METEOROLOGICAL SERVICE SINGAPORE

WORLD METEOROLOGICAL ORGANIZATION

Leadership and Management programme

5th September 2023



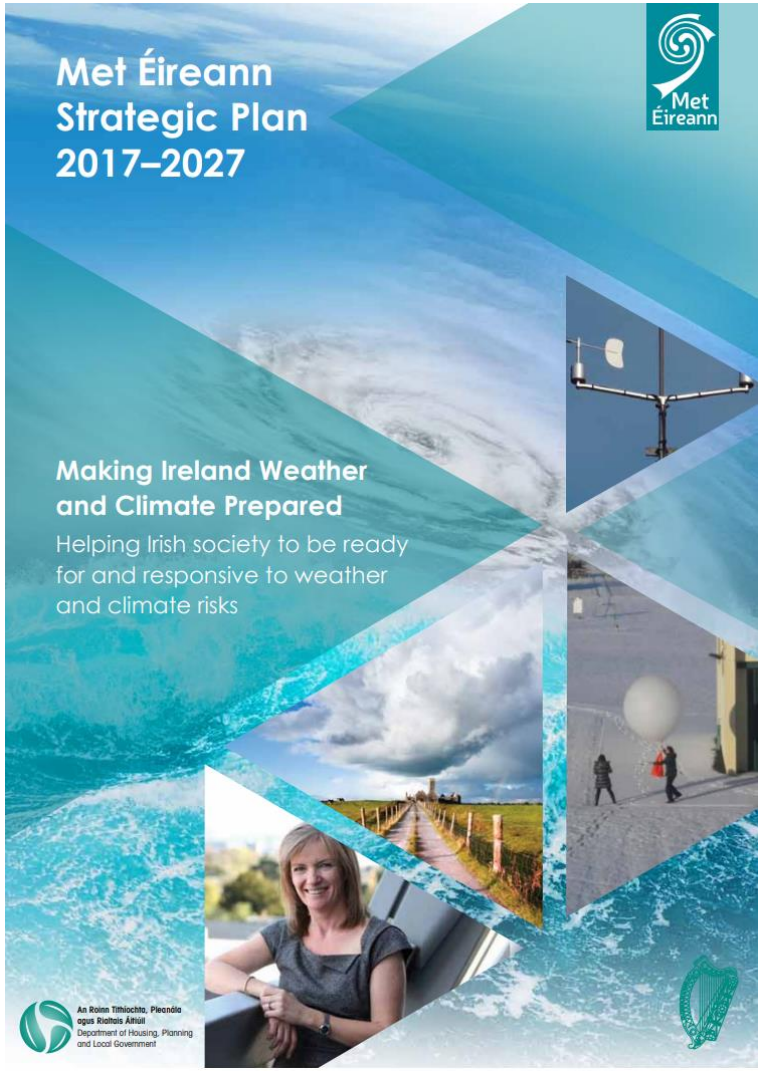


MET éireann

An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreacht
Department of Housing, Local Government and Heritage

Organisational Development of Met Éireann since 2016

Met Éireann, Headquarters, Glasnevin Dublin, Ireland



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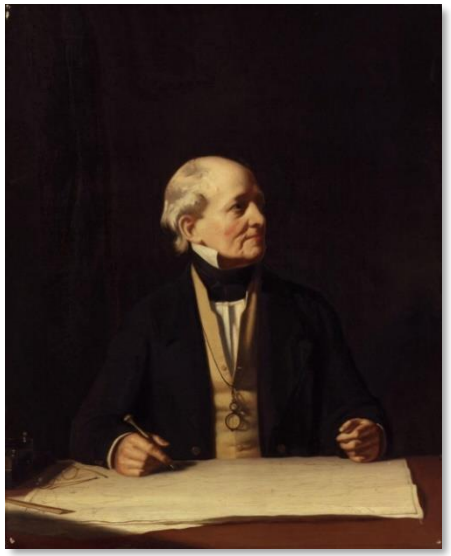
Department of Housing, Local Government and Heritage

1. Background

Ireland a Heritage in Meteorology

Robert Boyle
1627-1691



Francis Beaufort
1774-1857

John Tyndall
1820-1893

George Gabriel Stokes 1819-1905

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Department of Housing, Local Government and Heritage

Climate of Ireland

Storm Emma March 2018

Mean air-temperature (1991-2020):

- Summer mean air-temperature: 14.6°C
- Autumn mean air-temperature : 10.3°C
- Spring mean air-temperature : 8.8°C
- Winter mean air-temperature : 5.4°C

- Annual mean air-temperature : 9.8°C

Mean annual rainfall (1991-2020):

- Mean annual rainfall: 1,288mm

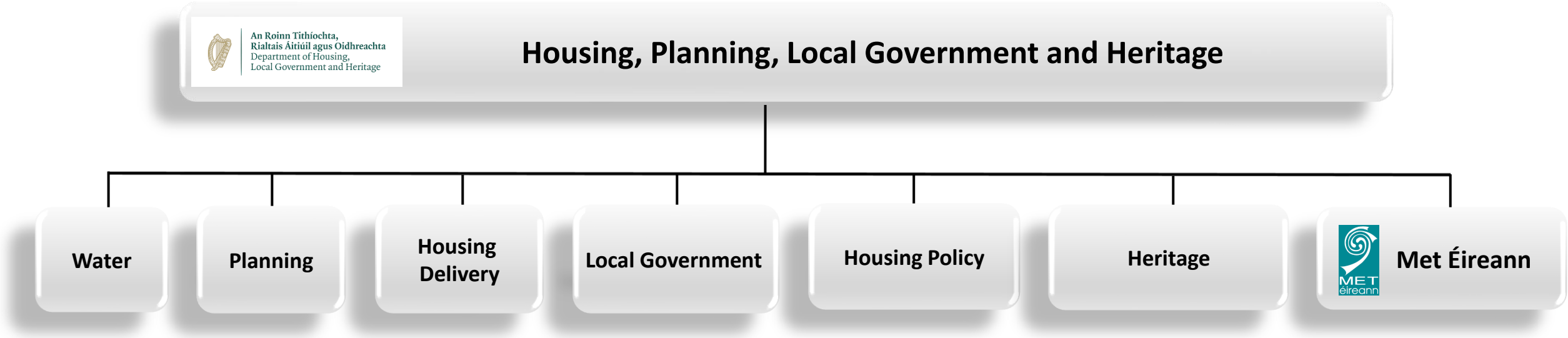
Mean annual sunshine duration 1991-2020:

- Annual mean sunshine hours: 1403.3 hours
- Greatest 1541.9 hours
- Lowest 1252.3 hours

Changes to Irish climate 1961-1990 vs 1991-2020**:**

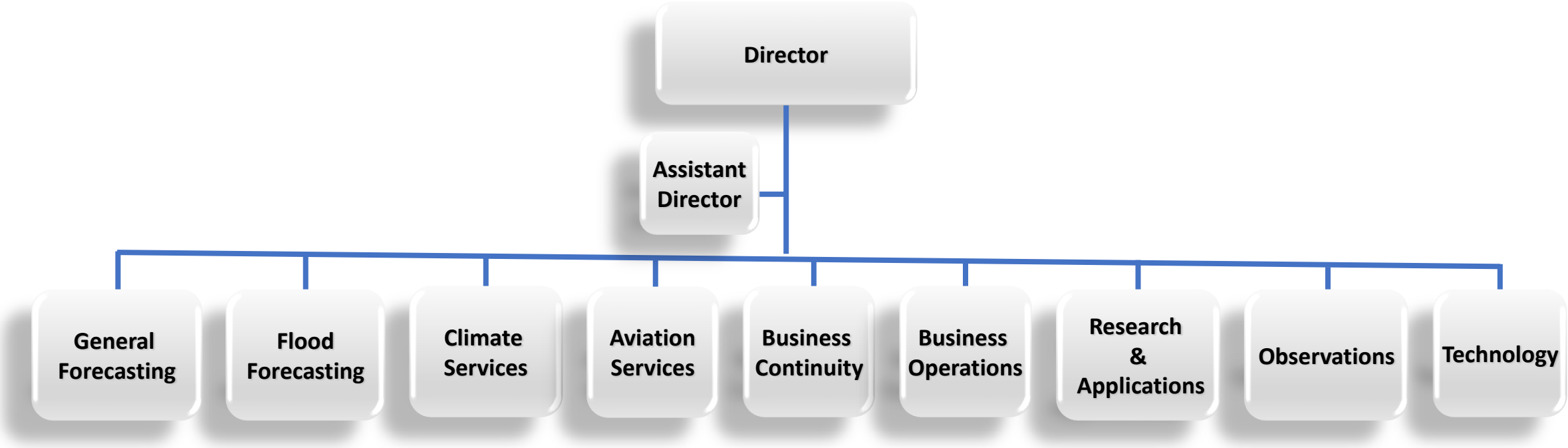
- Annual mean air temperature increased by approx. 0.7°C
- Annual average rainfall increased by approx. 7%
- Sunshine increased: 4.5% (58.6 hours)

Organisational Situation



- Line Division of the Department of Housing, Planning, Local Government and Heritage
- Met Éireann, Emergency management and Local Government in one Government Department
- Climate change policy, Environment policy and Energy policy are within Department of Environment, Climate and Communications

Met Éireann Organisational Structure



International Ecosystem

- WMO
- ECMWF
- EUMETSAT
- EUMETNET
- EC-EARTH
- ACCORD
- MET ALLIANCE
- UWC

Joined 1947

Joined 2020

Joined 1950

Met Éireann

Established 1936

Joined 2018

Joined 1975

Joined 1996

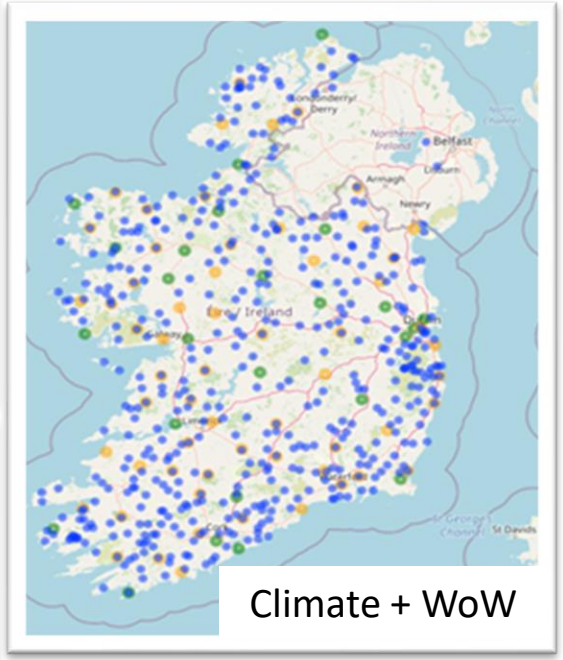
Joined 1985

Benefits of Forecast information in EU27

BENEFIT AREA	MINIMUM	LIKELY
Protection of Property and Infrastructure	€1.3 billion/year	€5.5 billion/year
Added Value to the European Economy	€10 billion/year	€41 billion/year
Private Use by European Citizens	€4 billion/year	€15 billion/year
TOTAL (rounded)	**€15 billion/year**	**€61 billion/year**

SUMMARY OF ESTIMATED ANNUAL BENEFITS OF FORECAST INFORMATION IN THE EU27

From: EUMETSAT excludes protection of life



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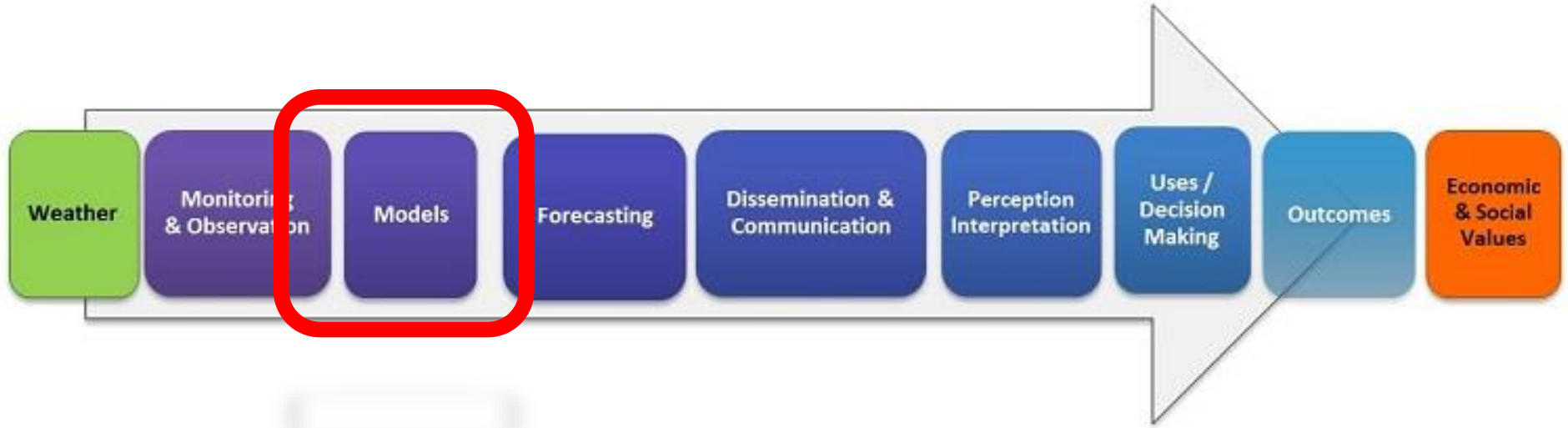
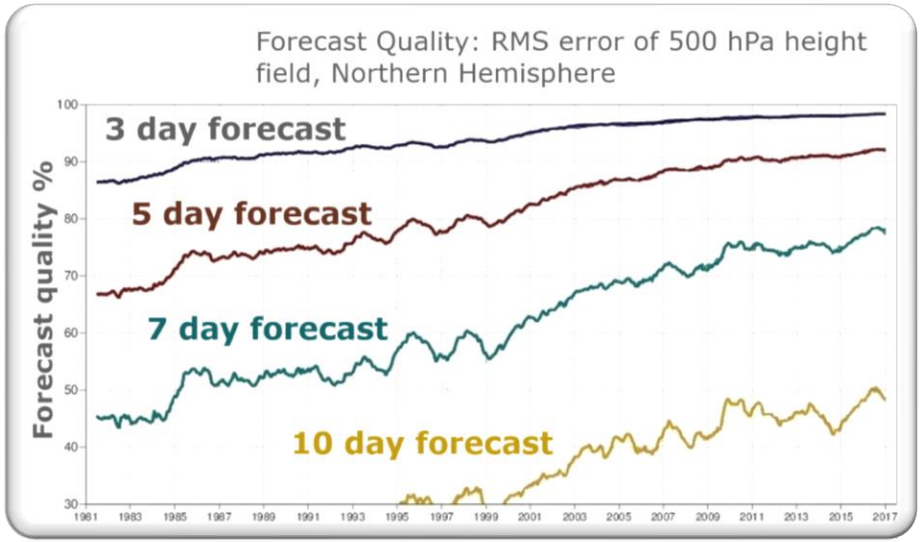
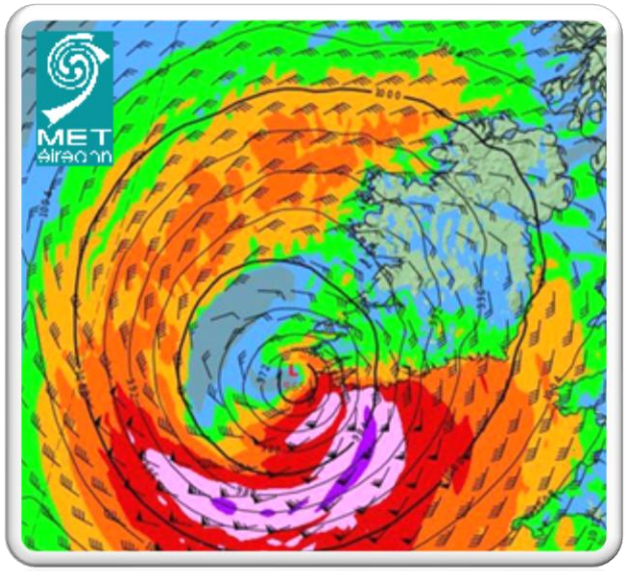
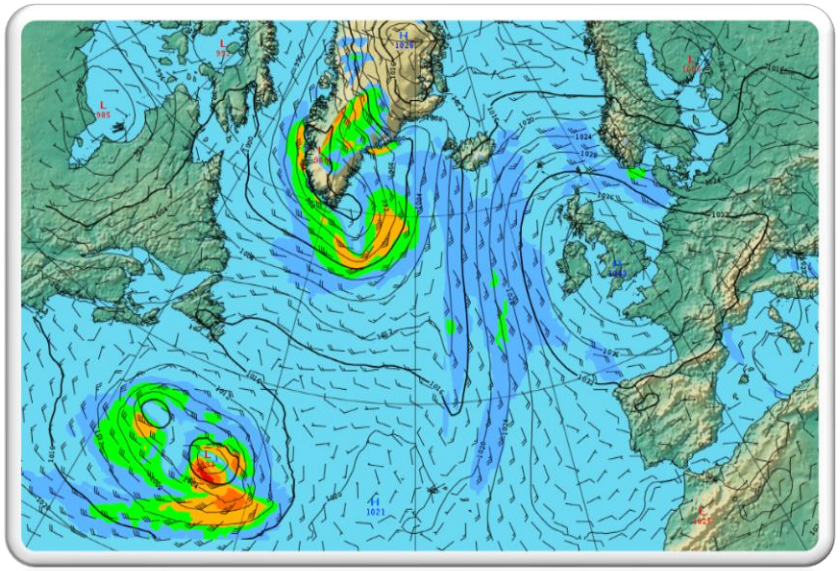
Weather Observations used to predict weather and monitoring climate





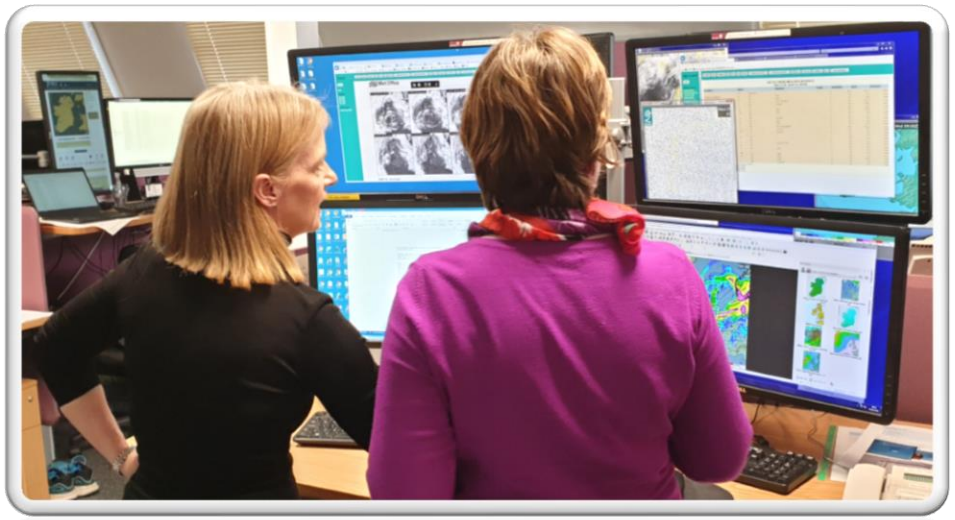


Harmonie-Arome LAM



ECMWF Global

Knowledge-leading numerical Weather Prediction models used to forecast weather



Flood-forecasting centre

Aviation Services

Meteorologists & Hydro-meteorologists analyse and predict the weather

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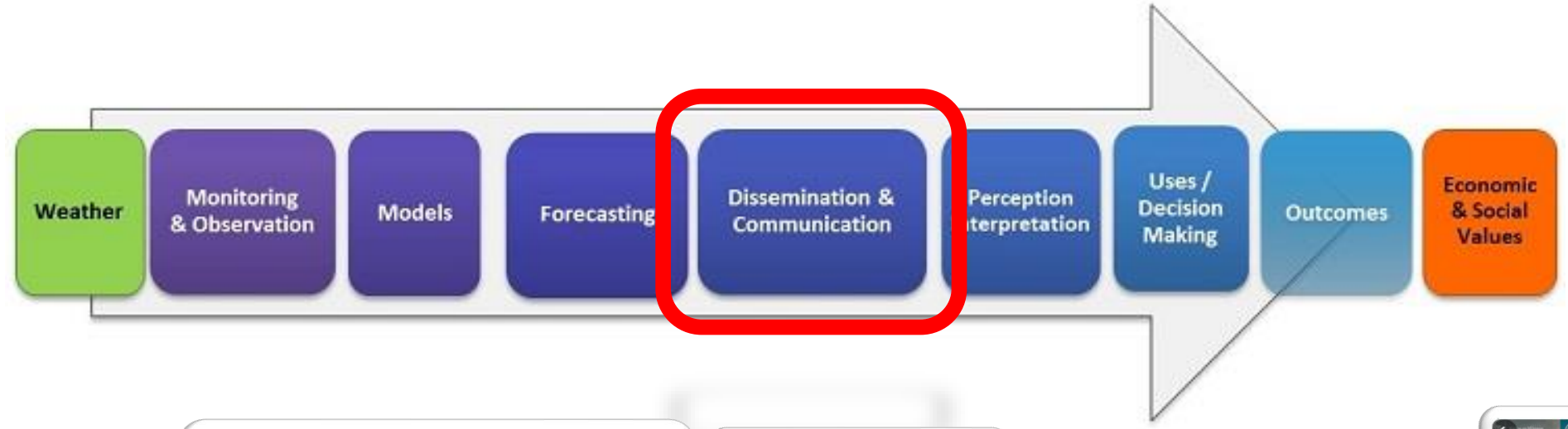
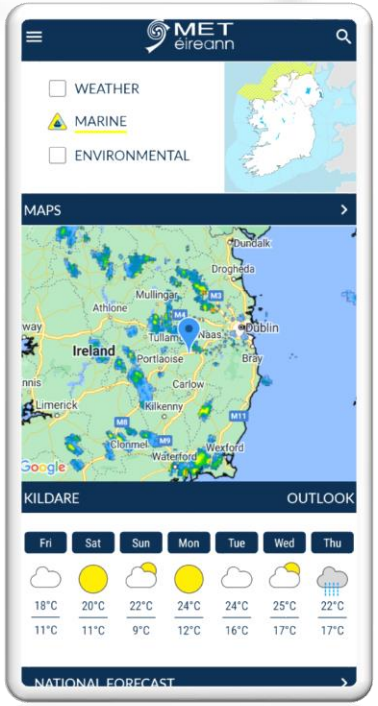
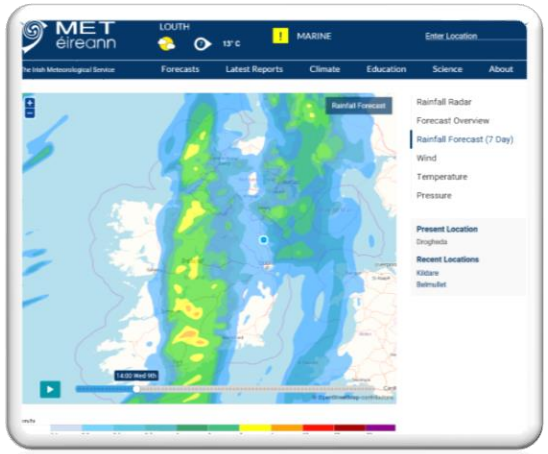
Department of Housing, Local Government and Heritage



TV & Warnings

Storm naming





Web, app and social media

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Department of Housing, Local Government and Heritage

Response Process

Factors associated with **Sender** Characteristics

Warning information: Content Style

Source: Authoritative voice; Familiarity

Channel: Frequency; Interaction

Awareness → Understanding → Believing → Personalise → Response

Confirmation

Environmental: Physical&Social Cues Location

Social: Network, Culture Resources, Role etc

Physical: Mobility, Disability

Psychological: Knowledge, Stress, Past Experience

Factors associated with **Recipient** Characteristics

Met Éireann

Ireland's National Meteorological Service

Updated mission:

Met Éireann, the national meteorological service, monitors, analyses and predicts Ireland's weather and climate, supporting Irish society and decision-makers with world-class weather, climate and flood services. We do this to protect life and property, and to promote wider societal and economic wellbeing.

Vision:

"Making Ireland Weather and Climate Prepared"

Helping Irish society to be ready for and responsive to Weather and Climate challenges

World Meteorological Organisation

2. Development

Met Éireann Strategic Plan 2017–2027

Developments since 2017:

Predictive capability
- Harmonie, high resolution Numerical Weather Prediction (NWP)
- Ensemble Prediction Capability
- Flood Forecasting Centre
- Met Éireann weather and climate research programme

Services and Communication
- Support for impact-based decision making
- Support for emergency management
- Web-site and app
- Social media
- Citizen scientists
- Open data

National meteorological infrastructure
- UWC-W High Performance Computing
- Aviation (AWOS), Automation (CAMPS), Upper-air
- Weather Radars
- ICT Capacity, Resilience and Security (iMaMs)
- Business Continuity

Climate services
- National Framework for Climate Services
- CCAC support
- Climate prediction and analysis

MET éireann

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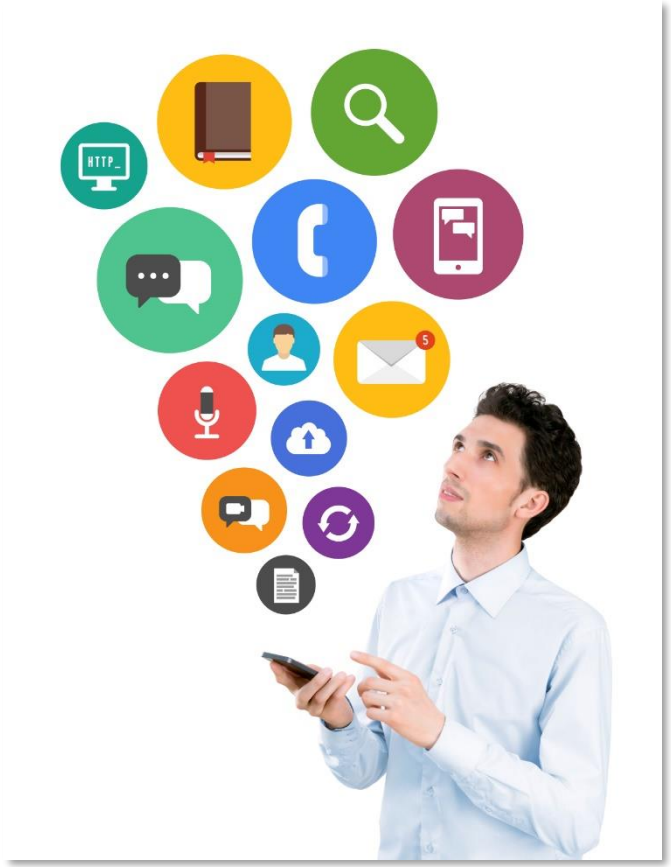
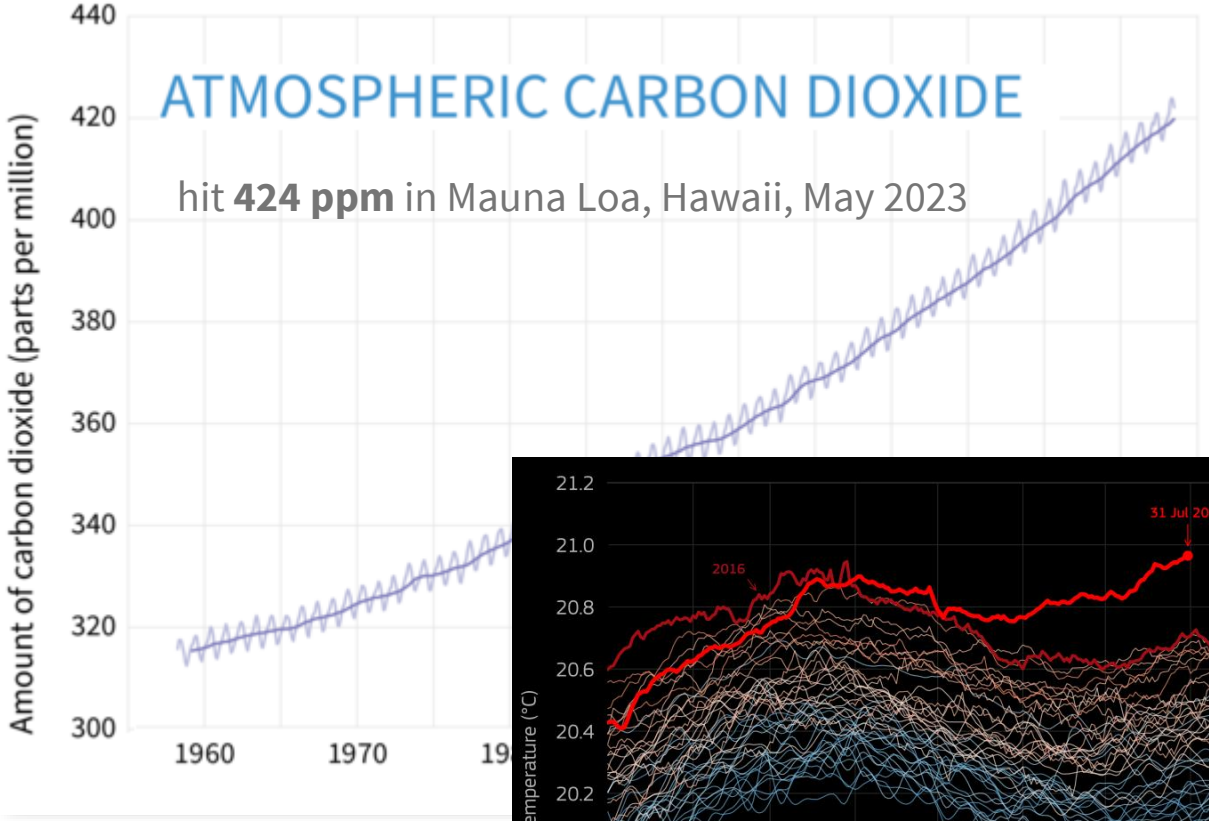
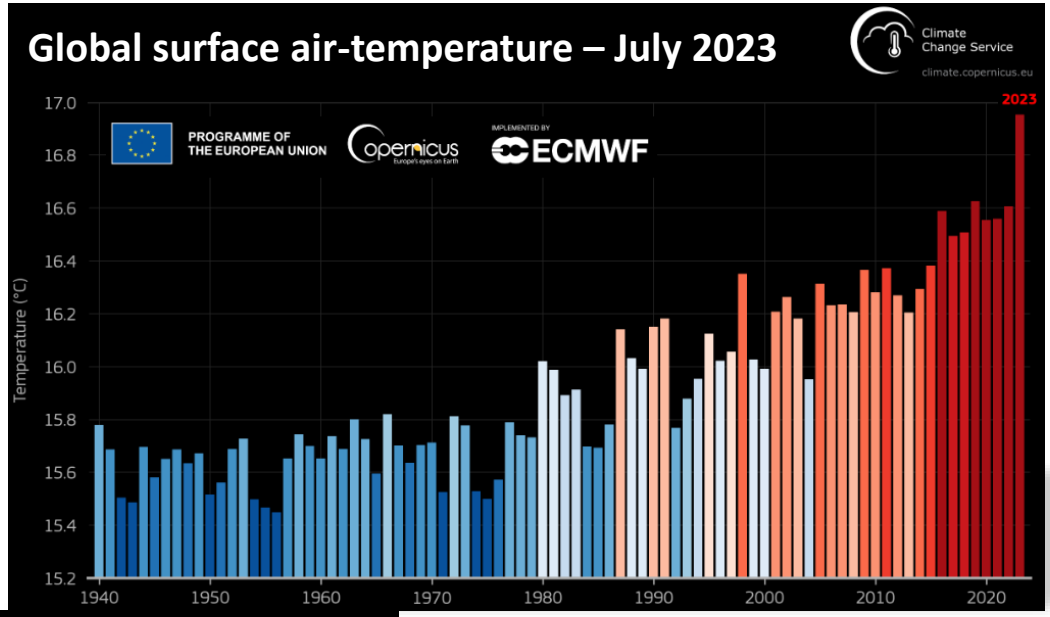
An Era of Change

- Climate and weather is changing
- Societal vulnerability is increasing
- The nature of weather information is changing
- Evolving Government priorities e.g. flood forecasting



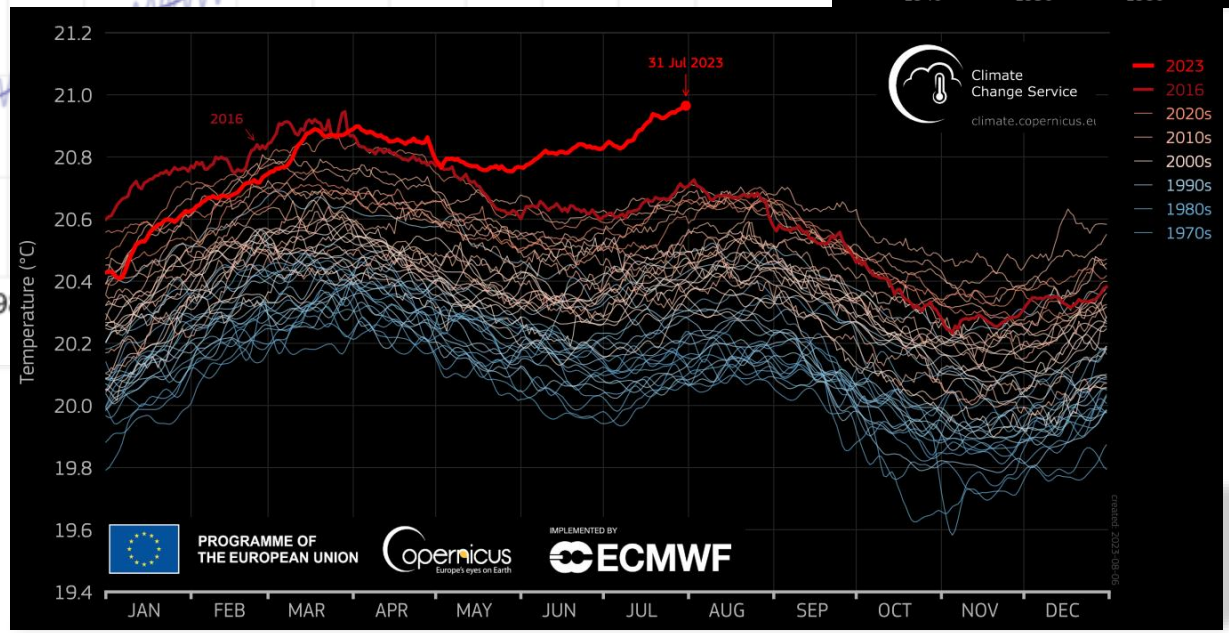
Climate is Changing





climate.copernicus.eu

Global warming reached 1.23°C above pre-industrial levels **July 2023**



DAILY SEA SURFACE TEMPERATURE 60°S 60°N

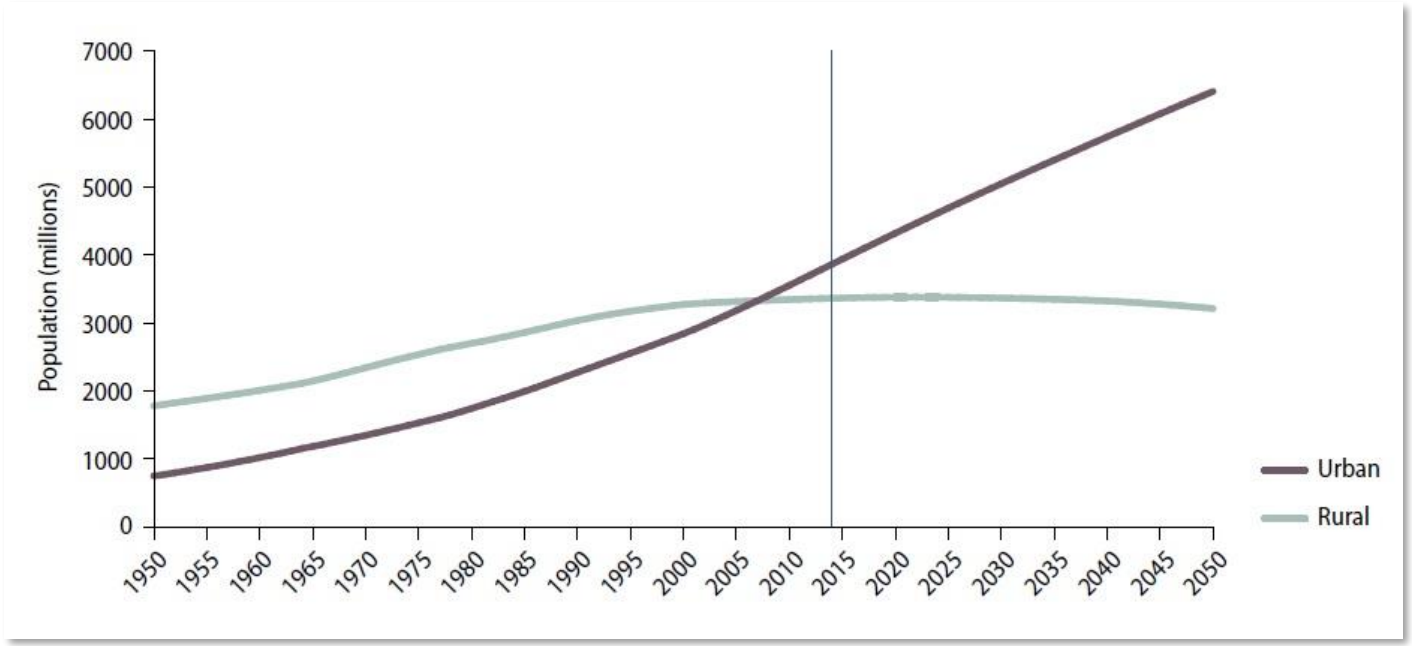
31st July, the daily **SSTs reached a record high of 20.96°C**

Carbon dioxide Reached 424.0 ± 0.1 parts per million in the atmosphere.

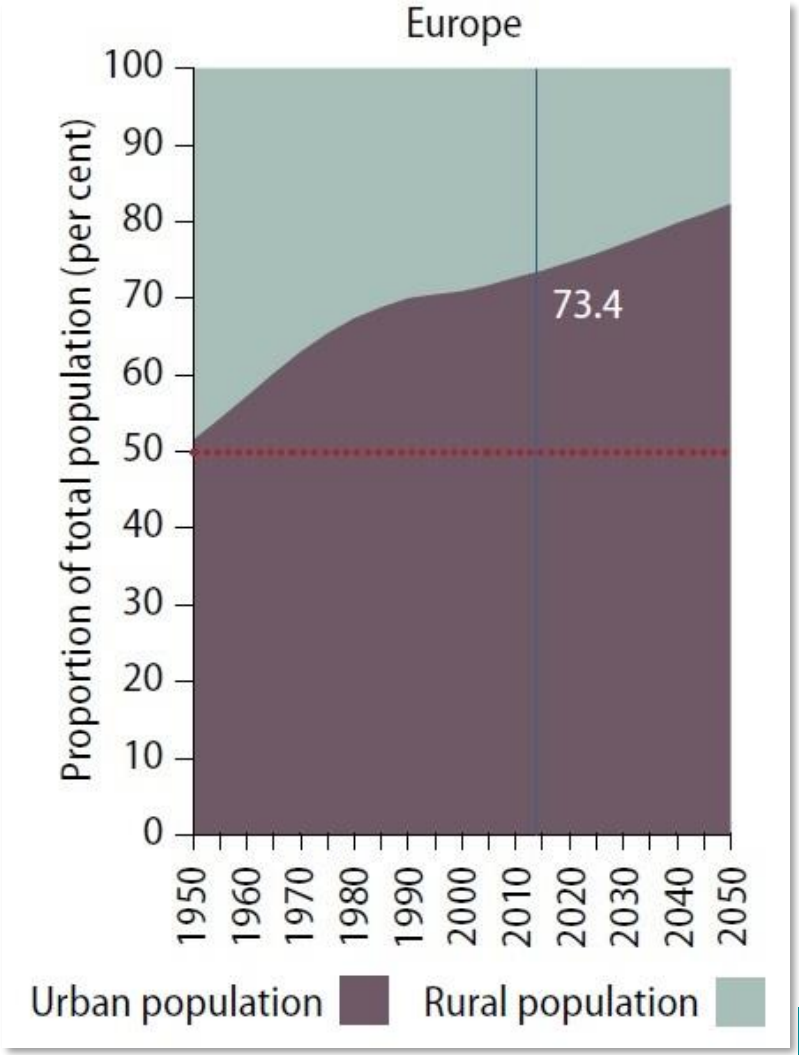
NOAA climate.gov & WMO (2023)

Increased Urbanization

Urban and rural population of the world, 1950–2050



By 2050, 66 per cent of the world's population is projected to be urban.



From: UN World Urbanization Prospects, 2014 Revision.

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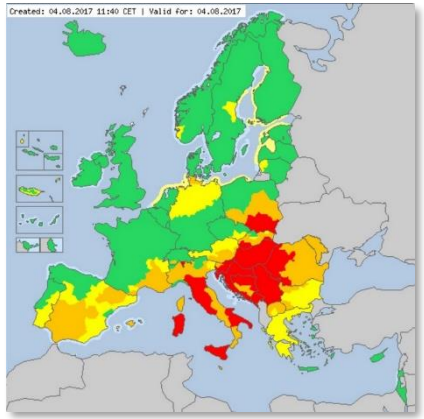
Department of Housing, Local Government and Heritage

Extreme Weather 2016/17

"…this time it's different…"

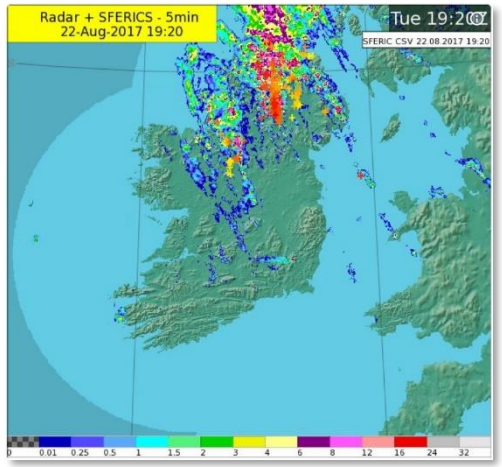
USA: Hurricane Harvey



Europe: Heatwave

Portugal: Fires

Donegal, Ireland: Flooding

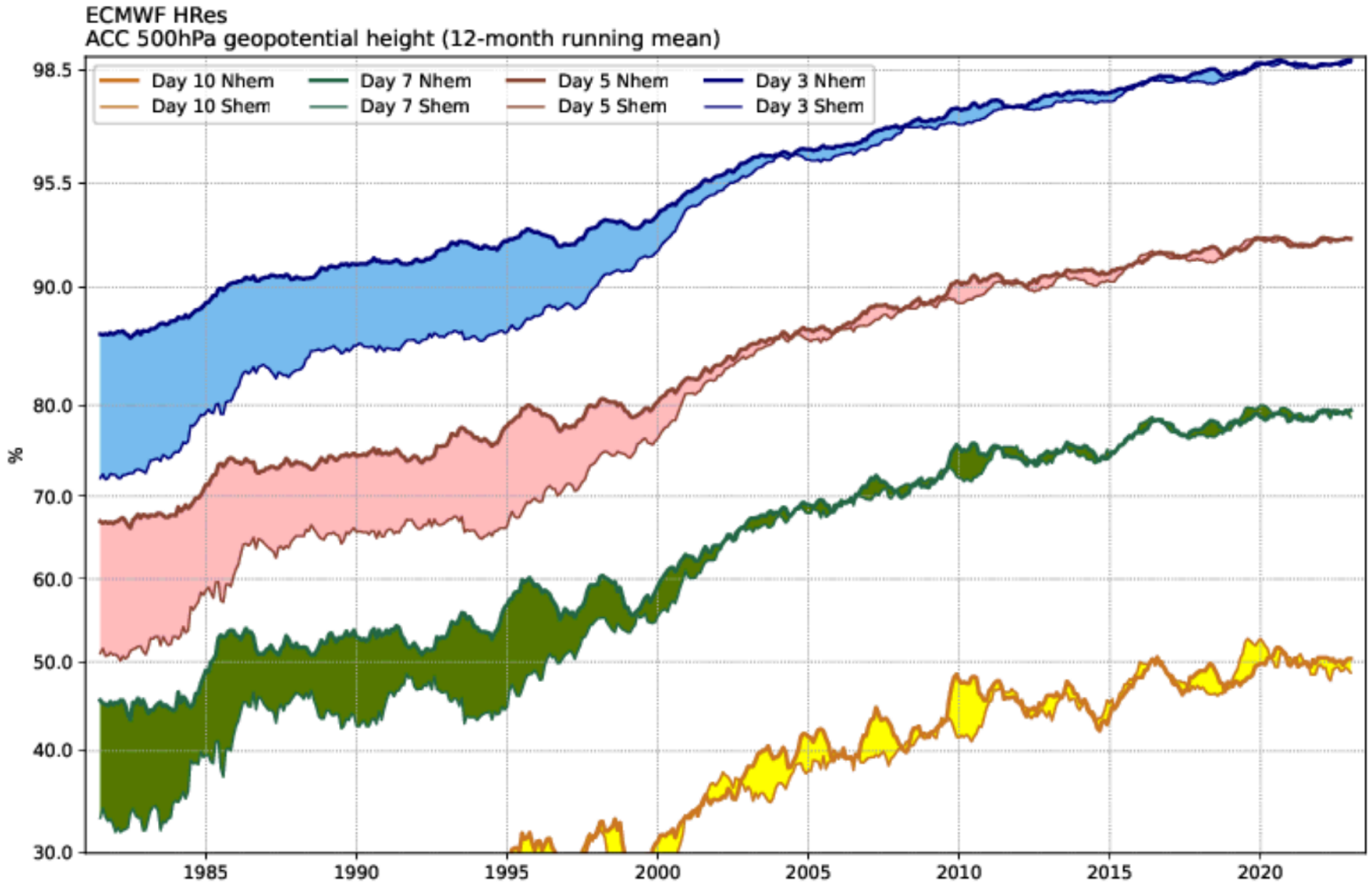


Ireland: Thunderstorms

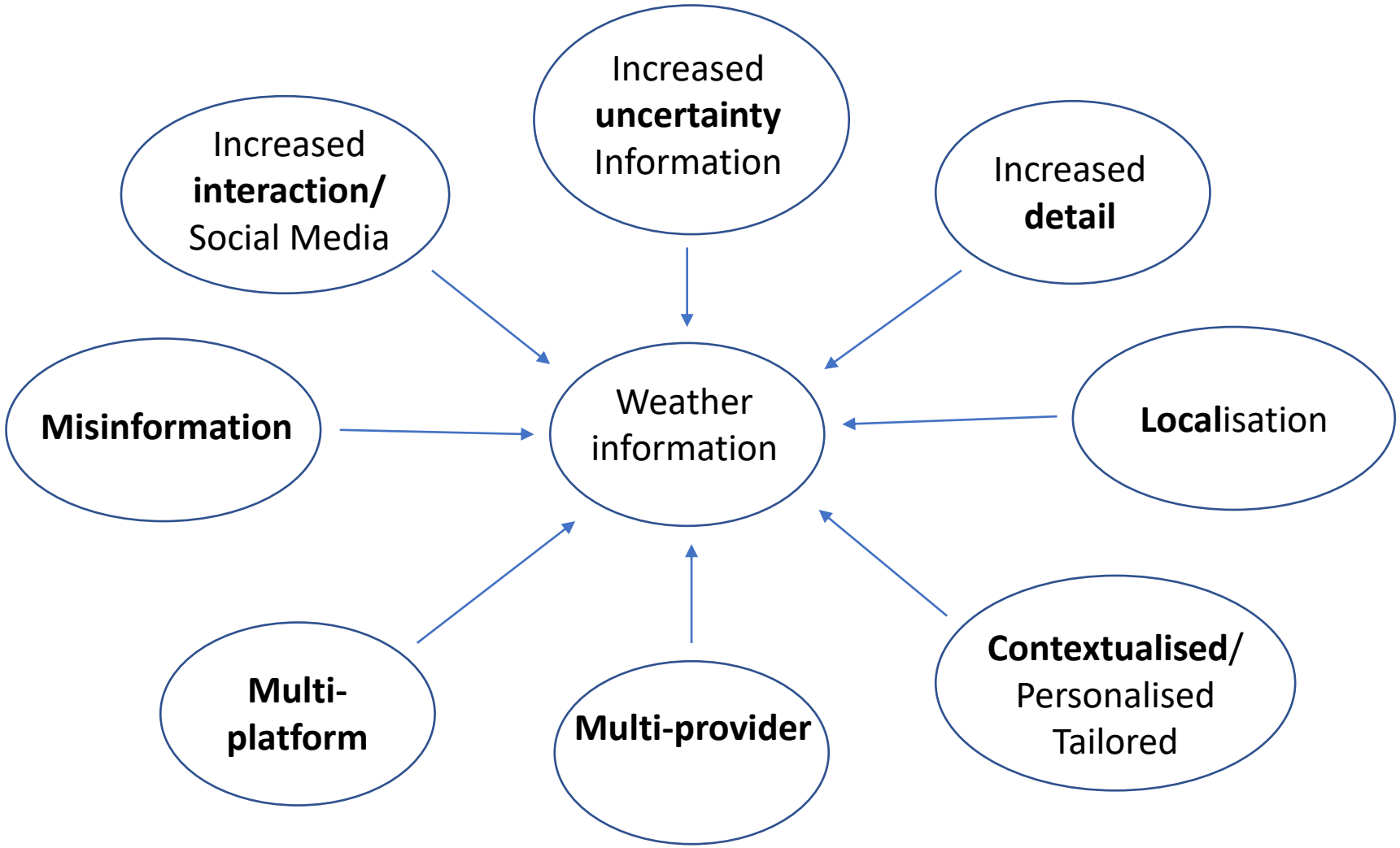
Tripura, India: Flooding

Accuracy and reliability of weather information

Lead time of anomaly correlation coefficient (ACC) reaching multiple thresholds (High resolution (HRES) 500 hPa height forecasts)



Changing nature of weather information



Leadership challenge

Putting in place Strategic plan:

- Understanding and developing a new vision and setting direction:
- communicating that vision and why it is important;
- developing a clear strategy and an implementation plan;
- shape conditions so that Met Éireann and its partners could co-create the future together

Provide adaptive leadership – inside the organisation:

- Create a culture and organisational capability to leverage diverse talents, experience, expertise perspectives for the collective good.
- Letting go of formal authority and inviting people to innovate.

Build connections – outside the organisation:

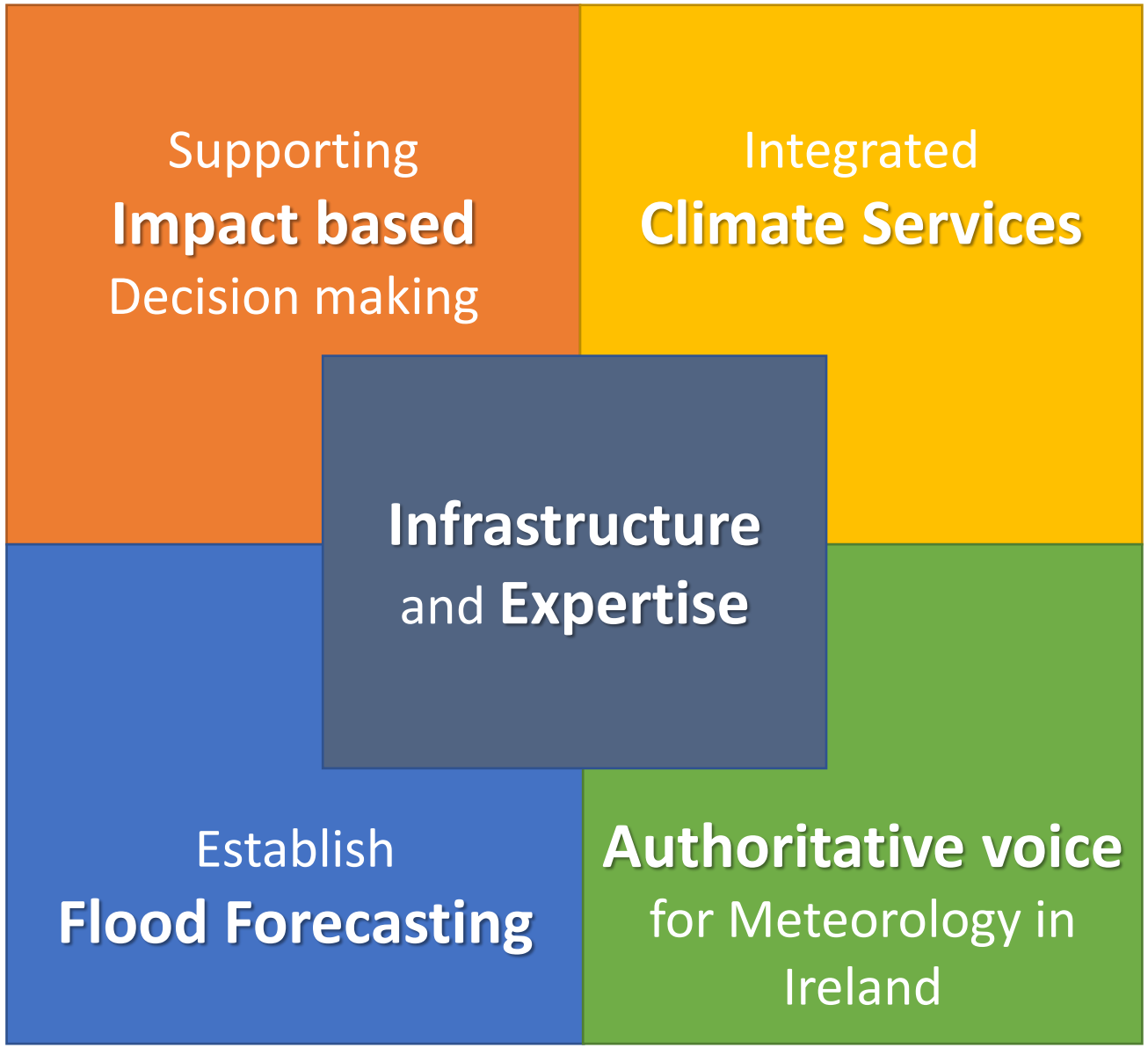
- Build core capabilities by going outside the organisation to access what was needed, talent, skills, knowledge.
- Bridge between external consortia and partners with internal core capability – using for example accelerators to connect with complimentary partners.

Catalyse, influence, nudge – the system, the community:

- Accelerate co-creation across the whole system or in parts of the system.
- This where ambition is greater than the organisation – endeavour to lift the whole, so that everyone gets lifted.
- Exercising influence beyond formal authority.

Building Met Éireann's strategy to address **areas of strategic significance**

- Challenge to **Authoritative voice**
- Support for **impact-based decision making**
- Communication and reach of **user-centric services**
- Improve **sector-relevant information** in support of economic productivity
- Maintaining **workforce expertise** and fit-for-purpose **infrastructure**
- **Climate services**
- **Open data**
- Establish **Flood Forecasting Service**



Vision:

Making Ireland weather and climate prepared

Helping Irish society to be ready for and responsive to weather and climate risks

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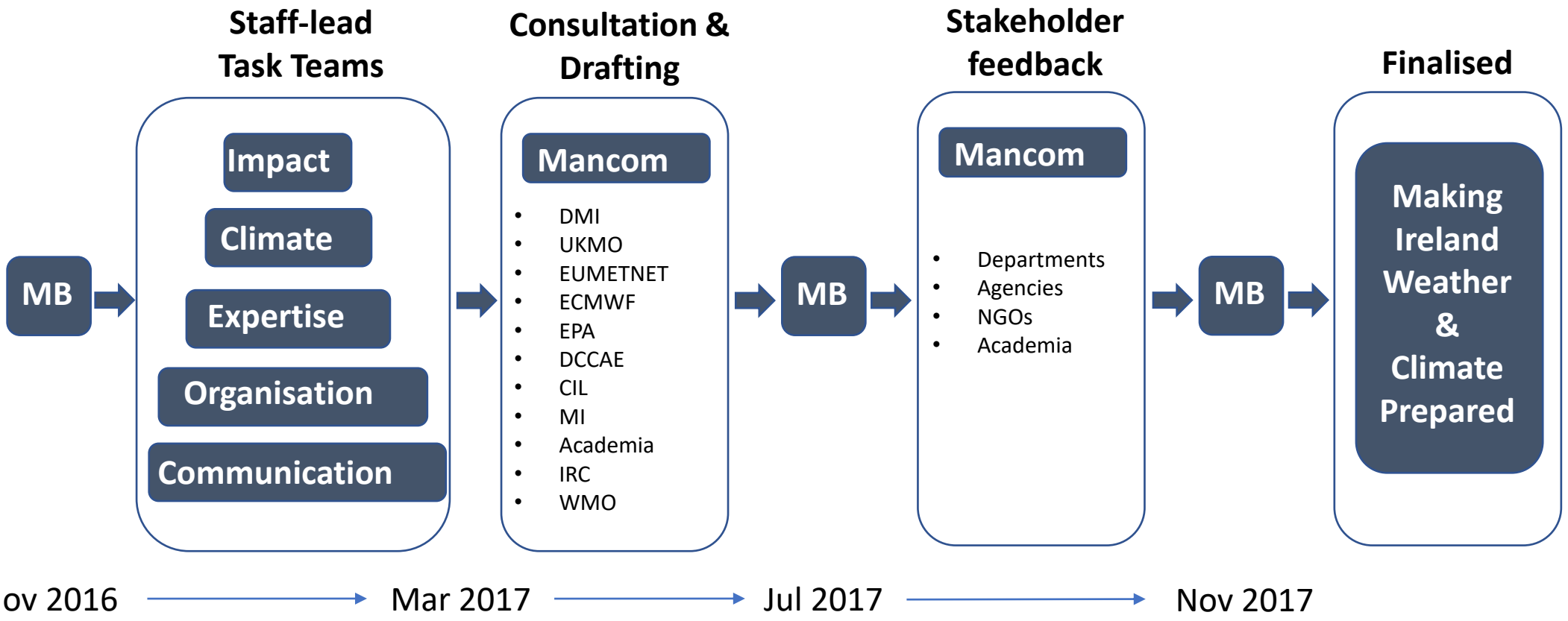
Department of Housing, Local Government and Heritage

Preparation of Strategy



Met Éireann Strategic Plan 2017–2027

Outcomes and Achievements:

Predictive capability
- Harmonie, high resolution Numerical Weather Prediction (NWP)
- Ensemble Prediction Capability
- Flood Forecasting Centre
- Met Éireann weather and climate research programme

Services and Communication
- Support for impact-based decision making
- Support for emergency management
- Web-site and app
- Social media
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- Open data

National meteorological infrastructure
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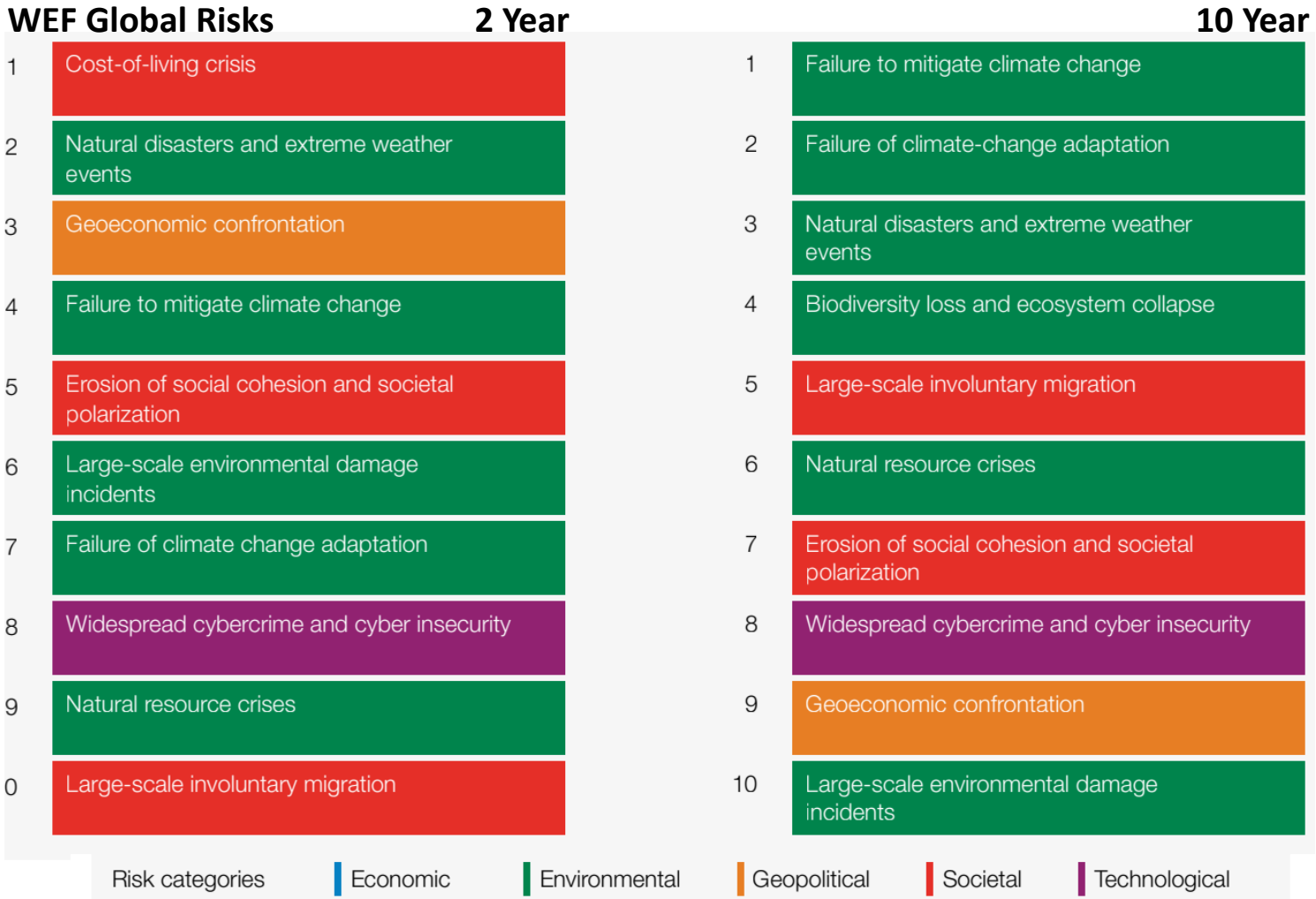
- CCAC support
- Climate prediction and analysis

MET éireann

An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta
Department of Housing, Local Government and Heritage

Continuous process: Start of process to develop Met Éireann's new strategy for 2024-2034



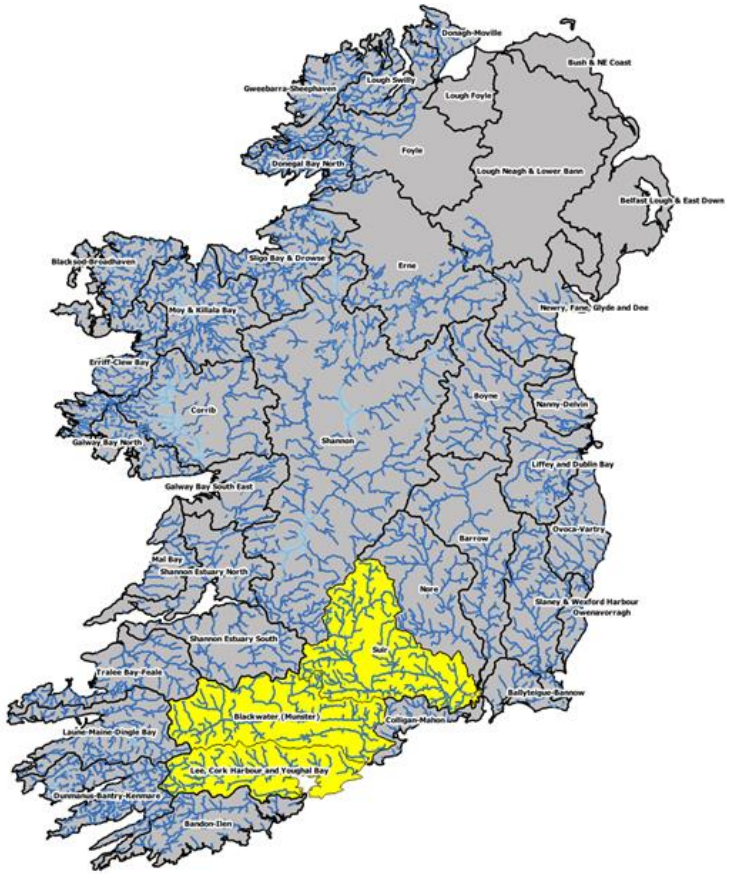
- Extreme weather
- Climate change
- Biodiversity
- Food security
- Cyber security
- Disinformation & misinformation
- Energy
- Water management
- COVID-19
- War in Europe
- Inflation
- AL/ML
- Cost of living
- BREXIT
- Blended/hybrid/remote working

Volatile **Uncertain** **Complex** **Ambiguous**

3. Selected Outcomes

Building a new National Flood Forecasting Capability

Development of a new National Flood forecasting system



River catchments and sub-catchments

New National Flood Forecasting & Warning Service:

- Government decision 2016 to develop a National Flood Forecasting Centre (FFC) in Met Éireann
- As part of a National Flood Forecasting & Warning Service (NFFWS)

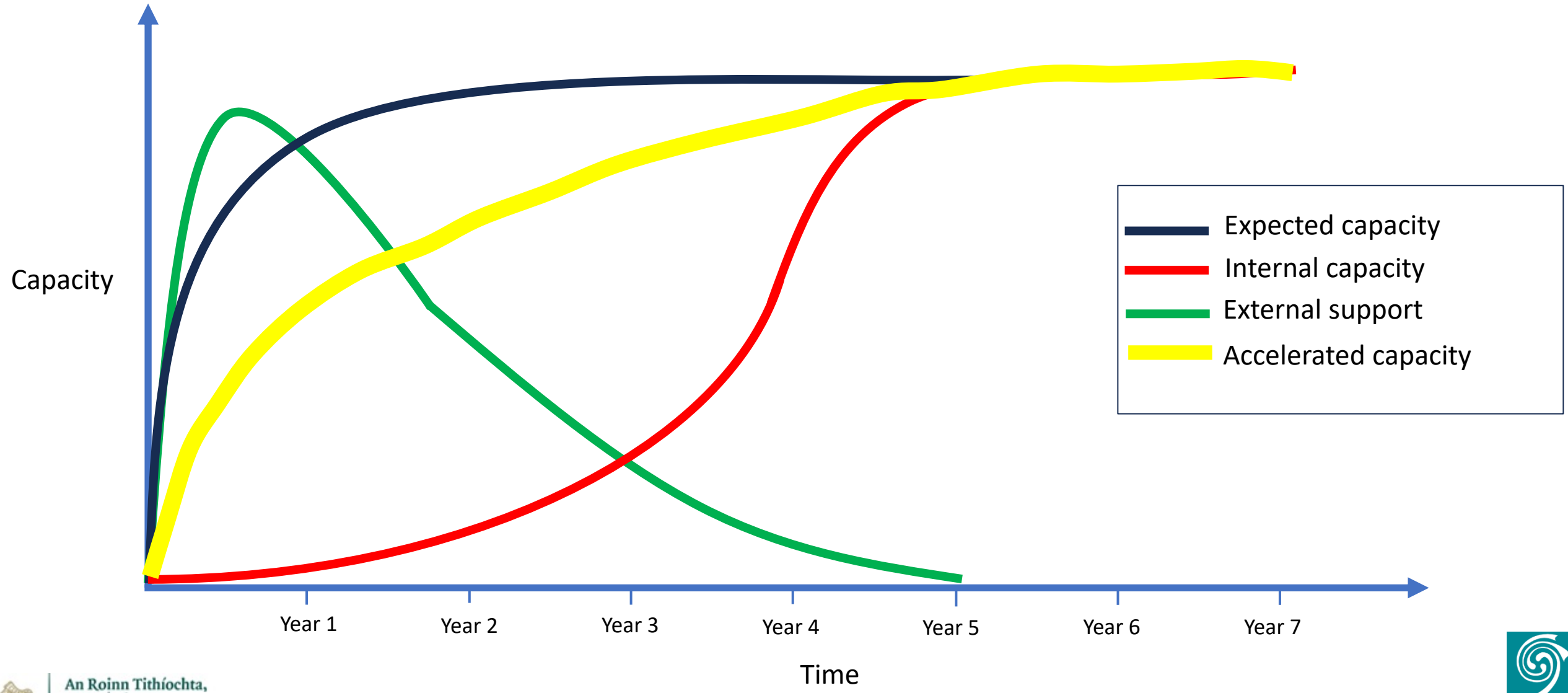
Partners:

- Flood Risk Management: Office of Public Works (OPW) – Tide and Storm Surge Forecast service, river gauges
- Emergency Management: NDFEM
- Environmental Protection Agency (EPA)
- Local Authorities
- Academia

Objectives:

- Develop monitoring infrastructure: River gauges, flow-guages; Coastal observational capability
- Develop river catchment modelling capability
- Develop coastal flood modelling capability
- Develop partnership to support preparedness management

Accelerated Capacity Development



National Flood Forecasting:
Fluvial, Coastal

RIVERS:

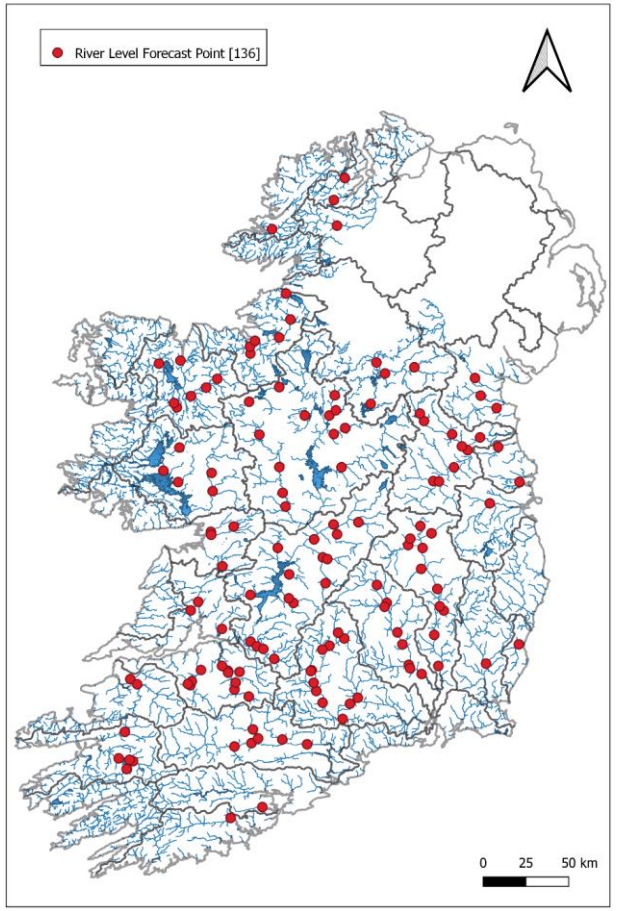
- **External independent advisory panel:** Leading International and internal experts and practitioners
- **Fluvial model Tender:** Build, calibrate, test available fluvial catchment models
- **River monitoring:** Expand Riverguage network to meet modelling requirements

COASTAL:

- **Tide and Storm Surge Model:** Move to HPC, drive with Harmonie, EPS. Develop improvement plan
- **Coastal Monitoring:** Collaborate with Commission with Irish Lights to develop near shore buoy monitoring. Wave sensor trials.

INITIAL OPERATIONS 2023:

- **Fluvial:** National Catchment Fluvial System – 36 models - FEWS
- **Coastal:** Tide and Storm Surge Forecast (TSSF) model moved to HPC environment
- **Coastal Flood Forecast Strategy:** NDP plans for coastal observation network
- **Communications:** – Irish Flood Integrated Communications System
- **Flood Forecasting Centre (FFC):** Initial Operations – Autumn 2023

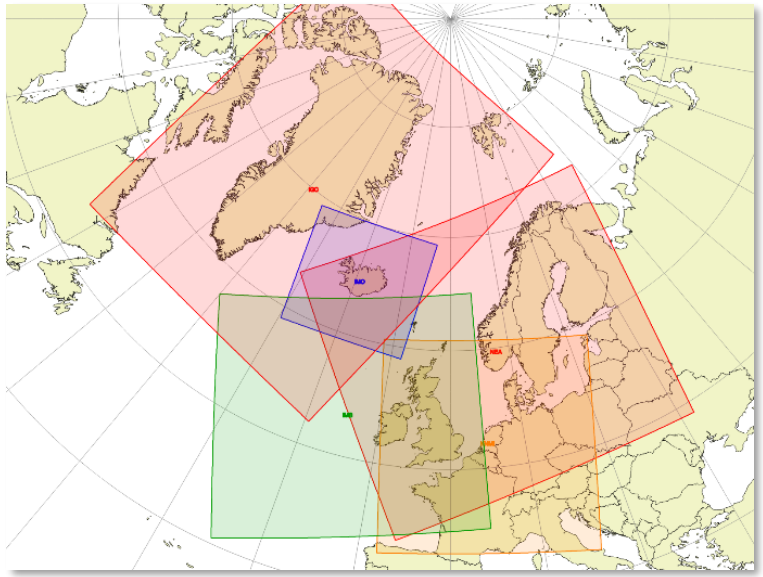


Putting in place HPC infrastructure needed to support NWP developments

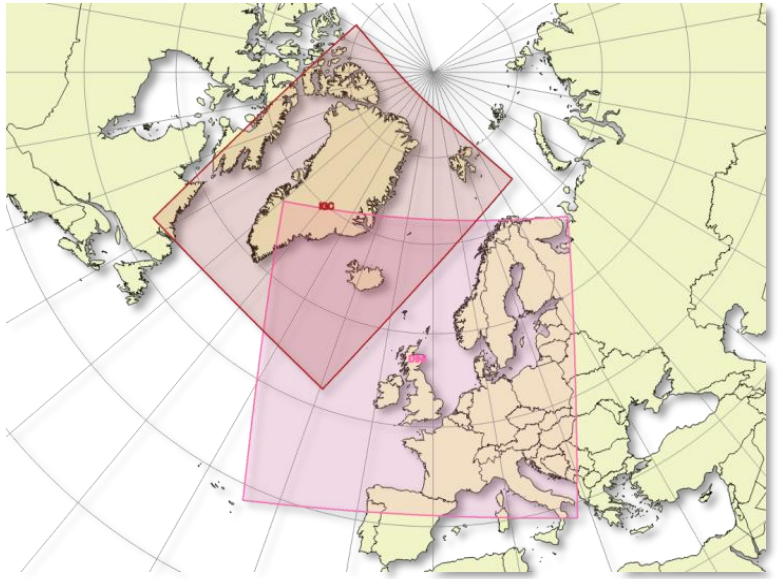
United Weather Centres

Operational NWP collaboration

Separate:
NWP
domains



Unified:
NWP
domains



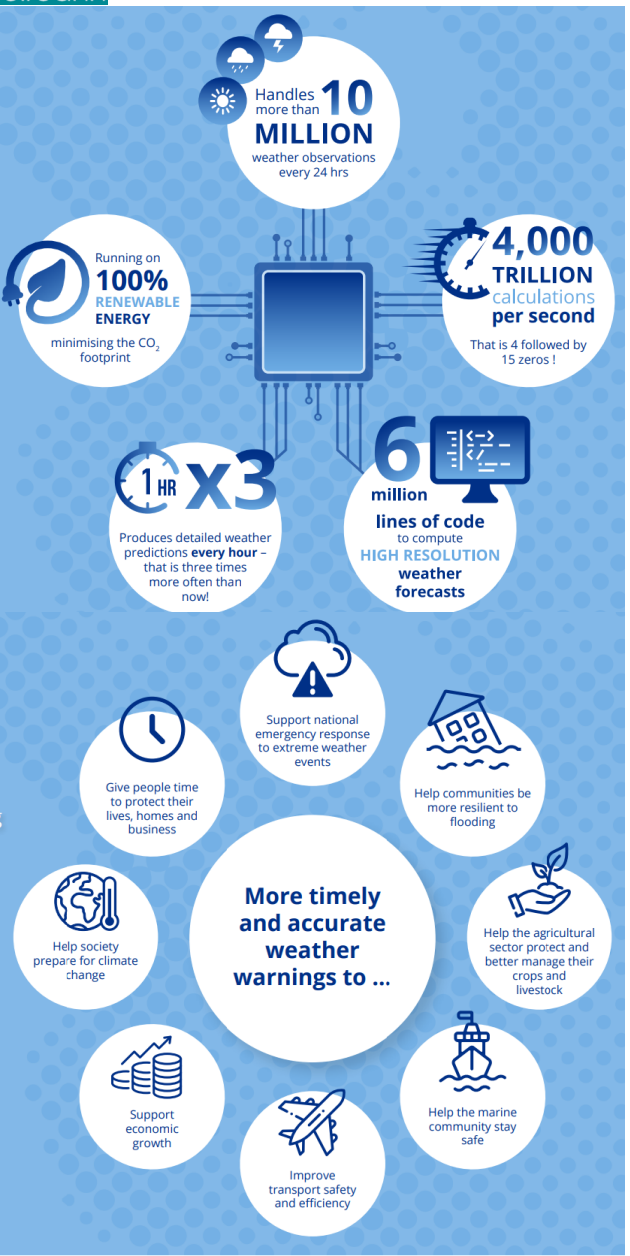
“Best short-range weather forecasts for citizens”

UWC West:
2018: Join MoU agreement between Denmark, Iceland, Ireland and the Netherlands

Joint UWC West HPC and NWP operations from Q1 2024:
Netherlands,
Denmark,
Ireland
Iceland

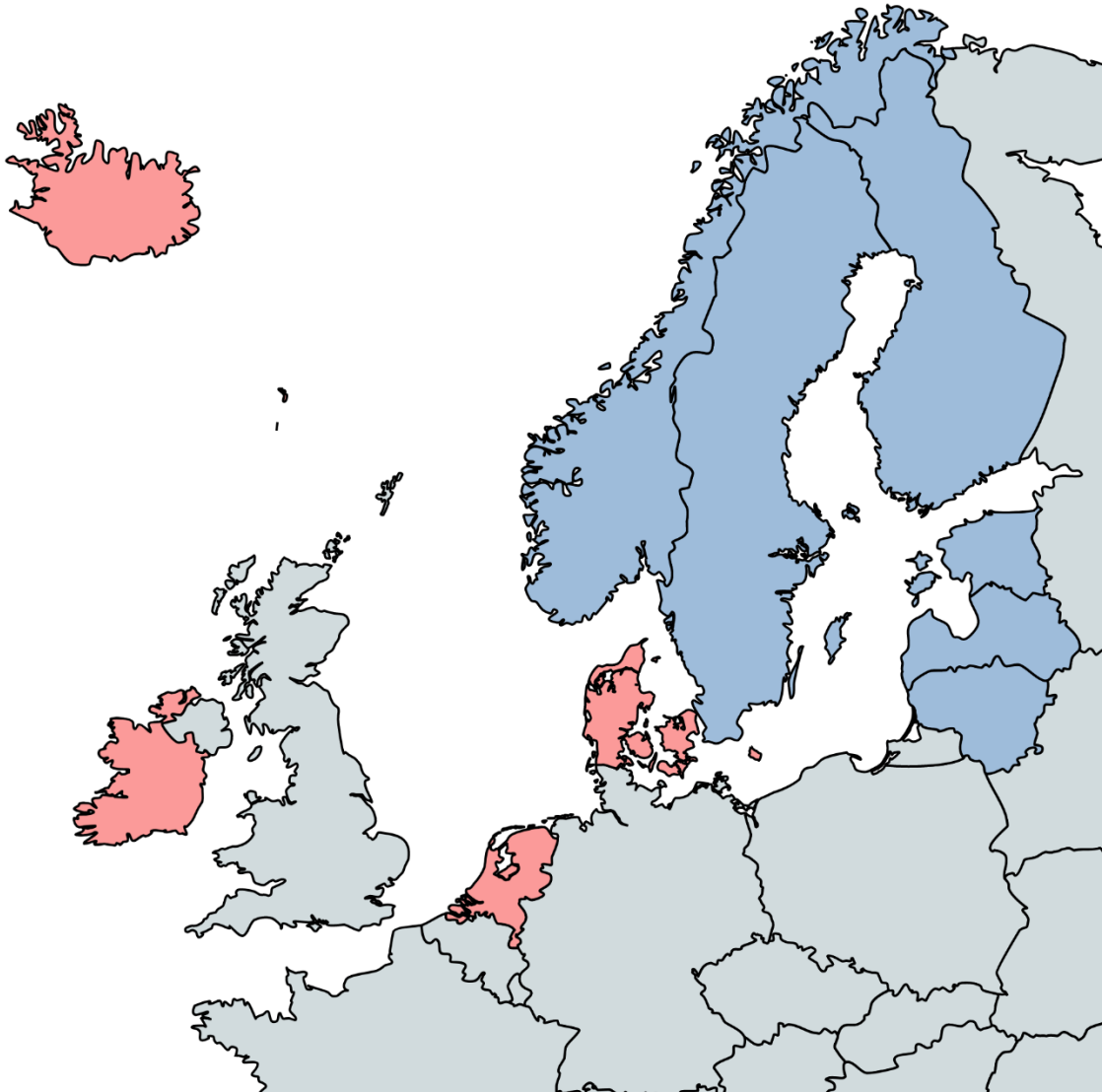
UWC:
2023: Join MoU agreement between Norway, Sweden, Finland, Latvia, Lithuania, Estonia, Denmark, Iceland, Ireland and Netherlands and Spain

High Performance Computing:
United Weather Centres



International HPC Cooperation

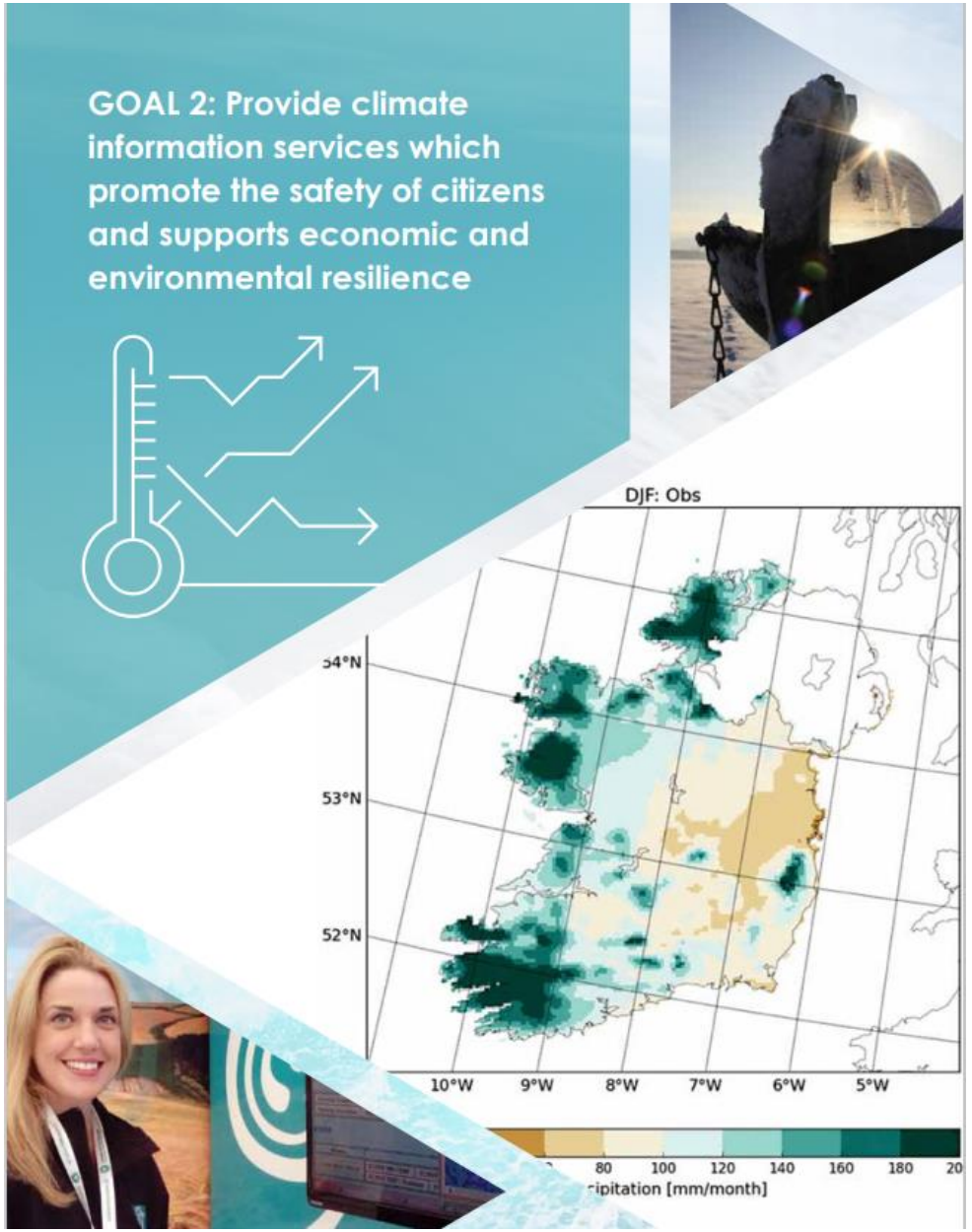
- International HPC cooperation between Ireland, the Netherlands, Denmark and Iceland
- Expanding to 10 countries in 2027



KEY MILESTONES

- Delivery of HPC complete Q1 2023
- Commissioning Q4 2023
- New domain development Mar 2023
- Operational Q1 2024

Development of national climate services and information



Climate Services

Immediate leadership challenge:

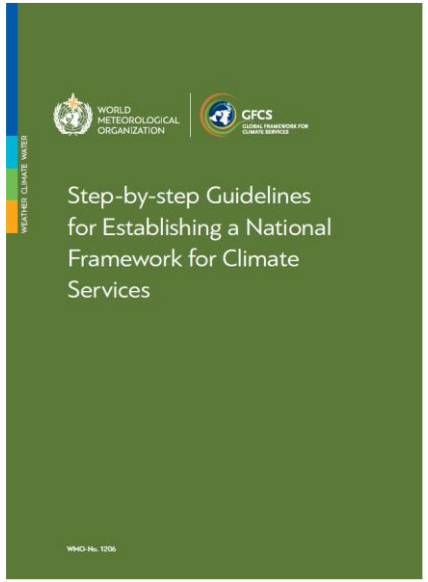
1. **Support National Climate Adaptation Planning:** Developing climate services to meet the Irish adaptation sector's climate information requirements.
2. **Using:** Standardising national climate projections for Ireland.

Strategic challenge:

- **User-centric service:** enabling the co-development of tailored climate services to support sectoral decision makers.
- **Nationally coordinated service delivery:** reducing duplication of data processing. Enabling knowledge generation between sectors, while promoting knowledge transfer across Irish society.
- **Support for citizens, businesses, policy makers & planners:** Expert support in understanding and applying climate information in their decisions.
- **New climate information products and tool:** Developed using standardised national climate projections and available through an easy-to-use national portal *Climate Ireland*
- **Enhanced communication:** among climate service users and providers to help achieve maximum usability and reach of the services that are developed.
- **Training and support of users and developers of climate services:** to enhance the uptake and to standardise underlying climate assumptions.

Irish National Framework For Climate Services

WORLD METEOROLOGICAL ORGANIZATION | GFCS GLOBAL FRAMEWORK FOR CLIMATE SERVICES



C NFCS Steering Committee

B National Climate Service Development Hub

(Platform for regular meetings between climate service developers and sector experts for co-production of climate services)

Climate Ireland

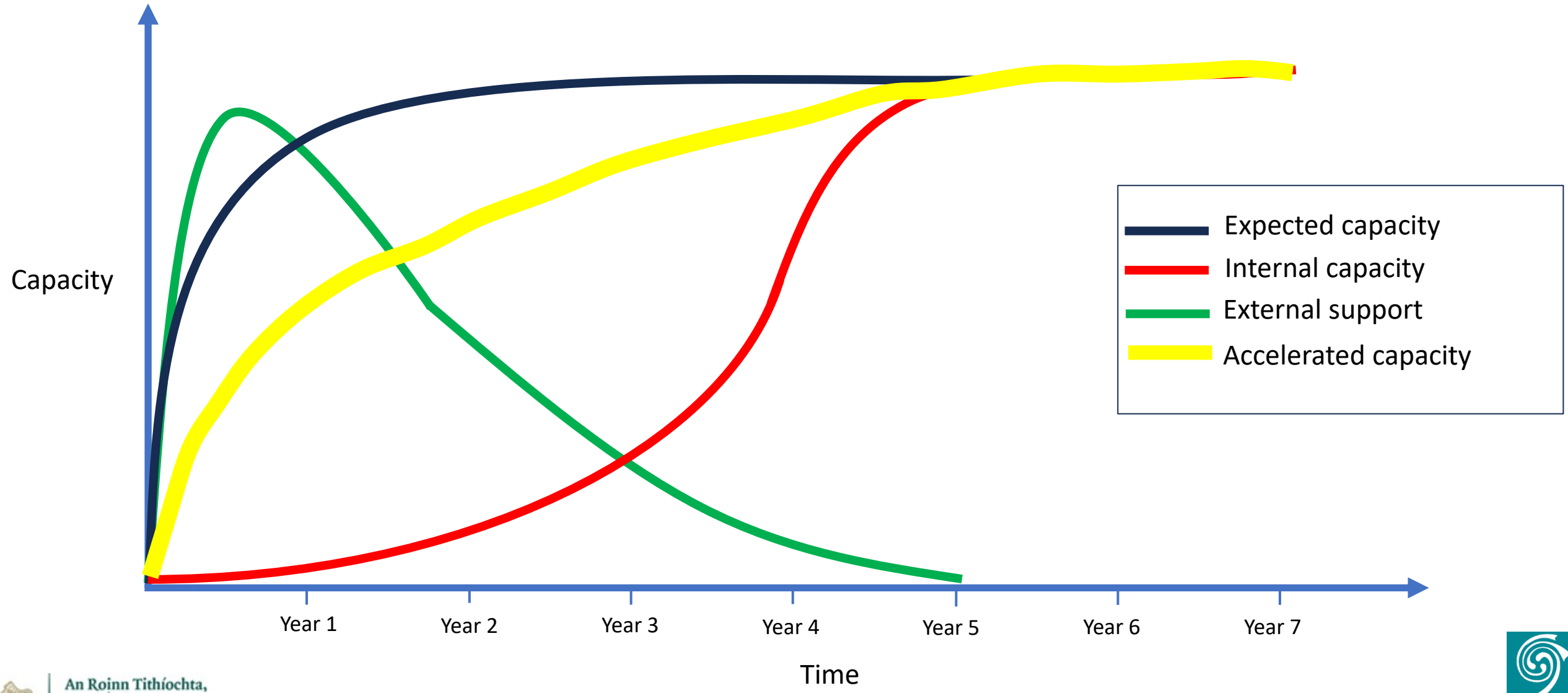
A Government Sectors | Local Authorities | Semi-State | Private | Academia

Climate Research | Modelling Groups | National Adaptation

Copernicus | EU Research | International CS Centres

Adapted from Fig 3 WMO No. 1206
The most common governance structure of NFCS

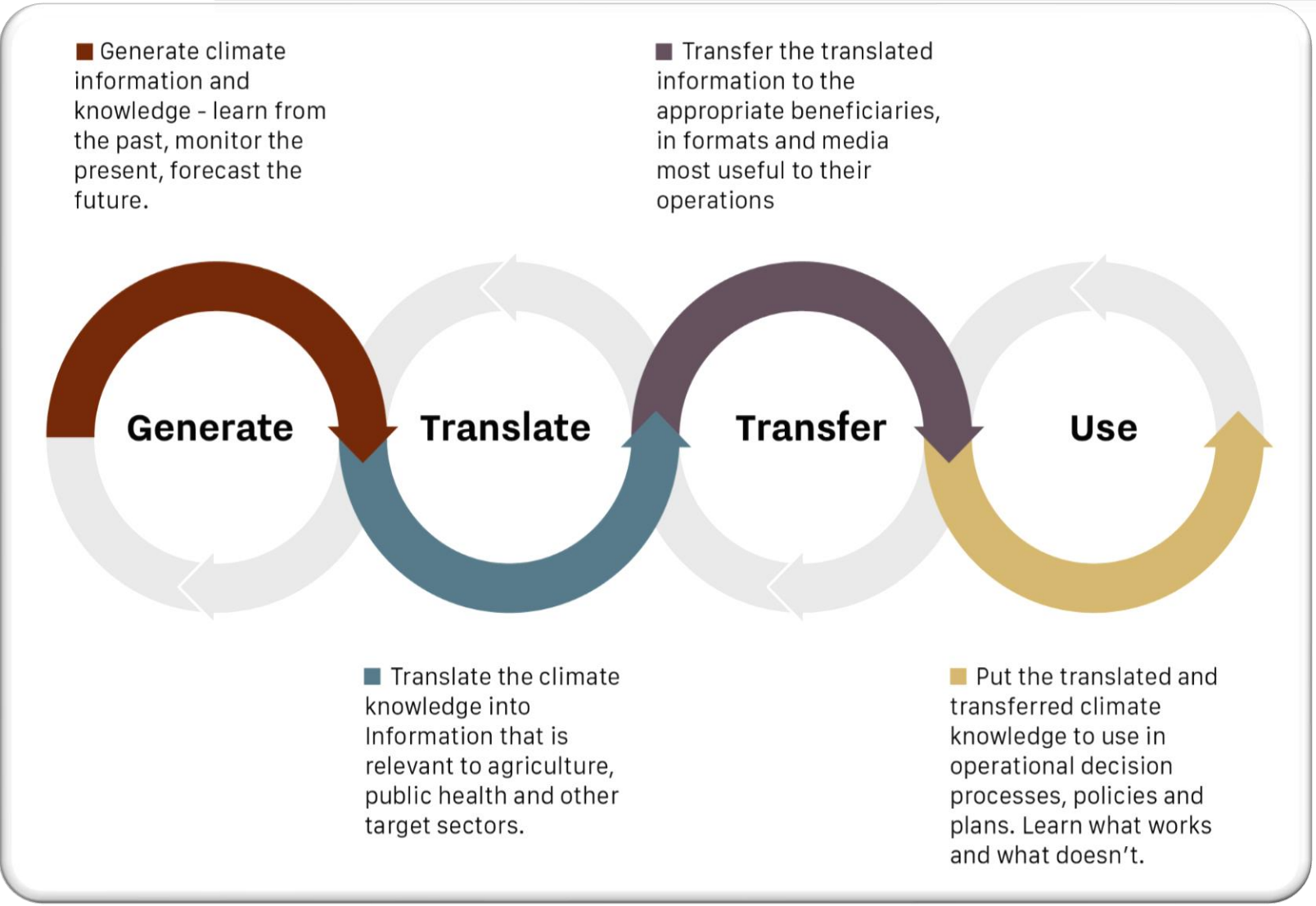
Accelerated Capacity Development



Aims:

1. Standardising national climate projections for Ireland.
2. Developing climate services to meet the Irish adaptation sector's climate information requirements.

National Framework for Climate Services

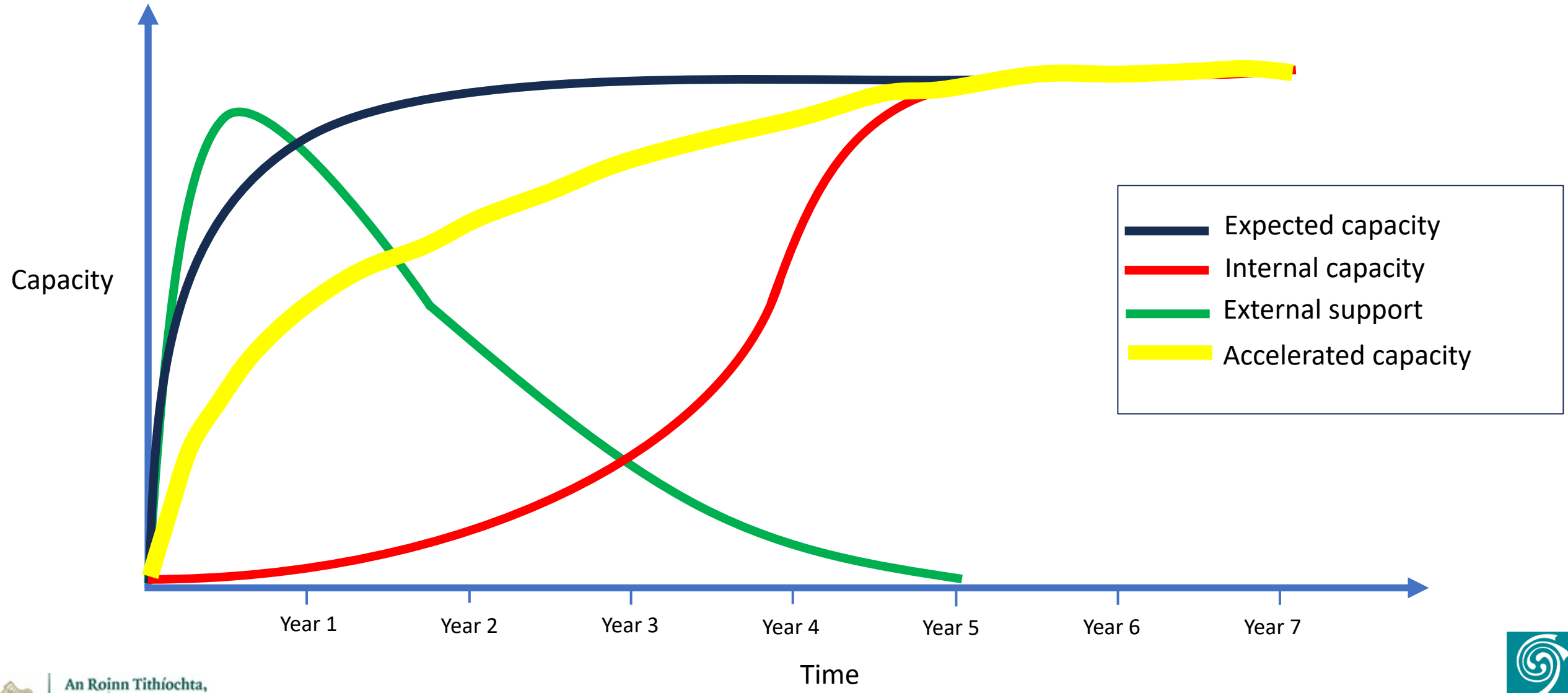


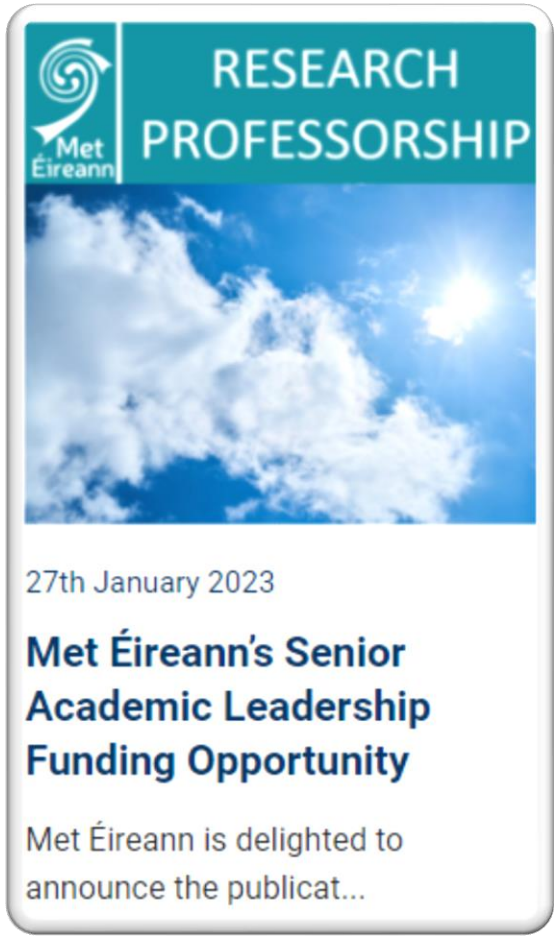
- A strong **user-centric** approach underpinned by user engagement and user needs analysis;
- **Nationally coordinated** joint service delivery;
- Support for citizens, businesses, policy maker, planners etc. who need **help understanding and applying climate information** in their decisions;
- Developing **new climate information** products and tools;
- **Increasing access** to climate data and information.

Image taken from (IRI.Columbi.edu). C. Vogel, et al. Climate Services 15 (2019) 100107
https://www.researchgate.net/publication/335333286_Climate_services_in_Africa_Reimagining_an_inclusive_robust_and_sustainable_service

Met Éireann national weather & climate research programme

Accelerated Capacity Development

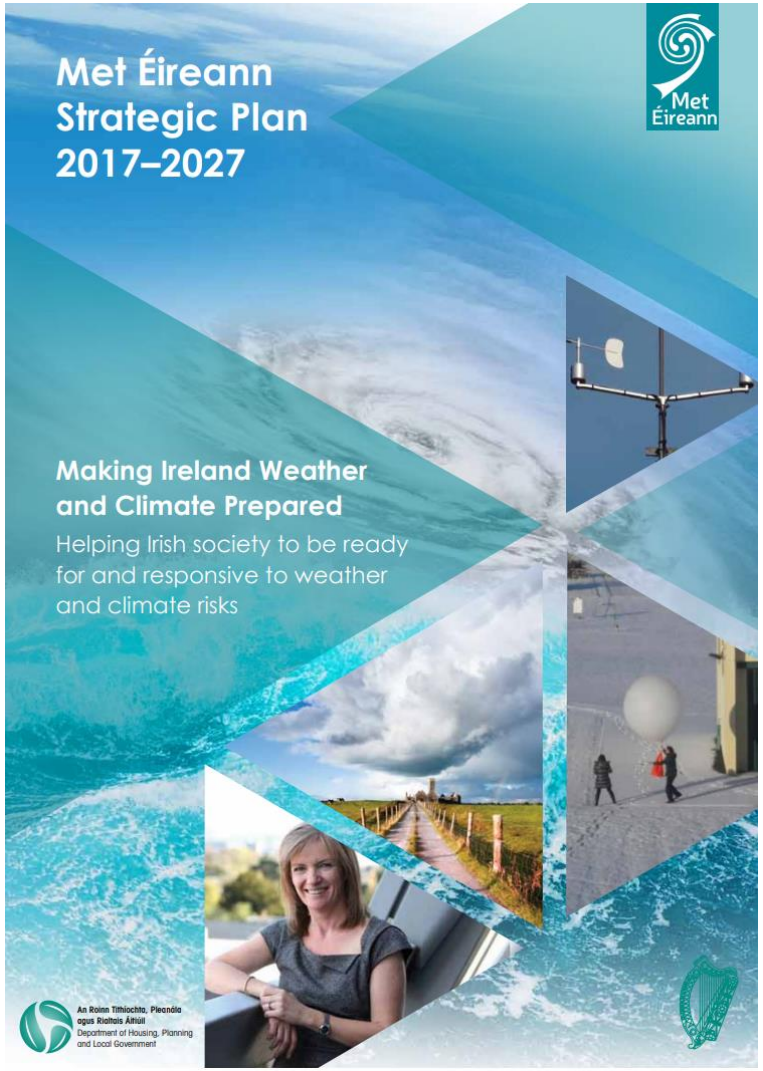




- Develop national capacity in weather, climate and flood forecasting
- Coastal modelling
- TRANSLATE II in support of the NFCS
- Atlantic Meridional Overturning Circulation
- Climate modelling
- Impact based information – UV, pollen, droughts, fires, behavioural science
- New Met Éireann Professorship programme: Computational science, Artificial Intelligence and Machine Learning and Impact-oriented prediction

Organisational Development of Met Éireann since 2016

Met Éireann, Headquarters, Glasnevin Dublin, Ireland



An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreacht
Department of Housing, Local Government and Heritage

METEOROLOGICAL SERVICE SINGAPORE

WORLD METEOROLOGICAL ORGANIZATION

Leadership and Management programme

5th September 2023





MET éireann

An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreacht
Department of Housing, Local Government and Heritage