

UK Environmental Observation Framework

Coordinating Observations: Progress and Challenges

Report for ERFF Main Board
November 2009

Version as presented to the board plus minor updates and board recommendations



**Environment Research
Funders' Forum**

LWEC merged with the Environment Research Funders Forum (ERFF) in June 2010, before this date the UK-EOF was a programme under the ERFF.

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EXECUTIVE SUMMARY

Since the launch of the UK-EOF in 2008 significant progress has been made.

There is now much greater recognition that investments in long term observations are critical to help us address the greatest modern challenges of e.g. climate change, food security and biodiversity issues amongst many others. Observations underpin the scientific knowledge and research as well as contributing directly to practical policy development and implementation. Observations form part of the evidence for action. This acknowledgment comes from national, UK, European and Global efforts to tackle societal and environmental challenges.

The UK-EOF programme has achieved its first key objectives and:

- Produced a first 'Towards a Statement of Need' document to gather all views
- Built and partially populated an observation activity catalogue which has already been used by 250 individuals
- Scoped the data sharing issues and proposed solutions to these
- Reduced the uncertainty over how much the UK invests in observations
- Explored the barriers to sustainable funding
- Proposed a joint decision support framework and criteria for investments
- Led UK inputs into SEIS, contributed to GMES and GEOSS.

This paper outlines the key knowledge and efficiency gains from the deliverables. Acknowledgement of the issues is a step forward but the scale of the challenge to solve them is also emphasised in this report.

The key question remains – what should the UK be investing in and how can the UK ensure we continue to collect and share the right data and information in a timely manner?

To obtain best value and return from the £300m/year investment from public sector funders, investment decisions must be transparent, challengeable by and within the Framework and based on an agreed set of criteria. Lead organisations should be identified to take responsibility for funding common-good datasets. These criteria and best practice must be adopted at the highest level in Departments and Agencies and decisions implemented and supported.

Over 250 individuals across at least 40 organisations have directly contributed to the UK-EOF so far and involvement and enthusiasm is high. There is a huge community involved in observing the environment across numerous science and policy areas. However, outside of each domain there remains limited dialogue and ignorance about the UK's current expertise and capability and the reasons for many of the activities. This means that it is not yet clear if these activities collectively meet current needs and are even less certain that the capability is in place to address future environment-related societal challenges such as climate change, food security or biodiversity. The challenge for the UK-EOF is to engage the community around a common goal of identifying the key datasets are needed now and in the future.

Data issues are another key challenge. It was recognised in 2006 that, of the observation data collected, only 20% can be shared and reused. There are a host of data related initiatives from Global, European and individual domains trying to solve the issues. The UK-EOF has reviewed and built relationships with these initiatives in order to understand what is happening, if they are adequate to address the issues and what the impacts for observation data collectors will be. The conclusion is that

there will be some impact and benefit of these initiatives but they do not address all of the data issues. The role of the UK-EOF will be to provide a catalogue/ discovery tool as well as a set of key activities to coordinate and enable the UK to influence and gain maximum benefit from the plethora of initiatives.

The challenge is to change cultures, hearts and minds at all levels in organisations which fund and collect observations. A small increase in management time by the original funders and collectors can significantly improve the value and benefits derived from environmental observations.

The UK-EOF is specifically challenging the ERFF board to consider how they can ensure members:

- Provide leadership to initiate cultural and organisational change within each organisation.
- Adopt decision making criteria and identify areas to work collaboratively to ensure the UK is funding the infrastructure and observations needed
- Provide, at least annually, an estimate of the costs of investment plus a breakdown of what activities these cover and where the data is held so that there is an enduring mechanism for sharing information on the observations made.
- Adopt and implement data policies which proactively and transparently determine the long term curation and reuse options for each dataset.
- Continue to support the development of a central set of tools for decision making, discovery of what is already going on, sharing of the outputs and advocacy and promotion of best practice.

This change will not happen overnight but the UK-EOF has, in its first 18 months proved that the ambitions, vision and path are correct. The question is how far and how fast do we travel together on that path?

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ADDENDUM The ERFF Main Board considered this report and:

Expressed thanks and recognition for the progress made so far and the willingness of the team to respond to changing demands.

Agreed to widen the scope of the UK-EOF to include the relevant social sciences. ESRC offered to help the UK-EOF team identify the key data sets.

Discussed the emerging concepts of the Decision Support Framework. and agreed

- 1) The importance of an open and transparent information exchange process.*
- 2) The need to undertake pilots of the system and the criteria used.*
- 3) The need to explore the possibility of having a senior chairperson.*
- 4) The need to establish a package of activities which are the core ones that should be funded by the public sector.*
- 5) The lateral thinking required to tackle some of the issues around delivery and data reuse.*

Recognised that the SoN was a vital component for the UK-EOF in terms of identifying the UK's key evidence requirements. Together with the Observations Catalogue and capability analysis, this information would help to inform the decision-making process.

The emphasis should now be on developing a 'prioritised' list that the public sector should focus on rather than 'balanced' suite of observations for everybody.

Asked for the headline issues used to inform the Statement of Need (SoN) should be rephrased to make it clear that both marine and terrestrial issues are included. Done see Box 1

Considered that the UK-EOF was engaged with the key data initiatives emerging at the UK, EU and global level (e.g. SEIS, GMES, INSPIRE, GEOSS).but cautioned that care should be taken to not duplicate existing efforts or have data issues swamp the UK-EOF workload. The conceptual model (of increasing effort and resources for good data management at the collection stage significantly reduces efforts required to reuse or discover the data) was acknowledged as the ideal.

Asked for the wording on axis of the PSVI diagram should be reconsidered. This has been revised see figure 4.

Reaffirmed their commitment to this flagship programme of ERFF and agreed in principle to explore the possibility of a two-year funding horizon.

Advised the priority for the UK-EOF in 2010 is to focus on using the tools (catalogue, SoN and Decision Support Framework). A positive demonstration of the benefits of using the tools would hopefully encourage uptake and accelerate their development.

1 Introduction and aims

What is the UK- EOF?

The UK-EOF was established in 2008 to provide a strategic decision making framework to change the way the UK perceives, values, archives and uses information from long-term environmental observations. This 5-year programme will provide the vehicle to allow all organisations to work collectively towards optimising their investments and measurements made (e.g. for research, policy and regulatory needs) and achieving the outcomes of the UK-EOF. The work is organised in a series of workstreams within five themes to achieve real change. It will enable funders and users to:

- see the entire observation portfolio;
- understand how and why the various parts are collected;
- improve data accessibility and quality;
- address the barriers to longer term financial security of observations.

Overall, the UK Environmental Observation Framework aims to shape the UK's capability to:

'facilitate the ongoing environmental evidence required to understand the changing natural environment, thus guiding current and future environmental management, policy, science and innovation priorities for economic benefit and quality of life'.

The main outputs, tools and benefits are shown in Figure 3.

What is the aim of this report?

The UK-EOF was launched in 2008 following recommendation of a 2006 study. The framework has established a secretariat (approximately 4 FTE) and initiated, contracted or undertaken a number of inter-related workstreams. The Management Group have met 7 times in 18 months and the Data Advisory Group have met 4 times. A number of workshops, events and consultations have engaged a wider community of scientists, policy makers, voluntary representatives, funders, collectors, industry etc. The UK-EOF newsletter, for example, is directly circulated to over 900 people in the UK as well as to European colleagues.

This report to the ERFF main board summarises the issues, key achievements and future challenges in order to understand:

- Why the UK observes the environment
- What questions want/need to be answered
- How to assess the gaps and opportunities in capability to collect the evidence needed
- How much the UK invests and in what key areas
- The risks/ financial security of observations

And propose:

- A framework in which to make joined- up decisions
- Initial recommendations for UK-EOF and all other organisations involved.

The basis of the evidence and the confidence in it.

The evidence used to generate this report has been drawn from all the UK-EOF's workstreams, the secretariat accumulated knowledge and the Management Group. The main deliverables available on the UK-EOF website are:

- **'Towards a Statement of Need' overall report** - articulating what general observations needed for each domain and for 9 fundamental issues (see Box 2) and the more detailed **Requirements Tables** generated from 6 workshops.
- **The Observation Activity Catalogue** - This website www.ukeof.org.uk allows searches of information on who is collecting what long term evidence where and why. It is being updated continually and helping to highlight and resolve data access and discovery issues. Discussion of these can be found on Workstream 2 pages of <http://www.ukeof.org.uk/datainitiative.aspx>
- **The scale of UK's Investment** in environmental observations has been estimated for 20 public sector funders using a **common methodology**.
- **Financial Mechanisms: are they adequate?** a report that summarises the issues in funding observation activities now, in the long term and in a collaborative framework
- **The background to a conceptual Decision Making Framework**

Progress and evidence accumulated is assessed in Figures 1 and 2. Firstly, how complete is the evidence the UK-EOF holds for certain aspects and secondly how much confidence is there in being able to meet the UK-EOF objectives by 2013.

Figure 1. The Completeness of UK-EOF evidence

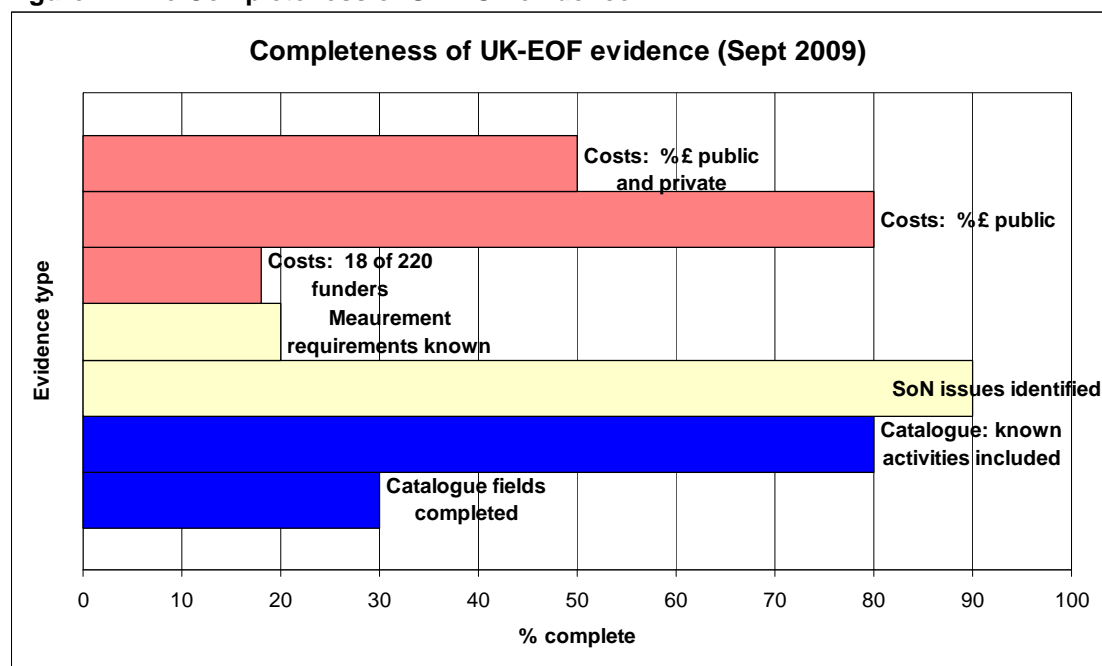
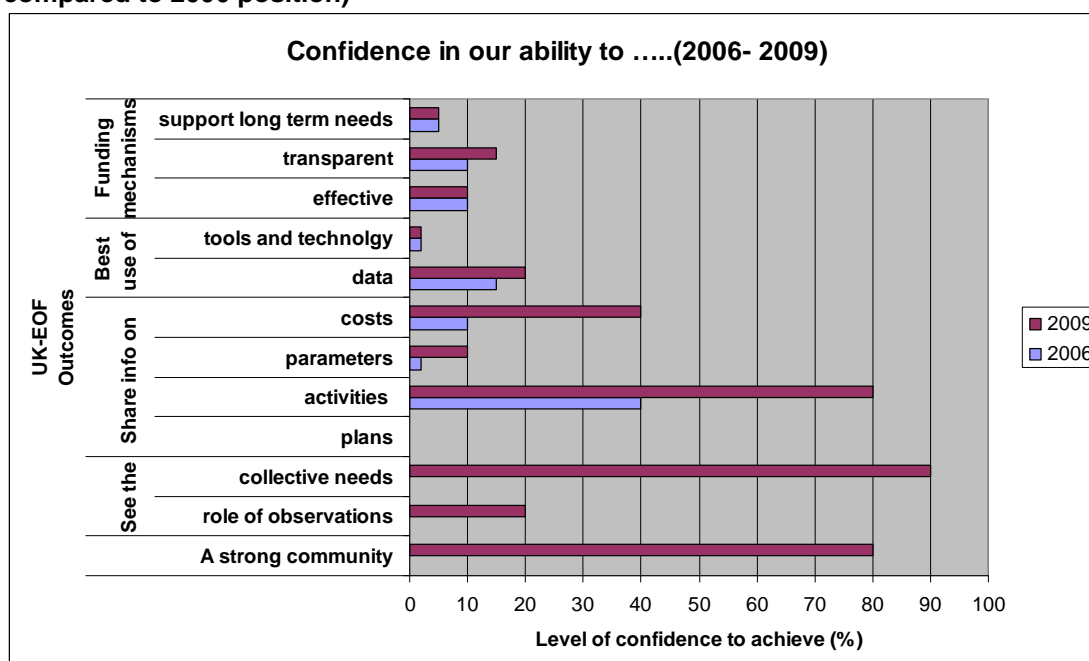


Figure 2 Confidence in our ability to reach the UK-EOF outcomes by 2013 (2009 compared to 2006 position)



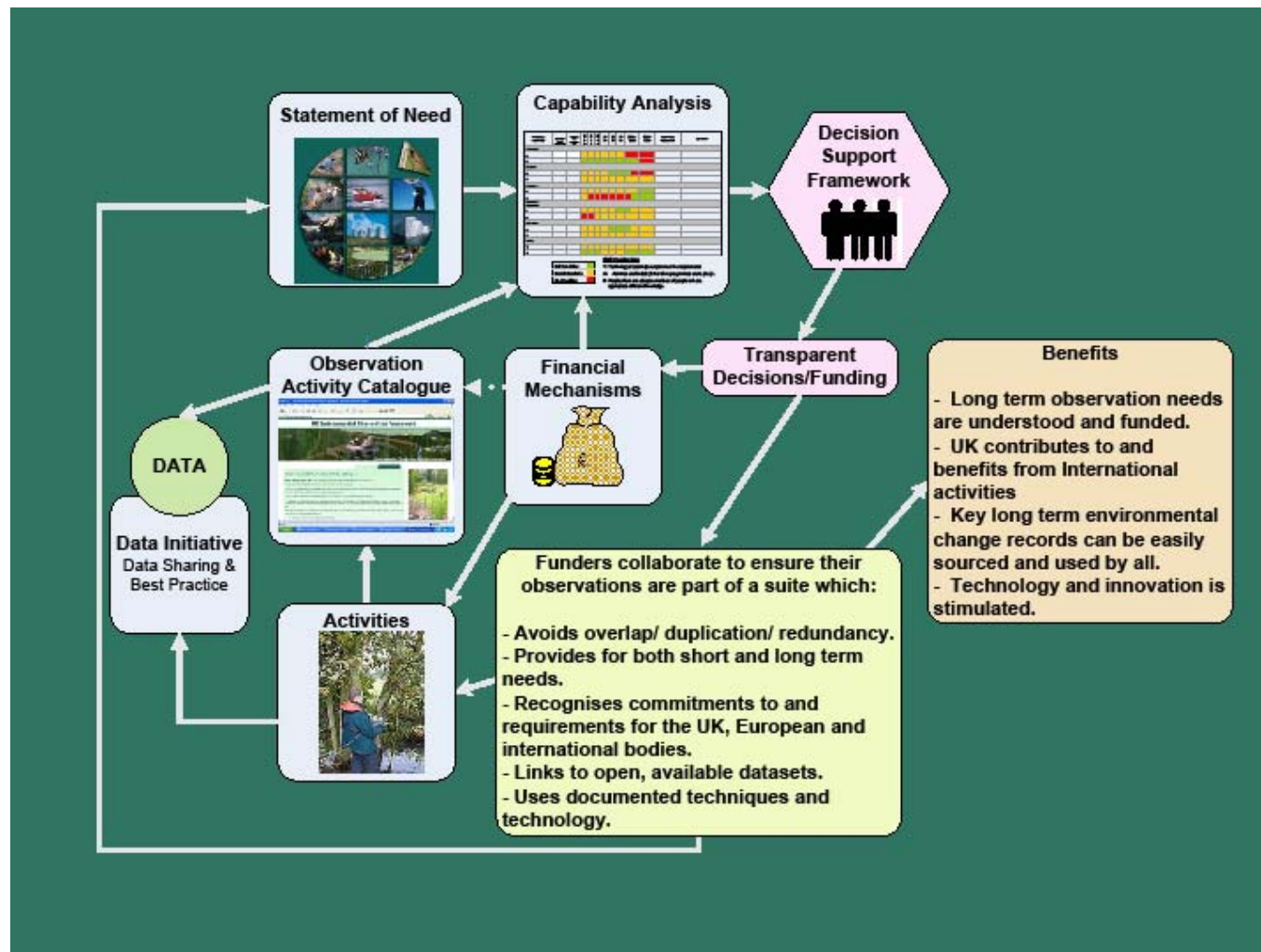
Benefits of the UK- EOF: some examples:

- The NERC Theme Action Plans and LWEC defer some issues to the UK-EOF rather than pursuing them individually
- The Statement of Need workshops brought together, for the first time, a broad range of the community funding or managing observations. This raised awareness and knowledge of the excellent activities the UK is involved with
- The UK can give a view and help guide the development of SEIS and GEOSS and, through the Data Advisory Group, have an overview of the data initiatives and issues and feed these into the UK Location Council.
- CEH has used the new Observation Catalogue to find out who is collecting and storing physical samples
- The observation catalogue and Statement of Need workshop outcomes have been used as a key resource in the Defra project '*Understanding and improving the policy alignment of natural environment-related research and monitoring evidence commissioned through the Defra Network and key Research Councils*'.

In the near future:

- Defra can use Towards a Statement of Need to prioritise datasets submitted to the Cabinet Office as part of Making Public Data Public.
- When EA and Defra review their spend on Environmental Protection monitoring as part of the Public Value Programme.
- Natural England's internal review of observations

Figure 3 UK-EOF tools, outputs and long term benefits



2 Who observes the environment and why?

Situation in 2006	- No strategic coordination and vision for observations and monitoring. Lack of knowledge of what others were observing
Progress	- The need for a balanced suite of observations has been agreed by public funders of observations - Collective requirements and reasons for observing have been identified and recorded (via consultation with the community and experts) in the Statement of Need
Future Challenges	- Further details on the actual measurements required are necessary to fully analyse future need against capacity. - Broadening the scope to cover known gaps in the information, such as socio economic data or environmental health. - Understanding the primary and secondary usage of the observations will help to achieve efficiencies.
Questions to the ERFF Main Board	- Is a 3 yearly update process for the Statement of Need acceptable? - Should social-economic data be included within the scope of the UK-EOF and to what extent? - What level of detail is required as evidence for a central decision tool (and what will organisations add when using the framework internally)? Should the UK-EOF collect more detailed information on the spatial and geographical needs and the potential use of the required measurements?

Who needs observations?

It was recognised in 2006 that the UK monitoring community is large, diverse and fragmented across the public sector policy makers, regulators and scientists as well as industry, the general public and volunteer groups. Their needs for observations arise from local issues to global environmental problems and natural disasters and therefore they require very diverse measurements and technologies to capture them. Establishing a collective, strategic vision was therefore a major goal of the UK-EOF.

Towards a Statement of Need

UK-EOF Workstream 1, the Statement of Need process, is working to understand the UK's overall evidence needs and the role of observations in providing this information. Over the past year the UK's requirements for observations have been gathered from targeted experts and tested in a series of environmental domain based workshops in summer 2009. These allowed approximately 120 people, from 45 separate universities, public and private organisations, to provide direct input and advice. The documents were then circulated for wide consultation.

The information gathered has been used to develop and revise '**Towards a Statement of Need**' and it's supporting Annexes. The document:

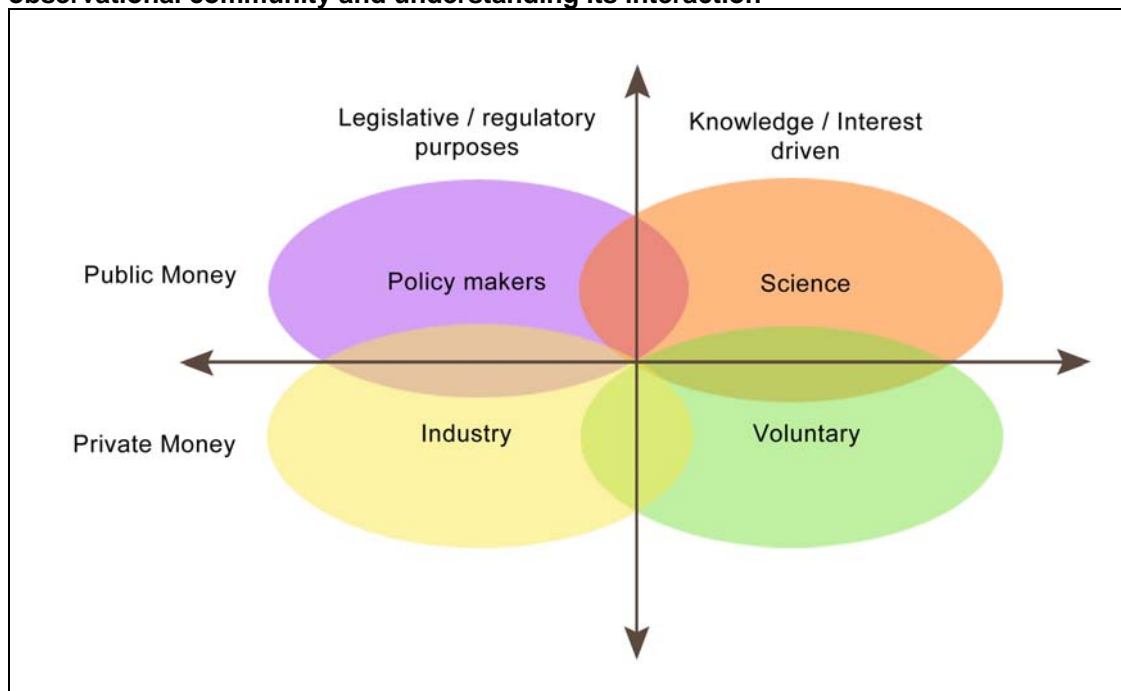
- is the UK's first attempt to capture, in one place, the requirements to fulfil national and international commitments, as well as to define the evidence needed to understand and manage major environmental issues and to answer crucial scientific questions

- identifies the main strategic questions relating to the environmental challenges both within the UK and globally and outlines how observational programmes can help provide the tools or evidence to tackle these.
- asks what a balanced suite would include for each environmental domain – such as land, biota, water, air;
- reviews the motivations of various sectors of the community, recognising that many resources go to collect information required by legislation or by local, national or international obligations. The communities of business, non-governmental organisations (NGOs) and individual volunteers may have different motivations to the publicly funded activities, but they are also essential to UK capability.

Types of Organisations

The UK-EOF has enabled an understanding of the diversity of the 220 organisations collecting observational information for the UK. These organisations and individuals can be grouped in many ways such as what they are collecting, why or how. One such grouping- PSVI (Policy, Science, Voluntary and Industry) is shown in **Figure 4**. It could refer to those generating the information as well as the users, such as the modelling community and report writers. The PSVI model has been useful for example when establishing how and where cultural or operational changes could be most effective or potentially most difficult.

Figure 4 The Policy, Science, Voluntary and Industry (PSVI) model: clustering the observational community and understanding its interaction



The reasons for collecting observations

There are many factors which motivate the collection of observations. For example national and international obligations drive the Environment Agency to collect the data required to meet the European Water Framework Directive; and industry has to take measurements to meet the 'polluter pays' regime. Long term observations are often fundamental to providing the data to answer research questions and to science developments, e.g. observing volcanoes and their associated activities or sea level rise. In addition there are groups of volunteers collecting information on for example

butterflies and beetles simply because they want to. Under the PSVI model (above) the former examples would fall into the 'have to make observations' and the latter into the 'want to make observations'.

Legislation often determines the shape of observation programmes but observations are often collected and used for multiple purposes. For example the UK Air Quality Network provides information for national legislation, policy formulation and to inform ministerial commitments to conventions such as the 1997 Kyoto protocol. The information can be for the public good such as weather forecasting or provide evidence for policy or to validate models. Some observations are taken to answer short term questions whilst others are for general surveillance over a long time period.

There are needs for very local information for example on habitat change as well as an expectation regarding UK's contribution to global requirements. For example what is the Group on Earth Observations (GEO) are building a Global Environment Observation System of Systems (GEOSS) capable of providing evidence to address the major global social sustainability challenges.

The UK's Suite of Observations

With so many requirements, many of which are changing regularly, the UK-EOF sponsors agreed in 2008 that, in summary: ***'The UK needs a suite of environmental observations to tackle the challenges associated with our changing natural environment. The programme must span all environmental media, accommodate temporal and spatial variability, and allow changes to be assessed in the short, medium and long terms, in local, national and international contexts'***.

The overall set of observations should provide the primary information to facilitate evidence-based decision making and increase our knowledge of present and future environmental issues.

In order to achieve this suite, the requirements must be understood and then prioritised using the best information available. The statement of need is addressing the former, the decision making framework will put in place a framework that will permit organisations to make informed decisions (see Chapter 4). In this way the UK will collaboratively achieve the balanced suite and have effective observation programmes in place.

It should be noted that a number of other elements need to be in place before a suite can be achieved. These are covered in other workstreams.

The questions that need observations to answer

The key messages from the Statement of Need process are not a surprise. Almost all of the issues raised fell into one of the 9 fundamental issue categories (see Box 1). Those raised under 'Other' tended to be issues concerned with data policy, storage and capability, all of which will be taken forward by the UK-EOF Data Initiative (see Chapter 4c).

Many of the issues which need observations relate to established topics such as pollution or to topics that are currently high on both the political and public agenda e.g. Climate Change. Climate Change is one of the 9 fundamental issues but the

impacts of change are inherent in many of the other fundamental issues. For instance, the risk of increased droughts and flooding can affect both Agriculture & Food Security and Human Health.

For many issues there is a need to observe the inputs to, and impacts of, change on the natural and built environment to assess the effects and predict the extent and intensity of change. There are many common themes which need to be addressed that require a wide variety of observations to assess for example, pollution, diseases, non-native species and natural resources.

Some of the issues are closely linked to research questions. Basic research is often needed prior to the generation of big questions, which themselves may require effective observation programmes. Conversely long term observations are often fundamental to providing the data to answer research questions, or to stimulate new ones.

Box 1: Fundamental issues to address with observations

How may observations help to:

- Understand the pressures on the environment, particularly in the light of population growth and associated pollution.
- Support economic growth reconciled with sustainable use of natural resources such as aggregates, minerals, and energy – including nuclear, biofuel and renewable energy.
- Understand future states of the earth, particularly the carbon cycle (but not excluding other element cycles), in domains such as air, soil and seas.
- Understand the consequences of environmental change for agriculture, food security and water supply.
- Understand the consequences of environmental change for human health, wealth and well-being.
- Understand, avoid and mitigate the effects of extreme events and disasters.
- Understand and reduce the impacts of environmental change on marine and terrestrial biological diversity, including ecosystems and the services they provide.
- Understand climate variability and climate change within earth system science.
- Stimulate scientific and technological advancement and innovation.

Many of the requirements are needed at UK scale but many of the issues are global in nature. Some environmental domain requirement tables focus on the UK, whereas others such as Atmosphere, Marine and Cryosphere have more links to global issues, international agreements and joint observation programmes. Whilst this can cause additional complications surrounding observation programmes (participation and funding), it is important if large issues such as climate change are to be understood.

Many of the issues and questions require measurements from more than one domain. Therefore cross sectoral working and an increase in awareness of observations being carried out for or by the UK and the ability to share the information is crucial. This is the aim of the Observation Activity Catalogue.

At first glance it appears that there are many occasions when one observation can be used to address many issues. However, these may be required in different media or, because they are being collected for different reasons, they have different spatial or temporal resolutions. Without fully understanding what the observations are being used for it is difficult to determine whether the same observations could be used for multiple purposes. It is therefore proposed that the UK-EOF support further work on the applications and uses for the information (such as legal obligations, research, decision making, management etc). This will help to identify basic suites of

information that may be used to answer or provide supporting information for many questions or issues.

How good is the Statement of Need?

Already the value of this strategic and comprehensive picture of needs has been recognised as a cornerstone to decision making regarding UK investments in environmental observations. This should ensure that the overall UK infrastructure, skills and funding to sustain them are fit for purpose and that those measurements crucial to understanding our planet and its variability are collected, stored, valued and used most efficiently.

However, whilst 80-90% of the issues which need observations have been captured or identified, some gaps remain. There is little definition of the actual measurements required to assess each issue and further work to determine the spatial, temporal and geographical requirements is recommended. Socio-economic and related information is an important area that has been added to the scope of UK-EOF for 2010 and these remain to be explored.

There is an enormous range of observation requirements needed to answer the fundamental issues and encompass the needs of each of the environmental domains from the perspective of policy, science and operational activities. There is also no prioritisation of the needs in the current document.

FUTURE CHALLENGES: understanding our observations

'Towards a Statement of Need' is just the first step to *'Develop a holistic picture of what the overall evidence needs are and the role of observations in providing this information.'* It is the starting block for the basis of creating a balanced suite of observations, taking into account many different views.

- The Statement of Need is fundamental to the development of the decision making framework. It is, however, a wish list capturing all needs. These requirements need to be prioritised by potential funders. See section 4
- The documents and its contents need to be authoritative and stable to allow for planning but must be maintained and refreshed so that the issues are current and relevant. A 3 yearly process is recommended.
- The level at which observation requirements are described may be different within the Statement of Need, the capability analysis or the decision framework but the information must be consistent for all observation requirements. The level of detail required from a central resource / tool compared to the details that can be added on an individual or organisational level has to be decided and the appropriate information supplied and curated.
- To date many issues and sub-issues have been identified but the actual measurements required to assess each issue and provide the associated spatial, temporal and geographic information is missing This is required in order to carry out a full analysis of current and future need. In addition further information on the application or use for the measurements would increase the ability to identify measurements which could meet multiple needs
- Engagement with social scientists will begin the debate over what degree the UK-EOF covers socio- economic data sets and a decision will be needed on where to draw the boundaries.
- All the challenges require further communication with the broad, diverse but enthusiastic community. The observation catalogue will help to facilitate

3 The UK's Investments

Situation in 2006	The estimates of UK spend on activities and infrastructure was between £80m and £500 million per year. There was no mechanism to work in partnership and decide what should be funded
Progress	A set of cost guidelines have been produced and 17 organisations have estimated their spend. UK-EOF now estimate that a minimum of £300million is spent annually on observations by just 17 public sector bodies. With all 100 plus funders, and the private sector, the estimate could double.
Future Challenges	Public expenditure will become increasingly challenged and investments in observations will come under increasing pressure. Existing financial mechanisms rarely enable observation programmes to be funded effectively and on a sustainable basis The main challenge is to establish a suitable mechanism to collaborate and ensure maximum benefits and efficiency from the combined investments
Questions to the ERFF Main Board	Can each organisation begin to install mechanisms to account for their spend on observations and give UK-EOF a set of figures annually? How much progress can be made in the current climate with changing financial mechanisms?

Why understand our investment in observations?

One of the most fundamental and long standing issues surrounding observations is that there is little stability in funding or common reporting of what is being spent. The UK-EOF is committed to understanding and addressing the barriers to effective funding so that observation programmes are capable of supporting the long-term needs of the UK. Workstream 4 aims to:

- develop a generalised understanding of the UK's investment in environmental observations and its financial value.
- refine the estimate of environmental observation investment by the UK
- encourage consistency in reporting investment figures across the community
- identify the barriers to sustaining long-term funding for national and international observations in order to allow planning for sustainable observational infrastructure which meets current and future needs
- develop an understanding of the status and security of funding for the UK's environmental observation activities and develop a process to secure sustainable observations.

Comparing like with like

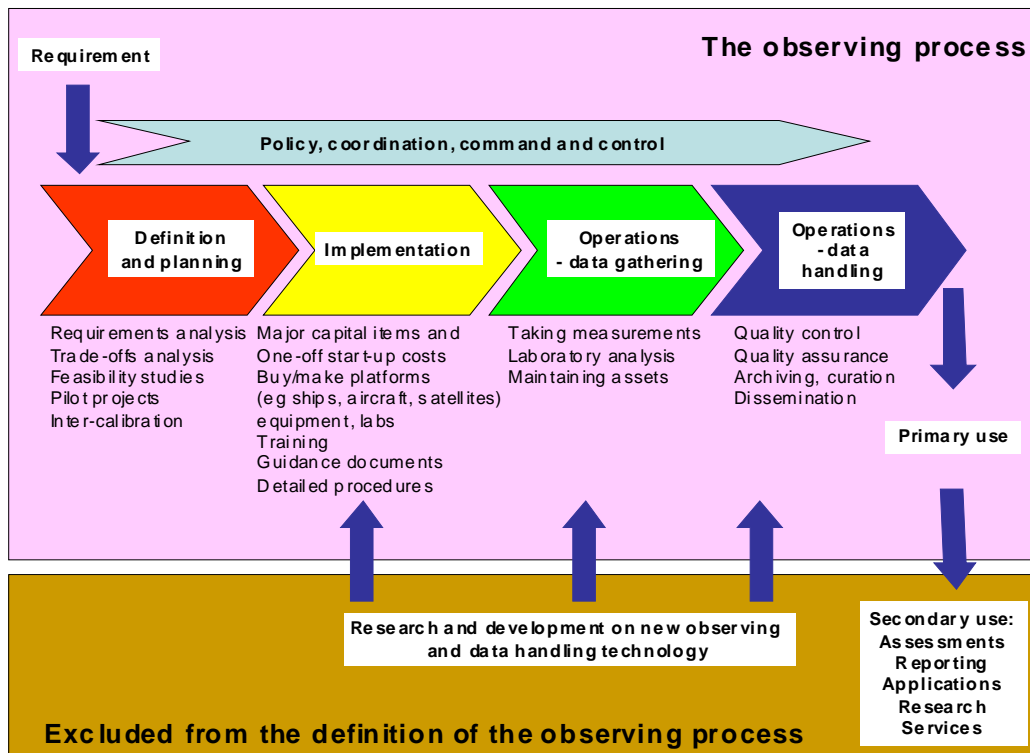
In 2006, the best estimate of UK spends on monitoring activities and infrastructure was between £80m and £500 million per year. Much of the uncertainty resulted from different costing methods in different organisations, no clarity over what to include

and no previous reason to coordinate or add up the investment within organisations or between them.

A joint UK-EOF/UKMMAS study in 2008 concluded that Full Economic Costing was the most appropriate method as a common currency. A set of guidelines were provided which asked for overall organisational cost per financial year as well as an annualised cost. If full economic costing was not possible then an idea of what was and what was not included in the figures is also important.

The method developed is applicable to the very wide range of activities undertaken by the public or private sector and accounts for the full investment organisations make in environmental observations, including costs incurred at all parts of the observing process – from planning to first use of the results (see figure 5).

Figure 5 A common definition of the observing process – and hence what is included as costs.



The 17 public sector organisations (from over 100 funders) that were assumed to have the largest investments in environmental observations were asked to submit cost information according to these guidelines. In general this was a significant challenge and some for, example NERC, had to consult across their research centres.

Table 1 Public Sector Investments in observation activities. Shown for each of the 17 organisations asked and by environmental domain for spend in 2008/9. Empty cells indicate no information has been given. Zeros indicate no cost allocated to that domain. Figures in brackets indicate contribution in kind. Italics indicate where the secretariat have estimated the domain split.

Organisation	Domain						Investment per Organisation (£million)		
	Atmosphere	Biosphere	Cryosphere	Lithosphere	Freshwater (inc Groundwater)	Marine	Direct Investment	Contributions in kind	Max. investment (inc. contributions in kind)
Agri-Food and Biosciences Institute (ABFI)					1.1	2.9	4.0		4.0
Countryside Council for Wales (CCW)									0.0
Centre for Environment, Fisheries and Aquaculture Science (CEFAS)						7.4	7.4		7.4
Department of Energy and Climate Change (DECC)	0.3	0.0	0.0	0.0	0.0	1.1	1.4		1.4
Department for Environment, Food and Rural Affairs (Defra)	8.0	13.7	0.0	8.9	2.8	35.0	68.4		68.4
Department of Environment for Northern Ireland (DOENI)	0.8	3.1	0.0	0.2	4.2	1.6	9.9		9.9
Environment Agency (EA)	0.9	0.1	0.0	0.1	58.3	7.0	66.4		66.4
Forestry Commission (FC)	0.0	1.7	0.0	0.0	0.0	0.0	1.7		1.7
Joint Nature Conservation Committee (JNCC)	0.0	1.4 (16.2)	0.0	0.0	0.0	0.0	1.4	16.2	17.6
Marine Scotland (MS) -previously FRS						4.1	4.1		4.1
Met Office	43.8					2.0	45.8		45.8
Natural England (NE)		9.1 (26.5)				0.3 (0.1)	9.4	26.6	36.0
Natural Environment Research Council (NERC)	12.0	9.3	1.6	10.0	8.4	10.6	51.9		51.9
Scottish Environment Protection Agency (SEPA)	0.3	0.1	0.0	0.1	17.1	5.0	22.6		22.6
Scottish Government (SG)	0.0	0.2	0.0	0.2	0.0	0.0	0.4		0.4
Scottish Natural Heritage (SNH)	0.0	0.8	0.0	0.0	0.1	0.5	1.4		1.4
Welsh Assembly Government (WAG)	0.1	0.3	0.0	0.0	0.0	0.2	0.6		0.6
Investment per domain (£million)	66.2	39.8	1.6	19.5	92.0	77.7	296.8		
Contributions in kind	0.0	42.7	0.0	0.0	0.0	0.1		42.8	
Max.investment at this stage (inc. contributions in kind)	66.2	82.5	1.6	19.5	92.0	77.8			339.6

Caveats to Table 1

1. These figures represent organisations' best efforts. They may not all strictly adhere to the cost guidelines: therefore confidence is low.
2. CCW have not been able to provide financial information
3. No organisation was able to give an accurate breakdown of investments by domain. This reflects the differences in how the activities are managed internally.
4. The domain split is an artificial breakdown and many observations span 2 domains e.g. freshwater fish could be in freshwater or biosphere. Waste is included in Lithosphere.
5. Contributions in kind have not been given by all organisations, so the figures need amendment.

The costs of observations in 2008/2009

Public Sector Spend.

The results in Table 1 represent the best available figures for 16 organisations but should be used with extreme caution due to the caveats attached to the table. From this a minimum spend of approximately £300 million per year by 16 public sector organisations is estimated. Given that there are at least 220 organisations collecting observations **it is reasonable to assume that the total investment in observations by the UK is nearer £500m per year.** By extending this study to include private spend, a further increase could be expected.

Table 1 is an initial breakdown of investment by organisation and by domain area but please see the caveats regarding confidence in these figures. The largest funders are Defra, NERC the EA, and the Met Office.

The spend by SEPA, NIEA and EA is assumed to be for regulatory needs; this amounts to approximately 30%. This is significant because there is less scope for amending or reducing these observations without changing legislation or the confidence in the results recorded.

There is approximately equal funding across the domains with the exception of the Cryosphere which appear low when considering the capital equipment required to work in hostile environments.

Further detailed analysis is not possible due to the lack of confidence in the estimates or how they are attributed to activities.

Other funding sources

The contributions in kind (over £40m) are significant. By estimating the voluntary effort as a financial quantity, Table 1 shows that a large number of the biosphere observations in particular are based on volunteer effort. The activities described in the catalogue support the conclusion that most (144 of the 152) 'voluntary sector funded' activities are associated with the biosphere domain. Without the contributions of volunteer observations much more money would be needed from the public purse.

Currently only 20 activities listed in the catalogue (2%) are privately funded. This implies that the activities are not catalogued rather than there being a lack of spend in this area. This is a large area of information which would need to be captured from numerous sources. Anecdotal evidence is that private sector funded activities could be as much as the public sector. It is proposed to look at this area in 2011.

The financial security of observations

Several studies undertaken by the UK-EOF or others identify barriers and issues associated with long-term funding. These are collated in Workstream 4b.

The issues and barriers

- Observations are funded through a large variety of mechanisms –including grant in aid, programme spend, research, charitable trusts, etc. Since there is no single pot of monies for observations either nationally or within funding organisations the funding routes and sources are often unclear and complicated.
- The length of funding, particularly from public bodies is often only 1 – 3 years. This does not offer stability to the activity and therefore key staff and skills as well as investment in capital equipment and new technology become problematic. Significant time and resource is spent on business cases and re-justifying the work instead of analysing the results.
- The definition of research funding (Frascati definitions under EU regulations) specifically excludes long term routine monitoring. Therefore these pots of money are not available for sustained observations. Despite this many observations are initially collected as part of research investigations. At the end of the 1, 3 or 5 yrs there is then no funding route to maintain the observations.
- Funding sources other than public sector sponsorship, such as charities and private sponsorship, are available yet these rarely supply long-term activities and many of the criteria act to prevent monitoring activities applying. In addition the extra staffing costs endured to source multiple small pots of funding are a real issue which faces small organisations such as Sir Alister Hardy Foundation for Ocean Science.
- There is a perception that when public agencies face insufficient funding they are unable to advance or undertake new monitoring activities. In addition they are often limited in how and what they can spend monies on. For example, if money has been collected by the agency in association with undertaking one type of activity, transferring efficiency savings or under-spend to another activity is not an option, therefore many activities remain unfunded or under funded.
- When observations require large capital investment (such as satellites), are part of large international programmes or have no one obvious lead funder who require the data, there is no mechanism in the UK to agree who will cover the costs. This results in inefficient decision making and can result in lost opportunities for the UK to influence and gain maximum benefit from the technological developments or the data.
- The value of observations is often not apparent until a time series has been established. Therefore securing investment in activities for say 10 years before results are seen is almost impossible from either public or private sources.
- The current economic climate has increased the threat of unsecured funding to government bodies and their activities. Six member organisations have directly stated that funding is a significant risk to the future of current activities.

The funding issues are as much about the mechanisms and length of funding than the overall magnitude of spend. In summary there are issues of funding which are internal to individual organisations or where the solution calls for internal change, issues where collaboration between organisations (using the

UK-EOF framework or other mechanisms) will be beneficial and issues that could only be resolved with cross Whitehall agreement.

FUTURE CHALLENGES to investing in observations

- Even the 17 public sector organisations committed to the UK-EOF have had difficulty reporting their investment in observations. Many will have to establish an internal mechanism to streamline the reporting process. This is the first stage to participating in a joined up decision making framework.
- There are at least a further 200 organisations, who cover over 600 activities in the observation catalogue, that have not yet been included in the cost work. In addition the private sector has not been included so far. This is a significant challenge for the UK-EOF in both external communication and in data handling. It is recommended that this work be started in 2011 after the Statement of Need process identifies the needs of industry.
- Institutional and economic barriers exist to funding observations on a sustainable basis and there is a significant challenge to address these. A dedicated study to understand the issues and propose solutions should be established. Solutions need to address both the mechanisms and magnitude of funding. There is no presumption to a preferred solution and the options (such as a central pot of money to fund long term monitoring of national interest) need to be scoped.
- A more joined-up, strategic and cross-government approach to global observations is required. This could be the responsibility of the Strategic Advisory Board – see section 4.

4 Joined- up decision making

4a A framework in which to make joined- up decisions

A key central outcome of the UKEOF is to *'Develop a holistic picture of what the overall evidence needs are and the role of **observations** in providing this information which will **enable and empower the UK, and each agency, department or observation initiative to make a clearer contribution to existing and anticipated national and international programmes, optimise its investments, recognise dependencies and work in partnership**'.*

This implies a decision framework is needed which will enable individual organisations to make informed investment decisions within a consistent, transparent and collaborative framework to ensure that the suite of observations as a whole avoids overlap/ duplication/ redundancy, provides for both short and long term needs, recognises commitments to and requirements of the UK, European and International legislative bodies and addresses key evidence gaps.

The UK is currently a long way from having such a mechanism.

A conceptual framework

Discussions about a conceptual framework and decision criteria started in Autumn 2009 with funders keen to achieve efficiency gains in a more austere economic climate.

The Decision Making Framework will constitute a tool which can be used by decision makers and funders to make informed decisions on their investments in observational activities. The framework must be credible, reliable and accurate for scientists, funders and policy makers to be able to use and requires testing to validate its worth.

A decision framework must encompass:

- The criteria
- The evidence
- The people and discussion / governance elements
- The actual implementation of the decisions

Initial thinking is that this will cover public sector spend (which accounts for at least £300m / year) in the light of private and voluntary sector investments. The outstanding discussion centres on how it will operate, (the people, discussion and governance elements).

A consensus is emerging is for a Strategic Advisory Board to help steer informed decision making, with the final decision remaining with the organisations themselves. All members of the body would have to sign up to the pre-agreed criteria. This would be signed by the top management of each organisation and require that nominated representatives would act in accordance with the criteria when making decisions internally.

Challenges

This decision framework represents a major challenge and cultural and operational shift from how observations are currently managed and funded. For success it is necessary to have:

- Strong (senior) leadership from at least a core set of funders

- Willingness to commit to the process over a medium to long time period
- Robust and defensible evidence on which decisions can be made.

The UK-EOF has begun to put these in place but needs each of the organisations on the ERF main Board and the UK-EOF management group to drive the process of change.

This needs to be agreed by all organisations to achieve consistency across all agencies and domains.

If agreed, a new way of working will be required.

A trial could be beneficial to see if a single framework would work for all areas.

The evidence required to make informed decisions should also be considered. The Statement of Need and the UK-EOF catalogue will provide critical evidence for the decision framework – but both tools need refining. At present the Statement of Need is a wish list from all in the community. It does not identify the priorities which are needed to make informed decisions. The needs of any one sector could be drawn from the report as it provides strong evidence owing to its ability to cross cut policy and science, industry and voluntary sector.


4b A method to assess the if the evidence needed is being collected


In order to make joint or joined up decisions on the UK observation portfolio it is necessary to have an understanding of the requirements, the current activities and how long they will be active for.


The UK-EOF has developed a series of tables to capture (visually) all the measurement ‘needs’ and how well placed the UK is to collect this information now and over the next 20 years.

Figure 6 Example capability table to see how existing activities meet current and future requirements.

VARIABLES / PARAMETERS	GEOGRAPHICAL COVERAGE	TEMPORAL COVERAGE	2010	2011	2012	2013	2014	2015	2016 - 2020	2021 - 2025	ACTIVITIES / PROGRAMMES	COMMENTS
Atmosphere												
X			Full	Full	Full	Full	Full	Full	Full	Full		
Biosphere												
V			T	T	T	T	Full	Full	Full	A, T	A, T	A, T
Cryosphere												
E			Full	Full	Full	This is an example, for illustrative purposes only				A	A	A
Freshwater + Groundwater												
R			P	P	P	P	P	P	P, A	P, A	P, A	P, A
Lithosphere												
J			P	P	P	P	P	P	P	P	P	P
Marine												
X			P	P, T	P, T	P, T	P, T	P, T	P, T	Full	Full	

Full Capability 

Partial Capability 

No Capability 

Capability affected if: T: Technology is **not** available (to use) to meet the requirements
A: Activities are **not** funded (& therefore programmes are in place)
P: People; there are **not** adequate numbers of people with the appropriate skills and knowledge

These capability tables give a rapid, visual way of assessing where our strengths are, which existing observations activities could be at risk from a funding or skills shortage in the future, and where there is currently no capability.

The areas of amber and red immediately highlight the gaps. These, at present, are not prioritised. The decision framework (see section 4a) could use these tables and apply the criteria to prioritise or, that the capability analysis is only undertaken for the priority requirements.

Initial attempts to complete these tables illustrated that experts were more confident completing information for legislative activities than those for process related issues, This may be due to having more guidance over what should be measured for statutory or legislative reasons. The trial also emphasised the difficulties in gathering information on future capability; generally information was only provided for the current or following year. The main limiting factor was the short term nature of many of the funding schemes.

Challenges

Populating the tables requires detailed and in-depth scientific and management knowledge of needs and current observations activities and their security of funding. This information is being brought together for the first time by the two UK-EOF tools

(the catalogue and the Statement of Need). However, the analysis and the interpretation of the details requires specific expertise and time.

The challenge is

- Populating the UK-EOF tools with enough information to make a fit-for-purpose analysis. The requirements and benefits of this information should be reinforced from the ERF main board and should be allocated as a task/responsibility to key individuals in each organisation.
- Capturing and maintaining the information must involve experts who represent their domain or issue and who have time to assist.
- A phased approach could be taken by developing one capability table per domain or issue at a time. Climate change, marine or environmental protection have been suggested as examples.

5 A culture shift and vision for sharing the evidence

The issues

In 2006 ERFF estimated that 80% of the output from observations is not or cannot be reused by others. There are significant barriers to the awareness and discovery of data such as cultural and technical issues as well as licence conditions. Data management is often poorly resourced and managed as it is an after thought to contracts or projects. There is often little reward or incentive for the original collector for sharing data.

Agreeing the vision for data

Workstream 2 of the UK-EOF programme has been set up to develop the knowledge base of environmental observations and tackle issues surrounding data sharing and reuse. The work investigates who is collecting what data, data policy development and data suitability so that;

'People/organisations in "UK plc" actually share and reuse environmental observation data to inform policy decisions, expand knowledge, contribute to international activities, stimulate markets for innovation, improve operational capabilities and improve their responses to the changing environment'.

The UK- EOF began by articulating the issues and produced a paper outlining the legal, institutional, cultural and technical aspects. A Think Tank was then run to highlight the issues and agree the vision with senior government officials. Potential solutions and ongoing initiatives to solve the issues have been explored in more detail. Following this continued consultation with data specialists and establishing a Data Advisory Group, the Data Initiative project has been developed to prioritise actions.

The UK- EOF Data Initiative

The proposed UK-EOF Data Initiative has 6 work packages focused on achieving the vision set out by the Think Tank. The outcomes have many ways of being achieved and the role of the UK-EOF secretariat may be to undertake the work, to let, manage or facilitate the work, or encourage others to lead each area. Meetings during winter 2010 will seek agreement and endorsement of the actions under these work packages which will run until 2013.

Possible work packages are:

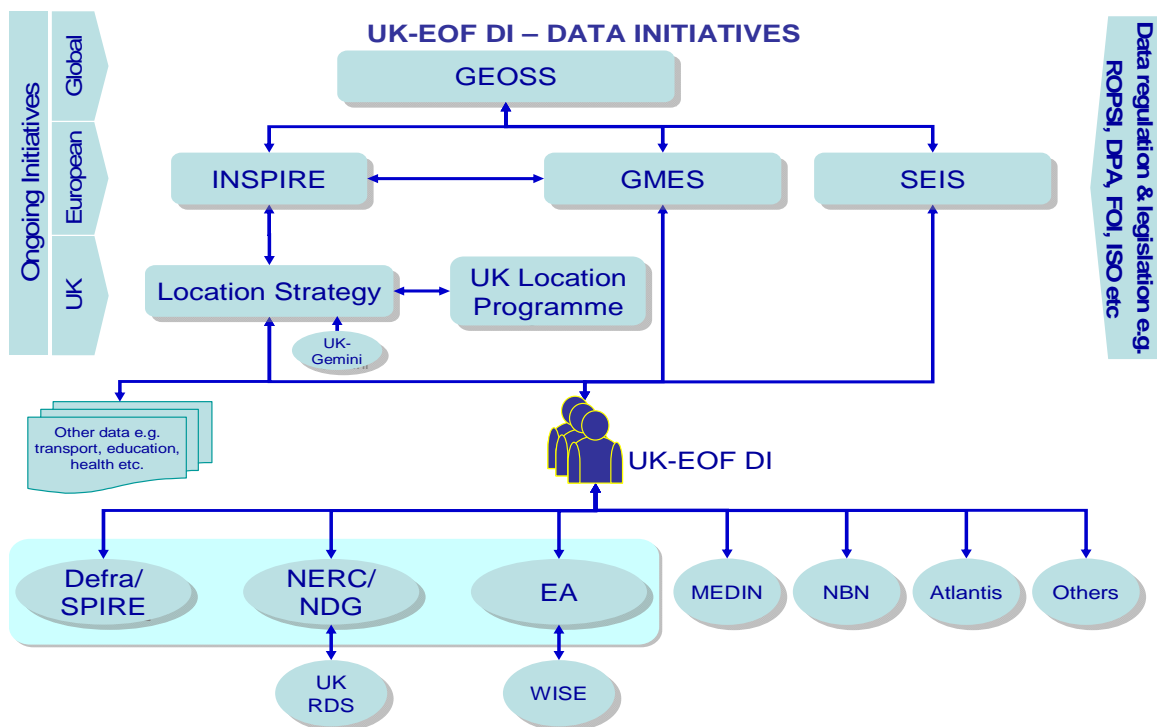
- 1. Observation Activity Catalogue** The key outcome is the discovery of information on who, what and why environmental observation activities are being undertaken and the ability to assess if the data is suitable and can be reused.
- 2. Suitability for re-use** The outcome is a cultural change in data collectors to generate the information to enable new users to readily assess if the information/ data is of appropriate scientific quality and does not have prohibitive conditions for reuse.
- 3. Status of ability of UK to share data** The principle means of confirming that progress is being made and for auditing how well the UK is able to collect, store and publish environmental observation data, will be through the development of a Data Status Table.
- 4. A focal point for observation data sharing best practice** In order to achieve clarity on data sharing terminology, tools and best practice and

initiate a cultural change in the environmental observation community, UK-EOF will be a focal point for data collection, storage and publication. Whilst some of the larger sponsors may not need advice, many smaller organisations will seek support from the UK-EOF or its data sharing community. UK-EOF will be in a strong position to represent the community when a UK or environmental view is needed and make a valuable contribution to the INSPIRE, Location Programme, SEIS, GMES, GEOSS etc. (See Figure 7) For example, a Data Solution Workshop was held in June 2009 with more than 60 delegates from across the UK and Europe.

5. Data policies, contracts and citations. To be in a position where funders of activities take responsibility for the management and sharing of data and collectors have rewards and benefits for allowing data to be shared and sanctions if they don't, this work package will enable the cultural change to begin. It will, with key stakeholders, develop and disseminate very simple tools such as standard contract clauses so that best practice is followed whenever new activities are commissioned. As a means of rewarding data sharing, a citation process is thought to be an essential long term goal that UK-EOF should encourage its members to establish.

6. UK Infrastructure and resources A sustainable future proof infrastructure is required to ensure that all data collectors have somewhere that their data can be stored and managed for the long term. This work package is not looking to build big new IT or data warehouses but ensure there is sufficient UK capacity for key data sets and physical samples to be curated and accessed for future use i.e. data warehouses, archives and storage facilities and the skills required to achieve this.

Figure 7 The UK-EOF as a focal point for the environmental data sharing initiatives. Note that the lines are indicative only and many other direct relationships occur e.g. with EA and INSPIRE or DEFRA and GEOSS.



The Observation Activity Catalogue

The 2008 Think Tank agreed that the most immediate challenge was to allow discovery of what activities (and hence data) already exists. The need to understand what programmes and activities generate observation data is the core of the UK-EOF. Therefore the first phase of the Environmental Observation Activity Catalogue was built and launched in August 2009.

Nearly 250 individual users have already visited the site www.ukeof.org.uk. There are currently 1069 activities stored in the catalogue including activities funded for basic science, legislation, data collection and direct environmental management and they indicate that over 220 organisations are involved in observations in some way.

The Observation Activity Catalogue provides for the first time an easily searched tool to get a general overview of all the observation activities undertaken by or for the UK. Stage 2 is currently being developed to enable the contents to be increased to include more detailed series level information such as geographic coordinates of sample sites and parameters as well as information on where to download the data. In time the catalogue will become part of the UK Location Programme portal.

FUTURE CHALLENGES for sharing knowledge and data

Significant progress has been made but the vision and hence the Data Initiative project is ambitious.

- The scale of the overall programme must enable progress to be tangible but realistic. Many of the organisations are at very different stages and abilities to supply data or to adopt best practice. However, community involvement is essential and all organisations will be impacted in some way. Some elements of the project will be outsourced whilst others will be done in partnership with different organisations. The Data Advisory Group and the UK-EOF Management Group will manage this process.
- A key challenge is the need to change the culture within organisations to ensure that observation data is valued. Therefore it is essential to build into business plans, contracts and ways of working data management activities which make data available for reuse. This will take time, tenacity and cooperation from all parties particularly senior staff who can highlight the benefits and rewards.
- The information contained within the catalogue needs to be accurate, up-to-date and complete. Populating the catalogue is the first challenge. Some of fields are as little as 30% complete. Each organisation should be tasked with supplying at least programme activity level information this year and series level information in 2010/11. A second phase of development of the catalogue will ensure that the information model is compatible with best practice and legislation and that maintaining and supplying the data in the catalogue requires minimal effort from each organisation.

6 Conclusions and next steps

This paper outlines the key knowledge and efficiency gains from UK-EOF in the first 18 months. Acknowledgement of the issues is a step forward but the scale of the challenge to solve them is also emphasised.

In section 1 the evidence that is now held regarding the UK's observation activities is shown. Key sponsoring organisations have supplied information on their current activities, the costs and their requirements for ongoing or future observations. Whilst 100% completeness is not realistic ERFF Main Board agreed some detail and robustness is necessary in the central evidence tools and that these should be maintained. They have committed their organisation to supplying this basic information on an annual basis.

In Chapters 2 and 3 the major funders and the reasons for collecting observations are discussed along with the most pressing questions the diverse community need to answer. The need for a suite of observations is discussed.

Chapter 4 begins the discussion of how to prioritise the needs of all interested parties and allow the public sector in the first instance to collaborate and ensure that funding decisions are strategic, joined up and enable best value for the UK.

To obtain best value and return from the £300m/year investment from public sector funders, investment decisions must be transparent, challengeable and based on an agreed set of criteria. These criteria and best practice must be adopted at the highest level in Departments and Agencies and decisions implemented and supported.

A new method is proposed in Chapter 4b to allow the list of what is required with information on what is already being done to be drawn together. There are potentially many areas where one observation or measurement can service a number of purposes. However, there will be a large effort needed by experts in each domain, the users and funders of the data to identify these key efficiency savings, bring clarity to understand how these activities collectively meet our current needs and if the capability exists to address future environment related societal challenges such as climate change, food security or biodiversity. A pilot capability table is therefore proposed.

Chapter 5 outlines why a cultural shift in sharing the evidence is needed; data issues remain a key challenge. It was recognised in 2006 that, of the observation data collected, only 20% is available to be readily shared and reused. Conversely there is a host of data related initiatives from Global, European or domain based trying to solve the issues. The UK-EOF have reviewed and built relationships with these initiatives in order to understand what is happening, if these are adequate to address the issues and what the impacts for observation data collectors will be. The conclusion is that there will be some impact and benefit of these initiatives but they do not address all of the data issues. The role of the UK-EOF will be to provide a catalogue/ discovery tool as well as a set of key activities to coordinate and enable the UK to influence and gain maximum benefit from the plethora of initiatives.

The key question remains – what should the UK be investing in and how can the UK ensure the right data and information is collected and shared in a timely manner?

The UK-EOF specifically challenged the ERFF board to consider how they can ensure members:

- Provide leadership to initiate cultural and organisational change within each organisation.
- Adopt decision making criteria and identify areas to work collaboratively to ensure the UK is funding the infrastructure and observations needed
- Provide, at least annually an estimate of the costs of investment plus a breakdown of what activities these cover and where the data is held so that there is an enduring mechanism for sharing information on the observations made.
- Adopt and implement data policies which proactively and transparently determine the long term curation and reuse options for each dataset.
- Continue to support the development of a central set of tools for decision making, discovery of what is already going on, sharing of the outputs and advocacy and promotion of best practise.

This change will not happen overnight but the UK-EOF has, in its first 18 months proved that the ambitions, vision and path are correct. The question is how far and how fast do we travel together on that path?

The next step for UK-EOF is to take account of the ERFF Main Board debate and to propose a work plan covering the key priority areas to the UK-EOF Management Group in January 2010.

Definitions

For the purpose of the UK-EOF the following definitions and scope of 'Observations' and 'Environmental' are being used:

Observations: *the taking, on a reasonably regular basis, of any form of observations relating to the status of the environment, regardless of the frequency and purpose for which the observations are made or how they are made (for example, satellites, ships or scientists). Such observations are designed to meet a wide range of societal needs by providing a variety of products and services.*

Environmental: *the broadest sense of observations from the natural environment concerning physical (including geological), chemical and biological properties of the environment. This includes observations collected from land, air, ice, freshwater, coastal and marine environments, for compliance or statutory information, earth observations from space and the effects of humans on the environment. Note the exceptions of social science and human health data*.*

*Note the ERFF main board agreed to revise the scope and include the relevant socioeconomic evidence.