Examination of potential microphysical drivers of NIR emitted radiance variations on the Venus night side

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Venus exhibits near infrared brightness variations in night side emission. These are most apparent in spectral windows near 1.74 micron and 2.3 micron in the near infrared. These variations have long been associated with changes in the middle and lower cloud opacity. Furthermore, changes in vertical transport (upwellings or downwellings possibly triggered by free or forced convection) have been shown to be capable of producing the observed variations. However, the Venus cloud system covers a large vertical extent (approximately 20km and two orders of magnitude in pressure between the traditional cloud top measured by remote sensing and the cloud base measured by in situ sampling), and its drivers are strongly coupled. Having a high vapor pressure, sulfuric acid growth and evaporation rates can be very fast. The primary source of the sulfuric acid is the photochemistry near cloud tops; effects of changes in this rate can propagate to the deeper more massive cloud. Thus, other drivers of the observed radiance variations might also be acting.

In a separate work, I had shown that plausible changes in microphysical properties produce observable variations in the distribution of the cloud mass and cloud particle sizes. Most notably, a two-regime quasi-steady state cloud was found in the simulations. The most notable difference between the two regimes was the presence and absence of a 1-2 km thick cloud layer near cloud base. This layer bears some similarity to the intermittently observed lower cloud deck between 48-50 km that is believed to be responsible for much of the observed NIR radiance emission on the night side of Venus. Here, I calculate the radiance variations that these changes can produce, specifically considering the spectral ranges observable using the Akatsuki IR2 camera and its associated filters.

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