Ultraviolet Observations for Lunar Volatile Detection and Mapping

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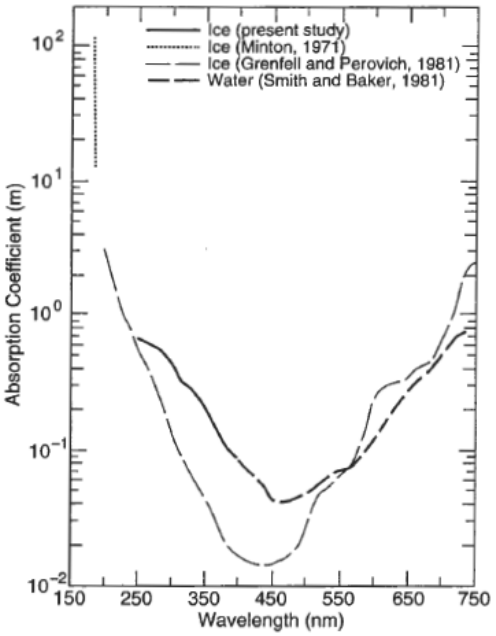
KISS: New Approaches to Lunar Ice Detection and Mapping

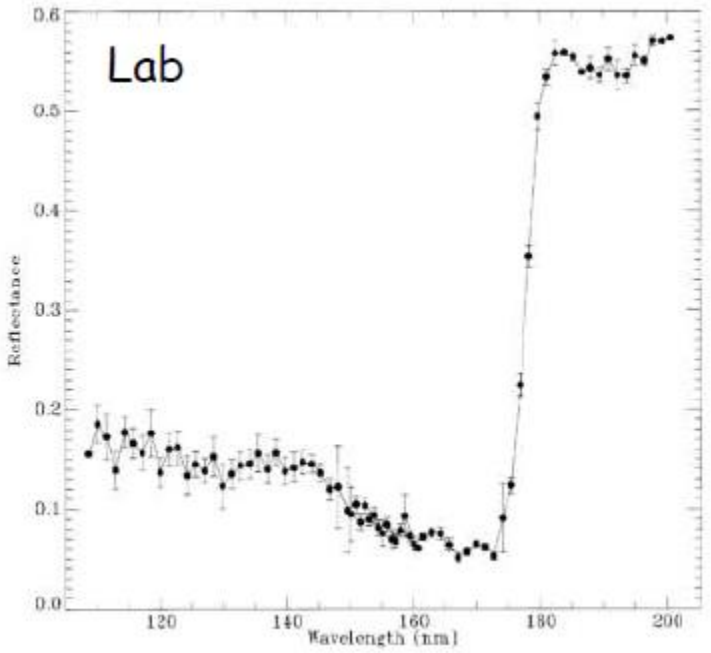
Ultraviolet defined here as FUV through UVA measurements

- FUV (“vacuum UV”): 100-200 nm
- UVV:200-280 nm
- UVB: 280-315 nm
- UVA: 315-400 nm
- Can look for water ice, weathering, atmospheric gasses

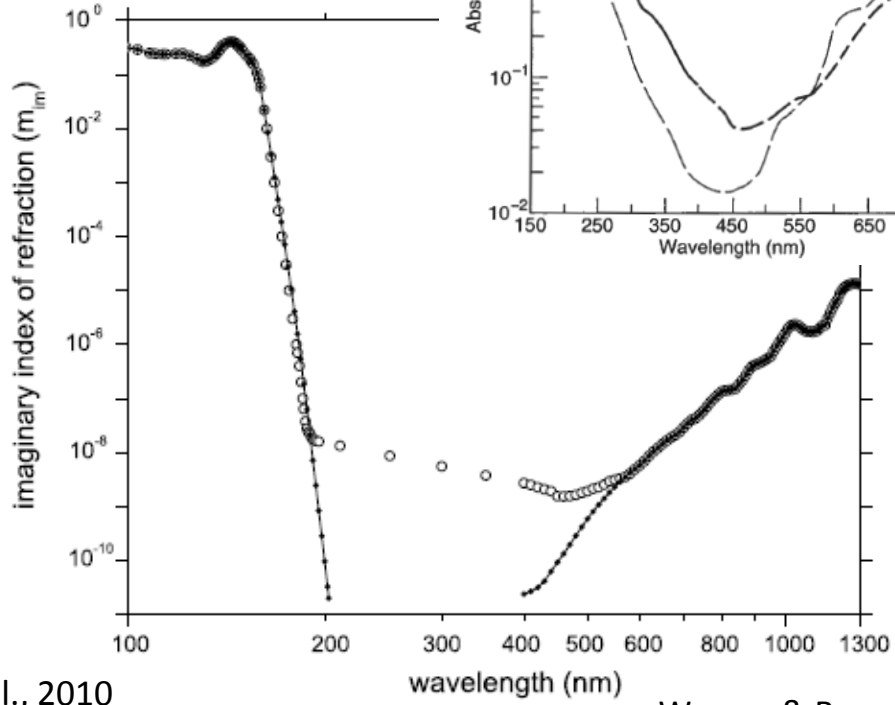
Perovich & Govoni (1991)



FUV Water Ice Absorption

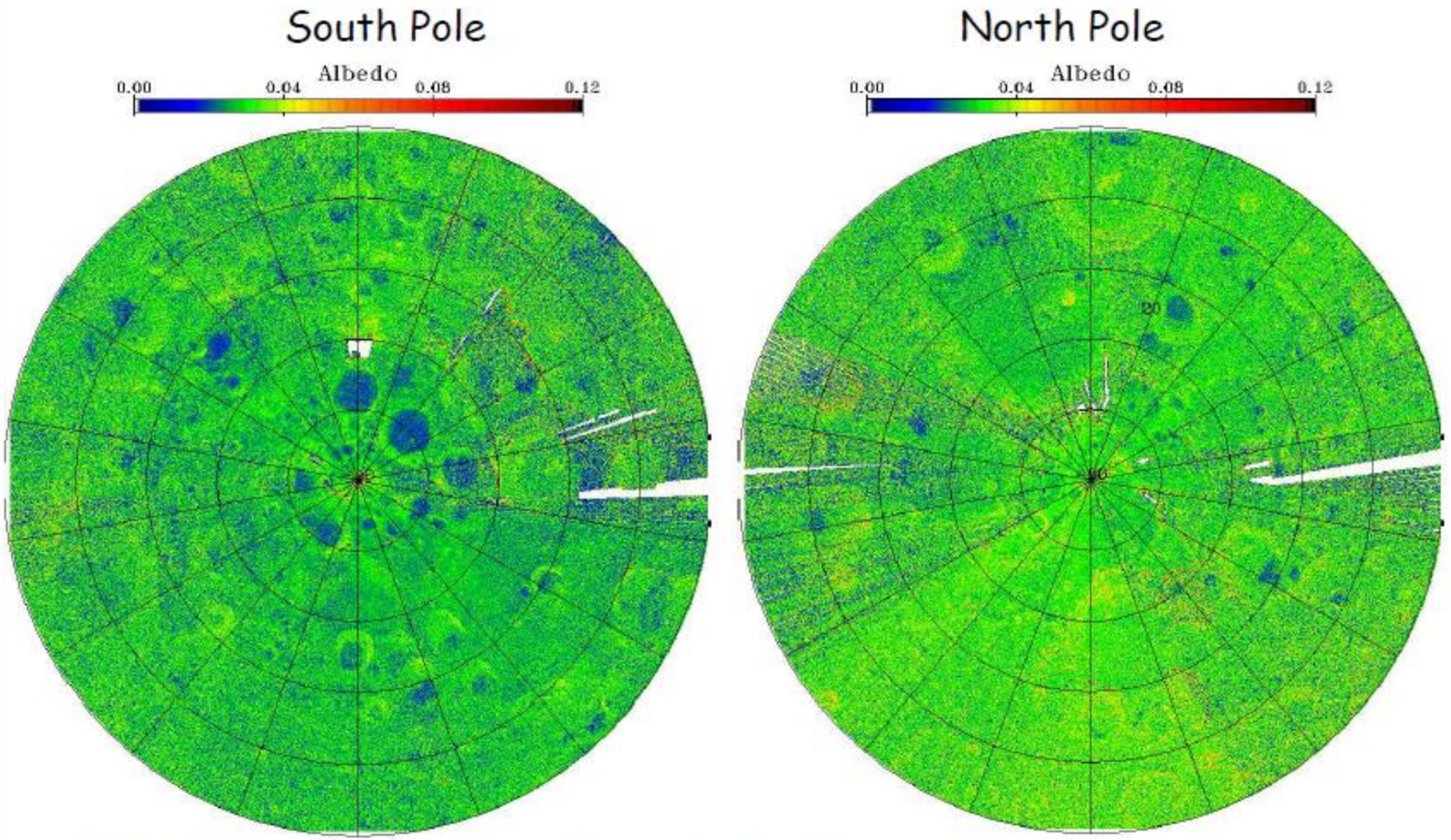


Gladstone et al., 2010



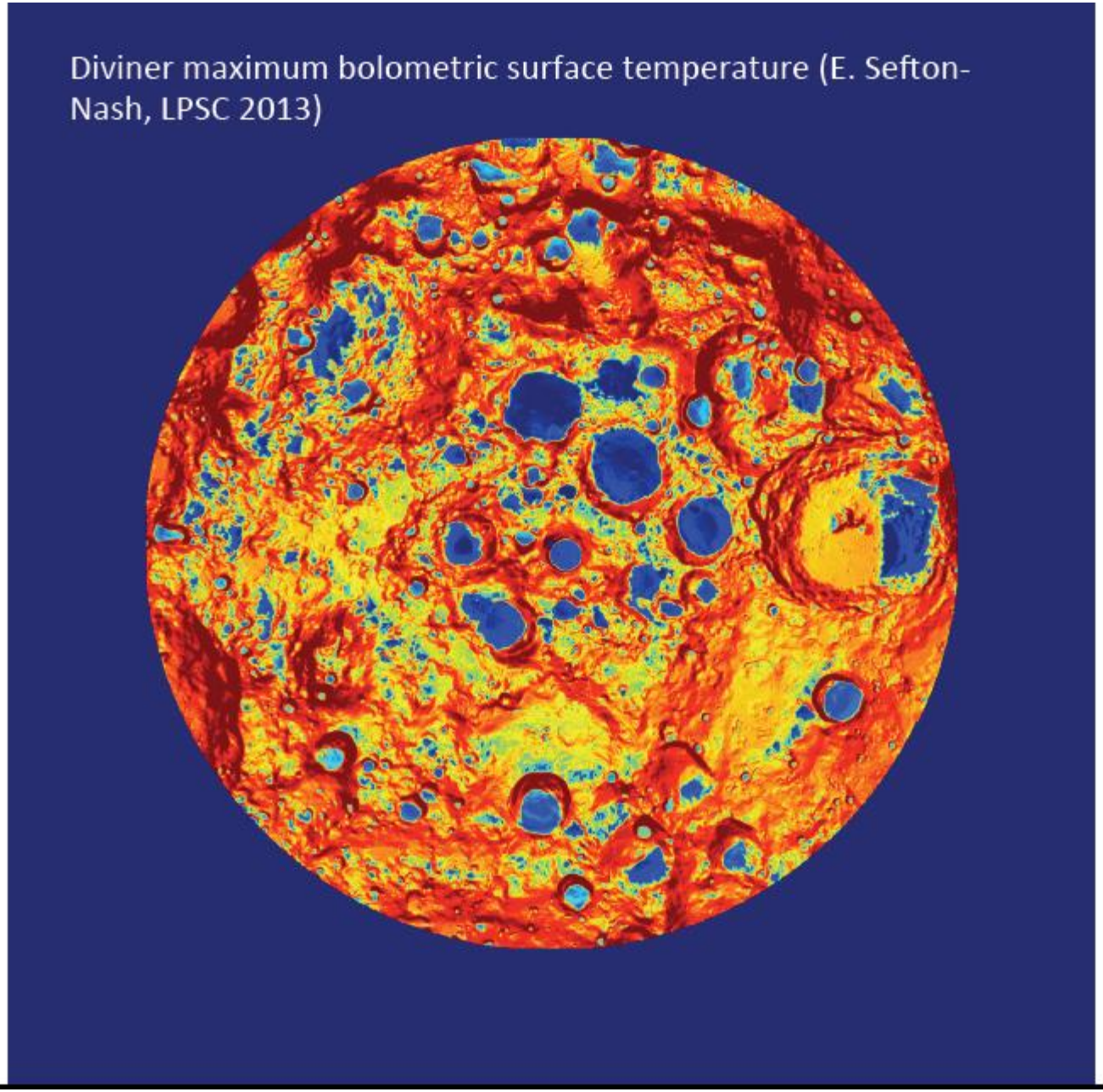
Warren & Brandt (2008)

Cumulative Polar Nightside Lya Maps

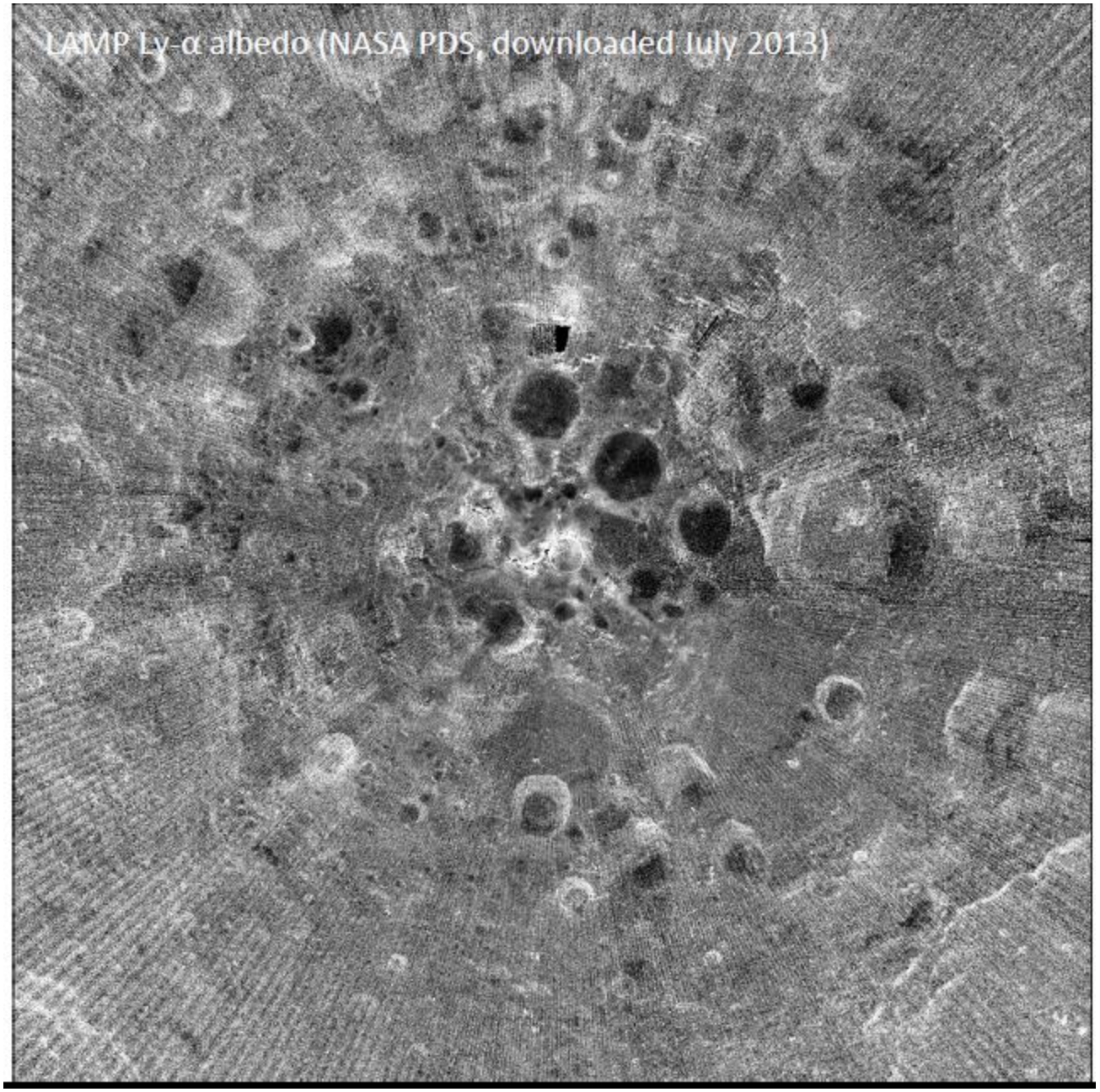


- PSRs have substantially darker FUV albedos than their surroundings

From Gladstone, 2011

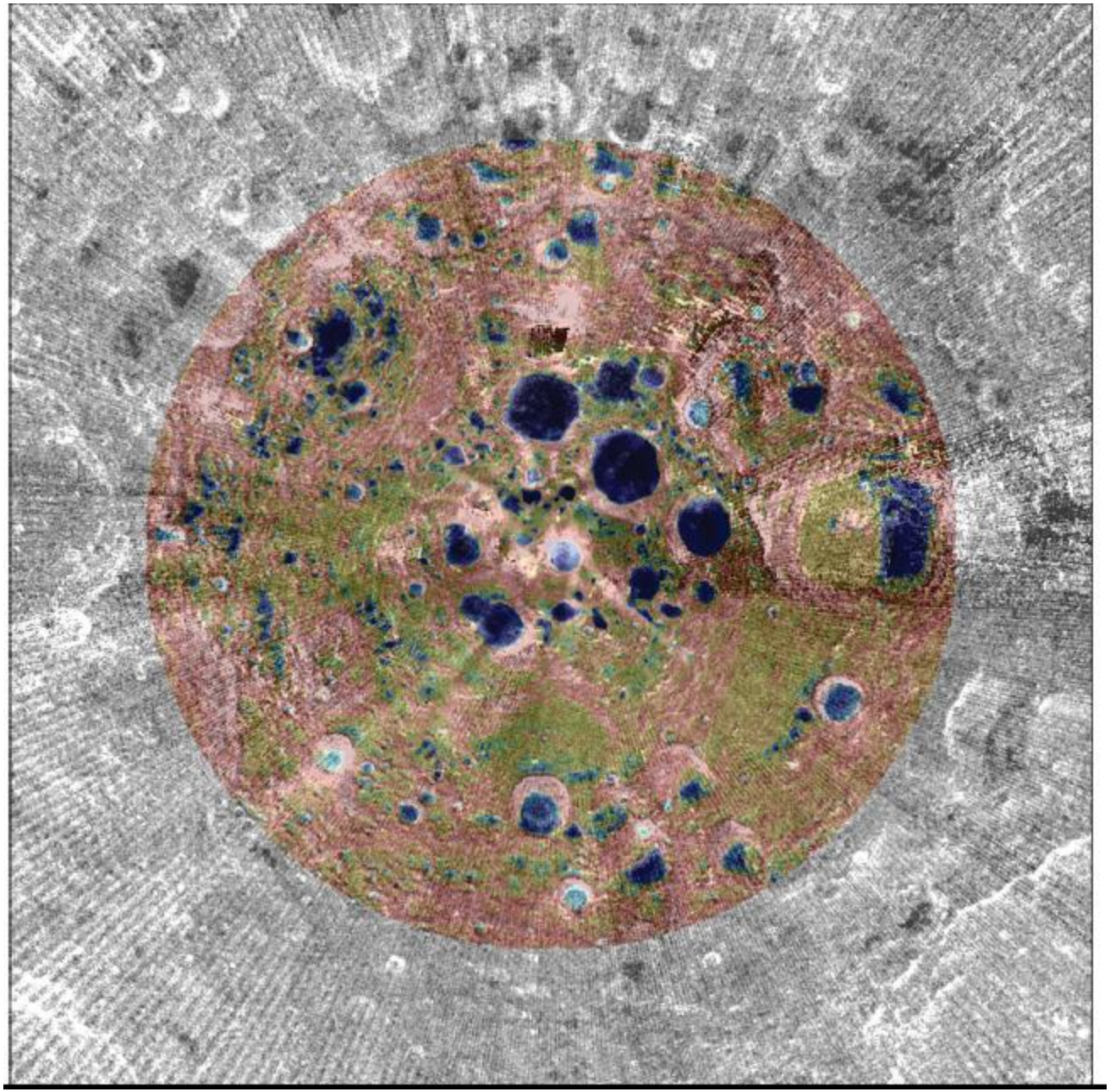

Diviner maximum bolometric surface temperature (E. Sefton-Nash, LPSC 2013)

Hayne, 2013



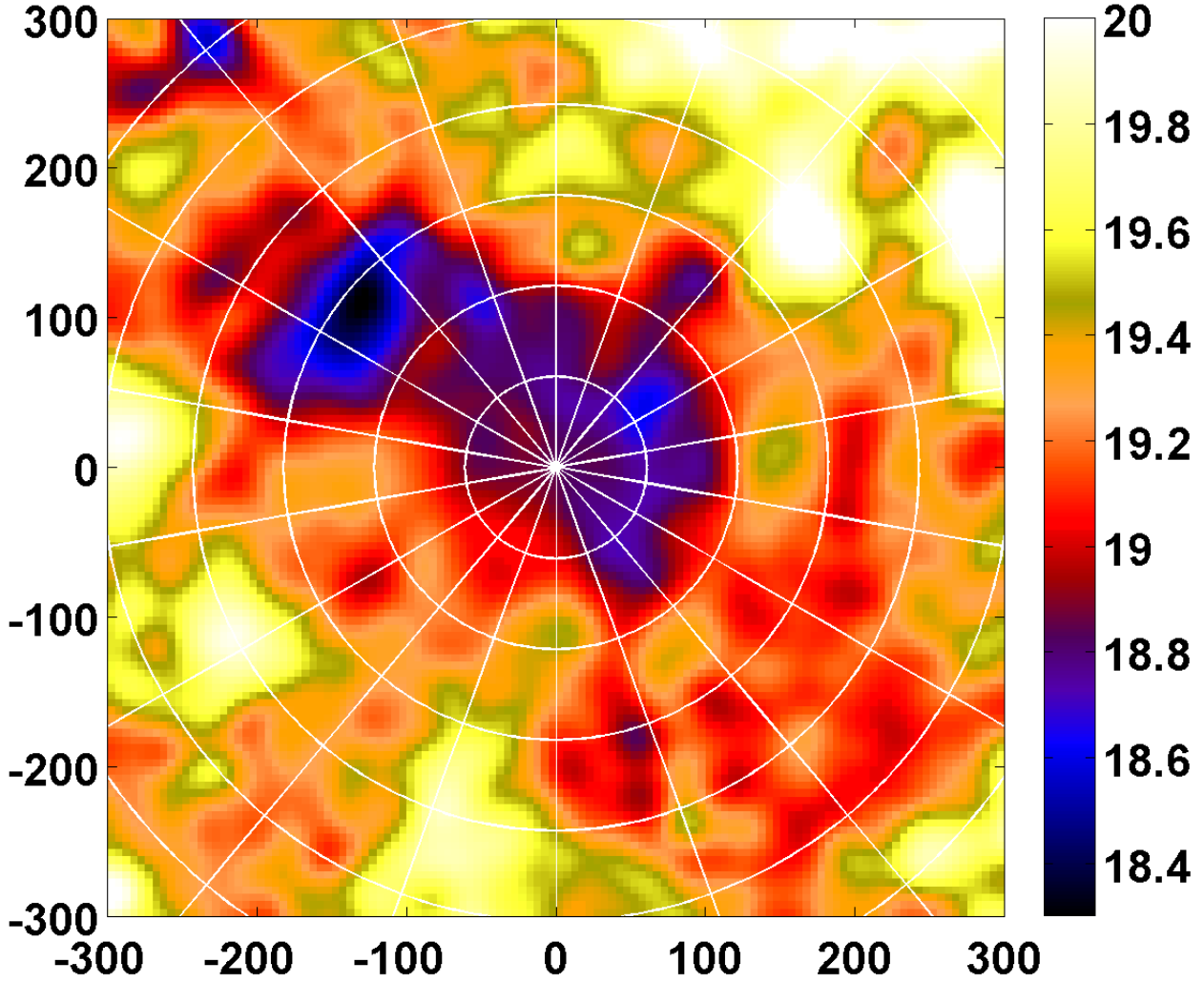
Hayne, 2013

LAMP and Diviner Overlay



Hayne, 2013

South Pole

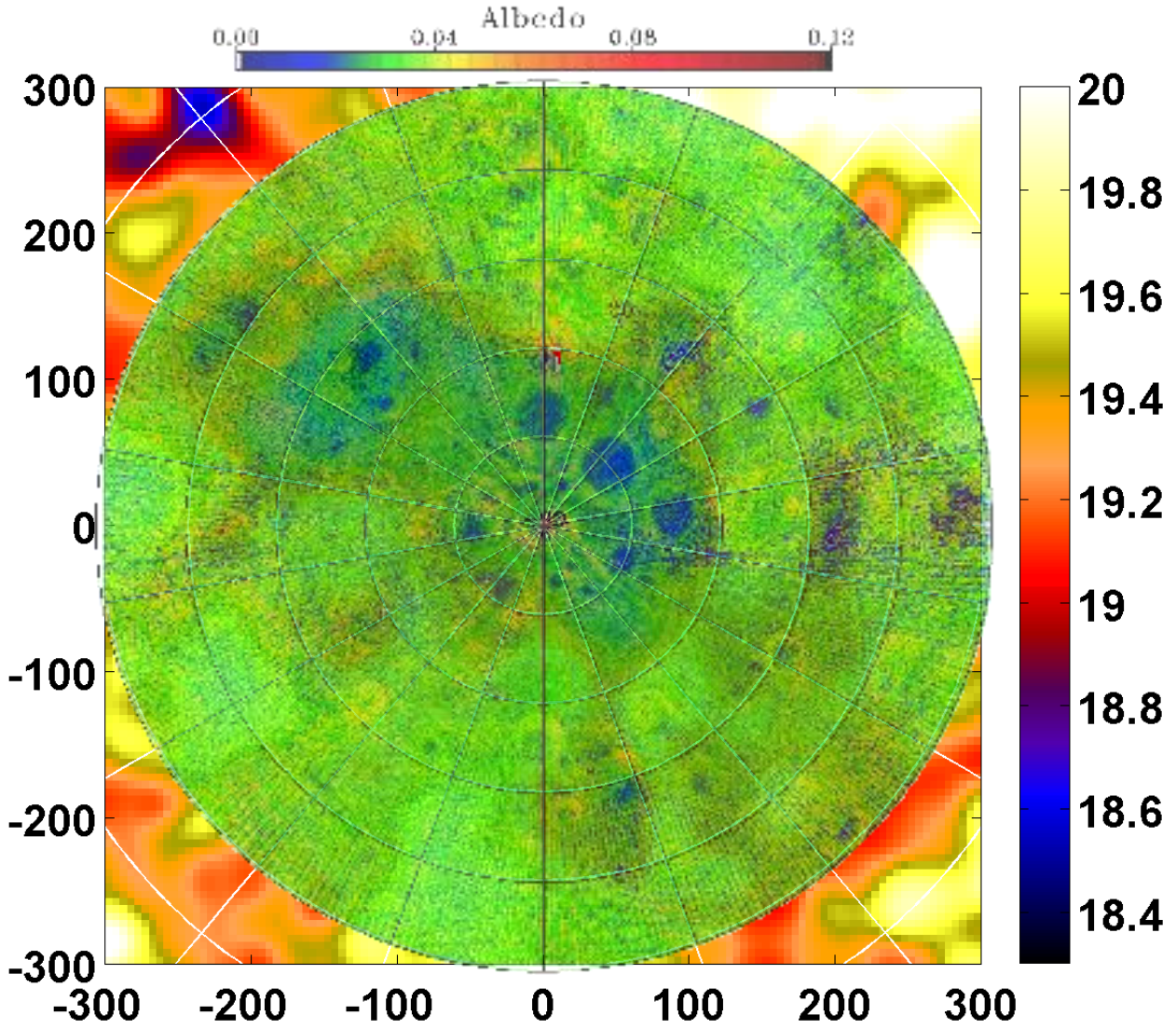


Elphic, 2012

Bottom layer: LPNS epis, smoothed with a gaussian having 30-km FWHM

Top layer: LAMP Ly-alpha Albedo

South Pole



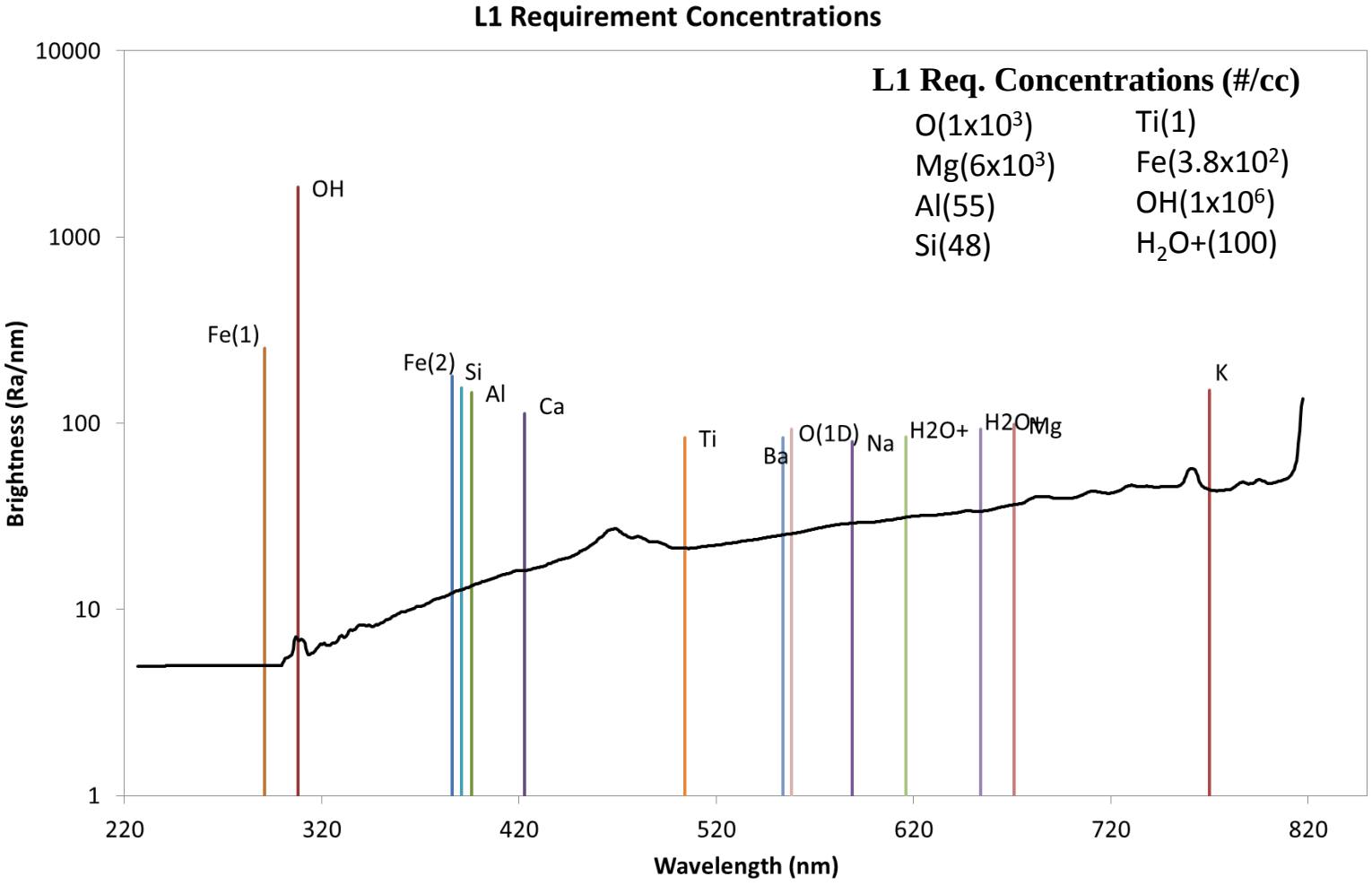
Elphic, 2012

Bottom layer: LPNS epis, smoothed with a gaussian having 30-km FWHM

Top layer: LAMP Ly-alpha Albedo

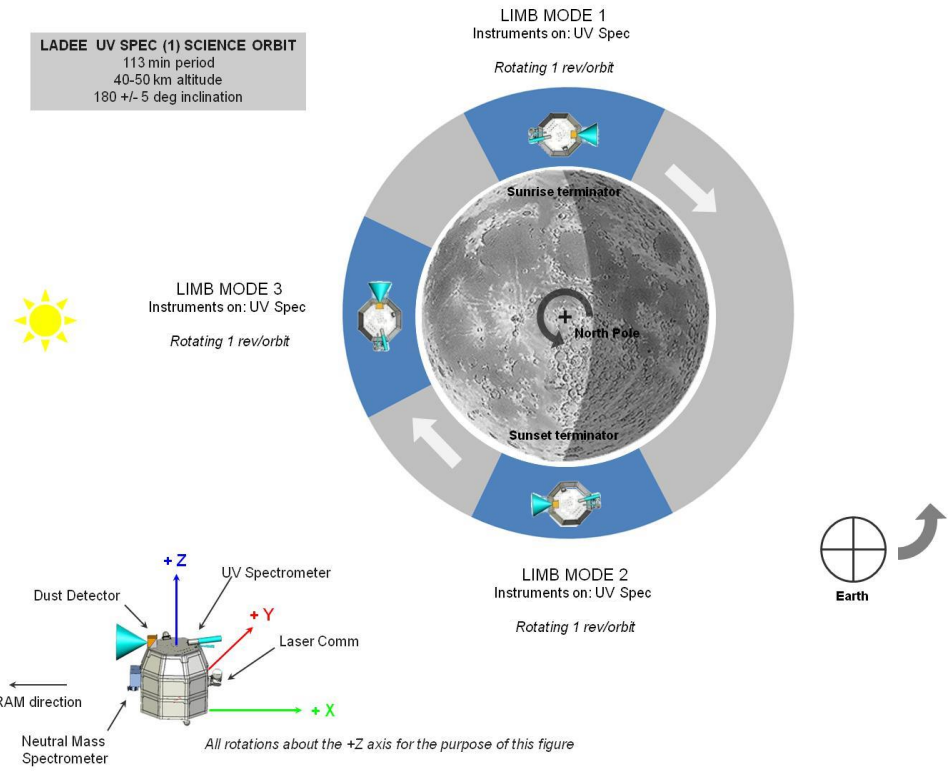
Example of UV/Vis gas emission sensitivities

The Gas Emission Line Brightness for several Required Species and NEP (Ra/nm)



LADEE UVS Observations of OH & H2O+

Limb



OH

Δt x # coadded	For SNR=5 (#/cm^2)	For SNR=5 (#/cm^3)
1x1	5.48E+11	12894.78
1x10	5.48E+10	1289.48
10x10	1.73E+10	407.77
10x100	5.48E+09	128.95
10x400	2.74E+09	64.47

H2O+

Δt x # coadded	For SNR=5 (#/cm^2)	For SNR=5 (#/cm^3)
1x1	1.80E+11	4246.51
1x10	1.80E+10	424.65
10x10	5.71E+09	134.29
10x100	1.80E+09	42.47
10x400	9.02E+08	21.23

Possible Applications

- FUV: Similar to LAMP, using Lyman-a as a source to see in the dark, but for longer times for better SNR.
- Dedicated small orbiter or lander/rover
- Monitor impacts (e.g., LRO LAMP)

UVC/B: Monitor for OH mobility

- Beyond LADEE lower altitudes and higher latitudes
- Dedicated small orbiter or lander/rover
- Monitor impacts (e.g., LCROSS VSP)

Strength:

- Good way to look for mobile OH/H2O

Weakness:

- Surface reflectance may be ambiguous