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New measurements of Venus winds with ground-based Doppler velocimetry at CFHT

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Since Venus Express spacecraft operations started in 2006, an ongoing effort has been made to coordinate its operations with observations from the ground using various techniques and spectral domains (Lellouch and Witasse, 2008). We present an analysis of Venus Doppler winds at cloud tops based on observations made at the Canada France Hawaii 3.6-m telescope (CFHT) with the ESPaDOnS visible spectrograph. These observations consisted of high-resolution spectra of Fraunhofer lines in the visible range (0.37–1.05 μm) to measure the winds at cloud tops using the Doppler shift of solar radiation scattered by cloud top particles in the observer's direction (Widemann et al., 2007, 2008). The observations were made during 19-20 February 2011 and were coordinated with Visual Monitoring Camera (VMC) observations by Venus Express. The complete optical spectrum was collected over 40 spectral orders at each point with 2-5 seconds exposures, at a resolution of about 80000. The observations included various points of the dayside hemisphere at a phase angle of 67º, between +10˚ and -60˚ latitude, in steps of 10˚, and from +70˚ to -12˚ longitude relative to sub-Earth meridian in steps of 12˚.

The Doppler shift measured in scattered solar light on Venus dayside results from two instantaneous motions: (1) a motion between the Sun and Venus upper cloud particles; (2) a motion between the observer and Venus clouds. The measured Doppler shift, which results from these two terms combined, varies with the planetocentric longitude and latitude and is minimum at meridian $\Phi_N = \Phi_{Sun} - \Phi_{Earth}$ where the two components subtract to each other for a pure zonal regime. Due to the need for maintaining a stable velocity reference during the course of acquisition using high resolution spectroscopy, we measure relative Doppler shifts to Φ_N. The main purpose of our work is to provide variable wind measurements with respect to the background atmosphere, complementary to simultaneous measurements made with the VMC camera onboard the Venus Express. We will present first results from this work, comparing with previous results by the CFHT/ESPaDOnS and VLT-UVES spectrographs (Machado et al., 2012), with Galileo fly-by measurements and with VEx nominal mission observations (Peralta et al., 2007, Luz et al., 2011).

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