Planetary Science from a balloon-based Observatory

Prelude to the January 25-26, 2012 Workshop NASA Glenn Research Center

Additional info can be found at
http://spaceflightsystems.grc.nasa.gov/SSPO/SP/Balloon_Platform/

Purpose of Workshop

- Level 0: Determine the level of planetary science interest for a balloon based planetary observatory
- Level 1:
  - Present the Planetary Science community the SOA in balloon platform capabilities and near term plans
  - Present recent mission examples
  - Explore, discuss, and articulate the expected science benefits
  - Identify driving architecture requirements
  - Identify technical tall poles

Workshop Notional Agenda

- Overview of SOA and ongoing capabilities advancement activities for Balloon missions
- Recent mission experiences highlighting science capabilities
- Community impact if this facility was available today
  - Break out for discussion of various science that may achieved
  - Driving architecture/mission requirements to achieve the desired science
- Identify key technical challenges, if any
- Identify follow-on activities (concept developments, focused research, studies, etc)

Science Impact Example: VENUS Science Applications

Broad Science Goals:

- Understand Venus' 3-D Circulation
- Understand Venus' Atmospheric Chemistry

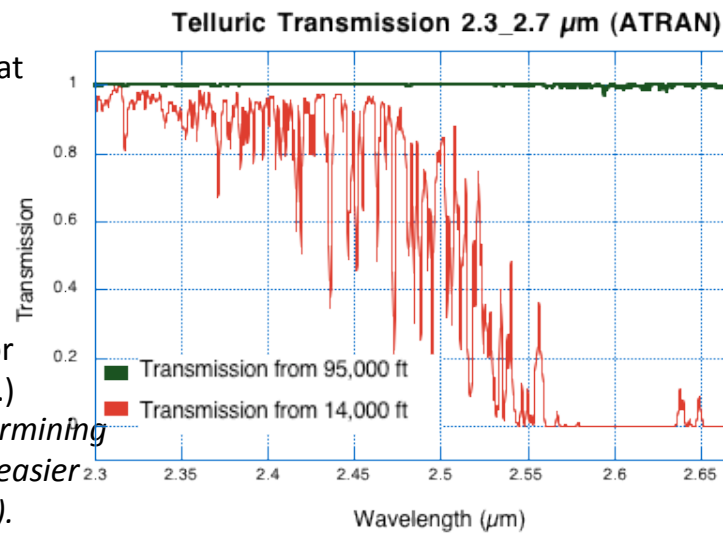
Observations:

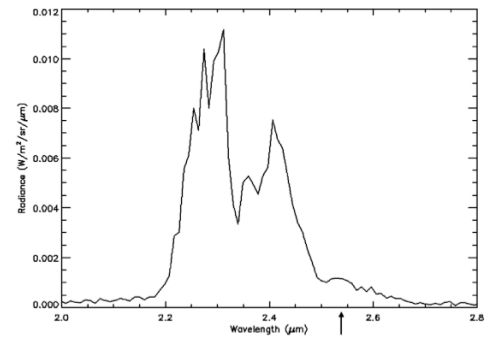
- Track UPPER clouds (day-side) at UV wavelengths.
- Track lower & middle clouds in IR windows, *including* windows longward of 2.5 µm.
- Doppler-shift experiments in visible and near 10-12 µm.
- Maps of tracer species (e.g., CO, OCS, H_2O, H_2SO_4, sulfur compounds).
- Correlate tracers with cloud coverage and possible regions of upwelling and downwelling.
- High-resolution (0.1" or better) image sequences of evolving cloud morphologies.

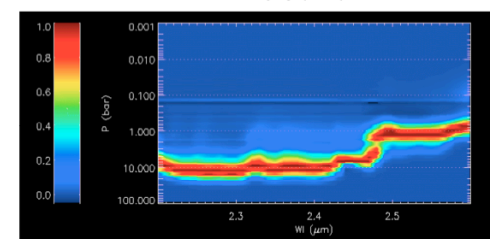
Observational Advantages of Balloons:

- Spectroscopy in critical bands not available at 14,000 or 41,000 ft (e.g., at 2.5 - 2.6 µm or near 4.3 µm).
- Observations when Venus is near the Sun (i.e., during inferior conjunction observations of the night side).
- Diffraction-limited spatial resolution.
- Continuous observations for weeks (or months with super-pressure balloons.)

Venus' flux near 2.5-2.6 µm is critical to determining cloud altitudes (far right panel) and is much easier to observe from the stratosphere (near right).







Balloon Science Opportunities:

- Inferior conjunctions (every 19 months) provide several months of night-side viewing with disk diameters up to 60". Imaging at 0.1" resolution would rival VIRTIS spatial resolution.
- IR spectra to characterize cloud heights, particle sizes and composition, particularly at some wavelengths that are obscured from the ground.

PSD Charge

- Increasing cost pressures will require novel approaches for getting more science with fewer resources

- Recent technical advances with balloon platforms have been developed, demonstrated, and used by other SMD divisions. What, if any, impact may this have on Planetary Science?

- The workshop is expected to address a couple key questions:
  - Can high-value planetary science be achieved using a high-altitude balloon based “observatory” ?
  - And a related question: Is there broad planetary science support for continuing this assessment?
  - If yes, what are the driving architecture requirements to achieve that science (e.g. instrumentation, aperture size, pointing/tracking requirements, flight durations, float altitude, etc)?