Geophysical Research Abstracts
Vol. 14, EGU2012-3098, 2012
EGU General Assembly 2012

Water Vapour Abundance and Distribution in the Lower Venusian Atmosphere

S. Chamberlain (1) and J. Bailey (2)

(1) University of Lisbon, Centre for Astronomy and Astrophysics (CAAUL), Lisbon Astronomical Observatory, Lisbon, Portugal (sac@oal.ul.pt), (2) University of New South Wales, School of Physics, Sydney, Australia

We present ground-based observations and modelling studies of water vapour abundance and distribution in the Venusian lower atmosphere through analysis of absorption band depths within the 1.18 μm window.

The lower atmosphere of Venus is difficult to study by both *in situ* and remote instruments. This is due to the planet wide cloud cover that obscures visual wavelengths and surface pressures approaching 100 times that of the Earth. In 1984 ground based observations resulted in the discovery of atmospheric windows on the Venusian nightside (Allen and Crawford, 1984). Here, near infrared radiation originating at the surface and lower atmosphere, pass relatively unimpeded through the Venus clouds. This discovery enabled remote studies of the Venusian subcloud region.

Determining the abundance and distribution of water vapour is key to understanding the development, maintenance and links between major radiative and dynamical features of the Venus atmosphere. Water vapour in the lower atmosphere plays an important role in heat transfer and is pertinent to the runaway greenhouse effect and dynamical superrotation observed on Venus. Detailed studies of water vapour abundance and distribution throughout the lower atmosphere of Venus are therefore needed in order to develop accurate chemical, radiative and dynamical models.

Ground-based spatially resolved near infrared spectroscopic observations of the Venusian nightside have been obtained from Siding Spring Observatory at each inferior conjunction since 2002. Observations have been made using the IRIS2 instrument on the Anglo-Australian Telescope and CASPIR on the 2.3m ANU telescope. The model VSTAR (Bailey and Kedziora-Chudczer 2012) is used to simulate the observed Venus spectra as seen through the Earth's atmosphere and best fit water vapour abundances are found for approximately 300 locations across the Venus nightside disk. Recent improvements in ground-based near-infrared instruments allow a substantial improvement in the spectral and spatial resolutions that can be achieved, whilst recent updates to high temperature line lists have been critical to improving the accuracy of spectroscopic modelling for the hot Venus atmosphere (Bailey 2009).

Prior to these studies, water vapour abundances have been derived by modelling the spectral shape of the 1.18 μm window, in particular the gradient of the short wavelength wing where water vapour has a strong influence (Meadows and Crisp, 1996; Bézard et al., 2009,2011). Here we present best fit abundances and distributions determined by matching water vapour absorption bands located at 1.174 μm, 1.178 μm and 1.182 μm. We compare these results to those obtained by matching the short wing gradient of the 1.18 μm window. Results confirm previous findings for a best fit water vapour abundance of 32ppmv in the lower atmosphere and are consistent with no spatial variation. The 1.18 μm window has a peak sensitivity at 16 km altitude, however we also outline a method by which it is possible to obtain water vapour abundances from the near surface environment (0 – 4 km).

D.A. Allen and J.W. Crawford, Cloud structure on the dark side of Venus, *Nature, Lond.* **307** (1984), pp. 222–224.

J.Bailey, A comparison of water vapor line parameters for modeling the Venus deep atmosphere, *Icarus*, **201** (2009), pp. 444-453.

J. Bailey and L. Kedziora-Chudczer, 2012, Modelling the spectra of planets, brown dwarfs and stars using VSTAR, *Mon. Not. R. Astr. Soc.*, **419**, 1913-1929

B. Bézard, C. C. C. Tsang, R. W. Carlson, G. Piccioni, E. Marcq, and P. Drossart, Water vapor abundance near the surface of Venus from Venus Express/VIRTIS observations, *J. Geophys. Res.*, **114**, (2009) E00B39.

B. Bézard, A. Fedorova, J.-L. Bertaux, A. Rodin and O. Korablev, The 1.10 – and 1.18- μm nightside windows of Venus observed by SPICAV-IR aboard Venus Express, *Icarus*, **216** (2011) 173-183.

V.S. Meadows, and D. Crisp, Ground-based near-infrared observations of the Venus nightside: The thermal structure and water abundance near the surface, *J. Geophys. Res.*, **101(E2)**, (1996) pp. 4595–4622.

SC acknowledges support from the Portuguese Foundation for Science and Technology through projects PTDC/CTE-AST/110702/2009 and PEst-OE/FIS/UI2751/2011.