UK Space Weather Strategy
linking research to operations

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Outline

The work of the Civil Contingencies Secretariat

- Cabinet Office – at the centre of UK government
- CCS work on space weather

How the UK Space Weather Strategy has evolved

- Background
- Relation to the UK government National Risk Register
- Building the strategy
- http://tinyurl.com/coxc4le

Royal Academy of Engineering report

- "Extreme space weather: impacts on engineered systems and infrastructure"
- www.raeng.org.uk

The work of the Civil Contingencies Secretariat

- Short-term horizon scanning and medium term risk assessment
- building capability
- ensuring consistency
- critical infrastructure
- planning for the big stuff
- supporting community and corporate resilience
- .....and dealing with it when it goes wrong

RAL Space

Cabinet Office

Building resilience: approach

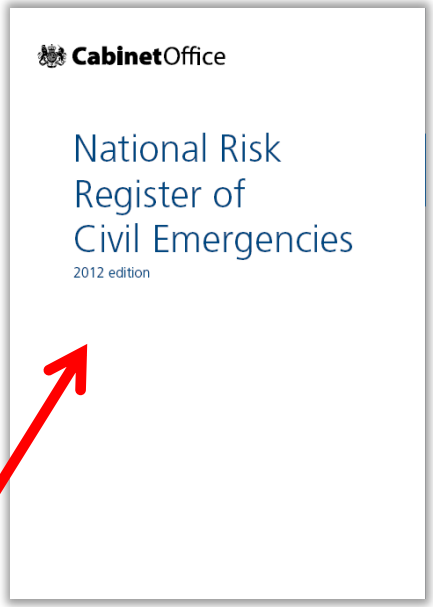
RAL Space

- Top risks on the National Risk Assessment have high likelihood and high impact and range from a flu pandemic, to terrorism, to an ash rich volcanic eruption abroad
- Also focus on lower likelihood, high impact risks: severe space weather and gas-rich effusive volcanic eruption
- Risk assessment and planning based on ‘reasonable worst case scenario’
- Generic capabilities built through the National Resilience Capabilities Programme provide a baseline of capability for these risks, however more focussed planning is required to:
  - develop additional capability / capacity; and / or
  - develop bespoke capabilities to meet the specific consequences
- Our approach to high impact risks involves working with Government Departments, operational agencies and external experts to develop specific contingency plans

Cabinet Office

Background to UK work on severe space weather

- Space weather fits in national agendas on security & resilience: UK, US, Sweden, …
- UK National Risk Assessment
  - Space weather discussions started May 2010
  - Space Environment Impacts Expert Group formed Nov 2010
  - SEIEG provides independent scientific advice, much appreciated by policy-makers
  - Emphasis on (peer reviewed) scientific evidence
  - Space weather risk formally recognised with publication of NRR in Jan 2012
  - SEIEG extreme cases now available as RAL technical report: http://tinyurl.com/czejfnz



With added space weather & volcanoes

Figure 2: Risks of natural hazards and major accidents

NRR risk matrix

non-malicious risks

Impact score based on

- Fatalities
- Injuries/illness
- Social disruption
- Economic harm
- Psychological impact

http://tinyurl.com/cycruu7

or

https://www.gov.uk/government/publications/national-risk-register-of-civil-emergencies

Resilience planning challenges

- Nature of underpinning science means there's greater uncertainty about reasonable worst case scenario compared to other risks on National Risk Register and limits our ability to forecast and model impact.
- Getting buy in to lower likelihood risks.
- Interdependence of potential impacts presents high level of complexity in providing resilience.
- Effective communication co-ordinated internationally, both to industry and the wider public, vital to prepare effectively for this risk.
- Very short notice were a major event to happen.
- Impact would be felt internationally. Therefore, international collaboration vital to build resilience.

Resilience planning update

RAL Space

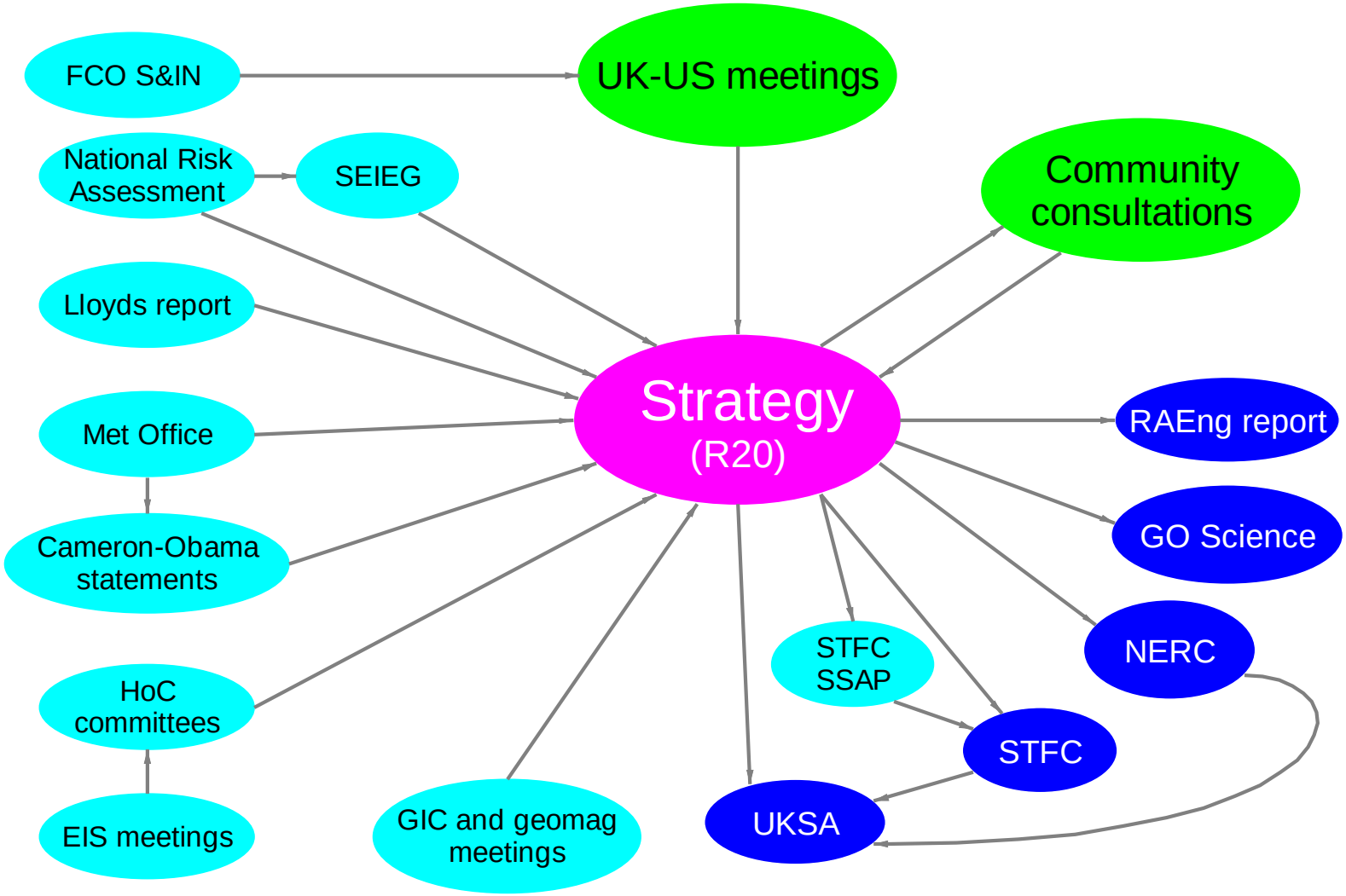
- Lot of work to understand the nature of this risk for the UK since it first appeared in National Risk Assessment in 2011.
- Met Office ‘own’ this risk. Lead departments responsible for mitigating the impacts. Co-ordination provided by CCS in Cabinet Office
- Severe Space Weather Project set up in CCS. First project board meeting, 23 April co-chaired by Met Office and CCS.
- Accountable to High Impact Hazards Programme Board as part of National Security Council structure. First meeting on 29 April. Chaired by Director, Civil Contingencies.
- Expert Advisory Group (based on the SEIEG) being set up as formal part of governance to ensure the work of the project is informed by scientific evidence
- Continue international collaboration (US, Sweden, Canada, JRC)
- Main outputs: enhanced capabilities to be reflected in response strategy for responding to a severe space weather incident.

Cabinet Office

Building the strategy

- Aims: how best to link research to operations (R20)
  - Put this in national and international context
- Process
  - Collected evidence from wide range of national and international sources (next slide)
  - Constructed first draft for review by selected colleagues
  - Showed need for major restructuring
  - New draft reviewed by expert community
  - Then a series of updates and public reviews

Landscape – key points



Structure, part 1

Why a strategy?

Link all UK players fr 20

Put UK work in glo

Governance

What are pacts?

Nat egister

O ctors at ri

busines

Space weath e

Analysis of ma

Monitoring

Modelling

weathe

gstorms &

High-s

Radiatio c rays

Solar e emissions

climate

internal field

Focus first on need for mitigation of risk

Then on relevant science – so science flows from needs

Trace from impacts so we engage wider community, (scientists prefer to trace the energy flow)

Structure, part 2

Space weather processes
Magstorms & their solar origin
High-speed streams
Radiation storms, Cosmic rays
Solar electromagnetic emissions
SpW & Earth's climate
SpW & Earth's internal field

Research & Operations
By risk sector : grounded i… s,
aviation, satellites, radi… tem
Cross-cutting the… …here,
magnetosphere, io… …rmosphere,
int… …d,
econo… …al imp… …s

From UK-US w'shops, updated after review

Details in annexes
UK skills, meetings, participants, documents

Implementation & Organisation
Governance: S… …ategy Board
Investment : Strat… …sential both to win supp… …be efficient
Web: to mai… …evolve the strategy, and …ciated resources

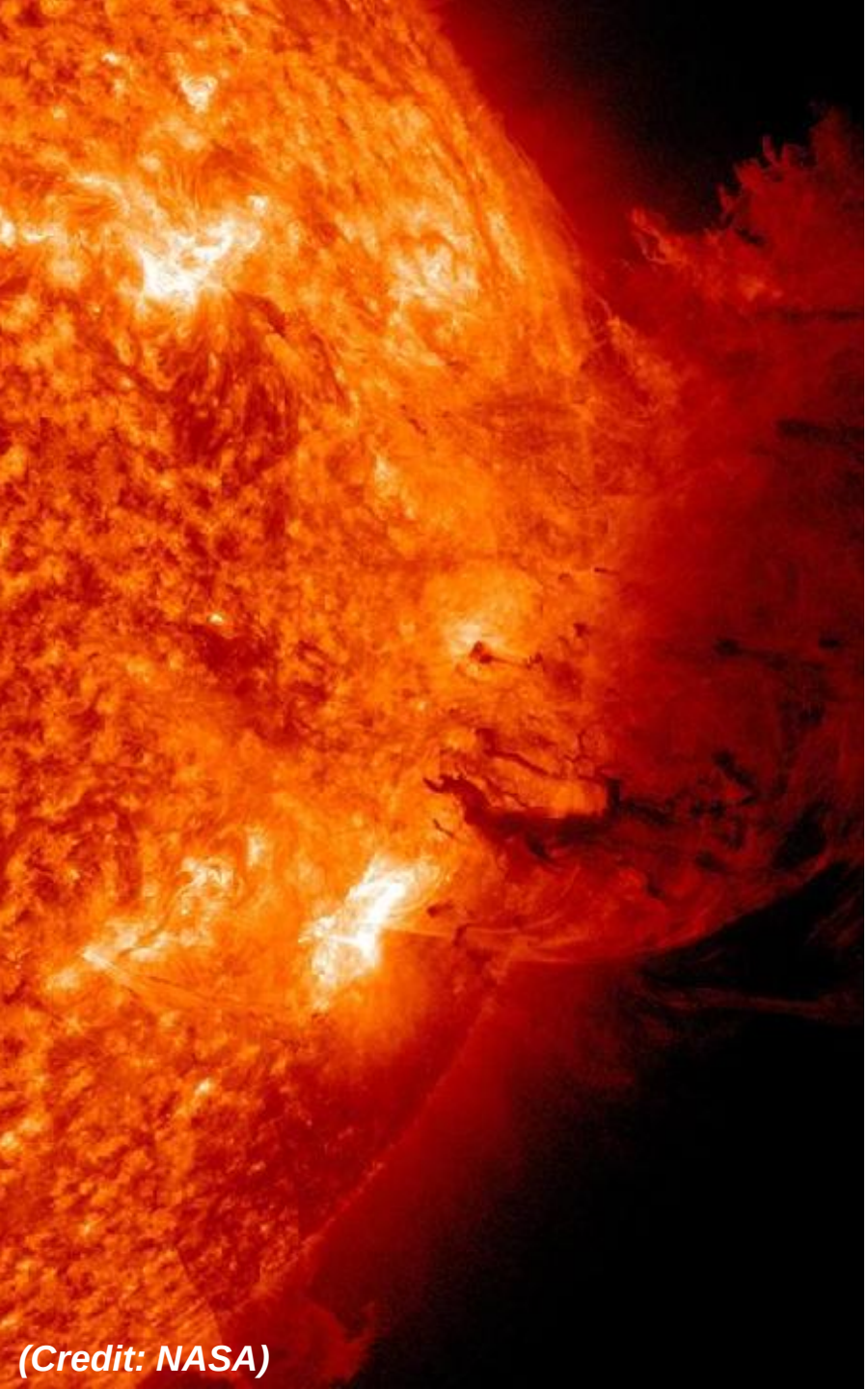
Governance is key

Where is it?

http://www.ukssdc.ac.uk/twiki/bin/view/UKUSSpaceWeather/SpaceWeatherstrategy

Or

http://tinyurl.com/coxc4le


(Credit: NASA)

ROYAL ACADEMY OF ENGINEERING

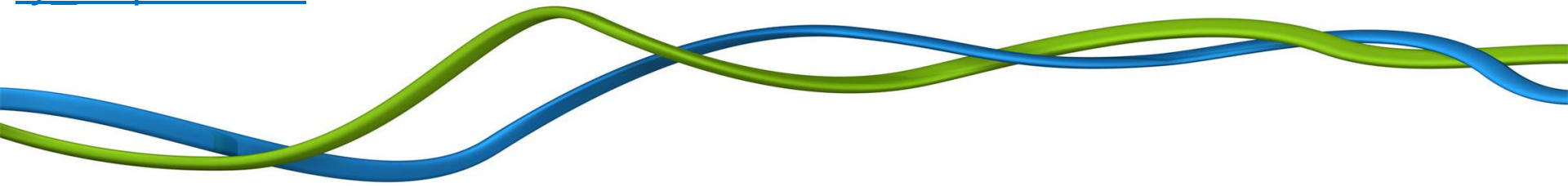
Extreme Space Weather: Impacts on Engineered Systems & Infrastructure

Prof. Paul Cannon, FREng
Royal Academy of Engineering
Study Chair

Plus a very extensive team of space scientists and engineers

The full report can be downloaded from:
http://www.raeng.org.uk/news/publications/list/reports/Space_Weather_Full_Report_Final.PDF

A summary report can be downloaded from:
http://www.raeng.org.uk/news/publications/list/reports/Space_Weather_Summary_Report.PDF



Recommendations (e.g. p6 of summary):

- Government should initiate a space weather board to provide leadership in SW activities
- UK should work with international partners to refine the environmental specification of extreme solar events and reasonable worst case scenarios
- Specific recommendations are made on protection/research against worst case scenarios in sectors covering grid, satellites, aviation, ground and avionic technology, GNSS, terrestrial mobile, HF and broadcasting communications