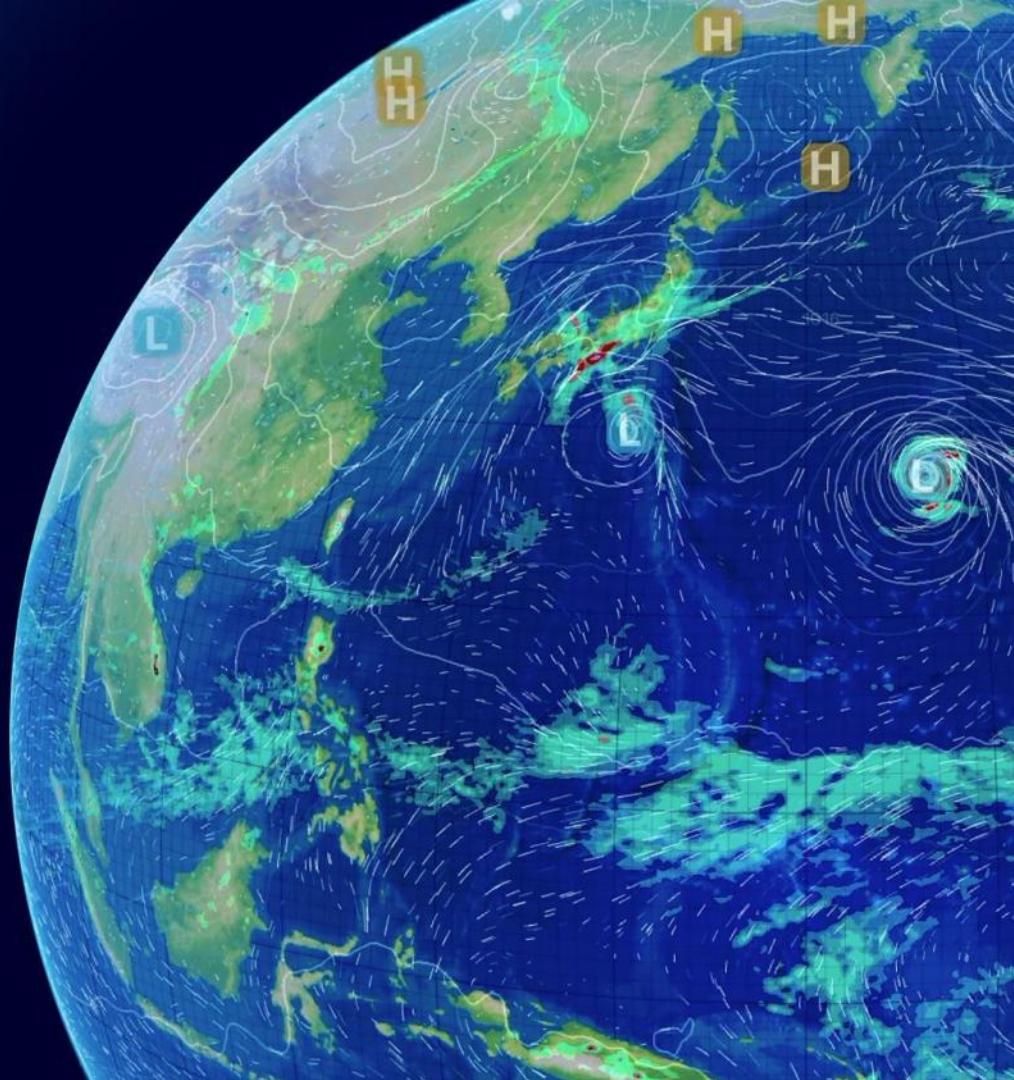
Met Office

ITU/WMO Use of Radio Spectrum for Meteorology:
Weather, Water and Climate Monitoring and Prediction

From radio spectrum to socio-economic benefits



Phil Evans – Met Office Chief Operating Officer

23 October 2017

Met Office

Our Purpose

‘Working at the forefront of weather and climate science for protection, prosperity and well-being’

Path to Social Economic Benefit

Enabling **protection** of lives, infrastructure and the natural world;

Improving **well-being** now and in the future; and

Increasing **prosperity,** enabling UK economic growth and international competitiveness

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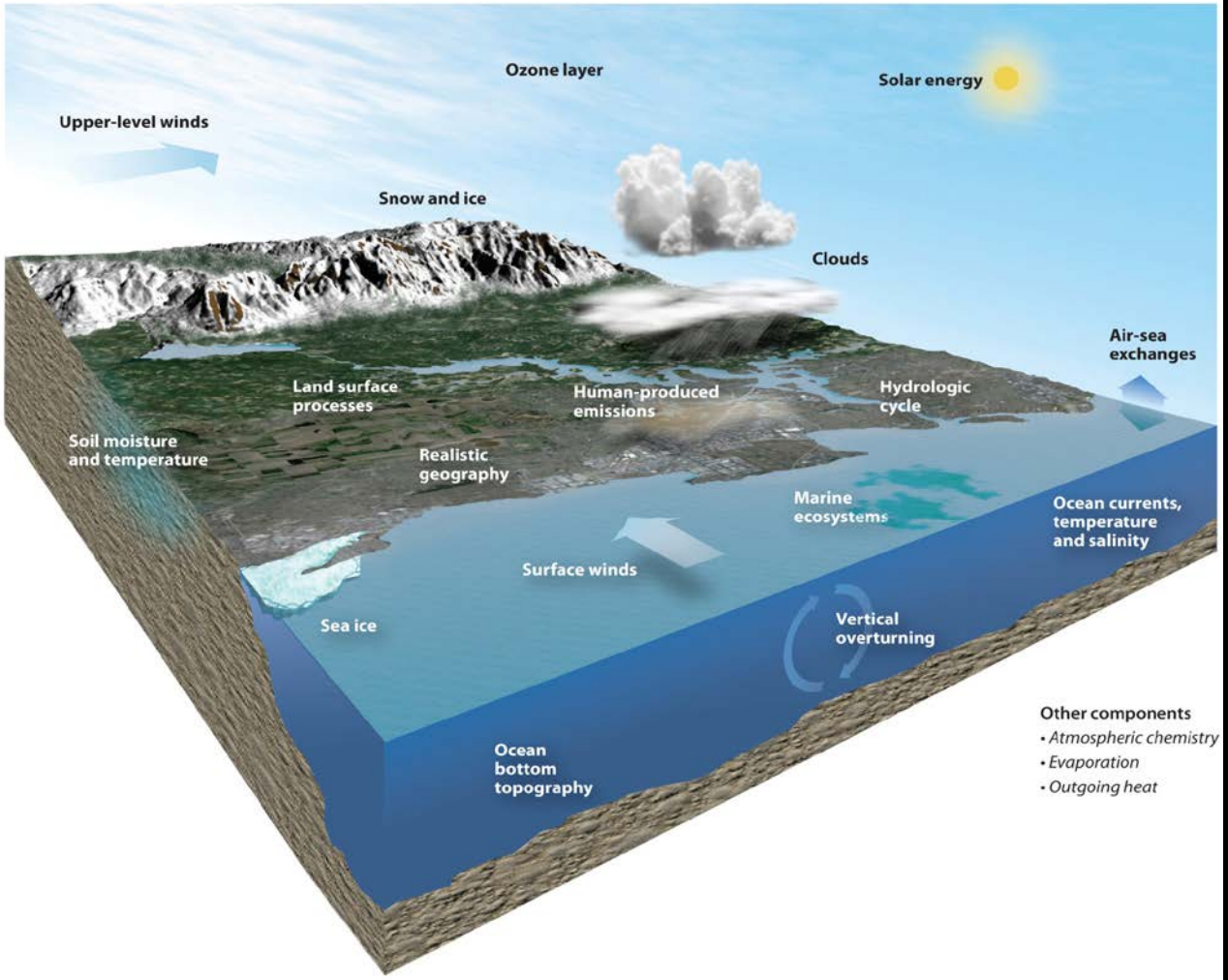
“… behind every weather, water and climate condition forecast, every disaster mitigated, and every prediction debated, are the observational data”

(WMO RA-V, 15th Session, May 2010, General summary)



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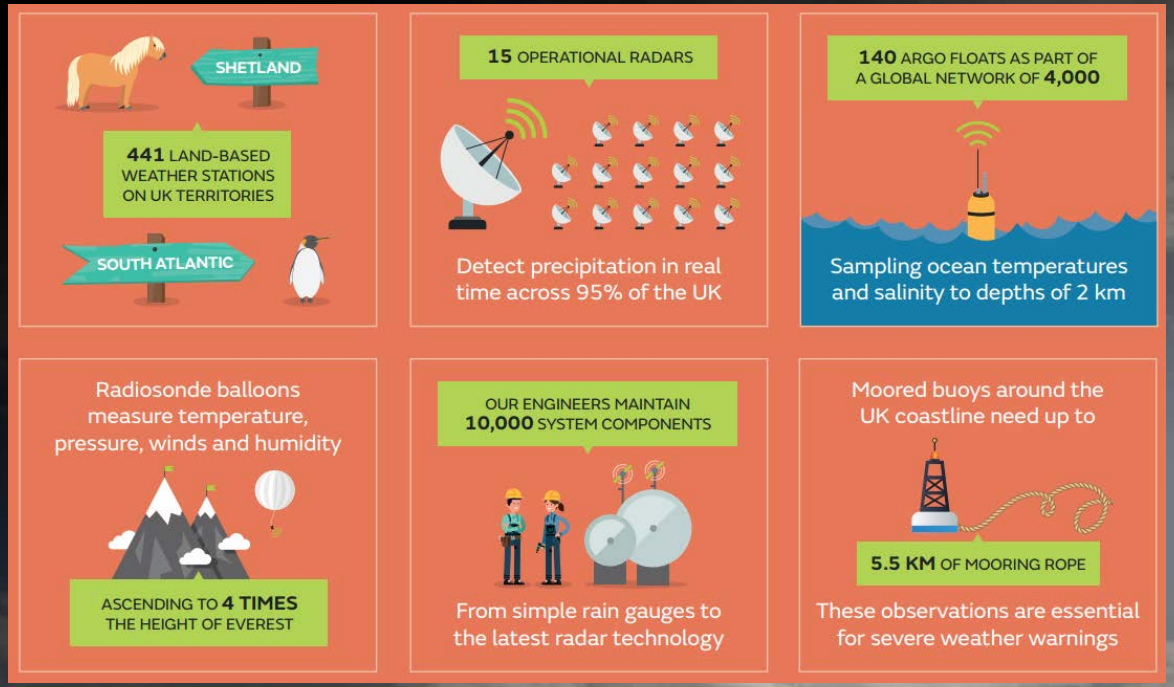
Observations and Spectrum



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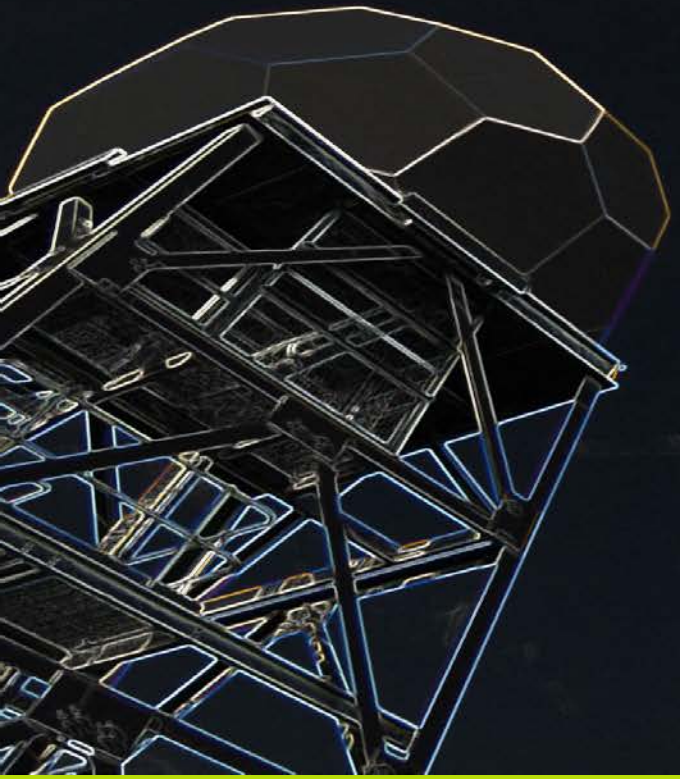
Observations and Spectrum



10 LIGHTNING ANTENNAS DETECT **78 MILLION** STRIKES

Across Europe each year

OUR CLIMATE DATABASE RECEIVES **6** MILLION OBSERVATIONS EVERY YEAR

100% ARE QUALITY CHECKED
25% WITHIN 24 HOURS

New Mode-S network

RECEIVES **5 MILLION** WIND AND TEMPERATURE MEASUREMENTS EVERY DAY

From sensors on civil aircraft

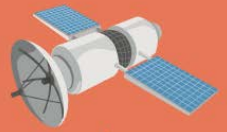
The Weather Observations Website

RECEIVED **800 MILLION** CITIZEN OBSERVATIONS IN ITS FIRST 5 YEARS

Our Lidar Network (light detection & ranging systems)

DETECTS CLOUDS AND VOLCANIC ASH UP TO **15KM** ABOVE THE GROUND

To support flight safety



4.8 MILLION OBSERVATIONS FROM **42** SATELLITE INSTRUMENTS ORBITING THE EARTH

Feed into our global weather forecast every 6 hours

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Spectrum Management

Spectrum Access

- World Radio Conference
- OFCOM
- Spectrum Strategy Committee
- CEPT (Europe)
- ITU

Spectrum Access

- Planning issues
- Obstructions e.g. buildings and windfarms
- Trees
- Beam blockage & obstructions
- Responsibilities as a statutory consultee

Compliance and Frequency Management

- Interference
- Out of bound emissions/reception monitoring

Strategic ⟷ **Tactical**

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Big Data, Big Science, Big Operations

'Each day the Met Office processes and stores 106 million observations, completes 20 quadrillion (10^{15}) calculations, archives 10 Tera-(10^{12}) bytes of model data and produces over 4 million forecasts'

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Improving forecast accuracy

SCIENCE

SUPERCOMPUTING

OBSERVATIONS

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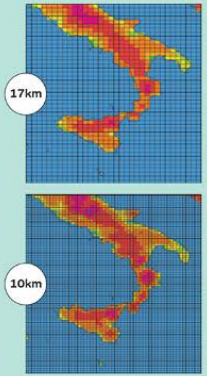
High Performance Computing

GLOBAL NUMERICAL WEATHER PREDICTION MODEL

Provides medium-range UK forecasts and short-range weather forecasts for all around the world.

INCREASED HORIZONTAL RESOLUTION

From ~17km to ~10km in mid-latitudes



- ✔ Improves model outputs
- ✔ Improves medium and short term forecast accuracy
  - particularly near the surface
  - during snow-melt
- ✔ Better representation of coastlines & topography
- ✔ Enhanced representation of tropical cyclones

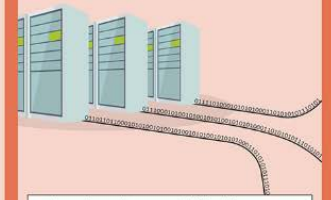
UK HIGH RESOLUTION MODEL

Provides detailed accurate weather information to the UK

INTRODUCTION OF HOURLY 12 HOUR FORECASTS

- ✔ Improves very short-period forecasts

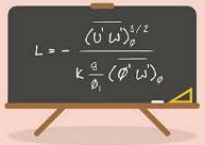
CHANGE FROM 3 TO 4 DIMENSIONAL ANALYSIS SYSTEM (4D-VAR)



- ✔ Uses observations more intelligently to produce more accurate forecasts

ENHANCED PHYSICS

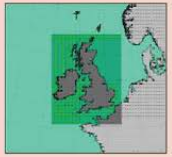
Provides detailed accurate weather information to the UK



- ✔ Improves forecasting of cloud and precipitation
- ✔ Helps with more accurate rainfall information, in support of flood forecasting

HIGHER RESOLUTION LATERAL BOUNDARIES

Now at global 10km resolution



- ✔ Gives us better information about weather coming in to the UK model

MET OFFICE GLOBAL AND REGIONAL ENSEMBLE PREDICTION SYSTEM (MOGREPS-G)

Allows users to estimate the risk of high impact weather events

GREATER NUMBER OF ENSEMBLE MEMBERS

Increased from 12 members to 18 every 6 hours, making a 36 member ensemble when time lagged with previous runs

- ✔ Makes our 48 hour forecast as good as our 36 hour forecast was previously
- ✔ Enables us to provide better guidance for probability of higher impact weather events

INCREASED HORIZONTAL RESOLUTION

From ~33km to ~20km in mid-latitudes

- ✔ Improvement in forecast accuracy of near surface variables

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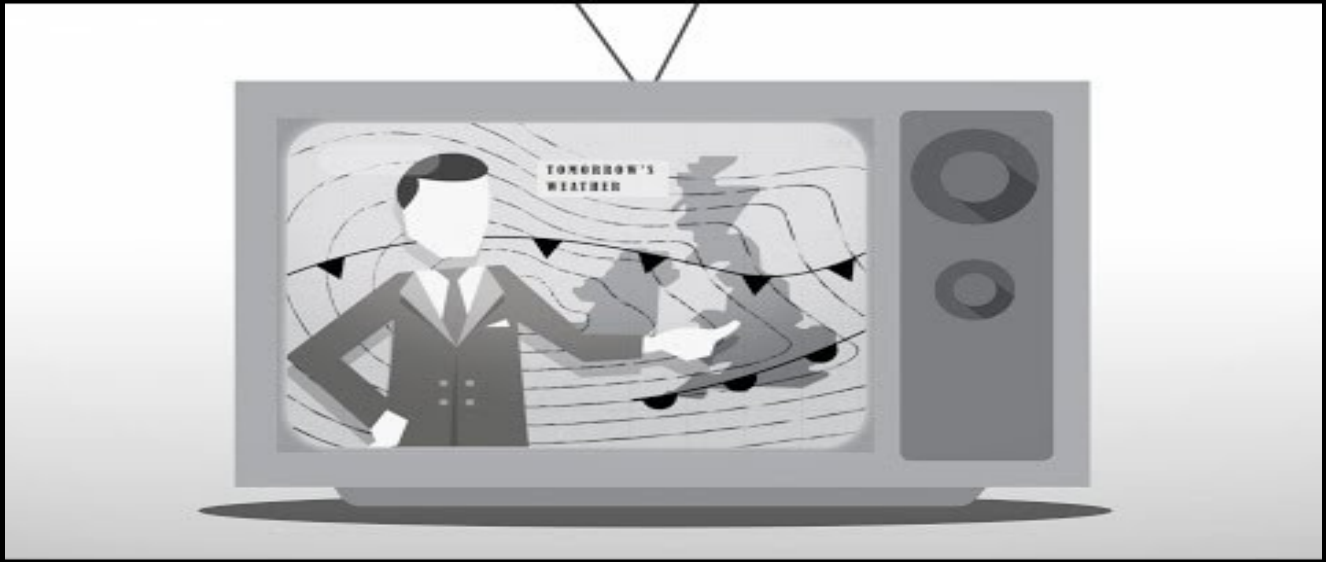
Met Office Big Data Challenge



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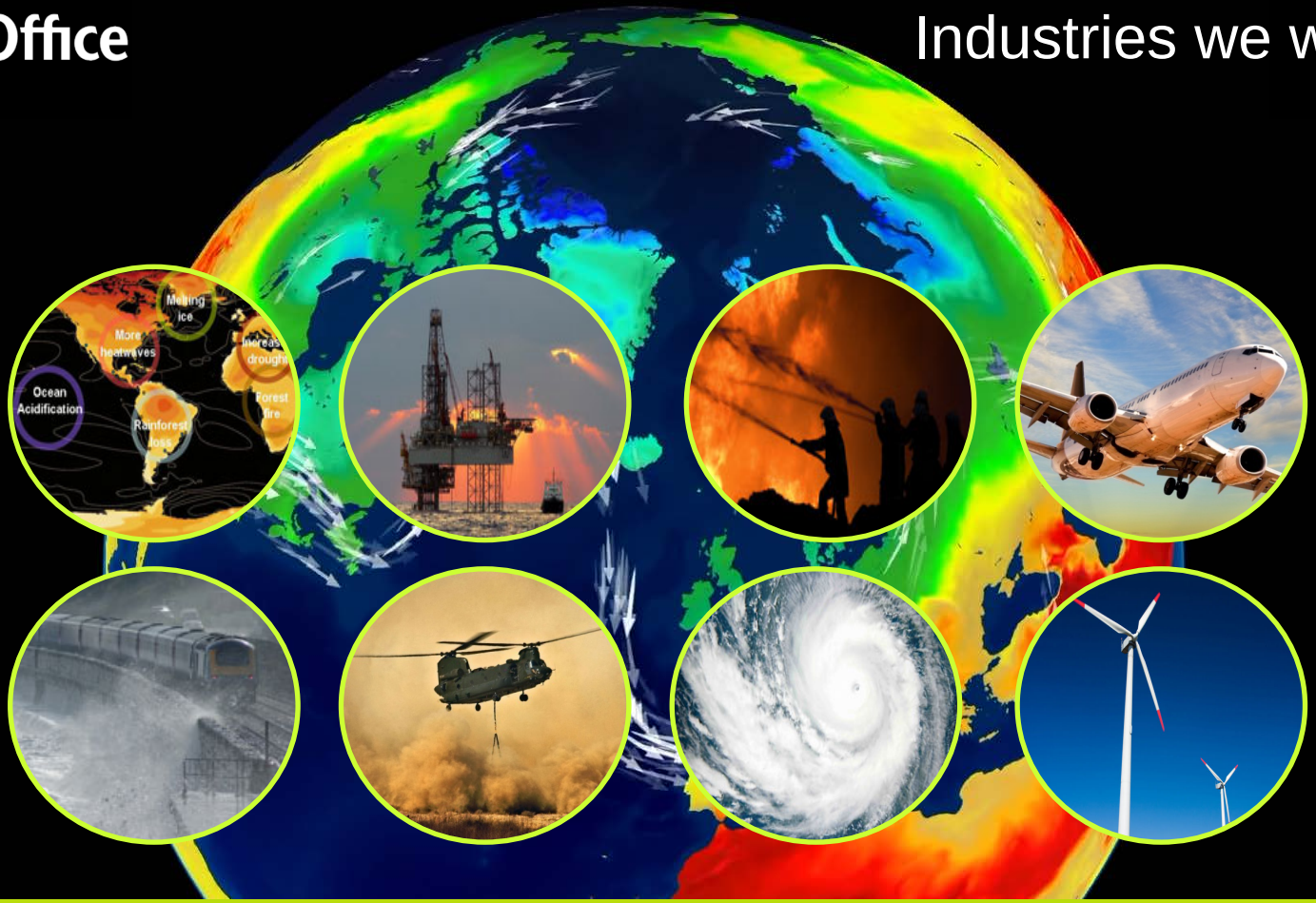
Industries we work with



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Building on success

Met Office = £30 billion in value to the UK over ten years*

20% loss of “quality” ~ 20% loss of benefit

That’s a benefit to cost ratio of 14:1

Security and warnings ~ 10%

*In 2015 a General Review conducted by Met Office and the Department for Business, Innovation and Skills (now Department for Business, Energy and Industrial Strategy) calculated the value of the Met Office's work for UK companies at £30bn over 10 years to 2025.

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SUSTAINABLE DEVELOPMENT GOALS/WMO

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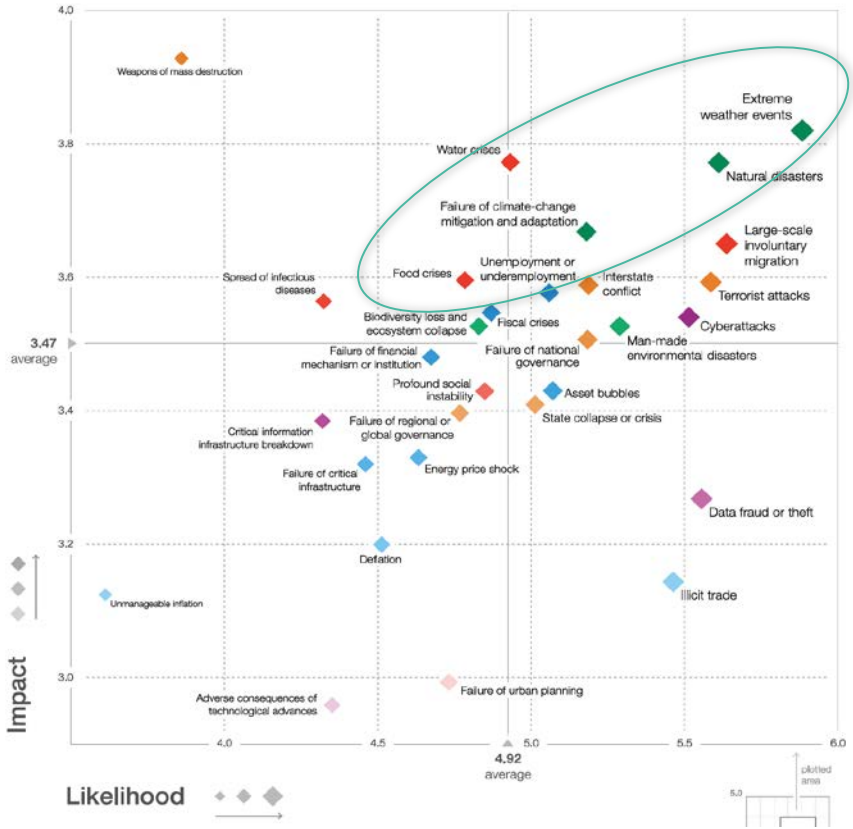
Global Risk Landscape 2017



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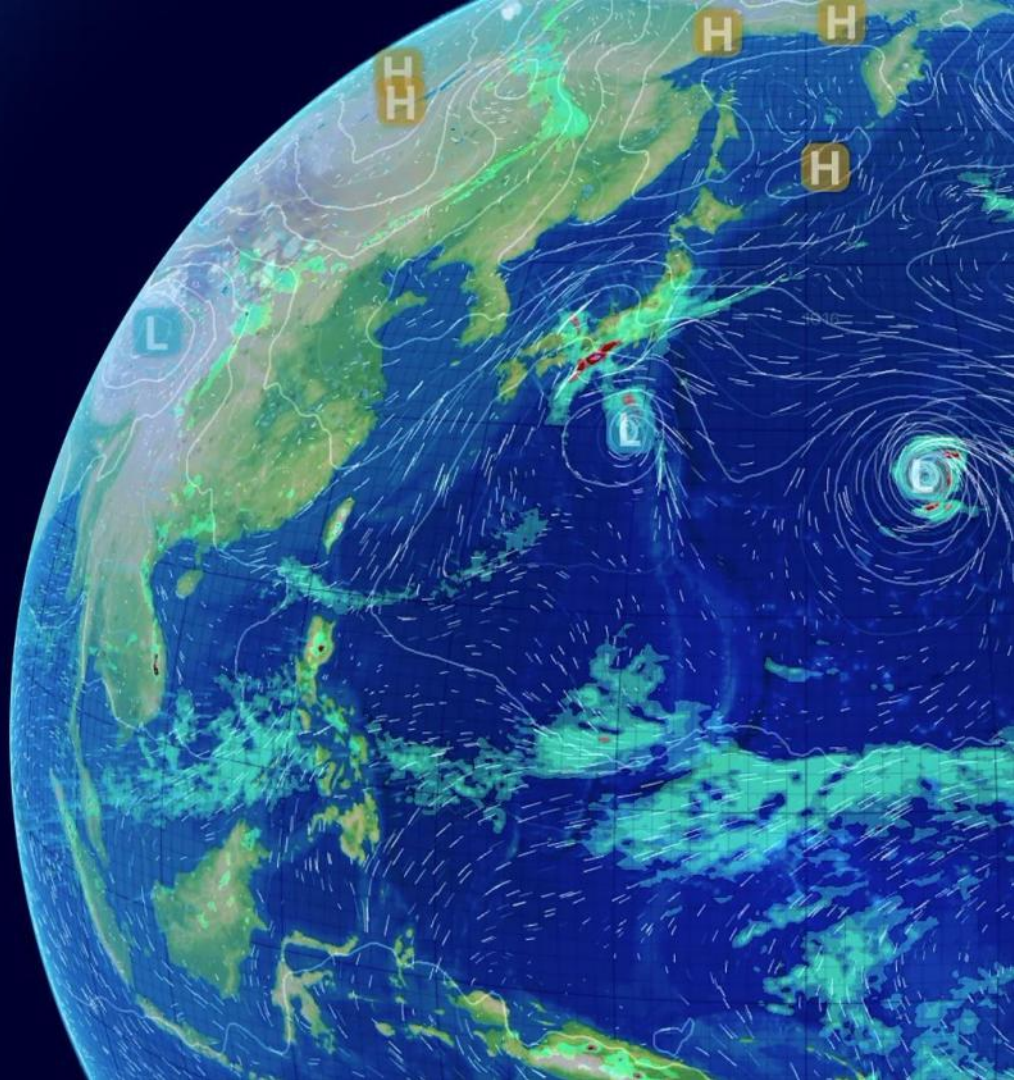
Thank you for listening