Observation of Dynamical Tracers in the Venus Atmosphere. Machado P.[1,2] , Widemann T.[1], Luz D.[2], Peralta J.[2], Chanberlain S.[2], [1]Observatoire de Paris - LESIA, France pedro.machado@obspm.fr , [2] CAAUL-Centro de Astronomia e Astrofísica da Universidade de Lisboa, Portugal.

The core atmospheric processes of Venus and the Earth are similar, despite the different evolutionary paths they took since their formation in the Sun's habitable zone. Since the Venus Express spacecraft operations started in 2006, a continuous effort has been made to coordinate its operations with observations from the ground using various techniques and spectral domains. Understanding the vertical, horizontal and temporal distributions of minor species in the troposphere of Venus are pertinent to studies of atmospheric dynamics, radiative processes and chemical interactions. Understanding the abundance and distribution of green house gases, such as water vapor, are critical due to their influence on planetary evolution. In the lower troposphere below 40 km, the absence of clouds precludes the direct measurement of the winds, and indirect methods must be used to estimate the flow in the lower branch of the Hadley circulation. In the lower mesosphere (65-85 km), visible observations of Doppler shifts in solar Fraunhofer lines have provided the only Doppler wind measurements near the cloud tops in recent years [1,2,3]. The region is important as it constrains the global mesospheric circulation in which zonal winds generally decrease with height while thermospheric SS–AS winds increase [4,5]. Renewed interest in measuring the winds at clouds top from the ground has emerged in the course of the Venus Express mission as well as reanalysis of Galileo observations [6,7].

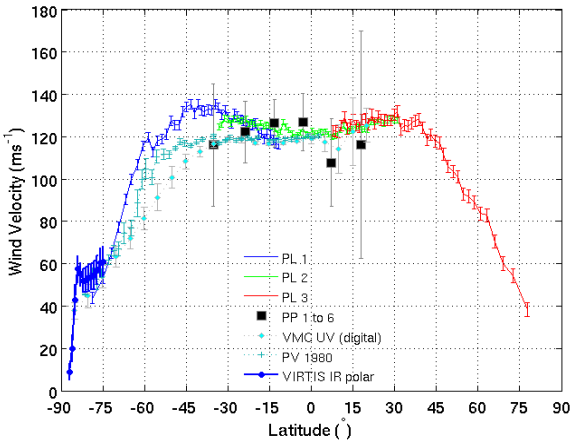

Fig. 1 - VLT/UVES has provided the first ground-based characterization of the latitudinal profile of zonal wind in the atmosphere of Venus, the first zonal wind field map in the visible, as well as new constraints on wind variations with local time. We measured mean zonal wind amplitudes between 106 and 127 m/s at latitudes between 18°N and 34°S, with the zonal wind being approximately uniform in latitude bands. The latitudinal wind profile is consistent with previous measurements. Near 50° the presence of moderate jets is apparent in both hemispheres, with the southern jet being stronger by ~ 10 m/s. Small scale wind variations with local time indicate relative differential velocities ~50 m/s over spatial scales of ~200 km. The winds retrieved in each observation show an average magnitude consistent with other space and ground-base observations, but with a significant variability in local time (longitude) and in latitude [3].

Ground-based observations in the 2.3-micron window will allow deriving lower cloud winds, complementing VMC and VIRTIS measurements of the upper cloud winds. This will allow estimating the relative importance of the transport of angular momentum by the Hadley circulation and the equatorward transport by eddies. Another of our objectives is to constrain wave motions by measuring the spatial variability of the wind field both in latitude and longitude. Mapping the cloud distribution in a latitude-local time coordinate system will also allow to check the consistency of vertical motions inferred from the measured wind field, if greater cloud opacity in the lower cloud deck is associated with upwelling regions and lower opacity with downwelling regions. This work will be coordinated with VEX and with other ground-based observations. The first batch of 2.3-micron data will be acquired in July 2012 at Telescopio Nazionale Galileo/Near IR Camera and Spectrometer (TNG/NICS, at La Palma). Venus Doppler winds are measured cloud tops based in observations made at Canada France Hawaii's 3.6-m telescope (CFHT) with visible spectrograph ESPaDOnS. These observations consisted of high-resolution spectra of Fraunhofer lines in the visible range (0.37–1.05 μm). The observations were made at 19-20 February 2011 and were coordinated with VMC observations from ESA's Venus Express (VEx) mission. 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 67 degrees, between +10° and -60° by steps of 10° in latitude, and +70° to -12° to sub-Earth meridian in longitude by steps of 12°. 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 VEx spacecraft. We will present first results from this work, comparing with previous results by CFHT/ESPaDOnS and VLT-UVES spectrographs [3], with Galileo fly-by measurements [7] and with VEx nominal mission observations.

References:

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