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UK Coastal Monitoring and Forecasting (UKCMF) Service - Strategy for 2009 to 2019

Environment Agency
November 2009



FLOODFORECASTINGCENTRE

We are the Environment Agency. It's our job to look after your environment and make it **a better place** - for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

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1 Vision

We will provide strategic coastal forecasts to support the current and future needs of those who provide coastal warnings.

We will secure the future of the monitoring networks that underpin those forecasts and provide evidence for a managed response to the potential impacts of rising sea levels and climate change on communities.

2 Overview

2.1 Purpose and audience

The purpose of this document is to define the strategic direction of the United Kingdom Coastal Monitoring and Forecast Service, known as UKCMF. The document explains the vision for UKCMF, the aims of the service, and how it proposes to achieve them. It also provides a timescale for carrying out the strategic activities.

The document has been prepared to provide direction to the service for those who have contributed to it. These include partners, suppliers to and funders of the service and those managing it.

As a strategic document it provides an overview of the activities which define the service. It does not provide a detailed technical description of current activities or give detail of future activities.

It is envisaged that this will be a "living" document, which we will regularly revise to take account of changes as UKCMF develops.

2.2 Current position

The current service is managed by the Environment Agency, who, with grant in aid funding from Defra and the Scottish Office, provides the main management team for the service. The Environment Agency is supported by a number of key partners and suppliers:

- the Met Office;
- Proudman Oceanographic Laboratory (POL);
- Centre for Environment, Fisheries and Aquaculture Science (Cefas);
- British Oceanographic Data Centre (BODC);
- Flood Forecasting Centre (FFC).

The service is mainly used to provide forecasts of tide levels and wave conditions around the coastline of the United Kingdom. The service also provides valuable long-term data records on tide levels (both astronomical and surge components) and recorded wave data, which underpins the forecasting service and improves the base of evidence for other activities in the coastal environment. Many activities ensure the monitoring of data and forecasting of coastal conditions. These activities complement each other and share both understanding and resources, providing an effective partnership and service.

As well as the Environment Agency, organisations that use the data include other national flood warning bodies (for example, Scottish Environment Protection Agency (SEPA), and the Dutch organisation Rijkswaterstaat), scientific organisations (for example, Natural Environment Research Council (NERC)), consultants, emergency services and others.

The Environment Agency has maintained and developed the service since taking over management from Defra in 2005. There is now a need to formalise the future for the service so that appropriate funding and resources can be obtained.

A range of strategic options were discussed for the service in autumn 2008 and the direction outlined within this strategy was agreed as the way forward.

2.3 History

The Storm Tide Warning Service (STWS) was set up after the east coast flooding disaster of 1953, to provide warnings of impending high water levels. This was originally based on a

network of tide gauges, which were then increased to cover the whole of the country. After weather and surge models were developed, the Met Office was then able to provide national forecasts and warnings.

In 1996, the Environment Agency took over the role of issuing flood warnings to the general public. In January 2005, responsibility for the service passed from Defra to the Environment Agency as the principal operational user. From 1 April 2009 the service was renamed 'UK Coastal Monitoring and Forecasting' (UKCMF) to more accurately reflect the service carried out.

2.4 This strategy

This strategy needs to link in with a number of other strategies developed by both the Environment Agency and other bodies. The main strategies that need to be considered in managing and developing UKCMF are:

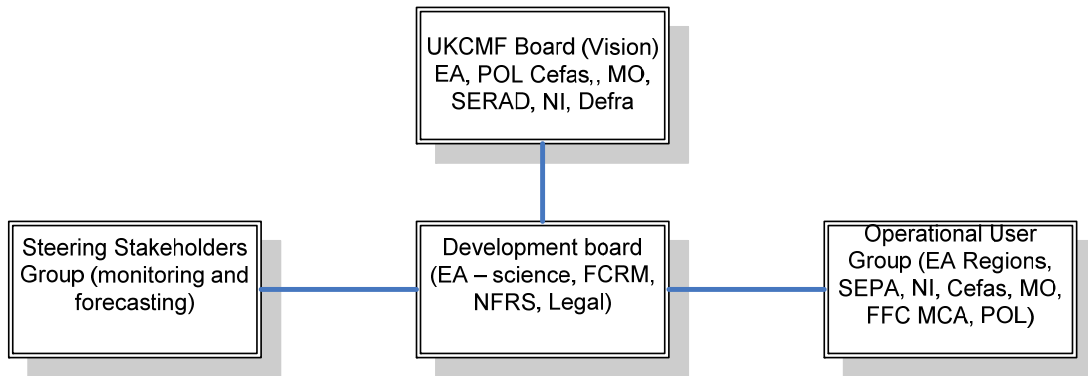
- Flood Warning Investment Strategy
- Data and Data Management Strategy
- Mapping Strategy
- Modelling Strategy
- Flood and Coastal Risk Management Strategy
- Environment Agency Long Term Investment Strategy
- Floods and Water Management Bill (England and Wales)
- Flood Risk Management Bill (Scotland)
- European Coastal Strategies
- Marine and Coastal Access Bill (England and Wales)
- Marine Bill (Scotland)
- European Environment Agency 2009 -2013.
- National Coastal Monitoring Strategy

Some of these strategies are still being reviewed and changed, and are yet to be fully released, we will have to investigate and strengthen these links further as these strategies moves forward.

3 Management

3.1 Structure

The diagram below shows UKCMF's management structure.



The UKCMF board will take policy and direction from Government to shape and communicate the visions and aspirations of the service. The Environment Agency, as the organisation managing the service, will chair the board, which will be made up of executive managers from each of the key organisations.

Three groups will support the board. The steering group aims to review the performance of the service, using the wider coastal risk management community. The group will make sure that best practice is used and that the service integrates with the wider community. The development board sits within the Environment Agency, providing direction and funding for activities. The user group will represent the operational need for the service. The operational users will provide both feedback on the service and direction for future development.

3.2 Flood Forecasting Centre

UKCMF provides a distinct UK-wide service, complementing the current work of the Flood Forecasting Centre, which offers an advanced forecasting service for England and Wales.

The Flood Forecasting Centre, a partnership between the Met Office and the Environment Agency, became operational in April 2009. The Centre provides the national forecasting and alert service to England and Wales on behalf of UKCMF, complementing the existing public flood warning arrangements. We will continue to work closely with the Flood Forecasting Centre in these areas.

4 Aims and objectives

The UK Coastal Flood Risk Monitoring and Forecasting Service is a unique co-ordinated partnership with resources and knowledge to provide forecasts of coastal flood risk events, supplying and encouraging this data to be used within the wider coastal community.

The outcomes in the Environment Agency corporate strategy we support are:

- Protect more homes from flooding
- Warnings are given in an emergency and acted on – accuracy and timeliness
- Flood defences operate effectively
- Fewer utility suppliers and transport are disrupted by flooding

To achieve our vision outlined in section 1, we have identified five keys aims.

We will:

1. work together to provide a comprehensive coastal flood risk forecast service for the UK;
2. develop the skills and capacity in strategic coastal forecasting and monitoring networks to meet the needs of those using them both now and in the future;
3. provide the long-term evidence to develop forecast models to meet the environmental challenge of climate change and inform coastal flood risk management;
4. work with European partners to share knowledge and forecast data;
5. encourage UKCMF data and information to be widely used by allowing it to be openly available.

Within these five key aims for the service there are a number of more specific objectives. These are listed in italics below. Following each objective there is a description outlining how we will achieve this.

4.1 Work together to provide a comprehensive coastal flood risk service for the UK.

Objectives that contribute to this aim are:

4.1.1 Continue to provide high quality forecasts that meet the changing operational needs of our customers.

The service provides both real time and future forecasts of water levels and wave heights around the UK coastline. Real time information is useful during an event but forecasting is also needed to provide advanced warning of the conditions so that there can be an appropriate response to any potential flooding.

Forecasts use models to predict future conditions and are validated using measured data. In forecasts, some flood warning locations are more uncertain than others. Forecasting and monitoring should concentrate on these areas to provide improvements. This will make sure that forecasts become less uncertain as the overall performance of the service improves.

UKCMF will carry out a regular review of the service with those who use it, to make sure it is meeting their forecast needs. The review will cover the relevance, accuracy, location, coverage and timings of forecasts. UKCMF will consider how the forecast events compare to measured data from actual events. This will provide evidence of the need for improvement. The review will involve consulting with partners and stakeholders to understand their requirements, what needs to be done and the impacts of any changes that may occur.

Using the recommendations from the reviews, UKCMF will update the implementation plan, prioritising the improvements. The targeted development of forecasts and techniques will improve responses, cost effectiveness and maintainability.

UKCMF will provide policy on the implementation of local forecasting tools. This will give a more consistent and efficient service in those areas where they have to meet local needs. This will cover areas such as models, instrumentation, collection and sharing data.

The service will provide information for developing non-operational improvements.

4.1.2 Continue to invest in developing improvements in the forecasting system in line with advances in science.

As the organisation managing this unique service, the Environment Agency is responsible for seeking funding for the service. As the main user of operational forecasts, they also have a vested interest in making sure that the service continues. If the level of funding is not maintained, it is likely that the performance of the service will suffer.

The funding needs to cover not only the basic operational costs of the service (contracts with partners, monitoring networks etc.) but also the costs associated with staff training, knowledge management and the wider management of the service and its development.

Changes to the service from external influences, such as political or environmental change, need to be accompanied by appropriate funding.

UKCMF will contribute to funding research within the coastal flood risk management community where activities will help improve the operational service.

As the system becomes more efficient, the level of future funding may reduce or the benefits may increase, leading to improved value for money.

4.1.3 Promote a culture across partner organisations that encourage skilled staff with knowledge of coastal forecasting to be competent and retained.

A key part of the service is invested in the knowledge of individuals and partners. It is essential that this experience is recognised and maintained for the service to operate efficiently and effectively. Identifying key roles, people and responsibilities, both within UKCMF and externally, is critical in continuing to manage this investment. We will need to identify individuals' specialist skills, their level of knowledge and how much they contribute to the activities. We will also need to maintain their interest and reward them for being involved in the service. Training, knowledge sharing and succession planning will also reduce the impact on the service when staff or roles change.

A UKCMF Board of Management, with members from the Environment Agency, other operational users and service supply partners will create a clearer structure and help in managing knowledge. This Board will lead the partnership in developing the service. An undersecretary will support the Board and provide a main point of contact for day-to-day management and communication.

4.1.4 Publicise the importance of coastal forecasting and the operational benefits and activities UKCMF provides.

Parts of the UKCMF are well known within the Environment Agency and the coastal community. However, the extent of the service and how its component parts interact is less well understood yet important in understanding the complete UKCMF service. Implementing a communication and publicity plan will help people understand more about the service and how it provides coastal flood risk forecasts to operational users. This will improve the security and longevity of UKCMF by allocating resources better and understanding the impacts of a change to any part of the service on the whole the service

UKCMF will publicise the service, its roles and responsibilities within the Environment Agency and the wider coastal community.

4.1.5 Be adaptable, understand the needs of our customers and have planned responses with each of our supplying partners.

The UKCMF service is a complex and interrelated system. Changes to any part of the service will have impacts throughout the service. The service needs to be able to adapt to any changes and minimise any adverse impacts. To identify changes and their impacts, the service and its relevant parts will need to be reviewed. This will show restrictions and areas where improvements can be made to help accommodate future changes. This needs to include data, modelling, knowledge, resources and communication needs.

To help achieve this, the management team, partners and the steering group need to keep up to date with political, environmental, technological and organisational changes.

4.1.6 How we prove we are achieving this aim.

Carrying out customer surveys with those involved in forecasting and warning in public organisations to understand their needs are and how well the service is meeting them. Consider further surveys with our public and commercial customers about the wider use of UKCMF services.

Continuing to validate the forecasts by using the data we have, reporting on performance to the steering group at least once a year, so that we can identify operational improvements and agree future programmes of work.

Monitoring the progress of planned operational development activities against the agreed programme and making sure that they meet the activity's objectives.

Carrying out our communication and publicity plans and monitoring completion of planned activities.

Logging enquiries about the service and its products to measure the take up of the newly named service.

4.2 Develop the skills and capacity in strategic coastal forecasting and monitoring networks to meet the needs of people using them both now and in the future.

Objectives that contribute to this aim are:

4.2.1 Develop the technological capabilities of the monitoring network, making it adaptable and able to meet operational needs.

The existing coastal forecasting models, wave and water level monitoring instrumentation, data transfer systems and long-term storage have been developed since the service began.

Regularly reviewing the tools will identify and recommend both technology and organisational improvements. Implementing these recommendations will make the service more adaptable and efficient.

To meet operational needs, now and in the future, UKCMF will identify critical tools, data and information. This will cover storage, transfer, parameters, location, frequency and length of records. This will allow changes within the network to be rapidly assessed and an appropriate response to be found.

4.2.2 Recognise the need for long-term funding of the strategic monitoring network for the ongoing operational requirements for coastal forecasting and to promote the service as a main source of evidence on trends in sea level rise and land movements.

The strategic monitoring networks need longer term funding to ensure data collection, checking and storage, beyond that needed by the forecasting service. This will allow data to be available for both operational (for example, model validation) and non-operational (for example, climate change evidence) needs now and in the future.

4.2.3 Provide long-term records of measured tidal records and forecasts which are secure and subject to strict quality control.

UKCMF provides the only strategic long-term record of tidal water levels around the UK and is currently building a similar strategic data set for wave data. The security of this data set is important, not just for the operational needs of the UKCMF and its partners, but for the wider coastal community who use this data as a basis for many uses such as extreme conditions or minimum water levels for navigation.

Maintaining the integrity and quality of data is crucial, therefore ensuring that the quality control procedures are maintained at an appropriate level, and data issues resolved will lead to increased confidence in, and use of the data.

4.2.4 How we prove we are achieving this aim.

Every three months monitoring the consistency and quality of measured data to confirm the information is reliable, identifying areas of concern and proposing changes where required.

Reviewing the coverage and resilience of the monitoring network for to meet the strategic requirements.

Monitoring how the data is used, both within coastal monitoring and forecasting and wider evidence-based applications, to demonstrate the value and wider benefits of the service.

Producing a catalogue of data standards, agreements and maintenance records to demonstrate security and quality of the systems.

Demonstrating reduced installation, maintenance and management costs by using nationally consistent systems and equipment.

4.3 Provide the long-term evidence to develop forecast models to meet the environmental challenge of climate change and inform coastal flood risk management.

4.3.1 Use the monitoring network as much as possible to capture on and offshore data.

The instrumentation, telemetry and data distribution networks developed and maintained by UKCMF could also be used to provide services for other data collection activities. These could provide efficiencies to both parties by sharing the costs (for example, collecting water temperature on a wave buoy).

4.3.2 Engage with academic researchers to understand their data requirements.

UKCMF, with the support and guidance of the steering group, carry out a series of consultations to understand the academic community's needs.

4.3.3 Compliment the Environment Agencies National Coastal Monitoring Strategy.

The Environment Agency, working with coastal authorities, is developing regional monitoring strategies where improvement plans are promoted and approved with coastal groups.

UKCMF can inform and provide data for these strategies and updates to the original Shoreline Management Plans.

Instrumentation, telemetry and data distribution networks developed and maintained by UKCMF could also be used to provide information for environmental coastal monitoring.

4.3.4 Inform asset management and all data and mapping strategies.

The asset management planning carried out by the Environment Agency is coordinated through Head Office down to the Area teams who manage the Area asset management systems and investment plans. Together with the modelling strategy, UKCMF can input data and expertise which will improve the understanding of coastal processes and benefit asset management planning and coastal modelling work.

4.3.5 Be forward looking as a service, able to provide high quality advice and information.
UKCMF will consult to find out what customers need. From this, the service can be developed to provide the best possible advice and information.

4.3.6 Introduce consistent standards in instrumentation, data storage, archiving and retrieval of data.

Some areas of the current data measurement and monitoring service use bespoke techniques. Developing and applying common standards, where beneficial, in instrumentation, telemetry, data storage, archiving and retrieval will help make the service more efficient and flexible, make maintenance easier and improve data compatibility.

These standards will link with those being developed as part of more general initiatives, such as the Data and Data Management Strategy, to ensure data and system compatibility.

It is important to clarify and, if necessary, formalise the agreements for access, maintenance and hosting of gauges and data recorders. This will ensure that the service is secure and the continuity of long-term records is not compromised.

4.3.7 Provide and share best practice in expertise, instrumentation, distribution systems, processes and products.

The service will investigate producing the catalogue of products standards and metadata as part of the operational service and work on data access. The expertise held by UKCMF partners is a valuable resource which can advise on and input into new systems, processes and products.

4.3.8 How we prove we are achieving this aim.

Having UKCMF data specified for use in academic research and coastal assessments.

Monitoring access to the data, recording what, when, who and why data is being used, together with the activity on real time data sites.

In our annual report include statistics to support selecting strategic and non-strategic measurement sites.

4.4 Work with European partners to share knowledge and forecast data.

Objectives that contribute to this aim are:

4.4.1 Work with European tidal forecasting organisations.

Through the steering group UKCMF has operational and academic contacts with the European tidal forecasting community. We will strengthen and, where appropriate, formalise these links to benefit the service.

4.4.2 Expand the service to the whole of the UK and explore opportunities to work together.

Northern Ireland, Isle of Man and the Outer Hebrides are to be encouraged to become full members of UKCMF.

4.4.3 Identify and assess the European partnerships, understanding what they contribute and when we will interact.

We will explore the potential for partnerships in shared research and funding joint projects with tidal forecasting service providers in the European Community. This will build on the wider collaboration that UKCMF is to promote through the members of the steering group.

4.4.4 Along with existing finance, explore other potential European funding for UKCMF.

The service is mainly funded by the Environment Agency, with contributions from operating authorities and research bodies. The commitment to seek beneficial partnerships and work on joint projects that would improve data, knowledge and tools will require a corresponding increase in funding.

Because of this, the service will continue to look at new sources of funding for these collaborative opportunities in the UK and within the European Community.

4.4.5 Make sure that any expansion in the scope or coverage of the service is sustainable and has clear benefits.

We will need to evaluate all potential improvements to the service against the operational needs of the contributing organisations. Any expansions which do not meet these needs should be accompanied by additional funding. The funding needs to be reliable so that service is not compromised in the future.

4.4.6 How we prove we are achieving this aim.

- By increasing and maintaining membership of the steering group
- By increasing international activity on the UKCMF website
- Recording feedback from attendance of European forecasting groups, conferences and seminars
- By increasing the reference of UKCMF sourced material in European publications

Showing an ongoing measurable increase in funding sources for UKCMF from the European Community on collaboration and knowledge sharing initiatives.

Showing an increase in the number of people using the service both within the UK and across Europe.

Including in the annual report any significant contacts and communications with similar authorities.

Carrying out market research with international customers to find out what they think of UKCMF.

4.5 Encourage UKCMF data and information to be widely used by allowing it to be openly available.

Objectives that contribute to this aim are:

4.5.1 Create and implement a data policy with agreements on data sharing with partners.

The data policy will define the data that is available, where it is stored and in what format, methods of data transfer and how it may be obtained. The policy follows the principle that UKCMF will work to benefit the public, that data will be openly available to all UK customers and that all data requests will only incur administration and data processing costs.

The service will consider providing a catalogue of products, standards, metadata, contracts, data rights, availability and costs (administration charges for the supply of data to UK and non-UK customers), which will improve the use of data and understanding of the products available and lead to data being used more.

The UKCMF will, in accordance with Environment Agency guidance, set out a clear Information Systems (IS) Strategy which it will apply across the service as it develops over the next five years. The IS strategy will allow us to share information and systems with customers and partner organisations, make sure that our technology is current, compliant and fit for purpose, and that the information and systems on which the service relies support the business objectives of the Environment Agency.

4.5.2 Allow UKCMF data to be openly available to all UK customers and only charge administration and data processing costs for data requests.

4.5.3 Publish descriptions of the data available and the administration charges for supplying data to UK and non-UK customers.

4.5.4 Work with partners on data access to make sure their interests are satisfactorily protected.

Alongside developing the data policy, we will address and regularly review intellectual property rights for UKCMF

Keeping partners informed and engaged in the overarching IT policy for UKCMF

4.5.5 Continue to develop and expand the web portal for UKCMF as the single point of access for data and information on the service.

UKCMF makes most of the extensive data archive freely available through a range of different data portals. However, some data is only accessible from paper-based archives. Making this data more accessible will provide efficiency and cost benefits.

Allowing general access to UKCMF data will:

- reduce manual data requests;
- improve logging of usage of data sets;
- increase use of the data;
- increase the benefits of collecting the data.

4.5.6 Automate the data supply process with partners.

Link in with the IT strategy.

4.5.7 How we prove we are achieving this aim.

Recording the number, type and purpose of the data requests, together with the number of hits on real time data sites, to demonstrate increased use and also to support selection of strategic and non-strategic measurement sites.

Include the statistics in the UKCMF annual report, giving a summary of the collection, storage and dissemination costs which demonstrate improvements to the instrumentation, collection and transfer of data in terms of reductions in installation, maintenance and management costs.

5 Challenges

5.1 Understanding the service

UKCMF is a complex and vital service for providing timely and accurate forecasts of coastal flood risk conditions for flood warnings. The Environment Agency is responsible for managing the service but all the organisations involved have a vital part to play.

Each of the groups involved has a range of responsibilities within the service which are connected. A key challenge we need to address is to make sure that both the Environment Agency and the other partners understand their own individual and service-wide responsibilities. Otherwise, changes to the service or parts of the service could be proposed and carried out without fully understanding the impacts on both the service or parts of the service. This could have a negative effect on both the operational service, its longevity and its supporting data streams.

To improve understanding, which in turn will lead to an improved partnership between the suppliers and users, we will need to promote the service further, not just in general terms but also in terms of the roles and responsibilities of all parties and how these interact.

5.2 Knowledge management

Although much of the service relies on physical hardware, software and automated processes, there are many skilled individuals and organisations who provide an essential part in meeting the objectives of the service. The service relies on the knowledge provided and could not achieve its full operational status without this.

Maintaining the level of knowledge is a challenge for the service in the future. Managing knowledge within the service, particularly the particular skills of individuals, requires careful consideration. These key individuals and roles need to be identified and specific plans drawn up to make sure that knowledge is not lost from the service in the future. This may be in the form of extra recruitment, shadowing of roles or succession planning.

We also need to take measures to retain key people within the service so that we can manage the amount of knowledge unexpectedly lost. We could do this through a range of activities such as ensuring staff satisfaction or ring fencing positions.

5.3 Flexibility of service

There are a wide range of outside influences that could affect the performance of the service. The following are potential influences:

- Changes in UK and European legislation that alter the operational delivery of the service.
- Environmental change - particularly climate change and the impacts this may have on both strategic monitoring and coastal forecasting.
- Social changes – With climate change there is the potential for population shift into coastal areas which are at risk of flooding. Increase in population and population density mean a greater need for accurate and timely forecasts.
- Technological change - it is inevitable that the technology supporting the service will change in the future.

Organisational change - such as structure changes within the Environment Agency or the other key partners.

These potential changes could have a dramatic effect on the service, and so it needs to be flexible enough to adapt to these changes.

All parts of the service need to be flexible. We need to consider developing generic systems and codes that can be ported across different platforms (software, hardware, telemetry etc). The service structure in terms of resources, contracts etc. also needs to be flexible so that any unexpected changes that may require changes to the partnership or internal structure do not adversely affect the service

5.4 Funding

Continued funding is essential if the service is to achieve its objectives. Short-term funding will ensure that the forecasts can continue to be issued and will allow for some limited development. But, without long-term funding, many of the activities needed to meet current and future operational needs will not be possible.

The strategic monitoring and forecast services require a long-term commitment to funding to make sure that they continue to meet the objectives and the vision. Identifying and seeking sources of funding from both within the Environment Agency through grant in aid and from other operating authorities and partners will need to be planned, together with ways to protect core services in times of funding shortages.

5.5 Operational delivery

UKCMF is managed by the Environment Agency and therefore is subject to public scrutiny. The scale of work carried out within the partnership, a measure of the performance and much of the data collected is freely available.

Many activities ensure the monitoring of data and forecasting of coastal conditions. These activities complement one another and share both understanding and resources, providing an effective partnership and service.

It is possible that in the future other organisations may wish to become involved with the service and to challenge the existing partners.

The Environment Agency, as the organisation managing the service, needs to make sure that any new partners focus on providing an operationally driven service that meets the vision.

5.6 Meeting the needs of the service

With any service that is made up of a number of parts, which are developed and maintained by separate organisations, it is important to develop it to achieve meet the operational needs of those using the service.

The operational needs relate to providing the level of service needed to meet the higher goals of the operating authorities. These will be limited to activities that fit within the strategic goals of the organisations and which can be demonstrated as fulfilling those needs. Activities which may improve the service beyond the required level will be critically considered and rejected if they do not provide any operational benefit.

5.7 How UKCMF will respond to the opportunities and challenges

We will:

- identify key roles and draw up specific development plans to recruit, retain and develop staff to ensure knowledge transfer and succession planning;

- promote the scale of the service through co-ordinated communications plans to demonstrate its benefits and maintain its profile;
- promote the capability of the monitoring network to provide the data for responding to environmental changes;
- adopt and promote alternate and new technology, such as satellite data and High Frequency radar, that will bring benefits and make the service more efficient;
- aim to maintain the level of core funding for the service and extend additional sources of short and long-term funding to include other operating authorities, partner organisations and commercial operations;
- continue to set standards that make UKCMF resilient to external pressures and challenges.

6 Implementation plan

The activities in section 4 of this document do not necessarily have to be implemented at the same time. The plan for implementing the activities prioritises them as follows:

- ongoing activities
- short term (0 to 5 years)
- medium term (5 to 10 years)
- long term (10 years +).

Some of the activities under short term will continue throughout the lifetime of the strategy.

6.1 Ongoing activities

Ongoing activities are activities that UKCMF are already carrying out. These include the following:

- Irrespective of all other activities, the operational running of the service should not be affected. Regularly monitoring and measuring the performance of the whole and parts of the service against set targets will ensure this does not happen.
- Operational running of the service.
- Monitoring and measuring.
- Annual reporting.
- Succession planning.
- Operational guidance.
- Providing evidence base.
- Improving efficiency of monitoring network.
- Testing exercise to check resilience, accuracy and performance.
- Regular monitoring to support quarterly reviews and annual report on the service, which the steering group uses to determine future development.
- Investigating and accommodating changes which impact on the service and require action (such as implementing the Pitt recommendations, where possible, such as probabilistic coastal forecasting or the development of wider partnerships to provide Tsunami warnings).
- Reviewing the tide gauge network and the WAVENET network, every five years.
- The work of the service coordinates with other strategies being developed both within the Environment Agency and outside. In particular, the service will co-ordinate with the Flood Warning Investment Strategy.
- The service follows scientific developments through the steering group and service board and considers whether any findings are adopted into the operational service. This considers how science is included and whether changes would meet operational needs. The service influences the direction of research into areas where there are operational needs.
- Securing approval for the UKCMF strategy and the subsequent changes accepted.
- Engaging with the Flood Forecasting Centre as a partner supplying organisation.

6.2 Short term (0-5 years)

- Consider whether other areas, for example currents, sediment transport, wind speeds and directions can be measured at existing networks sites. Preference will be given to those areas that would improve the service and the forecasting of coastal flood risk problems.
- Share cost of data network.
- Improve skill transfer and training.
- Expand the forecasting network to the whole of the UK.

- Manage expectations relating to forecast accuracy.
- Extend lead times on the forecasts.
- Access data anytime.
- Business disaster and recovery plan.
- Provide mobile warnings and advice.
- Interested parties in these areas should be encouraged to take up the service, where the take up of data and forecasts has been previously low.
- Develop a communication plan to promote the new identity of the service across the Environment Agency and the wider community. It should also include the views of the steering group and management team together with this strategy.
- Carry out customer survey and consultation.
- Develop a data policy/plan for improving access to data collected and stored. This will link with promoting the service and its new identity and allow for easy and regular monitoring of the what, how and why questions relating to data use.
- Develop an Information Systems (IS) strategy. This IS strategy will fit with the improvements to the data collection networks and data dissemination processes to ensure ease of data sharing and compliance with other organisational requirements.
- Develop a strong management structure for the service, including planned succession for key staff and knowledge areas. This should include identifying key staff and knowledge, recognising the steering group and considering a smaller targeted management board to strengthen the partnership between organisations, with its own under secretary to manage and promote the service.
- Adapting to changes will also become more significant in the longer term, with the need to accommodate longer term political and organisational changes. Future reviews of this strategy and the steering group considering longer term initiatives within the community may help in pre-empting change.
The impacts of environmental changes may well become more frequent in the longer term and the service may have to adapt to these changes as well as providing key evidence to verify the changes.
- Furthermore, there will be greater need to become involved with EU and international initiatives as time goes on, and this may mean changes to the service and the way in which data is provided.
- In continuing to make the coastal forecasting service more efficient, UKCMF should develop policy statements for local coastal forecasting tools together with guidance on what, when and how to validate any local tools developed.

6.3 Medium term (5-10 years)

- The service may need to expand in the future to cover other regions (such as Eire). This should be considered in terms of the benefits of data collaboration, improved service exposure as well as a potential source of additional funding.
- The service should consider monitoring coastal flood risk incidents, both flooding and coastal erosion, as this would provide a further valuable dataset to improve the coastal forecasts by improving the understanding of foreshore response, providing validation data for complete systems and providing evidence for future coastal erosion forecasting.
- Co-ordinate extended service to include near shore coastal monitoring.
- Carry out international initiatives in particular working with European partners.
- Provide combined fluvial and coastal forecasts.
- Investigate combined overtopping and near shore wave forecasts.
- Integrate modelling to improve forecasts.
- Single platform for all forecast information.

6.4 Long term (10+ years)

- In the longer term the service needs to tie in with the long-term Environment Agency Investment Strategy. This strategy states what the Environment Agency and others

will need to do to meet the Government's objectives in managing flood risk and coastal erosion in England over the period 2010 to 2035.

7 Costs and benefits

The benefits for UKCMF are wide ranging and many of them intangible. A benefits map demonstrates the benefits for UKCMF work activities. These benefits relate to both the aims of the Environment Agency programme, Flood and Coastal Erosion Risk Management (FCERM) strategic outcomes and the Environment Agency strategy.

As the service is reviewed and developed new activities and changes to existing activities will need to be checked against the benefits road map to make sure that the activity is providing value.

The cost of the service since 2005 has been £9 million, of which £2.9 million has been development.

The benefits of the £2.9 million are;

- finer resolution surge models
- wave network increased from 5 to 12
- wave data used in operational forecasts
- surge ensemble available
- Increased coverage of models
- more independent running of models
- further validation of existing models
- Investment in the science of astronomical predictions
- Investment in infrastructure of the service for example telemetry and data collection

All of which increased the confidence, accuracy, usability and reliability of the service

The implementation of the strategy above and the running of the service will increase costs over the next 5 to 10 years.

Appendix A

Current situation

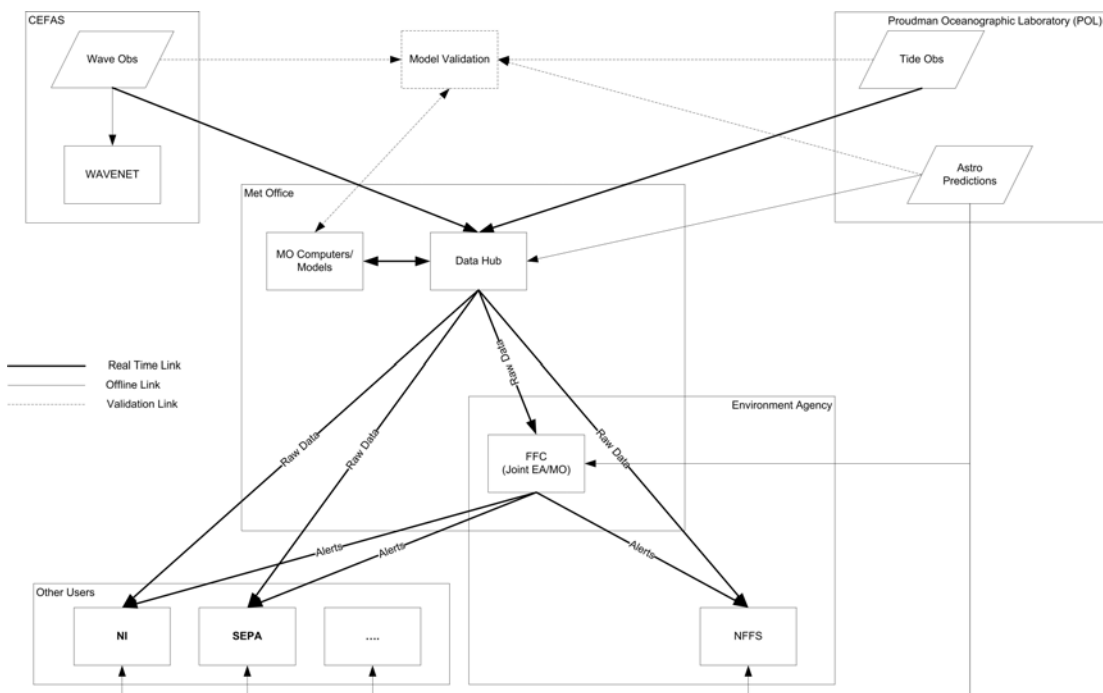
Introduction

The structure of the service is complex due to the quantity, forms, storage and transfer of data, as well as the number of organisations that use and help to process the information. This section briefly explains the structures that make up the service.

The service, forecasts surge residuals and wave heights using meteorological conditions. The measured tide data is used to predict long-term astronomic tide components. The wave measurements are used to aid decision making when forecast and validating the design of coastal structures.

All the data is made available in real time for flood forecasting and archived for model validation and other purposes.

The basic data flow diagram, showing parameters as data routes is shown in the figure below.



Water level measurements

Introduction

Water levels are measured around the UK for a number of different reasons. These include:

Specific monitoring for operating flood defence structures.

Monitoring for operating port facilities.

Measurement for technical and scientific behavioural studies.

- Prediction of astronomic tides for navigation, flood forecasting and other purposes.
- Validation of total water levels derived as forecasts.
- Long-term records for analysis of extreme levels for use in planning and design.

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- Investigating long-term changes in sea level (climate change).

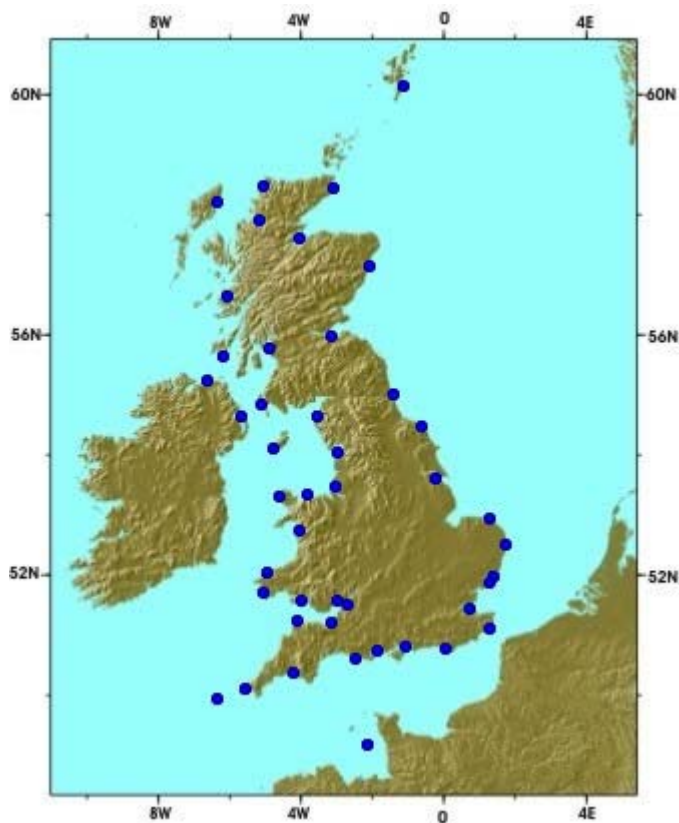
As part of UKCMF the Environment Agency funds the UK National Tide Gauge Network, which includes 44 primary gauges, which POL operate and maintain. These have been classified as strategic gauges for flood forecasting (formerly referred to as the Class A gauge network). As well as these, there are a number of non-strategic gauges which are operated by:

Associated British Ports
 Port of London Authority
 Falmouth Harbour Commissioners
 BODC
 Maritime Councils
 Environment Agency.

The following two sections discuss the tide data and use.

UK National Tide Gauge Network

The UK National Tide Gauge Network, run by the Tide Gauge Inspectorate, records tidal elevations at 44 locations around the UK coast. The UK national network of sea level gauges was established after violent storms in the North Sea in 1953 resulted in serious flooding along the east coast.



The Tide Gauge Inspectorate at POL is responsible for modernising and maintaining this network, with the aim of obtaining high quality tidal information through telemetry at coastal locations around the British Isles.

The gauges are polled regularly by a system at the Met Office and the data passed to:

- the National Tide and Sea Level Facility (NTSLF)
- the Environment Agency
- Flood Forecasting Centre.

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POL obtains a separate direct data retrieval that is forwarded to BODC who check quality and archive the data (there is approximately a week's delay in transferring this information) (historic data). The data is then made available via the NTSFL website.

Other tide gauges

As well as the UK National Tide Gauge Network, there are other gauges which are owned by:

Associated British Ports
Port of London Authority
Falmouth Harbour Commissioners
BOCD
Maritime Councils.

The Environment Agency tide gauge data is stored in raw form within a database. This is then processed and checked systematically, re-stored in the database and processed further, where necessary, and stored with individual projects.

Some of the Environment Agency gauges are used directly in the operation of flood defence structures.

The non-strategic tide gauges do not appear to be recorded centrally or systematically checked.

Water level analysis

POL uses the historic records of the 44 strategic tide gauges to extract harmonic constants for stating future tides at these locations. This is a commercial contract carried out annually and also includes deriving astronomic tides for other locations as required by the Environment Agency for flood risk management.

The predicted astronomic tides are used as the basis for the flood forecasts when combined with the modelled surge residuals. In addition, the measured water levels are also used in real time to verify the forecasts and also to validate the results of the service after the event.

Wave records

Wave conditions are measured all around the UK by wave rider buoys for a wide variety of reasons. These include:

- validating wave models, both in forecasting and hind casting;
- scientific research;
- planning and design, commercial and non-commercial;
- operational uses, forecasting.

The strategic wave monitoring network is hosted by Cefas, which collates wave records from a number of organisations. These include:

- Shell UK
- Total UK
- The Marine Institute and Met Eireann (data from the Republic of Ireland)
- Cefas
- Environment Agency and Gardline Environmental
- the Met Office.

In addition, more generic wave measurements are also obtained using satellite borne HF radar.

Disseminating wave data

Data from the wave buoys (both Cefas and others) is quality controlled and supplied by Cefas in real time to the Environment Agency (via our secure link to the Met Office). In addition, the majority of the data is uploaded onto WAVENET, a website funded by UKCMF to provide both real time and archived wave data for the UK and Irish waters.

Forecasting tools and models

Surge model

The key measures in surge forecasting are the height and the timing of the surge events. The resolution of these will depend on the rate of change in the tides heights, so that areas like The Seven Estuary and The Wash are subject to greater spatial variation than others.

The surge model is used for:

- forecasting sea levels for use in flood warnings and response;
- investigating and validating historic events;
- POL commercial and non commercial use of archived data;
- Met Office commercial use of the surge data;
- scientific research.

The surge model has been developed by POL over a number of years and has used both research and STFS funding. There are two variations of the model:

- an operational model which is run and operated by the Met Office;
- a development model which POL continues to use for validation and improving the operational surge model and other research.

The operational surge model requires a number of inputs which include:

- Met Office Atmospheric model
- POL Atlantic model (Tidal boundary input)
- Bathymetric data.

Wind and wave forecasts

Wave and wind forecasts are supplied to the service from the Met Office wave model (currently in transition from the UK Coastal Waters model to the Wave Watch III model). This data is supplied under licence by the Met Office who retains the intellectual property rights on this data. This data follows the same data dissemination routes as the surge residual data.

Warnings

The information described above will feed into both the Flood Forecasting Centre (FFC) and directly into the Environment Agency's National Flood Forecasting System (NFFS). The FFC will use the information within their flood guidance statements, looking forward over the next five days. The current forecasting service looks ahead 42 hours and further developments are planned to increase this time.

SEPA currently receives alerts for Scottish waters directly from the FFC.

The Regional forecasting teams will use the data along with localised models to provide more detailed information to the Area warning teams who will consider these against local conditions and issue appropriate warnings.

Associated activities

POL hosts the permanent service for mean sea level, storing long-term records of sea levels around the world. This is funded by research councils. This uses the water level data obtained by the Environment Agency as a key input.

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At selected UK Tide Gauge Network sites there are co-located CGPS stations, for which the GPS data can be obtained from the British Isles GPS archive Facility (BIGF) at Nottingham.

In addition to forecasts of flooding, the FFC will also provide forecasts of negative surges for navigational purposes.

Appendix B

Stakeholders

Introduction

There are a wide range of stakeholders within UKCMF, ranging from the key funders, through data and service providers to end users. A table of stakeholders was developed for the STFS strategy (2007), which listed the organisations and highlighted their general interests within the service. This table (shown below) has been developed further to highlight the range of stakeholders with an interest in the service.

Organisation	Overseeing	Funding	Operational user	R&D contributory	Data user	Data and service supplier
Defra	✓					
The Scottish Executive Environment Directorate	✓	✓				
The Welsh Assembly	✓	Possible				
The Environment Agency		✓	✓	✓	✓	✓
Scottish Environmental Protection Agency (SEPA)		✓	✓	✓	✓	Possible
Northern Ireland Department of Agriculture and Rural Development (DARDNI)	Possible	Possible	Possible		✓	Possible
Met Office			✓	✓	✓	✓
Proudman Oceanographic Laboratory (POL)				✓	✓	✓
Centre for Environment, Fisheries and Aquaculture Science (Cefas)				✓	✓	✓
British Oceanographic Data Centre (BODC)						✓
Research community (UK and overseas)				✓	✓	
Deltares/Rijkswaterstaat			✓	✓	✓	
Maritime and Coastguard Agency (MCA)			✓		✓	
Consultants					✓	✓
Local Authorities and Management Groups			✓		✓	

The headings above are defined as:

Overseeing - organisations that provide government level support to the service.

Funding - organisations who contribute financially (either directly or by providing services funded by others) to the operation of the service.

R&D contributory - organisations which contribute research and development knowledge to the service without the need for specific funding.

Data user - everyone using the data in a non-real time environment.

Supplier - organisations that supply data, information or knowledge to the service and are paid for this. This includes, for example, data collection, data dissemination and R&D contracts.

The following sections highlight some of the key stakeholders and their involvement in the service.

Environment Agency

There are a number of different stakeholder groups within the Environment Agency. They have a common goal, to provide forecasts of the risk of coastal flooding to the general public, but their interests and involvement in the service vary greatly with their specific functions. The list below indicates some of the key functions within the Environment Agency with interests in the service:

- Regional Flood Forecasting and Area Flood Warning teams - **Operational user**.
- R&D Science Themes - **R&D** and **suppliers**.
- Telemetry - **Data supplier**.
- National Capital Project Management Service - **Data user**.
- Development Control - **Data user**.
- Policy - **Funding, data user** and **steering/directing**.

As well as these roles, as the custodian and key funder of the service, the Environment Agency has to manage the service and make sure that it continues to meet the operational needs of all those that use it.

Flood Forecasting Centre

The Flood Forecasting Centre (FFC) is an independent body jointly set up and staffed by the Environment Agency and the Met Office. The FFC will initially provide the Extreme Rainfall Alert Service and National Flood Guidance Statements. The full roles and responsibilities of the FFC are still being finalised, but it is expected that it will both be a **supplier** and **operational user** of the UKCMF.

SEPA and DARDNI

The Scottish Environment Protection Agency (SEPA) is a major stakeholder in the UKCMF acting as a **funder, operational user, R&D contributory** and a **data user**.

The Northern Ireland Department of Agriculture and Rural Development (DARDNI) is, at present, only a data user but is interested in becoming more involved with the service.

Met Office

The Met Office is a partner in the service. It provides critical forecast information, runs the forecast models and shares the information and knowledge with all parties.

As part of their involvement in the service, the Met Office provides atmospheric condition forecasts to run the tidal surge models, together with wind and wave forecast results from their forecast models.

POL

The Proudman Oceanographic Laboratory (POL) is a partner in the service and currently provides a number of services to the UKCMF. They:

- provide annual astronomical tide predictions for the strategic gauges, together with a number of non-strategic locations used by the Environment Agency;
- provide ongoing support to the surge model developed by POL for forecasting surge residuals and currently run by the Met Office;

- maintain and collect data from the 44 strategic tide gauges (UK National Tide Gauge Network);
- manage the sub-contract with BODC for checking, archiving and retrieving recorded tide level data;
- allow public access to the real time data via the National Tide and Sea Level Facility website.

BODC

The British Oceanographic Data Centre (BODC) is a national facility for looking after and distributing data concerning the marine environment. It is hosted by POL who is committed to ensuring that BODC operates independently. BODC currently carries out quality control analysis of the recorded tide data and then provides both archiving and public access services for the data.

Cefas

The Centre for Environment, Fisheries and Aquaculture Science (Cefas) is a partner in the service and carries out data collection, dissemination and storage for recorded wave data. Cefas is an executive agency of the UK Government working within Defra and is an internationally renowned scientific research and advisory centre working in fisheries management, environmental protection and aquaculture.

They have developed the WAVENET site for UKCMF, for the storage of and public access to the wave data recorded from wave buoys around the UK. They also manage a number of wave rider buoys which are directly funded by the service.

Maritime Councils

The Maritime District Councils are both **operational users** and **data users** interested in real time data and archiving. They use the data to support a range of activities that they carry out or support on the coast such as surveying, coast protection activities and safety. The data is also used by the Coastguard (and the RNLI), Trinity House and the other emergency services.

International organisations

Within Europe the data is used for comparisons within operating authorities that also supply data for use as comparisons by the UKCMF.

Worldwide, the measured data provides evidence of mean sea level changes for climate change analysis and other scientific activities.

Industry

A range of non-public bodies have an interest in both the forecasts and the data behind the forecasts. Commercial organisations using UK waters benefit from the forecasts of extreme conditions in the same way as individuals along the shoreline benefit. Some of these organisations include:

- shipping companies
- energy companies (wind, wave, oil and gas, cables)
- fisheries and fishing
- insurers
- ports - navigation.

Developers and their designers use the recorded data to establish design conditions around the coast so that they can determine the risks to their developments and other activities that may be required.

Public

The UK general public is a stakeholder in the service as they receive the warnings derived from the UKCMF forecasts. Although most people know little or nothing about the service, those who's property or livelihood bring them into contact with coastal flooding rely on the forecasts provided by UKCMF. With improved communication and direct access to data, the general public is taking a

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greater interest in the processes and information that form the basis of flood warnings. This increased desire for knowledge and understanding will increase with time. UKCMF needs to continue to evolve so that it can support this growing desire for information. Any information made available must be clear and concise and help people to understand more about the service.

In addition to the directed flood forecasting and warning activities, there are some non-directed uses of the data. The main use is for recreation (sailing, surfing etc.).

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