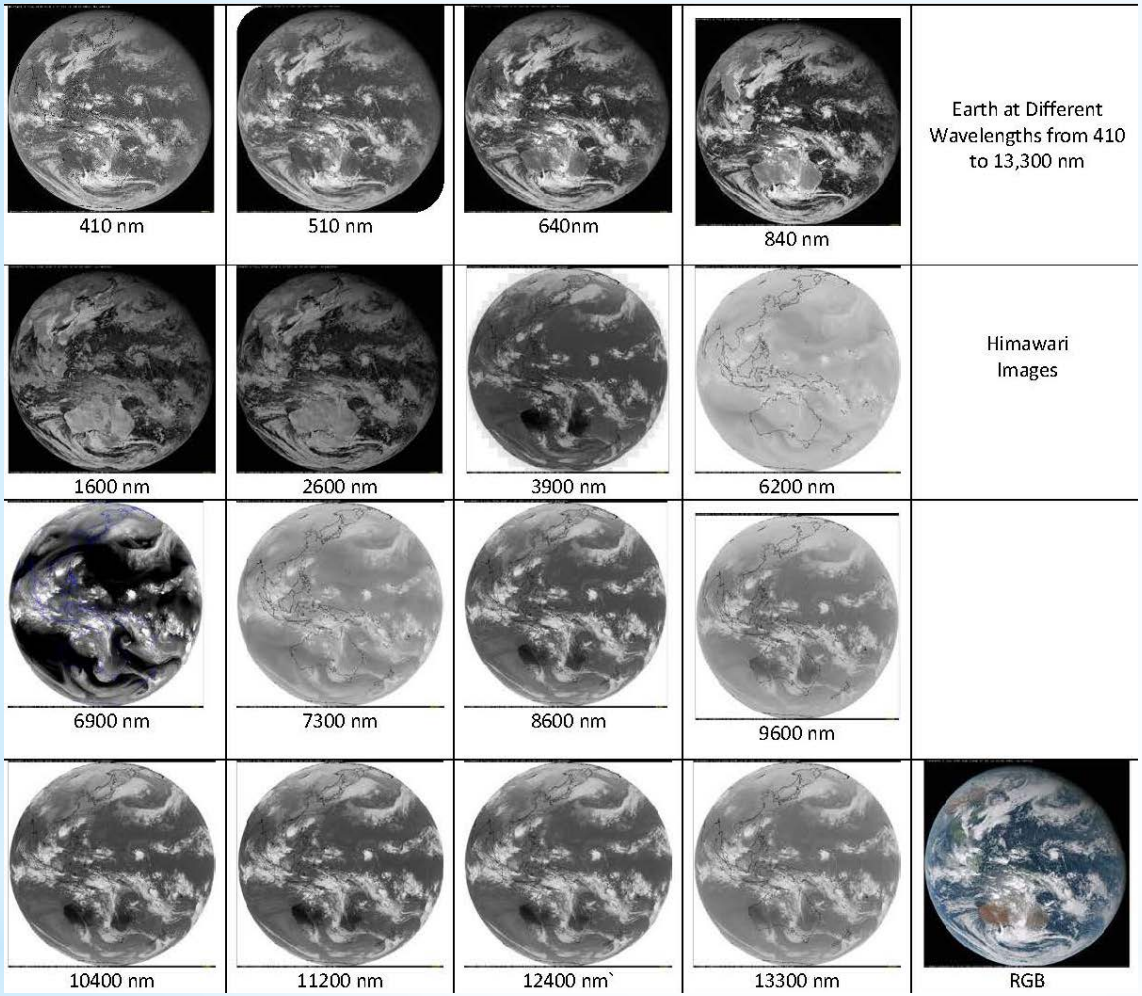

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18:10 UT
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"950 BW 7"
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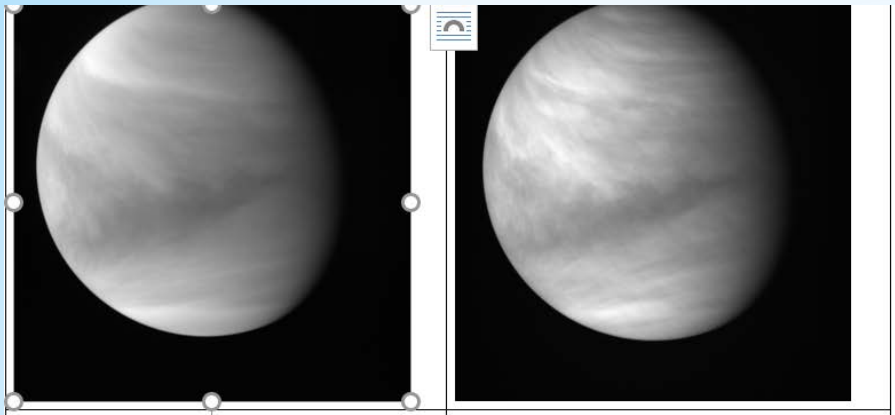

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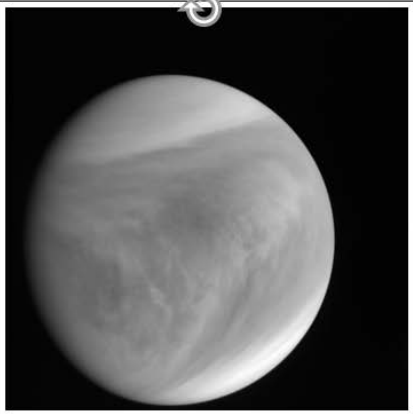

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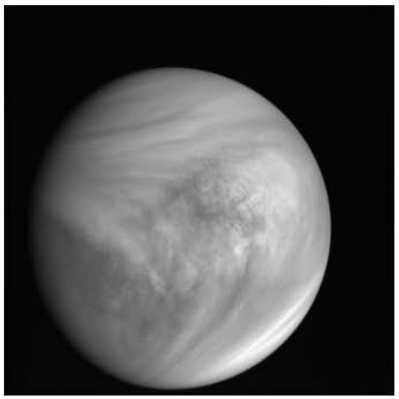

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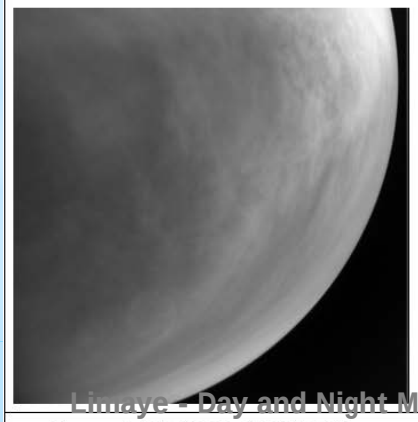

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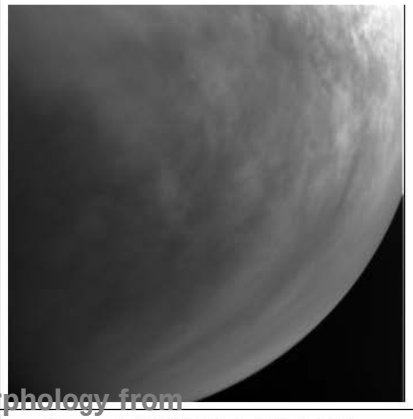

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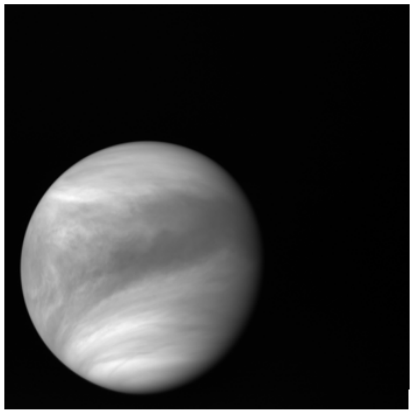

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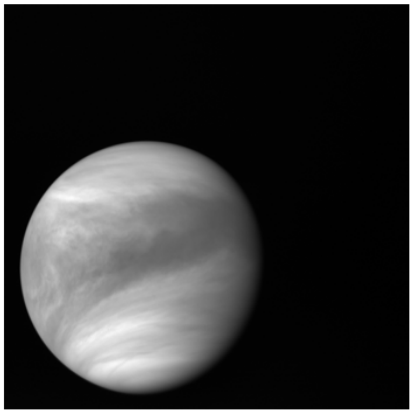

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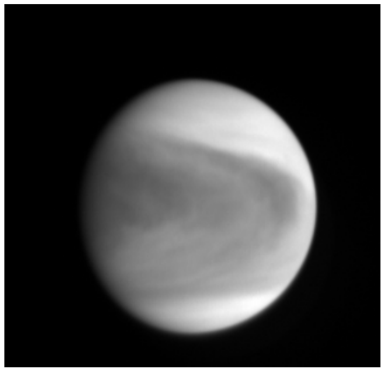

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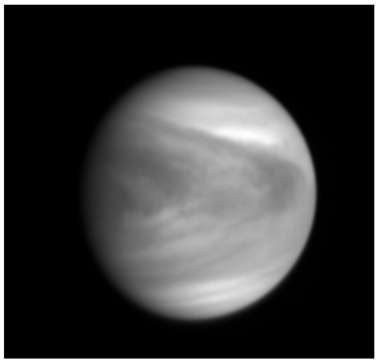

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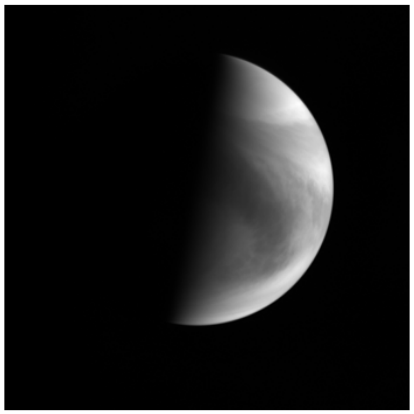

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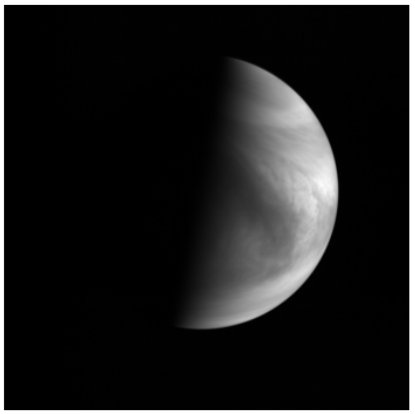

L. 20170205_180445_365

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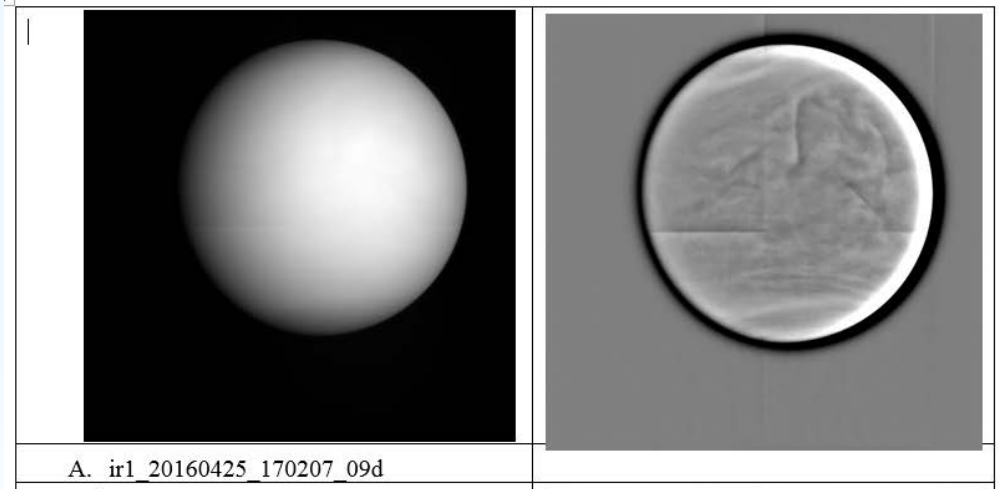

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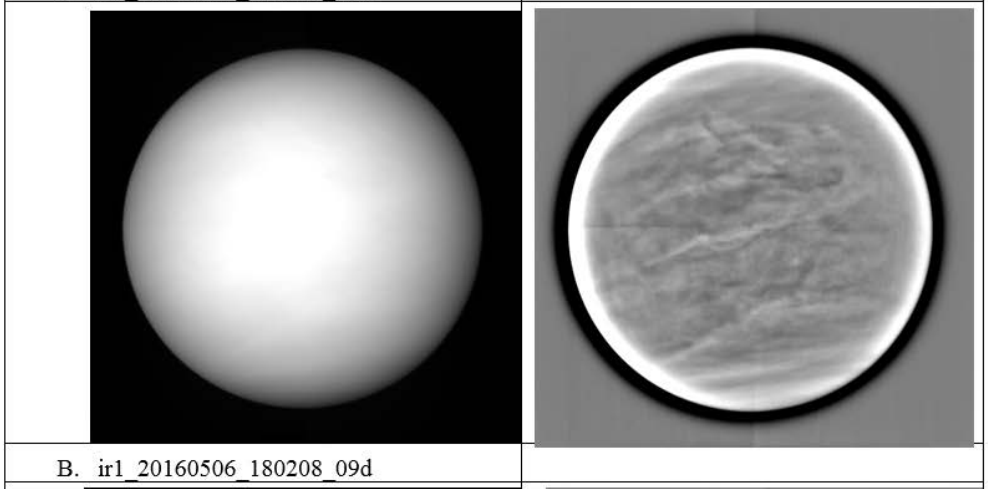

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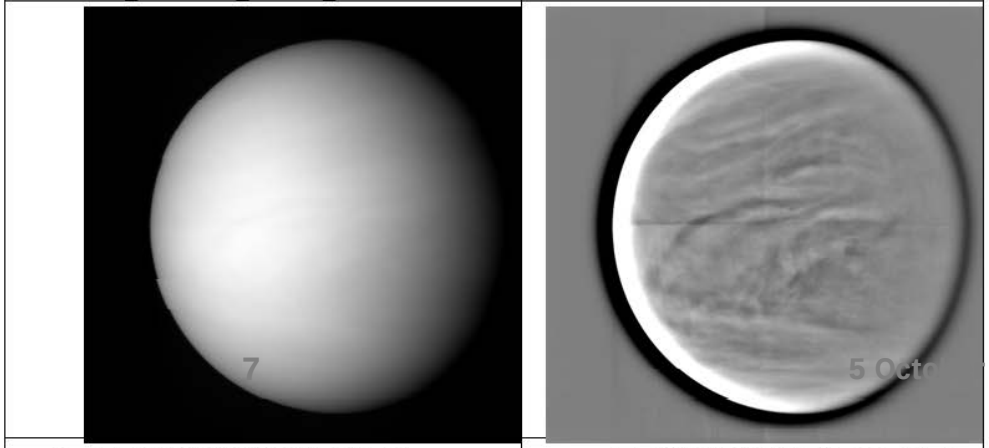

C. ir1_20160517_200207_09d_l2b ir1_20160517_200207_09d_l2b_hp

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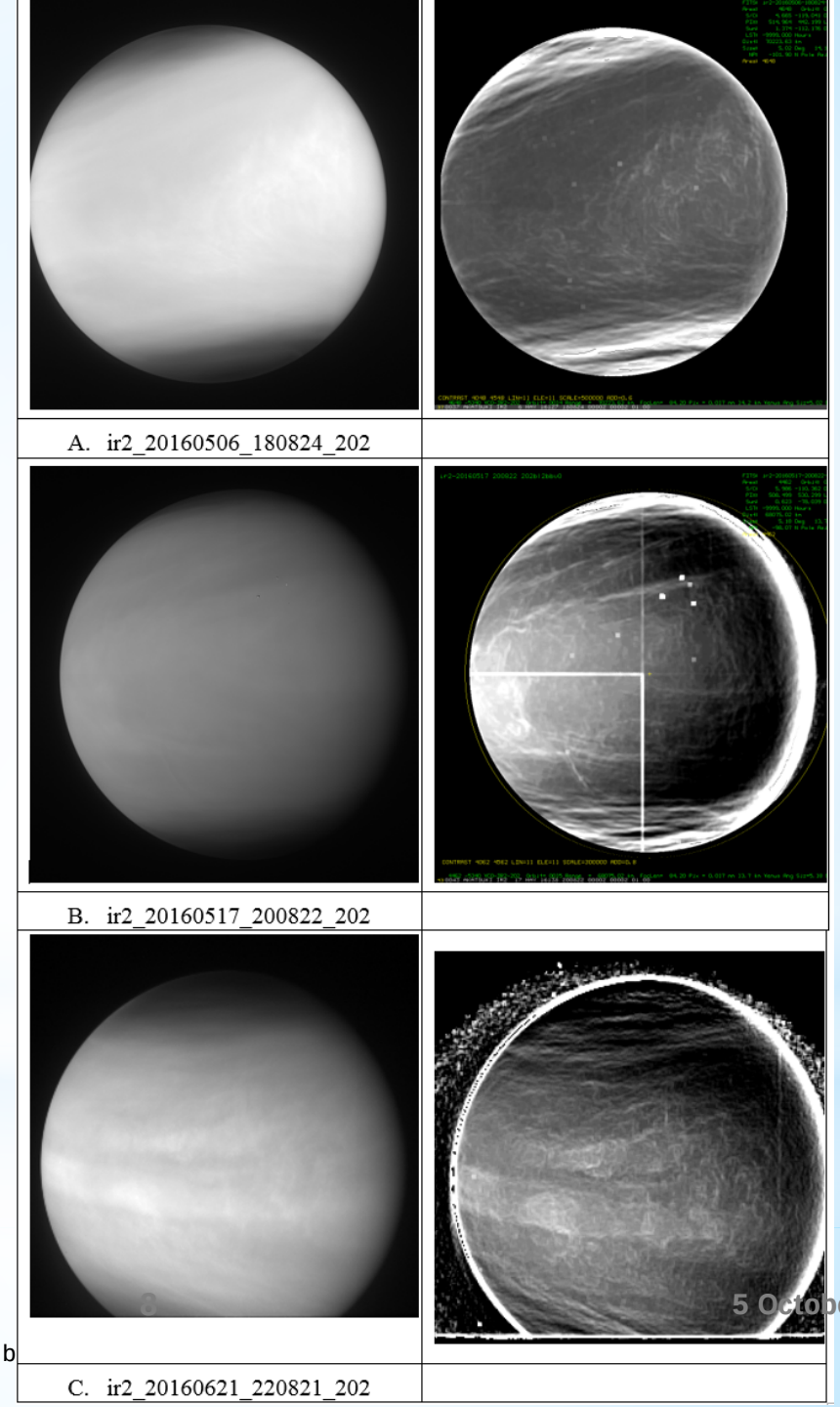
At 2.o2 µm (IR2) the appearance of Venus is generally different from what is seen at 0.9 µm.

The most visible feature is a dark high latitude region close to the high latitude boundary seen in the LIR images.

CO_2 absorbs at this wavelength, so the images reveal some altitude variations of cloud tops

Left column shows calibrated (I2b) images and the right column shows contrast filtered versions



A. ir2_20160506_180824_202

B. ir2_20160517_200822_202

C. ir2_20160621_220821_202

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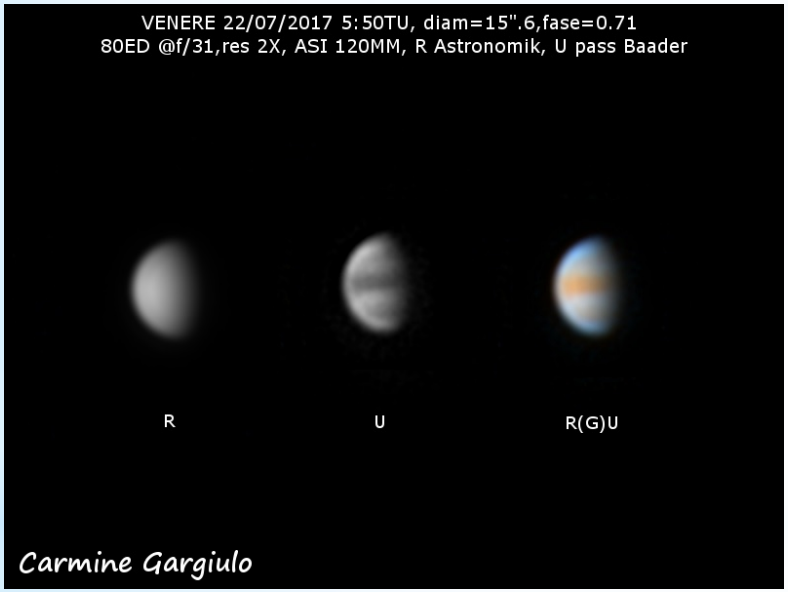

The high latitude dark region shows some banded structure with some waves where as the low and mid-latitudes show a variety of formations from small, discrete features to large areas of different brightness with sharp boundaries.

Occasionally some bans can be seen at equatorial latitudes

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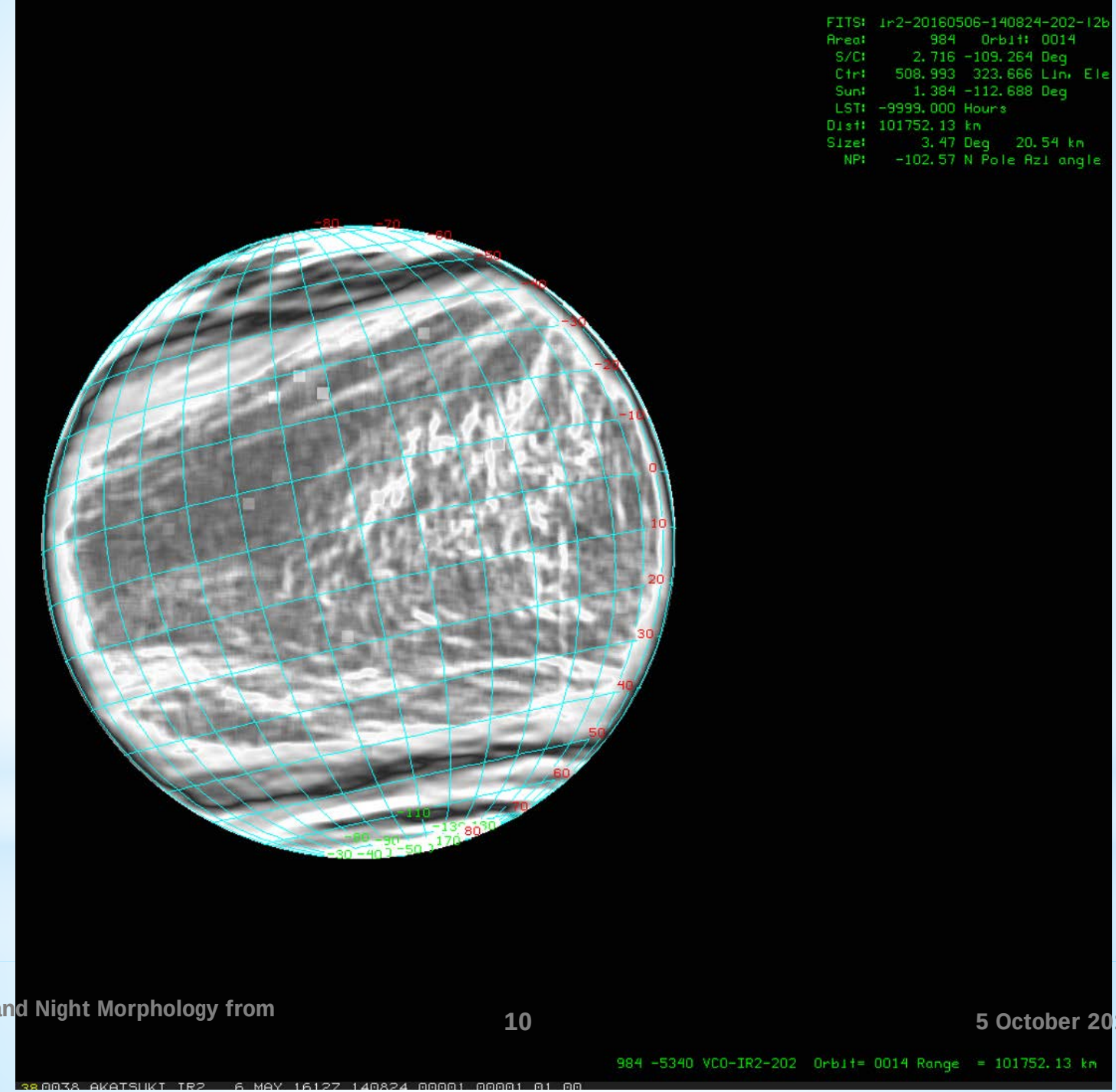
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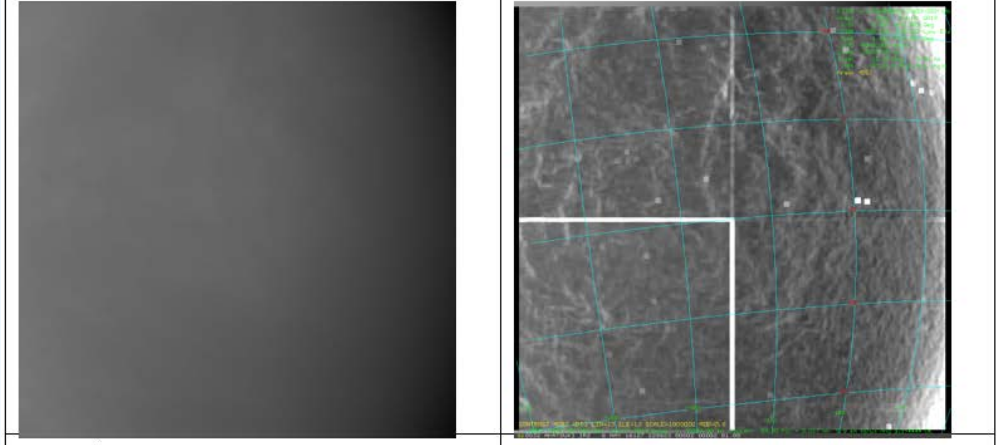
Area: 984 Orbit: 0014
S/C: 2.716 -109.264 Deg
Ctr: 508.993 323.666 Lin, Ele
Sun: 1.384 -112.688 Deg
LST: -9999.000 Hours
Dist: 101752.13 km
Size: 3.47 Deg 20.54 km
NP: -102.57 N Pole Azi angle
984 -5340 VCO-IR2-202 Orbit= 0014 Range = 101752.13 km

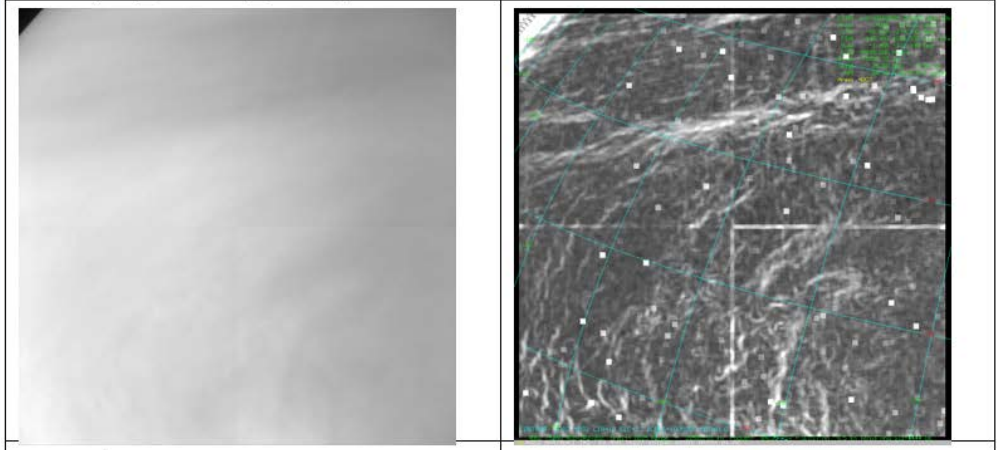
In high resolution images (~ 5 km/pixel) the 2.02 images show smaller contrasts, but isolated features can also be seen most of the time.

Occasionally some puzzling features are seen (Image C)

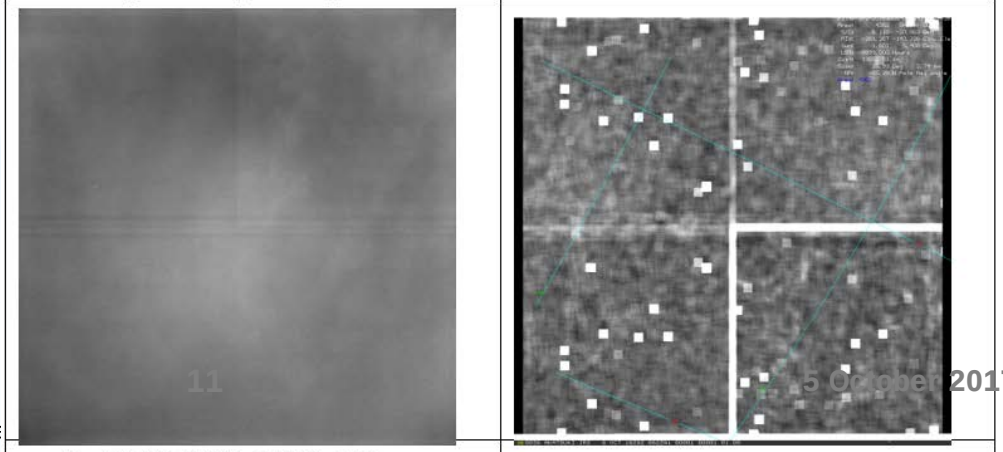
Calibrated images are shown on the left and contrast filtered versions are shown on the right



A. ir2_20160506_220823_202

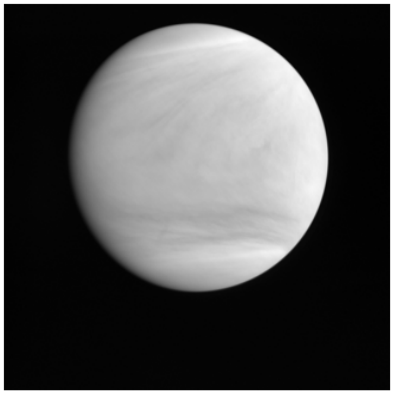


B. ir2_20160824_203242_202



C. ir2_20161008_062241_202

Simultaneous views at 283 nm, 365 nm, 0.9 µm and 2.02 µm



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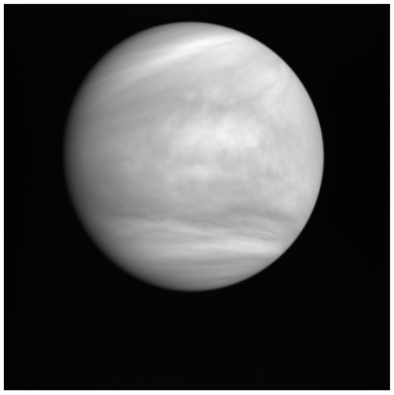
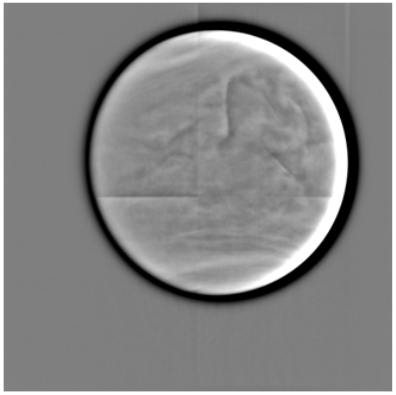
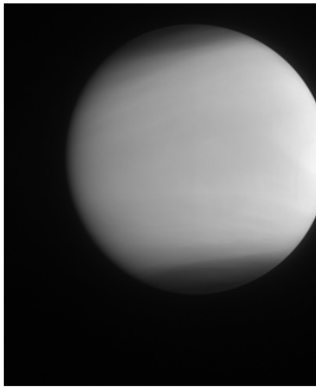


uvi_20160425_171716_365





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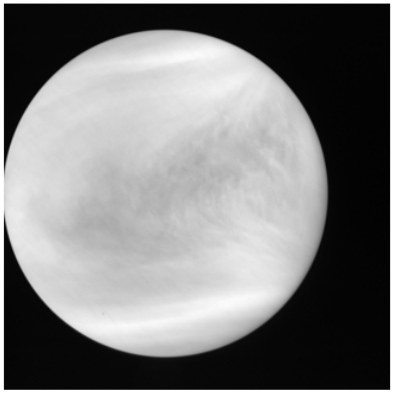

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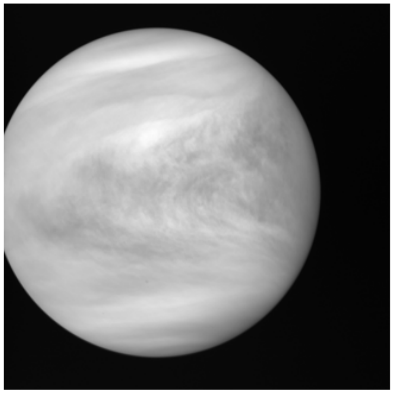

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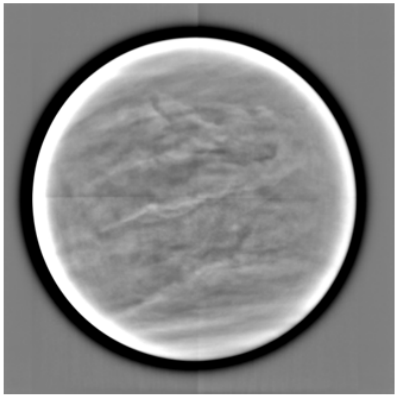

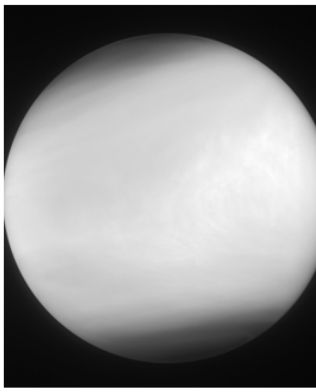

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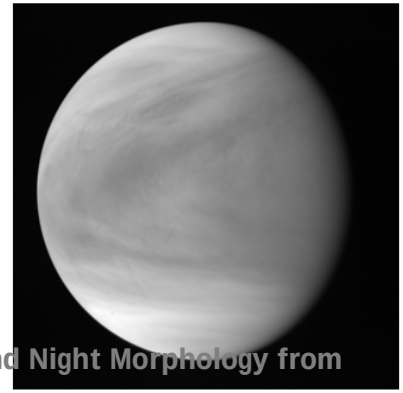

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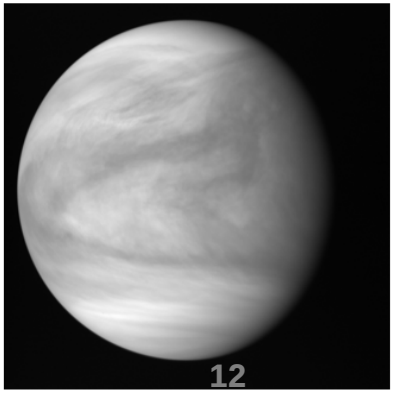

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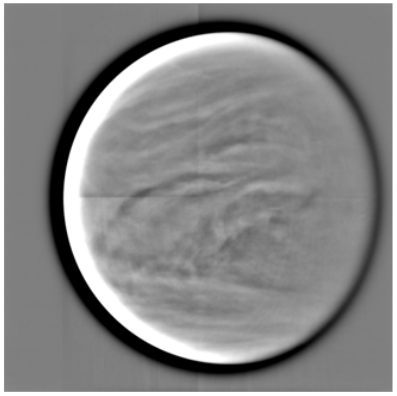
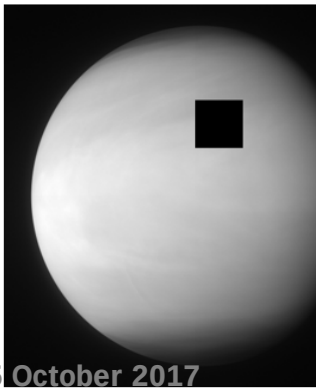
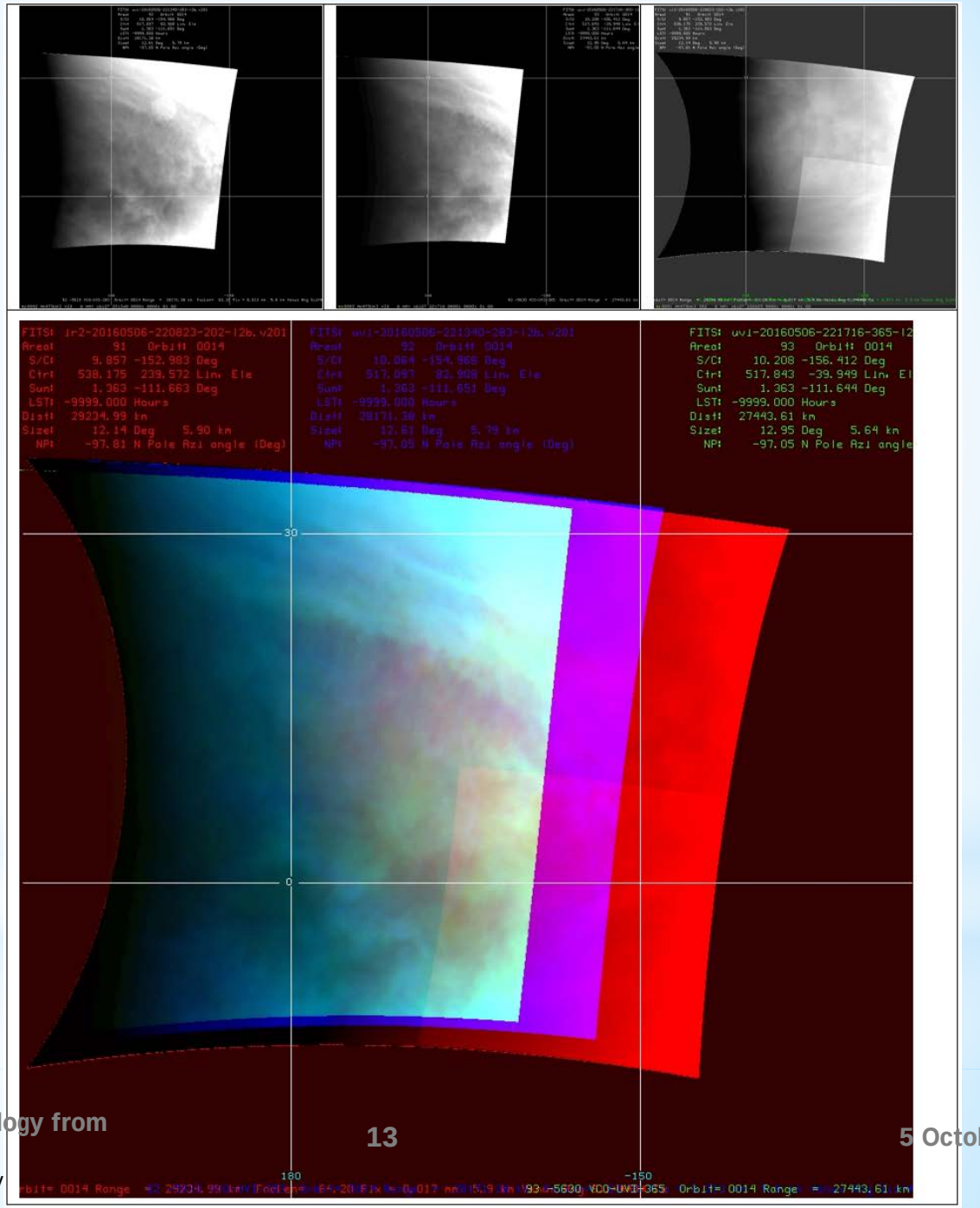


ir1_20160517_200207_09d



ir2_20160517_200822_

High resolution (~ 5 km/pixel) color composite of 2.02 (Red), 283 nm (Blue) and 365 nm (Green) images



Approv

Nightside Morphology at near IR wavelengths

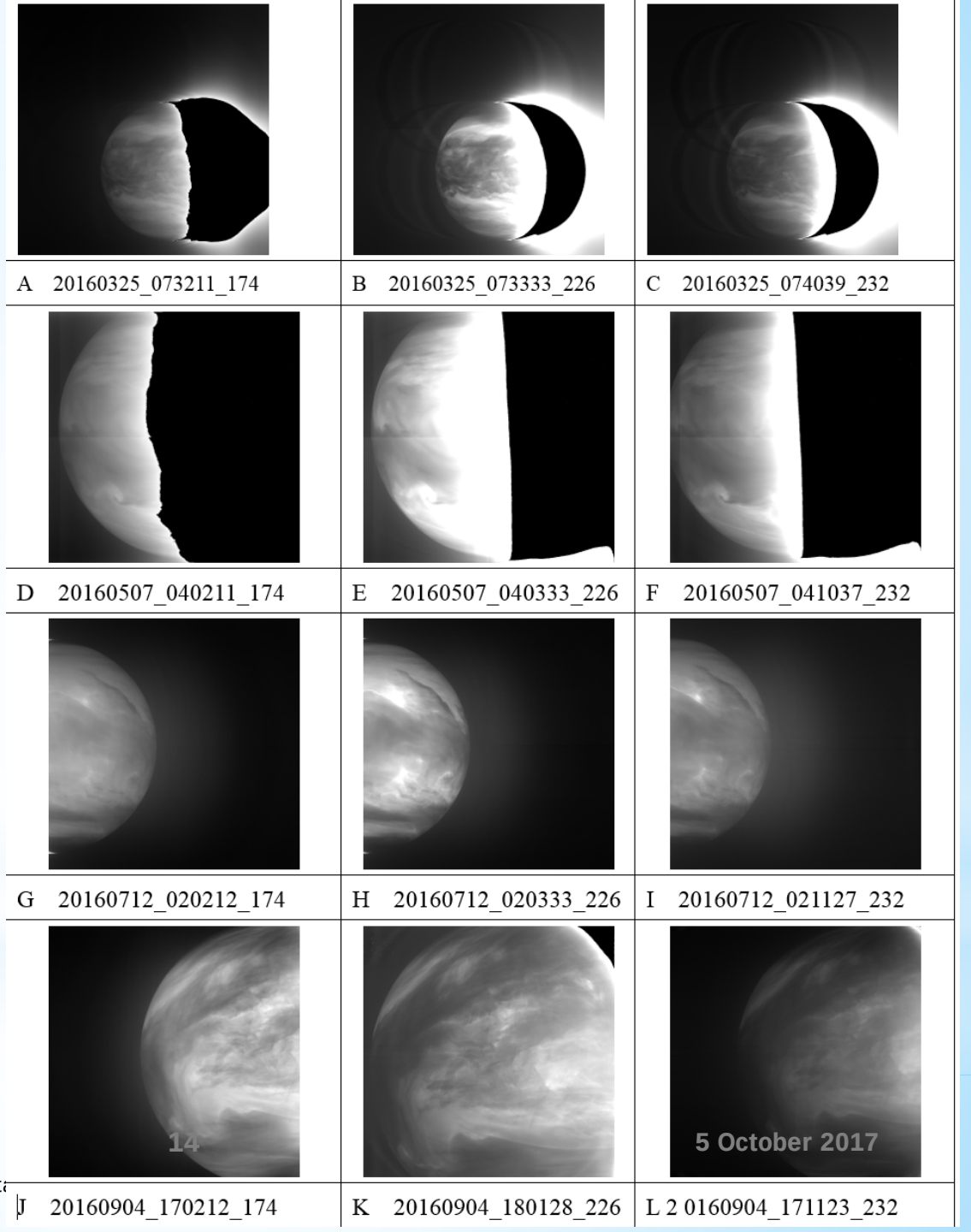
1.74, 2.26 and 2.32 μm images from IR2

Very different morphologies!

Looking at different depths of the cloud layer

Sometimes large scale features seen at UV wavelengths, at others completely different

Meso-scale features (local circulations) appear at some times



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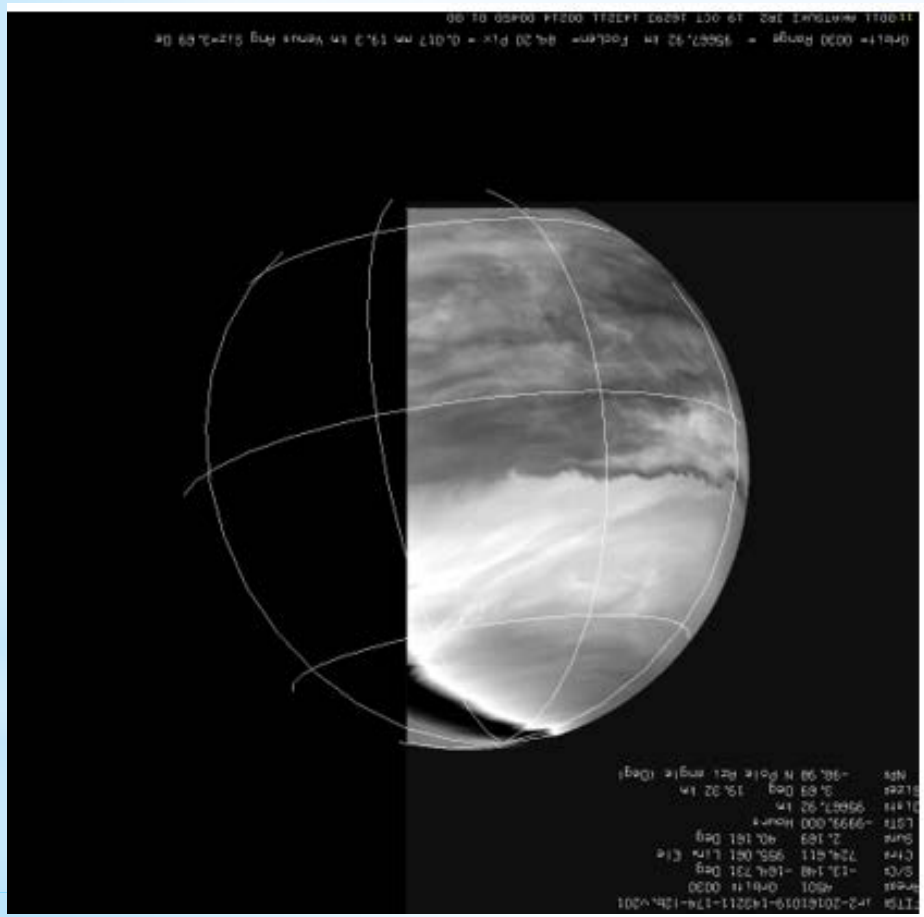
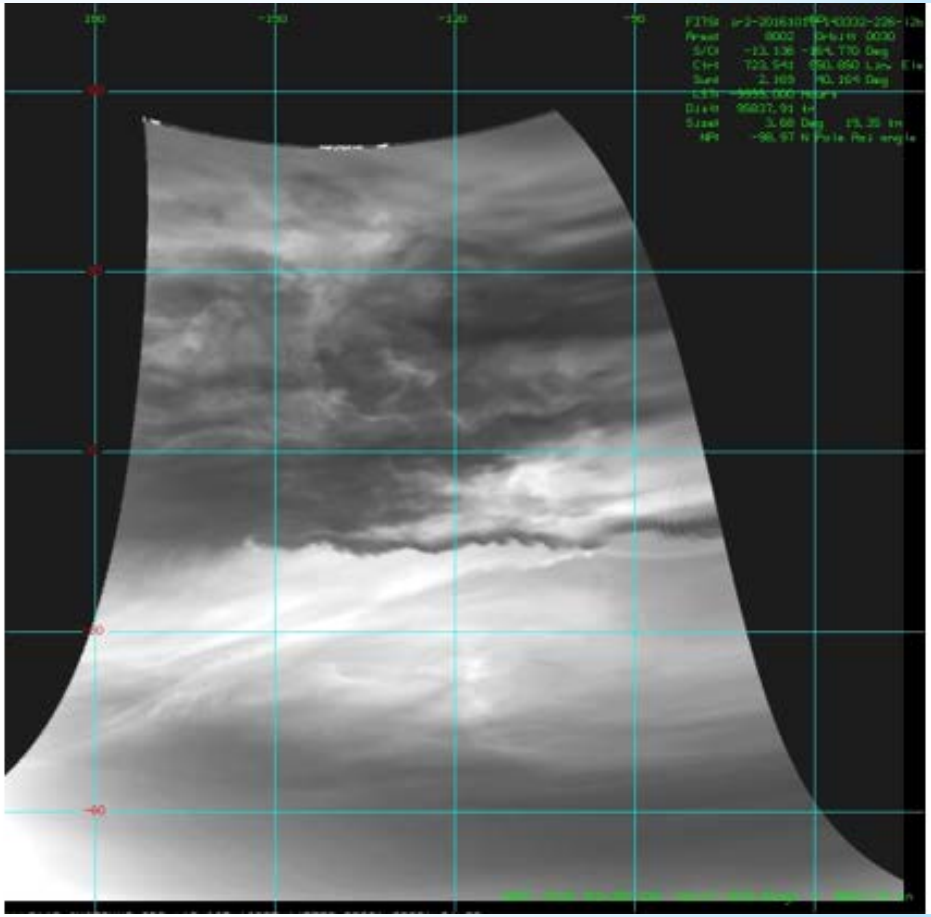
Ribbon Waves with sharp boundary seen on the nightside with almost zonal alignment





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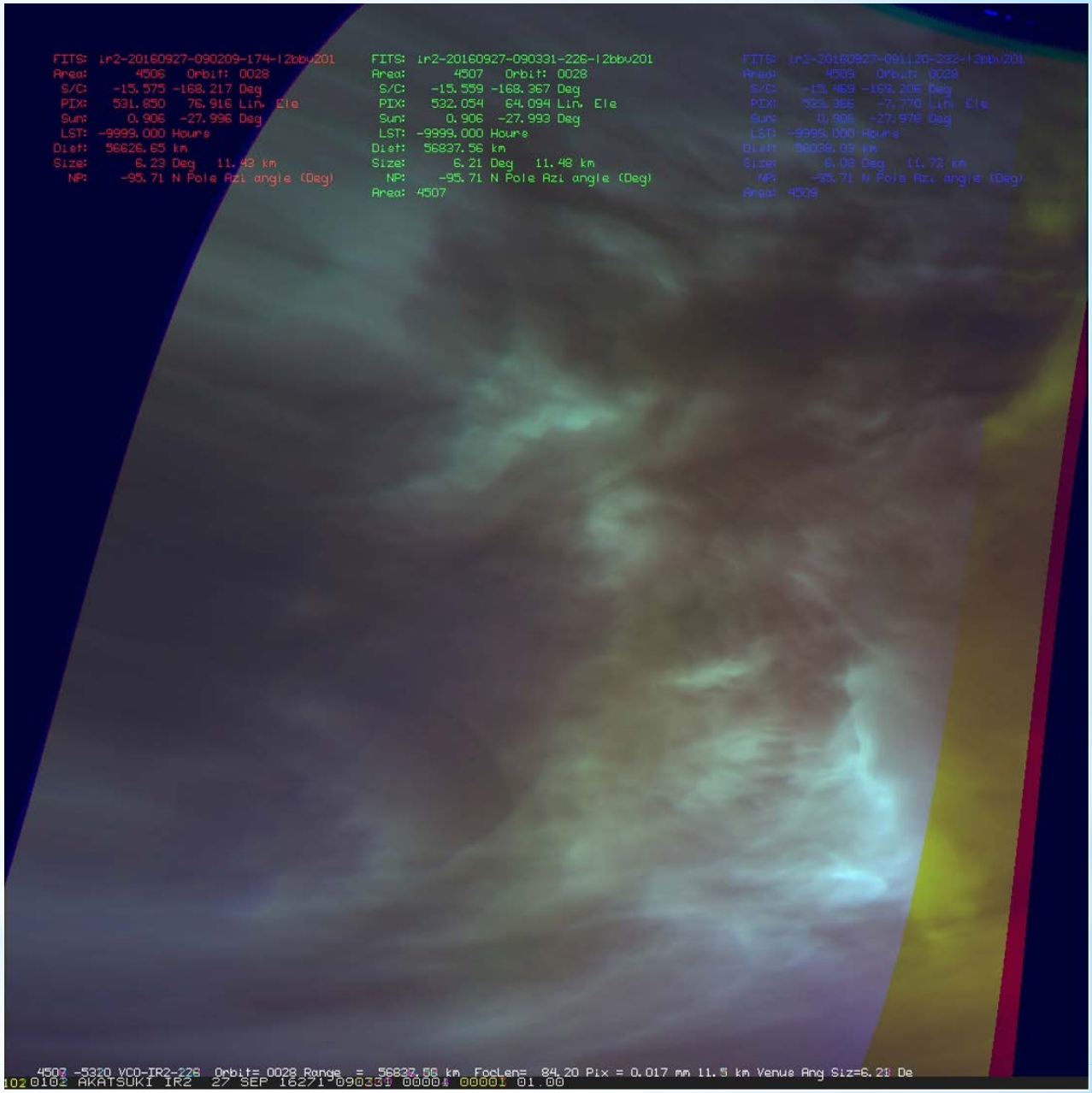
Multispectral coverage can reveal subtle differences in the cloud properties

Color composite of 1.74 (Red), 2.26 (Green) and 2.32 μm (Blue) images at ~ 11.5 km/pixel



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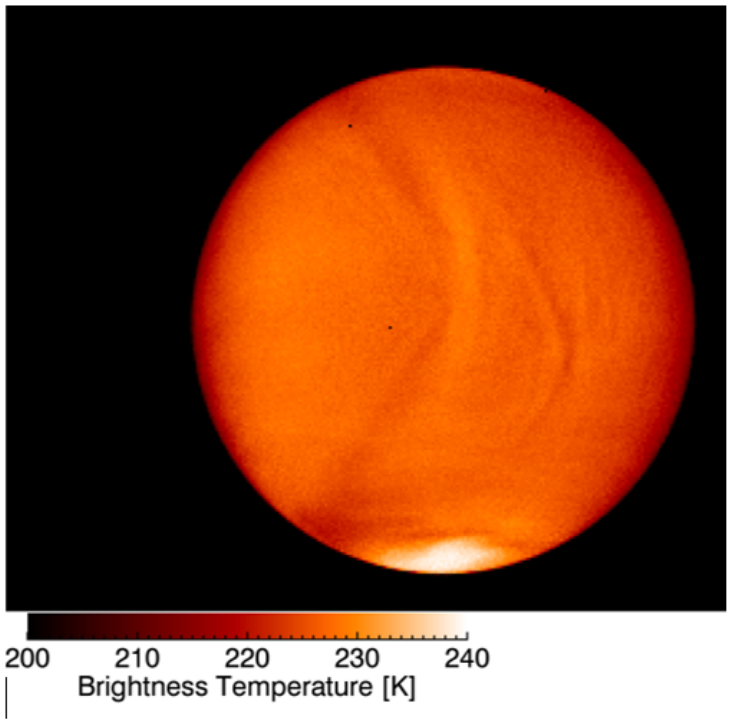

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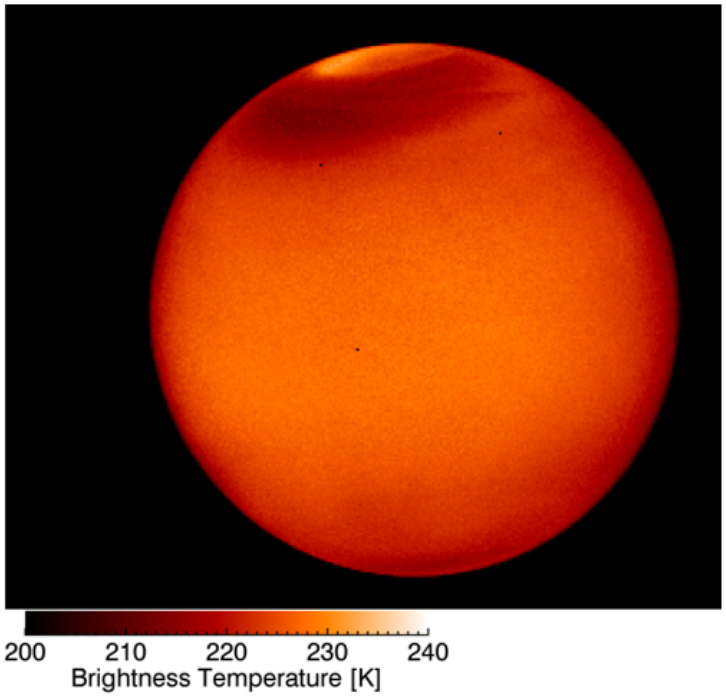

B. 20160506_182053_pic

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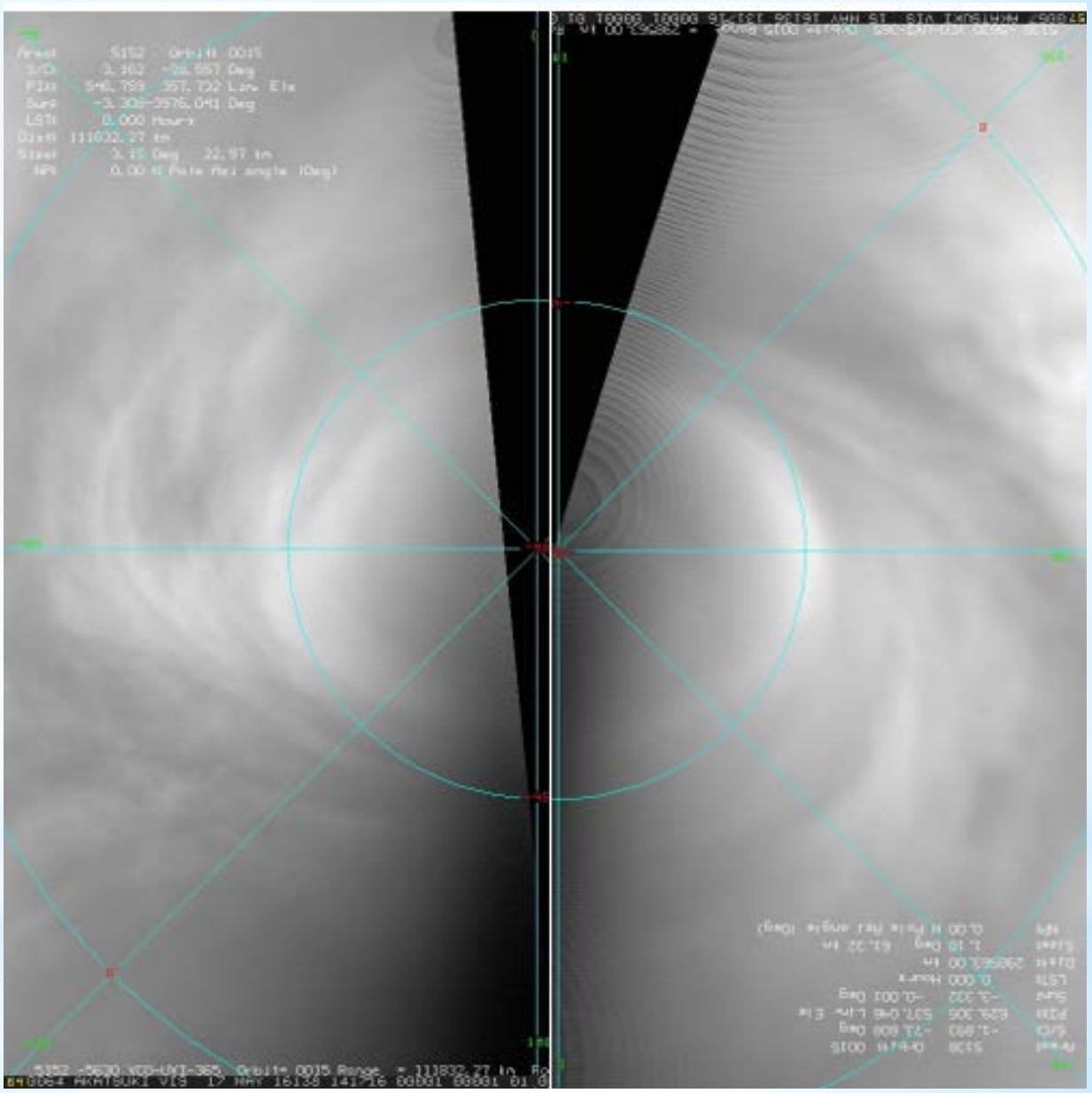
UVI images confirm the presence of the vortex organization – a permanent feature of the atmospheric circulation?



The presence of the vortex implies the presence of a mid-latitude jet whose amplitude varies as the vortex vacillates

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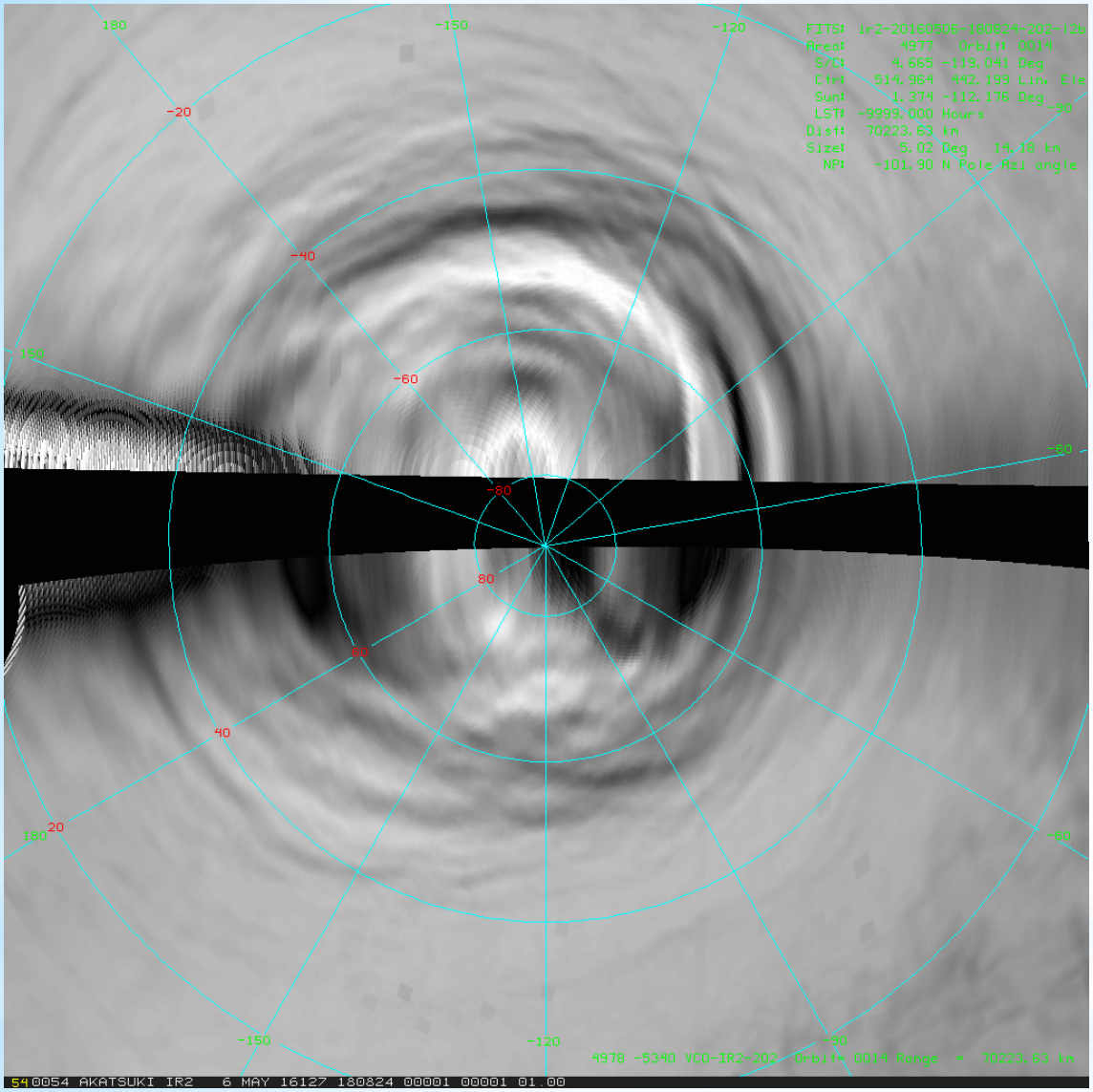

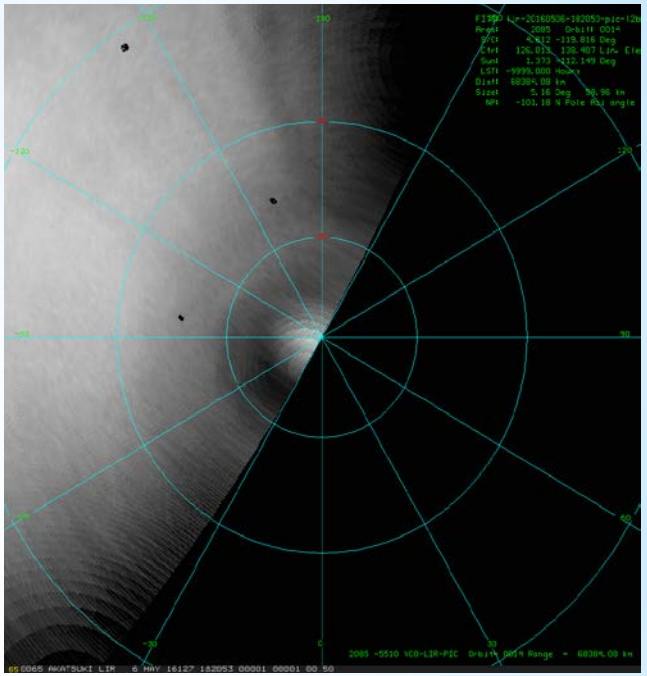

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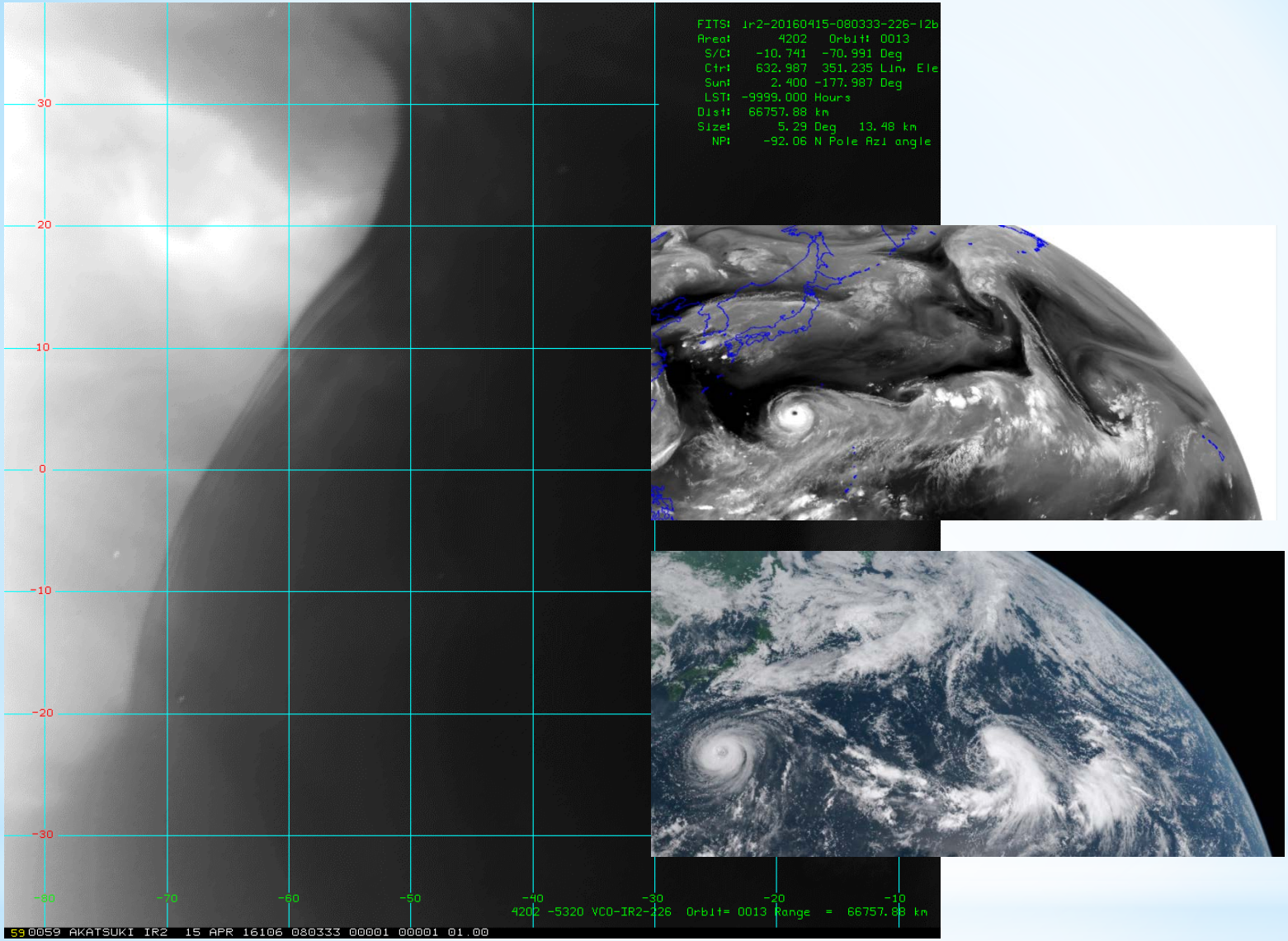

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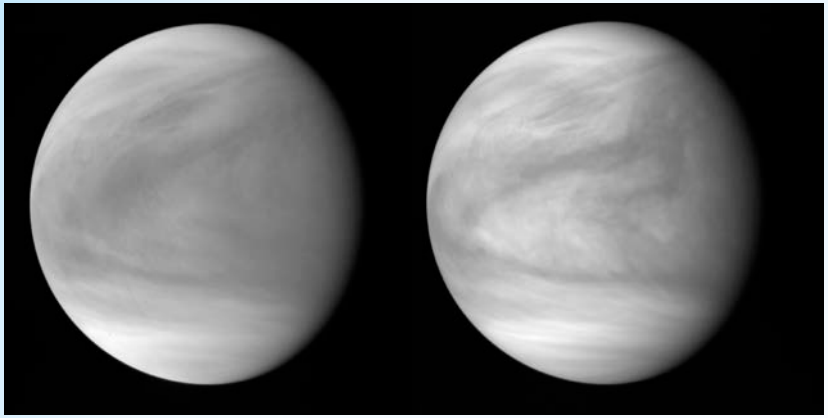

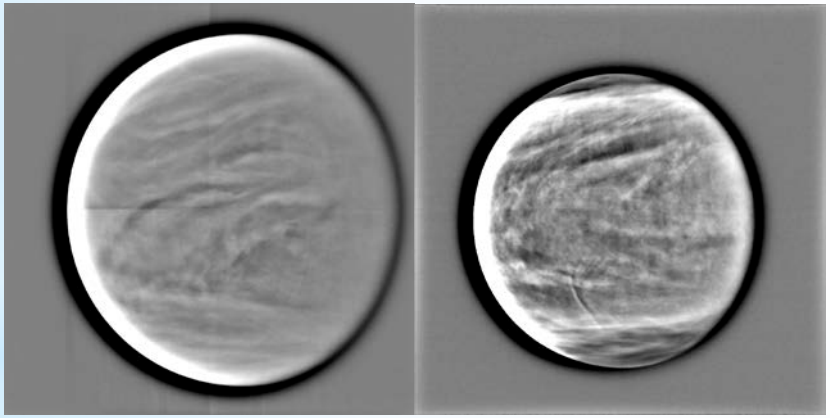

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Summary:

Venus cloud cover appears different at different wavelengths on day side and night side compared to global cloud cover on Earth

Differences due to different cloud forming processes at work, different cloud particle constituents and perhaps the temperature and pressure conditions

Not well understood why the contrasts peak at 365 nm on the day side and near 2.3 μm on the night side

Absorbers of incident sunlight at $\lambda < 600$ nm include SO_2, CS_2, COS which have been detected in the atmosphere of Venus and some others whose nature (organic or inorganic) and form (gaseous/vapor or particulate) is not yet known

There is a clear boundary in the morphology patterns at mid latitudes at all wavelengths (45-55°) except at thermal infrared (8-14 μm) where the boundary is between 60-70° latitude.

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