Met Office

The Public Weather Service
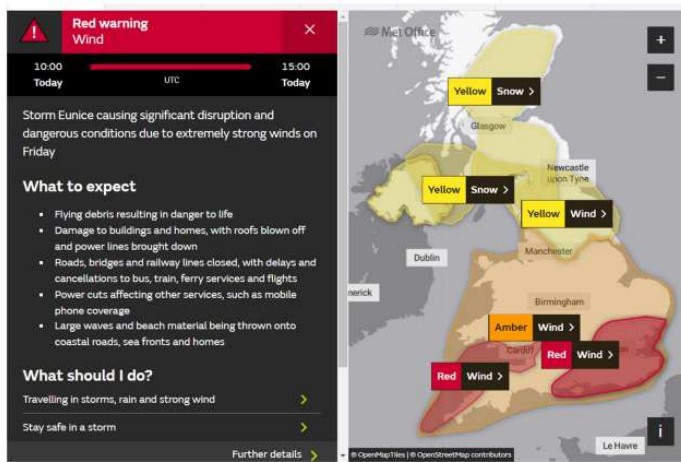# Annual Report 2021/22

Summary

Financial year 2021/22 saw several firsts for the Met Office Public Weather Service (PWS) including the launch of a new Extreme Heat Warning Service and for the first time three storms being named in one week.

Summer 2021 saw the launch of a new Extreme Heat Warning as part of the National Severe Weather Warnings Service (NSWWS), recognising that heat episodes as a result of our changing climate are likely to become more frequent and impactful, not only on public health but on infrastructure, transport, and supply chains. Shortly after the launch of the service the first warnings were issued to cover the period 17th- 23rd July 2021 in which we saw temperatures exceed 30 C for several days across large parts of the UK.

The week in which the warnings were in place saw 12 million visits to the Met Office website, 18,00 pieces of coverage of the Met Office, our Twitter posts about the warnings being seen 4.7million times and the Extreme Heat warning being carried by all major broadcasters, print, and online news outlets. Feedback from the responder community, the public and the media indicated that the new warnings capability was well received and helped to keep the UK public safe during the period of extreme temperatures.

In late November 2021, Storm Arwen brought unusually strong northerly winds and some snowfall, causing significant disruption to transport networks and interruptions to power supplies, more than one million homes experienced a loss of power as falling trees brought down power lines, with over 100,000 homes subsequently experiencing several days without power in some rural parts of Scotland and Northern England. Survey results reported that our warning messages successfully reached the wider public, with 97% of people being made aware of the red weather warnings with 80% of those who saw or heard the weather warning changing their travel plans.

February 2022 saw one of the most remarkable and busiest ever weeks in the Met Offices 168-year history. Three storms were named in one week, with two red weather warnings, significant flood risk and some of the highest wind speeds recorded in over 30 years, including an English record of 122 mph at Needles, Isle of Wight during Storm Eunice. Despite the onslaught from the weather, our forecasts and warnings, briefings to government and a host of organisations, as well as our communications to the media and the public, helped protect millions of people across the UK from

the worst impacts of storms Dudley, Eunice and Franklin. The Civil Contingencies Advisors alone participated in around 300 multi-agency resilience meetings in just a few days. Government, councils, transport operators, the NHS, businesses, and citizens were able to take early and pre-emptive action to stay safe whilst our warnings allowed decisions to be made to close schools, suspend flights, trains and ferries, close bridges, postpone appointments and deploy flood defences. Surveys of the UK public during the period of storms Dudley and Eunice shows that both levels of awareness and people taking action following the warnings were very high, awareness levels of storm Dudley and Eunice were both in the high 90%'s with 91% of people surveyed in London and the Southeast taking action based on the warnings issued for storm Eunice, the highest levels recorded since 2011.

Further highlights from surveys conducted on behalf of the Met Office during the year showed:

- Levels of public trust in the Met Office remain high, with the most recent results showing that 84% of those surveyed trust the Met Office.

- People who would use the Met Office for climate change information has tripled since 2020 and trust in the Met Office for climate change information has increased by 10 percent compared to 2020. These increases are expected to be linked to the prominence and significant involvement of the Met Office in COP26 which took place in Glasgow during October and November 2021.
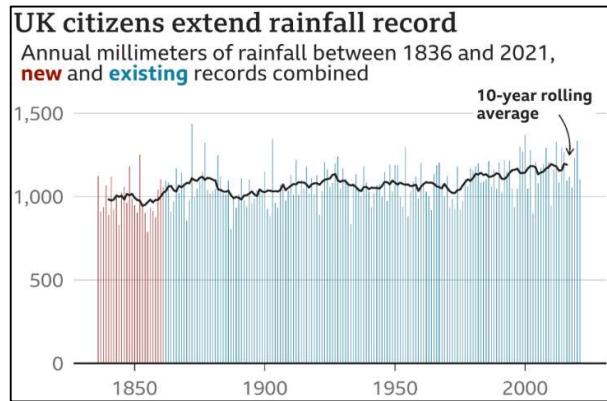
During 2021/22 the Met Office has seen significant growth in uptake of core data sets made available externally with the Met Office's Weather Data Hub service growing to more than 9 million data requests per month with an average of 1 Terabyte of data being downloaded per day. Additional datasets including the release of the Met Office global ensemble model data and further improvements being made to accessibility and ease of use of data being key priorities completed this year. Making key datasets available for external use by other organisations helps to drive socio-economic impacts and benefits to the UK public.

PWS have run a number of communication campaigns during the year, focusing on the Met Office objective of helping people to stay safe and thrive, some communication campaign highlights have included:

- **WeatherReady** - an all-year-round campaign run in partnership with the Cabinet Office to help individuals, families and communities prepare for and cope with severe weather. Two key bursts of activity took place in the summer and winter. Part of the project including aiming to reach seldom heard audiences (including non-digital and non-English speaking people) with winter content being translated into a number of languages as well as running a hyper-local test campaign in community magazines across Birmingham, Glasgow and Newcastle.

- **Misinformation** - The media plays a crucial role in distributing weather forecasts, keeping the public informed about possible impacts, and helping us all make better decisions to stay safe and thrive. However, misinformation has the potential to create confusion, undermine the legitimate message, threaten public safety, reduce trust and damage reputation. Work is ongoing at the Met Office to try to rebut erroneous but widespread weather-related media stories where possible.

- **AWS campaign** - As part of our ongoing strategic partnership with Amazon Web Services (AWS) the Met Office have taken part in an 'AWS is How'...campaign advert entitled 'Best Holiday Ever' which is designed to demonstrate how AWS helps customers including the Met Office innovate. The advertisement campaign started in February and aims to achieve 81M impressions across linear TV channels.

The Library and Archive have continued to support our customers remotely following the continuation of Covid-19 impacts but also accommodated visitors in person to facilitate major collaborative data recovery efforts ahead of the Library and Archive reopening to the public on 1 March 2022. Specific highlights this year included 'The Rainfall Rescue project' a citizen science project, launched by the University of Reading, which asked for help in digitalising the handwritten rainfall records held by the National Meteorological Archive. The project aimed to fill the huge gap in UK digital weather records between the 1820s and 1950s by inviting members of the public to transcribe observations made long before the age of computers. Converting all the data into a modern electronic form, able to be analysed by computer, was expected to take a long time, especially since the ornate handwriting on many sheets demanded human eyes do the job rather than an automated character-recognition system. But the British public raced through the information in just 16 days, including reviewing 66,000 sheets of observations with 5.4 million individual rainfall observations being logged.

UK citizens extend rainfall record
Annual millimeters of rainfall between 1836 and 2021, **new** and **existing** records combined

Along with the successes of this year there have been some challenges to overcome. Covid-19 continued to shape the ways of working especially in the early months of the year, with remote working continuing to be the main method for collaboration. The investment made last year in terms of technology improvements allowed the Met Office to continue to provide our services largely uninterrupted and to the high levels of standard expected during this period.

Summary of Performance Measures

Reference	Performance Measure	Delivery Status	Comments
PM1.1	Deliver timely, useful, and accurate warnings to the public and responder community	Met	Twenty- three verifiable Red or Amber National Severe Weather Warnings were issued this year. Of these Red and Amber warnings twenty were assessed as having provided 'excellent' or 'good' guidance to the public and Responder Communities, whilst one was assessed as 'poor' and two as 'very poor'. This assessment places the 36-month rolling average at 85.5% against a target of 77%. The rolling average over the same period for 'very poor' is 8%, against a target of being less than 20%. There have been six ad hoc surveys following National Severe Weather Warnings in FY21/22 with five of the surveys for named storms and one for Extreme Heat. All surveys exceeded targets for both 'usefulness' and 'reach'.
PM1.2	Maintain and develop the Met	Met	During FY21/22 both measures within PM1.2 were met. In responder surveys the satisfaction of the Civil

	Office Civil Contingency Advisor Service.		Contingency Advisor Service was 92% against a target of >85%, with the number of responders 'very satisfied' scoring 76% against a target of >75%. The Hazard Manager service had an average availability time of 99.93% against a target of 99.5%.
PM2.1	Produce timely and accurate weather forecasts that people use every day.	Met	During the year most aspects of the forecast that the Met Office provides to the public via the website and app have improved in accuracy. Of the six variables assessed (maximum temperature, minimum temperature, wind speed, wind direction, forecasts of precipitation, forecasts of heavier precipitation) at four different forecast periods (days 1, 3, 5 and 7 ahead), 83% have improved in accuracy across the year. There has been a modest decrease in accuracy (up to a quarter of one per cent) in some forecasts of wind direction and precipitation.
PM2.2	Improve the perceived accuracy of Met Office forecasts.	Partially Met	The Public Perception Survey confirmed that weather forecasts are perceived as "fairly accurate" or "very accurate" by 78% of the UK public (target of 80%). Of the total 78%, 15% of the UK public perceived the Met Office forecasts as "very accurate" (target of 13%). This represents a decrease on 2020/21, in which the combined accuracy was 82%. Measurement is carried out through monitoring tracker questions within the annual Public Perception Survey.
PM2.3	Maintain high public ratings of usefulness of forecasts.	Partially Met	The Public Perception Survey confirmed that weather forecasts are rated as either "fairly useful" or "very useful" by 88% of the UK public (target >87%). Of the total 88%, 38% of the UK public rated the forecasts as "very useful" (target of 40%). Measurement is carried out through monitoring tracker questions within the annual Public Perception Survey.
PM2.4	Ensure availability of products and services, including digital channels, scripts forecasts, observations, and the Public Weather Media Service (PWMS):	Met	During FY21/22 both measures within PM2.4 were met. The availability of products and services, including digital channels, weather scripts, forecasts, observations and the Public Weather Media Service were all above target. In addition, the availability of products by the specified publication times were above the target of >98.5%.
PM3.1	Maintain the reach and increase the engagement of the Met Office's direct	Partially Met	PM3.1 is made up of three measures with one sub-measure being met, one partially met, and one missed. The Met Office grew its average market share with a rolling monthly average score 7% above target (sub

	channels – app, web and social media channels.	 	measure met). Engagement rates of key social media channels (Facebook, Instagram, TikTok and Twitter) were partially met, with engagements rates above target for Facebook and Twitter, but below targets for Instagram and TikTok. User engagement as measured by the average total time spent in the Met Office apps was below targets set at the start of the year (sub measure missed).
PM3.2	Work with partners to increase the indirect reach of Met Office information.	Met	PM3.2 is made up of four sub measures with three being met and one missed. Met Office share of claimed usage which is based on user statements of 'top places to access weather information' measured via the Public Perception Survey along with the number of downloads of Met Office schools' material saw strong growth this year. The number of broadcast media partners taking the Met Office Public Weather Media Service has stayed consistently above target all year. The number of syndication video views for the year was short of target, this was due to the reach of publication, rather than Met Office content.
PM3.3	Ensure that essential weather and climate data gets into the hands of those who need it (indirect tertiary reach).	Met	This year continued to see month on month growth across every sub-section of PM3.3 as more data becomes available and is being accessed and utilised. The Met Office's Weather Data Hub service has grown to receiving more than 9 million data requests per month with an average of 1 Terabyte of data being downloaded per day.
PM3.4	Ensure the trust and reputation of Met Office forecasts is maintained.	Met	As measured via the quarterly 'Trust Tracker' survey the combined "trust a lot" / "trust a little" score was an average of 82% this year against a target of 80%. The average "trust a lot" score was 48% against a stretch target of 50%. August 2021 saw a dip in the scores to a low of 79%, down from previous August's, research has suggested that this is most likely a reflection of the challenging forecasting conditions and convective precipitation during this time, the July Consumer Accuracy Index showed that all providers' accuracy scores dipped during this period, supporting this hypothesis. The Met Office apps have both retained their respective star ratings to meet the target. Android has surpassed 4.5* attaining 4.6* in the Google Play Store, whilst the Apple Store rating surpassed the 4.6* rating attaining 4.7*

PM3.5	Increase awareness that the changing climate will influence frequency of severe weather events.	Met	During the year there have been six ad hoc surveys following severe weather events where warnings have been issued, five of these surveys were after named storms with three of these surveys after Red National Severe Weather Warnings were issued and one survey following the Extreme Heat Warning in July 2021. The proportion of the public who believe severe weather is linked to climate change averages at 63% over the six surveys conducted with the highest score following the Extreme Heat Warning at 81%.
PM3.6	Ensure action is being taken by the public after seeing or hearing a Met Office forecast.	Met	The percentage of the public who took action as a result of a weather forecast was 89%, ahead of the 85% target and the highest level of action since the question was introduced in 2019. Measurement is carried out through monitoring tracker questions within the annual Public Perception Survey.
PM3.7	Ensure the Met Office is the guardian of the nations' memory of the weather by providing a library and archive fit for the 21st century.	Met	100% of enquiries received this FY were responded to within the 5 working day target. Enquiries handled this year were down by 12% with an average of 124 enquiries received per month, with 80% of enquiries coming from members of the Public. 3,031 new items were added to the Met Office online catalogue including books, archive data and reports.

Other Service Delivery Highlights

Supercomputing capability

Work is continuing to progress the implementation of the Met Office's new and bigger supercomputing capability. The primary benefit of this supercomputing capability is the enablement of socio-economic benefits to users (both directly and indirectly) of Met Office weather and climate services through the improved quality of predictions. The enhanced capability brought about by the new supercomputer is expected to enable the Met Office to run very high-resolution UK models which will move us towards city-scale urban modelling, providing benefits to users including those located in the most populated areas of the UK. The benefits from this capability should be that users receive a greater level of local detail and in time will enable new meaningful services for citizen and industry provided via the Met Office's PWS remit.

International Commitments

World Meteorological Organisation (WMO): WMO activity was focussed on the Extraordinary Congress in October. Key decisions were the adoption of a new unified data policy and new standards for the Global Basic Observing Network. The Met Office Voluntary Cooperation Programme successfully delivered all of its planned objectives, including support for remote island observations, delivering of media equipment and training for Malawi, Vietnam and Zambia, supporting the management of climate data in developing countries, and provision of scientific and management training.

EUMETSAT: EUMETSAT operational satellites continued to perform well and progress on the replacement geostationary and polar orbiting satellite programmes continues. EUMETSAT will operate the Data Lake for the EU's Destination Earth Programme and will continue to operate a series of satellites and instruments as part of the EU's Copernicus Earth monitoring system.

European Centre for Medium Range Weather Forecasts (ECMWF): ECMWF have established their new EU facility in Bonn and opened its new data centre in Bologna. It also accepted an offer from the UK Government to provide a new headquarters on the University of Reading's campus. ECMWF will continue to deliver the EU's Copernicus Climate Change and Atmosphere Services and contribute to the Copernicus Emergency Management Service (CEMS). They will develop and operate the first two digital twins for the EU's Destination Earth Programme.

EUMETNET: Klemen Bergant took over as Executive Director in September. Members of EUMETNET and ECOMET agreed the European National Meteorological and Hydrological Service Strategy in May. This has been a busy year for EUMETNET as members seek to integrate ECOMET into EUMETNET and prepare for the next Programme Phase which will start in 2024.

Development Milestones

Reference	PWS Milestones Overview	Delivery Status
MS1.1	Advisor improvements.	Met
MS1.2	Warning improvements.	Met
MS1.3	Improvements to communication of warnings.	Met
MS1.4	Improvements to advice for 'when it matters' beyond the national severe weather warnings.	Met
MS2.1	Other accuracy improvements.	Met
MS2.2	Improvements in communication of weather forecasts.	Due October 2022
MS2.3	Health and wellbeing forecasts.	Due October 2022
MS3.1	Describe all the research and evidence for the performance metrics in Theme 3.	Met
MS3.2	Undertake a review of how forecasts, are seen and understood and via which channels with the aim of improving communication to drive action and reach of Met Office channels.	Met
MS3.3	Investigate and implement recommendations for visualisation of weather forecasts (including safety forecasts) and information for multiple audiences, when and where it matters.	Met
MS3.4	Develop a strategy for increasing awareness of the Met Office as the provider of weather forecasts in the United Kingdom for all members of the population.	Met

MS3.5	Develop and implement a strategy for reaching people who are not getting weather information, and those who are most vulnerable to impacts from the weather and climate.	Met
MS3.6	Maintain broadcast media customer satisfaction.	Met
MS3.7	Develop a roadmap for data releases over the next 4 years with an annual review.	Met

[MS1.1] - Advisor Improvements

Met Office Civil Contingency Advisors supports the UK Resilience Community at all levels of government across all four nations. Within this milestone the Met Office has developed a new method for reporting quarterly to the PWS Customer Group on key activities undertaken by the Advisors, its successes and challenges during the year. Additionally, we have reviewed options to extend aspects of the service to the UK voluntary sector, including community resilience groups, which increasingly form a key component of the response provided to the public in relation to severe weather. We are expecting to open up aspects of the service to this important sector during 2022 and provide training and education to support its use.

[MS1.2a] Warnings Improvements - Launch an extreme heat warning service

Following consultations with government departments, media broadcasters, responder organisations and the public, the Met Office increased the scope of the National Severe Weather Warning Service to include warnings for extreme heat across the UK. Warnings are issued based on assessment of impacts to safety, infrastructure and property and the likelihood of an event occurring, so a key part of this activity involved working closely with the health and transport sectors to ensure the impact criteria for issuing warnings is based on robust evidence including hospital admissions, temperatures likely to case softening of road surfaces and potentially disruption to rail services, amongst other impacts. The first warnings of extreme heat were issue in July for Southwest England, Wales and Northern Ireland.

[MS1.2b] Warning improvements – Improve the context and advice in warnings

Research from last year has confirmed that the public would like clear advice to be provided alongside warnings to enable them to take appropriate action. Within this milestone the Met Office has worked with a behavioural change psychologist and specialist communications agency to develop evidence-based impact and advice statements to increase the likelihood that the public undertake protective behaviour and action during severe weather. Additionally, advice statements have been developed, focussing on the more severe weather warnings (Amber and Red), which have been reviewed and endorsed by partner agencies to ensure that the Met Office is recognised as the source of UK National Severe Weather Warnings (NSWWS).

[MS1.2c] - Improve short notice warnings

New capabilities that provide greater precision in forecasting convectively driven precipitation, including thunderstorms have been developed and evaluated during the year. Intense rainfall may lead to flash flooding and have significant impacts to public safety, infrastructure and transport. Improving capabilities that assess the likelihood and evolution of severe convection is key to providing the public and emergency response partners with the best possible advice. Case studies have been completed which illustrate the potential of the new capabilities to improve the spatial and temporal accuracy of warnings of rainfall and lightning over the next few years. Further work is planned to evaluate their impact on the accuracy of warnings during the next few years.

[MS1.3] Improvements to the communication of warnings

The Met Office provides a range of services to the UK Resilience Community to support their activities to help the public stay safe and thrive. Within this milestone we have developed a number of options to increase the accessibility of weather information available to this broad sector, with the aim of improving its interoperability to enhance decision making. We are expecting to develop a series of Application Programming Interface's (APIs) over the next two years, prioritising where the demand is greatest, and the benefits are clear.

[MS1.4] Improvements to advice when it matters

There is a growing requirement from government departments and media partners to provide an extended range (up to 6 months) seasonal briefing to support planning and logistical activity. Within this milestone the PWS has assessed its capabilities to gauge whether useful and consistent information can be provided across this extended period and has concluded that non specialist bi-annual briefings to government departments and some strategic resilience partners are practicable.

Additionally, as part of this milestone, the PWS has undertaken research to evaluate user needs and benchmark the usefulness of mountain and beach forecasts, then developed a series of recommendations to improve accessibility and use over the next two years.

[MS2.1] Timely and accurate weather forecasts that people use every day - Improve Perceptions of Accuracy

Increasing public perception of accuracy is important because members of the public make decisions to stay safe and thrive when they have confidence that the forecast is accurate. Within the PWS we measure and aim to improve accuracy in three ways: actual through gains in science and technology, perceived through design and usability and comparable accuracy, how Met Office perform in relation to other providers.

Based on analysis carried out this year three themes have been identified that the Met Office can influence to increase or decrease a person's perception of accuracy, these are:

1. Scientific accuracy – how accurate the forecasts are compared to observations

2. Interaction with Met Office services – how the forecast is displayed and understood

3. Accuracy communications – what and how accuracy messages are communicated

[MS2.2] Improvements in the communication of weather forecasts

Most Met Office forecasts cover a period out to a week ahead, even though some users make a range of decisions across a longer period of time, spanning up to 2 weeks ahead or longer. Within this milestone the Met Office is evaluating user needs for forecasts that cover up to 2 weeks ahead, with the intention of providing these on the website and mobile app in a way which is engaging and recognises the inherent uncertainty in forecasts, particularly at longer forecast ranges.

[MS2.3] Health and wellbeing forecasts

In addition to common weather information, the Met Office provides forecasts that support health needs, including air quality, pollen and ultra-violet (UV). This milestone spans two years, during 2021/22 we have focussed on user engagement to better understand current awareness of these forecasts and user needs. We have also assessed the current level of science capability and developed recommendations to improve our accuracy and health services in ways that matter to our users. Key

findings confirm that there is a growing need for information, though current awareness is low. There is a need for additional education and advice to support decision making and action taken based on the forecast. Further work is planned during 2022 and recommendations will be delivered October 2022.

[MS3.1] Produce a report detailing the research and evidence underpinning performance measures that apply to Theme 3

A report was prepared and provided to the PWS Customer Group in November 2021. Rather than reporting on single performance measures, the report recommended developing a basket of measures which would use quantitative methodologies, supplemented by qualitative information to provide a richer evidence based to demonstrate the Met Office's performance. Monthly reporting of measures and written commentary will be provided to the PWS Secretariat each month, along with more in depth analysis of data at regular interviews throughout the year.

[MS3.2] Review of how forecasts are seen and understood and via which channels to improve communication and drive action and reach

To help the UK public make informed decisions to enable them to stay safe and thrive, it is important that users can interpret and understand the weather information being communicated to them. Informed decision-making is strongly influenced by a comprehensive understanding of the weather forecast. With improved public understanding, we expect to observe increases in perceptions of accuracy, higher levels of trust and a greater chance that the public will understand how the weather will impact them and therefore make appropriate decisions accordingly. The Met Office has assessed *current levels of* understanding and shared findings with communications and behaviour change specialists who used these findings to carry out subsequent research to understand the complexities of communicating weather. We have identified several areas where the public has a reduced level of understanding the forecast and has tested several digital design concepts to assess whether they improve the communication of weather.

[MS3.3] Recommendations for visualisation of weather forecasts and information

The Public Weather Service provides a range of channels to make weather information available to a diverse range of users, including the public, emergency responder organisations, media broadcasters and through its Voluntary Cooperation Programme, to meteorologists in other parts of the world. During the year we have reviewed each of these channels and developed options that will improve consistency of message, performance and our capacity to evolve them over the next 2 years, in-line with priorities of the PWS Customer Group. This will include establishing a common briefing capability and provide greater focus on priority audiences.

[MS3.4] Develop a strategy for increasing awareness of the Met Office as the provider of weather forecasts in the UK

A communications strategy and plan has been developed to increase awareness of the role of the Met Office in assisting the public to stay safe and thrive through taking appropriate action. The key components of the strategy include: delivering an enhanced weather communications plan and delivery of targeted communications to raise awareness of Met Office indirect services available to partners, and direct services.

[MS3.5] Develop a strategy for reaching people who are not getting weather information and most vulnerable to the impacts from weather and climate

The PWS has reviewed its reach by audience type and identified groups who do not currently access weather forecasts, including people who are more vulnerable to the impacts of weather. For the Met

Office to assist the UK public in decision making to enable them to stay safe and thrive, we need to be reaching people who are not currently getting weather information, including those groups identified as most vulnerable to the impacts of weather and climate. Work undertaken this year has established who these groups and will be followed in 2022/23 by further activity to develop recommendations outlining which channels, both direct and indirect will enable access to these groups.

[MS3.6] Develop a broadcast media customer satisfaction score

Providing high quality and consistent weather information to the public is essential and the Met Office works closely with media partners to achieve a consistency in message. The Met Office provides data and guidance for use on television, radio and digitally. We have assessed the quality of services provided via a series of surveys which will be used to establish a benchmark of satisfaction.

[MS3.7] Develop a Roadmap for data releases over the next 4 years with annual review

A roadmap highlighting when additional forecast and observational data sets will be available to users outside of the Met Office has been created, using a new prioritisation framework. This roadmap includes data releases to a range of sectors, including public, other weather service providers and industry. Uncertainty with release dates increases in time, meaning that just the first 12-months of the roadmap has been published on the Met Office website. The roadmap will be reviewed and updated annually.