Met Office

Research & Innovation Forward Look

Navigating weather in a changing climate



Section 1: Introduction

The Met Office strategy sets out an ambitious vision for the Met Office: Delivering the most trusted weather & climate intelligence in a radically changing world, which will deliver the Met Office purpose Helping you make better decisions to stay safe and thrive. Research and innovation are fundamental to the world-leading weather and climate science and services delivered by the Met Office and have never been more important than in this period of rapid change.

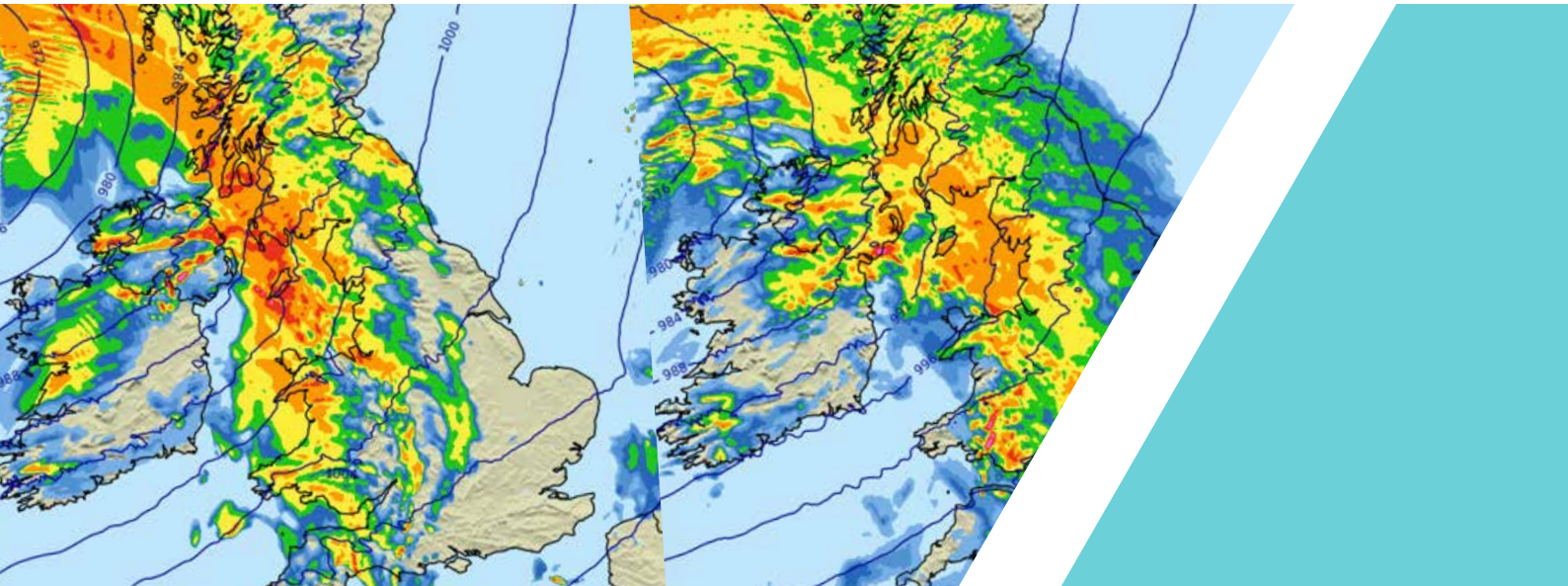
The UK is rightly seen as a leader in research into weather and climate science and in innovation of weather and climate services, with a rich network of national and international partners that includes research organisations, multidisciplinary university groups, strong Big Tech partnerships, and a hungry user community. The Met Office plays a unique leadership role in integrating the work of partners in scientific and technical research and development for innovation and delivery of weather and climate services. Delivering to the increased demand for weather and climate intelligence is driving even greater emphasis on partnerships with research institutions, universities, private sector and international organisations to maintain research and innovation progress.

This Research and Innovation (R&I) Forward Look complements the Customer Forward Look, which provides a market and customer perspective, setting out how customer, stakeholder and market needs are expected to evolve between now and 2030.

Five drivers of change are shaping the world today and the research and innovation required to ensure the Met Office delivers the most trusted weather and climate intelligence. Research and innovation will ensure we increase value and drive economic growth by delivering accurate, and trustworthy weather and climate data and intelligence supporting customer needs and delivering societal benefits. Embracing and enabling innovation will ensure we continue to create and apply new knowledge to deliver world-leading weather and climate services.

A strong focus in this R&I Forward Look is to recognise weather in a changing climate and to leverage the power of AI across the whole Met Office value cycle. This will enable us to increase cost-effectiveness, accuracy and reliability of weather and climate prediction methods, to increase agility and innovation in products and services to deliver true intelligence and to increase the efficiency of business process.

This Forward Look provides a directional view of how research and innovation will evolve across the Met Office over the next five years. It is intended to guide thinking, align effort, and support engagement with partners, and most importantly to inspire you.



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Section 2: Responding to drivers of change

Five drivers of change provide the foundation of this Research and Innovation Forward Look.

Each driver of change highlights where the Met Office needs to respond to societal needs with research and innovation strategic focus areas across the organisation.



Government priorities

As the UK's national meteorological service, the Met Office has a responsibility to support Government priorities. These include the provision of weather services and extreme weather warnings, whilst also building national resilience to climate change; the transition to clean energy; and accelerating economic growth for the benefit of citizens. Weather and climate intelligence can make significant contributions to each of these priorities. And the UK community, which includes the Met Office, research organisations and universities, is rightly recognised as a world leader in weather and climate science and services, so is well placed to respond.

Timely weather warnings allow citizens to stay safe and thrive in all weather, whilst understanding extreme weather characteristics and how they change with the climate enables us to build resilience and adapt to climate change. The clean energy revolution means that weather is the new fuel: it is a driver for both energy consumption and energy supply. There is a growing need for trusted, transparent, and relevant weather and climate intelligence that is accessible, interpretable, and directly usable by decision-makers across government and industry. The Met Office can help to drive economic growth by serving weather and climate data, intelligence, and services on easy-to-consume platforms, empowering others to create value. At the same time, financial and operational constraints require careful choices about where to invest. Demonstrating value for money and ensuring efficient organisational design and operations remain critical.



R&I questions:

- How do we nurture scientific and technological breakthroughs that enhance the UK and Met Office's status as a world-leading centre of excellence for sovereign good?
- How can we best anticipate, communicate, and help plan for unprecedented extreme events in the UK and worldwide in an era of climate change?
- With weather as the new fuel, how can weather and climate intelligence ensure that the UK's renewable energy system is secure, resilient and productive?
- How can Met Office data and intelligence stimulate and support innovation and inclusive growth across the UK economy?

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Geopolitical uncertainty

Shifting geopolitical relationships and security risks, the rise in conflict, and growing competition in the smart economy are reshaping the global landscape. More extreme weather patterns in our changing climate are increasingly influencing regional security, migration patterns, and access to critical resources. These shifts are driving a focus on specific geographical regions of strategic interest, for example vulnerable regions such as the tropics and the Arctic. There is a growing need to explore the intersection of climate and geopolitical risks to inform strategic planning and support national decision-making across energy, food, and water resilience, defence and migration policy, and ensure alignment with and responsiveness to UK international policies and agreements.

The spread of misinformation and the influence of social media further complicate the communication of trusted science. The UK, and indeed the world, requires trusted, resilient weather and climate services. As the trusted sovereign weather and climate service, it is vital that the Met Office safeguards citizens and national infrastructure through provision of robust weather and climate intelligence. Customers and partners seek assurance that services will remain secure and based on the best scientific evidence, thereby reinforcing public trust and confidence both domestically and internationally.

Research and innovation need to focus on strengthening sovereign capability, maintaining trust and transparency in a competitive landscape, and deepening understanding of the climate-security nexus. The response to these drivers includes building resilient and secure observing and forecasting systems, delivering insights that help safeguard national interests, and exploring how climate change influences migration and geopolitical stability. National and international collaboration with our partners remains central to ensuring continuity, resilience, and scientific leadership in this rapidly evolving global context.



R&I questions:

- How does the Met Office maintain trust and scientific authority against a background of geopolitical uncertainty and misinformation?
- How can weather and climate data and expertise be better combined with the intelligence from partners and other disciplines to provide advice to inform geopolitical decision-making?
- How do we work with international partners to ensure an efficient and globally resilient weather prediction capability?
- How is climate change amplifying security risks to the UK and other regions?

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Changing customer needs

Customer expectations are shifting toward forecasts that are more accurate and timely, more localised and personalised, and more relevant and actionable. In addition to forecasts, many users require broader weather and climate intelligence, which requires the integration of weather and climate data with other data sources: decision support rather than raw data. The rise of AI-driven interfaces and the spread of misinformation on social media are reshaping how weather and climate intelligence is consumed and trusted. There is a need for more intuitive services that bridge from science to decision-making under uncertainty. Many sectors, such as water, energy and food, increasingly require decision support across timescales—from short-term situational awareness to long-term resilience planning. Nowcasting and understanding hazards and impacts at short timescales are critical for situational awareness and response. On longer forecast lead times, as we experience more extreme seasons of weather, there is an increasing desire for actionable seasonal to decadal forecasting to help with planning for recovery, adaptation and resilience planning.

The Met Office's research and innovation needs to deliver personalised, timely, and actionable services that build trust and support actionable decisions. This includes enhancing data accessibility, deepening understanding of decision-making, and ensuring service agility to respond to evolving expectations and customer needs. We will innovate to ensure seamless and stable provision of weather and climate intelligence to customers. By collaborating and co-developing with partners across sectors and disciplines, we will ensure services remain relevant and trusted for both the weather of today and the weather of the future as climate changes.



R&I questions:

- How do we accelerate the research-to-development-to-operations cycles to enhance the value of products and services to decision makers?
- How can behavioural sciences ensure services support actionable behaviour and decision-making?
- What factors drive trust across different user groups? How can we enhance trust whilst responding to other drivers of change?
- How do we make our data and information readily accessible to software agents that are working alongside human users?

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Weather in a changing climate

Across the world we are already experiencing more frequent and intense weather events as an attributable consequence of climate change. As we approach warming of 1.5°C above pre-industrial levels, accelerating climate change is shifting the nature of weather hazards and increasing the likelihood of extreme, compound, and unprecedented events. With each extreme event we experience new and emerging impacts that affect people, disrupt ecosystems and damage critical infrastructure. This includes wildfires, marine heatwaves and effects of extreme weather on health. Meanwhile, potential tipping points and rapid transitions in the Earth system pose growing threats to infrastructure, ecosystems, and public safety. Communities and organisations need trusted intelligence to understand, anticipate, and respond to these emerging threats. Along with partners, the Met Office must ensure that people are prepared for these new events and the emerging impacts, and that our systems and services can forecast and warn for them in advance. Society at large needs early and actionable warnings of extreme weather events, and context through descriptions of plausible but previously unseen events, to support adaptation and to build resilience into all aspects of modern life and at local scales. In parallel we must also generate the evidence and insight needed to inform effective mitigation strategies, helping to reduce greenhouse gas emissions and limit future climate risks.

Research that enables the enhancement of our collective capacity to detect, characterise, and forecast extreme weather and climate events, including the identification of the early signs of tipping points will be key. Innovation will ensure that Met Office weather forecasts of extreme events in a changing climate are better informed and delivered with increased confidence in ways that are accessible and can be combined with other types of data and intelligence to support decision- making. Priorities also include deepening scientific understanding of the pace and variability of climate change across regions and scales and developing effective communication strategies to ensure stakeholders and the public are prepared for future weather and climate risks.



R&I questions:

- What is the full range of weather hazards we could experience now, and what is the range of changes we need to plan for in the future? How rapidly are risks changing and what new risks are emerging?
- How can the Met Office innovate to ensure customers are confident to make decisions in the face of unprecedented extreme events?
- What tipping points might be triggered, what impacts could result, and how can we detect their onset early to maximise the time to plan our response?
- How can we better scale the weather and climate services we deliver to enable more resilience and to unlock opportunities for all across the UK and beyond?

Technological disruptors

Technological innovation is rapidly reshaping all aspects of our lives. Advances in AI, supercomputing and data platforms, novel measurement techniques, and new communication channels are enhancing modelling, analyses, integration, and communication of information. However, the growth in data volume and complexity presents significant challenges in storage, interrogation, and communication. We have also seen the price of compute rise to unprecedented heights, demanding careful and responsible use of a precious resource. At the same time, there is increasing pressure to balance innovation with assurance, and to manage ethical concerns around the deployment of new technologies. These disruptive innovations are affecting everything we do at the Met Office, from the observations we make, our prediction codes, the methods to convert data into expert advice and intelligence to customers, right through to business processes and those of partners and customers.

We will accelerate the development and deployment of AI for code generation, for weather and climate modelling to enhance physics-based approaches, and for post-processing, while making cost-effective use of computational and data resources. The Met Office's approach to adopting AI is captured in a more detailed AI Plan. Focused research and innovation is needed to realise the potential of emerging technologies to deliver weather and climate information in products and services, strengthening cybersecurity, system resilience, while upholding transparency, ethics, and trust. We will leverage strategic partnerships with industry and government to support users in extracting value from Met Office data through agile, cost-effective, and collaborative approaches.



R&I questions:

- What is the optimal blend of physics-based and AI-driven approaches for weather and climate modelling to harness the strengths and cost-effectiveness of both approaches?
- With new technologies opening new methods of observation and data processing, how can we design an optimal observing network across space, atmosphere, land and oceans?
- How can we harness emerging technologies and their data to evolve products and services to provide the weather and climate information customers require?
- What role does emerging technology like AI play in improving efficiency in business processes, in technological development and in scientific discovery?

Section 3:
Where will we focus?

Responding to drivers of change requires a coordinated effort.

The Met Office is organised into three domains: **National Capability**, which delivers the science, data, research and expertise that underpin our mission; **Products and Services**, which transforms national capability data into impact for users; and **Enabling**, which provides the people, platforms and services that make delivery possible.

Research and Innovation is fundamental to all three domains, and the R&I Forward Look identifies areas for each domain in response to the drivers of change articulated in section 2.

With the world changing so rapidly, these priorities will be reviewed every eight months. For the coming period a major focus is to deploy AI across the whole Met Office value cycle.



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Focus areas for Products and Services

Maintain and nurture trust among customers and stakeholders

We will maintain our reputation by understanding the factors affecting customer trust and credibility. We must be able to explain how innovations work and how they improve services to customers and the public.

Accelerate research to development to operations to services

The cycle from research to services will be accelerated so that advances are visible, usable and clearly beneficial to customers. Rapid prototyping tools will support exploration of new customer questions and help demonstrate the art of the possible.

Efficiency and scalability through automation and AI

Automation and AI offer the potential to transform expert advice and delivery of products and services. AI-enabled weather and climate prediction will enable faster, cheaper, and more accurate products for customers.

Products and Services recognise the weather in a changing climate

We will ensure products and services are fit for weather and extremes in a changing climate. Seasonal prediction will be exploited more fully to support risk management and preparedness during extended periods of extreme weather, and recovery following extreme seasons of weather, through improved presentation, narrative and contextualisation of uncertainty. Longer term climate services will move towards scalable, reproducible workflows that can be applied consistently to improve efficiency, quality and coherence.



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Focus areas for National Capability

Maintain and nurture trust through internationally recognised expertise

Our people and their scientific and technical expertise are at the heart of the credibility of the services we provide. We will maintain and develop our internationally renowned expertise in weather and climate research, development, and operations through development of our people and through collaboration with strategic partners.

Greater exploitation of observations

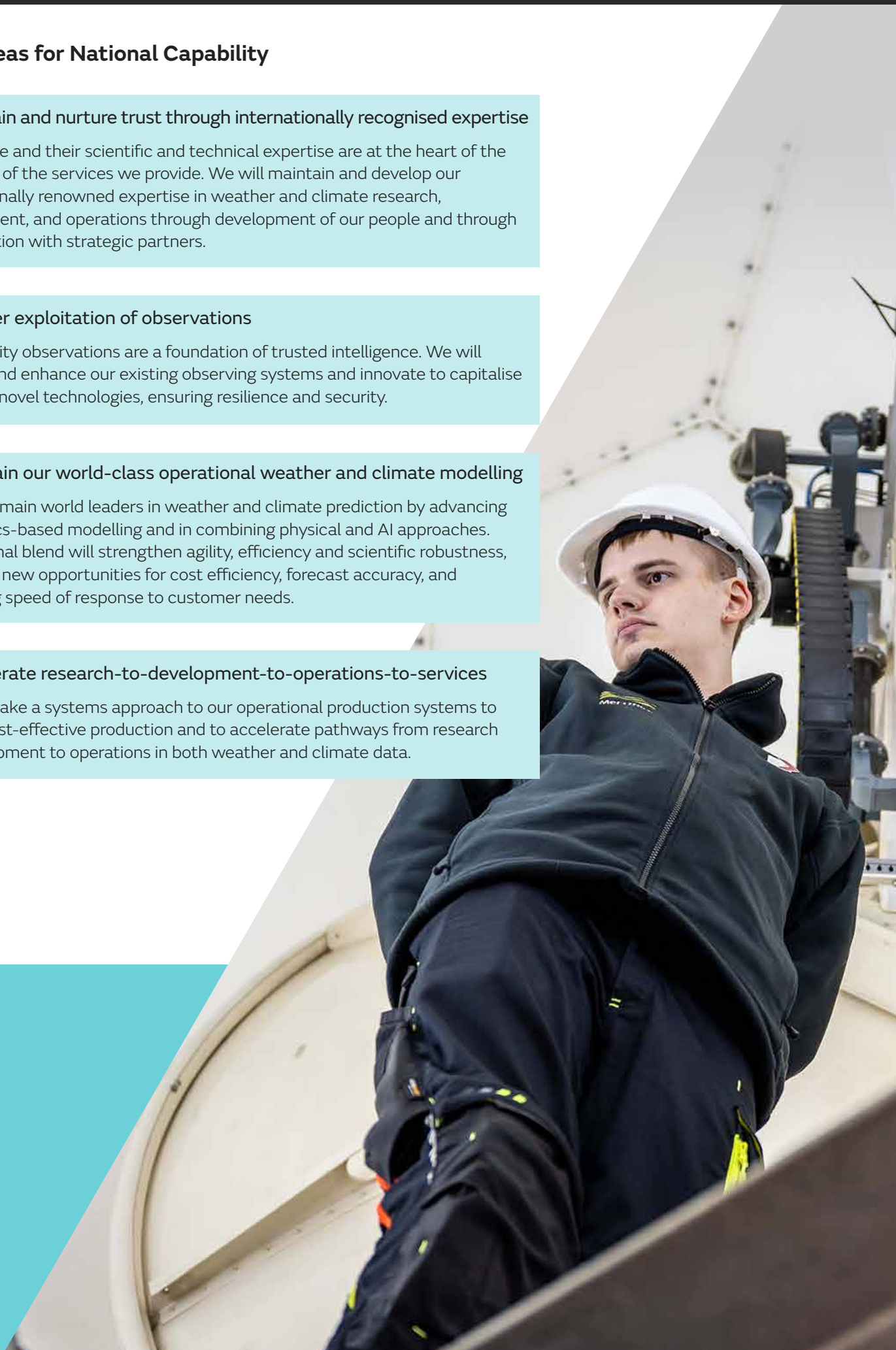
High-quality observations are a foundation of trusted intelligence. We will harness and enhance our existing observing systems and innovate to capitalise on future novel technologies, ensuring resilience and security.

Maintain our world-class operational weather and climate modelling

We will remain world leaders in weather and climate prediction by advancing our physics-based modelling and in combining physical and AI approaches. This optimal blend will strengthen agility, efficiency and scientific robustness, unlocking new opportunities for cost efficiency, forecast accuracy, and increasing speed of response to customer needs.

Accelerate research-to-development-to-operations-to-services

We shall take a systems approach to our operational production systems to ensure cost-effective production and to accelerate pathways from research to development to operations in both weather and climate data.



Focus areas for Enabling

Innovate in data, digital and technical foundations

Developing strong data and digital foundations will enable greater use of these critical assets, improve compatibility with AI tools, and enable greater flexibility and adaptability to new systems. We will reinforce cybersecurity and resilience, ensuring responsible data use and maintaining trust.

Harness AI and automation across the organisation

AI and automation will enhance productivity and consistency across the organisation, liberating staff to focus on creative and rewarding tasks.

Enable processes to accelerate research to-development-to-operations-to-services cycles

Improve processes and management to support National Capability and Products and Services to accelerate research to development to operations to services.

Communicate trusted information

Innovate through directed channels to reach the whole public and all customers, embracing social media and changing engagement patterns, building trust through careful curation and deployment of all our experts.

