A Compact, Versatile Net Flux Radiometer for Ice Giant Probes

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How does the energy balance contribute to atmospheric dynamics?

Is the intrinsic flux spatially inhomogeneous?

Is there a hemispheric dichotomy?

What is the nature of convection and circulation on the Ice Giants and how does it couple to the temperature field?

How are the energy inputs to the atmosphere distributed and how do these inputs interact to create the planetary-scale patterns?

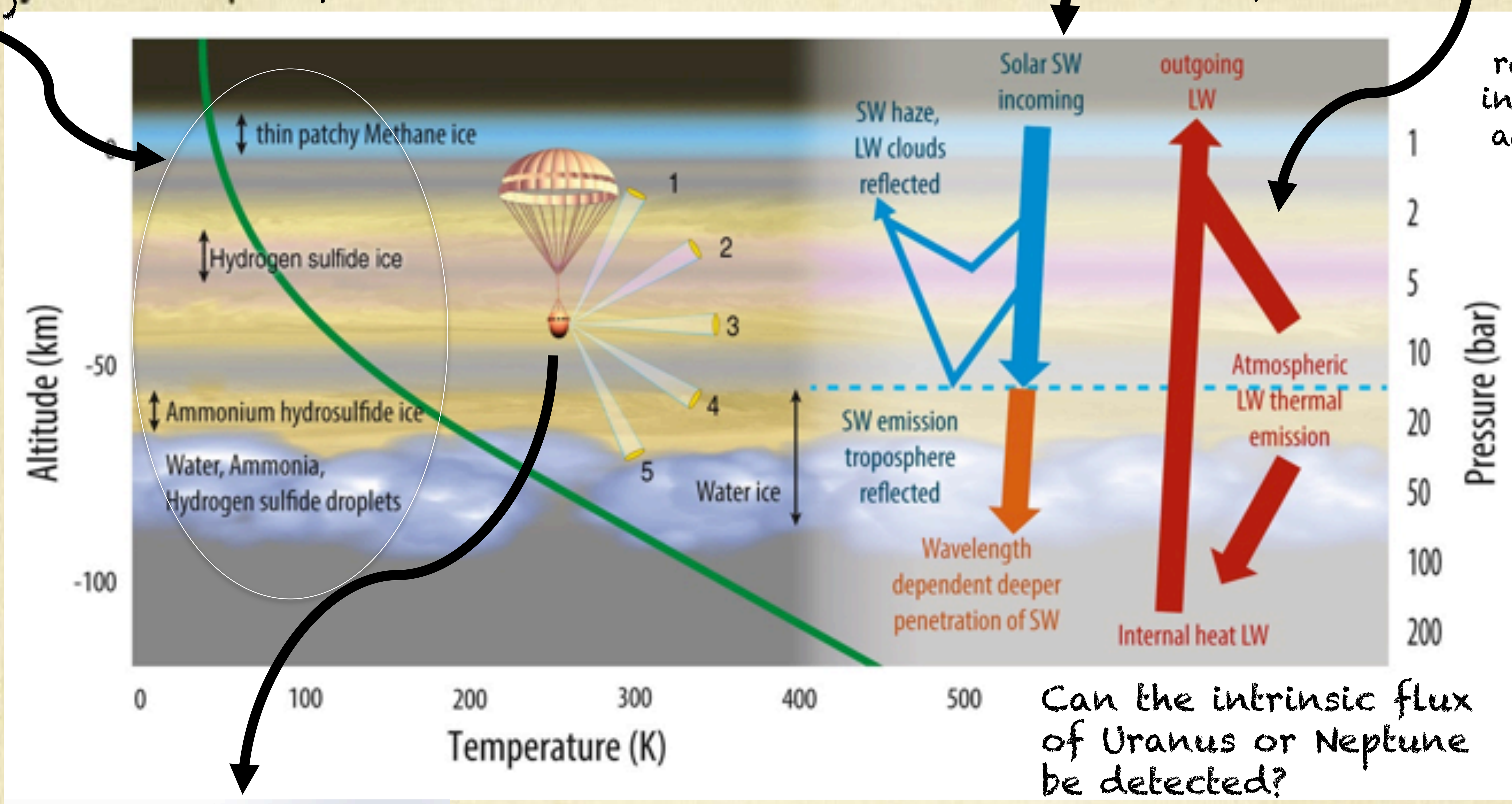
What are the altitudes/pressures and compositions of the cloud layers?

5-sky views

7-spectral channels

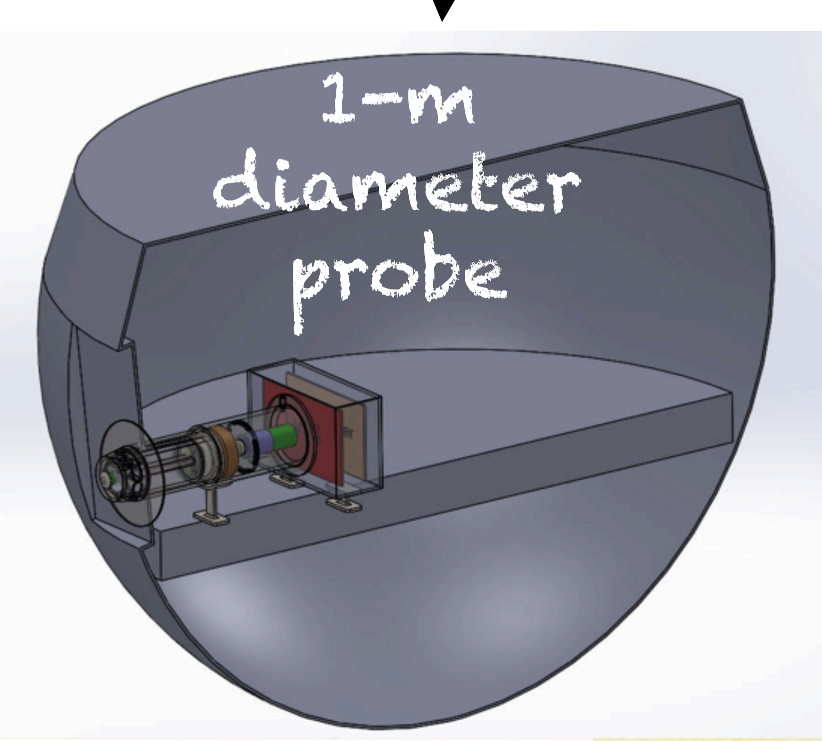
Measure a change of flux of at least 0.5 W/m² per decade of pressure

How do the cloud layers interact with solar visible and planetary thermal radiation to influence the atmospheric energy balance?



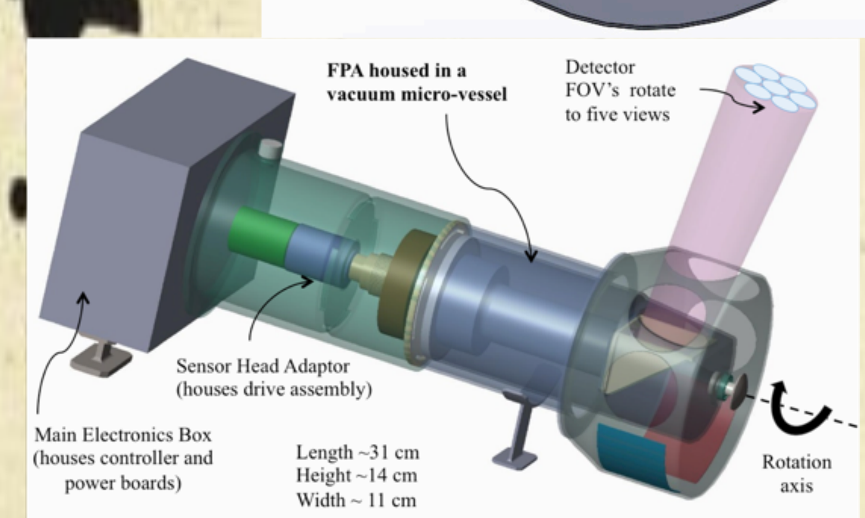
For the Ice Giants a 5-degree FoV at one-scale height above the 1-bar level captures the radiation field from 1-bar to ~7 mbar

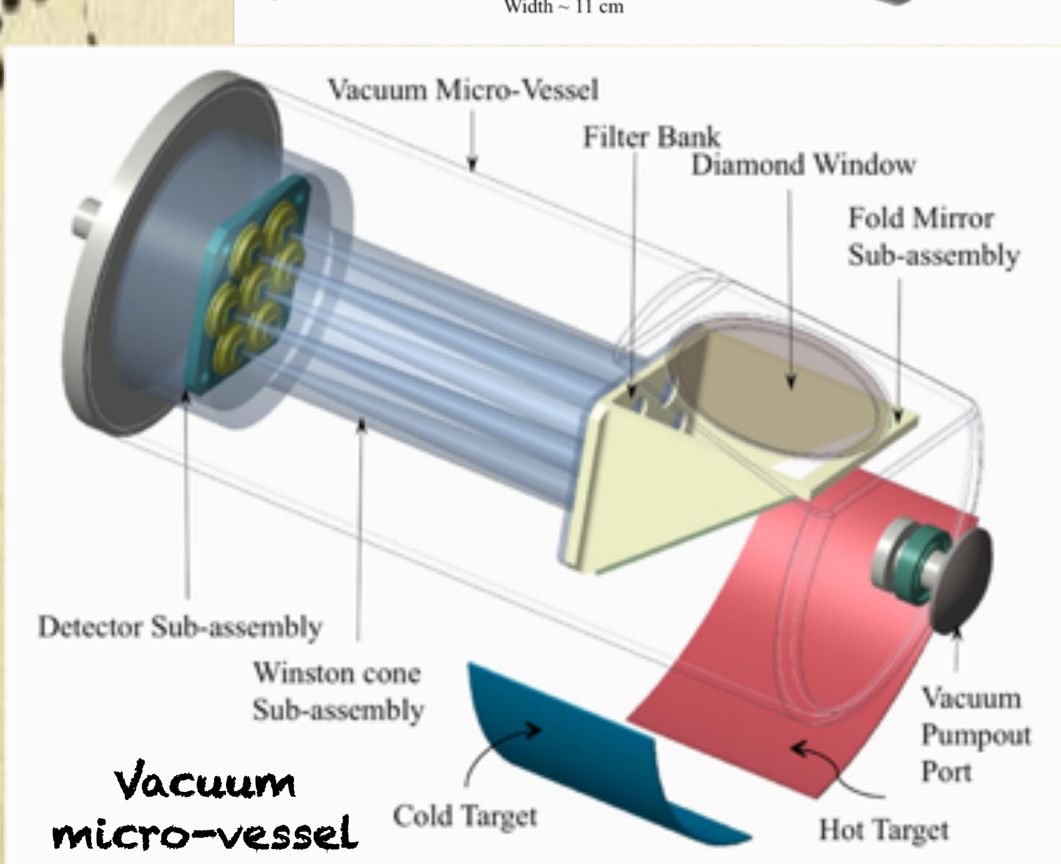
Can the intrinsic flux of Uranus or Neptune be detected?



It appears that the abundance of H_2S exceeds that of NH_3 in the observable atmosphere of Uranus and Neptune, which react/condense together to form a cloud of NH_4SH at a pressure of ~40 bars, leaving the left-over H_2S to condense alone at 3-5 bar.

de-Pater and his colleagues did observations at microwave wavelengths with the VLA and found a missing component of continuum absorption that was concluded to most likely arise from the pressure-broadened wings of H_2S lines and more recently Patrick Irwin and his colleagues have directly detected absorption lines of H_2S at near-infrared wavelengths above the main observable cloud deck on Uranus and Neptune (check out our abstract for references)

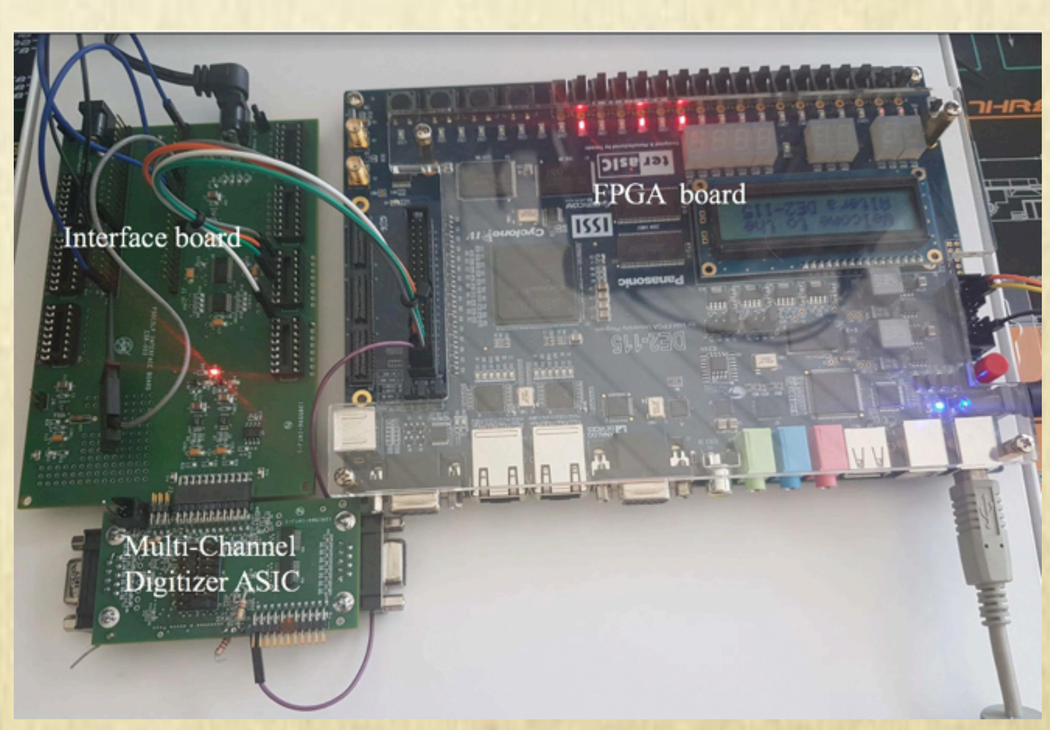




Parameter	IG-NFR
Spectral range	0.2 to 300 μm
Optics	Non-imaging Winston cones
Channels	7 science + 1 blind
Field-Of-View	5 degrees
Viewing angles	±80°; ±45° and 0° relative to nadir/zenith
Detectors (uncooled)	7 thermopile pixels + 1 dark
Pixel size	0.5 mm diameter
Mass	~ 2.4 kg
Basic power	~ 5.2 W
Envelope	(11 × 31× 14) cm³
Data volume (90 mins)	670 kbits
Operating modes	36 ms integration
Observation strategy	Sequential rotation into five sky view angles

Ch#	Wavelength (μm)	Objectives
1	2.5-300	Deposition/loss of thermal radiation
2	0.6-3.5	Solar deposition in methane absorption region; cloud particles
3	0.2-3.5	Total deposition of solar radiation and hot spot detection
4-7	Under radiative transfer modelling studies for H_2S, NH_3, H_2O and CH_4 gaseous abundances and cloud opacities	
8	Blind	Reference

Channel (μm)		SNR 50K	100K	300K
1	2.5-300	46	632	50819
2	0.6-3.5	140	140	168
3	0.2-3.5	226	226	254



A radiation hard CD ASIC with 20 delta-sigma ADCs, 10 ADCs, a serial port and a die temperature sensor reads out the 7 thermopile detectors under FPGA control

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Filters, Winston cones, detectors and fold mirror are all housed in a vaccum micro-vessel

A typical readout channel exhibits an average spot noise of ~27 nV/√Hz