

GIRO conference and exhibition 2010
Trevor Maynard, Deputy Head Exposure Management, Lloyd's

Emerging Risks

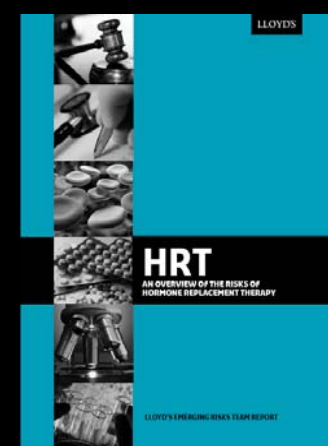
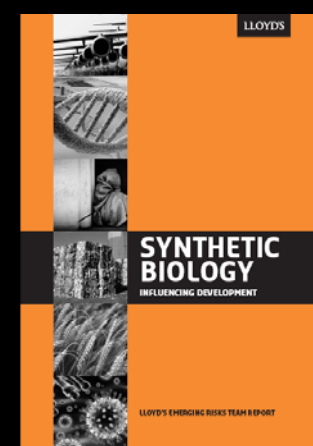
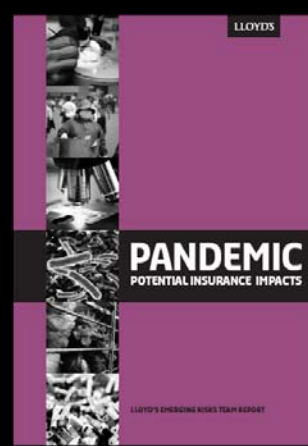
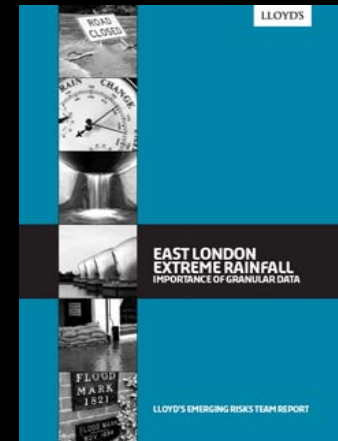
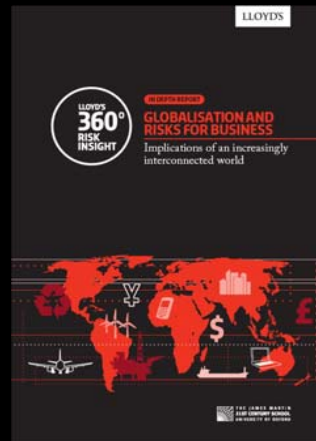
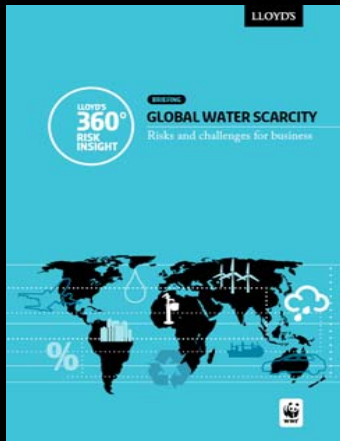
The future: in space and on earth

12-15 October 2010

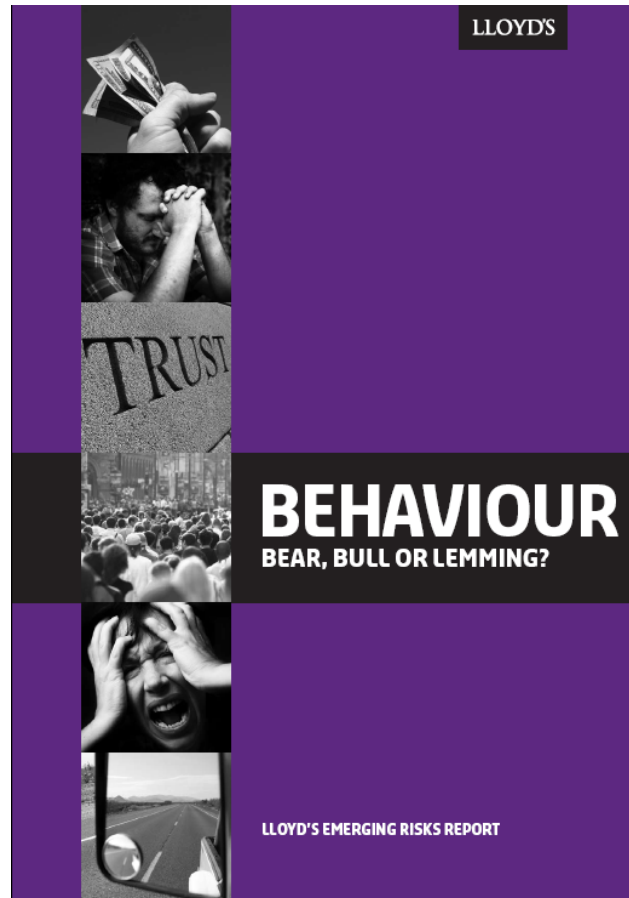


**What follows are
personal views.**

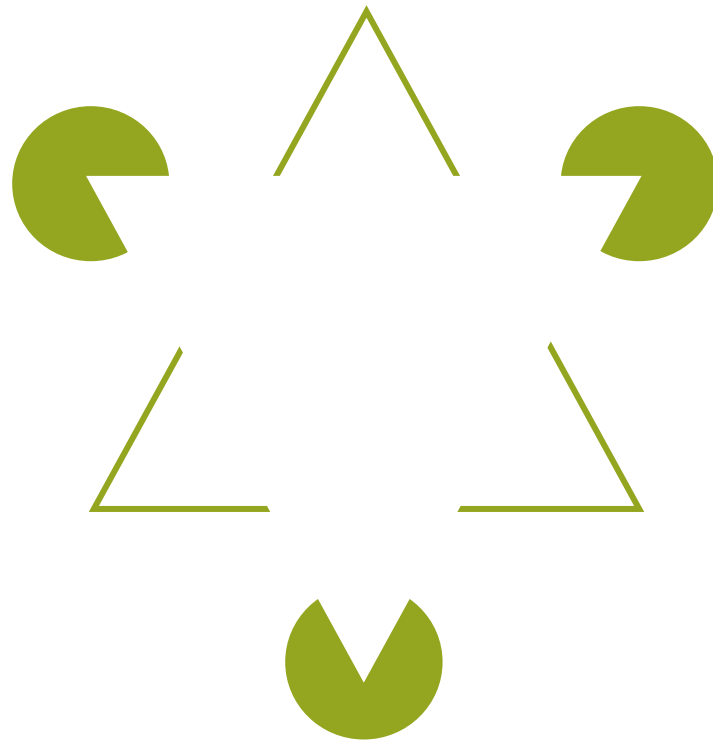
**The views in this
presentation do not
necessarily reflect those
of my employer.**



Some relevant behavioural issues for the later part of my talk....



Is there a white triangle?



**We accept that our eyes suffer
from optical illusions...**

**...our brains suffer from similar
biases**

Making a tough decision



Making a tough decision



Emotion is a strong driver of perception

- Not as rational as we thought
- More powerful when:
 - Under time pressure
 - Information limited (“tie breaker”)
- Older parts of the brain
- Positive feelings – reduce perception of risk
- Fear affects hindsight (“I always thought that was a big risk”)



GREED



PANIC



REGRET

How many of you recognise this statement

“I am an actuary and making financial sense of the future is what I do.”

How many of you recognise this statement

**“I am really busy and
would prefer to have less
to think about rather than
more”**

Cognitive dissonance: the state of tension that exists when a person holds two thoughts that are psychologically inconsistent.

Impact: your brain is about to work really hard to ignore what I'm about to say.

Representativeness Bias...

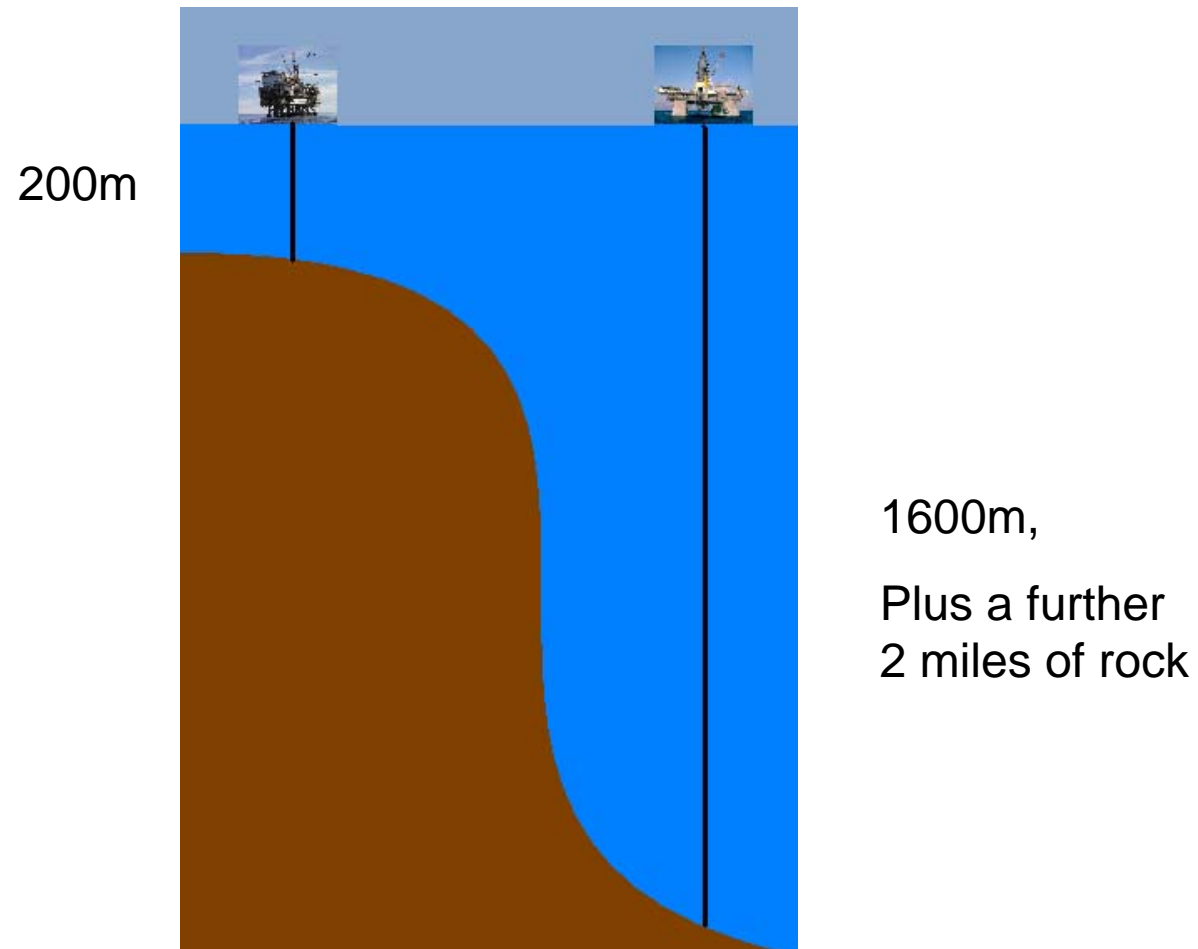
...the rule of typical things



A couple of offshore rigs....



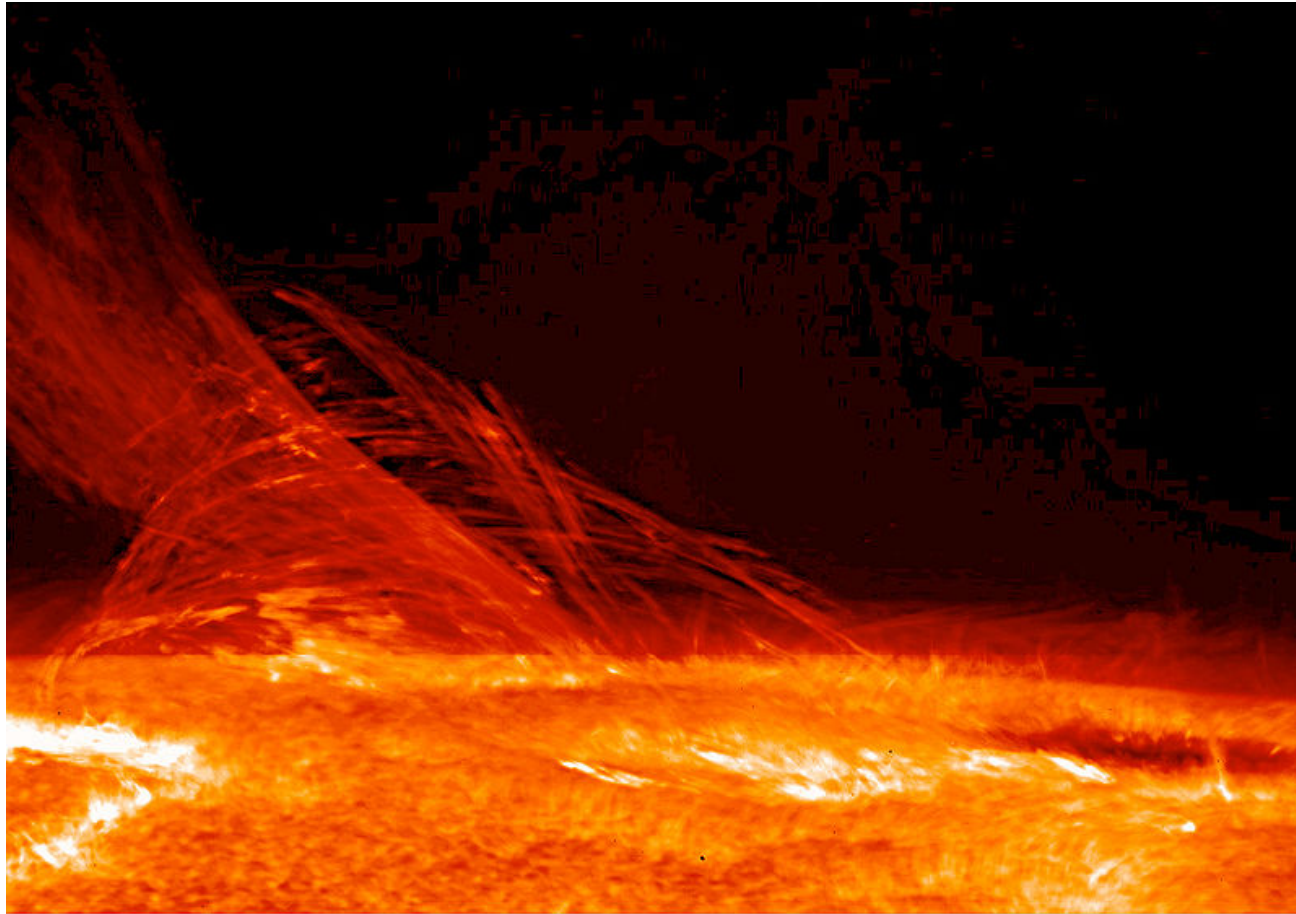
A couple of offshore rigs....



Our sun, giver of life...



Or vast nuclear bomb...



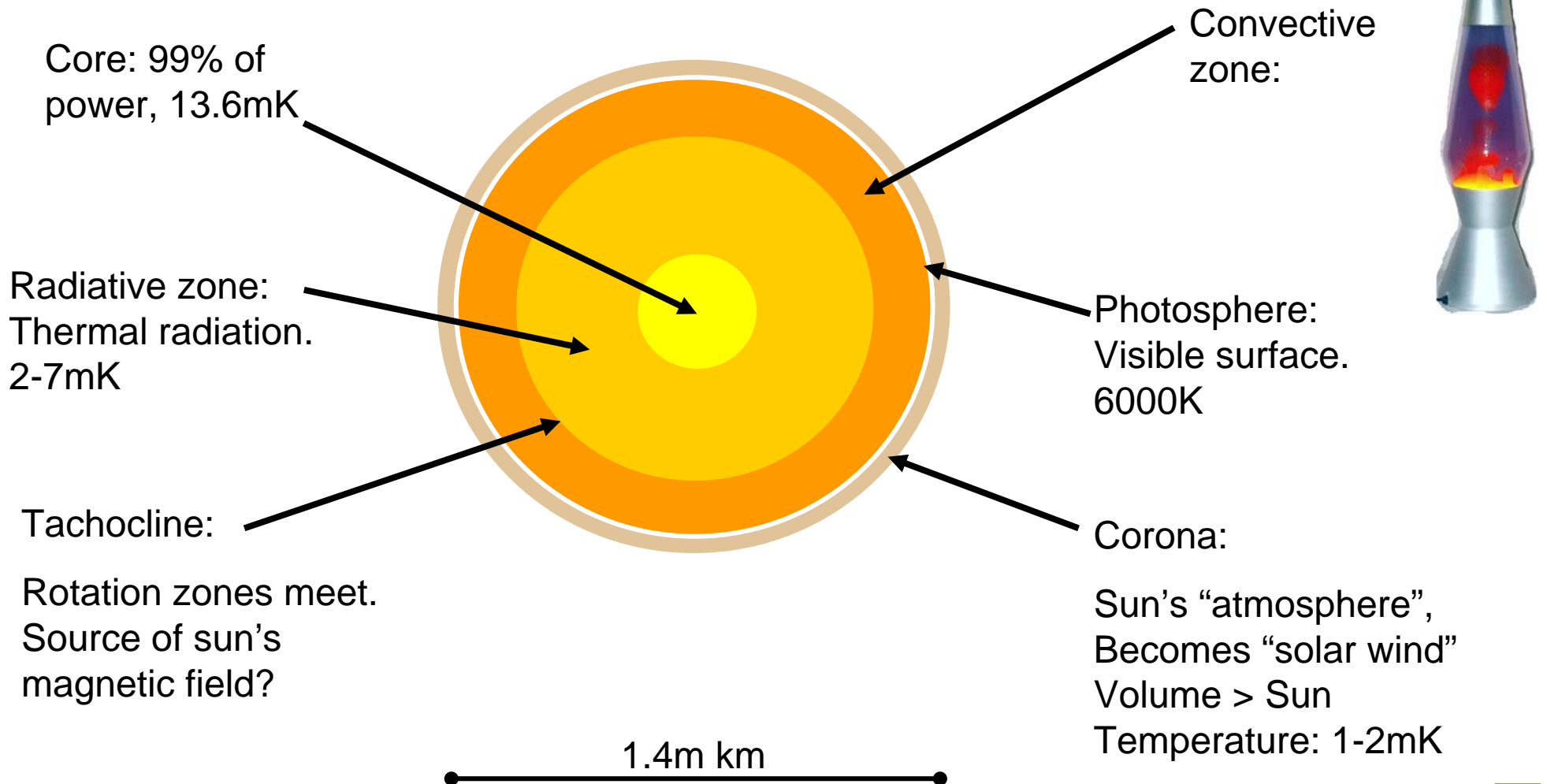
Power of the sun

If Earth's fossil fuel reserves were consumed at the same rate as the sun's energy output....

... they would last for 0.05 seconds.



Anatomy of the sun

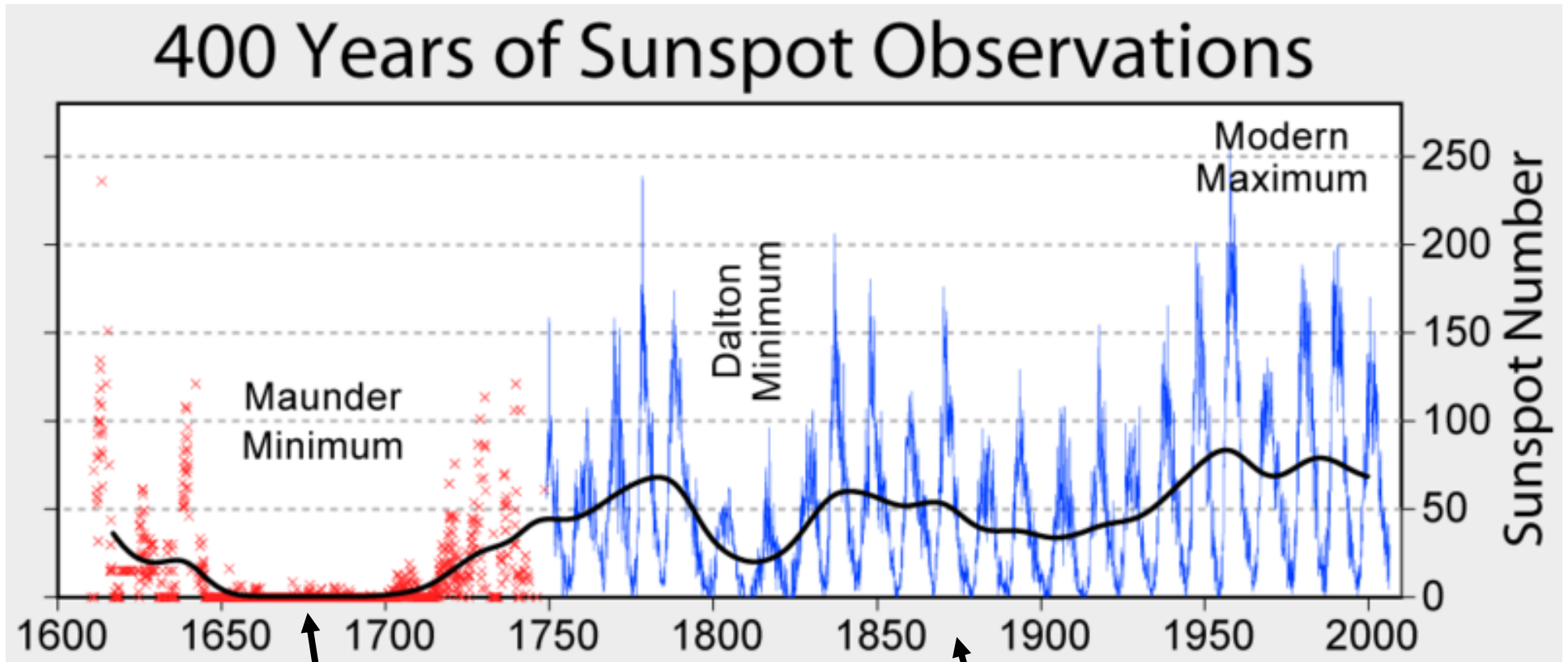


Sun spots

- Intense magnetic activity
- Suppresses convection...
...hence cooler 4000K vs 6000K
...hence darker
- 10,000 km across
- The Sun's hurricanes?
- Number of sun-spots highly correlated with sun's power output



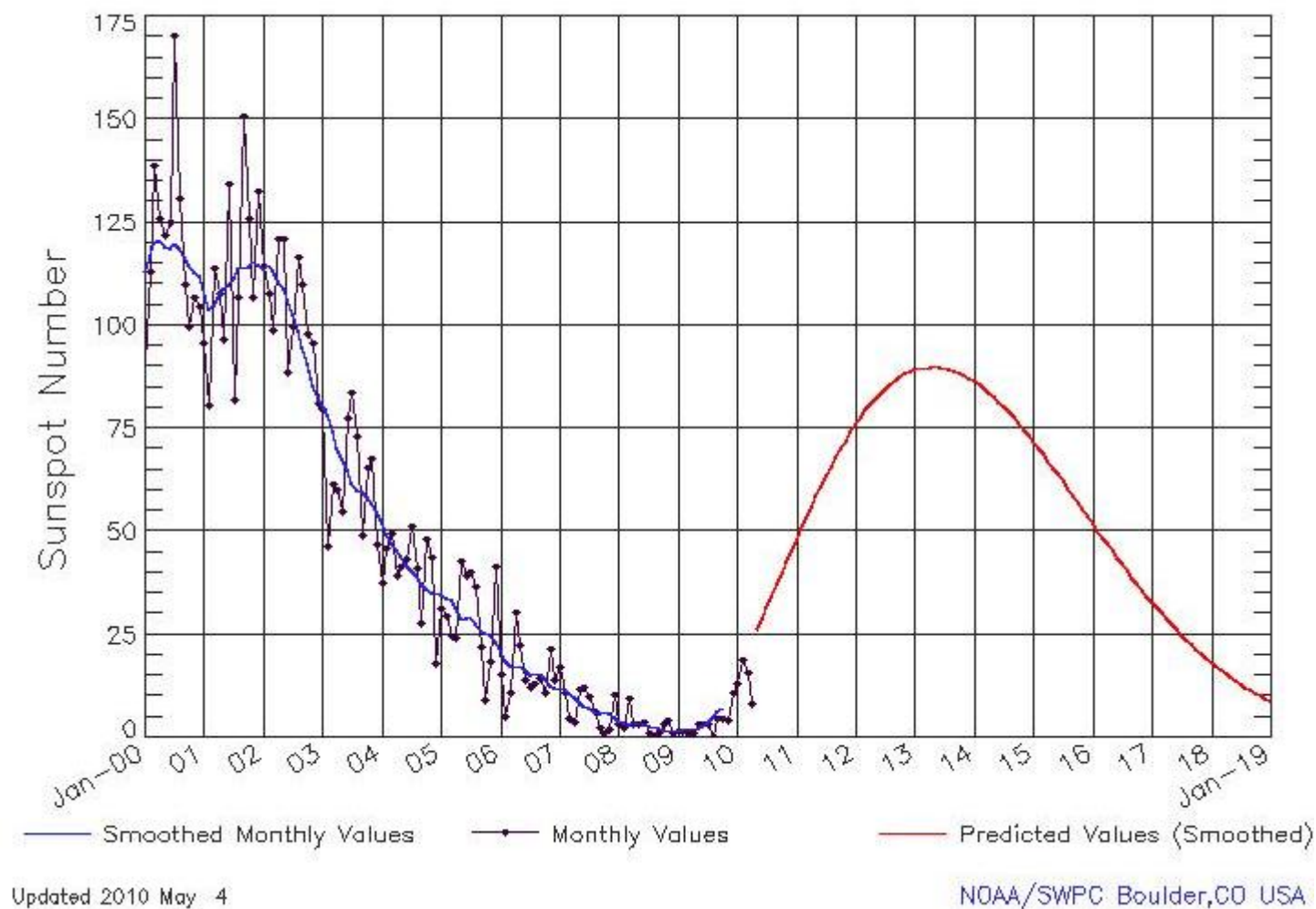
Solar cycle, observed for 4 centuries



Little ice age

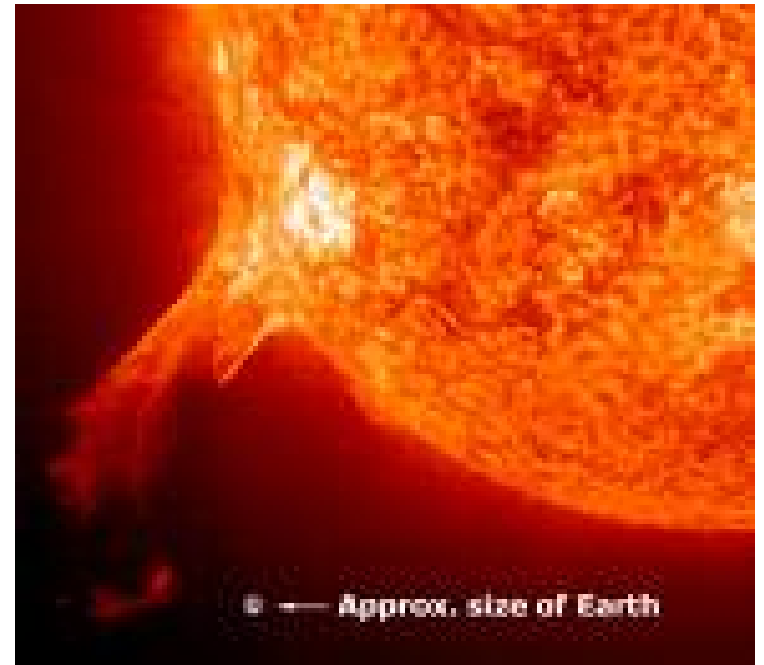
11 year cycle

Next solar peak in a couple of years...



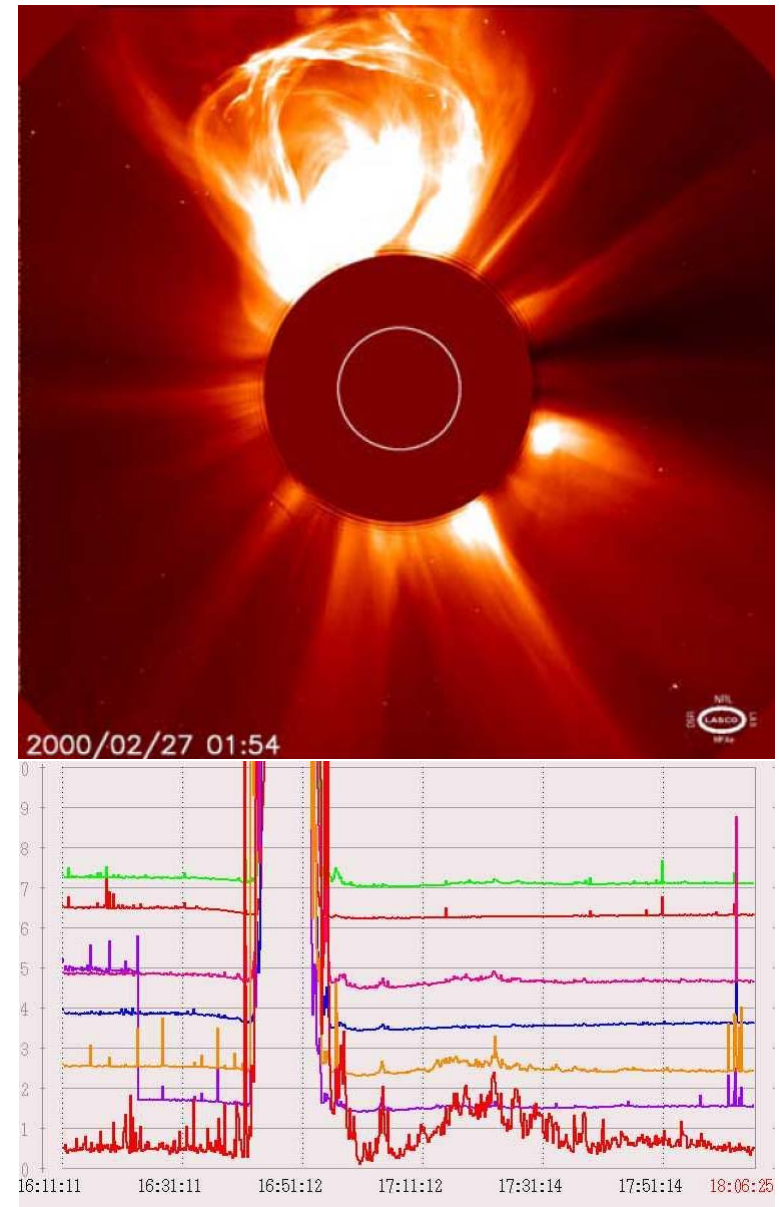
The Sun's weapons

- **Solar wind** – the part of the corona that reaches escape velocity
- **Solar radiation** – emissions from internal nuclear reaction
- **Solar flares** – large radiation bursts arising from reconnection of magnetic fields – travels at speed of light
- **Proton flares** – 1/3 speed of light; Lloyd's RDS=5% loss on each satellite policy
- **Coronal Mass Ejections (CMEs)** – next slide



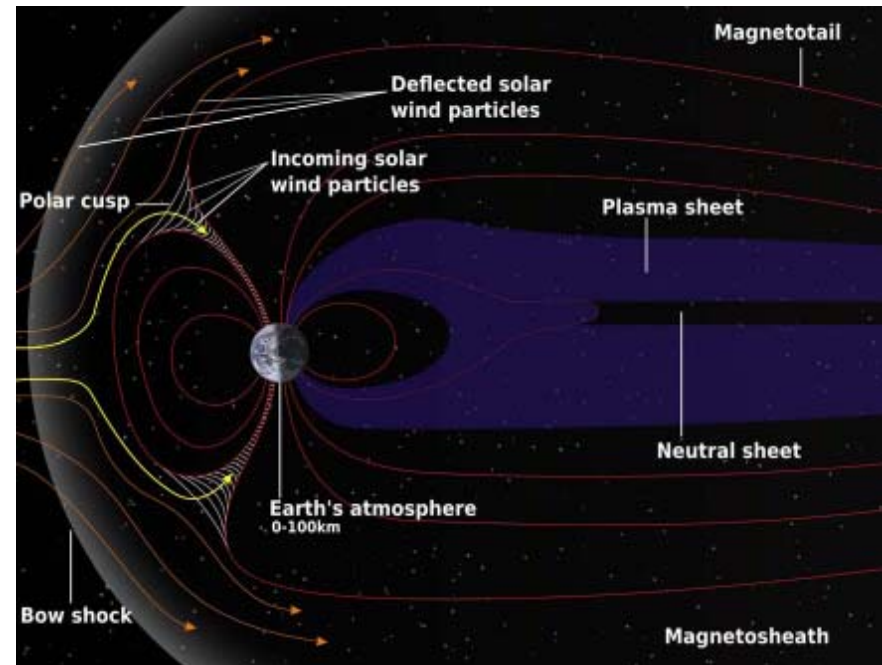
Coronal Mass Ejections

- Caused by magnetic reconnection; snapping
- Emit: matter (electrons and protons), magnetic fields and radiation into space
- Causes Geomagnetic storm on Earth
- Velocity of 20 km/s to 3200 km/s – typically 1 day to reach earth
- Frequency highest during solar maximum (but any time possible)
- Radio interference
- Associated with, but not caused by solar flares



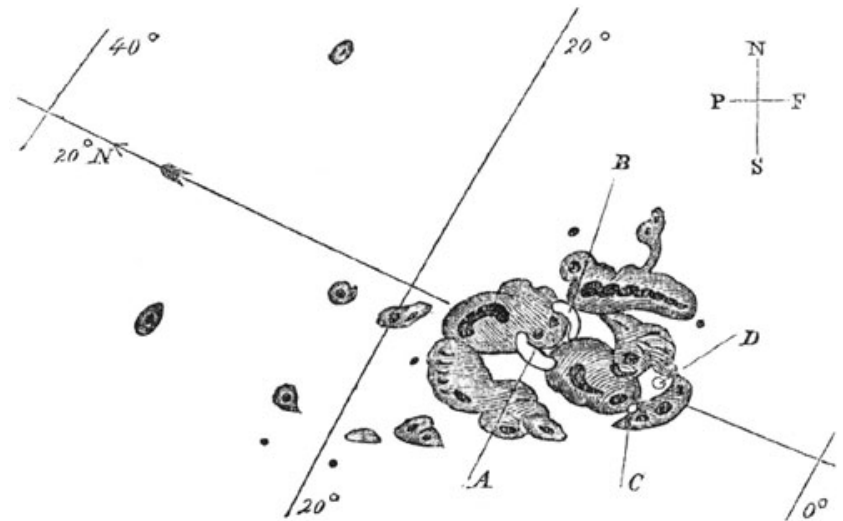
Earth's defenses

- Magnetic field deflects most radiation
- Some particles trapped in Van Allen radiation belts
- Sun facing magnetosphere usually 70,000km – but compressed to 35,000km in high solar wind



The Carrington Event

- 1 September 1859
- Most powerful observed solar storm
- Aurora in Cuba
- Telegraph systems haywire in northern latitudes, causing:
 - fires, shocks, failure
- Ice cores suggest 1 in 500 return period? Others suggest 1 in 100
- USD1-2 trillion if it happened today? 10 years to recover?



The Carrington Event

“...a contemporary repetition of the Carrington event would cause significantly more extensive (and possibly catastrophic) social and economic disruptions.”

**Severe Space Weather Events--
Understanding
Societal and Economic Impacts**

US National Research Council

<http://www.nap.edu/catalog/12507.html>

Some other recent events

- 1921 – 3 degrees magnetic interference
- 1940 – Easter Sunday – telephone wires fused (US)
- 1958 – Radio blackout cuts US off from rest of world
- 1989 – Quebec – total blackout in 92 seconds, USD6bn, affected 6m people
- 2003 – “Halloween storm” (in cold part of solar cycle) – Midori2 research satellite lost (USD450m), South africa lost 13% of power grid

See <http://www.solarstorms.org/SRefStorms.html> for more

Impact on Earth: Electrical power

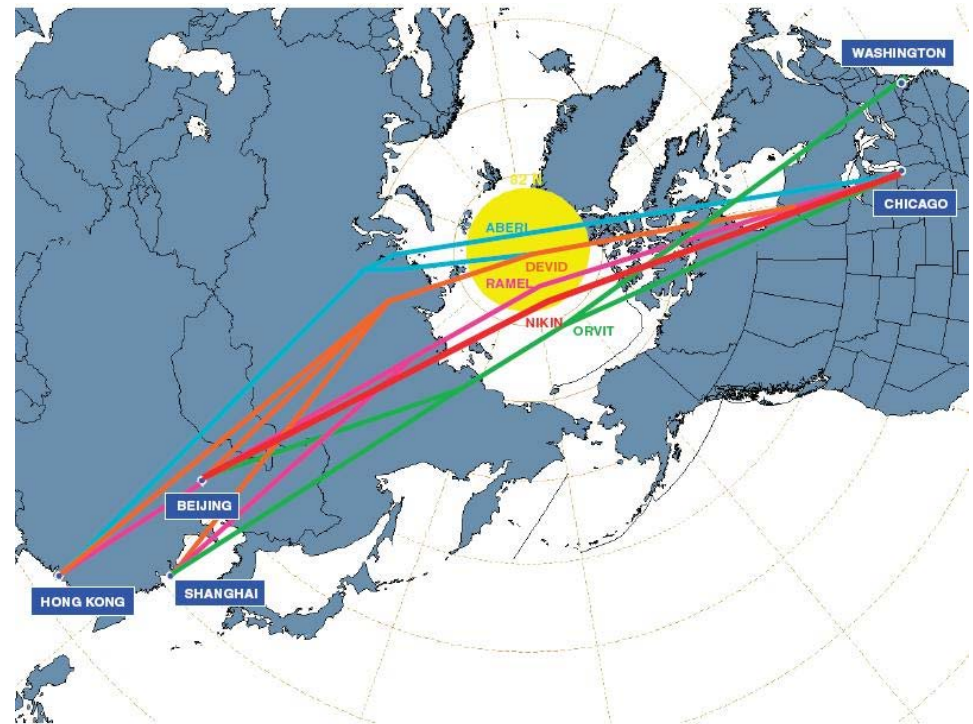
- Earth's power grid acts as an antenna
- Impact electricity networks.
- Limited availability and cost of transformers (developing world demand)
- Dependency of society and economy on electricity.
 - Water/ Food/ Sanitation/ Fuel/ Transport/ Healthcare/ Communication/ Heating/ Emergency services



See: <http://www.lloyds.com/News-and-Insight/News-and-Features/360-News/Emerging-Risk-360/Transformers-a-risk-to-keeping-the-power-on-230810>

Impact on Earth: Aviation

- Communications
 - HF radio blackouts
 - Vulnerability of polar routes
- Navigation
 - Interference with satnav signals
- Radiation
 - Risk at cruising altitudes



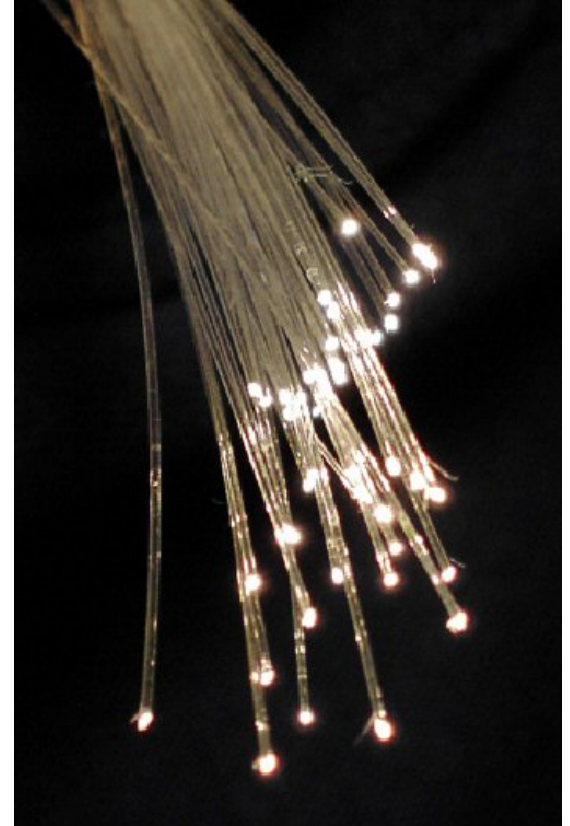
Transport

- Maritime shipping
 - Loss of shipping navigation
- Rail transport
 - Induced currents in rail tracks
 - Cause signals to switch (Sweden goes to red automatically – elsewhere?)
- Automobiles
 - Growing use of digital electronics for engine management



Communications

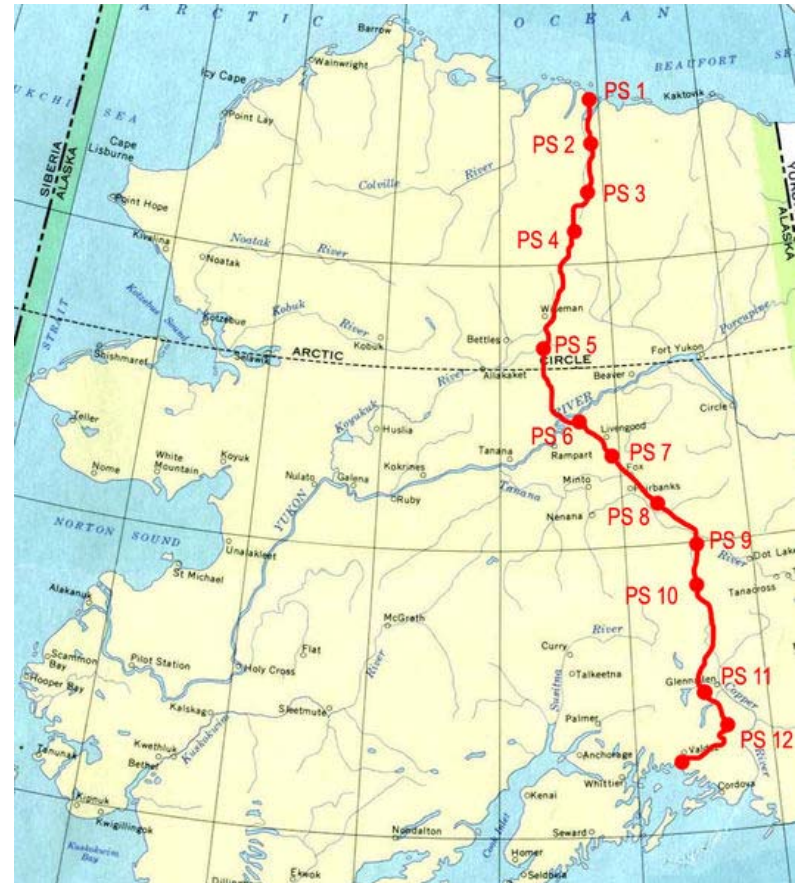
- Telephones
 - Optical fibres in telephone lines protected
 - Possible damage to amplifiers
 - Mobile phone interference from solar radio bursts
- Wireless
 - Interference of radio signal protocols
- Broadcasting
 - Damage to satellites
 - Galaxy 15 – zombie satellite damaged by “solar activity”?.



Source: BigRiz

Pipelines

- Induced currents in long pipelines
- Damage to “cathodic protection systems”
- Increasing length of modern pipes



Oil and mineral industries

- Drilling requires accurate magnetic measurements
- One company reported swings of 12 degrees in 1989
- Magnetic sensors in smart phones?



Finance

- Time stamping of financial transaction
 - Rely on satellite navigation signals
 - Moves towards automated trading on timescale of seconds



Want to know more?



Summary

- Don't let representation bias fool you into underestimating new things
- Be aware that in an attempt to reduce cognitive dissonance your brain may try to “explain away” new things (“interested” and “too busy” are not compatible)
- Extreme space weather risks appear to be within regulatory return periods – and could be extremely damaging to society
- “*Read books are far less valuable than unread ones*” Nassim Taleb

Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.

