Geophysical Research Abstracts, Vol. 9, 05768, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05768

Ground-based observations of the Venus 1.27-μm O_2 airglow and rotational temperature

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Several ground-based observations of the Venus 1.27-μm O_2 airglow were carried out from 2002 to 2006. Spectral image cubes were taken with Okayama Astrophysical Observatory/infrared imaging spectrometer (superOASIS), with the Gunma Astronomical Observatory/near-infrared camera and with the NASA's Infrared Telescope Facility/cryogenic echelle spectrograph (CSHELL). Spectral resolutions $\lambda/\Delta\lambda$ of the spectra observed at OAO and GAO were $\sim$1,000–1,500, and the spectra show the features of O_2 airglow, thermal emission, stray light from bright dayside. Each component was calculated using HITRAN and HITEMP which are molecular spectrum databases, VIRA1985 which is an empirical model of the Venus atmosphere, and US Standard Atmosphere (1976). The contributions of the three components and the rotational temperature were determined by optimizing the synthesized spectrum. On the other hand, spectral resolution of obtained at IRTF was $\sim$40,000, with which each rotational line was resolved. From slopes of the Boltzmann plot, the rotational temperatures were determined. The brightest airglow features were found at around the anti-solar point, which agrees with previous studies. And spatially resolved rotational temperature maps on the nightside hemisphere were also derived. They have some hotter regions which seem to overlap with bright regions. The temperature shows a positive correlation with the airglow intensity. This result indicates the bright region is heated chemically and/or dynamically, and supports the existing scenario for the Venus O_2 airglow. That is, the airglow is excited by the descending oxygen molecules which are transported from the dayside.