A possibility to recover the past Solar Constant (TSI) with the Moon

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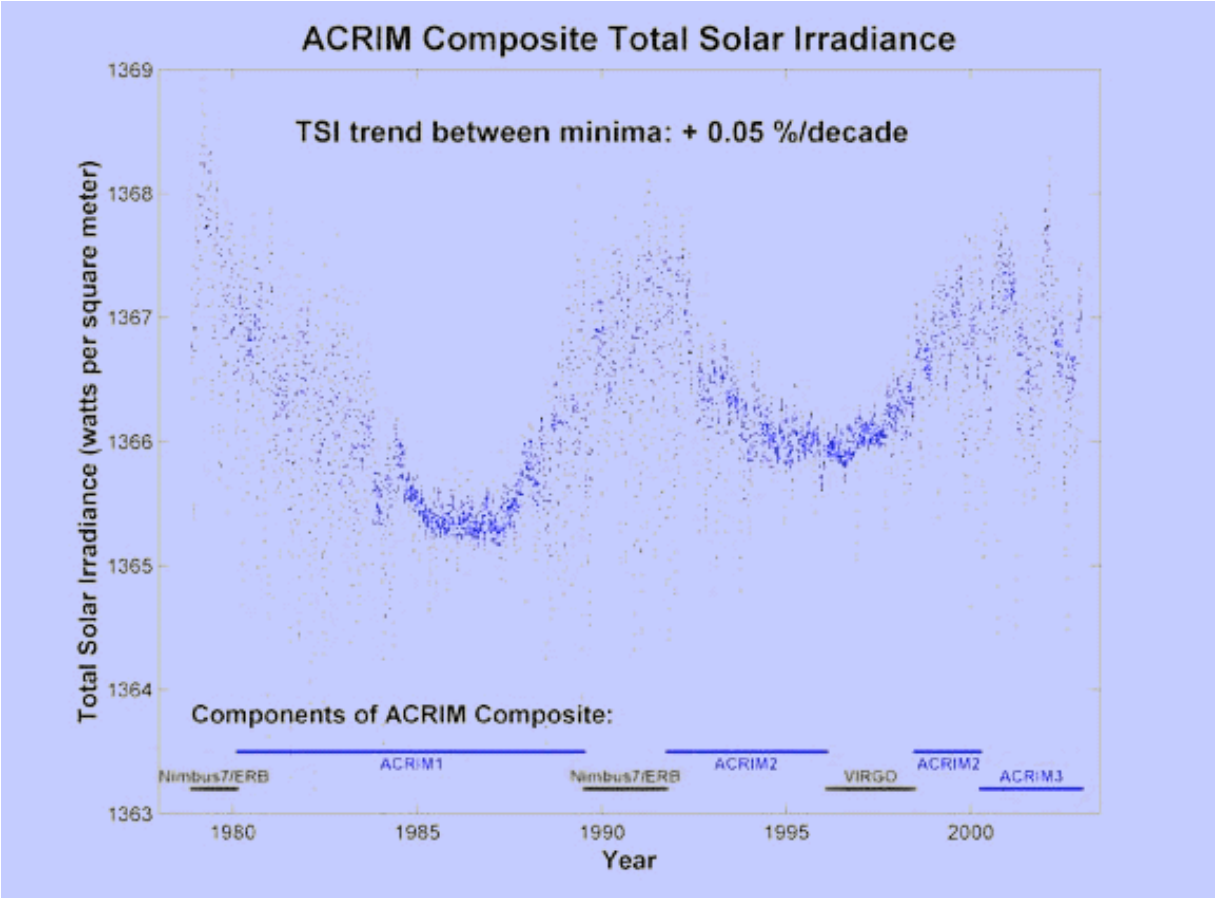
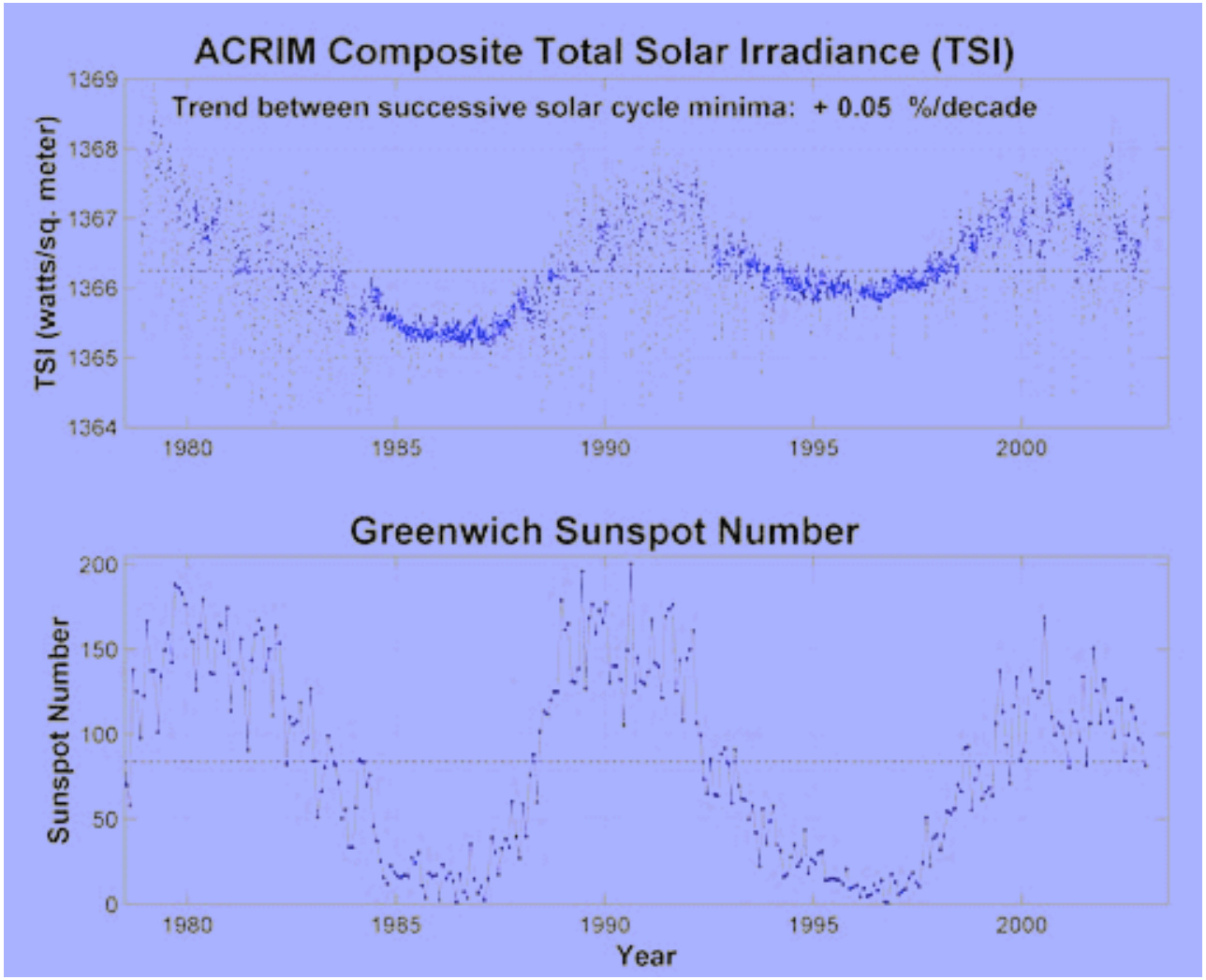
Rational to measure long-term TSI variability

The sun is the only energy source for the earth, and the solar constant (TSI) is one of the most important climatic factors.

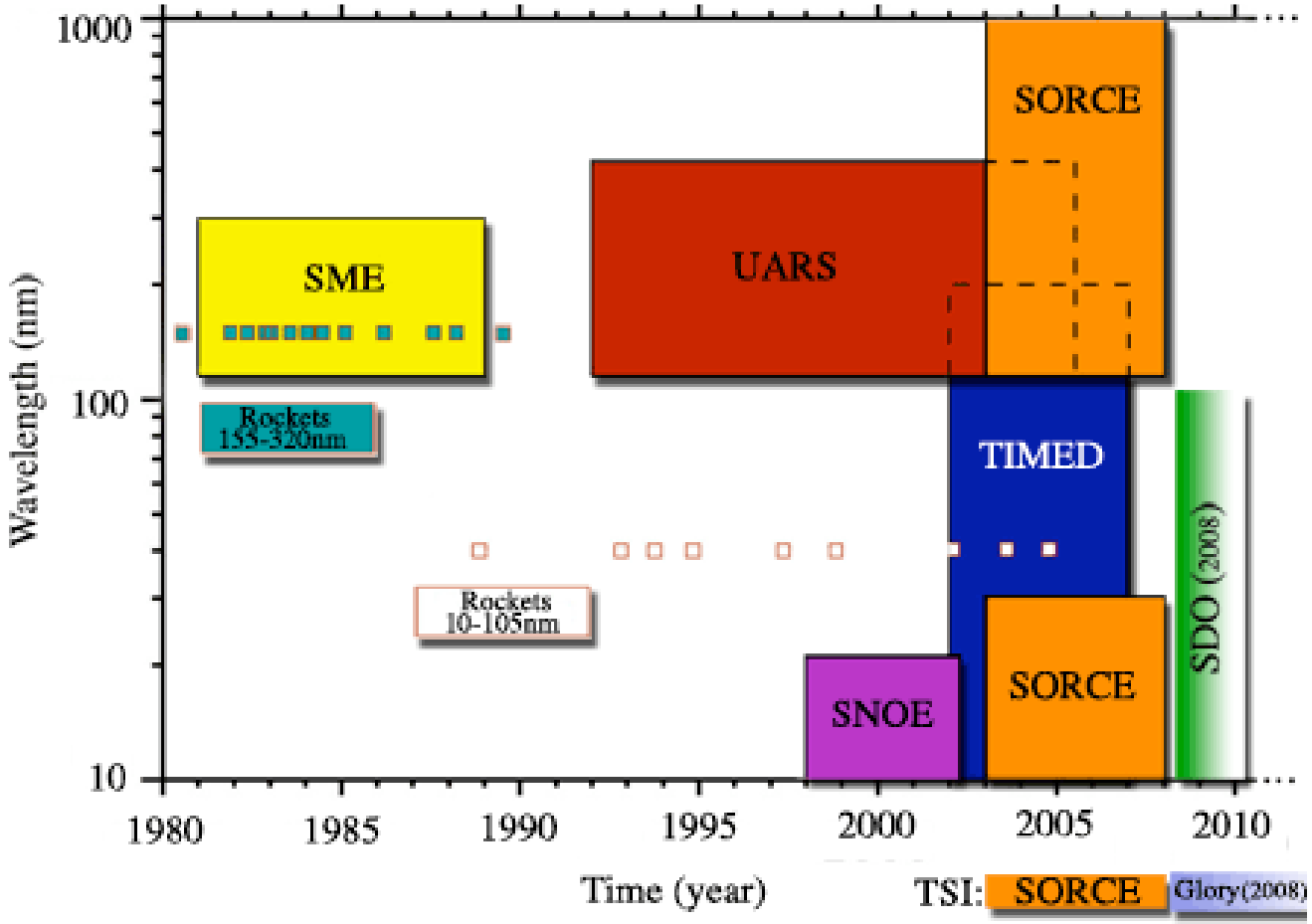
TSI definitely influenced the earth's climate in the past, but unfortunately we don't know how much.



TSI variability and sunspot numbers

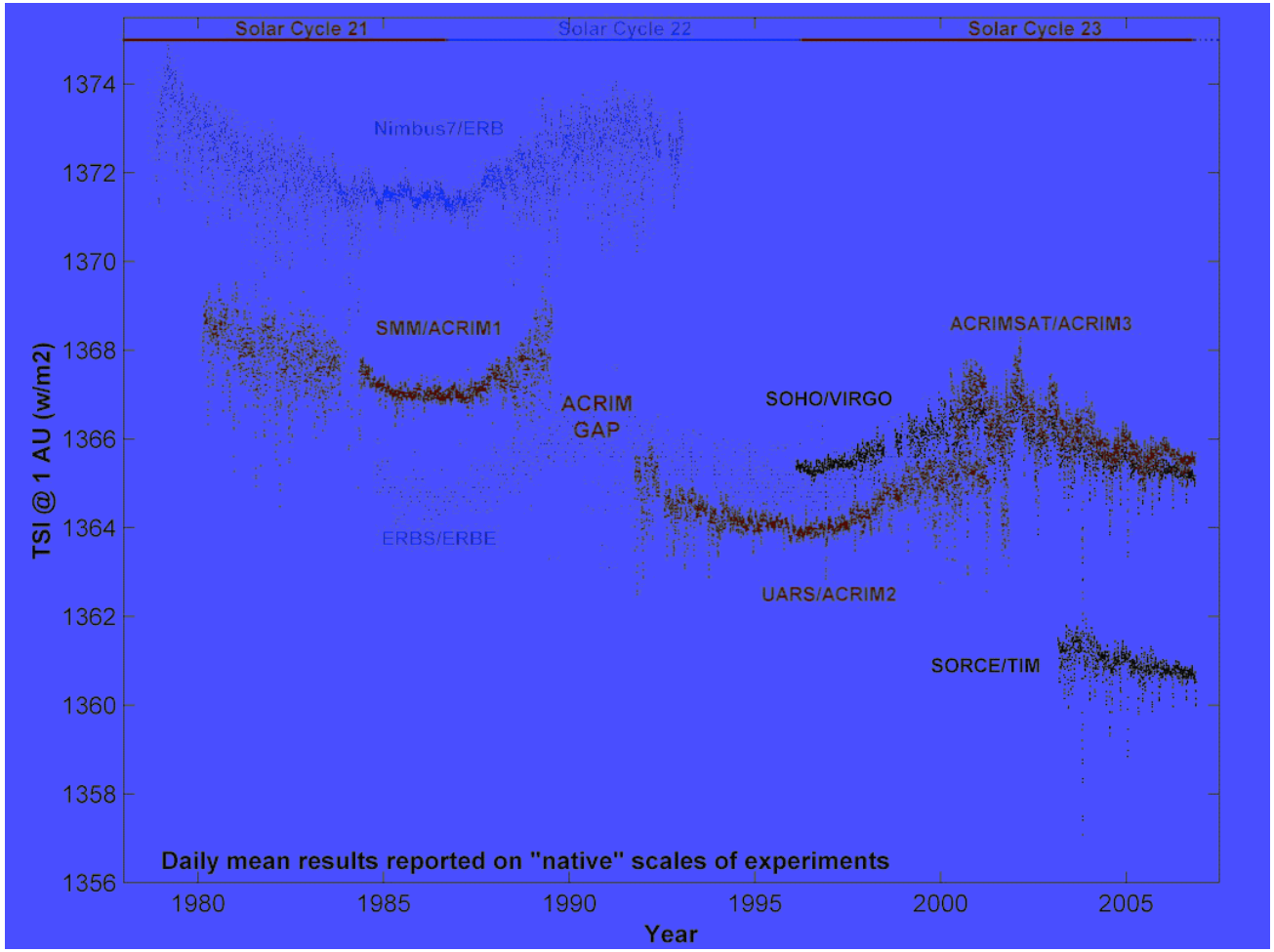


Available TSI measurements since 1979



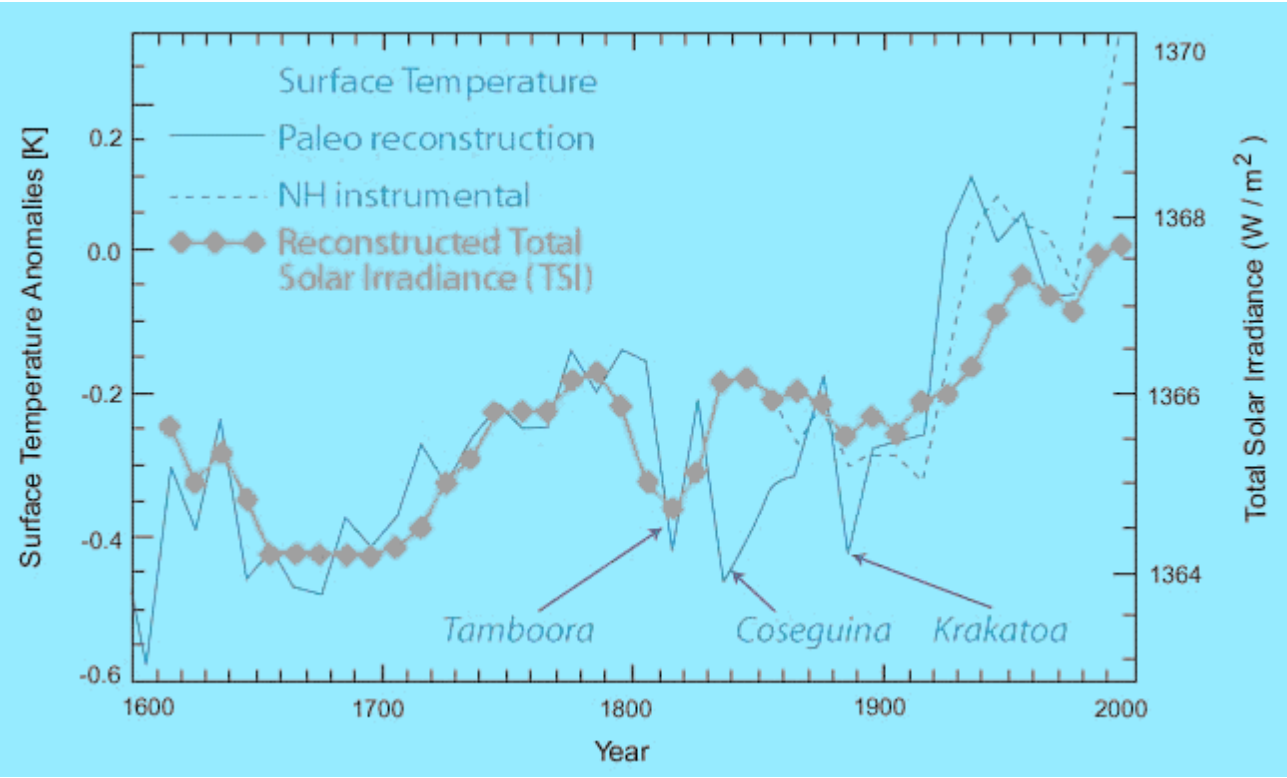
The direct measurement of TSI has been available since late 1978.

TSI relative accuracy from space measurements



Owing to too many sensors involved and the calibration uncertainty, we have diverse proposals of its trend, as figure shows.

What was the medieval TSI?



There are a number of effort to reconstruct TSI, based on sunspot numbers, and temperature proxy values.

It is therefore necessary to recover the lost TSI.

The Lunar surface is ideal to recover TSI

The proposal was made during the Radiation Panel Meeting (GEWEX) in August 2002 in Zurich.

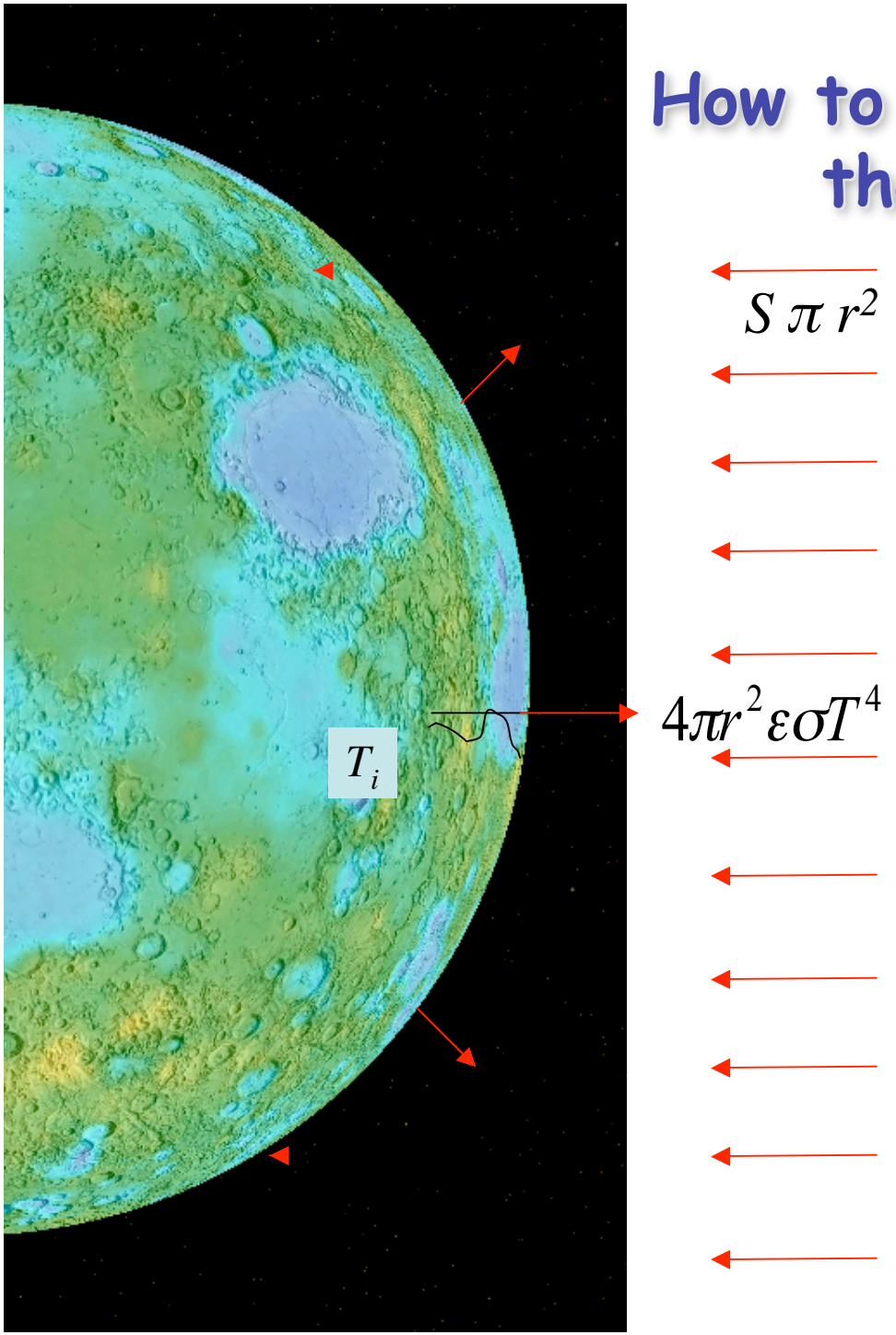
The method is based on the fact that the Lunar surface is in a state of radiative equilibrium between the absorbed solar radiation and the thermal emission.

The lunar surface temperature is determined by TSI.

By measuring the temperature profile and inverting the temperature to the surface temperature, one can recover the lost TSI of the past, and the albedo and emissivity can be assumed almost constant.

The ideal site will be near the Lunar Equator (large absolute flux and better resolution for TSI) and a spot with a thick lunar dust layer (easier to bore and heat conductivity is small; longer history in a short core). 100 m will do to reach 1600 AD, containing the Maunder and Dalton minima.

How to recover the lost TSI of the past on the Moon

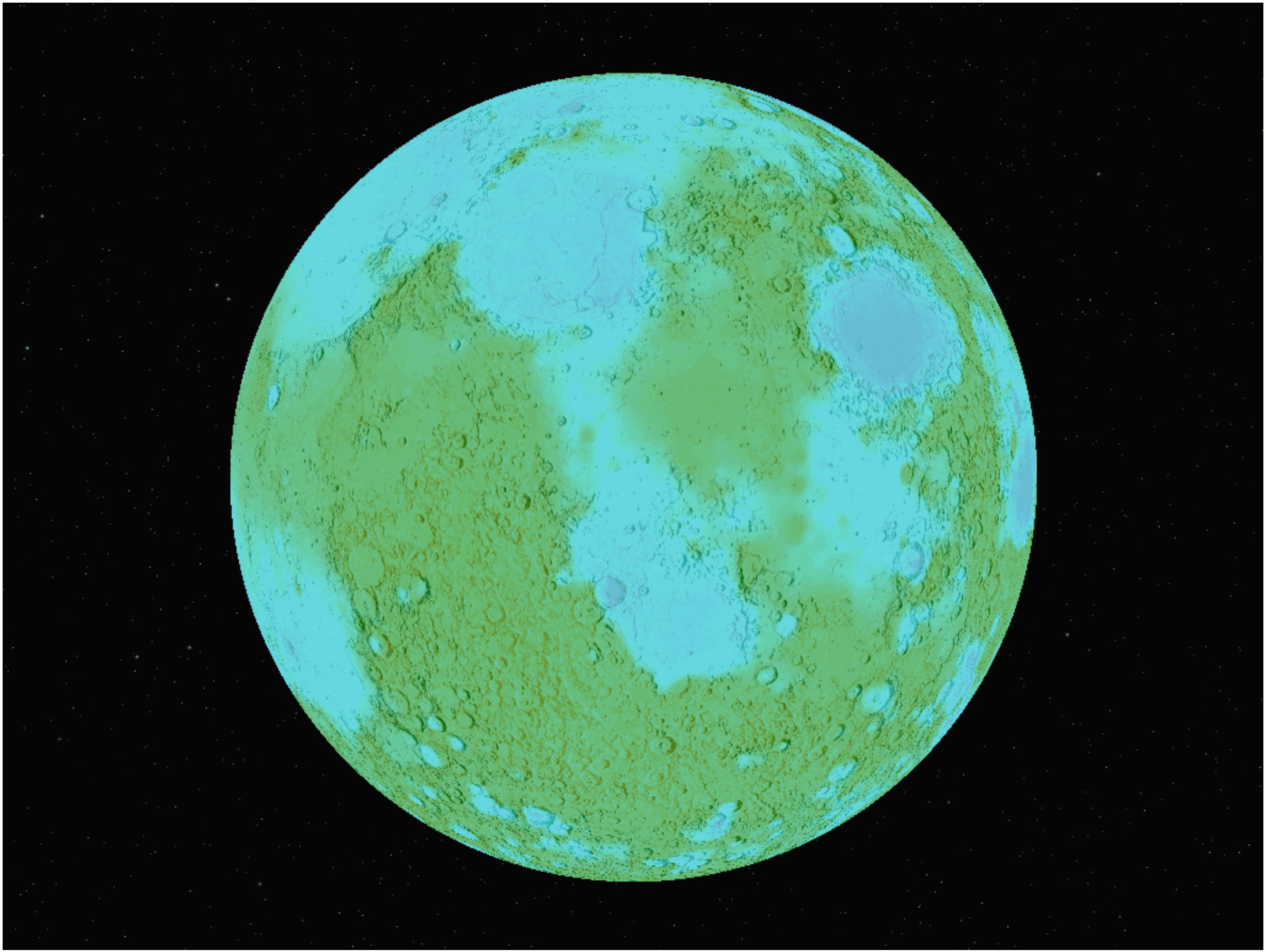


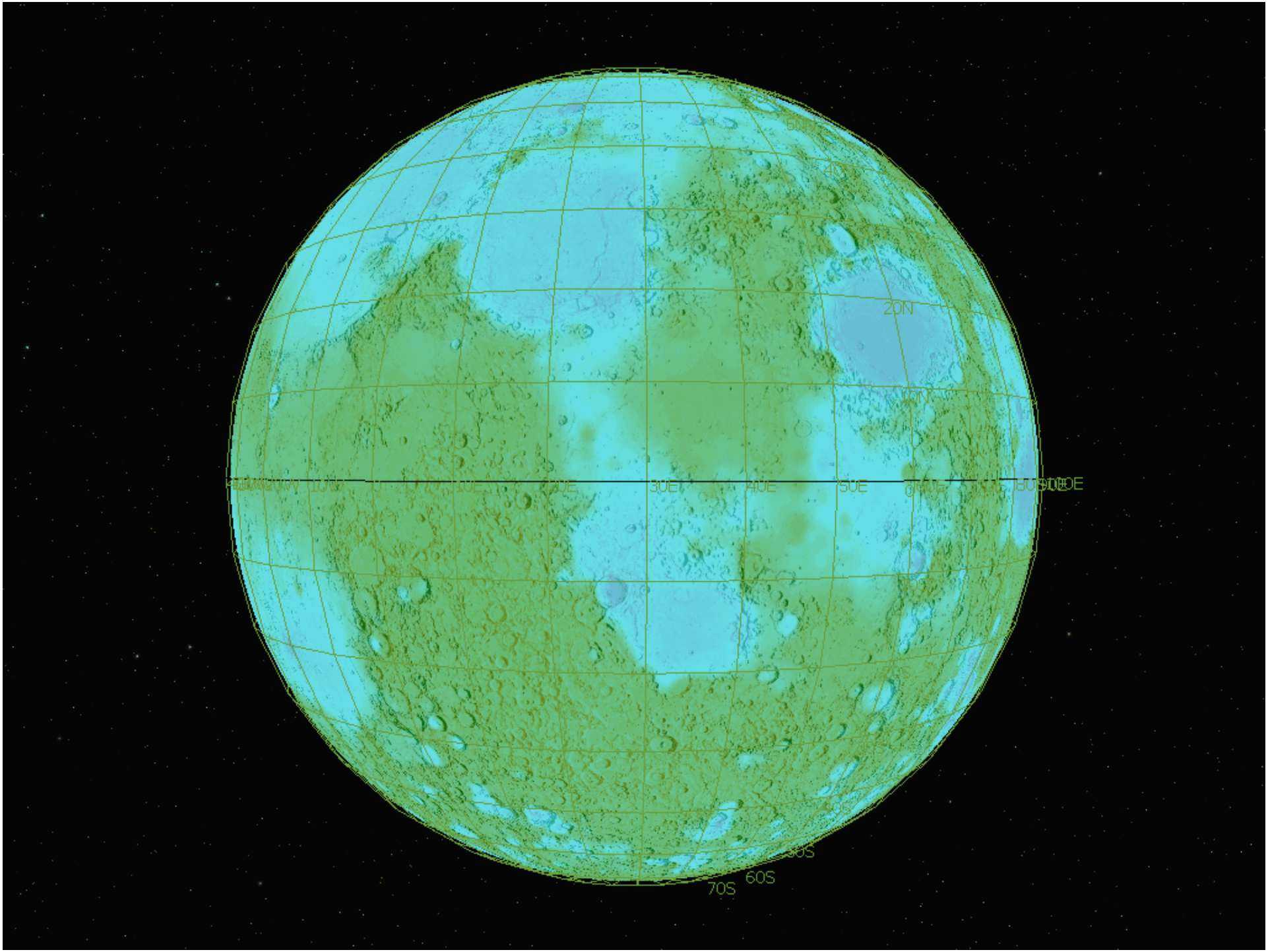
$$4\pi r^2 \varepsilon \sigma T^4 = (1-a) S \pi r^2$$

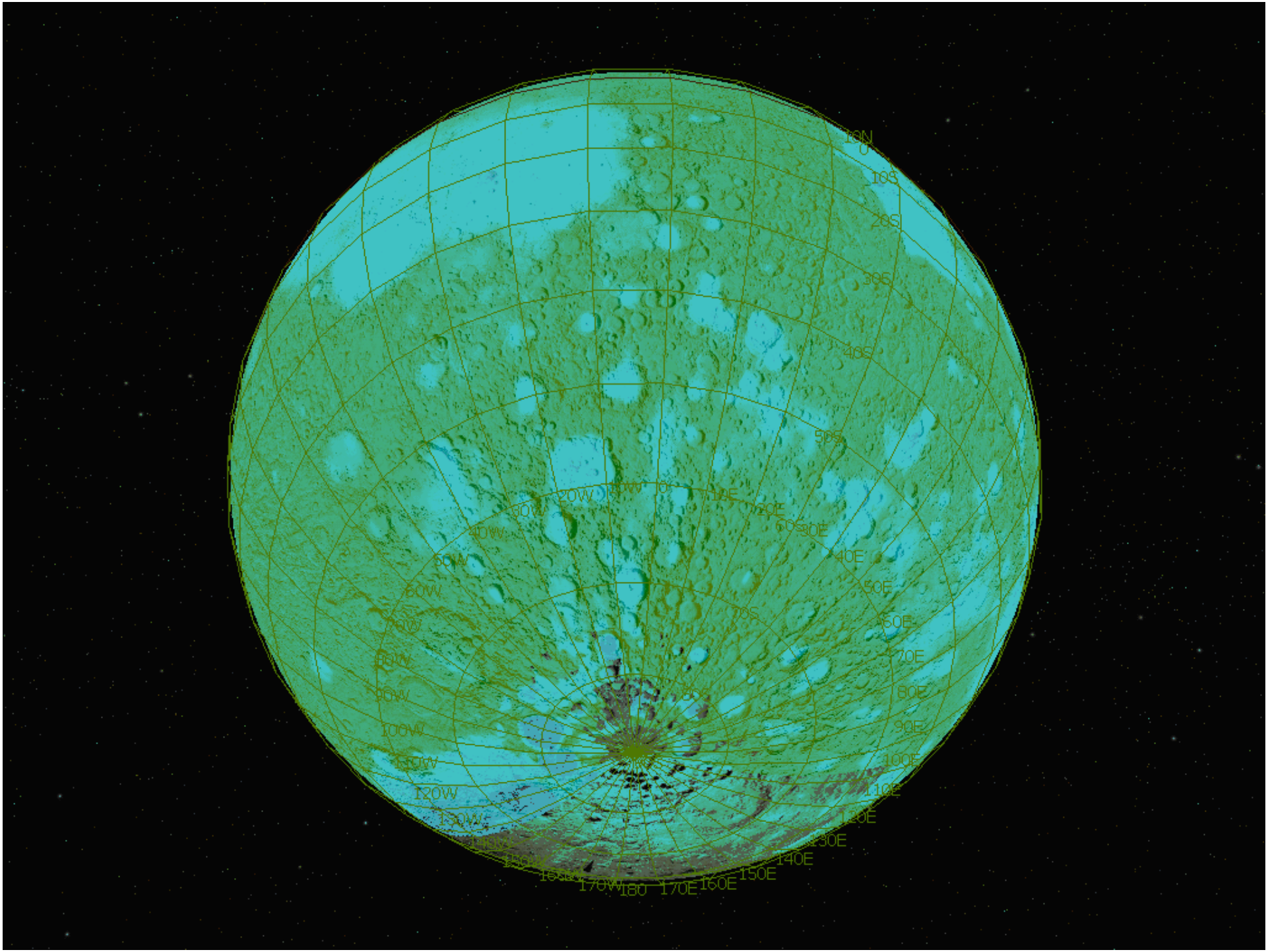
$$T = \left[\frac{(1-a)S}{4\varepsilon\sigma} \right]^{1/4}$$

T_i can be measured and inverted to obtain T, thus S as a function of time.

$$S = \frac{4\varepsilon\sigma T^4}{1-a}$$




20N
3UE
4UE
5UE
60S
70S


10N
0
10S
20S
30S
40S
50S
20W
0
10E
20E
30E
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
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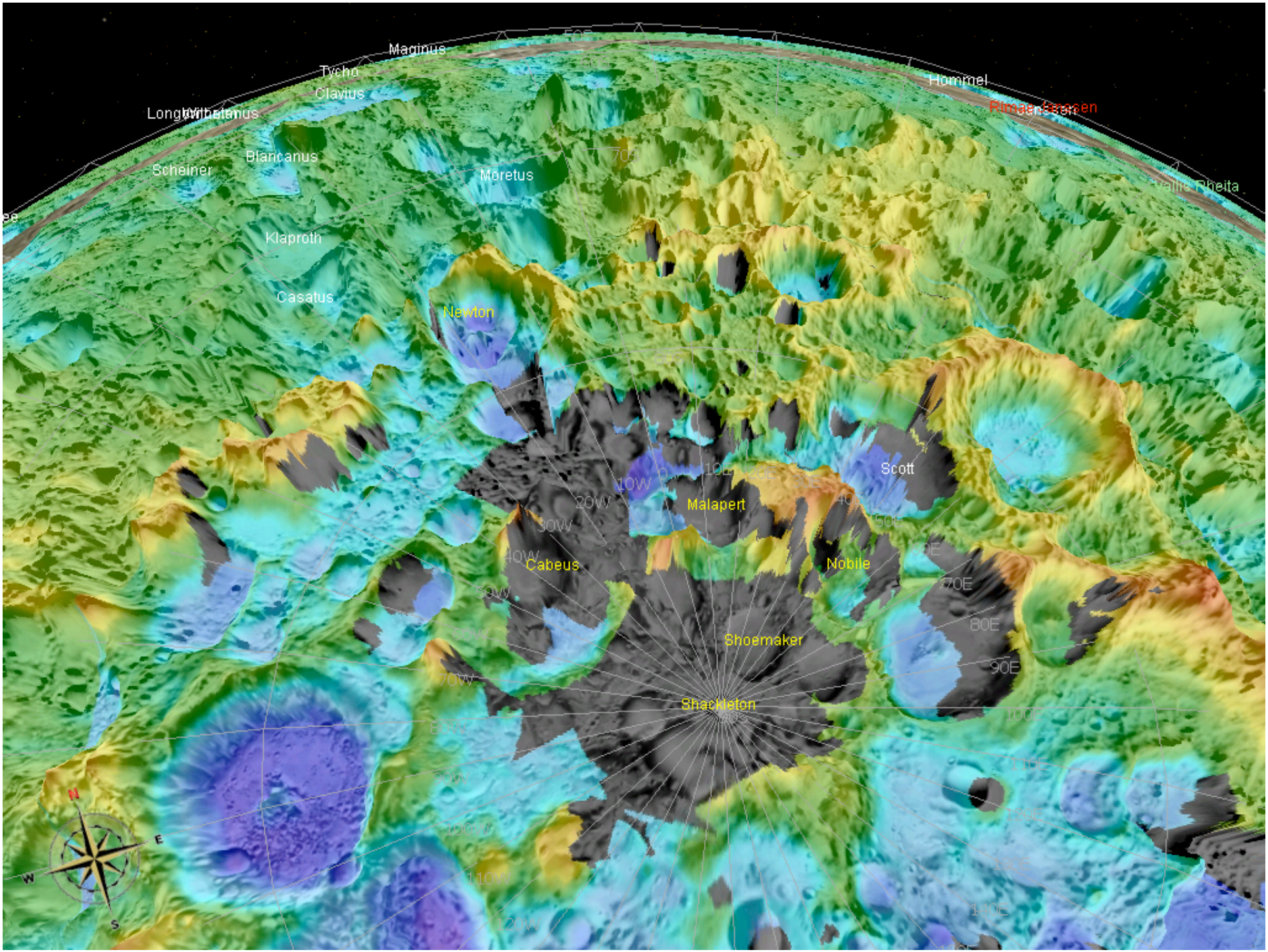
Maginus
Tycho
Clavius
Longomontanus
Wilhelmus
Hommel
Rimae Gerasen
Blancanus
Scheiner
Moretus
Vallis Rheita
Klaproth
Casatus
Newton
Scott
Malapert
Cabeus
Nobile
Shoemaker
Shackleton
N
E
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