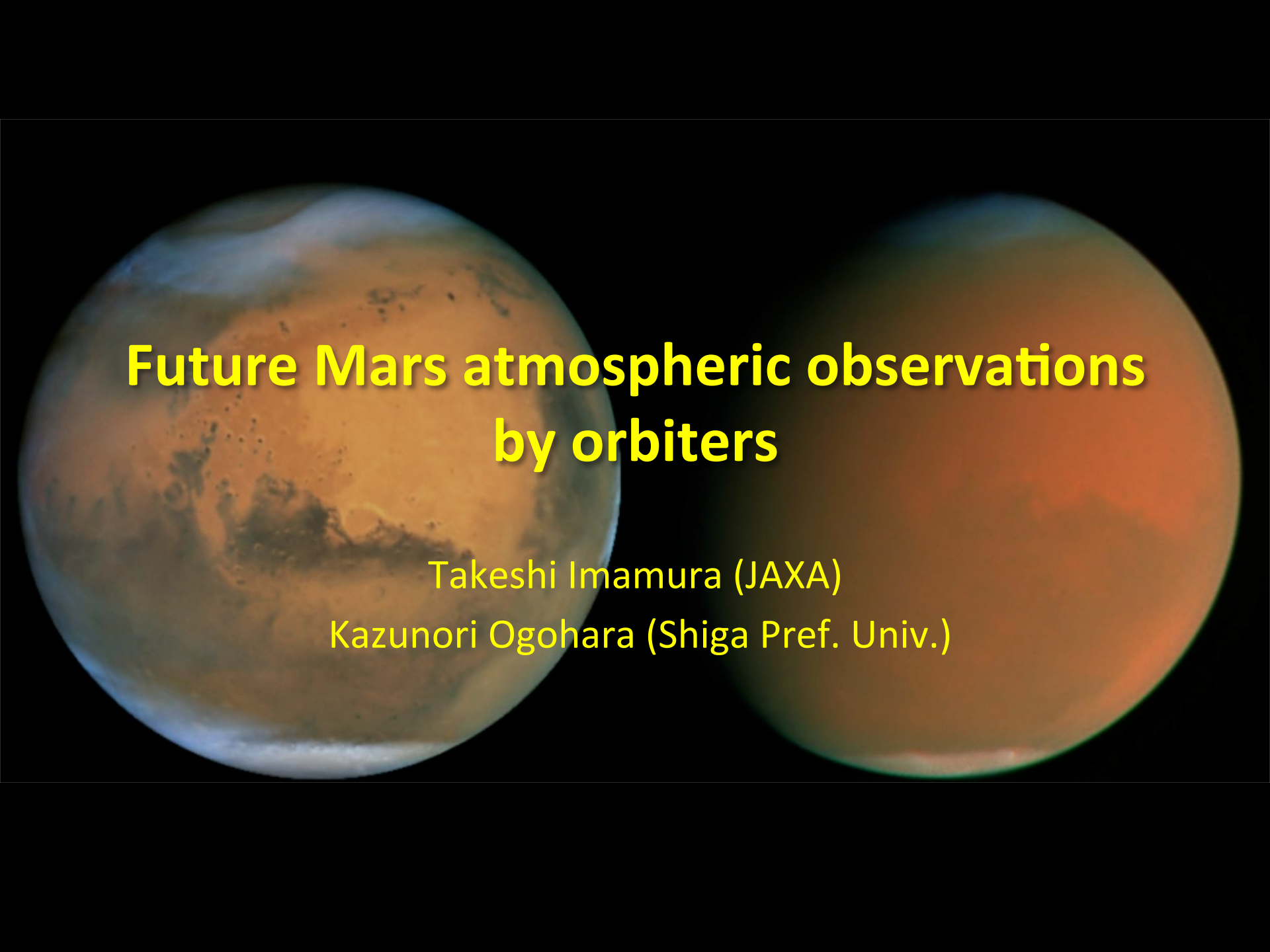
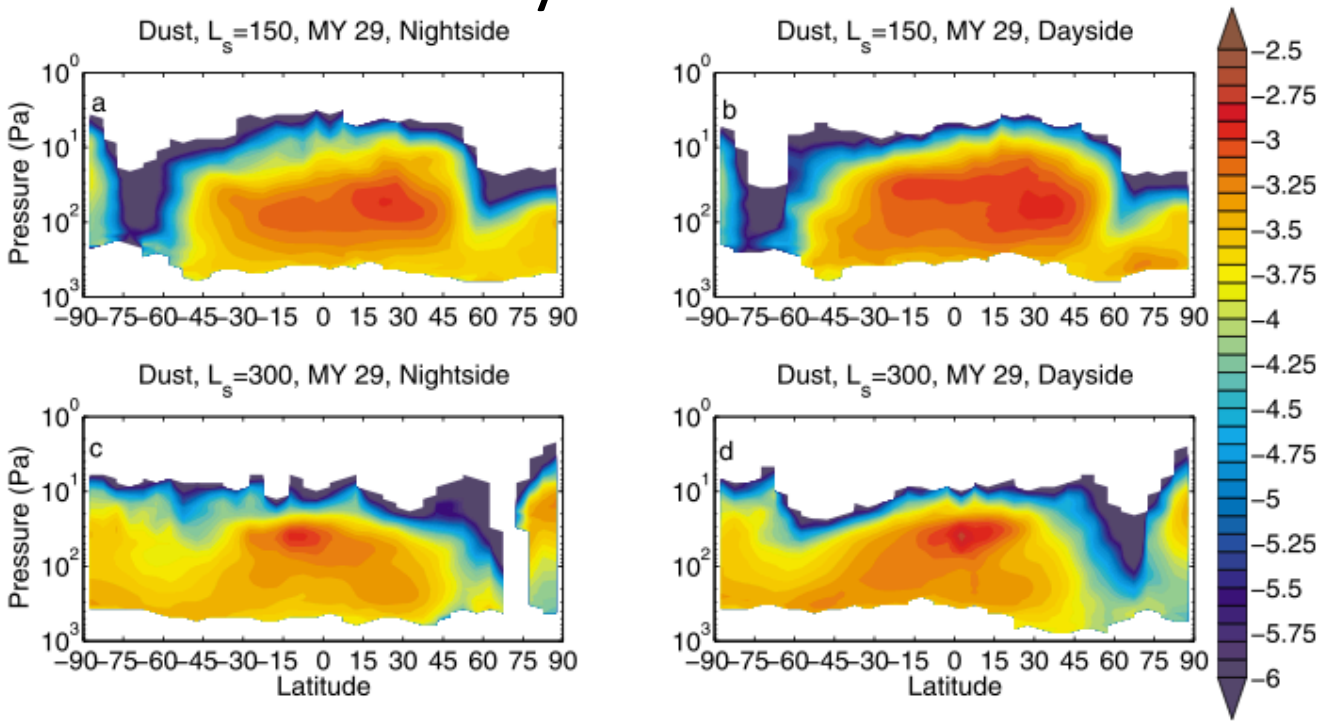


Future Mars atmospheric observations by orbiters

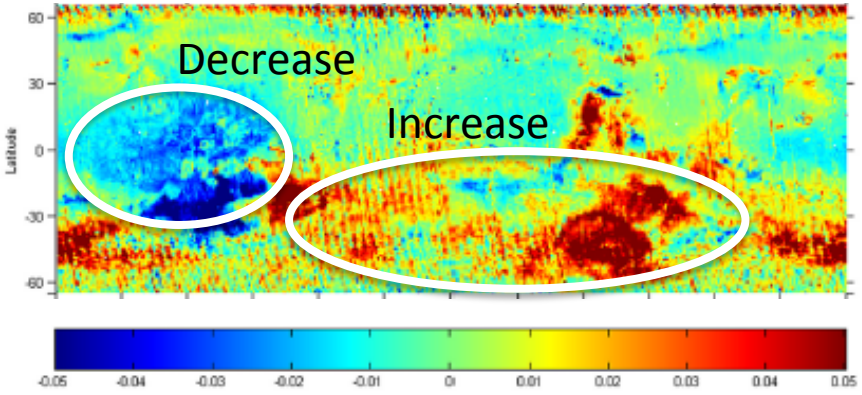
Takeshi Imamura (JAXA)
Kazunori Ogohara (Shiga Pref. Univ.)

Detached dust layers

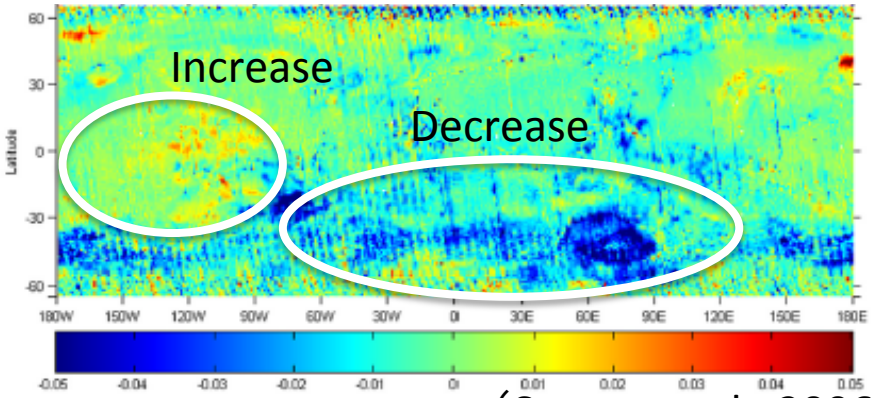


(Heavens et al. 2011)

Change of surface dust 2001 across the 2001 global dust storm

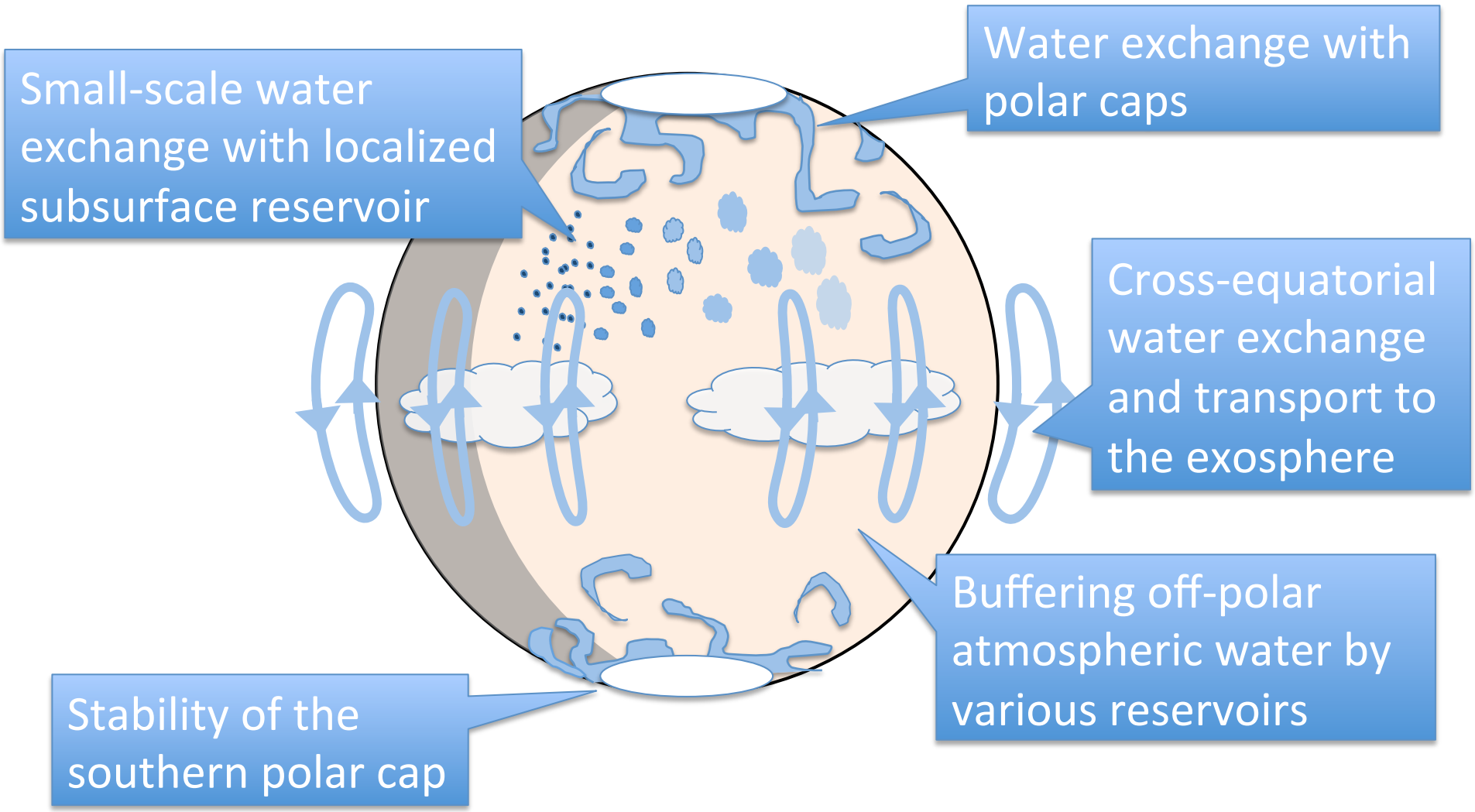


Change of surface dust during one Mars year after the 2001 global dust storm



（Szwast et al., 2006）

Water cycle

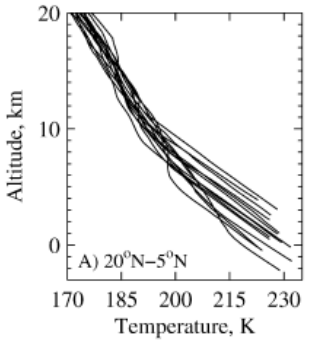

Small-scale water exchange with localized subsurface reservoir
Water exchange with polar caps
Cross-equatorial water exchange and transport to the exosphere
Buffering off-polar atmospheric water by various reservoirs
Stability of the southern polar cap

Status

- A Mars orbiter mission dedicated to meteorological study has been discussed for several years in Japan. The original, nominal mission plan is a small orbiter equipped with a suite of meteorological sensors ("full package"). The primary science targets will be dust meteorology and water cycle.
- The use of the next-generation "Epsilon" rocket, which is suitable for small-size planetary missions, now seems to be difficult. We may need to consider using a larger rocket such as H2A (In this case the mission might need to be more interdisciplinary).
- Another plan is to conduct selected meteorological observations from an orbiter whose primary goal is not meteorology. We consider several possibilities: orbiter for atmospheric escape, Mars lander, and Martian satellite sample return.

Original plan: Continuous global monitoring from high orbit using a set of dedicated meteorological sensors

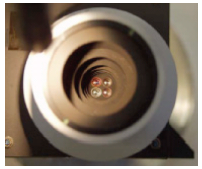
Radio occultation

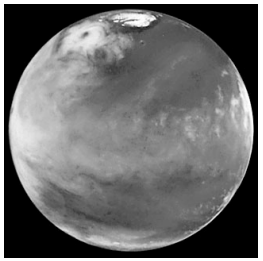


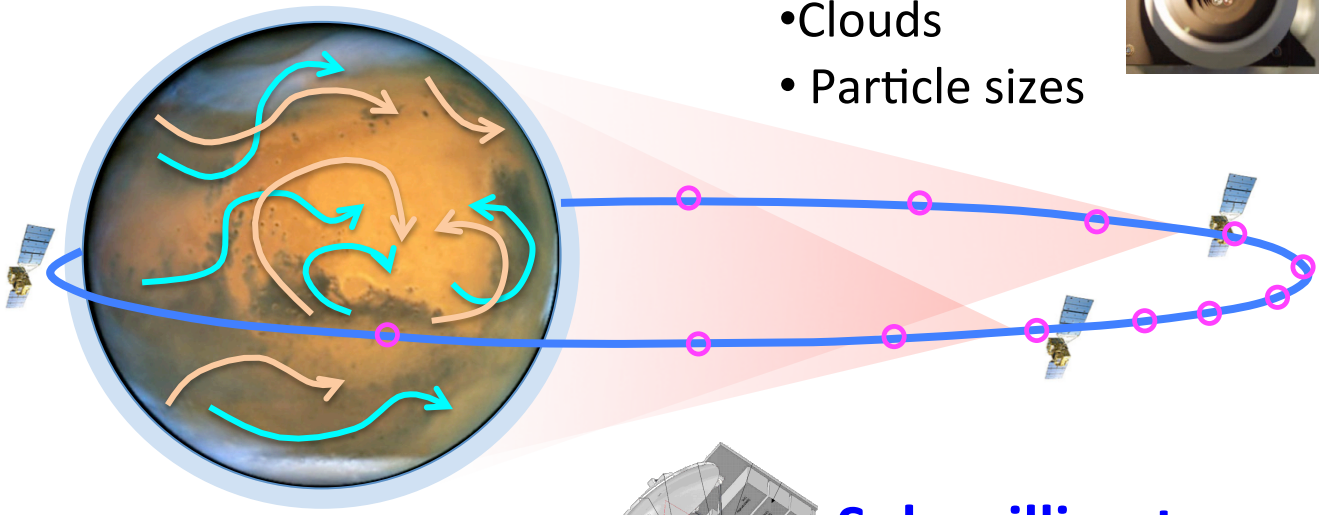
- temperature profile

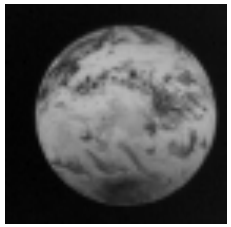
Polarimetric camera

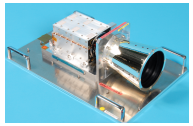
- Dust
- Clouds
- Particle sizes





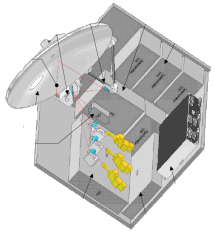






Mid-IR camera

- Dust
- Surface temperature



Sub-millimeter sounder

- 3-D temperature
- Water vapor
- Trace gases
- Isotopic ratios
- Surface temperature

- Orbital period: 12 hours
- Visualization of transport processes and diurnal cycle by global mapping conducted every one hour

Optional instruments

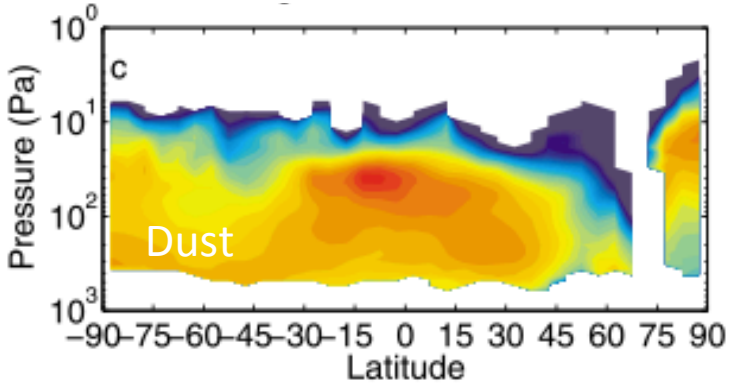
- Narrow angle camera
  - Monitoring localized dust events
- Near-IR mapping spectrometer
  - Mapping CO_2 column (surface pressure), water vapor, and surface ice
- Mid-IR spectrometer
  - Mapping dust, clouds, and trace gases
  - Limb and nadir

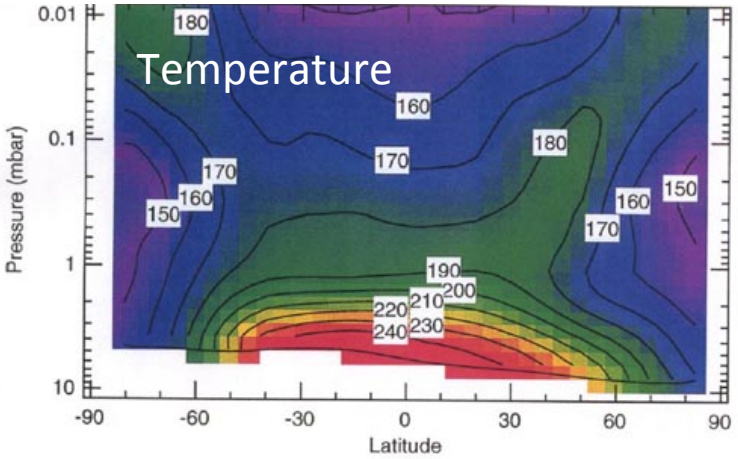
Changing views of Martian meteorology

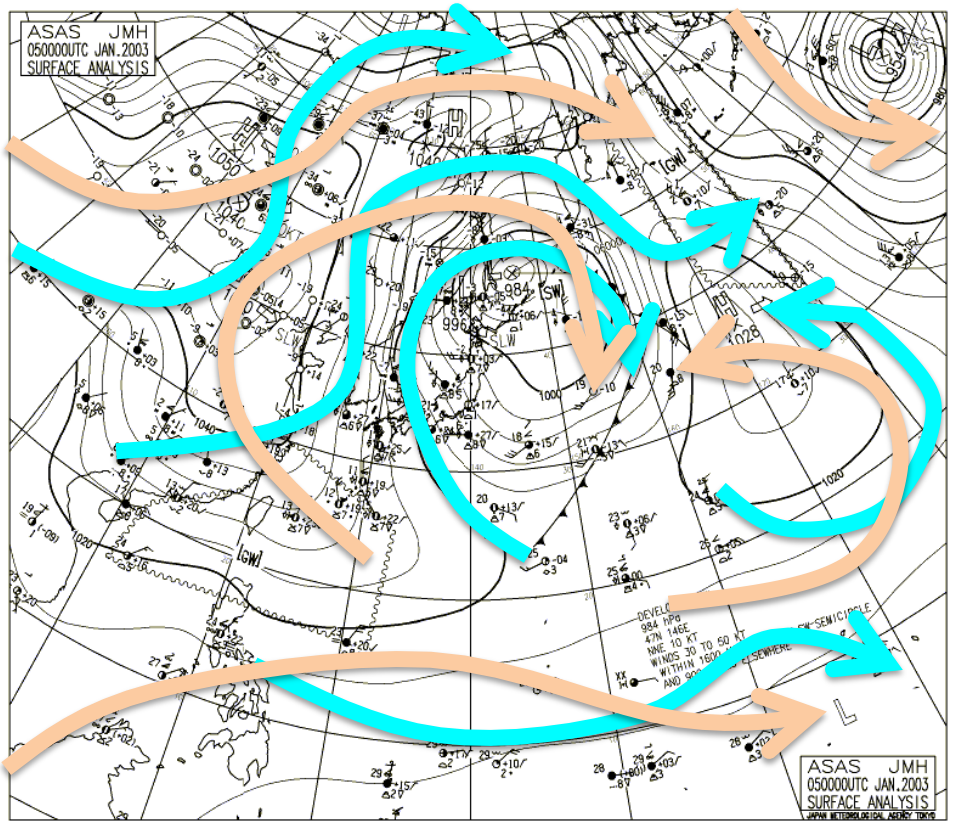
Before

After

Planetary-scale distributions of dust and other species are interpreted based on GCMs







Transport processes are directly detected and combined with meteorological data (with the help of data assimilation)

Issues to be clarified

- **How effective the "weather satellite-like" imaging observation is for better understanding Martian meteorology and material transport**
  - Is horizontal mapping of dust very helpful for characterizing dust transport (and data assimilation) even if no information on the vertical distribution is available ? Detached dust layer now seems to be essential.
  - Can regional/synoptic scale transport be really well understood even if no information on near-surface winds is available ?
  - Is dust/cloud tracking efficient also for Mars ?
  - Is CO_2 column (surface pressure) measurement helpful even if high-quality measurements are limited in time and space ?
- **Minimum set of instruments**
  - VIS/IR camera if only 2-3 kg is available ?
- **Expected unresolved issues after TGO**