

# 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



Cabinet Office

## 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](http://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



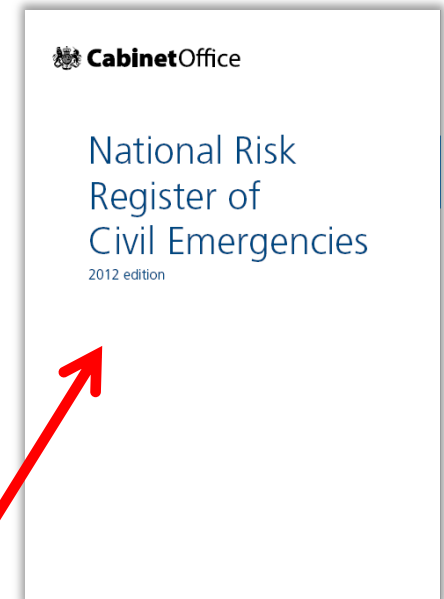
# Building resilience: approach

- 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



# 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



- 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.

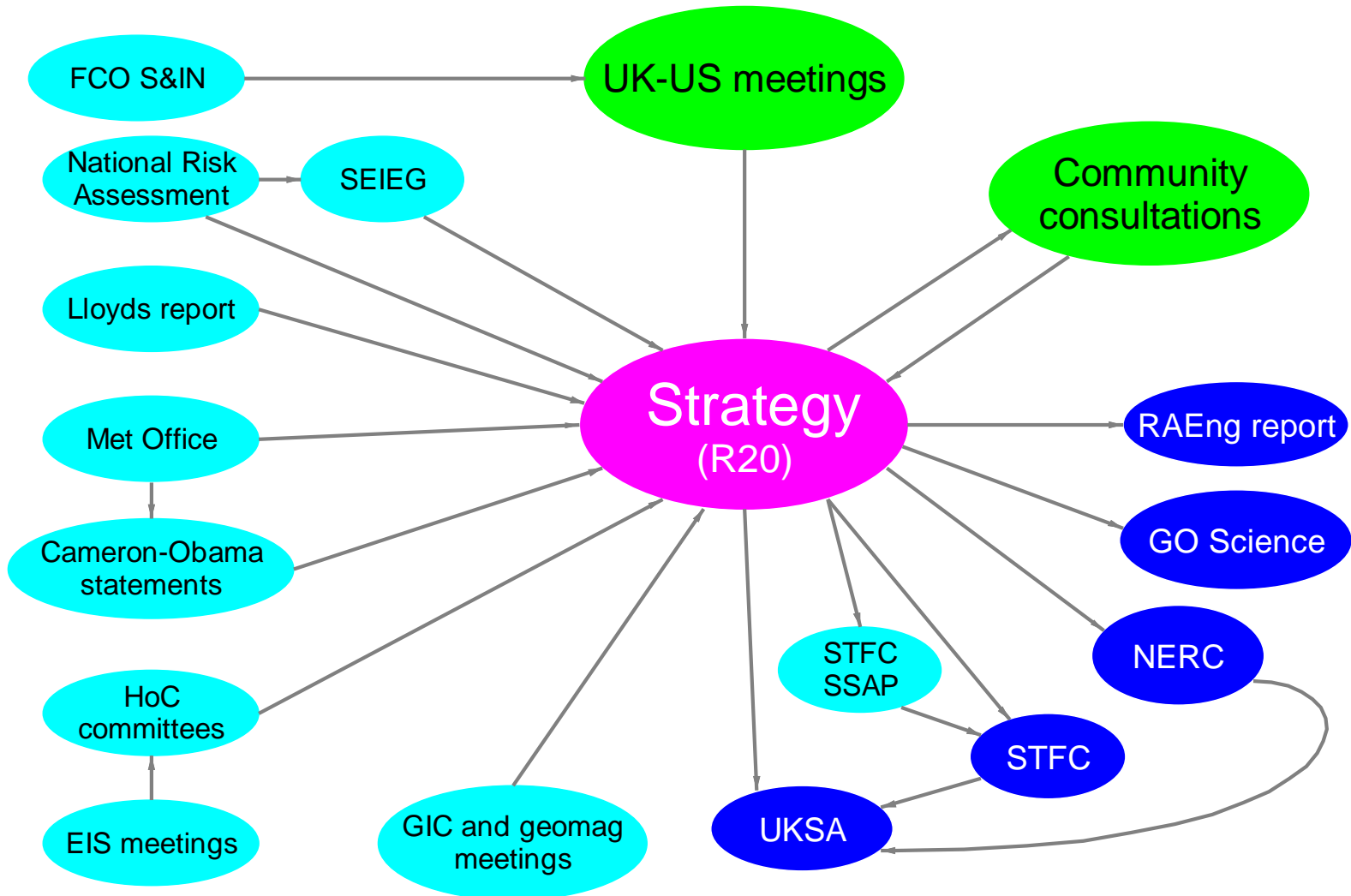




# Building the strategy

- 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 from 2000  
Put UK work in global context  
Governance

## What are the impacts?

National register  
Operational factors at risk  
Business

## Space weather

Analysis of major events  
Monitoring  
Modelling

High-energy particles  
Radiation  
Solar energetic particles  
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 infrastructure, aviation, satellites, radio, power system

*Cross-cutting the* : ionosphere, magnetosphere, ionosphere, atmosphere, interplanetary medium, economic and social impacts

## Details in annexes

- UK skills, meetings, participants, documents

## Implementation Organisation

*Governance*: Strategy Board

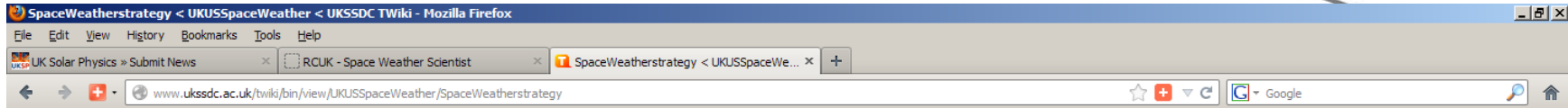
*Investment*: Strategic investment both to win support and to be efficient

*Web*: to maintain, evolve the strategy, and associated resources

From UK-US workshops, updated after review

Governance is key

# Where is it?



## UK Space Weather strategy - linking research to operations



This strategy aims to provide a cross-organisational framework to support space weather research and operations in the UK - in particular better linking research to operational activities and through to stakeholder requirements. It has developed from community-led activities involving both NERC and STFC and integrates research and operations. It is intended that this will feed into on-going NERC and STFC processes.

In particular, the Strategy builds on a series of discussions involving many UK experts:

- A UK-US space weather [ResearchWorkshop](#) in Boulder, Colorado, on 11-13 October 2011;
- [STFC Environment Futures workshop](#) at the Open University, 26-27 October 2011, included space weather as one of six potential themes for joint work by NERC and STFC communities;
- NERC-STFC Space Weather Meeting, 23 January 2012, Natural History Museum, London;

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

Or

<http://tinyurl.com/coxc4le>

- [Uk\\_space\\_weather\\_strategy\\_v64\\_clean.pdf](#): UK space weather strategy, draft 8 (PDF)

The [ExecutiveSummary](#) is also available as a separate page.

# **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](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](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