TEMPORAL EVOLUTION OF THE 1.27 μm O_2 AIRGLOW AT VENUS FROM THE INFRARED TELESCOPE FACILITY (IRTF) SPEX INSTRUMENT. E. M. Royer[1], M. A. Bullock[2], T. Navarro[3] and E. F. Young[4], [1]Planetary Science Institute (PSI, 1700 East Fort Lowell Suite 106, Tucson, AZ 85719, emilieroyer@psi.edu), [2]Space Science and Technology Corp. (STC), Boulder, CO, [3]Space Science Institute (SSI), Boulder, CO, [4]Southwest Research Institute (SwRI), Boulder, CO

Introduction: Airglow emissions occurring in Venus' upper atmosphere are ideal tracers of the atmospheric dynamics at high altitudes. In particular, the 1.27 μm $O_2(a^1\Delta g)$ airglow peaking around 95 km of altitude is at the transition between two circulation regimes: a retrograde superrotating zonal (RSZ) circulation below ~100 km and a sub-solar/anti-solar circulation (SSAS) above 100 km altitude. Using IRTF/SpeX O_2 nightglow observations in synergy with IPSL-GCM results, we characterize the mesospheric circulation at about 100 km of altitude and transport in the upper atmosphere of Venus in order to investigate the potential effect of Kelvin waves on the $O_2(a^1\Delta g)$ nightglow. Recent advancements in the modeling of the Venusian upper atmosphere and observed UV atomic oxygen dayglow periodicities strongly suggest that the Infrared (IR) nightglow is subject to a strong periodic behavior. These advancements hinted that a ~5-day period sub-cloud Kelvin wave modulates the intensity and latitudinal extent of the nightglow. Despite a 8-year record of Venus Express (VEX) observations, this behavior has never been confirmed nor discarded. The continuous record of IRTF images we are presenting allows for the search and investigation of the suggested periodicities in the IRTF-SpeX data.

Method: The Spex instrument acquired Venus observations from 2001 to 2022, through a program dedicated to the investigation of the Venusian clouds. However, signal from the 1.27μm O_2 airglow (an average of 2 images at 1.27μm per night) was also acquired during observations. Corrections for stray light, thermal emission from the lower atmosphere of Venus, sky background, telluric absorption and correction of Venus O_2 airglow emission that is scattered to the Earth by the underlying clouds were applied to extract the O_2 nightglow brightness. Scanning the SpeX slit across Venus' disk provide the necessary spatial coverage to image nightglow patches at the limb and on the disk, as shown on Figure 1. Geometrical correction is then applied to retrieve the latitude and longitude of each pixel on the disk and to reconstruct a geometrically accurate image of the Venus disk as seen at 1.27 μm.

We present here a subset of the SpeX dataset at Venus, showing series of at least five consecutive days of $O_2(a^1\Delta g)$ disk images. Our dataset uses the high throughput low-resolution prism mode only of the IRTF-Spex instrument, spanning wavelengths from 0.8 to 2.5 μm, with either a 15"- or 60"-long slit and a resolving power of R~160 at 1.27μm.

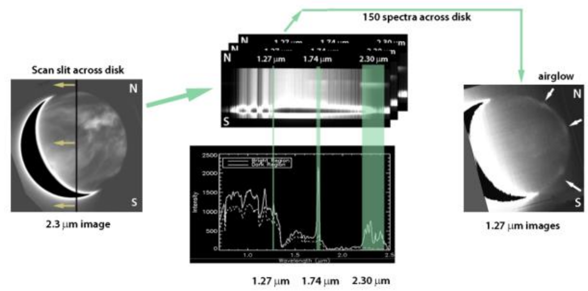

Figure 1: Construction of an O_2 IRTF SpeX Image. The cartoon shows a SpeX spectrum (center_bottom) and its associated spectral cube showing spectral and spatial variations across the Venus disk (center_top). O_2 images are created by stacking multiple slit exposures from a scan across the Venus disk. The 2.3 μm image on the left displays the position of the slit. The resulting O_2 image at 1.27 μm is shown on the right. White arrows on the picture on the right indicate the position of O_2 airglow patches visible at the limb.

Results: Periodicity found in the IRTF images are compared with Akatsuki cloud level winds measurements and GCM vertical propagation phase lag or with GCM morphological patterns and/or intensities to provide insight on the mechanisms that modulates the intensity and latitudinal extent of the 1.27 μm O_2 nightglow at Venus.