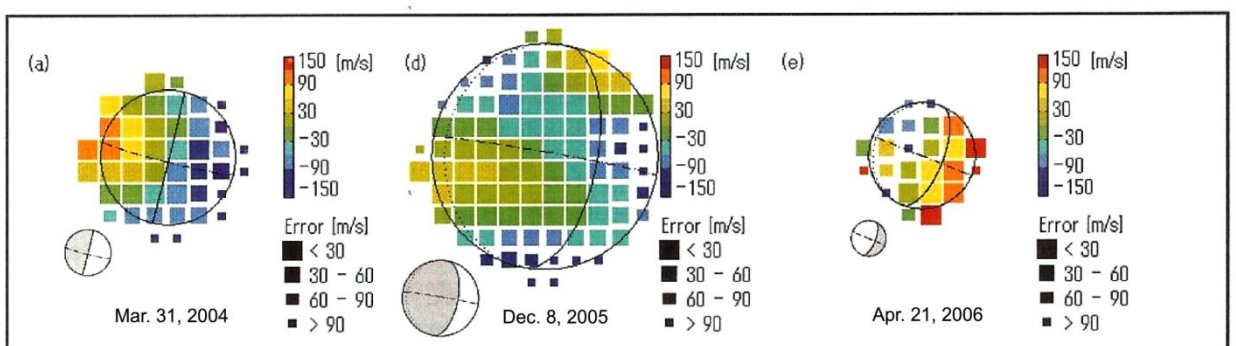
Supporting Spacecraft Missions with Ground-Based Observations

(4.3.2 Planetary Atmosphere)

Motivation

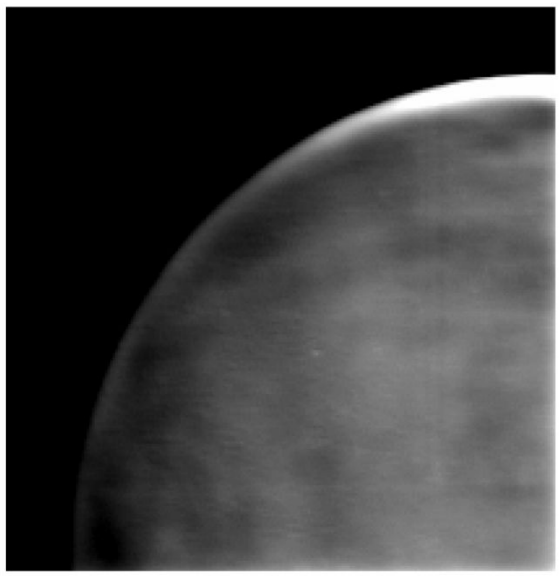
Spacecraft missions are with limitations in many aspects. Ground-based observations (more flexibility) are, therefore, useful and can compensate for what can *not* be seen from the space. Presented here are data in variety of wavelengths acquired by our group from the ground.



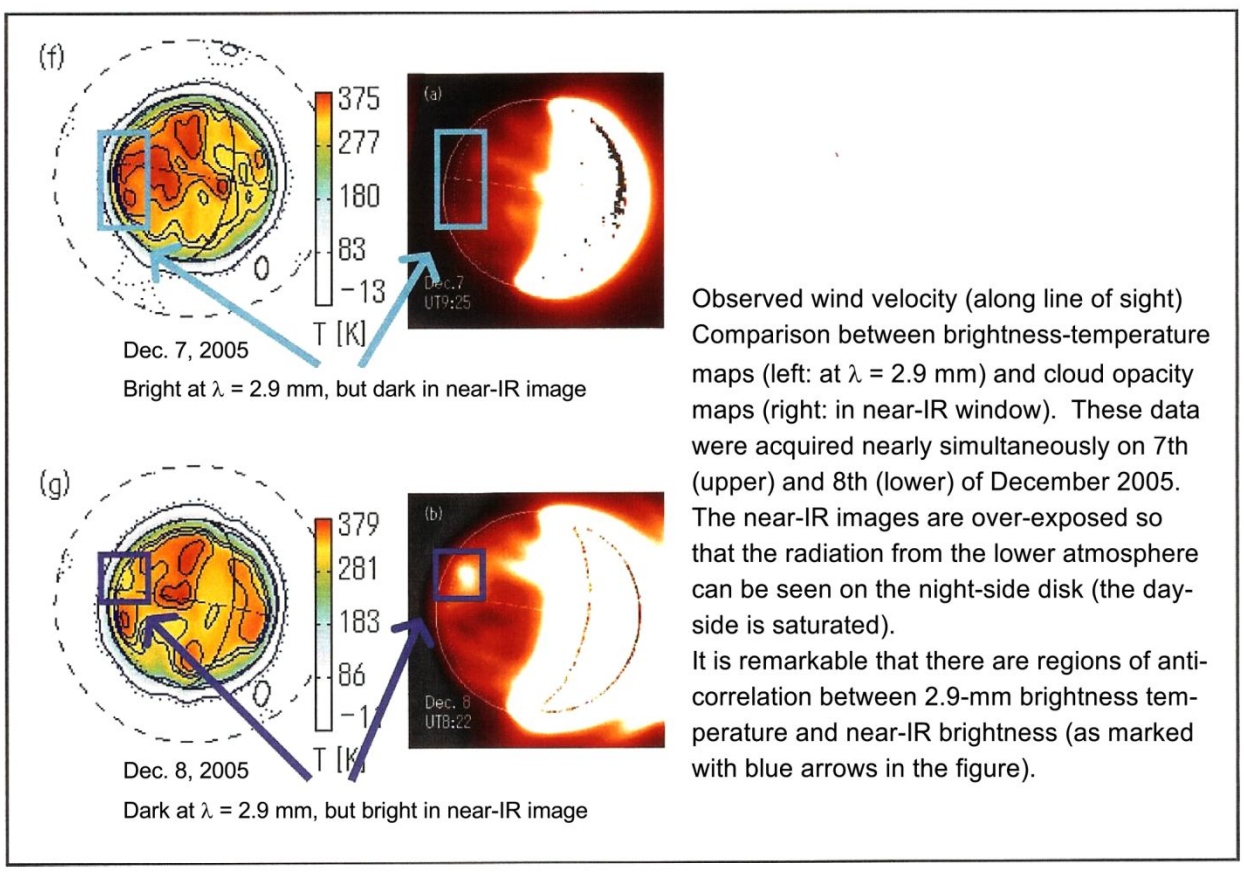
Observed wind velocity (along line of sight) distribution across Venus disk as observed in millimeter wavelength region (Nobeyama Millimeter Array). Red shift means the air moves away from the Earth and the blue shift is towards. The size of square is proportional to estimated error in the wind velocity. Taking into account for the angle of illumination, general wind pattern seems to be from the day to the night in all observations. The December 2005 data, with the highest spatial resolution, reveals north-south asymmetry, "night-to-day" (or eastward) flow in higher latitudes in the north.

Millimeter/near-IR observations of Venus atmosphere

Radio wave penetrates Venus atmosphere with lesser extinction due to clouds, while near-IR radiation from deeper atmosphere emerges with strong modulations by cloud opacity. Our observations in these two regions effectively separate variations of atmospheric temperature from variations of cloud opacity as demonstrated here. These are expected to greatly contribute to understandings of production/maintenance mechanisms of voluminous Venus clouds.



A map of Venus cloud-top temperature as observed in mid-IR wavelength (COMICS on Subaru Telescope). This image was acquired on December 16, 2005.
Study of physical/chemical processes near the cloud top, combining these with data from ESA's Venus Express, is in progress. We will accumulate more ground-based data, together with those from spacecraft, to answer the outstanding questions about Venus clouds and hazes.



Observed wind velocity (along line of sight) Comparison between brightness-temperature maps (left: at λ = 2.9 mm) and cloud opacity maps (right: in near-IR window). These data were acquired nearly simultaneously on 7th (upper) and 8th (lower) of December 2005. The near-IR images are over-exposed so that the radiation from the lower atmosphere can be seen on the night-side disk (the day-side is saturated).
It is remarkable that there are regions of anti-correlation between 2.9-mm brightness temperature and near-IR brightness (as marked with blue arrows in the figure).

Mid-IR mapping of Venus cloud top

Mid-IR (λ = 8–11 μm) region is sensitive to temperatures near cloud top. Our study with Subaru/COMICS high-resolution data unveils motions/waves, near cloud top, which may contain information different from those accessible in UV, visible, and near-IR.

Neither PLANET-C nor Venus Express (ESA) is capable of millimeter observation. Ground-based study is therefore valuable and we continue this to support on-going/future spacecraft missions.