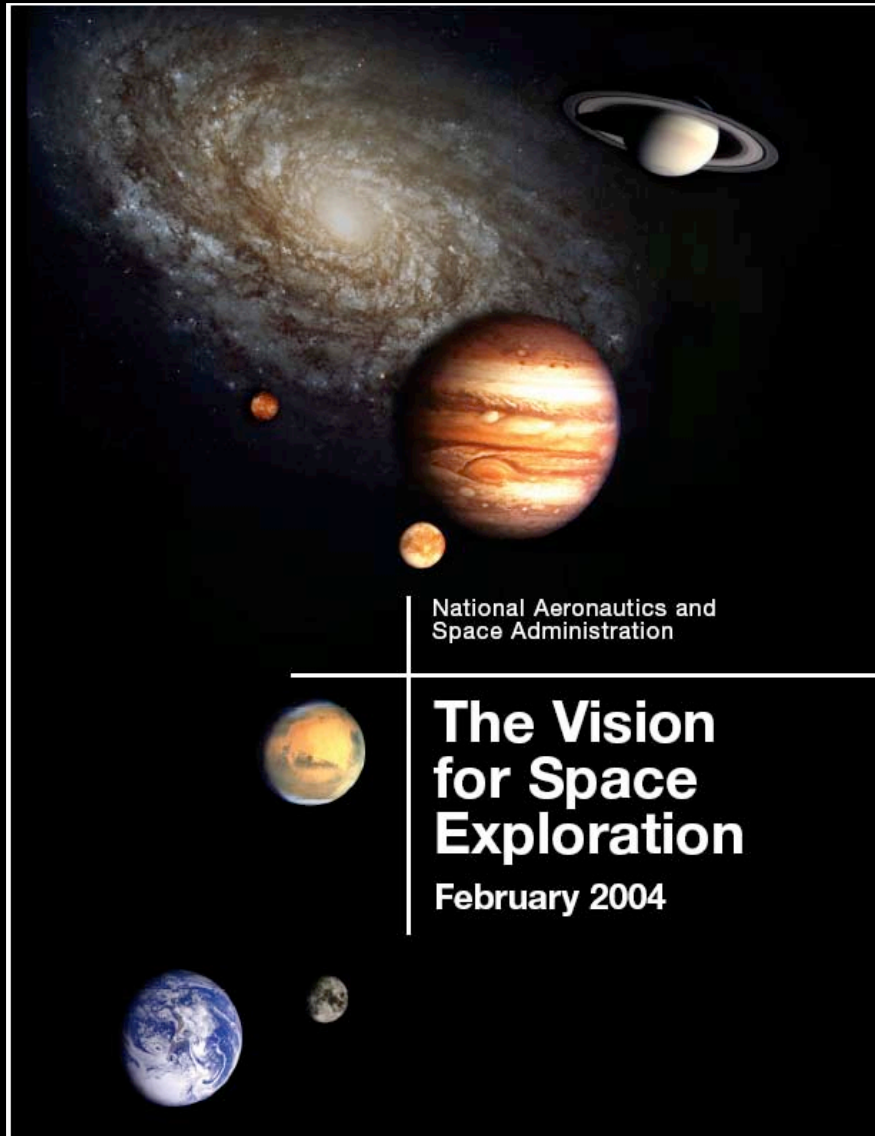


Accessing the Lunar Poles for Human Exploration Missions

**B. Kent Joosten
NASA Johnson Space Center**

Vision for Space Exploration (2004)



- “Extend human presence across the solar system starting with a human return to the Moon by the year 2020...”
- “Human mission to the Moon will serve as precursors for human missions to Mars and other destinations.”
 - Testing of new sustainable exploration approaches
 - Space resource utilization
 - Testing of human exploration systems
 - Surface power
 - Habitation and life support
 - Planetary mobility

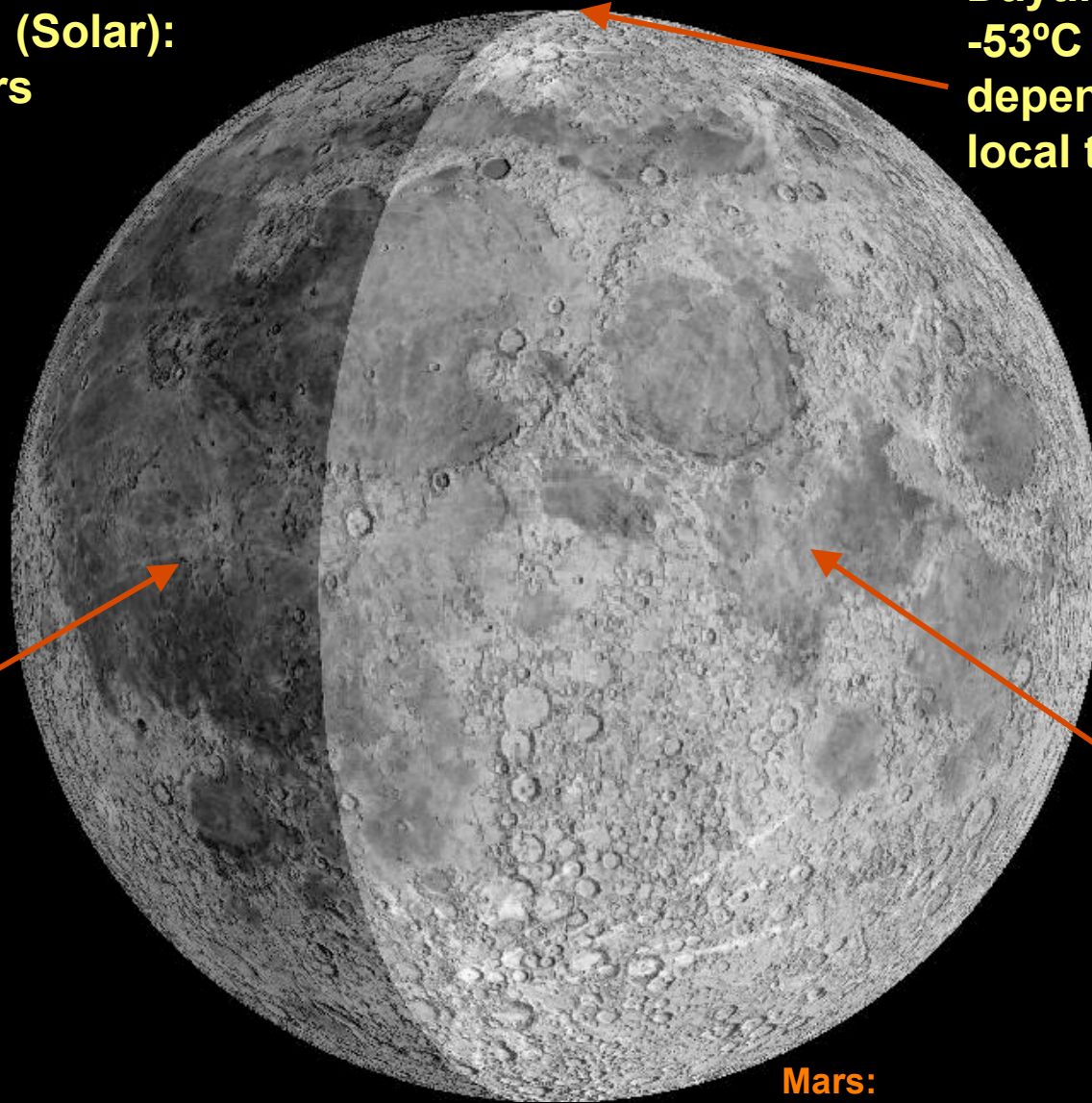
Lunar Thermal Conditions

Rotation Period (Solar):
29 days 13 hours

Daytime Polar:
-53°C (-67°F), highly
dependent upon
local topography

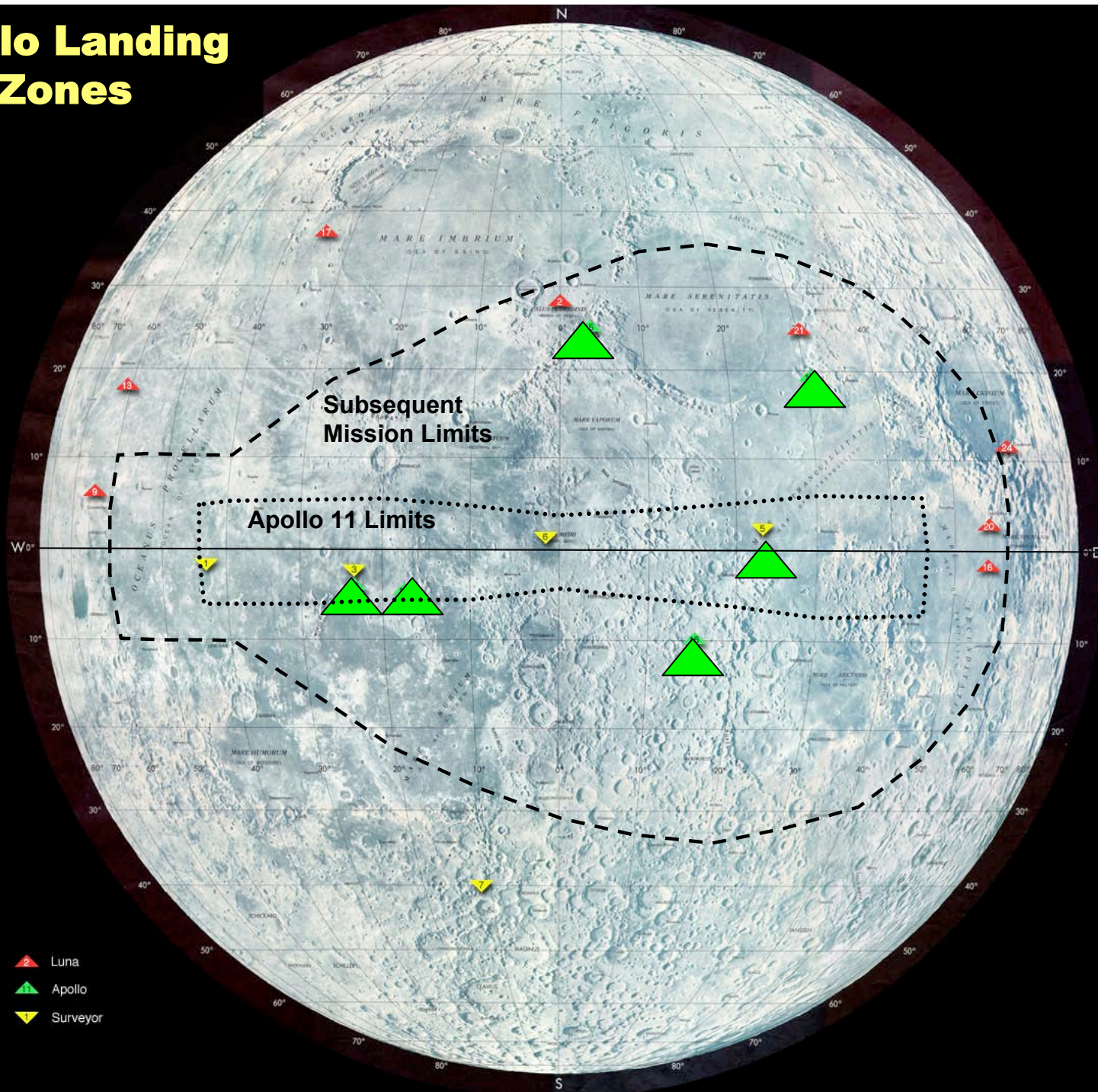
Nighttime:
-170°C (-272°F)

Daytime
Equatorial:
110°C (243°F)

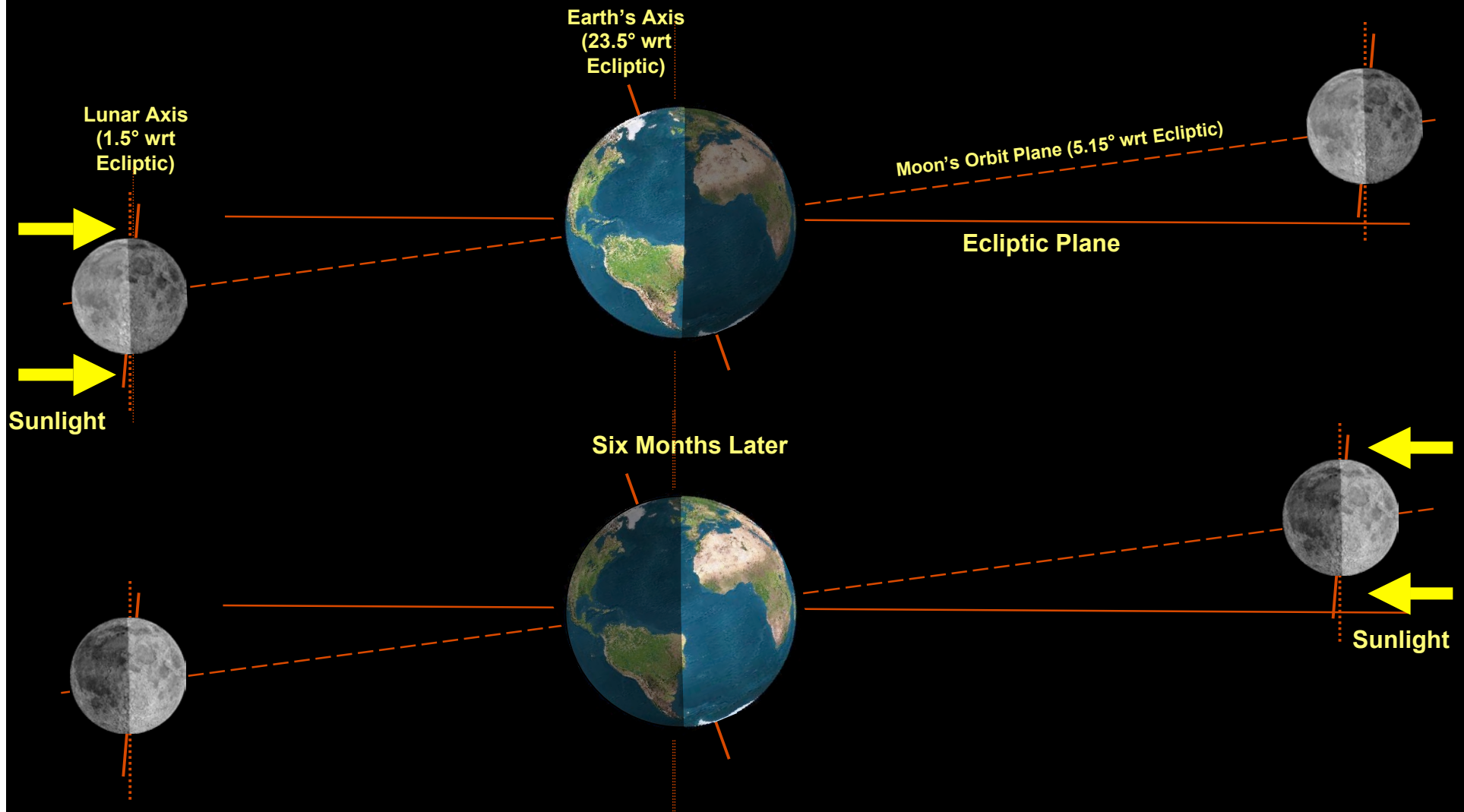


Mars:
Average Atmospheric: -63°C (-81°F)
Maximum: 20°C (68°F)
Minimum: -140°C (-220°F)

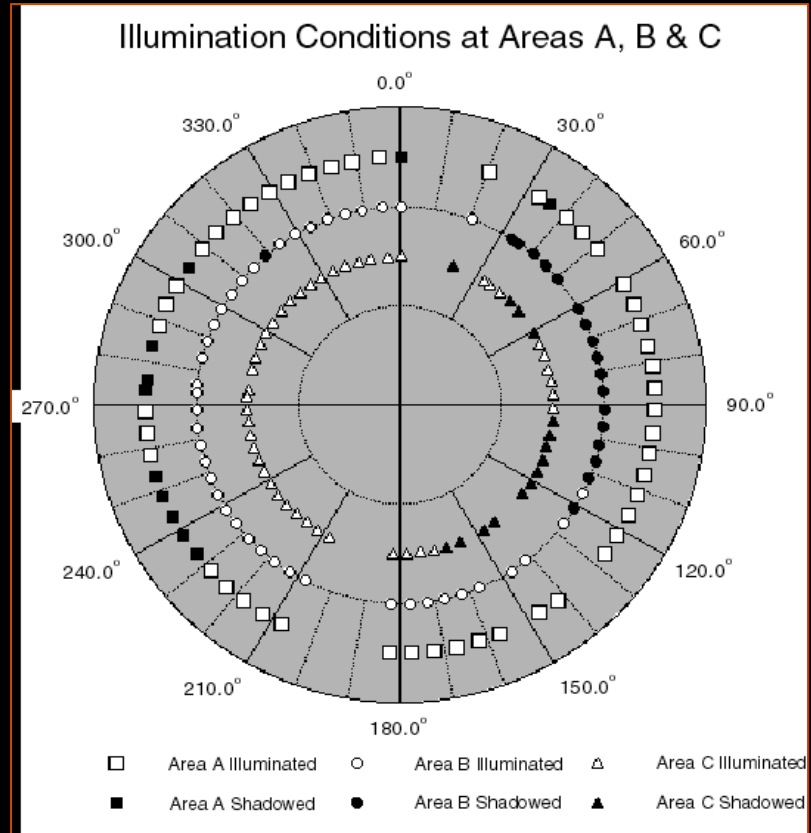
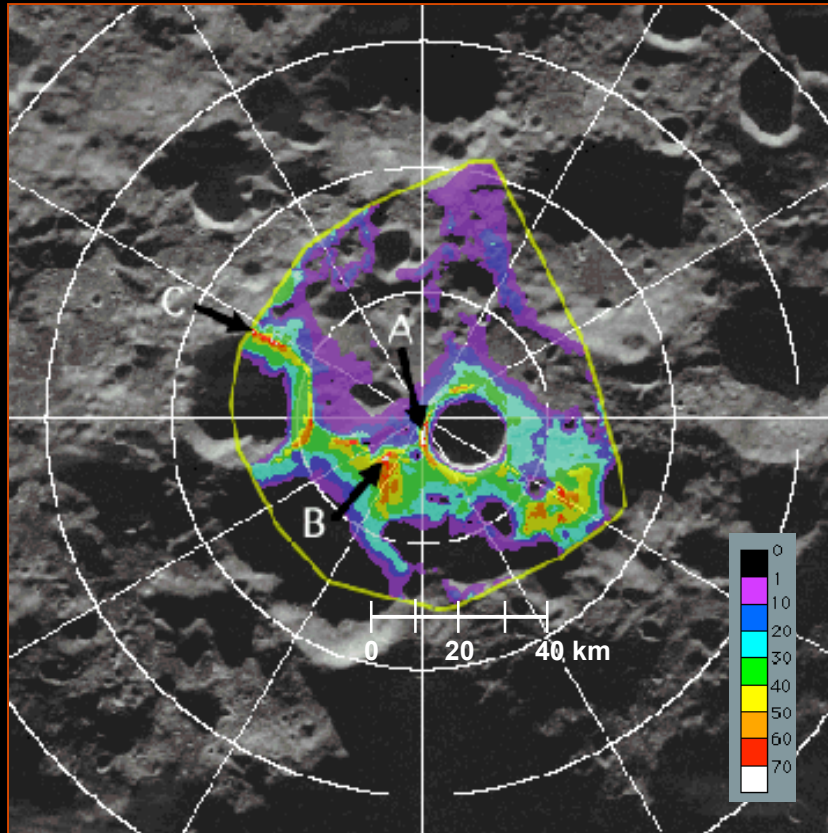
Apollo Landing Zones



Lunar Illumination

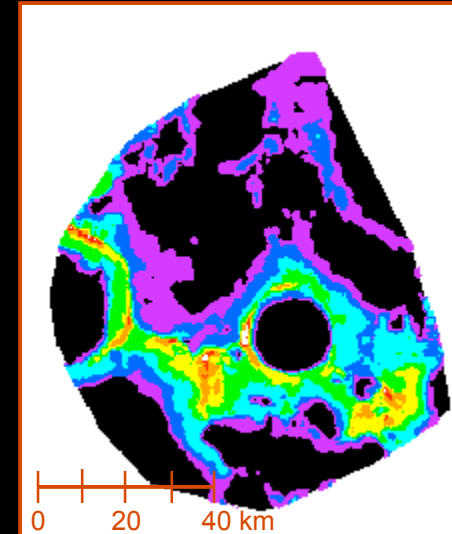
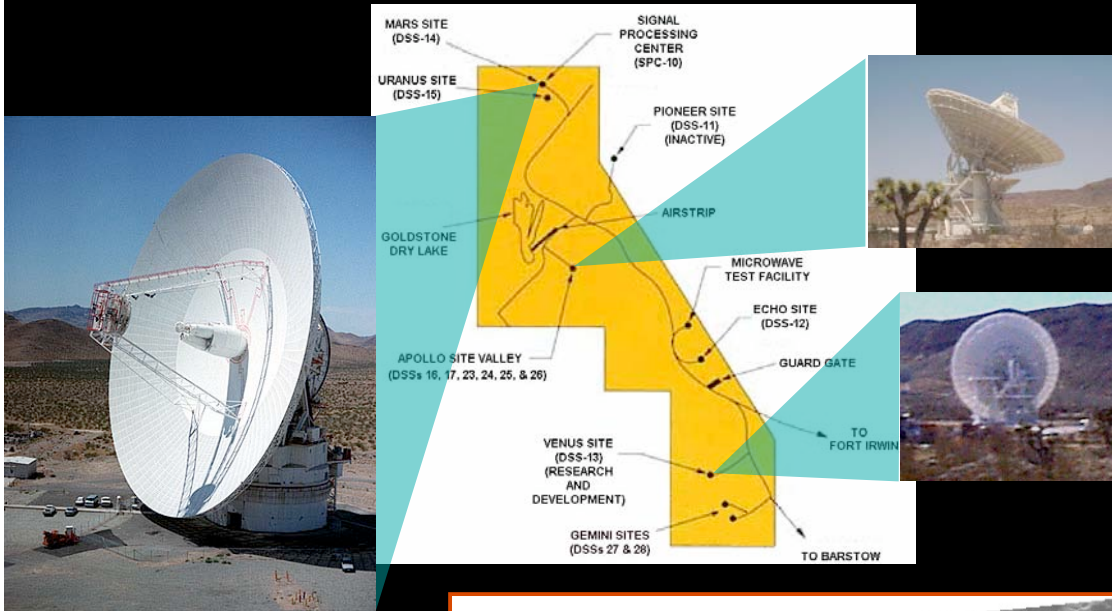


South Polar Illumination (Clementine Spacecraft, 1994)

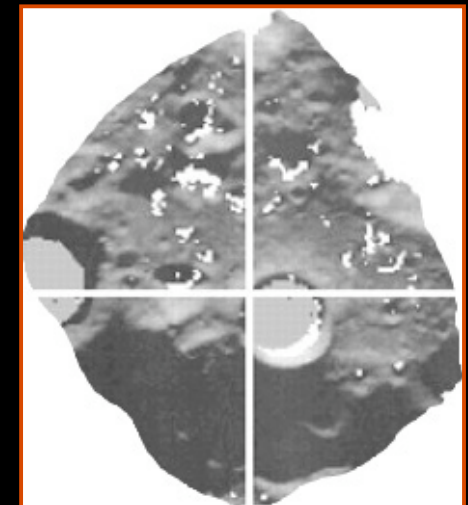
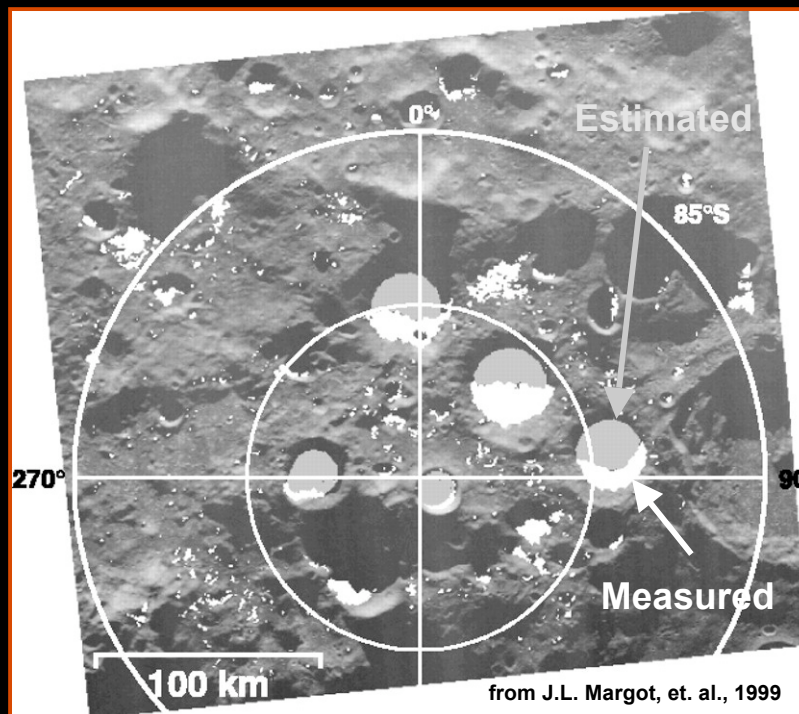


From Bussey, et. al. 1999

Goldstone Solar System Radar Lunar Polar Surveys (1997)

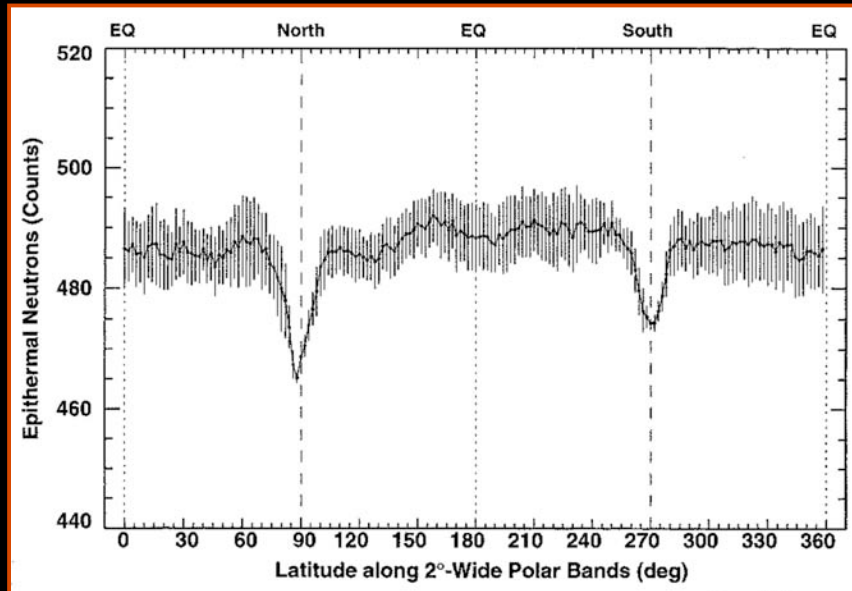


Clementine Illumination Map
from Bussey, et. al. 1999

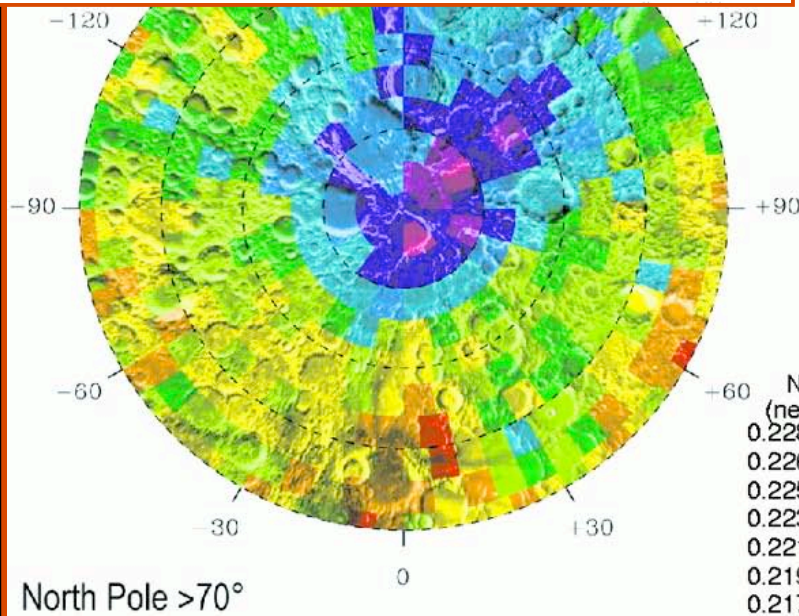


GSSR Cold Trap Map
from Margot, et. al., 1999

Lunar Polar Resources (Lunar Prospector, 1998)

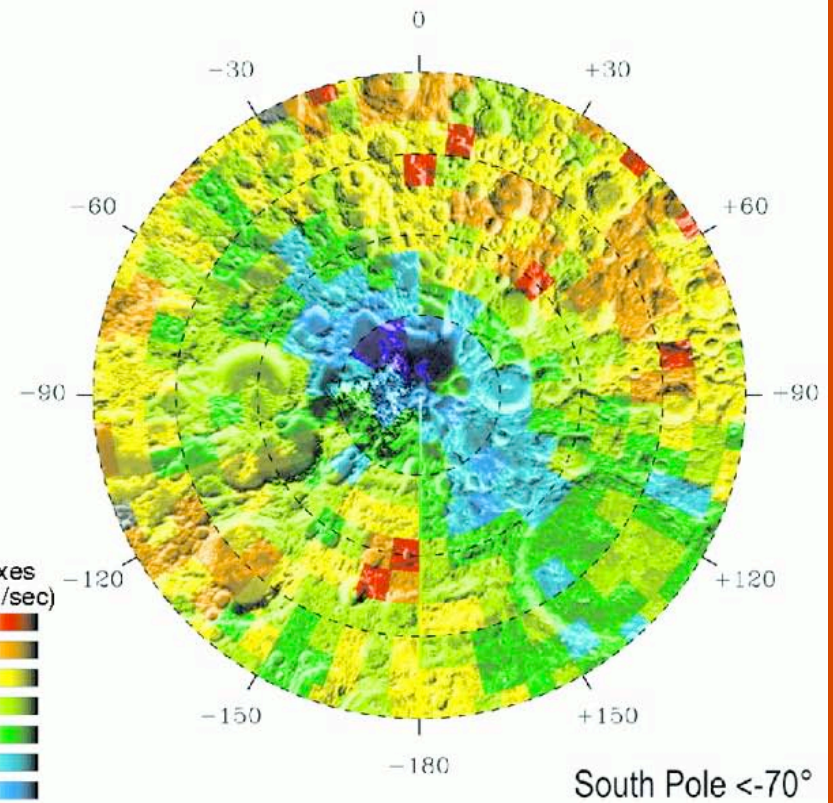


Epithermal neutron counting rates from Lunar Prospector
Neutron Spectrometer
From Feldman, et. al., 1998.



Neutron Fluxes
(neutrons/cm²/sec)

0.228-0.230
0.226-0.228
0.225-0.226
0.223-0.225
0.221-0.223
0.219-0.221
0.217-0.219
0.215-0.217
0.214-0.215
0.212-0.214



New Mission – “Lunar Reconnaissance Orbiter”

- **Scheduled for launch in 2008**
- **High-Priority Measurements:**
 - Detailed topography (especially at poles)
 - Polar resource assessment & associated landing site safety
 - High resolution global resource assessment
 - Characterization of radiation Environment in Lunar Orbit



References

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- Bussey, D.B.J, Spudis, P.D., and Robinson, M.S., Illumination Conditions at the Lunar South Pole, *Geophysical Research Letters* 26, No. 9, pp. 1187-1190, 1999.
- Margot, J.L., Campbell, D.B., Jurgens, R.F., and Slade, M.A., Topography of the Lunar Poles from Radar Interferometry: A Survey of Cold Trap Locations, *Science* 284, 1658-1660, 1999.
- Feldman, W.C., Maurice, S., Binder, A.B., Barraclough, B.L., Elphic, R.C., and Lawrence D.J., Fluxes of Fast and Epithermal Neutrons from Lunar Prospector: Evidence for Water Ice at the Lunar Poles, *Science* 281, 1496-1500, 1998.