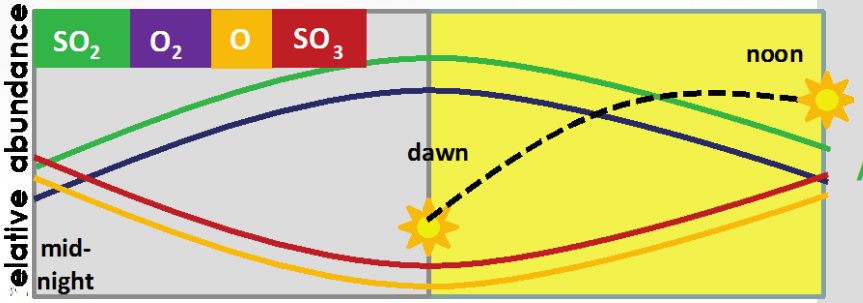
Hubble observations of Venus' sulfur-bearing species reveal a surprising twist

Coordinated observations by Hubble and Venus Express are helping scientists study Venus' thick sulfuric acid (H_2SO_4) clouds - the "greenhouse gas" that trap heat in the atmosphere.

- The H_2SO_4 clouds depend on SO_2, without which the clouds could not form and Venus' surface temperatures would be radically different.
- To understand how SO_2 and H_2SO_4 behave and control climate, scientists sought to understand how SO_2 behaves in a single day from sunrise to sunset.

Venus' atmospheric SO_2 abundance changes relative to the time of day. Coordinated observations allowed for the *first* map of SO_2 abundance from just before sunrise to noon.



EXPECTED BEHAVIOR

On the nightside:

$SO + O \rightarrow SO_2$

$O + O \rightarrow O_2$

as free O ↓ SO_3 ↓

As the night progresses the SO_2 abundance increases, peaking just before dawn.

On the dayside:

Sunlight (=hν) splits SO_2 & O_2

$h\nu + SO_2 \rightarrow SO + O$

$h\nu + O_2 \rightarrow O + O$

as the sun rises towards noon:

O_2 ↓ SO_2 ↓ and SO ↑

free O becomes available & SO_3 forms

- The coordinated observations confirmed some of our expectations, for example, the SO_2 abundance in the early morning was greater than SO_2 abundance at noon. However, other behaviors were the opposite of what was expected, such as the observed dayside SO abundance decreased as the SO_2 abundance decreased.
- The observed behavior suggests that we do not fully understand what controls SO_2 and SO in the atmosphere and that there is some transient process that occurs after dawn that can radically change the SO_2 density as the day progresses.
- Exploring these behaviors can lead to a new understanding of how Venus' sulfur chemistry relates to the H_2SO_4 cloud density and have the potential to reveal why Venus' climate became so divergent from Earth's.