

Study of the Venus cloud upper haze

金星雲・上部もや層の研究

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Early observation of the Venus cloud upper haze

- O'leary et al., 1975— Mariner10
 - Mariner10 found out about upper haze layer.
- Travis et al., 1979— Pioneer Venus polarization observation
 - Refractive index: 1.44, particle size: 0.4 μm
- Kawabata et al., 1980— Pioneer Venus polarization observation (UV)
 - Refractive index : 1.45 ± 0.04 ($\rightarrow$ sulfuric acid), particle size: 0.23 μm , optical thickness: polar region 1 • equatorial region: 0.2
- Mukai et al., 1981— Comparison of observation and calculation
 - Haze is not sulfuric acid?
- Crisp., 1986— Comparison of observation and calculation (UV)
 - Optical thickness: 1-12
- Pollack et al., 1993— updated Crisp. (1986)
 - Optical thickness: 10

Recent observation of the Venus cloud upper haze

• Wilquet et al., 2009/2012

- Venus Express
- Solar Occultation at InfraRed (SOIR)
- Upper haze: vertical and latitude distribution of extinction, particle size

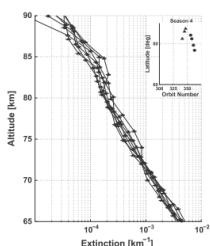
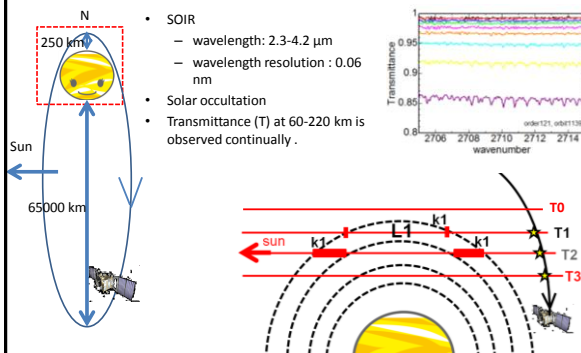


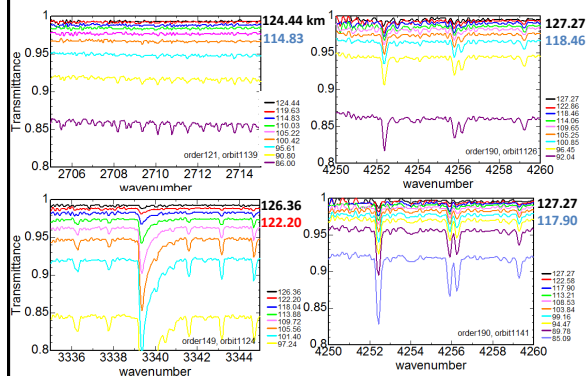
fig. Example of vertical distribution of upper haze

Venus Express Solar Occultation at InfraRed (SOIR)

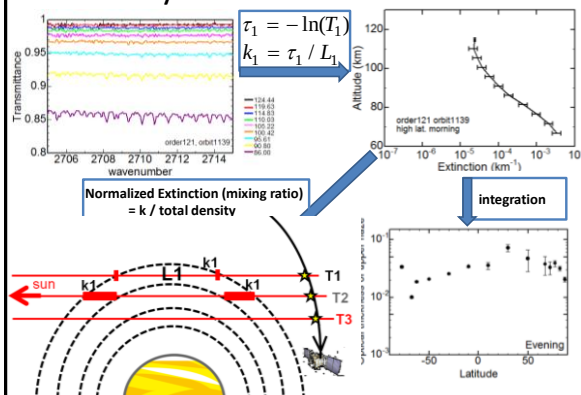


- SOIR
 - wavelength: 2.3-4.2 μm
 - wavelength resolution : 0.06 nm
- Solar occultation
 - Transmittance (T) at 60-220 km is observed continually .

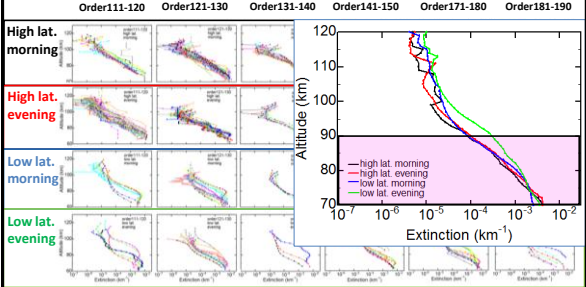
SOIR Data



Data analysis

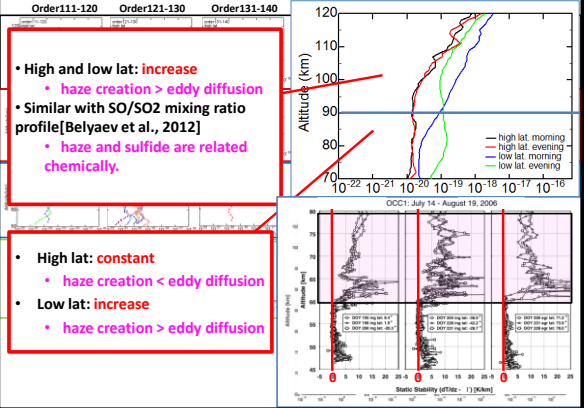


Extinction [km⁻¹]



- Haze exist at above 90 km at both high and low latitude.
- Curve structure at around 90 km at both high and low latitude
- Low latitude evening : thick

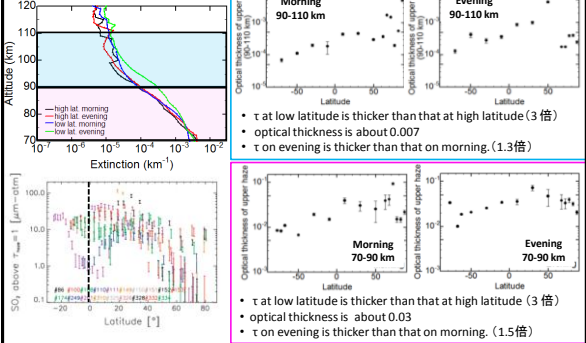
Normalized Extinction [km⁻¹/cm⁻³]



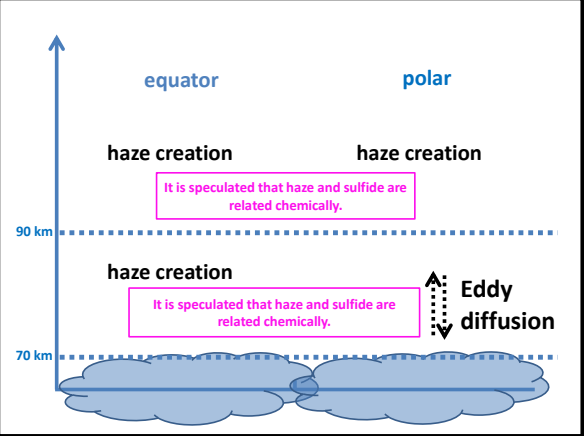
- High and low lat: **increase**
 - haze creation > eddy diffusion
- Similar with SO₂/SO₂ mixing ratio profile[Belyaev et al., 2012]
 - haze and sulfide are related chemically.

- High lat: **constant**
 - haze creation < eddy diffusion
- Low lat: **increase**
 - haze creation > eddy diffusion

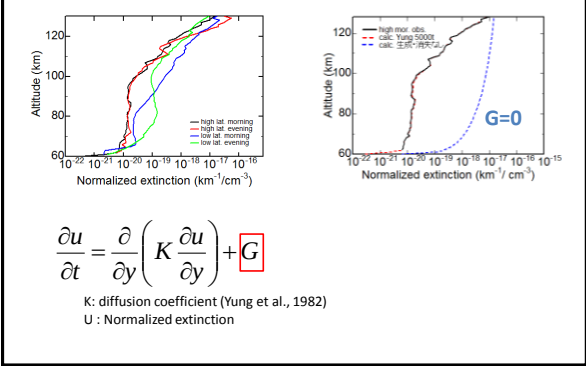
Optical thickness



- Similar with SO₂ latitude distribution [Marcq et al., 2011]
 - haze and sulfide are related chemically.



diffusion equation



$$\frac{\partial u}{\partial t} = \frac{\partial}{\partial y} \left(K \frac{\partial u}{\partial y} \right) + G$$

K : diffusion coefficient (Yung et al., 1982)
U : Normalized extinction

creation • loss

