The Timesnail

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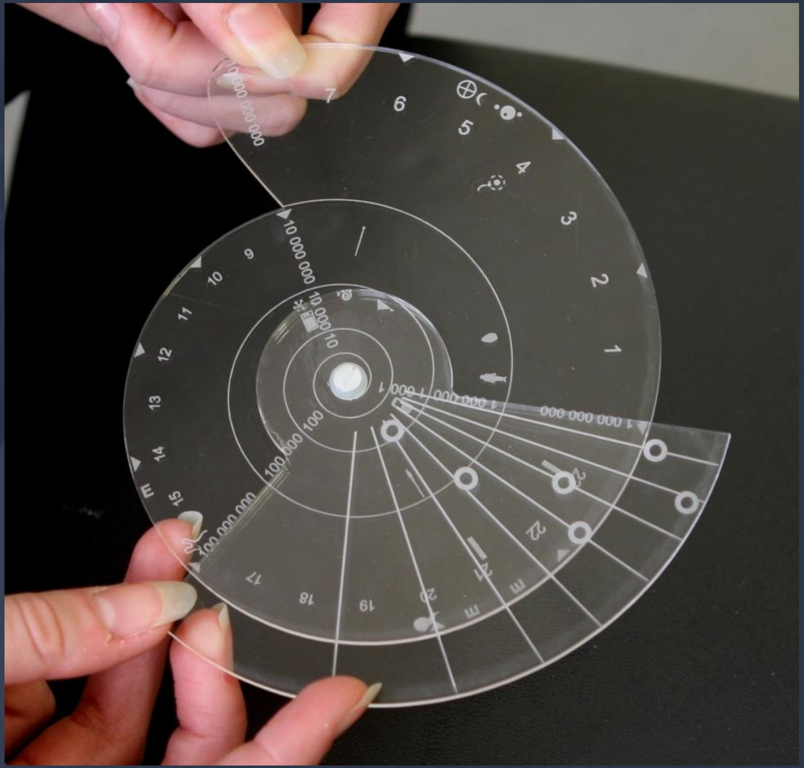
- What is the Timesnail?
- Introduction to powers of 10 and logs
- Making the snails
- ‘Powers of Ten’ quiz
- ‘How to use the Timesnail’ animation
- History of the Earth and estimation
- Estimation answers
- Using the Timesnail to tell the time
- Frequency and the Timesnail

Displays events in the natural history of the Earth from a few days ago to the formation of the Earth

Displays the frequencies of electromagnetic radiation

Tells the time by the stars



$1000 = 10^3$ thousand

$1000000 = 10^6$ million

$1000000000 = 10^9$ billion

$1000000000000 = 10^{12}$ trillion

Question: $1 = 10^?$

$100 \times 1000 = 100{,}000$

$10^2 \times 10^3 = 10^5$ note the indices add ($2 + 3 = 5$)

Now, we'll look at the small numbers in the powers of ten notation.

$1/1000 = \boxed{10^{-3}}$ thousandth

$1/1000000 = \boxed{10^{-6}}$ millionth

$1/1000000000 = \boxed{10^{-9}}$ billionth

$1/1000000000000 = \boxed{10^{-12}}$ trillionth

e.g. $1\ \text{mm} = \boxed{10^{-3}}\ \text{m}$

Place notation

MMVIII

2008 =
2000 +
0008

$2008 = 2 \times 10^3 + 8 \times 10^0$

Logarithms

$2008 = 2.008 \times 10^3$

$2.008 = 10^{\log(2.008)} = 10^{0.3027637..}$

$2008 = 10^{\log(2.008)} \times 10^3$

$= 10^{0.3027637} \times 10^3$

$= 10^{3.3027637}$

logs make multiplication into addition

Example: $100 \times 1000 = 100{,}000$

$10^2 \times 10^3 = 10^5$

$\log(10^2) = 2$
$\log(10^3) = 3$
$\log(10^5) = 5$

$2 + 3 = 5$

$\log(100) + \log(1000) = \log(100{,}000)$

Dealing with powers...

Example: $\log(1000) = \log(10^3) = \log(10 \times 10 \times 10)$

But we've just found

$$\log(10 \times 10 \times 10) = \log(10)+\log(10)+\log(10)$$

$$= 3 \log(10)$$

So

$$\log(10^3) = 3 \log(10)$$

Crafty ways of finding logs (roughly)

Example: What is log 2?

In other words $2 = 10^n$ what is the number n? It's not obvious is it! Well n=0 would give you 1 and n=1 would give you 10 so it must be between the 0 and 1.

$2^3 = 8$
$2^4 = 16$

But $\log(2^3) = 3 \log(2)$

So $3 \log(2) = \log(8)$
$4 \log(2) = \log(16)$

Rough guess: $\log(10) \sim (3/4) \log(8) + (1/4) \log(16)$

$\sim 3 (3/4) \log(2) + 4(1/4) \log(2) \sim (13/4)\log(2)$

But $\log(10) = 1$ so

$\log(2) \sim 4/13$ (accurate to ~ 2%)

Crafty ways of finding logs (roughly)

Example: What is log 2?

In other words $2 = 10^n$ what is the number n?

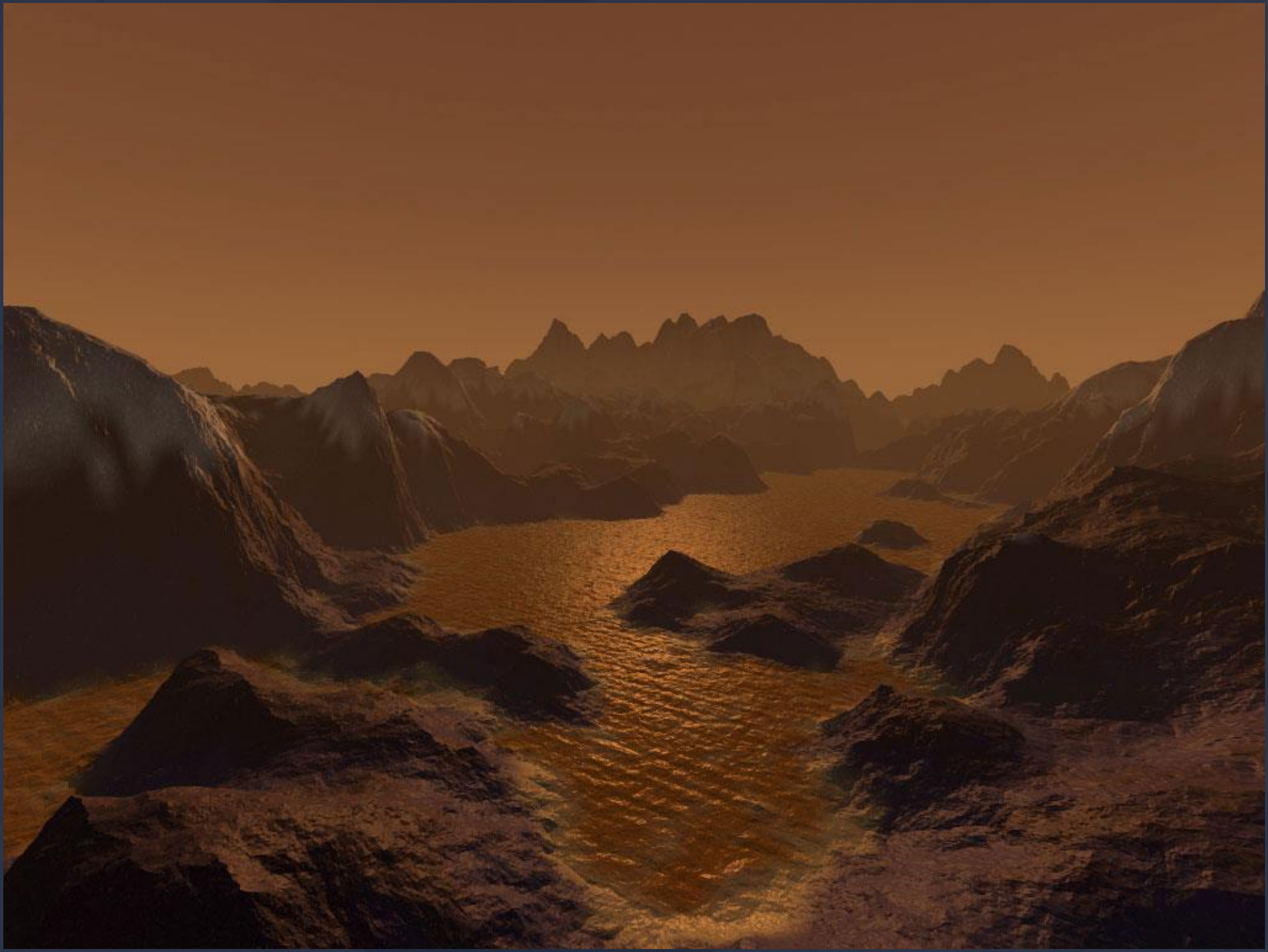
$2^3 = 8$
$2^4 = 16$

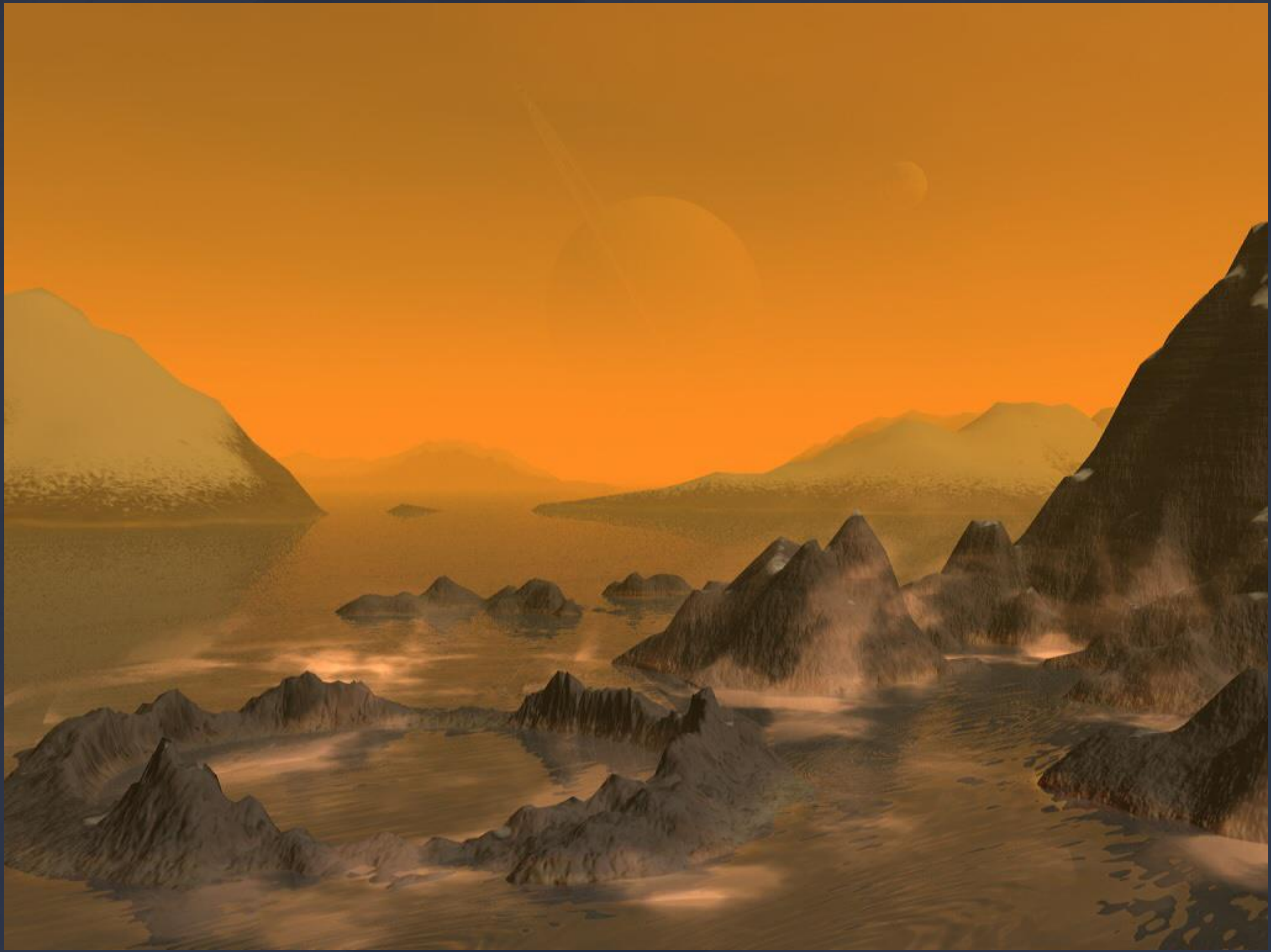
$2.008 = 10^{\log(2.008)} = 10^{0.3027637..}$

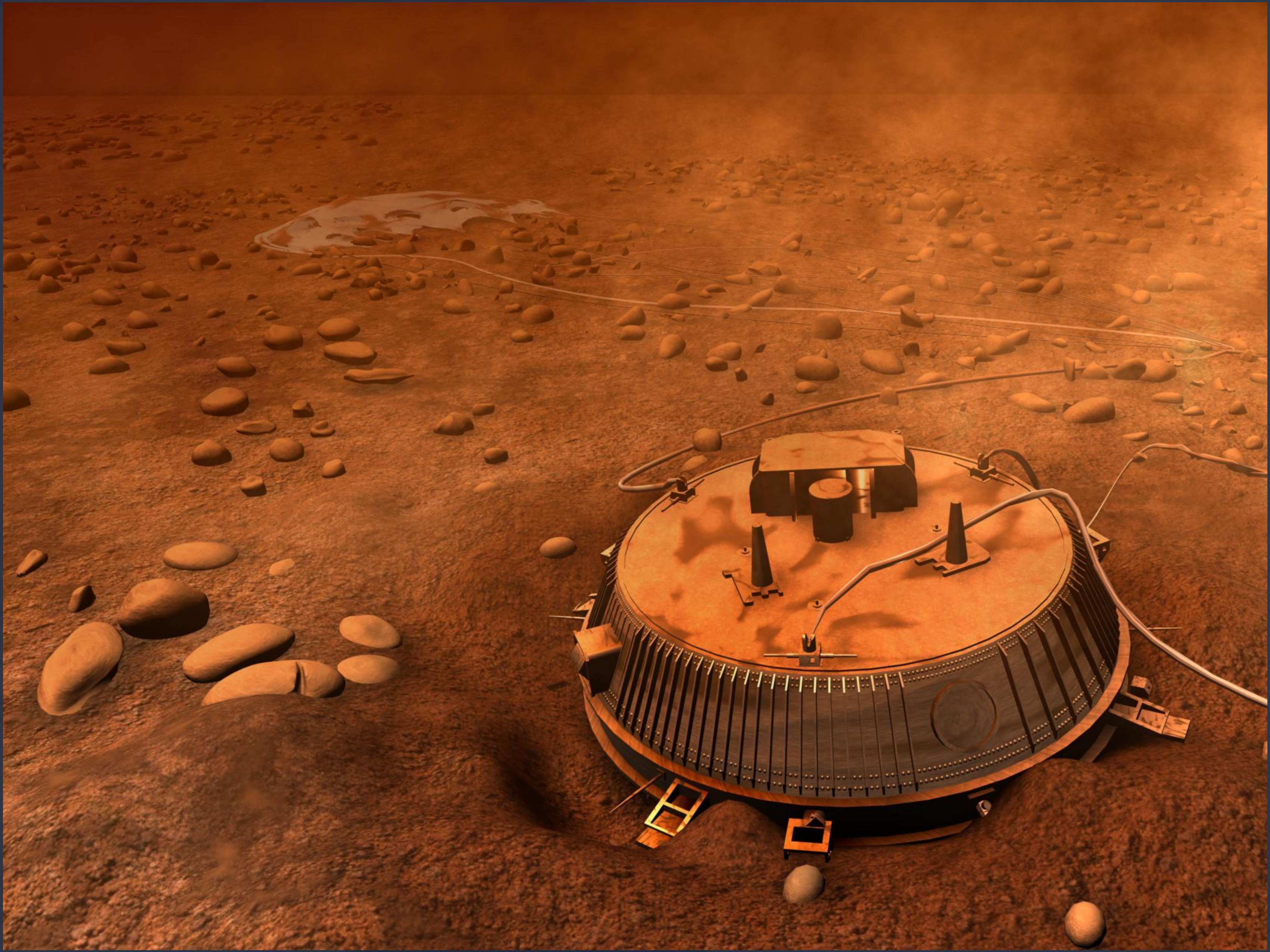
$2008 = 10^{\log(2.008)}$ x

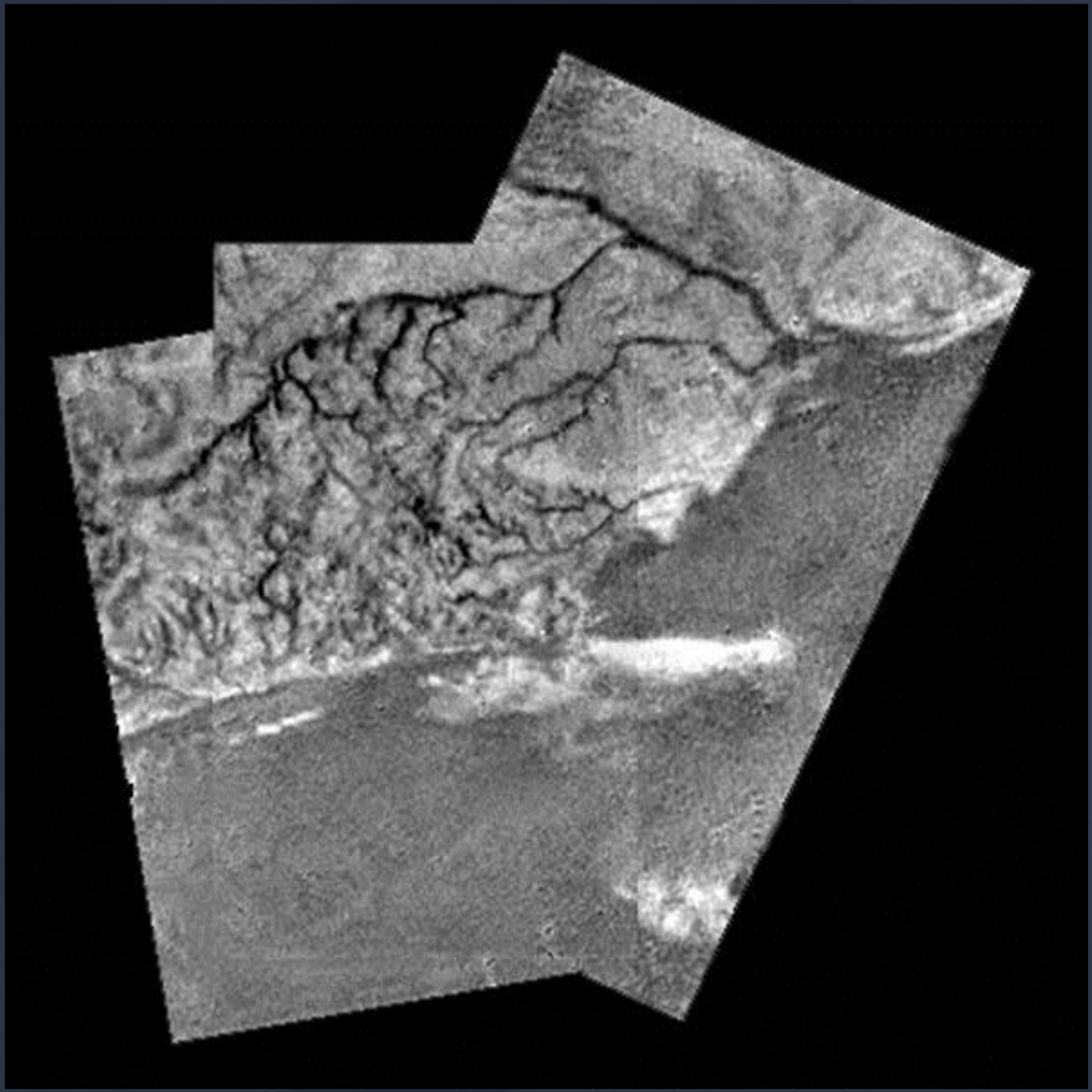
$= 10^{0.3027637} \times 10^3$

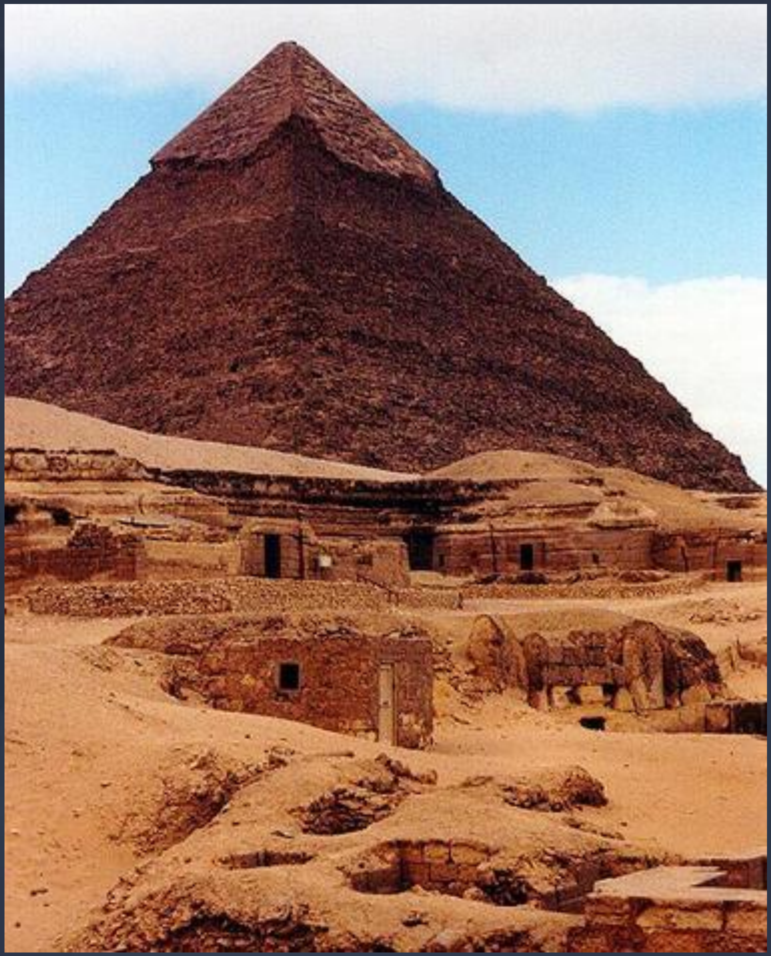
$= 10^{3.3027637}$

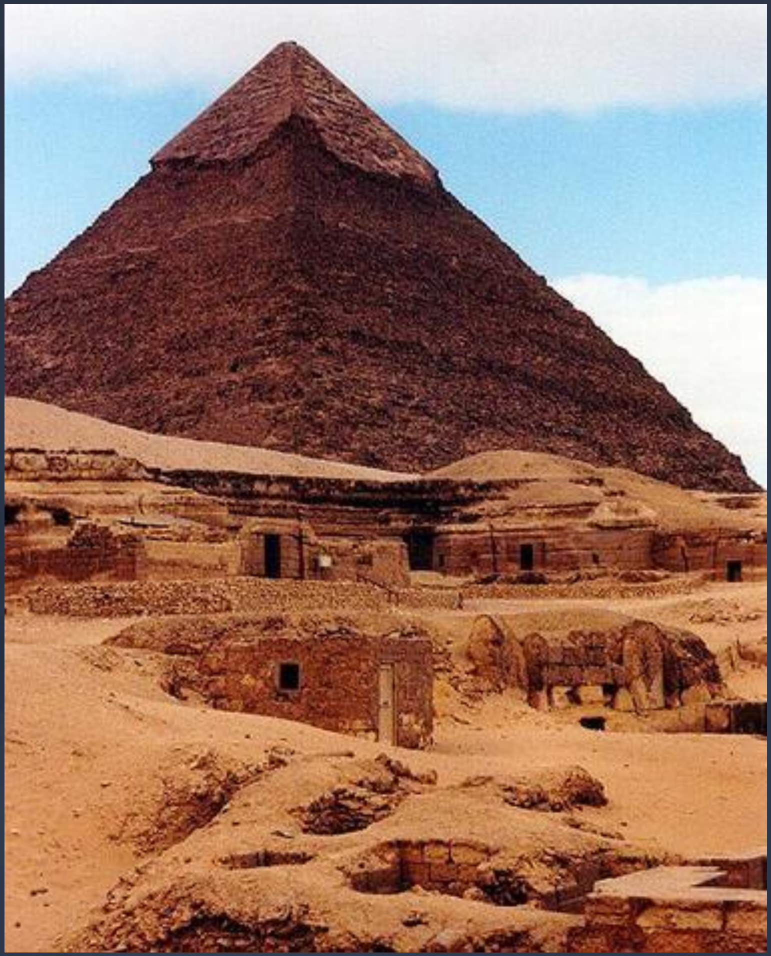






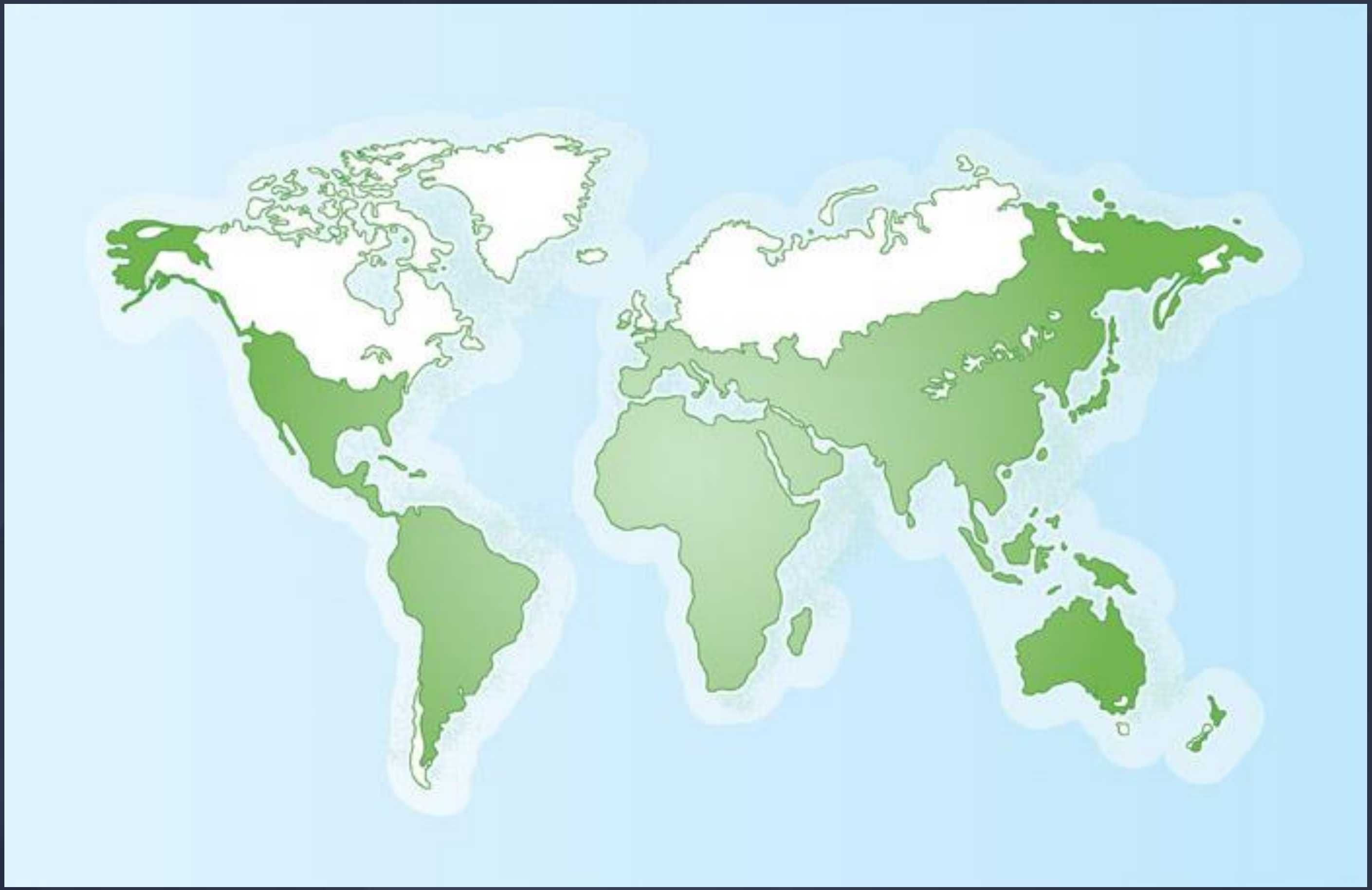


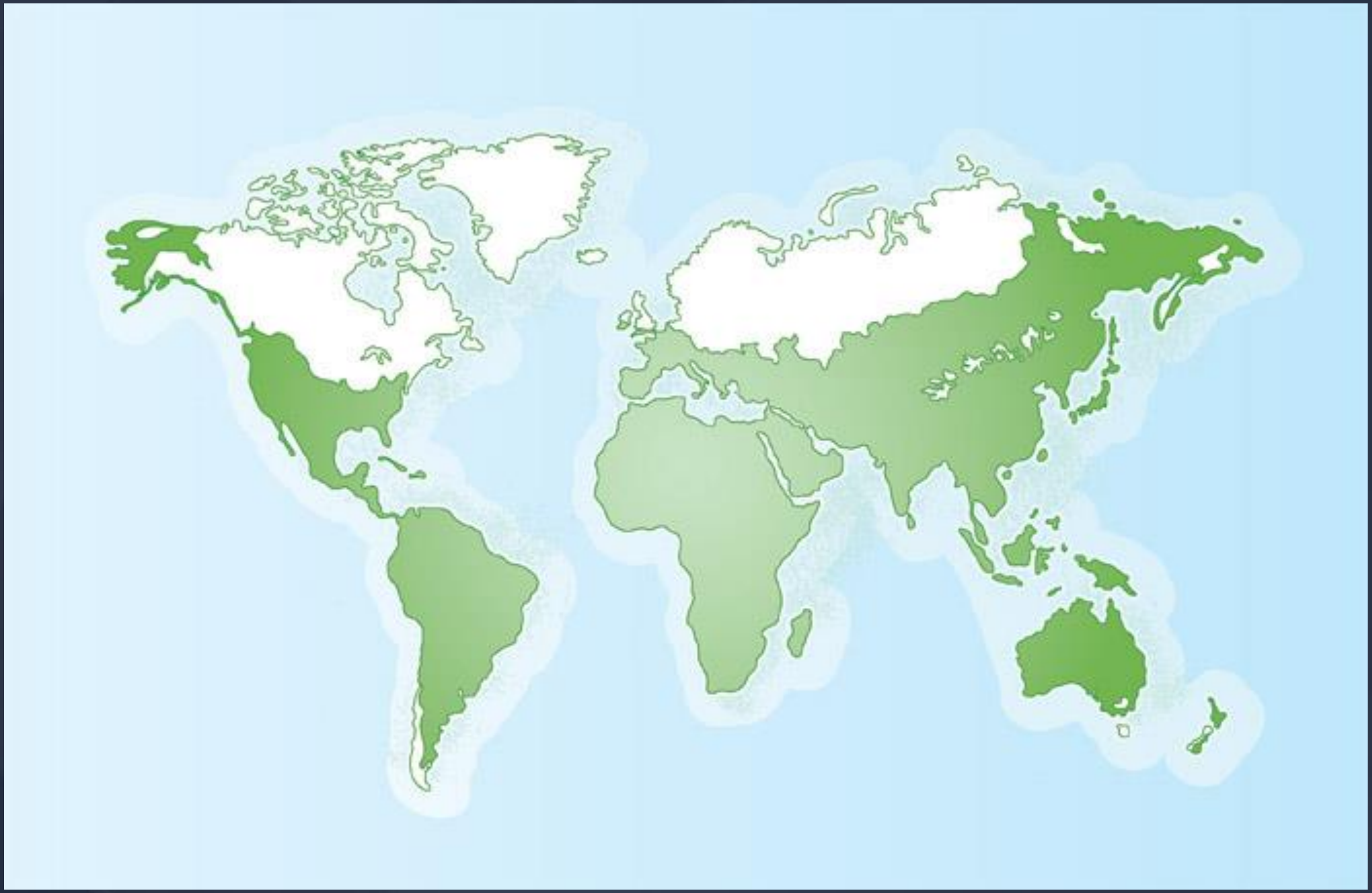





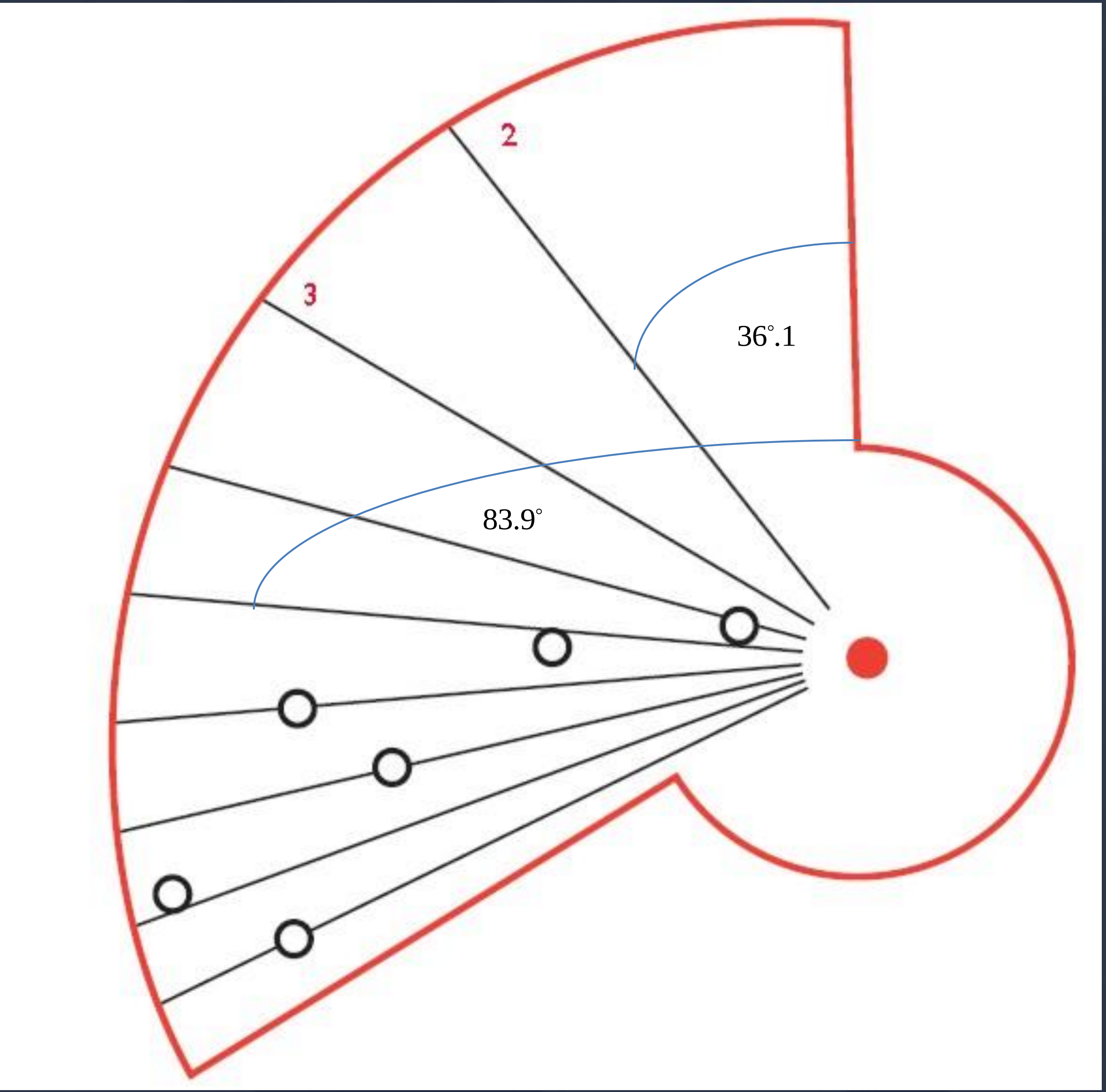
$$\frac{1}{3}(base\,area)\times height=\frac{1}{3}231^2\times 139=2.45\times 10^6\,\mathrm{m}^3$$

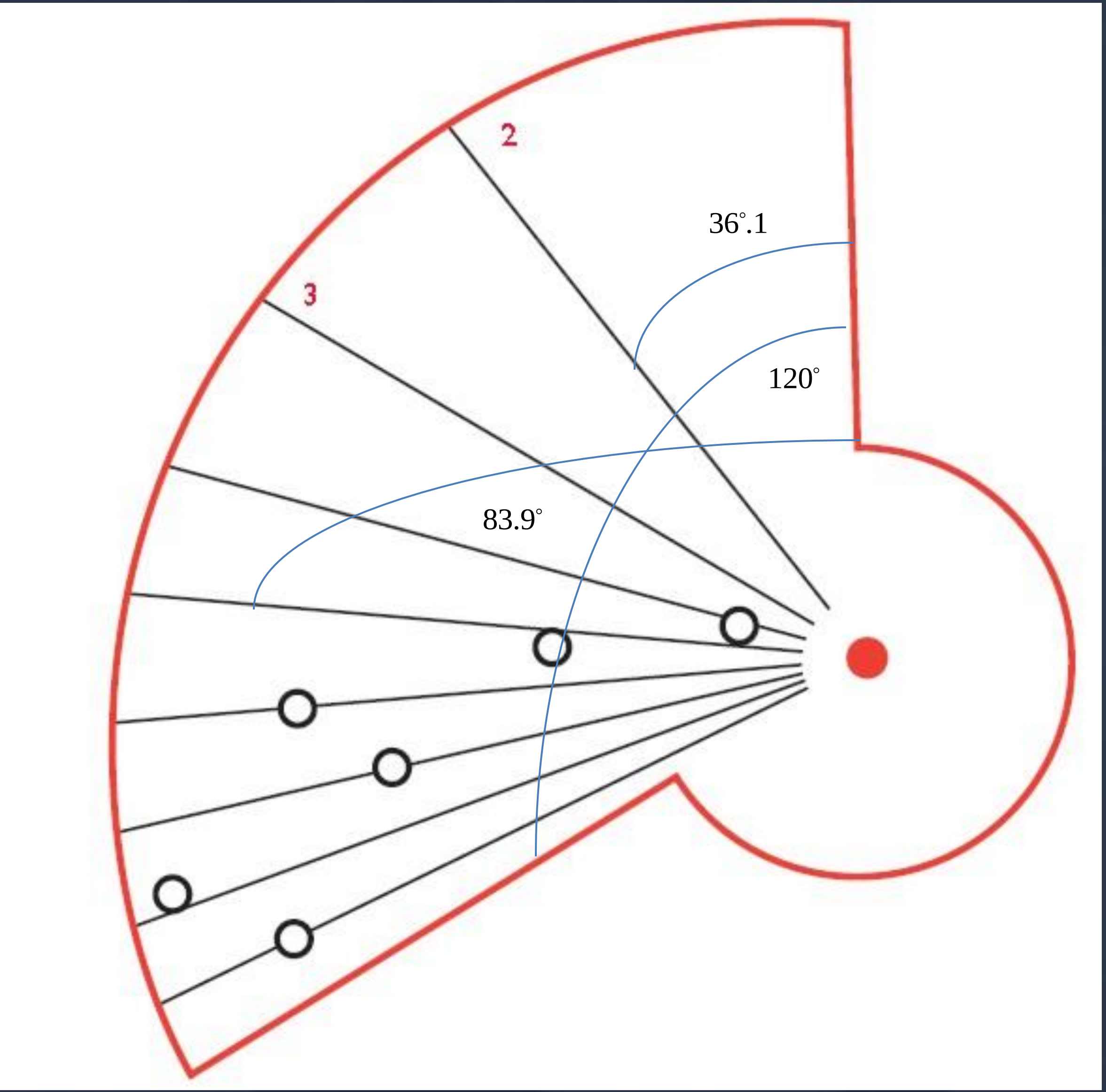
$$(base\,area)\times height = \pi \times 600^2 \times 170 = 1.92\times 10^8\,\mathrm{m}^3$$





$$(\,frac\,oceans)\times(\,frac\,ice)\times 4\pi R^2 = 0.7\times 0.5\times 4\pi\times(6.4\times 10^6)^2 = 1.8\times 10^{14}\,\mathrm{m}^2$$


2
3
36˚.1
83.9˚


2
3
36°.1
120°
83.9°


2008-05-15
04:10:51
Stellarium 0.9.1 (Earth, @ 83m)
FOV=146°
FPS=15.75
Arcturus
W
N
Capella
Vesta
E


Capella
N