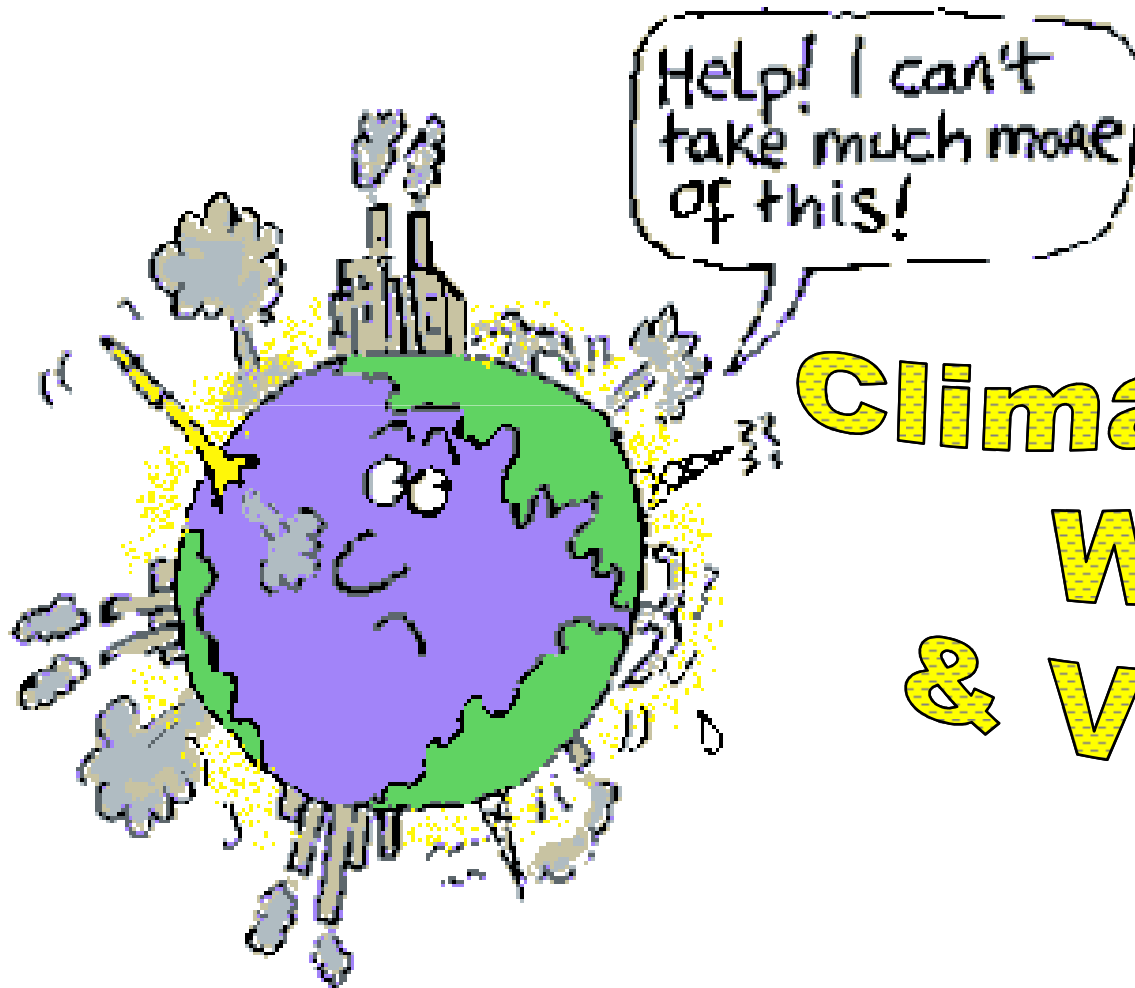




University of
Portsmouth



Climate Change Weather & Volcanoes

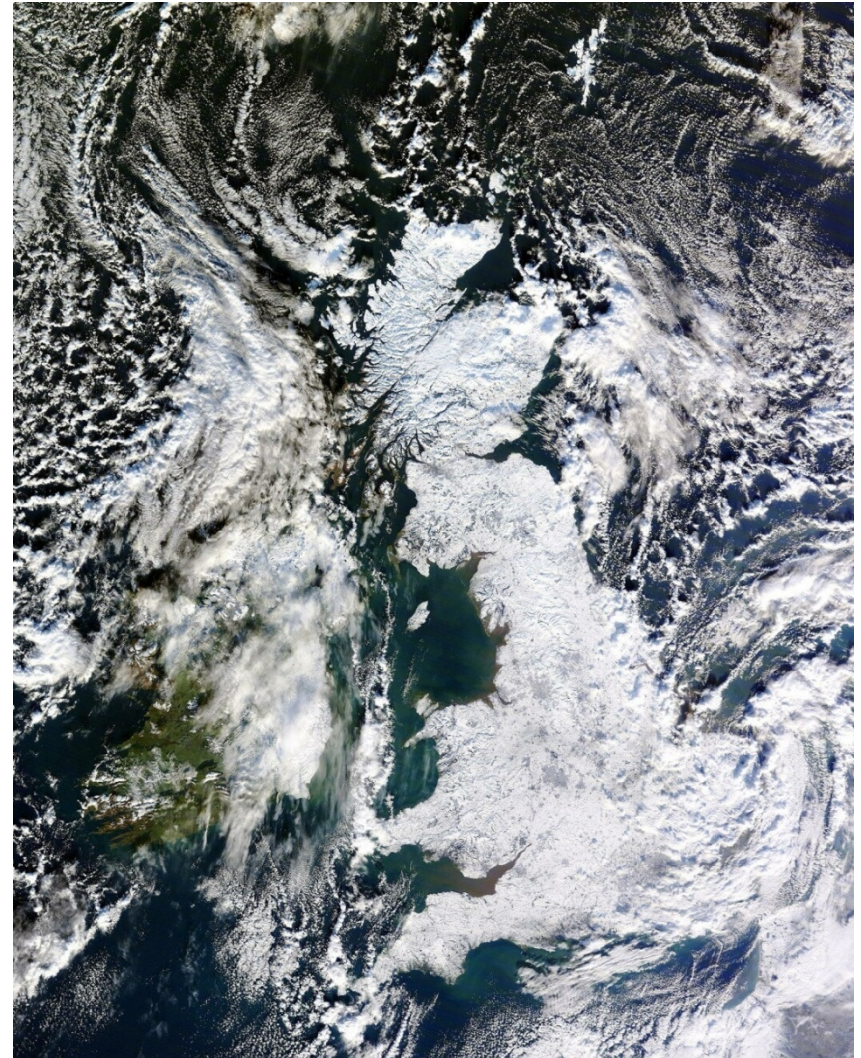
David Giles

Principal Lecturer in Engineering Geology
School of Earth & Environmental
Sciences
University of Portsmouth

Climate Change – Global Warming – Weather – Natural Disasters



Southsea January & December 2010



Boscastle

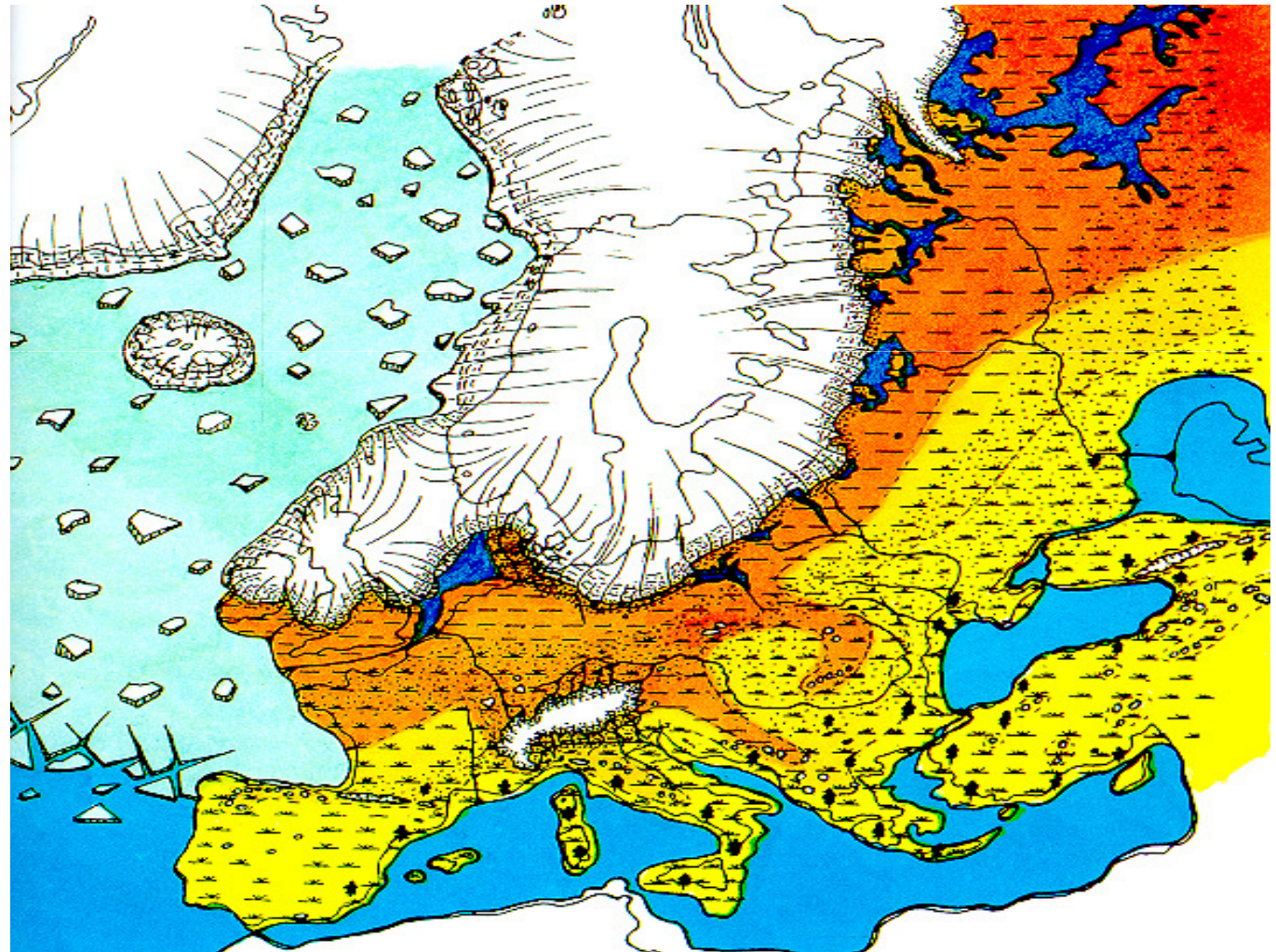
17th August 2004



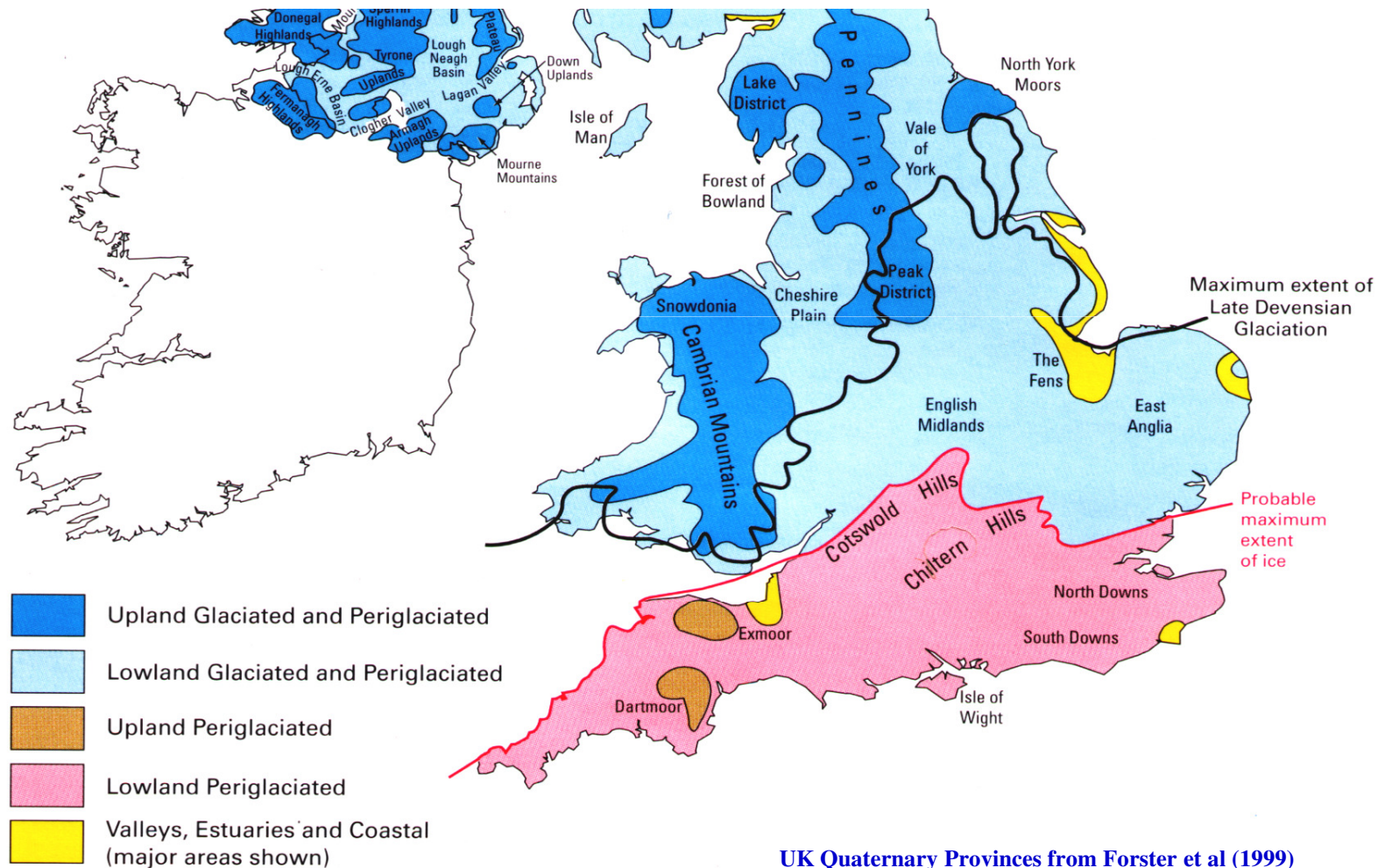
The Future?



Climate Change in the Geological Past

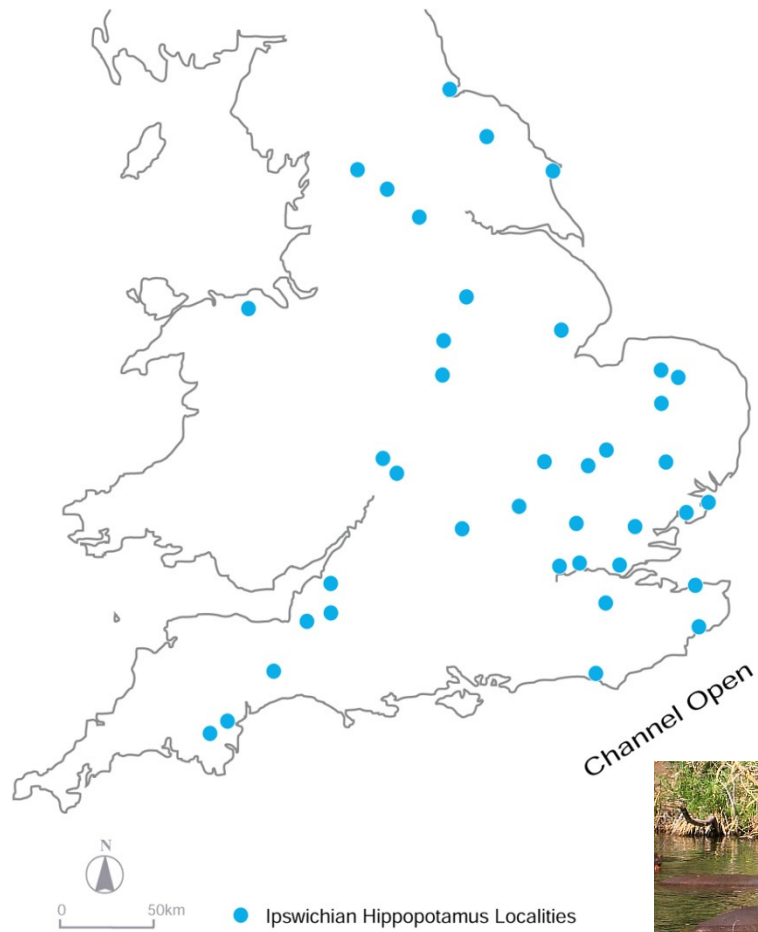


Quaternary Britain

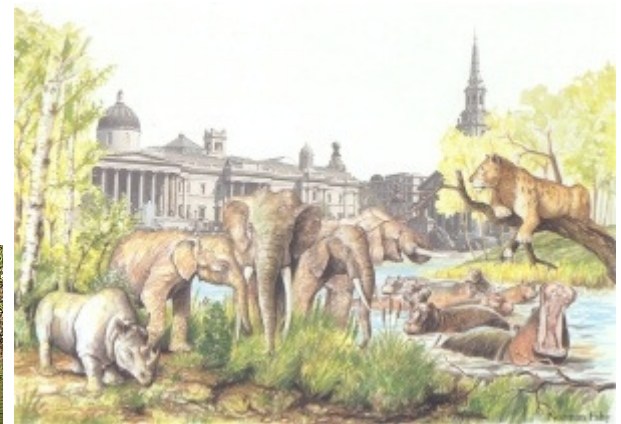
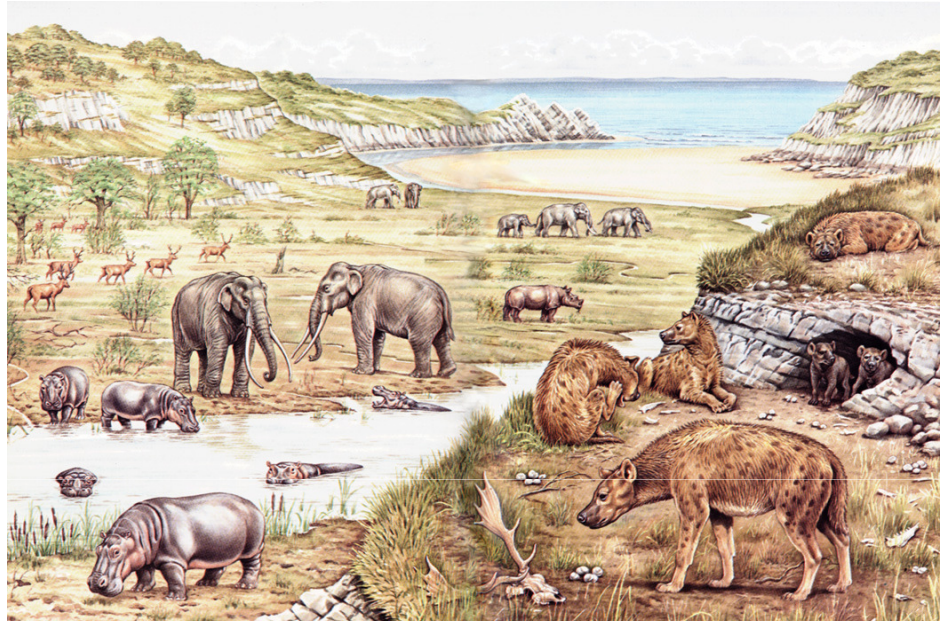


UK Quaternary Provinces from Forster et al (1999)

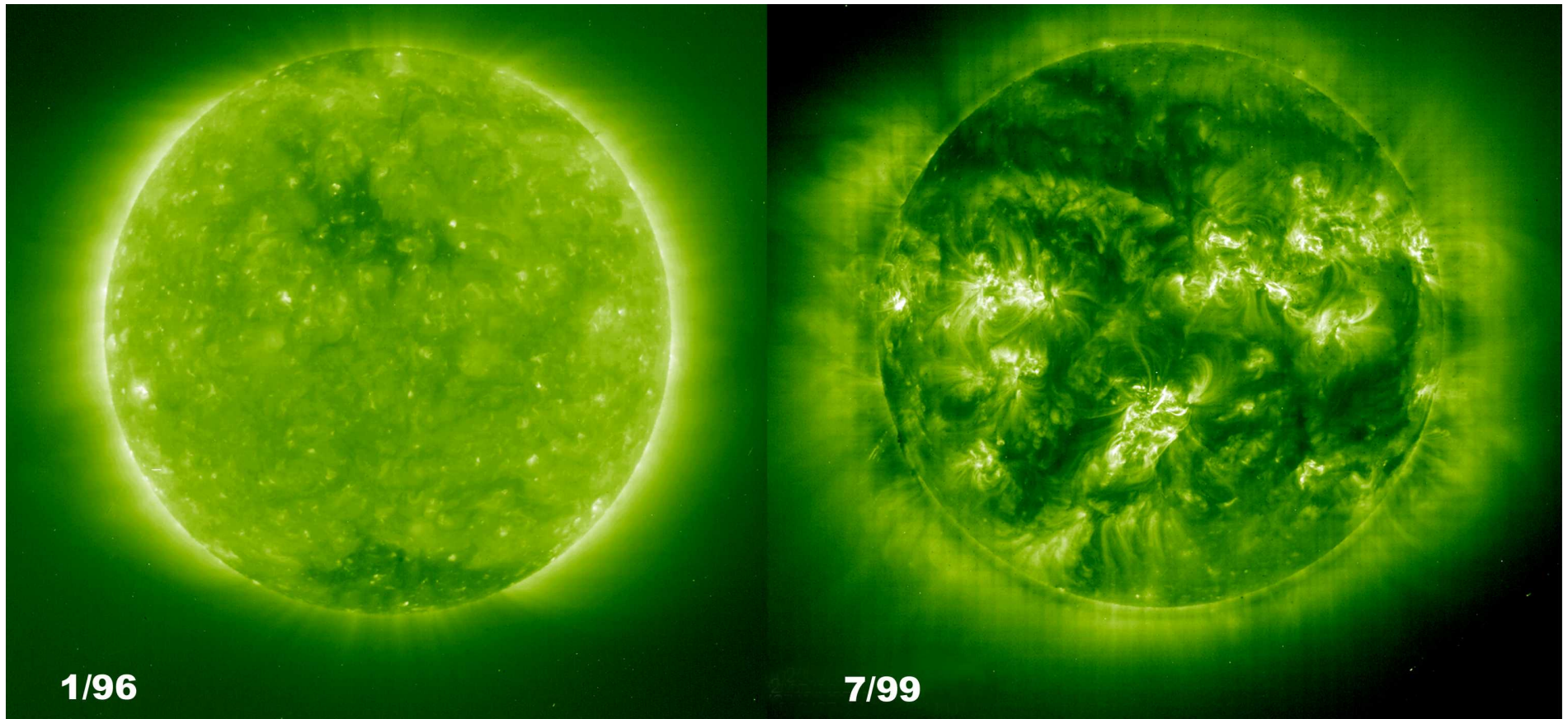
Ipswichian



www.nhm.ac.uk/

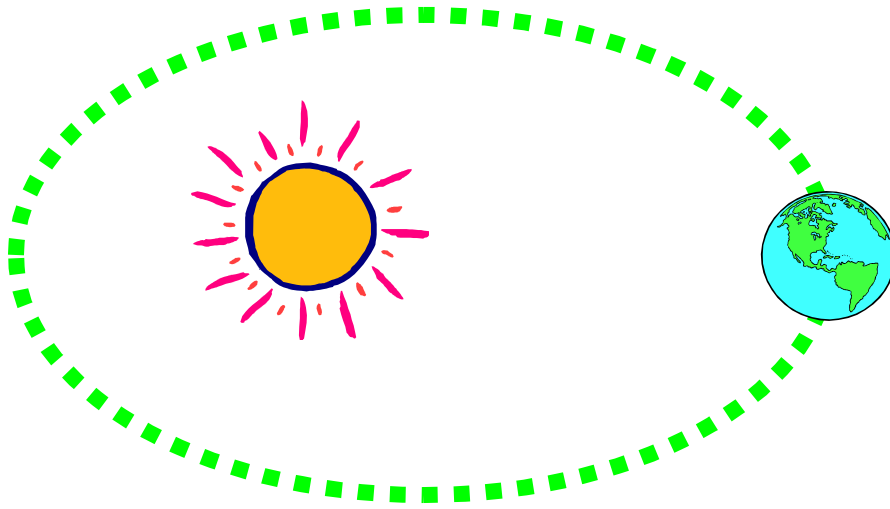


Solar Activity



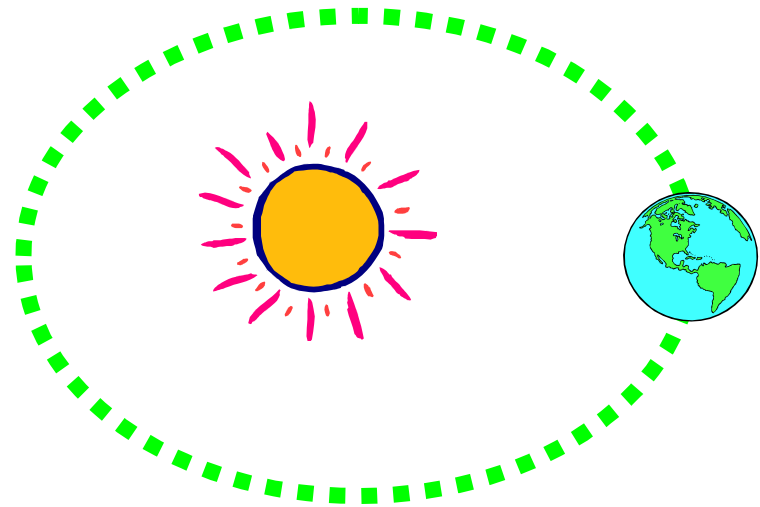
Eccentricity

More Elliptical



Periodicity 100,000 Years

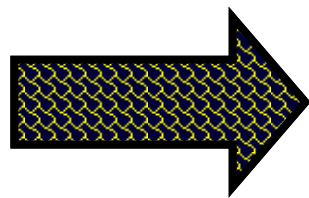
Less Elliptical



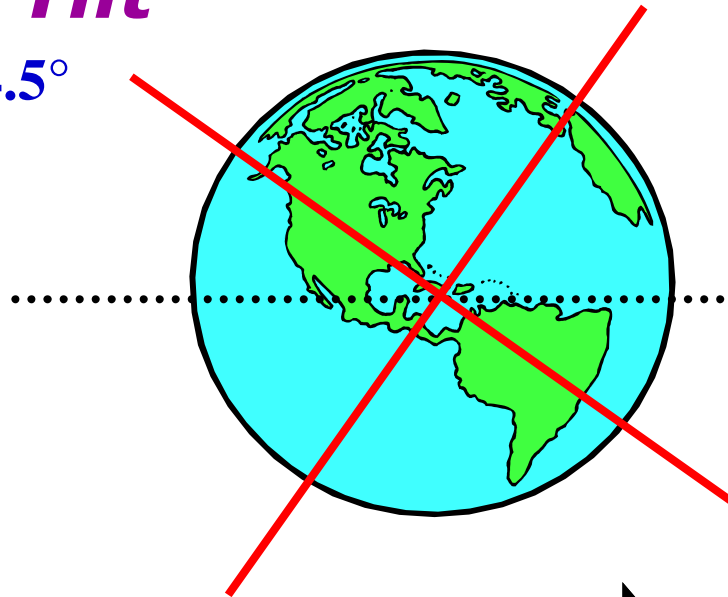
Axial Tilt

24.5°

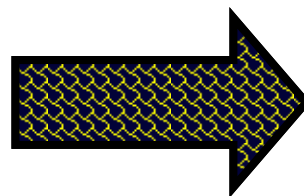
Periodicity 41,000 Years



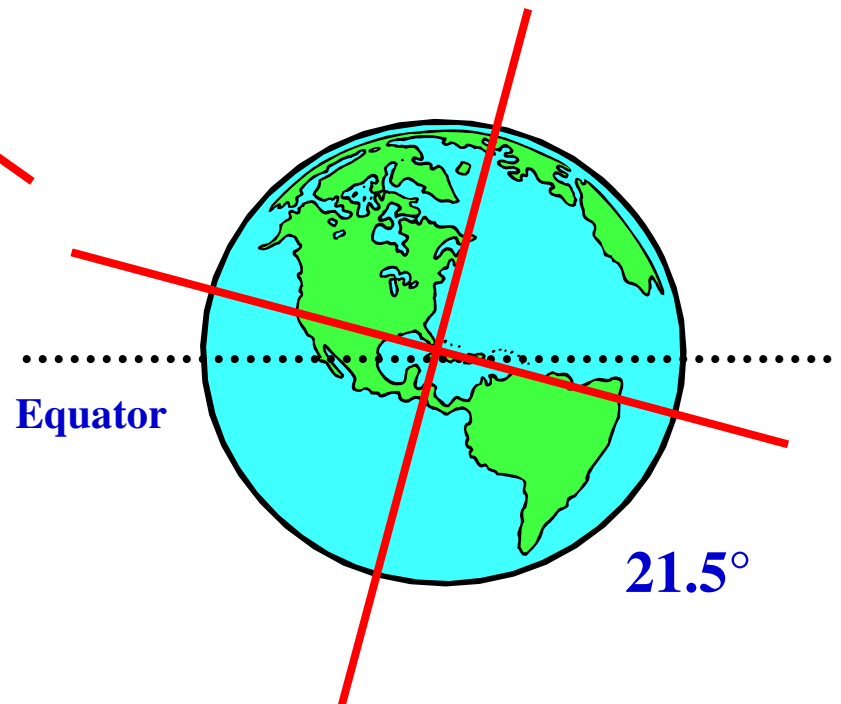
RADIATION



Equator



RADIATION

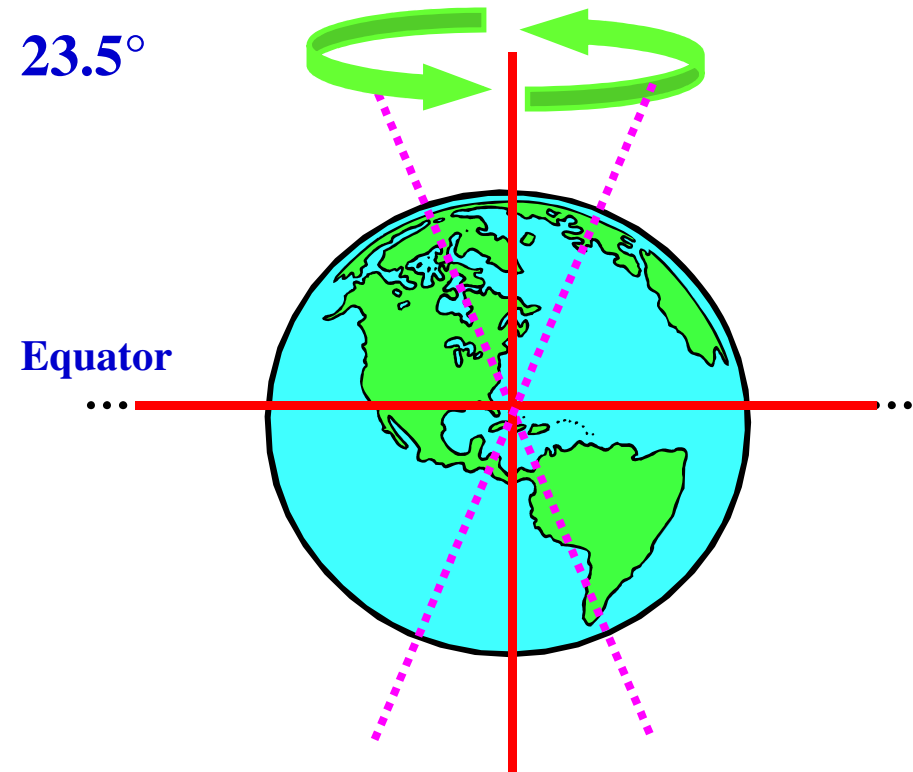


Equator

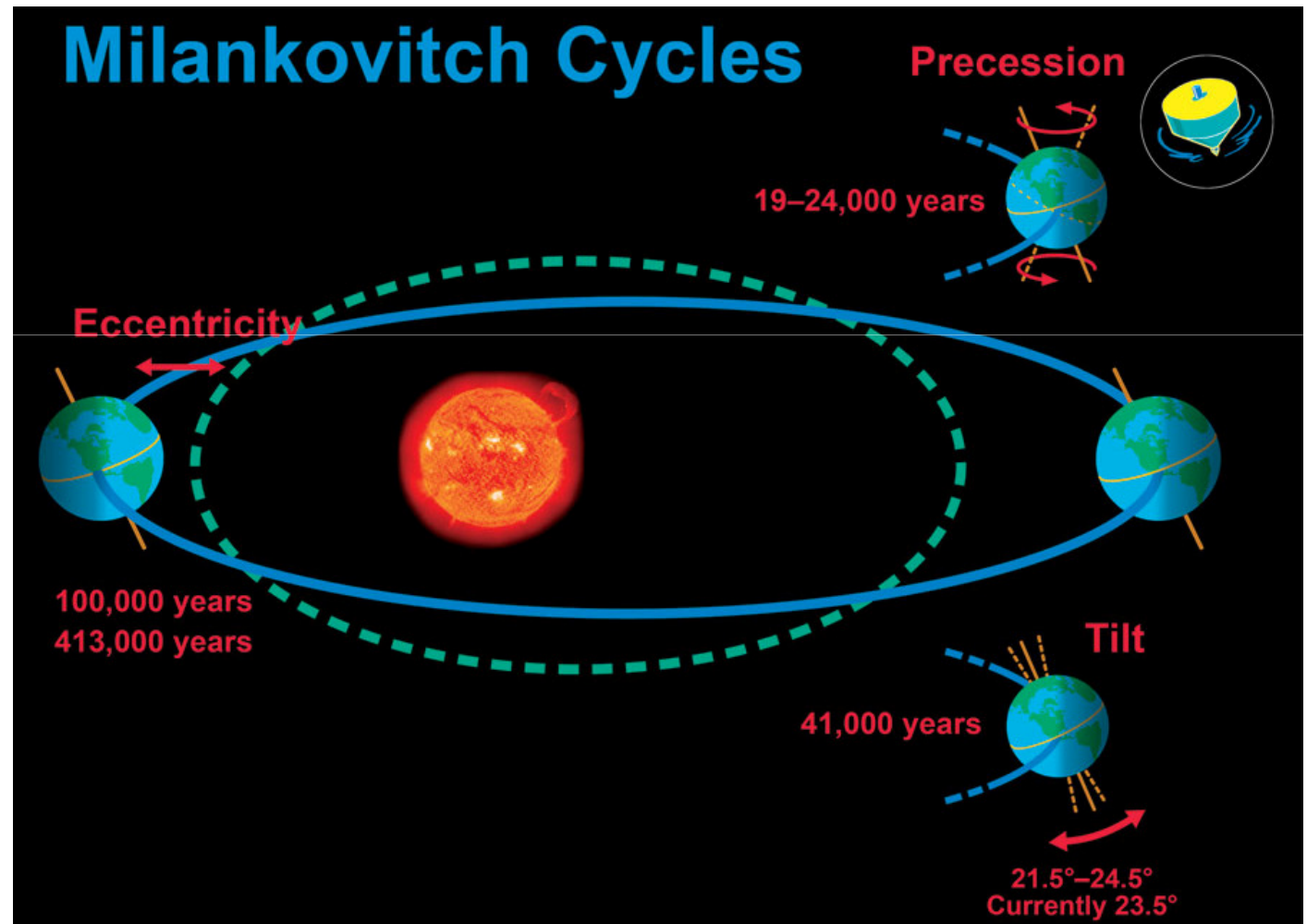
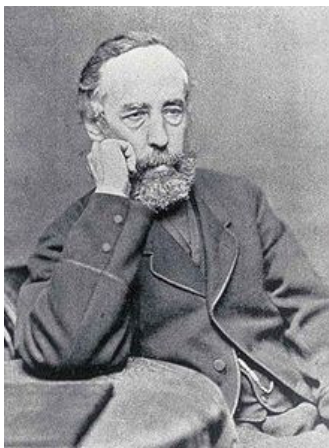
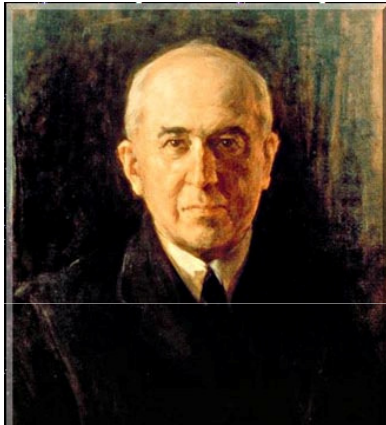
21.5°

Precession

Periodicity 23,000 Years

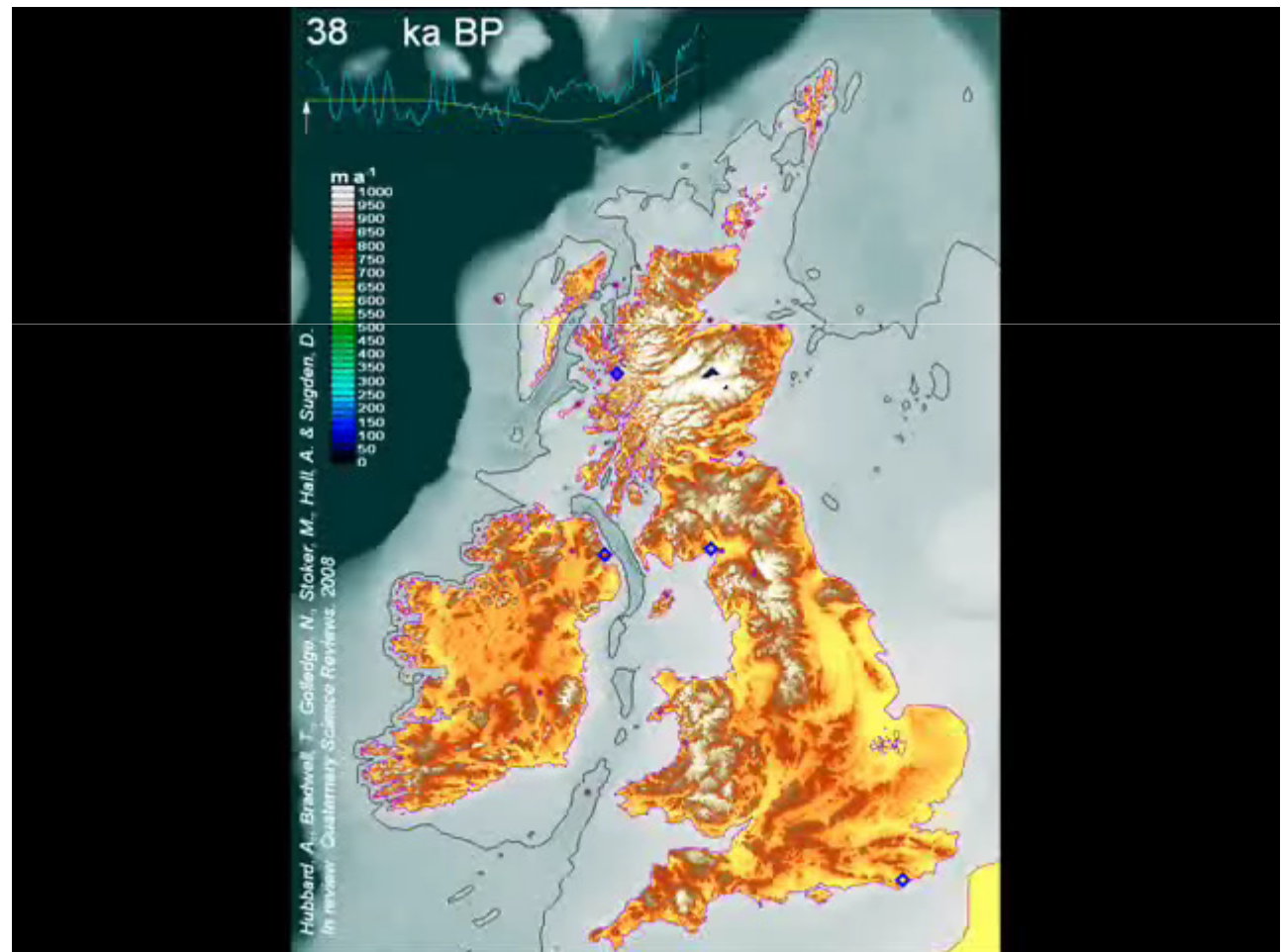


Milankovitch Cycles

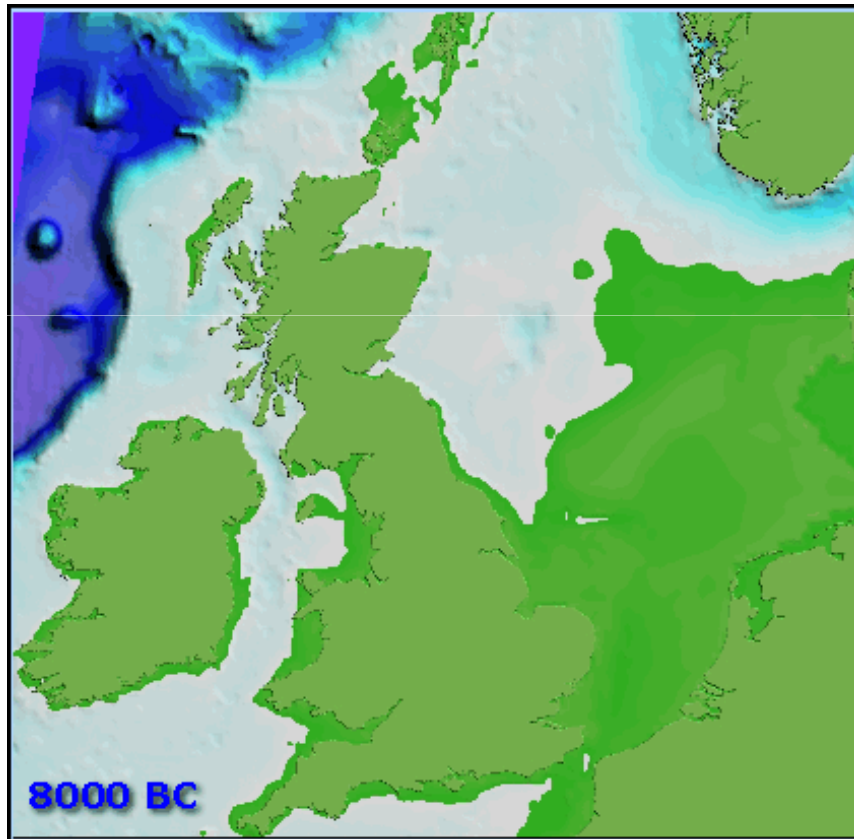


British Ice Sheet animation

Animation of the
British & Irish
Ice Sheet from
38,000 to
10,000 years
B.P.



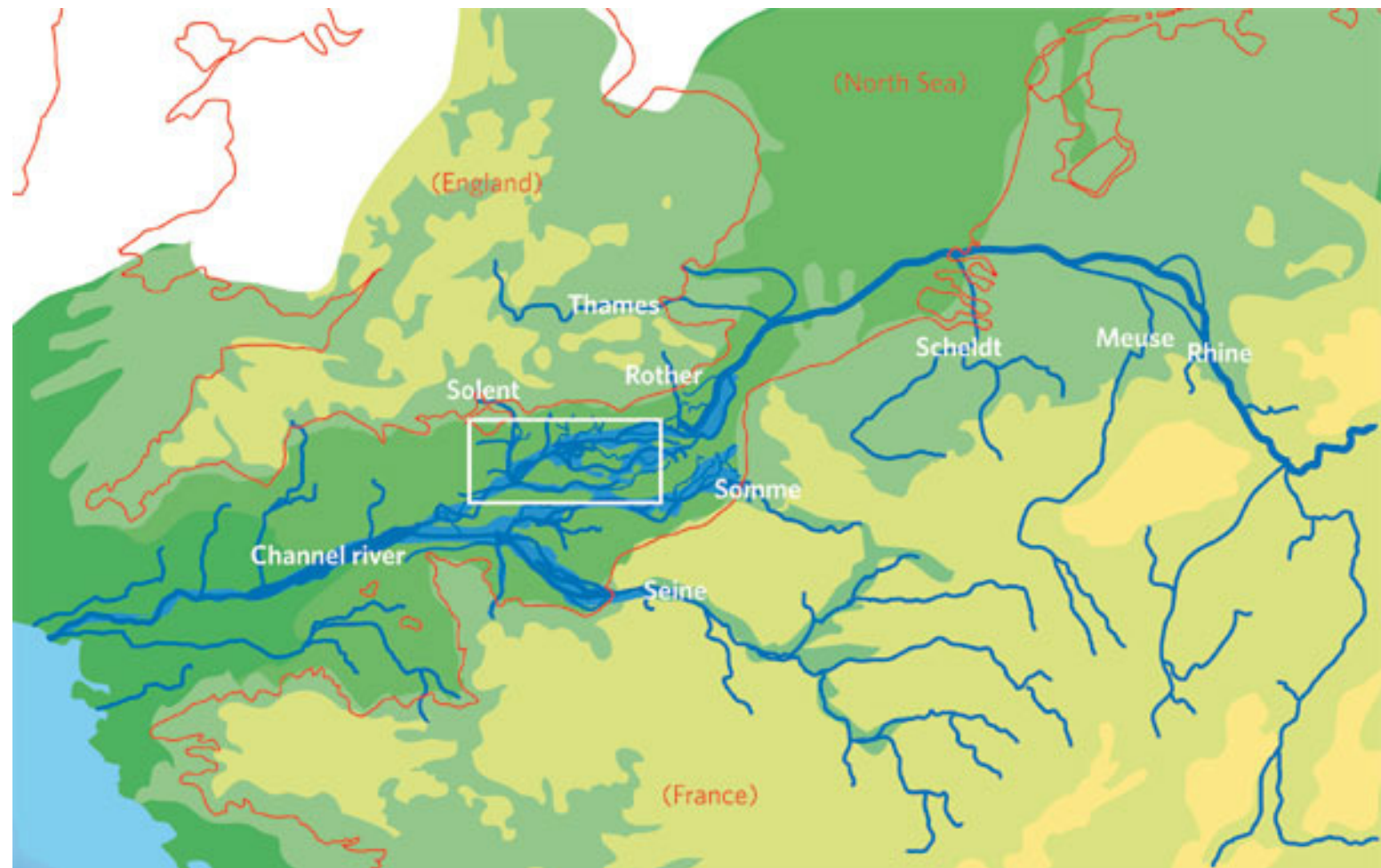
Sea Level Rise



Shennan *et al.* Durham University



Sea Level Fall



The Channel River system during the Last Glacial Maximum, from J-F. Bourrillet 2003.

Medieval Warm Period – AD 950 - 1250

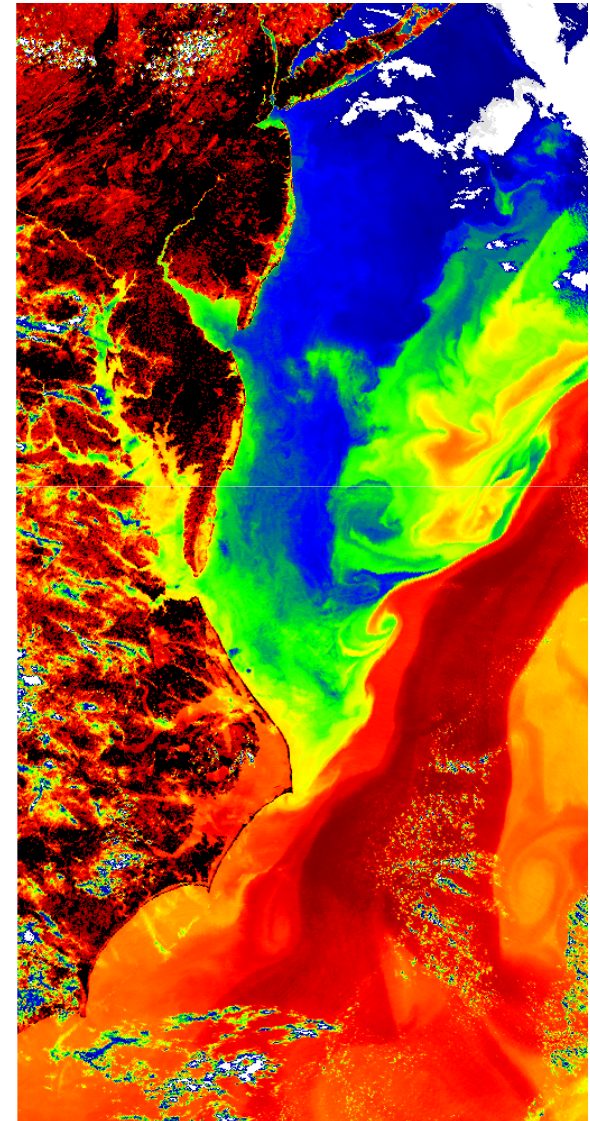
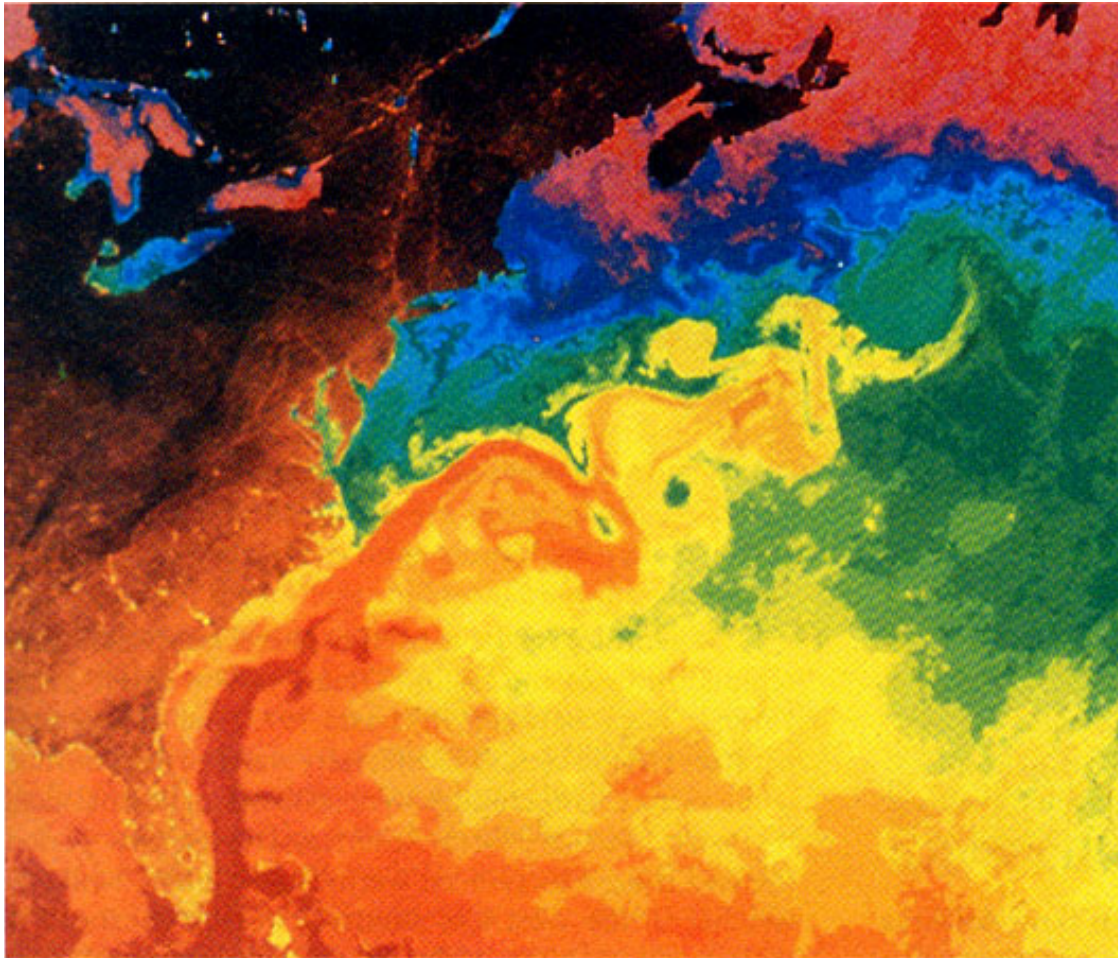


Little Ice Age - AD 1560 -1850

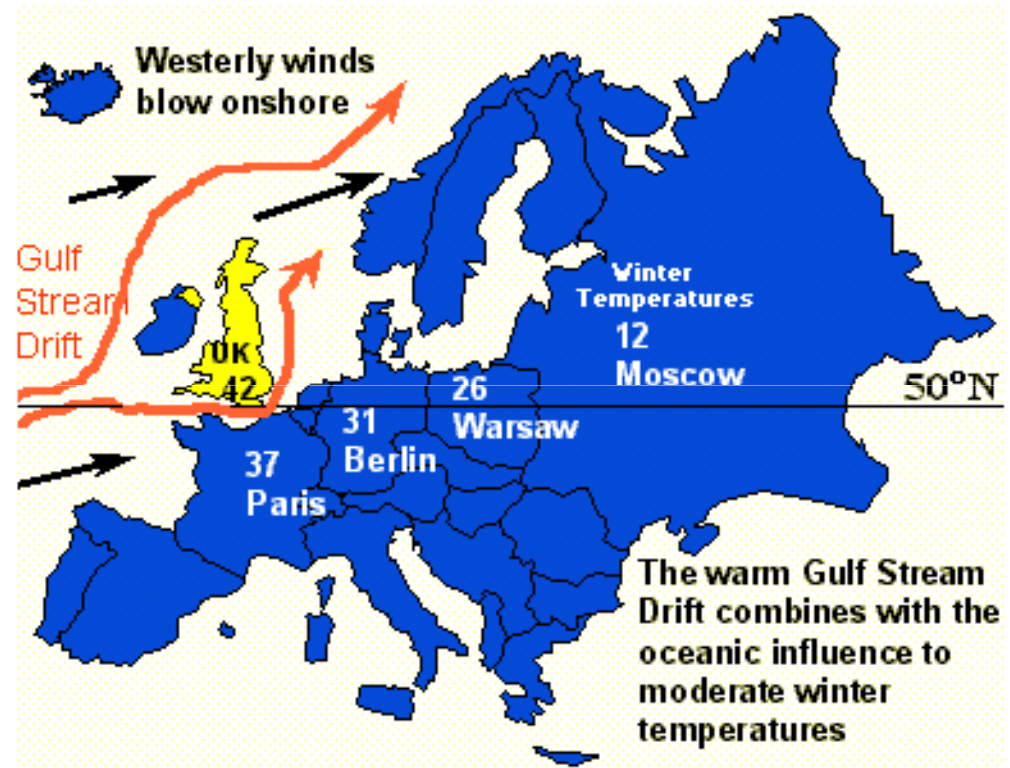
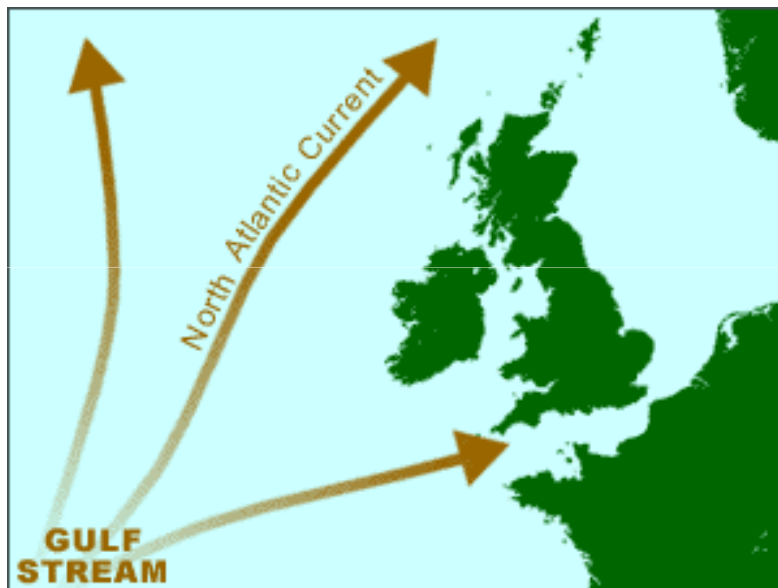
- Severe winters
- Cooler summers



'Gulf Stream'

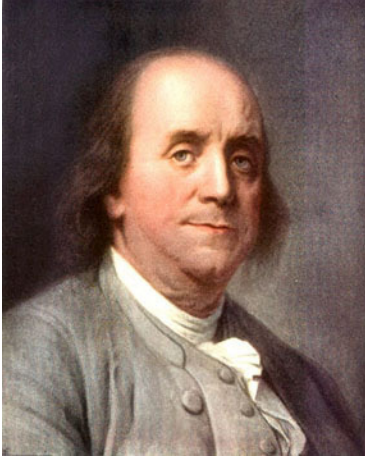


Ocean – Atmosphere Conveyor System

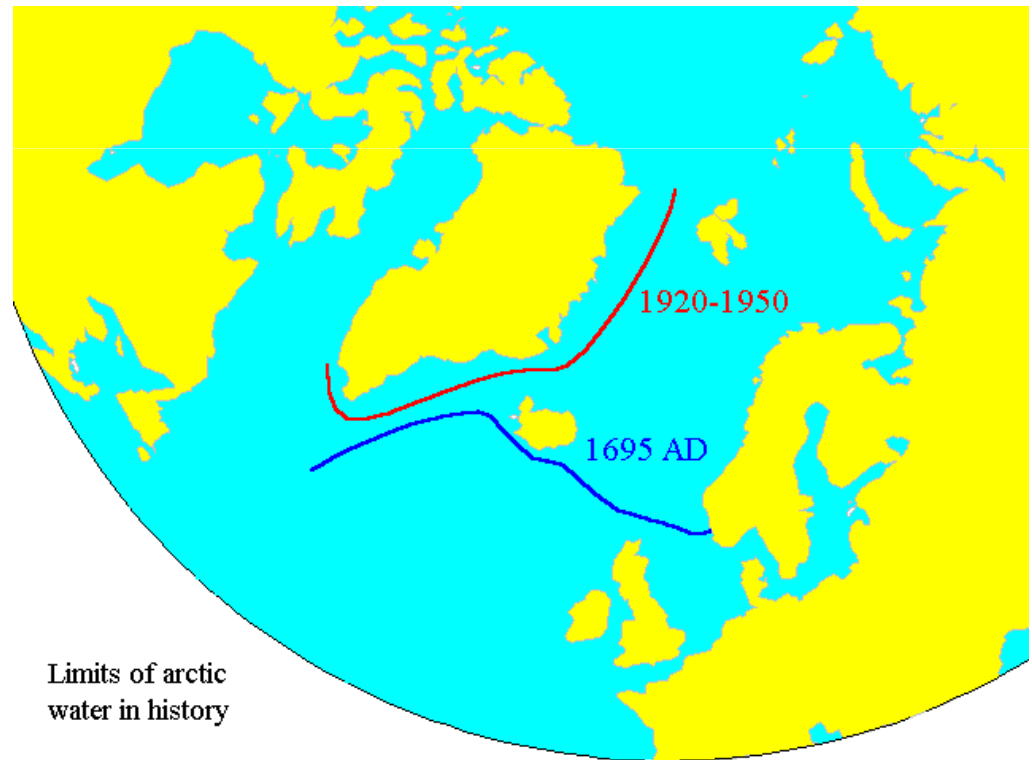


The waters in the Gulf Stream originate on the West Coast of Africa before flowing across the Atlantic to the Caribbean Sea and Gulf of Mexico. From there they travel eastwards to Western Europe. The surface temperature of the Gulf Stream is about 77 degrees F.

Benjamin Franklin's Map 1775 -

[illegible]

Gulf Stream Variability

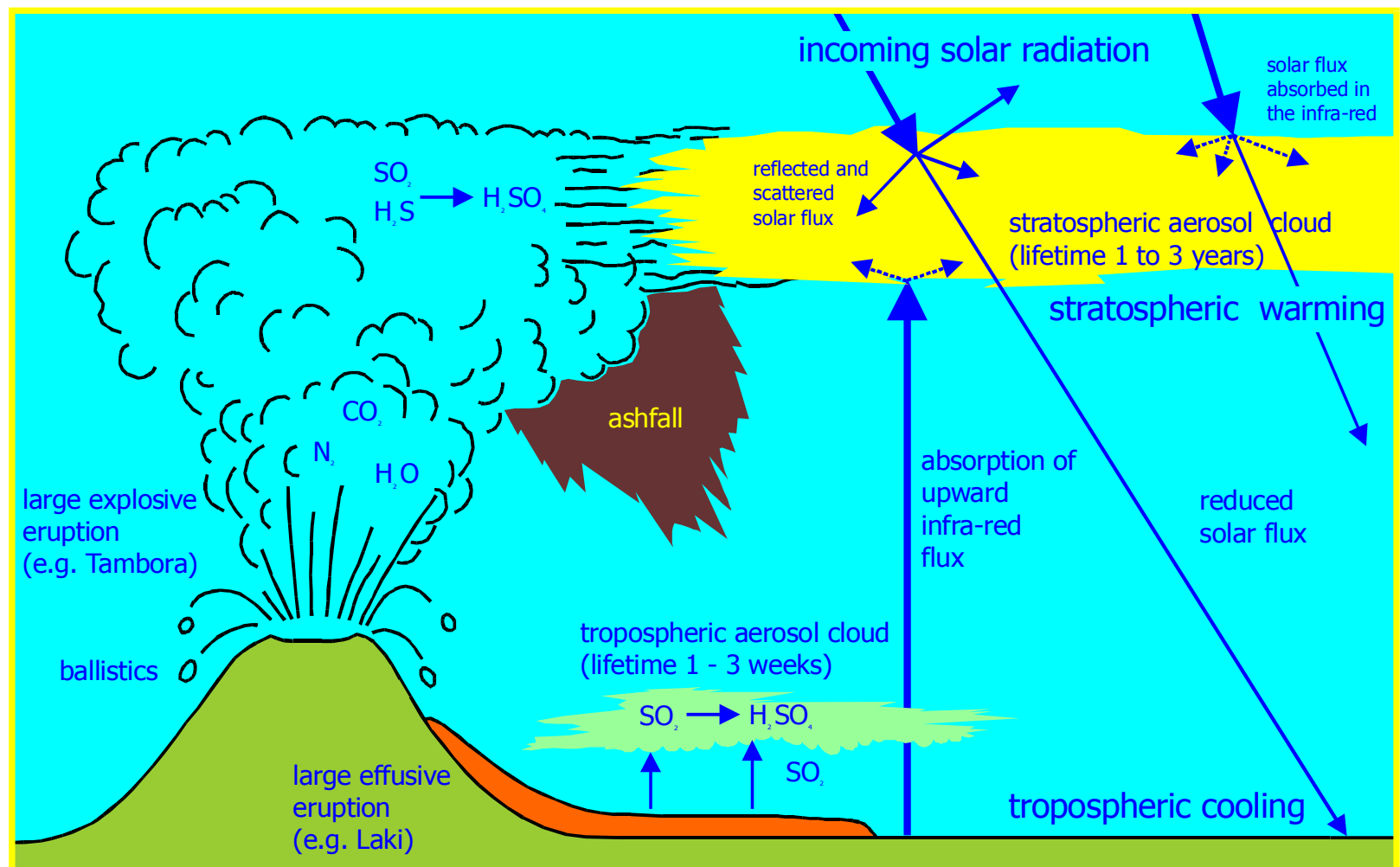


Limits of arctic
water in history

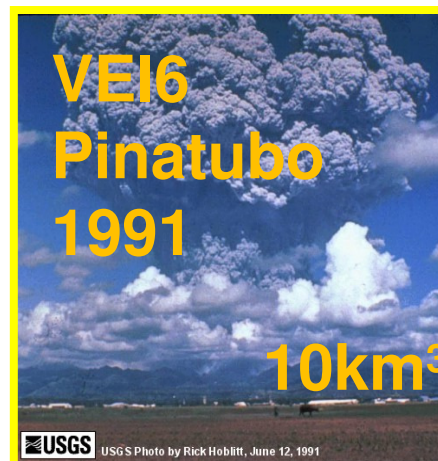
Volcanic Activity & Climatic Effects



Volcanic Activity

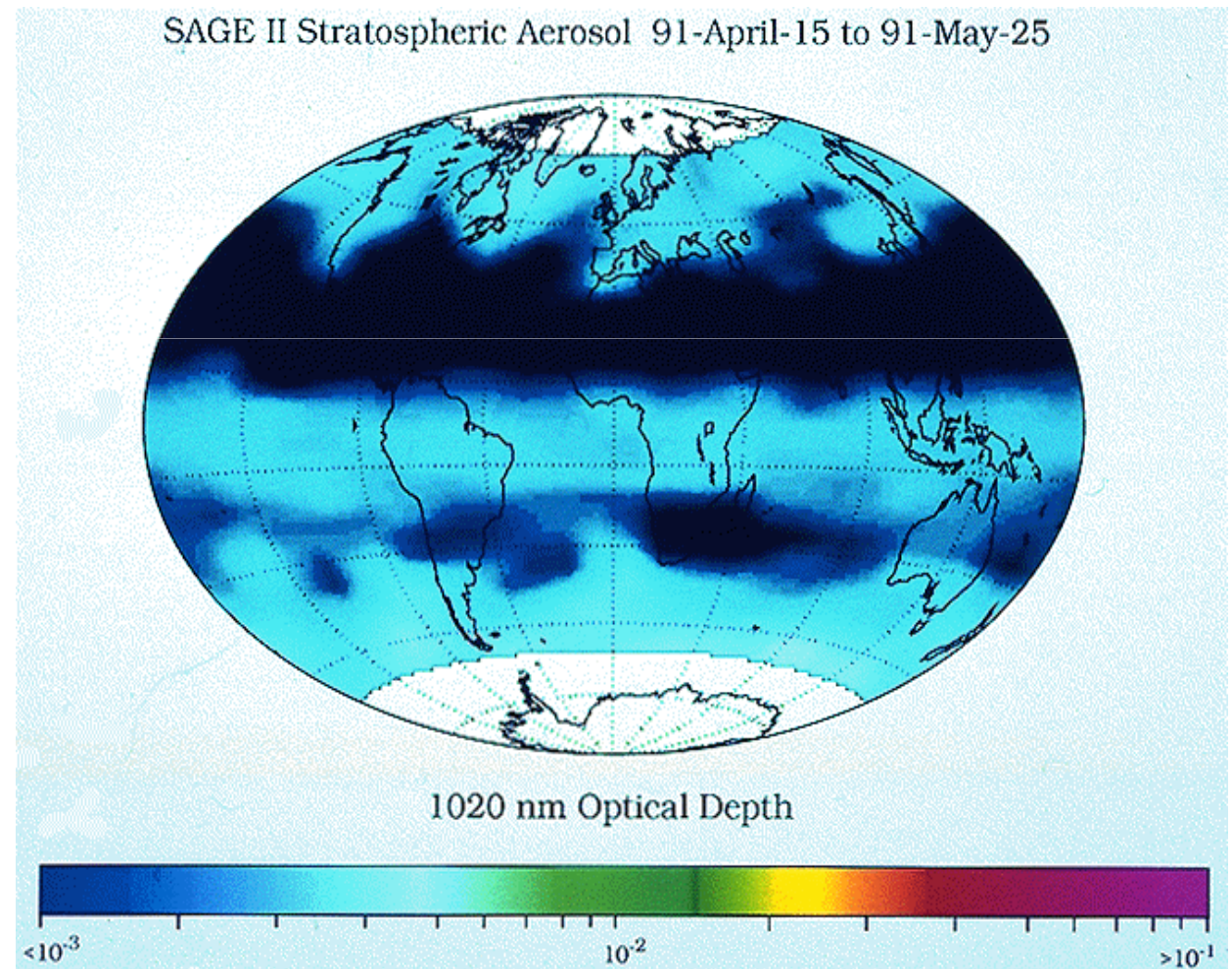


Big Eruptions



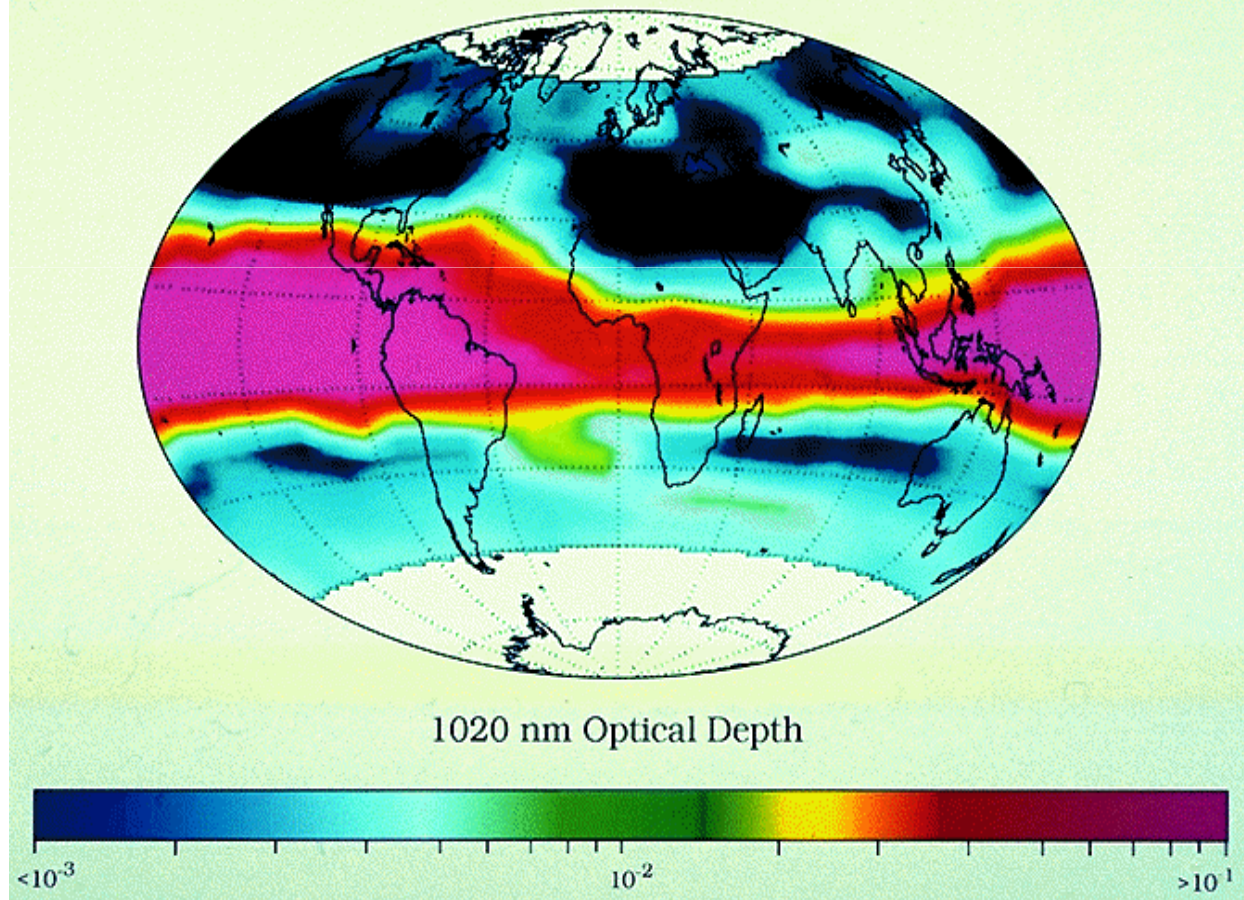
Mount Pinatubo, 1991

SAGE II – 40 Days Before Eruption



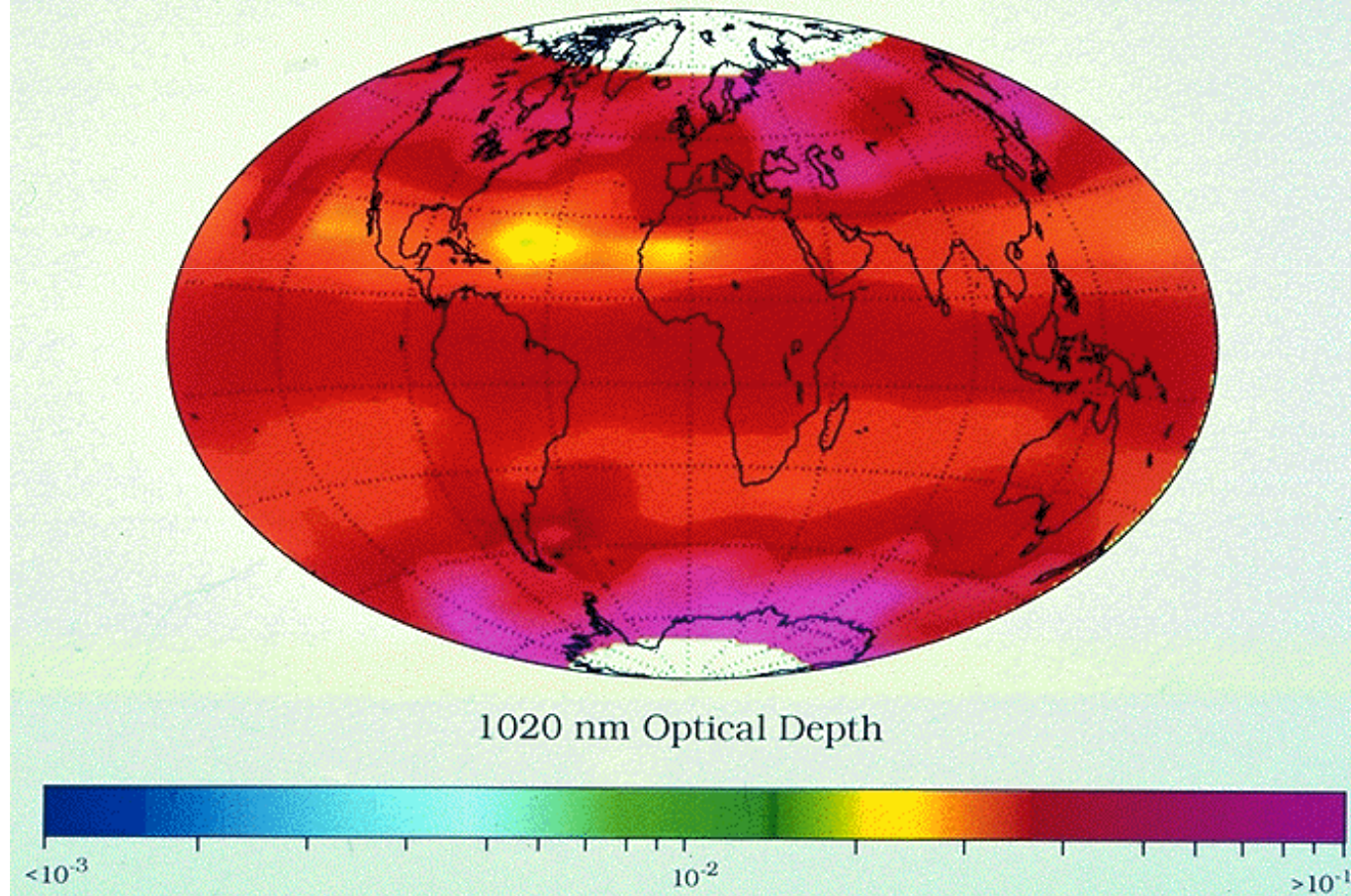
SAGE II – 40 Days After Eruption

SAGE II Stratospheric Aerosol 91-June-14 to 91-July-26



SAGE II – 20 Months After Eruption

SAGE II Stratospheric Aerosol 93-February-13 to 93-March-26



Portsmouth

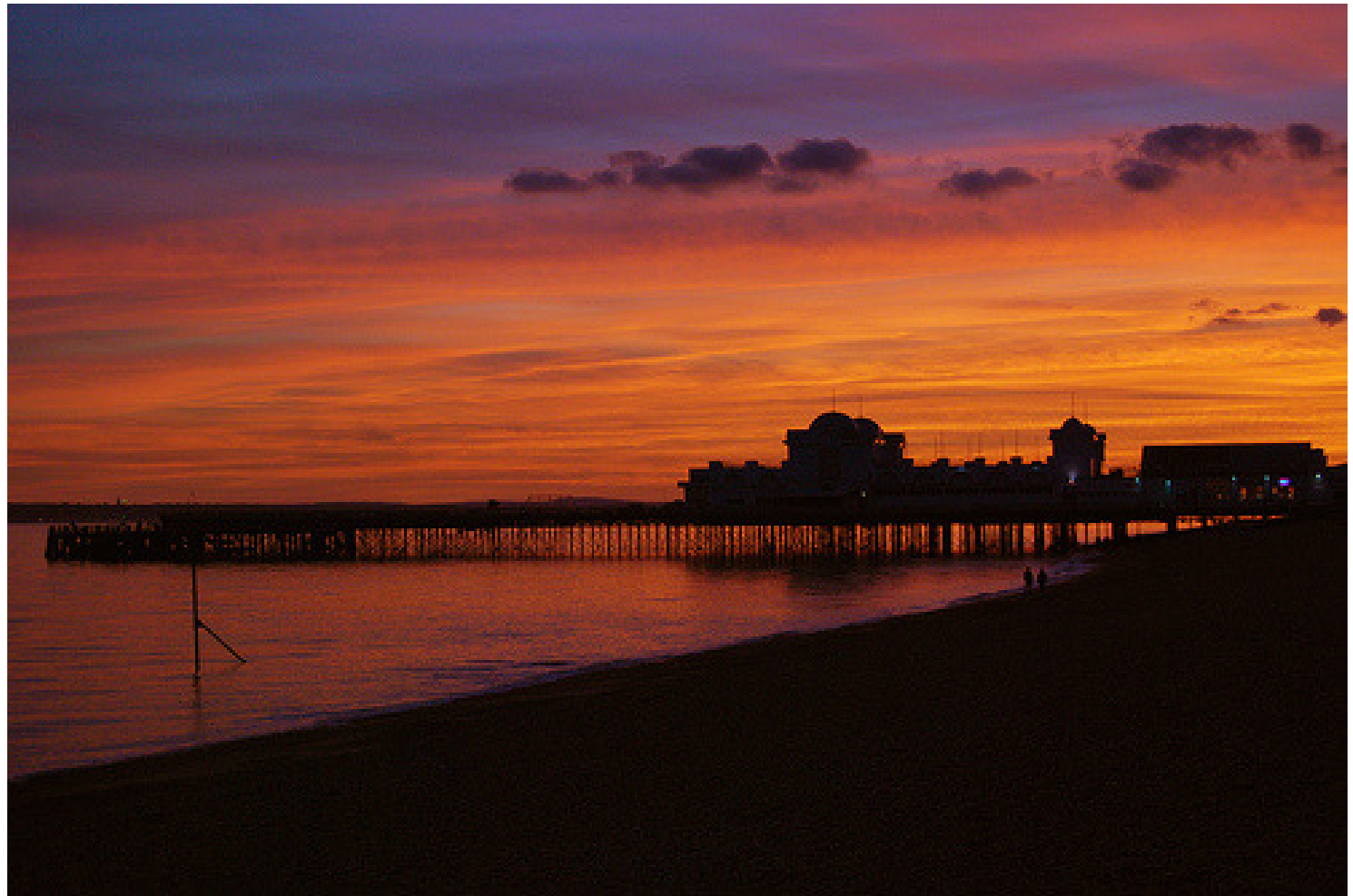


Photo: Gary Allman

A photograph of a person standing on the rim of a volcanic crater, looking down at a lake and a sandy beach within the crater. The sky is blue with white clouds. A digital timestamp '88 4 10' is visible in the bottom right corner.



100km³

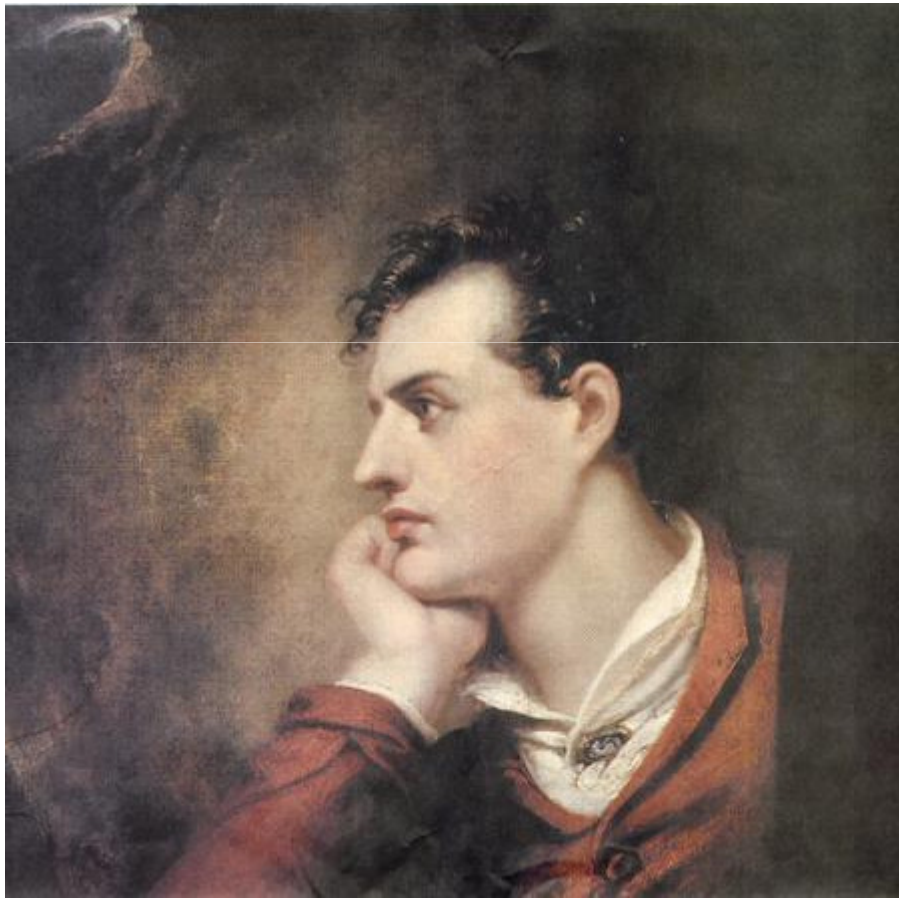


0 200 400 kilometers
0 200 400 miles

INDONESIA

Volcanoes labeled on the map include: Peuet Sague, Bur Ni Telong, Sorikmarapi, Tandikat, Marapi, Talang, Kerinci, Sumbing, Kaba, Dempo, Gunung Besar Suoh, Krakatau, Kiaraberes-Gagak, Salak, Gede, Papandayan, Galunggung, Cereme, Slamet, Merapi, Sundoro, Dieng Volc. Complex, Kelut, Arjuno-Welirang, Tengger Caldera, Lamongan, Batur, Tambora, Rinjani, Ijen, Raung, Semeru, Sangeang Api, Paluweh, Lerebong, Ilibolong, Lewotolo, Banda, Serua, Nila, Teon, Bandi Api, Awu, Banua Wuhu, Karagetang [Api Siau], Ruag, Dukono, Ibu, Gamkonora, Gamalama, Makian, Tongkoko, Mahawu, Lokon-Empung, Soputan, Colo [Una Una], Siring, Iliwerung, Lewotobi, Egon, Kelimutu, Iya, Ebulobo, Inielika, Gunung Ranakah.

1816 "Year Without a Summer"



"Darkness" by Byron

I had a dream, which was not all a dream.

The bright sun was extinguish'd,
and the stars

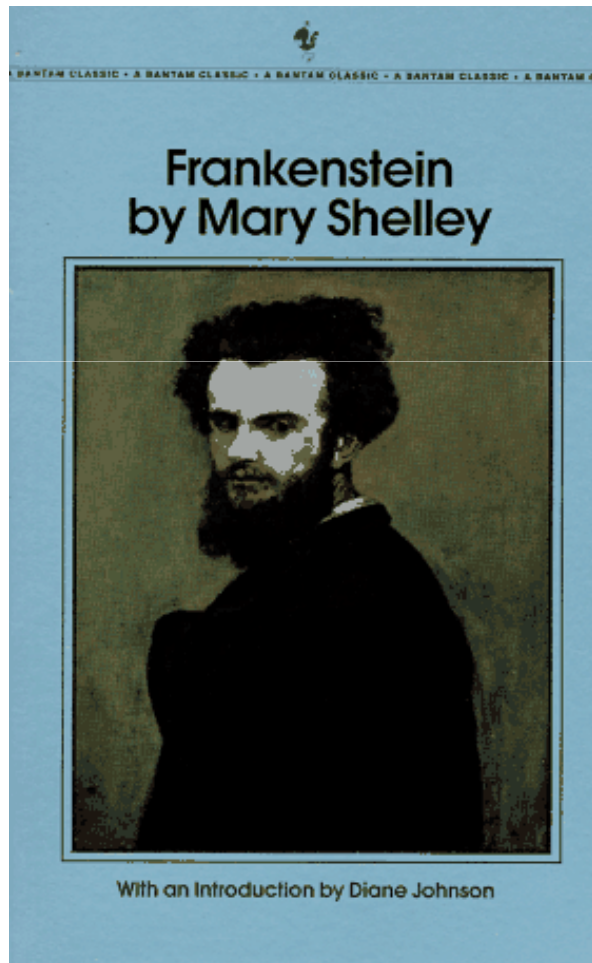
Did wander darkling in the eternal
space,

Rayless, and pathless, and the icy
earth

Swung blind and blackening in the
moonless air;

Morn came and went—and came,
and brought no day,

1816 "Year Without a Summer"



1816 "Year Without a Summer"



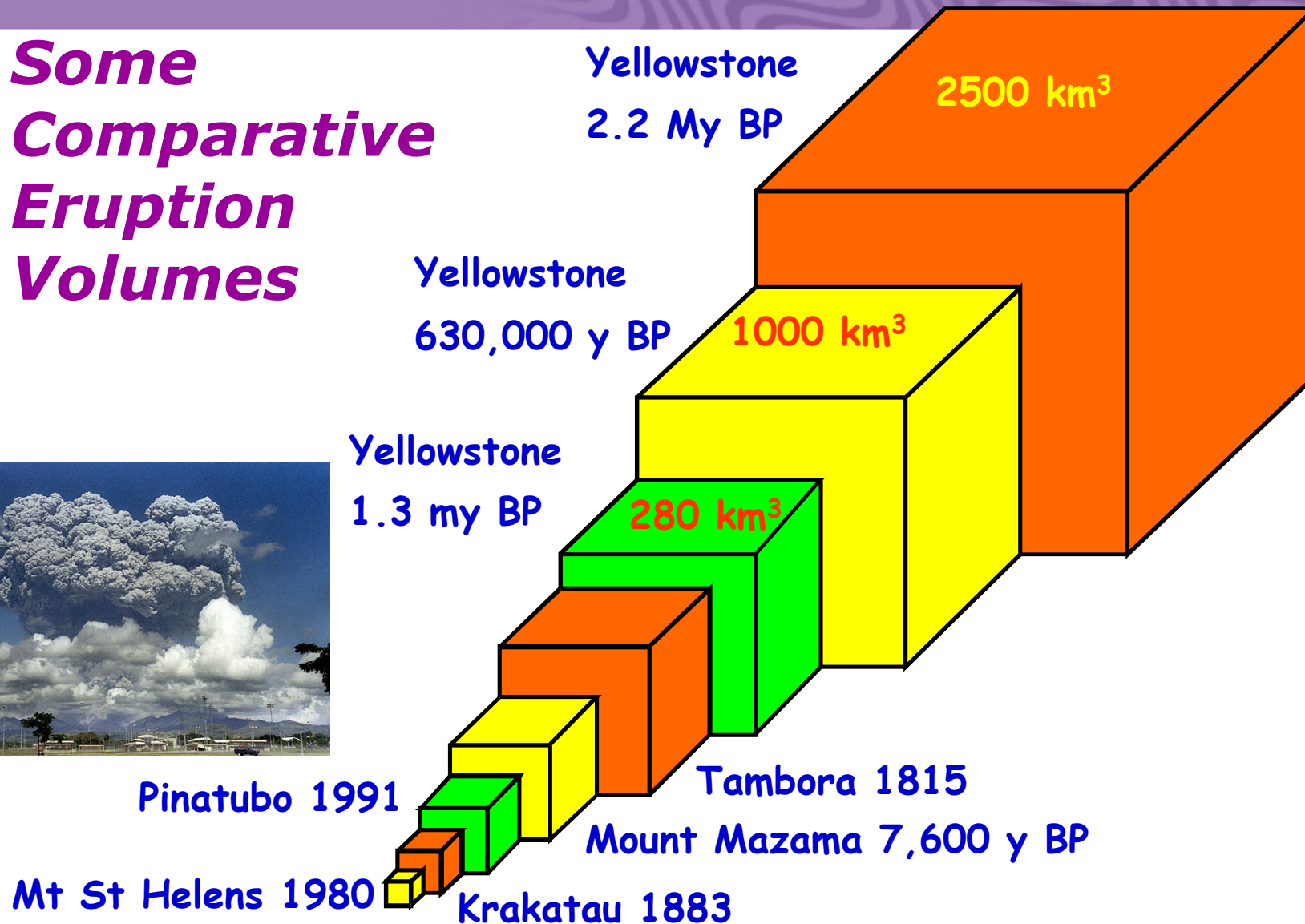
A J.M.W. Turner landscape (of the Chichester Canal circa 1828) shows skies of typical turbidity for the post-Tambora period, including, possibly, a secondary glow at sunset caused by stratospheric aerosols.



William Turner. *Crossing the Brook*. 1815. Oil on canvas. Tate Gallery, London, UK.

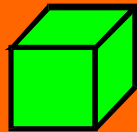


Some Comparative Eruption Volumes



5000 km³

Pinatubo 1991



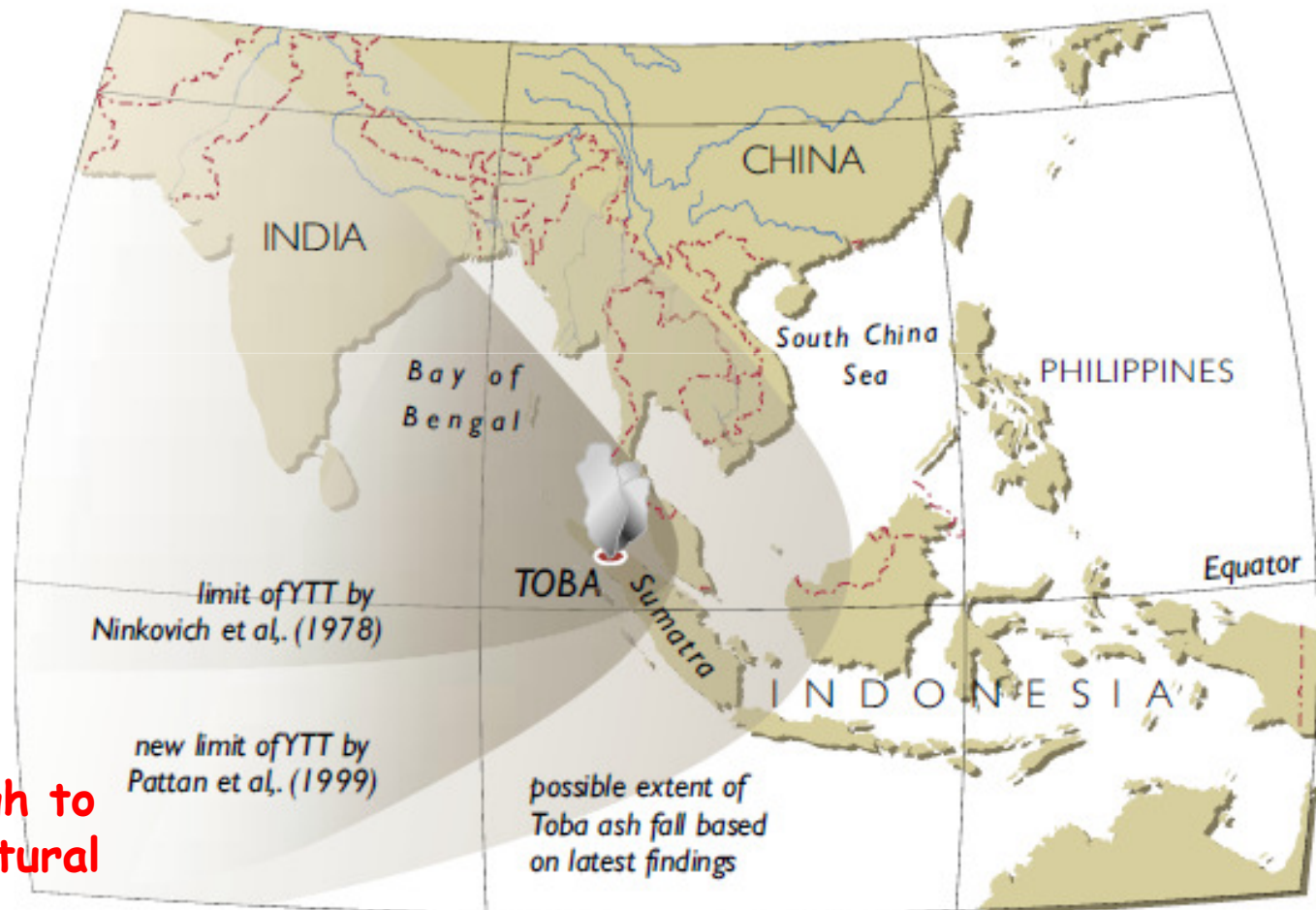
Fish Canyon Tuff
Event
Colorado
28Mya

Toba 74,000 BP

15cm ash over
Indian
subcontinent

Several cms over
Southern China

1cm of ash enough to
devastate agricultural
activity





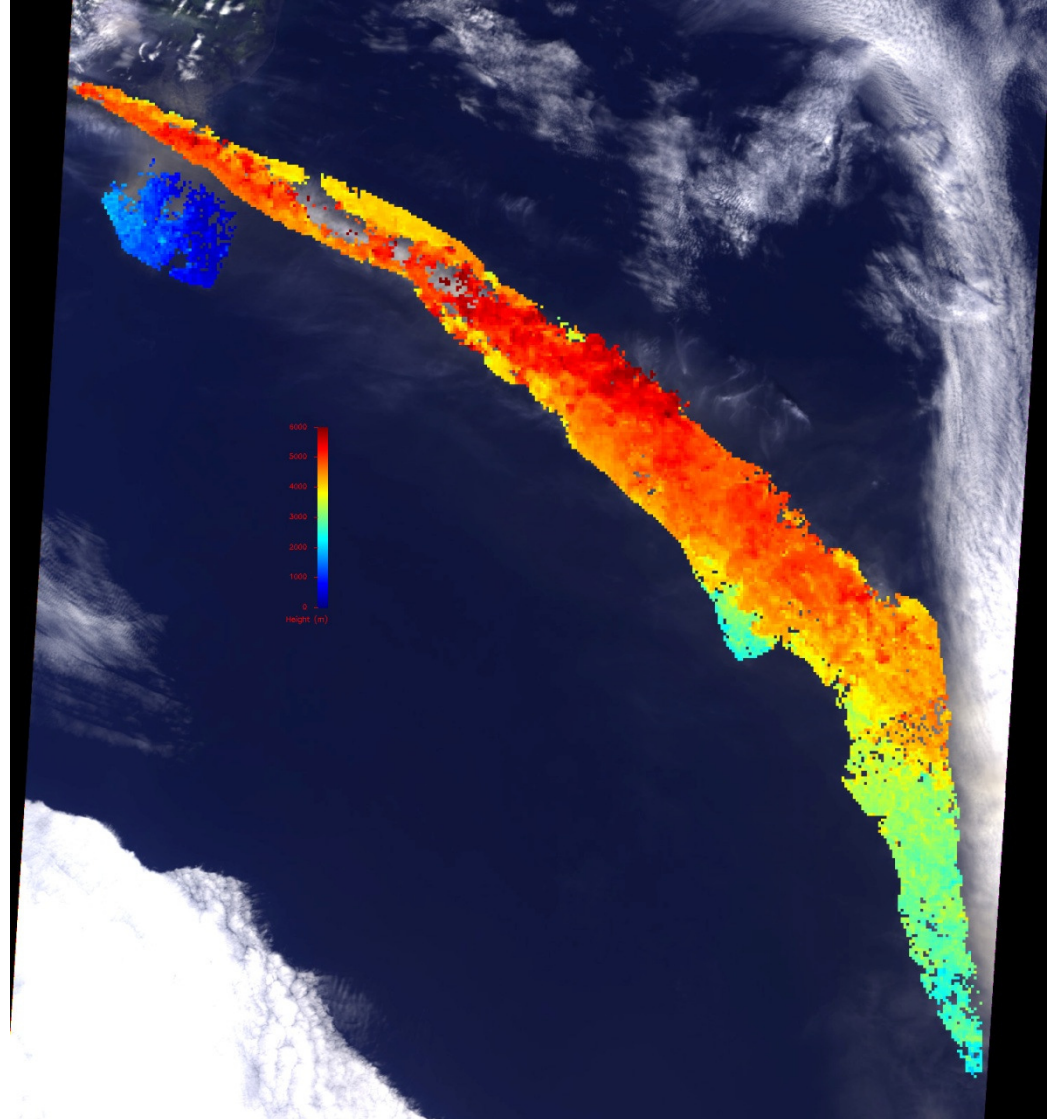
Closer to Home - Eyjafjallajökull 2010 Eruption

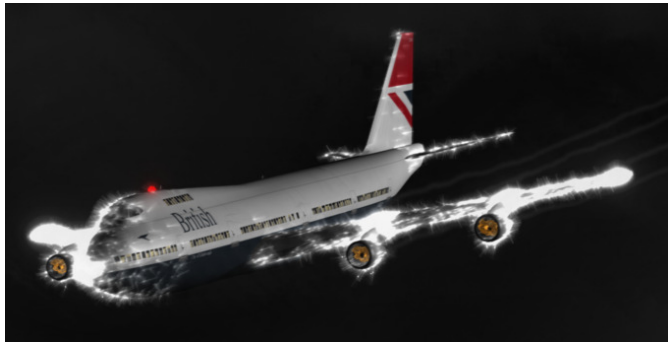
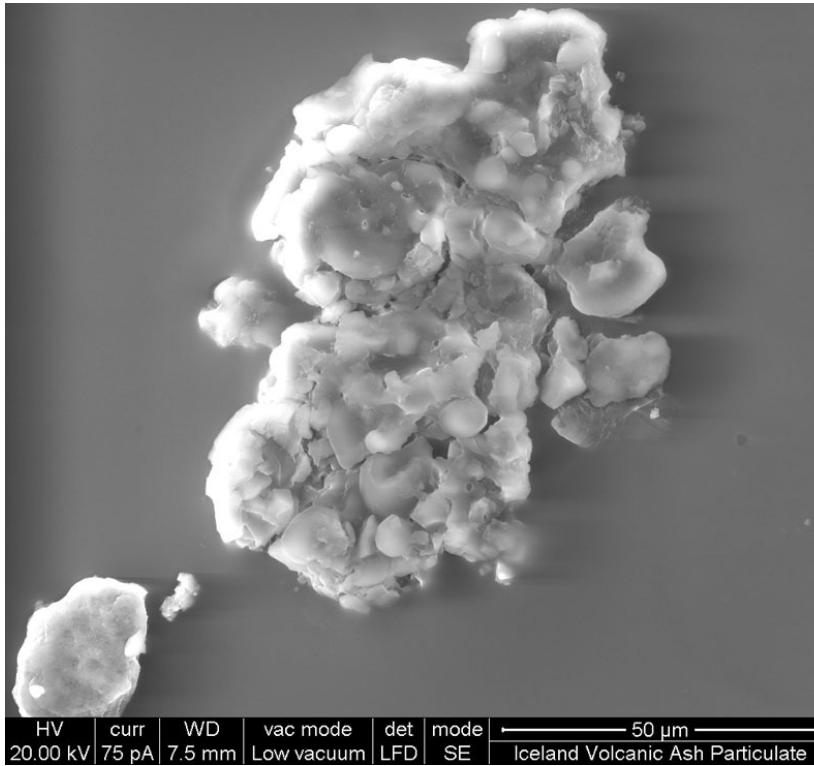


"AY-uh-fyat-luh-YOE-kuutl-uh".

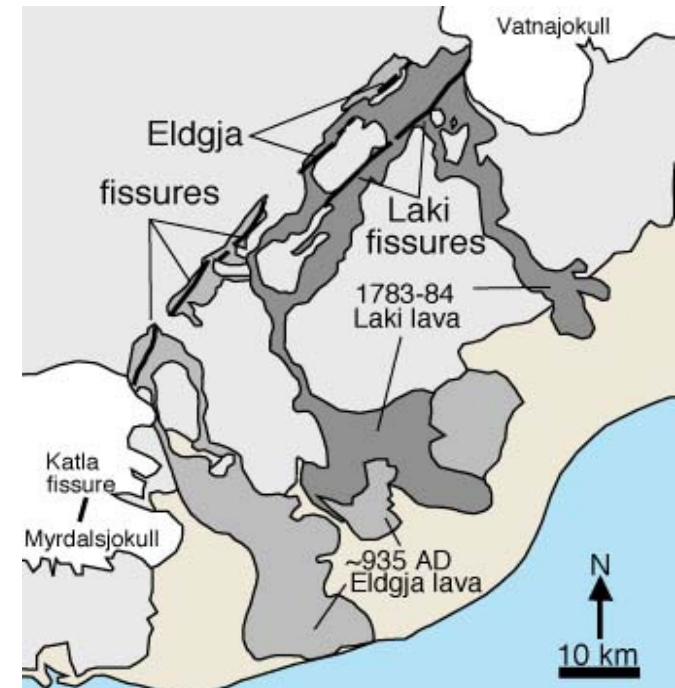
For clarity, that's that is -ay as in day, -fy as in few, -oe as in French "coeur", -uu as in boot, the -tl as in atlas. The (-uh) is "a" as in ago





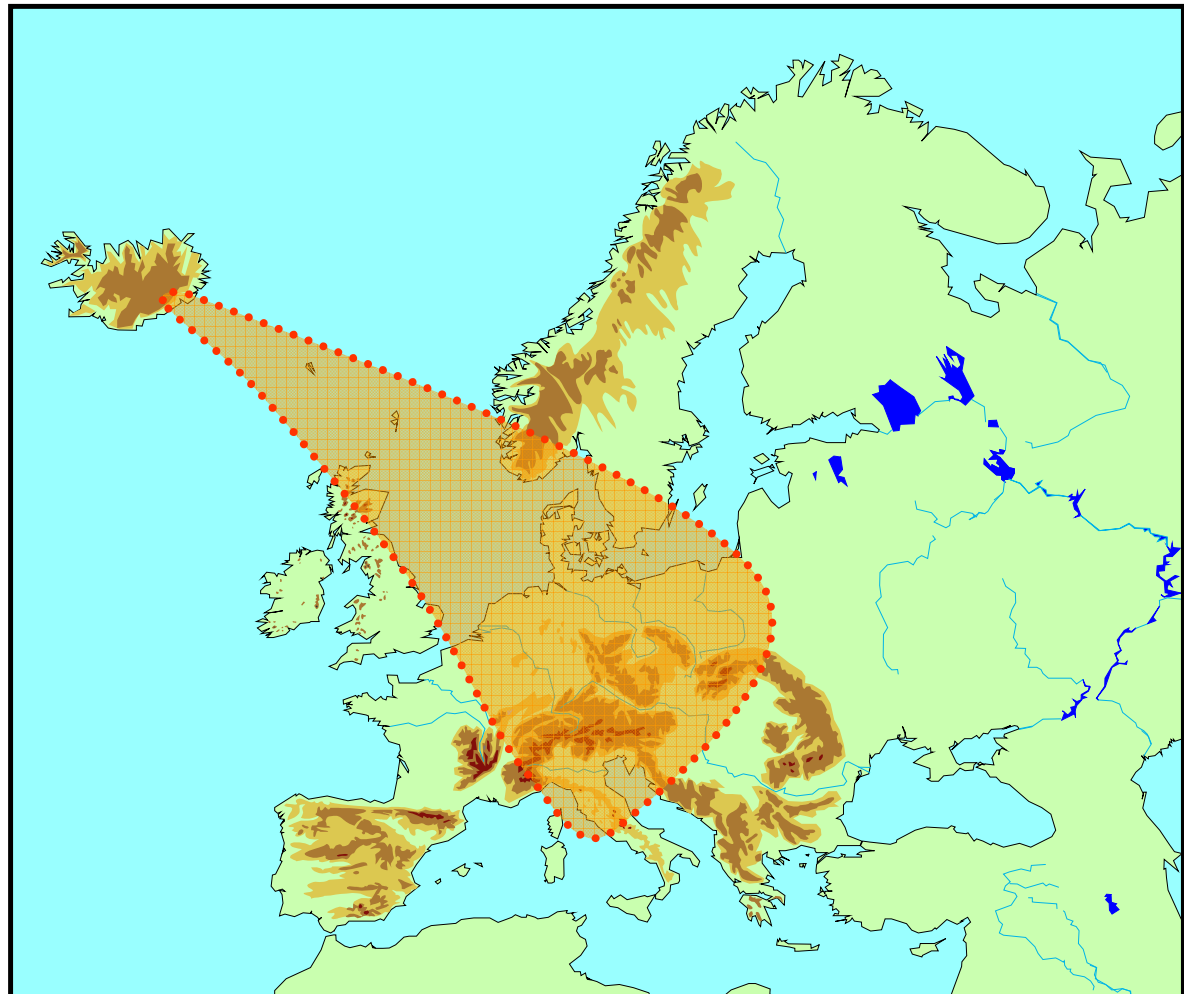


Laki 1783-4 Eruption



Laki 1783-4 Eruption

"10,500 dead"
Famine (1783)



Laki 1783-4 Eruption



Toxic Gases



F_2 & Cl_2 (Fluorine & chlorine gas)

$\text{HF}_{(g)}$ Hydrogen Fluoride

$\text{HCl}_{(g)}$ Hydrogen Chloride

H_2S Dihydrogen Sulfide

HCN – Hydrogen cyanide

NO - NO_2 - NO_3 - N_2O

Cl_2O dichlorine monoxide

NH_3 Ammonia

PCl_3 Phosphorus trichloride

Group 4a	Group 5a	Group 6a	Group 7a	2
6 C Carbon 12.011	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984	He Helium 4.0026
14 Si Silicon 28.086	15 P Phosphorus 30.9738	16 S Sulfur 32.06	17 Cl Chlorine 35.45	Ne Neon 20.183
32 Ge Germanium 72.61	33 As Arsenic 74.9216	34 Se Selenium 78.96	35 Br Bromine 79.904	Ar Argon 39.948
50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.9045	Kr Krypton 83.80
				Xe Xenon 131.29



**HYDROFLUORIC ACID
HAZARDOUS LIQUID**

Causes SEVERE BURNS which may not be IMMEDIATELY PAINFUL or VISIBLE.

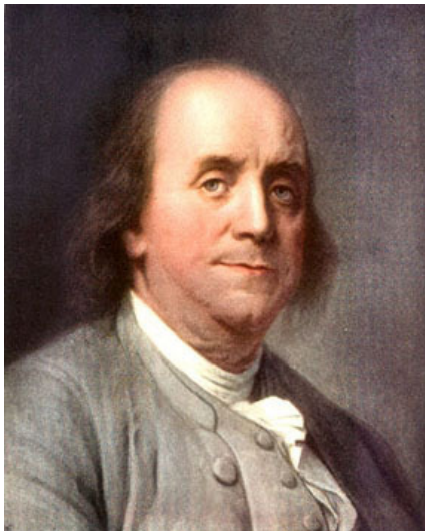
AVOID CONTACT WITH EYES,
SKIN AND CLOTHING!!

Use 2.5% Calcium Gluconate Gel
IMMEDIATELY on burn TO REDUCE SKIN
and BONE DAMAGE.



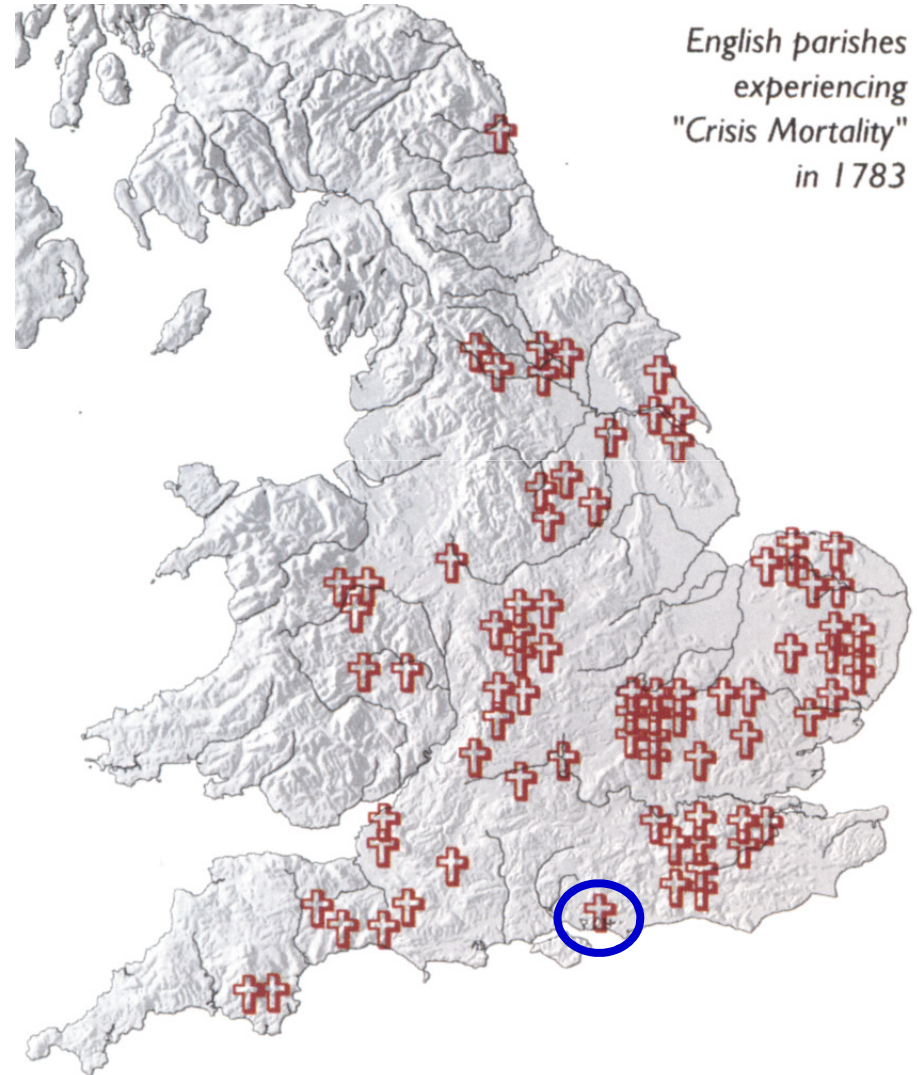
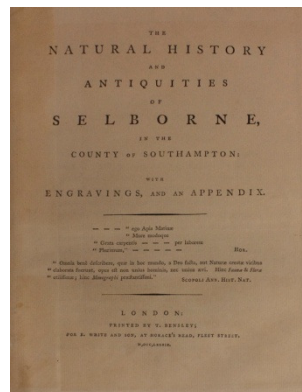
IT DISSOLVES
YOUR BONES!!

Crisis Mortality



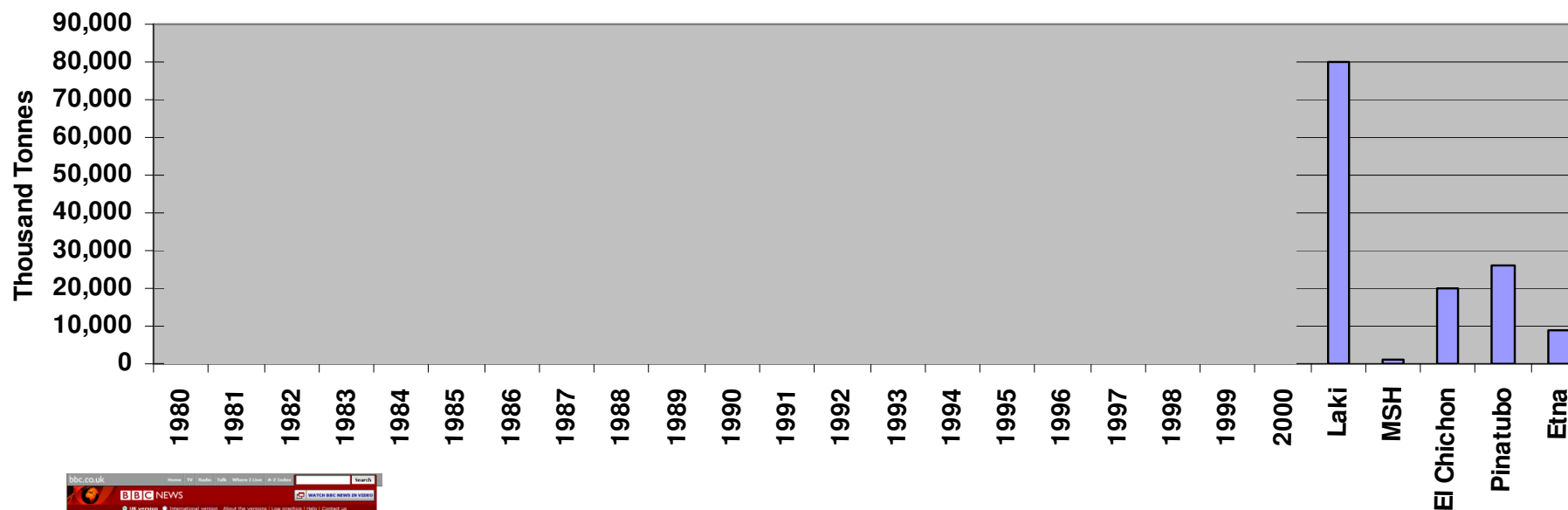
“ A thick, hot vapour had for several days before filled up the valley...so that both the Sun and Moon appeared like heated brick-bars ”

Gentleman's Magazine, July 1783



Sulphur Dioxide Emmissions UK

<http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=4228>



SO₂

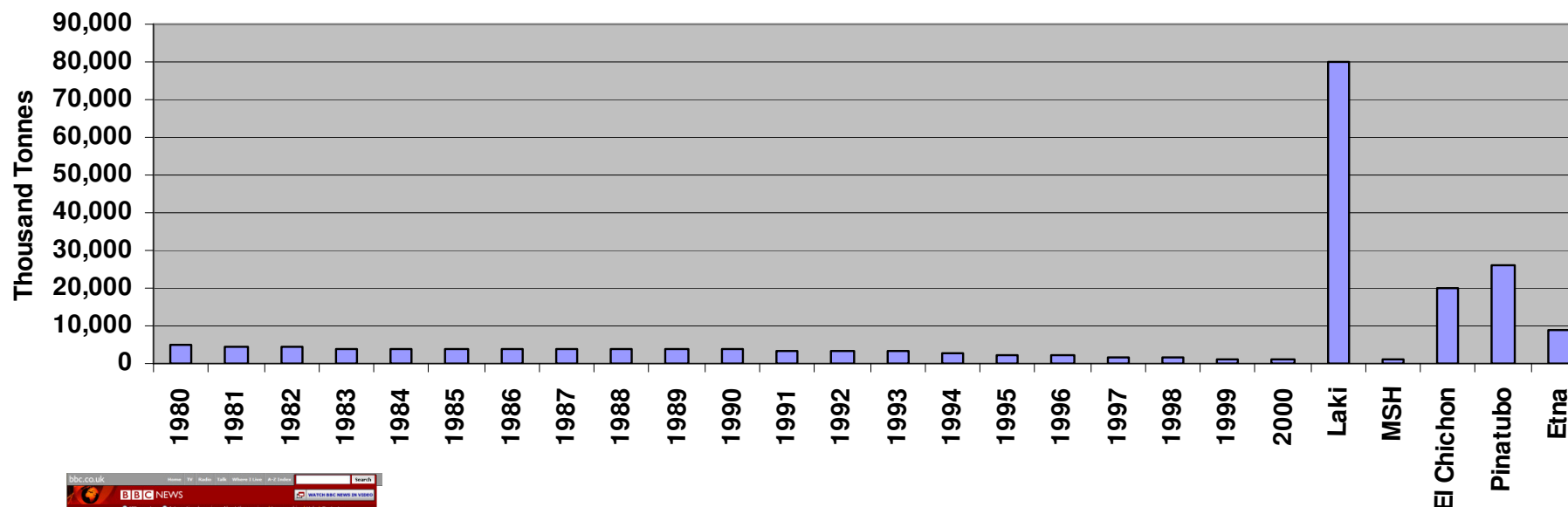
122 Megatonnes

HF

8 Megatonnes

Sulphur Dioxide Emmissions UK

<http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=4228>



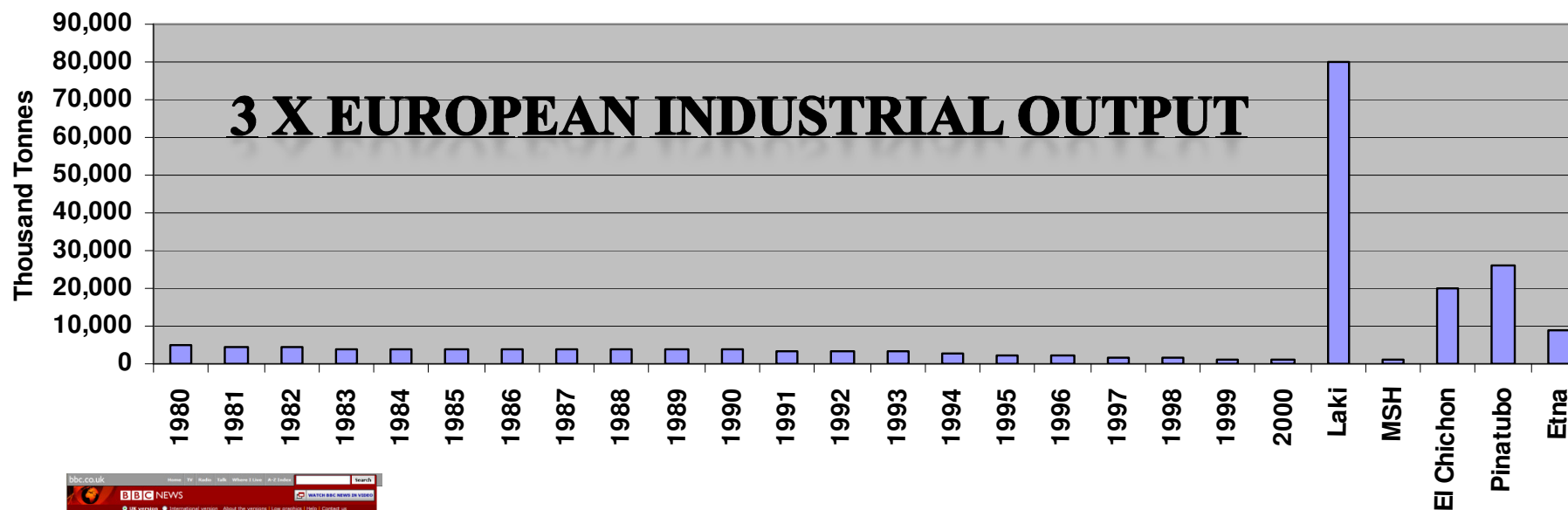
SO_2

122 Megatonnes

Laki style eruption - Every 1000 years - Europe wide impacts - Environmental & Economic

Sulphur Dioxide Emmissions UK

<http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=4228>

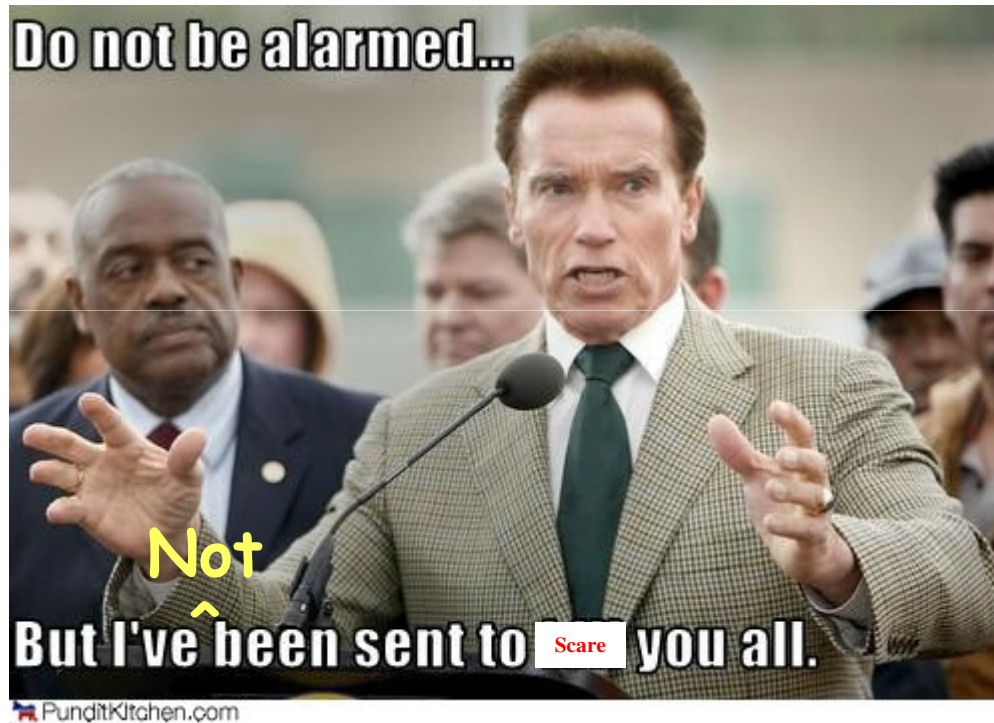


SO_2

122 Megatonnes

Laki style eruption - Every
1000 years - Europe wide
impacts - Environmental &
Economic

So.....



The ONLY thing
we have to fear is
FEAR ITSELF...
and spiders 🕷️ &

Volcanoes!

