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Understanding of the Venus upper atmosphere dynamics with $O_2(a^1\Delta)$ Venus Express observations

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The $O_2(a^1\Delta)$ nightglow emission at 1.27 μm may be used as a tracer of the dynamics prevailing in the Venusian upper mesosphere. This emission has thus been observed with ground-based telescopes and from space with instruments such as VIRTIS on board Venus Express. Observations have shown that the emission maximum is statistically located close to the antisolar point at $\sim$96 km. As originally suggested by Connes et al. (1979), such an emission results from the production of oxygen atoms on the Venus dayside by photodissociation and electron impact dissociation of CO_2 and CO, which are then transported to the nightside by the subsolar to antisolar general circulation, where they recombine to create excited $O_2(a^1\Delta)$ molecules. Their radiative deexcitation produces the $O_2(a^1\Delta)$ nightglow with a maximum near the antisolar point. However, VIRTIS observations indicate that the $O_2(a^1\Delta)$ nightglow emission is highly variable, both in intensity and location. Actually, when considering individual observations, the patch of bright emission is rarely located at the antisolar point and the brighter area around this point is the result of statics accumulation. Also, when considering several individual observations acquired in a short period of time, it is possible to follow an individual emission patch and to deduce its displacement and its brightness variation due to activation or deactivation. In this study, we analyze several sequences of VIRTIS observations in order to understand the Venus upper mesosphere dynamics. We show that the intensity can vary by several megaRayleighs in a couple of hours with effective lifetimes on the order of several hours. The horizontal motion of the spots leads to the conclusion that winds in the 95-100 km region are in the range of 25 to 150 m s^{-1}, in good agreement with the study by Hueso et al. (2008).