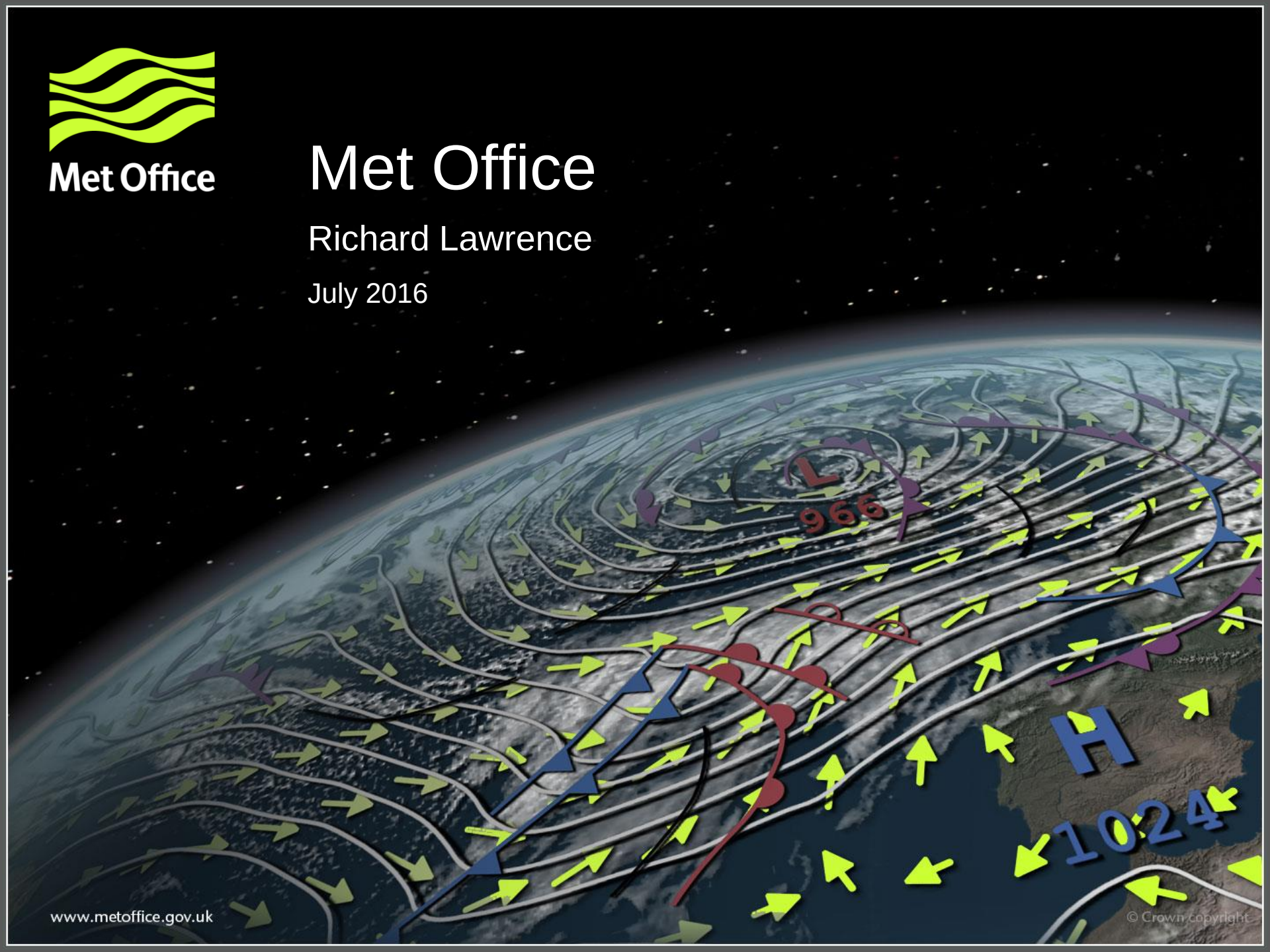
Met Office

Richard Lawrence

July 2016



Our Aim

To be the global partner of choice for weather and climate services

Our Purpose

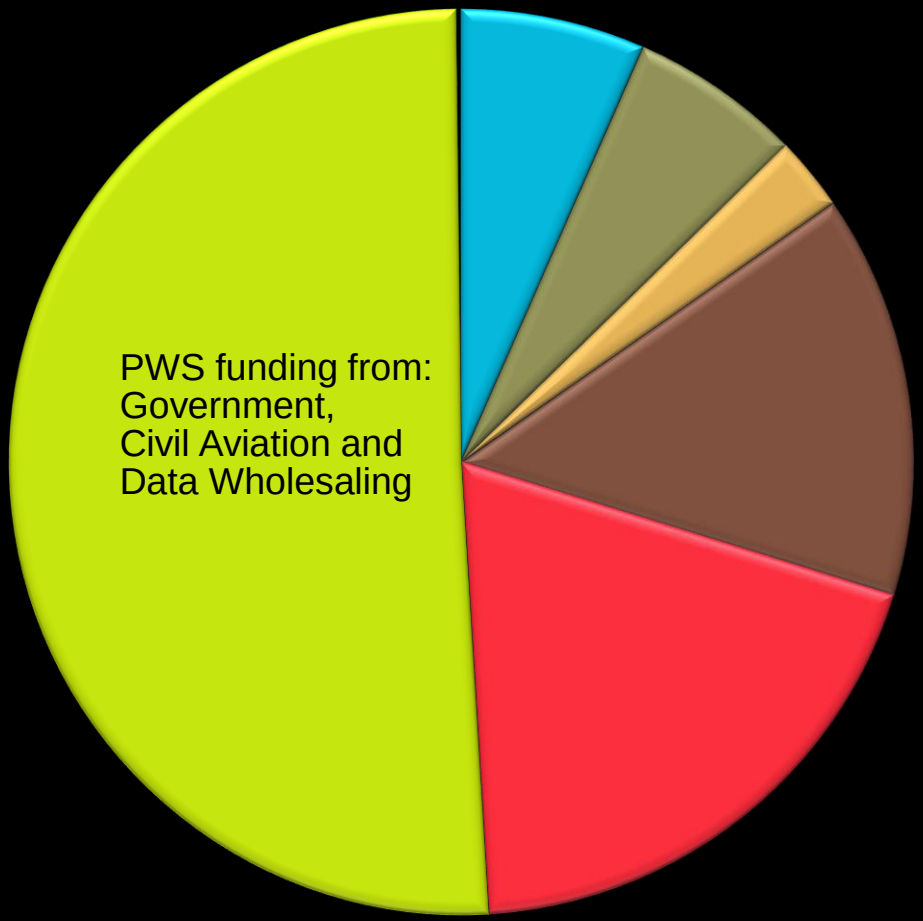
Working at the forefront of weather and climate science for protection, prosperity and wellbeing

www.metoffice.gov.uk

Basic facts

Turnover	~£228m (approx 15% Commercial)
People	~2100 Staff ~1500 at Exeter HQ
Locations	~50 manned locations ~Many more unmanned observing sites ~inc 4 permanent, plus Mobile Met Unit overseas sites
Working areas	35% Forecasting & Observations 29% Science & Research 16% Technology (IT) 13% Commercial and Government Business 7% Corporate Services

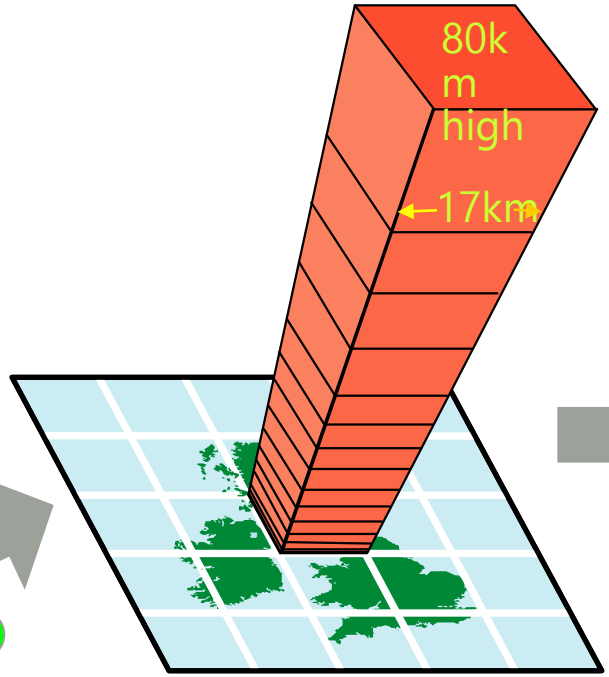
Funding



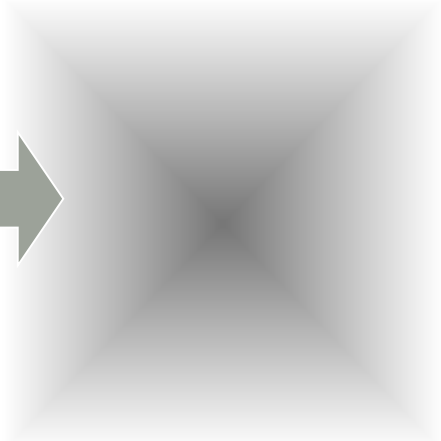
- Aviation
- Commercial Business
- Digital and Global Media
- Defence
- Government Services
- Public Weather Service
- Observing

Forecasting the weather

Observations



Forecast Model



Risk Analysis &
Communication

$$\frac{du}{dt} = \frac{\partial p}{\partial x} - fv$$

$$\frac{dv}{dt} = \frac{\partial p}{\partial y} + fu$$

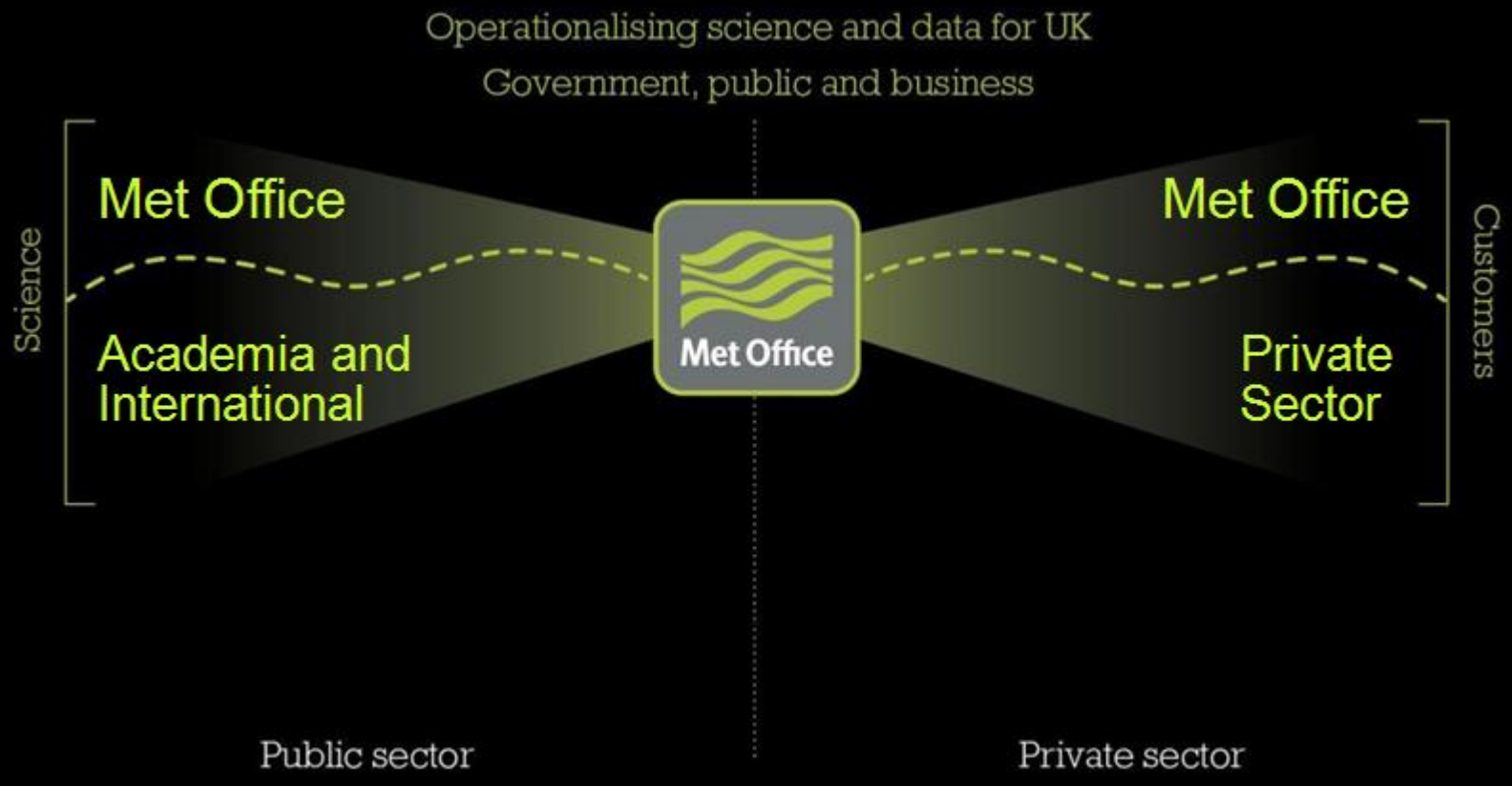
$$\frac{p}{\rho} = RT$$

Knowledge

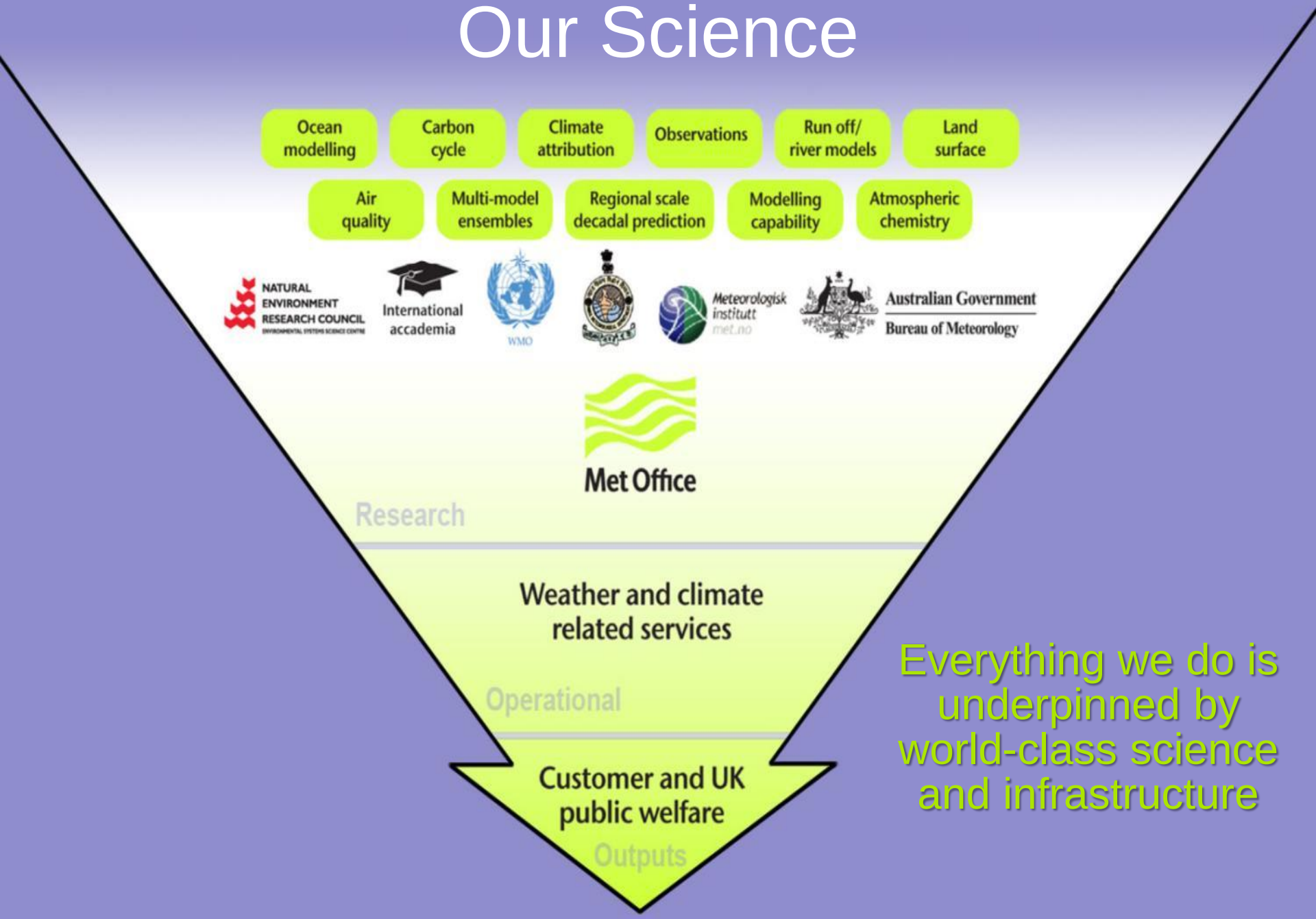
Met Office

www.metoffice.gov.uk

The way we work



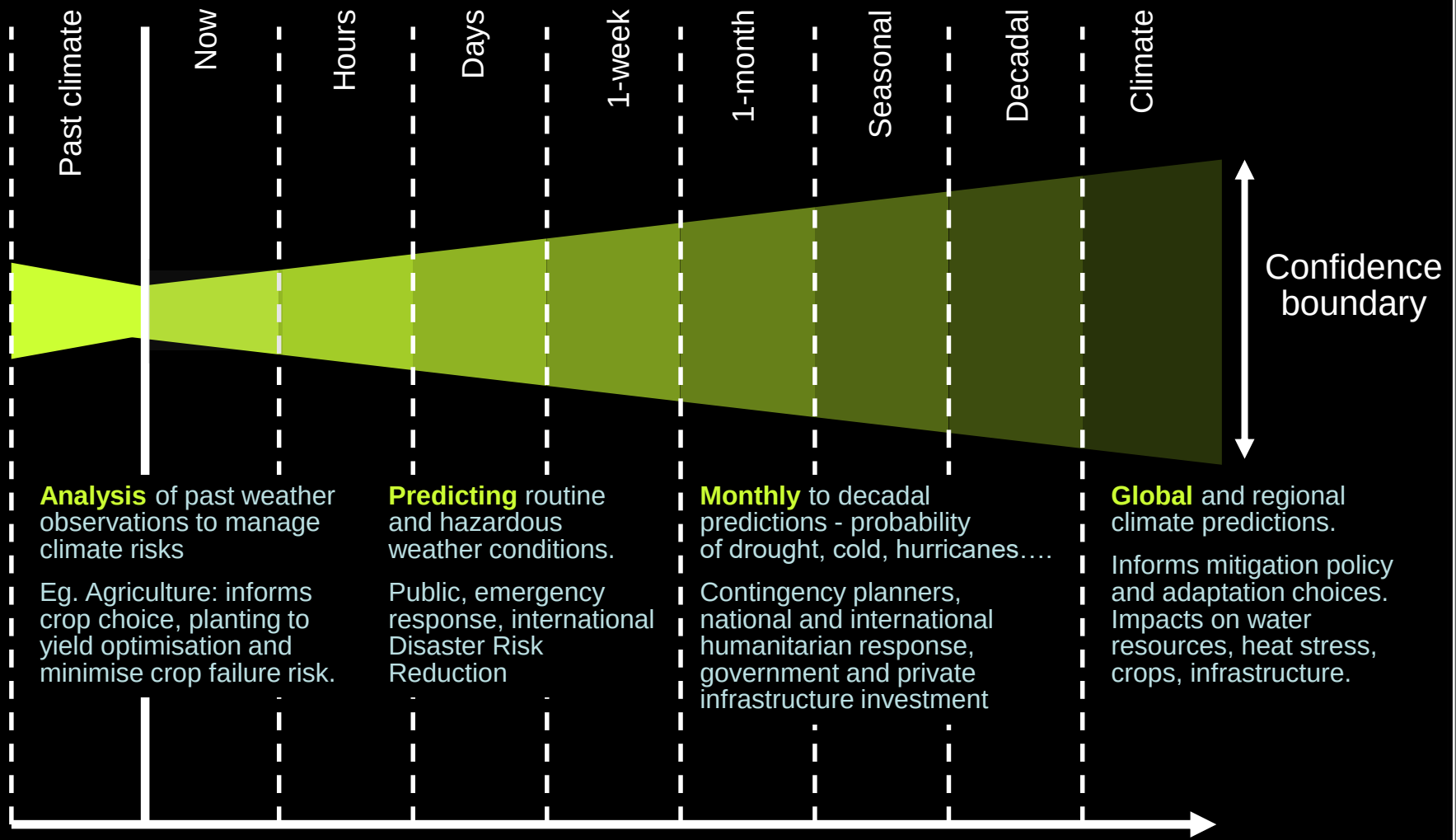
Our Science



Everything we do is underpinned by world-class science and infrastructure

Seamless Prediction

Essential support to decision making on all timescales



Analysis of past weather observations to manage climate risks

Eg. Agriculture: informs crop choice, planting to yield optimisation and minimise crop failure risk.

Predicting routine and hazardous weather conditions.

Public, emergency response, international Disaster Risk Reduction

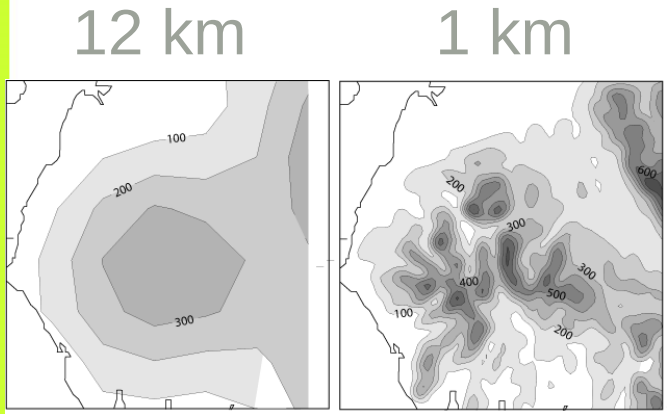
Monthly to decadal predictions - probability of drought, cold, hurricanes….

Contingency planners, national and international humanitarian response, government and private infrastructure investment

Global and regional climate predictions.

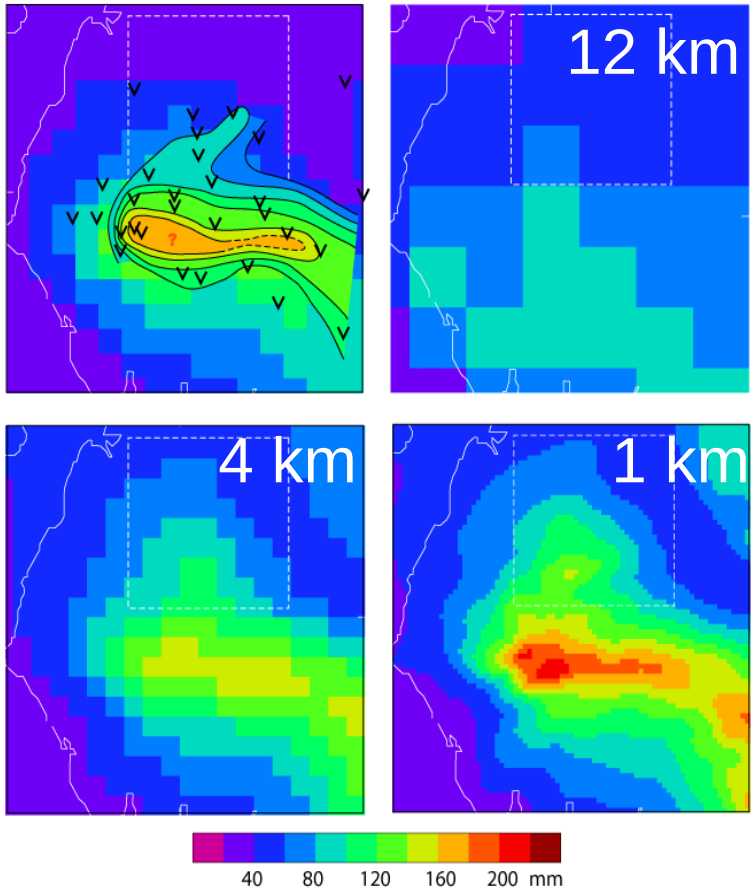
Informs mitigation policy and adaptation choices. Impacts on water resources, heat stress, crops, infrastructure.

Focussing in on the UK

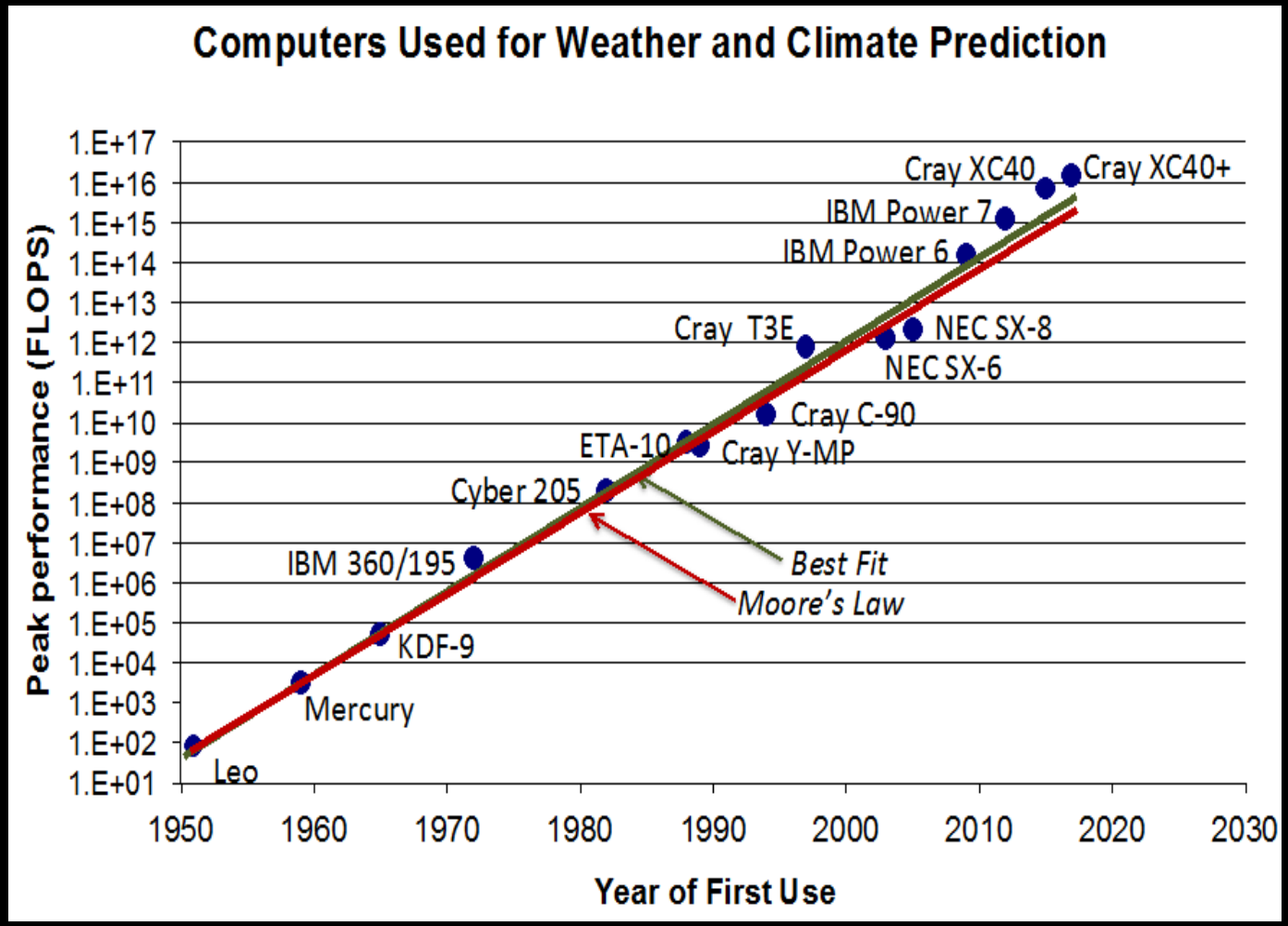


Model Orography

Carlisle Flood 2005:
Observed and forecast rainfall

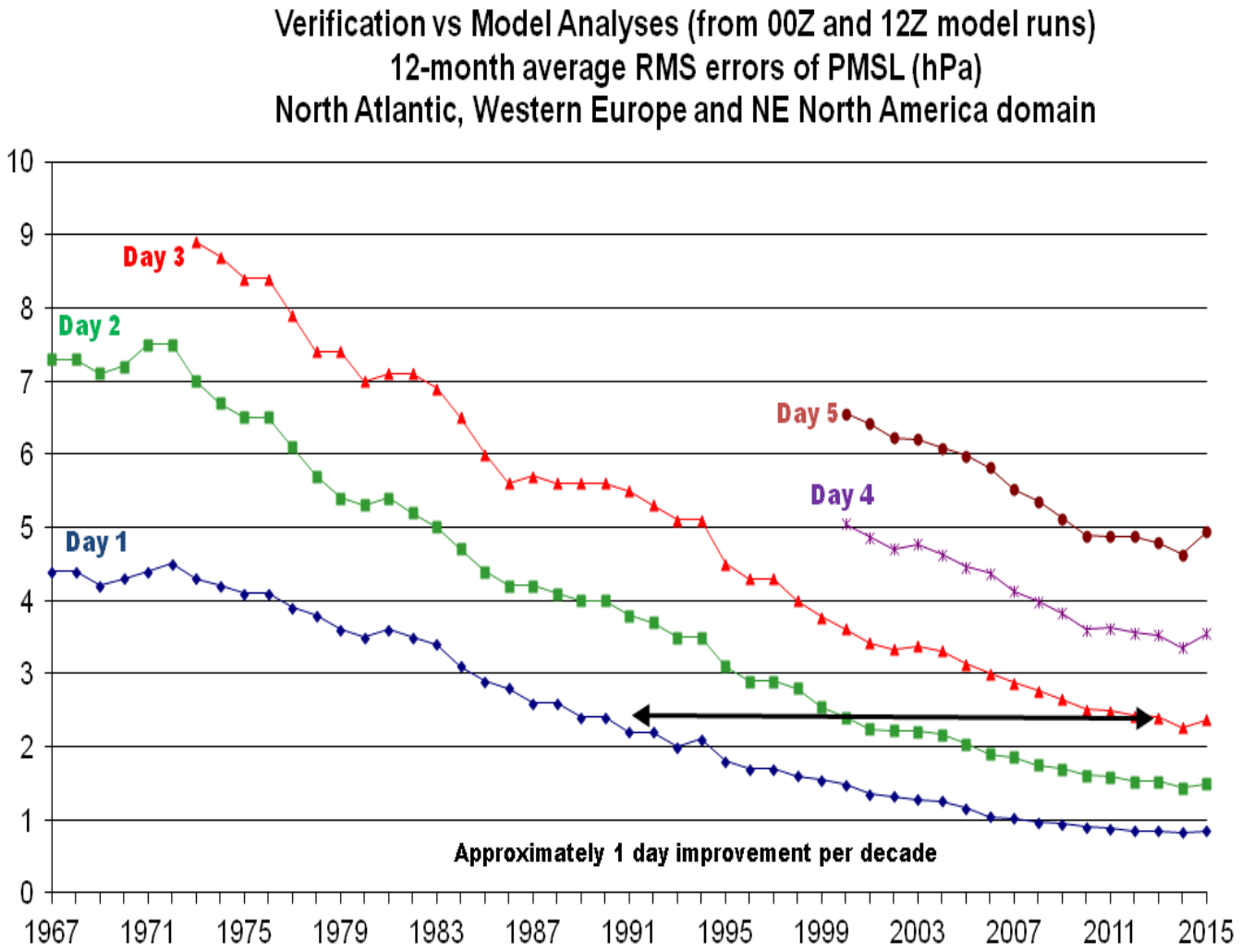


Computers used for weather & climate prediction

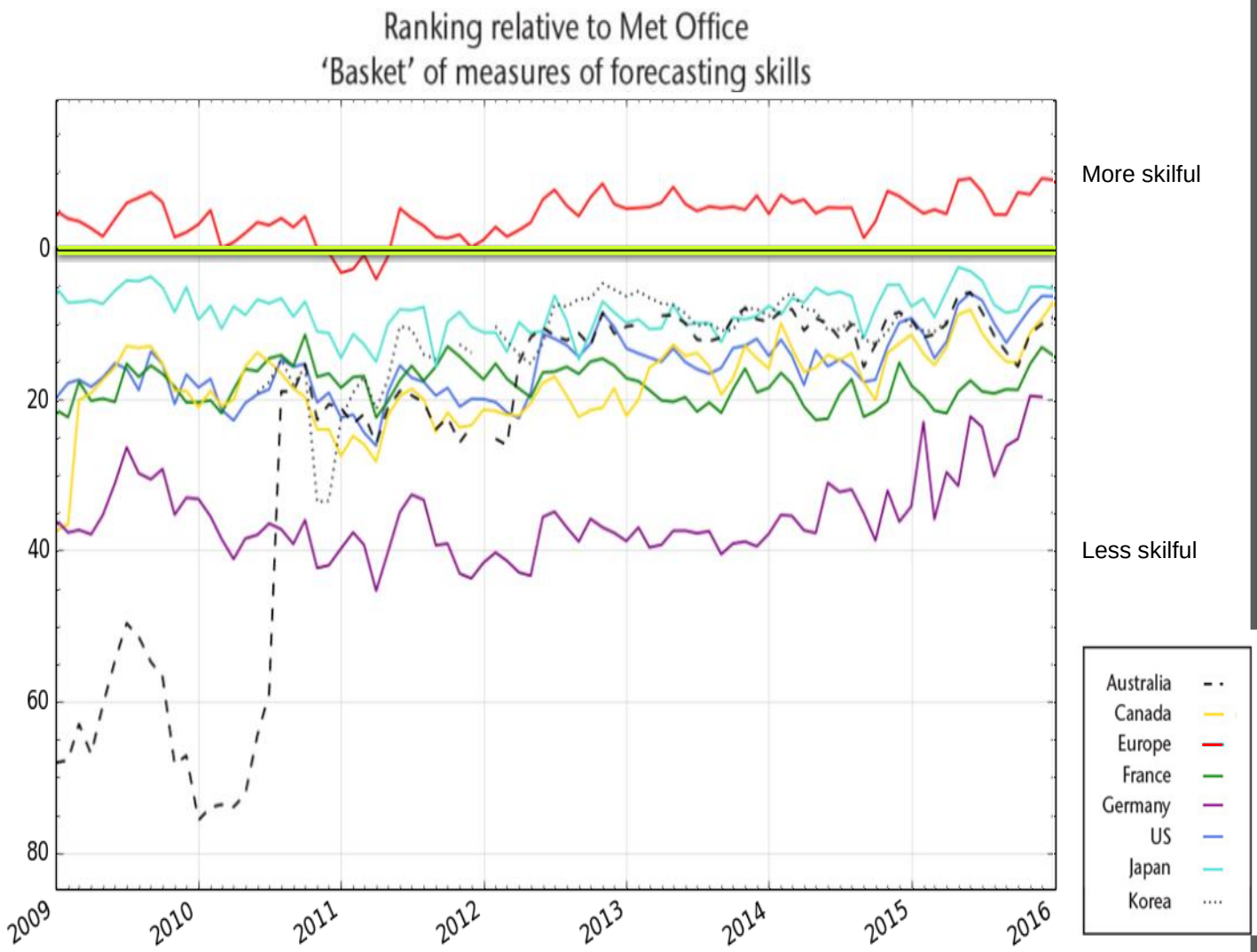


Super computer

Providing Accurate Forecasts



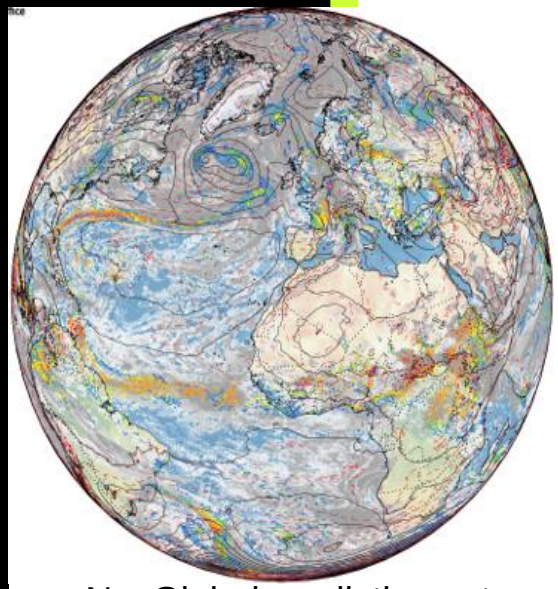
World-leading forecast accuracy



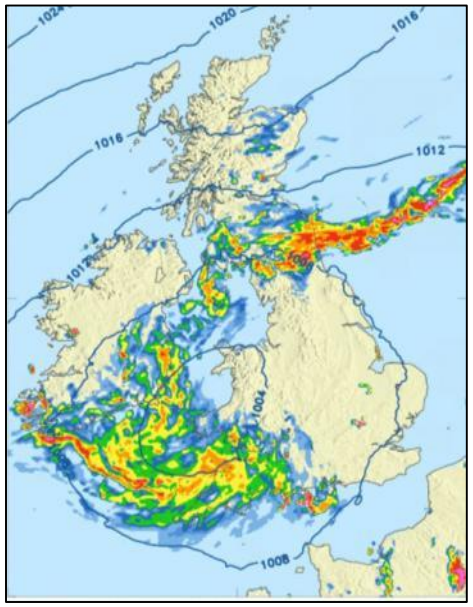
Northern Hemisphere NWP Index (v analysis)
basket % difference relative to Met Office

Full Implementation of Seamless Prediction

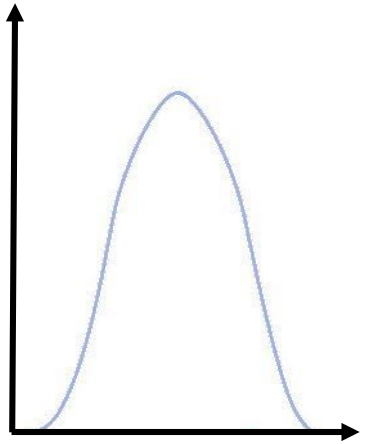
From Global to Local and from Weather to Climate



N x Global predictions at ~10km with lead times of days to years:
Synoptic drivers



<N x Regional predictions at ~1km:
Local meteorology



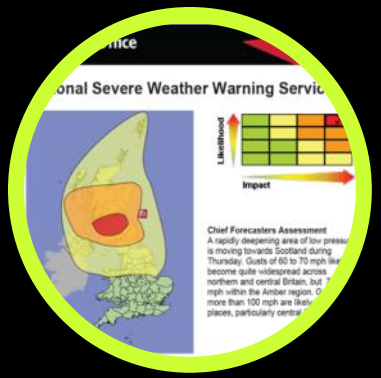
Probability of local hazard:
Impacts

Challenges

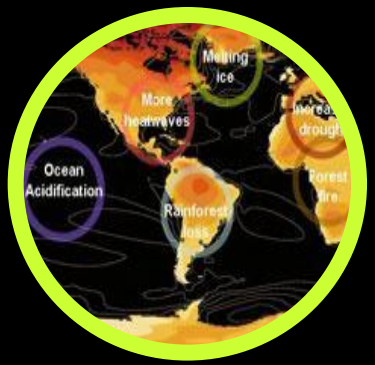
Technology

- HPC Benefits realisation
- Big Data and Decoupler
- Open Data and APIs
- Collaboration
- The Road to Exascale

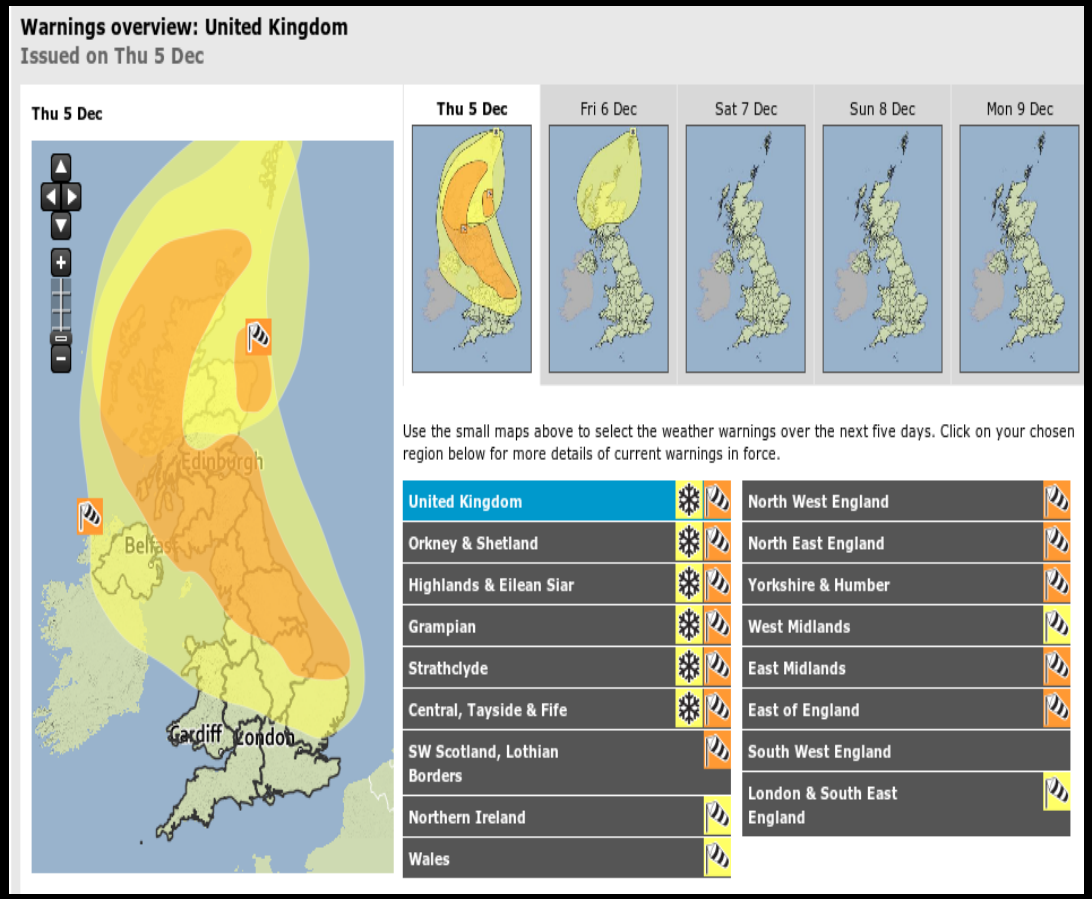
Met Office Public Services

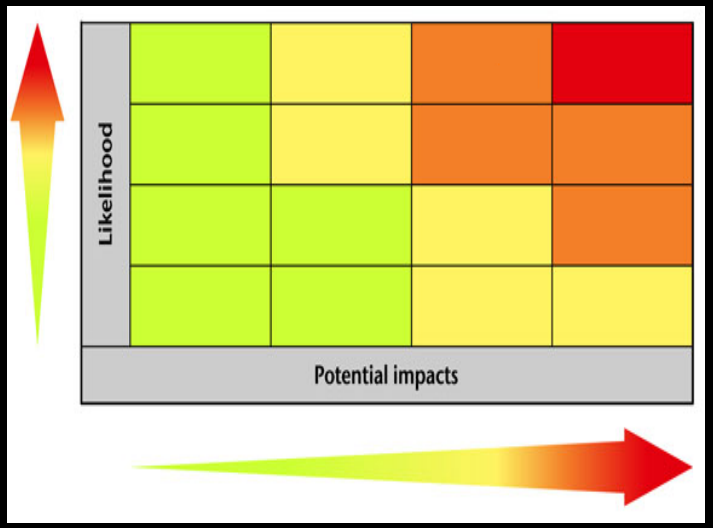


We provide services for…



National Severe Weather Warning Service





Flood Forecasting Centre

Met Office

FLOODFORECASTINGCENTRE

a working partnership between Environment Agency | Met Office

Flood Guidance Statement 10:30hrs Sunday 09 February 2014

Our assessment of daily flood risk for England and Wales, working with flood forecasting teams in the Environment Agency and Natural Resources Wales, is below.

10:30 - 23:59hrs Sunday 09 February 2014 | Monday 10 February 2014 | Tuesday 11 February 2014 | Wednesday 12 February 2014 | Thursday 13 February 2014

HIGH flood risk on the Somerset Levels today and tomorrow. MEDIUM flood risk from ongoing river and groundwater flooding across much of southern England throughout the five day period.

General overview of flood risk

Ongoing disruption from river and groundwater flooding continues in many parts of southern and central England. Further rainfall is expected here on Tuesday and late Wednesday into Thursday and this is expected to cause further disruption from river and surface water flooding. The overall flood risks are as follows (see Areas of Concern Map for detail):

- HIGH river flood risk on the Somerset Levels today and tomorrow, with a MEDIUM flood risk from Tuesday onwards.
- MEDIUM flood risk from river flooding on the Thames for the next five days.
- MEDIUM flood risk from groundwater flooding in the Croydon area of Greater London for the next five days.
- MEDIUM flood risk from ongoing groundwater flooding in Hambledon, Hampshire for the next five days.
- MEDIUM flood risk from groundwater flooding in Nailbourne in Kent for the next five days.
- LOW flood risk from ongoing groundwater flooding in south Wiltshire and parts of Dorset and much of south-east England for the next five days.
- LOW flood risk from river flooding in parts of south-west England and South Wales today in response to rainfall last night and this morning.
- LOW flood risk from river flooding in Wrexham and Cheshire on the Dee for today, Monday and Tuesday.
- LOW flood risk from additional river and surface water flooding in south Wales and south-west England on Tuesday, Wednesday and Thursday.


Met Office | SEPA Scottish Environment Protection Agency | Scottish Flood Forecasting Service

Working in partnership

Flood Guidance Statement 10:30hrs 09 March 2011

Our assessment for daily flood risk in Scotland is below. This statement is valid at the time of issue.

10:30 - 23:59hrs Wednesday 09 March 2011 | 00:00 - 23:59hrs Thursday 10 March 2011 | 00:00 - 23:59hrs Friday 11 March 2011 | 00:00 - 23:59hrs Saturday 12 March 2011 | 00:00 - 23:59hrs Sunday 13 March 2011

General Overview of Flood Risk

The general assessment for flooding for the coming five days is for very low flood risk.

Although a spell of heavy rain is expected in western areas overnight, rainfall totals are not expected to result in flooding and precipitation will fall as snow at higher altitudes.

Coastal flood risk remains very low.

Weather Situation

Showers will be heavy and wintry this morning, especially in the north and west. Showers easing this afternoon then a spell of rain spreading northeast this evening, preceded by snow on high ground, and to lower levels in the far north. The rain will clear to blustery showers tonight, heaviest in the West Highlands with lying snow at lower levels melting, though remaining on the hills.

Showers will turn wintry to lower levels again on Thursday and Friday. Further rain and hill snow over the weekend.

Warnings and Alerts in force in Scotland at 10:38hrs

Flood [click here]
0 Severe Flood Warnings / 0 Flood Warnings / 0 Flood Alerts

Severe Weather [click here]
Warning - No / Alert - No

River Flood Risk

A spell of unsettled weather that is expected this evening and overnight is expected to have most significance in Argyll & Bute, and Skye and Lochalsh. Rainfall totals are expected to reach an average of 15mm, with higher isolated totals in south facing exposed areas.

However, with river levels generally low and much of the precipitation falling as snow above 600m overnight the flooding from rivers remains very low.

Coastal / Tidal Flood Risk

Strong winds are expected over the next two days which will result in large offshore waves. However, as peak tidal levels are not particularly high and tidal flood risk also remains very low at this time.

Next Statement Due: 10:30hrs Thursday 10 March 2011

For Further Details: SEPA Communications Centre - 01738 445414

FLOODFORECASTINGCENTRE

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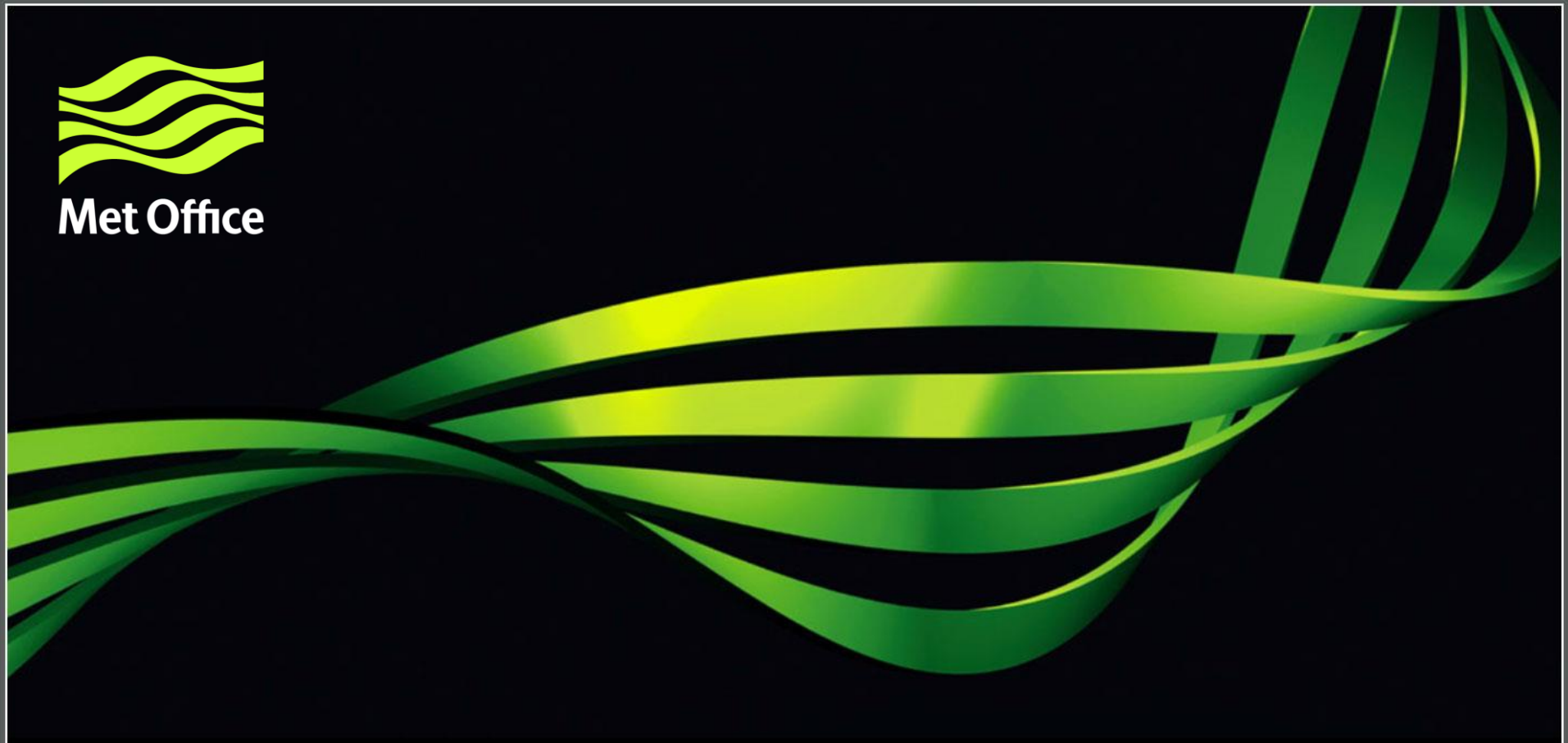
Space Weather



Cyber security

Australian Bureau

Bureau of Meteorology target of 2015 cyber attack, Prime Minister Malcolm Turnbull confirms

What are we worried about?

Harm Reputation	Disrupt Operations	Financial Gain	Espionage
• Deface • Disclose • Embarrass • Expose	• DDOS • Disclose	• Disclose • Subvert • Extort	• Disclose • Damage • DDOS • Exfiltrate • Subvert

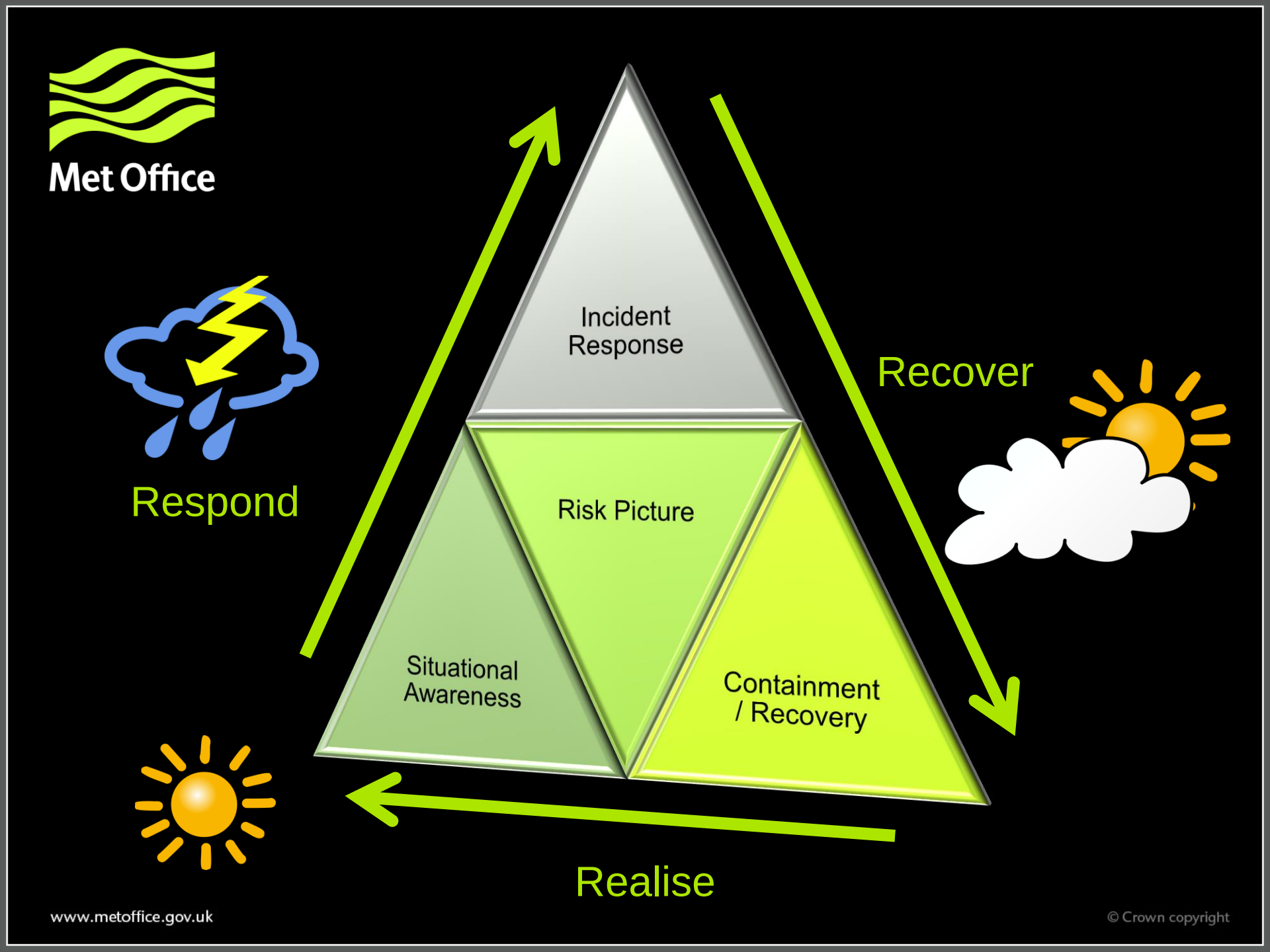
What are we worried about?

But the primary objective is to

PROTECT OUR ABILITY TO EXPLOIT information!

What's our exposure?

Large	# collaborators	Gov, Foreign, Academia, Public
Complex	architecture	HPC, Observations, Organic, X boundary
Critical	services	Defence, Aviation etc


Met Office
Respond
Incident Response
Risk Picture
Situational Awareness
Containment / Recovery
Recover
Realise
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CSOC CAPABILITIES

- Technology
- Processes
- People

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Trust zones

Met Office

As-Is

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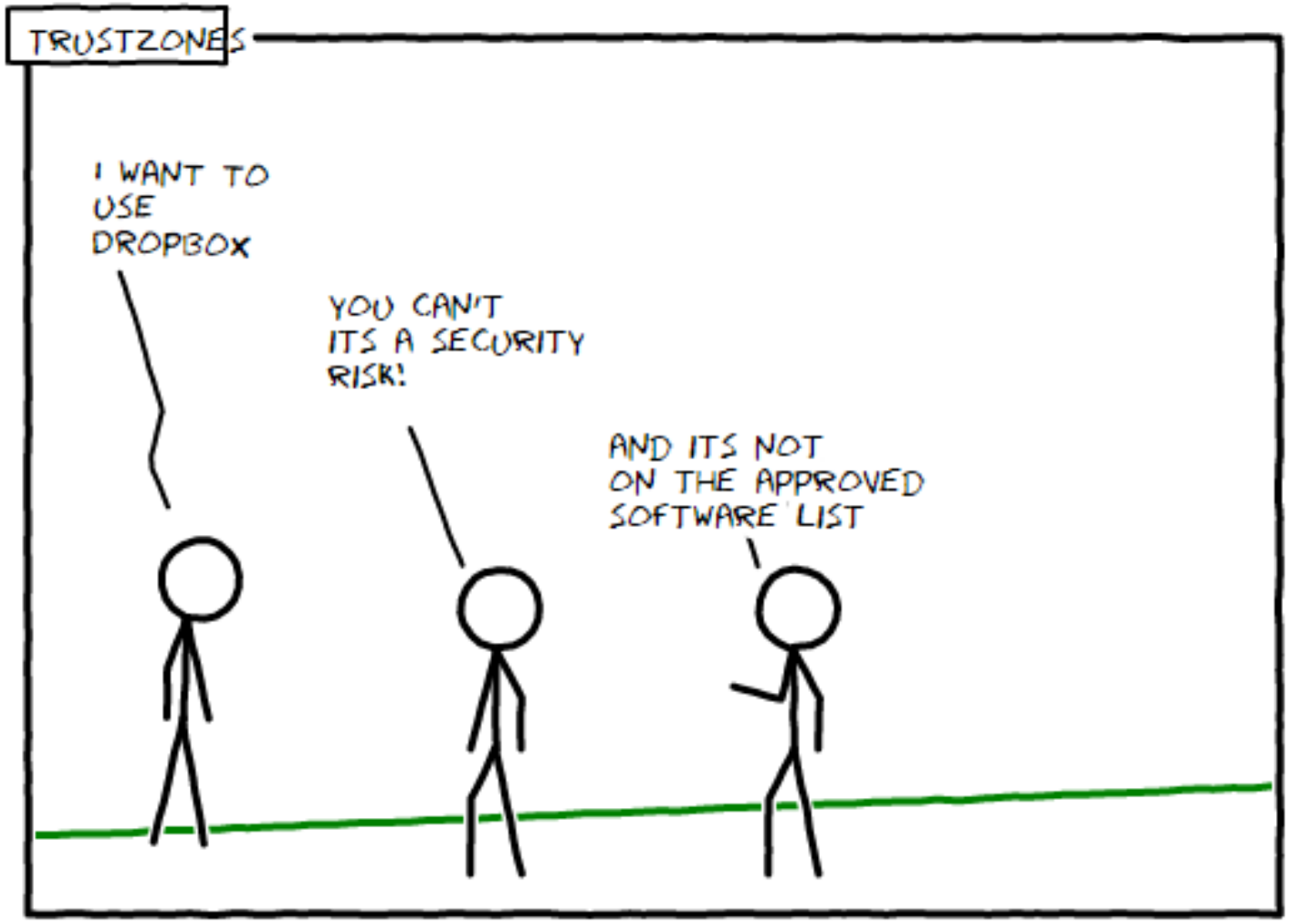
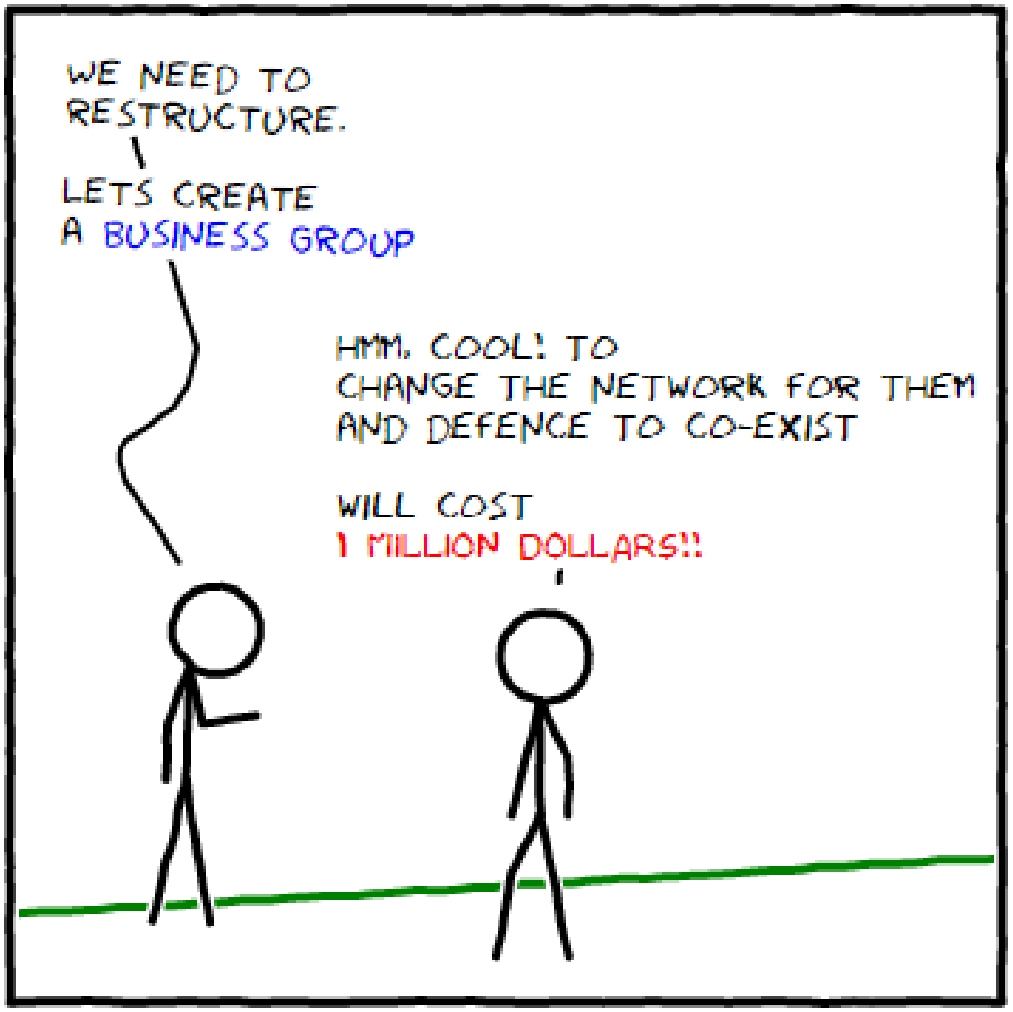


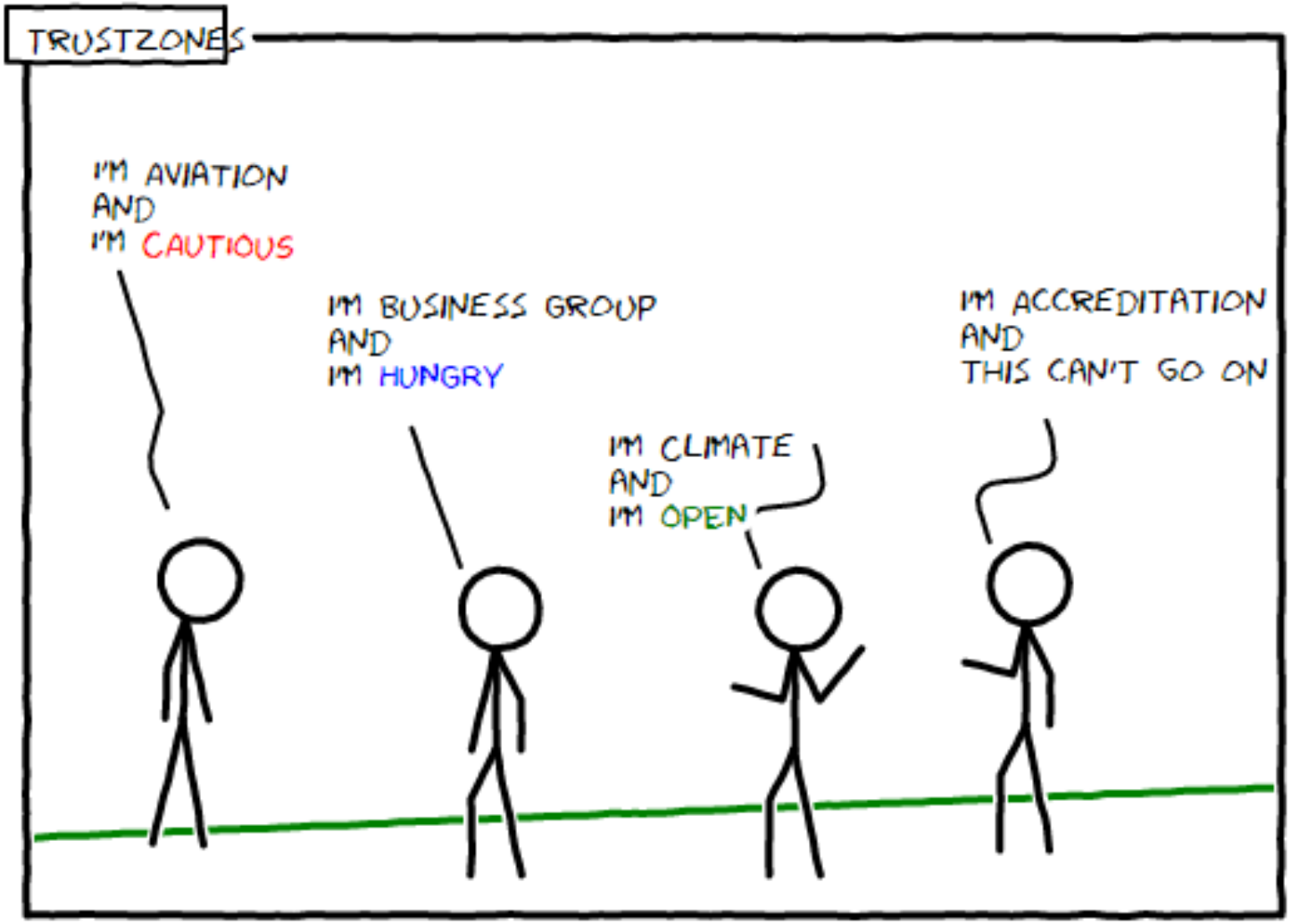
In-flexible

Met Office



High cost of change

Met Office



Mixing of risk appetites

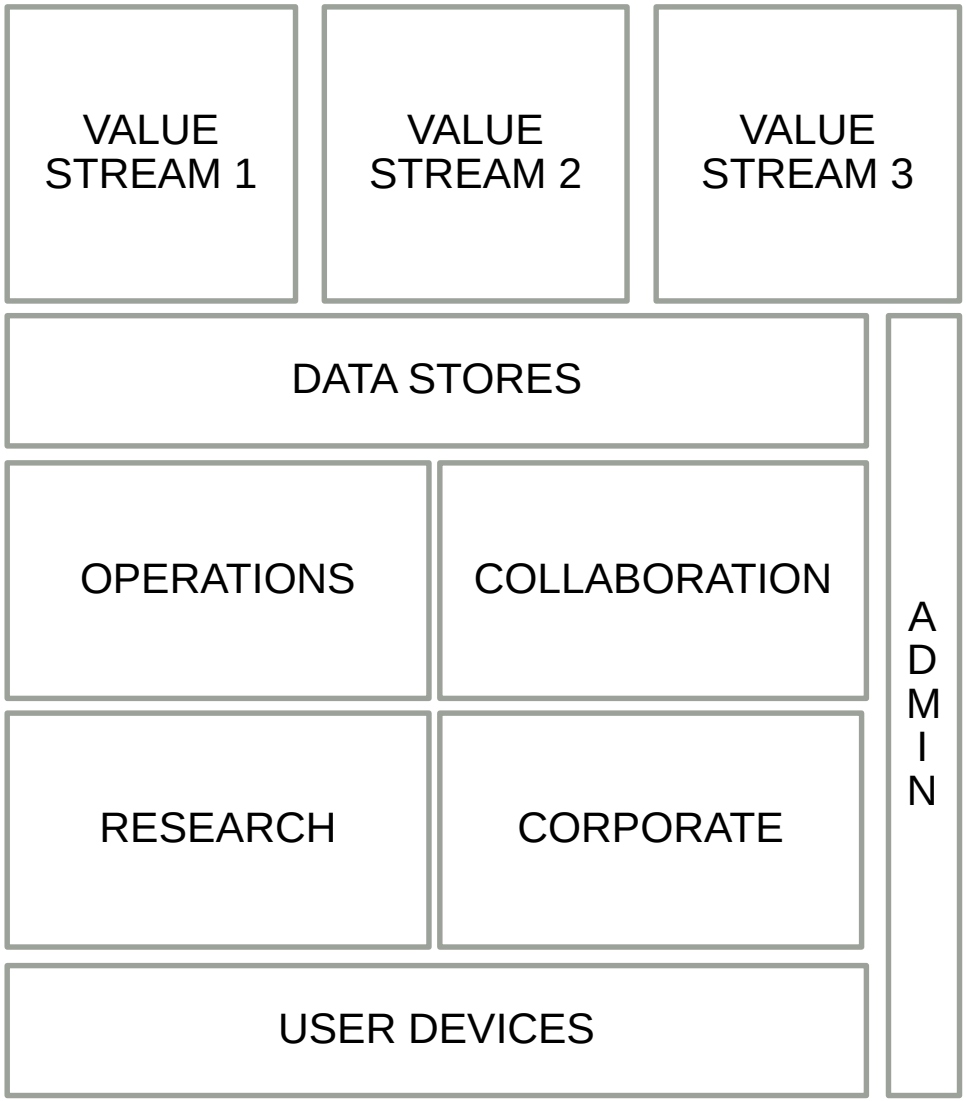
Everything is all mixed into together

Workloads

Met Office

To-Be

www.metoffice.gov.uk



Segregation

Separation of workloads

Questions