Science Case for Planetary Science

KPAO is definitely the most promising technology for planetary Science.

- Gain in image quality in the NIR.

-> in contrast quality to detect faint and variable features such as clouds on Titan, surface changes and volcanoes on Io and other bodies.

-> in sensitivity for some programs such as moonlet detection around asteroids

-> medium FOV for study of Giant planet atmospheres

- Observations in the visible range

-> boost the scientific return of AO in planetary science.

existence of several absorption bands linked to the presence of mafic or hydrated minerals in optical

-> better angular resolution and sensitivity?

MCAO & MOAO: large FOV AO cannot compete with space mission projects dedicated to Mars and Venus (resolution < meter, multi-wavelength from UV to Radar, excellent spatial and time coverage)

Variable phenomena in the Solar System

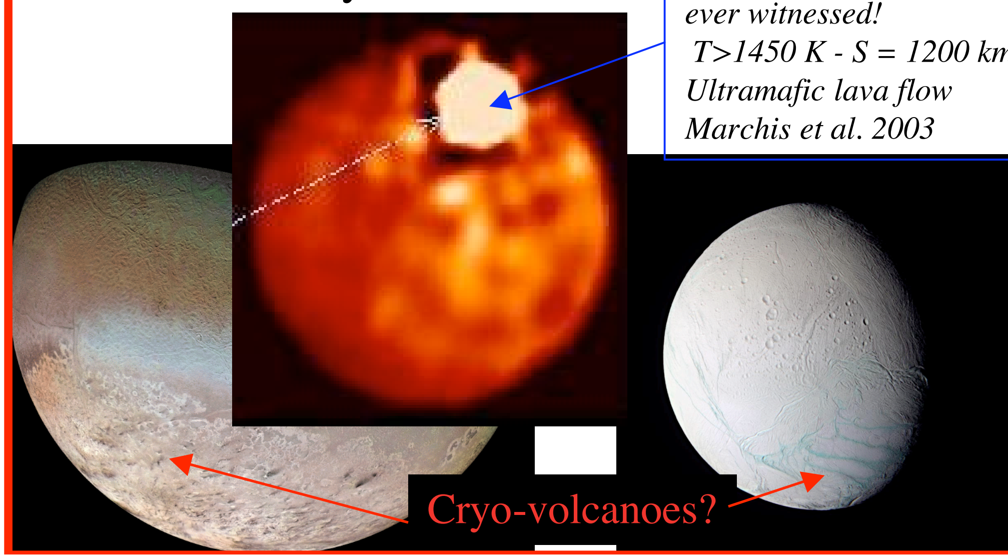
It is still interesting to study the bodies of our Solar System!
even if space missions provided high angular resolution data, it is mostly a "snapshot". They cannot provide a monitoring on a large timeline which is <u>necessary to understand variable phenomena</u> (volcanism, dynamic of atmosphere, …)

Volcanism

- Mostly basaltic on Io (after Voyager+ Galileo + ground-based monitoring on 26 yrs)
- Cryogenic on Triton (N_2?)
- Recently discovered on Enceladus (origin?)

Continuous monitoring needed to estimate origin, source, chemistry and evolution.

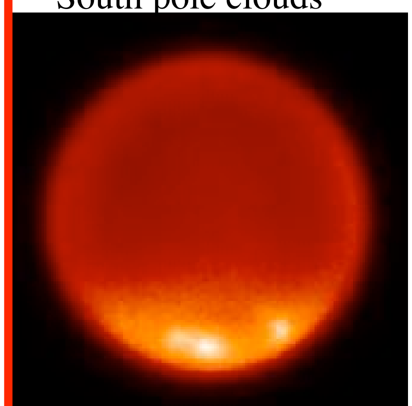
Most energetic volcanic ever witnessed!
T>1450 K - S = 1200 km^2
Ultramafic lava flow
Marchis et al. 2003



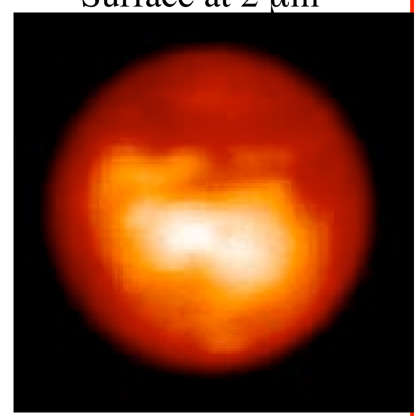
•Dynamic of **Titan atmosphere** due to seasonal changes (Saturn year = 30 yr)
•Surface changes
Cassini primary mission will last 4 yrs, maximum 8 yrs.

Keck-10m data

South pole clouds



Surface at 2 μm



Roe et al. 2002
Brown et al. 2002

+ Spectroscopy!
(Adamkovics et al., 2005)

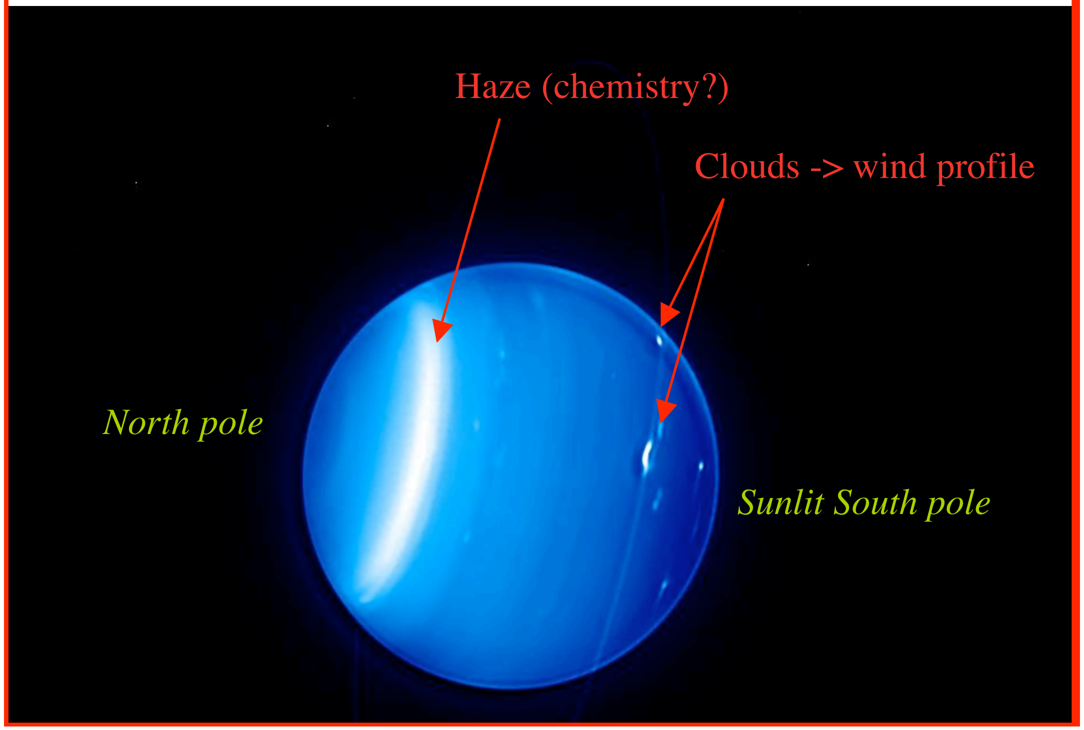
Atmospheres of Giant Planets

KPAO will provide full AO correction on a moderate FOV (R=30”).
Good enough for the jovian planets!

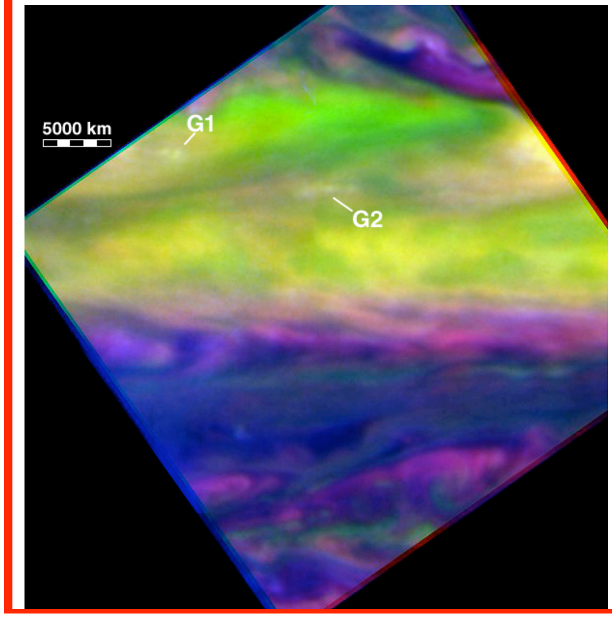
-> Study the dynamic of their atmospheres

- Visible+NIR data to follow-up several tracers and the dynamic (ex: NH_3)
- Determine the source driving the dynamic (internal heat or solar radiation?)
- Nail down the internal composition linked with early solar nebula (ex:amount of H_2O)

Atmosphere of Uranus (south pole activity) - Keck AO observations *(de Pater et al., 2004)*



Jupiter atmosphere observed with HST/NICMOS
False color composites of images in four NICMOS filters reveal relative cloud heights and upper-level ammonia absorption.



Wong & de Pater, DPS, 2005

KPAO: Adaptive Optics in visible

An AO system working up to 0.45 µm!

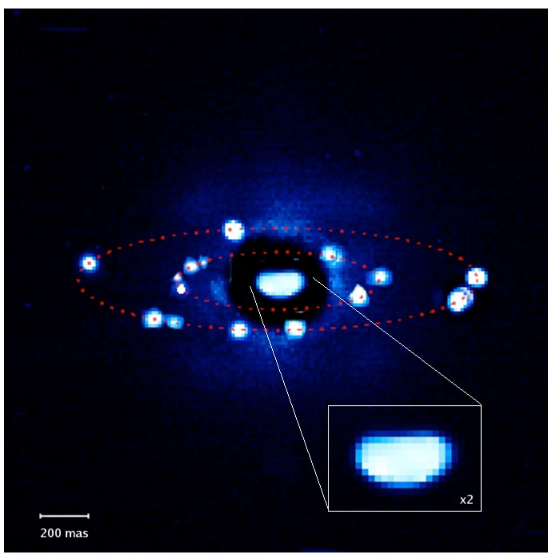
-> Better angular resolution, better sensitivity(?), enhanced spectral capabilities

PSF quality and stability + sensitivity must be quantified (-> simulations?)

Better sensitivity?

-> find smaller fragments around asteroids. More multiple systems?

Bulk-Density and formation scenario



87 Sylvia and its two moonlets

(Marchis et al. 2005)

Better angular resolution

-> estimate directly Size and Shape of asteroids such as larger TNOs (internal structure)

Example: 130 Elektra main-belt observed with Keck AO and comparison with 3D-inversion process (based on 6 years of lightcurve observations)