

DECC Earth Observation Strategy

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Executive Summary

DECC exists to counter two risks. These are:

- Dangerous climate change
- A shortfall in safe, affordable energy

We shall be unable to counter these risks unless we have access to a wide range of Earth observation data to understand how the climate might change in the future and to estimate the magnitude of wind, solar and other resources available for renewable energy.

By Earth observations we mean measurements of the Earth system, including physical, biological and infrastructure (e.g. roads, settlements) components. They can be made in a wide variety of ways: at the surface of the Earth or ocean, beneath the oceans' surface, at altitude within the atmosphere, and, increasingly, from space. Long-term time series data are important because they allow changes to be detected. Observations of wildlife may also be needed to ensure successful development of new energy infrastructure without planning delays.

Earth observation measurements are made by a huge number of organisations in the UK and around the world. This Strategy seeks to ensure that DECC has access to robust information on the climate and on environmental resources in a cost effective manner for the purpose of effective policy making.

We shall seek to achieve this by drawing on quality assured information that is freely available in the public domain, through partnerships with UK and international organisations. Where necessary, we also fund specific measurement programmes ourselves.

Specifically, the purpose of the strategy is to:

- Identify the key data sets on the climate system and data sets on environmental resources that DECC needs to deliver its goals
- Set out how DECC will access these data sets
- Set out how DECC will ensure the sustainability of new monitoring programmes, ideally in partnership with others, to make the best use of resources.

A strategic approach to Earth observations is becoming more important in the face of budgetary pressures around the world. A key objective for the next few years will be to agree with other UK funders a mechanism for securing stable UK funding for Earth observations.

Introduction

The Department of Energy and Climate Change (DECC) exists to counter two important risks, firstly of dangerous climate change, and, secondly, a shortfall in the supply of safe, affordable energy. Actions to tackle climate change and deliver secure energy supplies are inextricably linked, with more than eighty percent of UK greenhouse gas emissions coming from the provision of energy for end-uses such as electrical appliances, transportation and heating.

Our vision for 2050 is for the UK to have made a safe and secure transition to low carbon electricity, low carbon homes and buildings, and low carbon transport and industry, at least cost to the UK's economy, **in support of a global transition to a low carbon future**. We aim to achieve national and international action towards this goal by mobilising investment in low carbon infrastructure, by setting an appropriate framework of regulation, by providing incentives and information, and by building a broad coalition for change.

To achieve this vision, we will need to:

- Predict as far as possible how the climate will change, including likely changes in weather patterns and frequency of extreme events, so that we can plan what mitigation actions we need to take and when
- Monitor the effects of climate change to verify predictions and identify departures from the expected trends
- Prepare to adapt to a changed climate
- Provide best estimates of how much wind, solar and other resources are available for renewable energy
- Develop systems for effective measurement, reporting and verification (MRV) of international action on climate change

We will not be able to counter the important risks or achieve our vision unless we have **access** to a wide range observation data about **the earth system, including physical, biological and infrastructure components**.

Purpose of the strategy

Earth observation measurements are made by many organisations in the UK and around the world. This Strategy seeks to ensure that we have cost-effective access to robust information on the climate and on environmental resources for effective policy making.

We will seek to achieve this by drawing on quality assured information that is available in the public domain, through partnerships with UK and international organisations. Where necessary, we will fund specific measurement programmes ourselves.

Specifically, the purpose of the strategy is to:

- Identify the key long term data sets on the climate system and data sets on environmental resources that DECC needs to deliver its goals
- Set out how DECC will access these data sets where these are available
- Set out how DECC will develop new monitoring programmes where these are needed, often in partnership with others.

Monitoring the climate system in support of national and international climate policy

What we need

Observations of the land, oceans and atmosphere provide information to¹:

- Characterise the state of the global climate system and its variability
- Monitor the forcing of the climate system, including both natural and anthropogenic contributions
- Support the prediction of global climate change
- Enable projection of global climate change information down to regional and local scales
- Enable characterisation of extreme events important in impact assessment and adaptation and for the assessment of risk and vulnerability.

Many of these observations need to be global in coverage and, therefore require concerted international action. Whilst parts of the climate system are well observed, there are major gaps which have been identified in reports from the Global Climate Observing System (GCOS) Secretariat.

GCOS has identified a number of *Essential Climate Variables* (ECVs) (see Annex 1) which are required and set out 138 actions to deliver them. **Key issues requiring further work are observation of the oceans, ice caps, land biosphere and atmospheric constituents; and observations of all kinds in developing countries.**

The DECC/Defra funded Climate Programme (CP) at the Met Office Hadley Centre (MOHC) undertakes world-leading climate change research and modelling, and provides essential policy-relevant evidence to DECC.

The MOHC's work (and, indeed, climate research and modelling activity generally) relies heavily on observations of the ECVs, which are available from many sources - both organisations and data centres - world-wide.

Particularly important for the future development of the MOHC Climate Programme are:

- Precipitation
- Sea Surface temperature
- Ocean temperature and salinity (to a depth of 3,000m)

¹ Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC
<http://www.wmo.int/pages/prog/gcos/Publications/gcos-138.pdf>

- Sea level

Recent changes in the Arctic have given rise to concern that methane emissions from the region could increase. MOHC will be asked to investigate this emerging issue (in collaboration with other researchers) but to do this will require improved observations, both in situ (process studies of permafrost areas) and satellite-based (of atmospheric methane and carbon dioxide concentrations).

What we are doing to meet these needs

Globally, many Earth observations have adequate operational arrangements, and many data are shared and available via international data centres. However, in a few cases DECC co-funds the gathering of Earth observation data, usually as one of a number of UK partners where the data are particularly crucial to climate science. These include:

AATSR (Advanced Along-Track Scanning Radiometer) – DECC, its predecessor departments, the Natural Environment Research Council (NERC), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia and the Australian Department of Innovation, Industry, Science and Research, have since the early 1990s funded the AATSR instrument. Flying on the European Space Agency's ENVISAT satellite, this has provided measurement of global sea surface temperatures (SST).

The data are a key component of an ocean temperature dataset. As well as measuring global sea surface temperatures to the level of accuracy required for the monitoring and investigation of our global climate, AATSR data have been used as a common reference for correcting sea surface temperature data products from other satellite instruments.

They are used for climate change detection, attribution and model validation work.

Following the loss of communications with ENVISAT in April 2012, efforts are now focussed on reprocessing the data to incorporate further improvements in the data quality, and ensuring this vital SST record can be linked to, and extended by, a new SLSTR (Sea and Land Surface temperature Radiometer) instrument, to be launched on the ESA (European Space Agency) Sentinel 3 satellite due to be launched in 2014. The AATSR costs to DECC were ca. £0.8 million in 2011/12.

Argo Floats - DECC and NERC support the UK contribution to the Argo programme. This is a global array of some 3,000 floats that measure temperature, salinity and currents throughout the world's oceans. Argo is funded by many countries throughout the world. The network of floats was initiated in 2000 and the data are used in calibrating and validating climate models, for measuring recent climate change, and for initialising decadal forecast models. DECC's contribution to Argo is ca. £0.15 million pa. Figure 1 overleaf shows Argo observations have appreciably reduced the uncertainty in estimates of upper ocean heat content since 2002, where analyses (Hadley and PMEL/JPL/JMAR) of all the available data sets have included estimates of sampling error.

JASON-3 is a high-precision satellite altimeter (the third in a series) which can measure sea-level height more accurately than any other means. The programme is being led by EUMETSAT (European Organisation for the Exploitation of Meteorological satellites), in conjunction with the US (who will provide the launcher). DECC provides part of the UK contribution to this European programme, together with BIS, Defra and DfID. DECC's contribution to JASON-3 is ca. £0.25 million pa.

In addition to these three specific programmes, we work with many organisations to prioritise and co-ordinate the international scientific effort. These include: the United Nations Framework Convention on Climate Change (UNFCCC), Global Climate Observing System (GCOS), World Meteorological Organisation (WMO), European Space Agency (ESA), UK Space Agency (UKSA) and Natural Environment Research Council (NERC).

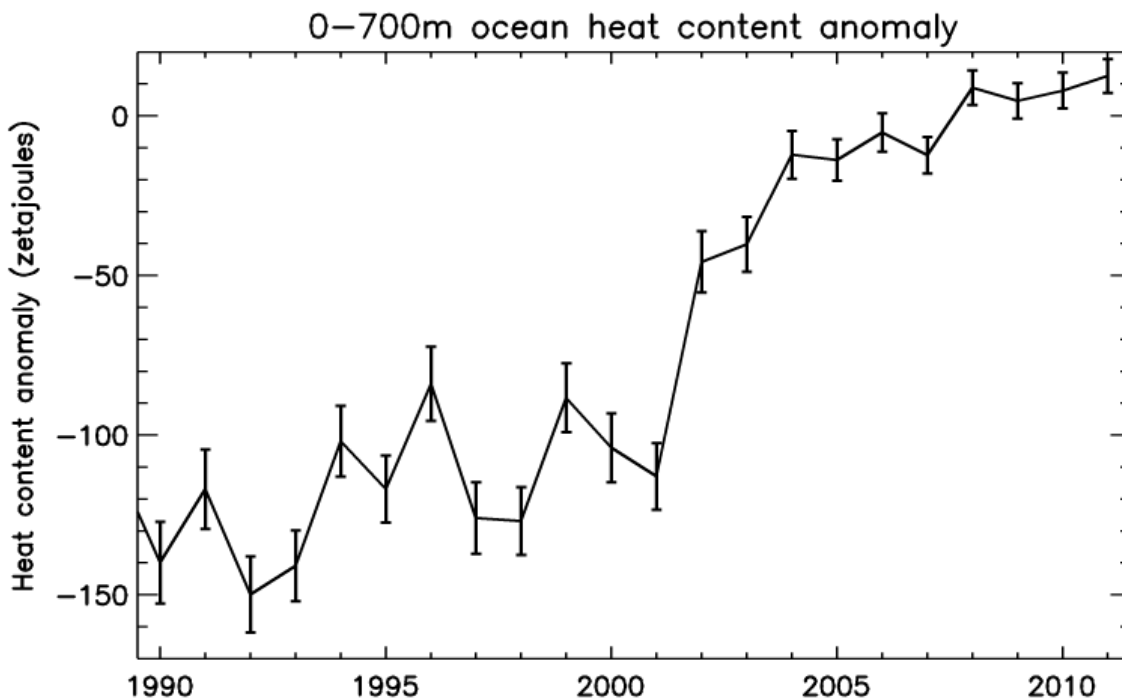


Figure 1: Time series of anomalies in annual average upper ocean heat content (zeta joules (10^{12} J), 0-700m depth) relative to average over 2004-2011. The effect of the inclusion of Argo data (which began to become available early this century) on reducing uncertainty can be seen in the reduced size of the error bars, which illustrate sampling and measurement uncertainties, towards the end of the time series. (Figure supplied by Met Office Hadley Centre)

Next steps

There is a continuing issue about securing funding for long term climate observations, notwithstanding the acceptance that these are essential. Indeed, programmes are threatened with reduced support around the globe. As discussed above, DECC supports ARGO floats, Jason-3 and AATSR missions. A key objective for the next few years will be to agree with other UK funders a mechanism for securing stable UK funding for Earth observations, including those moving from a research to an operational phase.

This issue has been given renewed impetus by the recent review of the MOHC Climate Programme, which says that :

Observations are vital to support both weather and climate science research, modelling, detection and attribution (i.e. to assess whether extreme weather events are the result of changing climate, or simply due to natural weather variability). The panel is concerned that many observations programmes are under threat, nationally and internationally.²

We shall continue to engage with national and international bodies to ensure that this vital component of the evidence base is maintained and enhanced where necessary. Specific actions are set out in Annex 2.

These will include carrying out specific recommendations of the MOHC Climate Programme review, and ensuring that the MOHC Climate Programme has access to the data it needs.²

² Risk Solutions Ltd: A report for DECC 2011

Resilience of the UK energy infrastructure to weather extremes and climate change

What we need

In order to meet our commitment to deliver secure energy, energy infrastructure (both current and future) must be resilient to change.

Infrastructure faces a number of threats, including changing patterns of supply and demand, space weather, and climate change.

Power stations may become more vulnerable to floods in areas where rainfall is expected to increase with climate change. Where rainfall is expected to decrease in the summer months, the availability of cooling water may be at risk.

The changing patterns of supply and demand, especially demand, will in turn be affected by changing climate – for example, due to increased demand for air conditioning in summer.

In addition it is possible that geomagnetic storms could disrupt electrical power supplies in the UK.

To understand these threats we need observational data on:

- Current weather patterns and extremes
- Changes in the UK climate and frequency of extreme weather events
- Space weather including geomagnetic storms.

What we are doing to meet these needs

Weather forecasts and information on the risk of extreme weather events are provided by the Met Office to Government, electricity suppliers, distributors, network operators and the National Grid.

To make these forecasts, the Met Office relies on an international network of national meteorological organisations that take measurements of land and ocean temperature, atmospheric temperature, pressure, wind and humidity and various other parameters, both *in situ* and via satellite observations.

Projections of the future climate in the UK are currently provided by UKCP09. This set of climate projections was produced by the Met Office Hadley Centre (MOHC), with collaborators, and relies on a Regional Climate Model (RCM) which has been appropriately downscaled.

The models used rely on the measurement of Essential Climate Variables (see previous section). Figure 2 below shows precipitation projections for Wales.

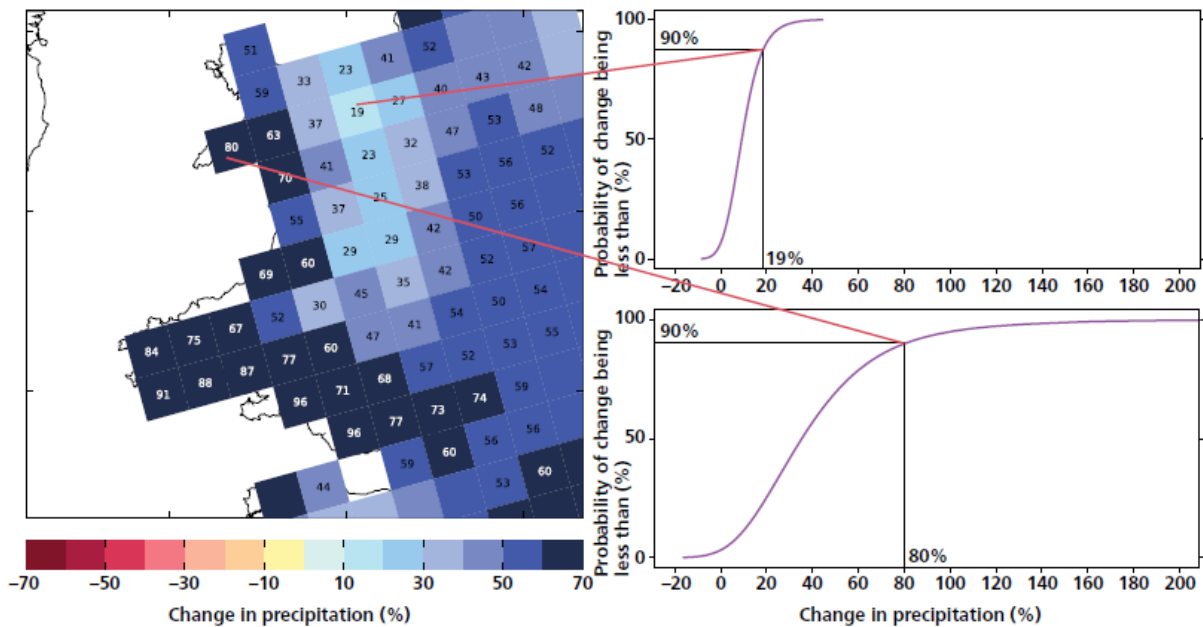


Figure 2: A map of changes, at 90% probability level, to mean winter precipitation over Wales by 2080s for a high emissions scenario. Source: Murphy et al 2009, UK Climate Projections Science Report: Climate change projections. Met Office Hadley Centre, Exeter.

Defra is currently leading work on the National Adaptation Programme, following publication of the Climate Change Risk Assessment in January 2012, and is looking at the Energy Sector with a view to making recommendations on adaptation to climate change. Much of the work described in the section *Monitoring the climate system in support of national and international climate policy* is relevant to ensuring the resilience of our energy infrastructure.

We are working with other UK agencies, including the British Geological Survey and UK Space Agency, who provide information on space weather and the likelihood of any geomagnetic storms that might affect the UK electricity system. Their work draws on national and international data sources including instruments funded by the UK Space Agency.

Next steps

We have no plans to provide additional or increased funding to weather, climate or space measurements but will work closely with national and international organisations working in these fields.

Land Use and Reduced Emissions from Deforestation and Degradation

What we need

Remote sensing is a recognised technique for monitoring land use, land use change and forestry (LULUCF). Interest in the international climate negotiations has focussed particularly on the role of remote sensing in monitoring the effectiveness of activities to reduce emissions from deforestation and forest degradation (REDD+). Remote sensing is also used in greenhouse gas emissions inventories for LULUCF in general – see next section, on measurement, reporting and verification (MRV).

The climate negotiations have agreed that countries should use guidelines developed by the Intergovernmental Panel on Climate Change (IPCC) as a basis for estimating forest-related greenhouse gas emissions and removals, by sources, and following the 2011 Durban conference it is likely that the IPCC will be asked to develop additional (or supplementary) guidance for this. Countries also need the institutional basis to use remote sensing data, and to integrate it effectively with ground based data. These steps are crucial if remote sensing data are to be used effectively. We need to ensure that the best use is made of remote sensing data for these purposes.



Figure 3: Deforestation in the Amazon

What we are doing to meet these needs

The UK provides support through the Forest Carbon Partnership Facility (FCPF) which aims to provide capacity building for REDD+, including for developing methodologies for the measurement and monitoring of emissions from deforestation in a number of developing countries.

The Group on Earth Observations (GEO) is seeking to facilitate the supply and use of forest observations through its Global Forest Observations Initiative (GFOI). The GFOI aims to coordinate observations, provide guidance on their use, develop methods and protocols, and promote research and development. DECC has played an active role in shaping the GFOI, especially in making the links with IPCC. The UK is also represented on the IPCC Task Force which develops inventory methodologies.

Next steps

DECC will:

- Continue to support capacity building in developing countries
- Ensure continuing UK representation on the IPCC Inventory Programme and the GFOI so that guidelines for effective use of remotely sensed data are suitable in the context of greenhouse gas inventory estimates for LULUCF and REDD+ purposes.
- Coordinate effectively with the relevant parts of the climate negotiations

Measurement, Reporting and Verification

What we need

Action to mitigate climate change, and negotiations under the United Nations Framework Convention on Climate Change (UNFCCC), requires quantification of emissions by source. Earth Observations are potentially useful in meeting these requirements. Current interest focuses on:

- Monitoring land-use, land-use change and forestry (LULUCF), and reduced emissions from deforestation and forest degradation (REDD+)
- Compiling and verifying emissions inventories.

Use of EO data in the REDD+ context is a rapidly developing area and DECC's contribution is covered in the preceding section.

The UK greenhouse gas inventory includes estimates of emissions from LULUCF; these rely on observations made by field studies (i.e. direct observation) to identify land-use categories. Indirect use is made of remote sensing data via its input to maps and data produced by the Forestry Commission, which contribute to the greenhouse gas inventory. Wider use of remotely sensed data is under consideration, e.g. for identification of fires, and for land use change detection.

There is increasing interest in the use of EO data and inverse modelling to verify greenhouse gas emission inventories. The techniques are not straightforward since wind transport data are needed as well as concentration data. The IPCC held an expert meeting on this in 2010 which concluded that *while remote sensing, ambient measurement and inverse modelling techniques have been successfully demonstrated they are currently not sufficiently developed to provide comprehensive verification at the required accuracy, much is to be gained from working together, to improve verification techniques as well as gain better understanding of inventory estimates, and of natural emissions and removals.*³ *The meeting also acknowledged the growing international interest in monitoring and verification and the importance of dealing properly with uncertainty and is suggesting new initiatives for emissions inventories that can improve prospects for independent verification.*

The UK is helping to pioneer the use of EO data for inventory verification, via measurements of atmospheric trace gases made at Mace Head in the Republic of Ireland and funded by DECC, combined with inverse modelling. The Mace Head measurements also contribute to the Essential Climate Variables (see section on *Monitoring the climate system in support of*

³ http://www.ipcc-nggip.iges.or.jp/public/mtdocs/pdfiles/1003_Uncertainty%20meeting_report.pdf

national and international policy). The data are submitted to an international data centre for use by climate researchers worldwide.



Figure 4: The trace gas measuring station at Mace Head in Ireland.

What we are doing to meet these needs

DECC is participating in the international atmospheric observation programmes and expanding the use of EO data within the UK. In 2011 a further three measurement sites were established in the UK at Talconeston (Norfolk), Ridge Hill (Herefordshire) and Angus Tall Tower (Angus). Data from these sites will be available from 2012. The UK is one of only a very few countries in the world to use atmospheric observations to verify emissions estimates in its greenhouse gas emissions inventory, and we are expanding our efforts to use the data for verification purposes.

Next steps

DECC will:

- Use the data from the additional UK measurement sites to improve the spatial resolution and enable verification at the devolved administration level
- Continue to work closely with Defra, contractors and the academic community to improve understanding of UK emissions and to identify the most reliable and efficient means of compiling the inventory
- Expand the use of remote sensing data in the LULUCF estimates made for the UK greenhouse gas inventory
- Engage with the IPCC emissions inventory programme internationally

The “next steps” bullets under REDD+ are also relevant for MRV (measurement, reporting and verification).

Availability of renewable energy resources

What we need

In planning a low-carbon economy for the UK, we need a realistic assessment of the amount of energy which might be supplied by renewable technologies. To date the renewables sector has used a *UK Renewables Atlas*, updated in 2008, which assessed the magnitude of the available renewable resource.⁴ The data (e.g. of wave height) have been supplied by the Met Office and Proudman Oceanographic Laboratory. They were derived from models which in turn rely upon a wide variety of satellite-based and surface observations.

However, this “snapshot” of present-day climatology is not necessarily an adequate guide to future renewable resources, which will vary with weather and with climate change. Thus estimation of future available resource requires forecasts of future climate and weather regimes.

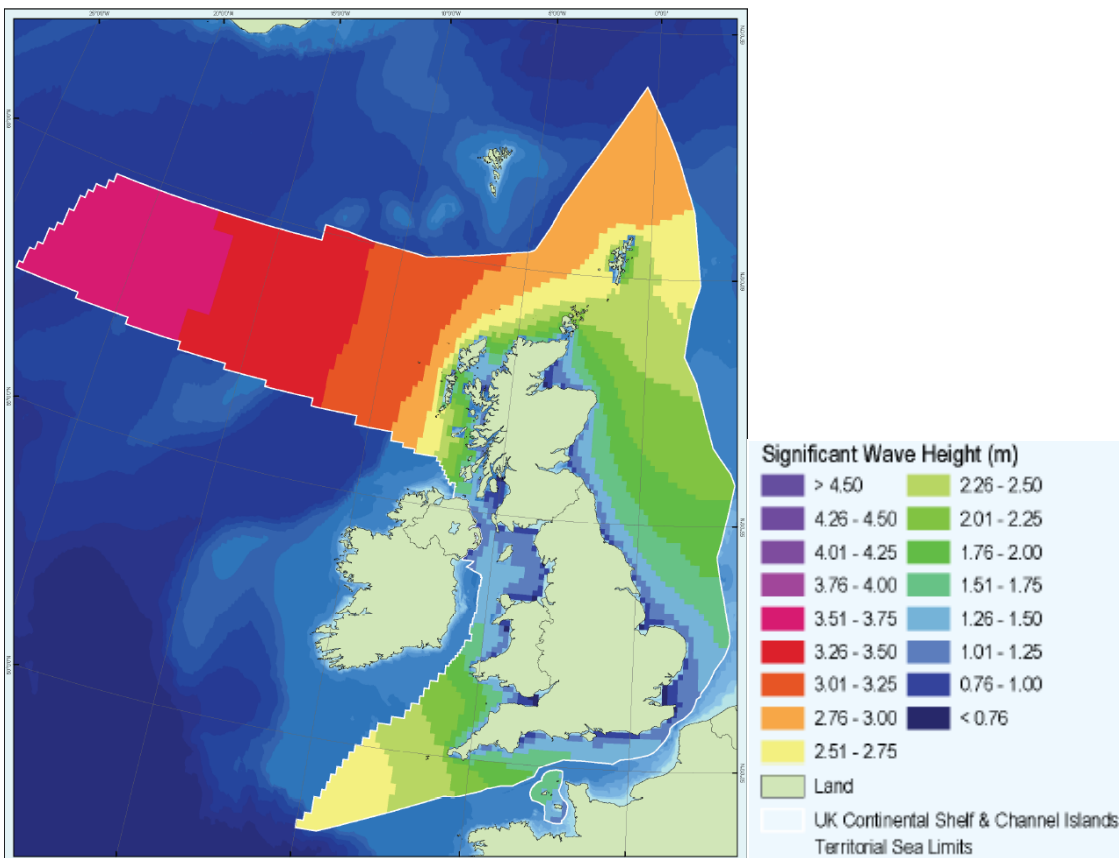


Figure 5: Annual Mean Significant Wave Height. (Adapted from the Atlas of UK Marine Energy)

⁴ <http://www.renewables-atlas.info/>

What we are doing to meet this need

To date, climate projections at regional scale have not been robust enough to make detailed regional projections, other than for temperature (ref. UKCP09). State-of-the-art Earth System models, running at the highest possible spatial resolution, are needed for better predictions of weather variables that drive renewable resource availability, including precipitation, on- and off-shore wind, waves and sunshine. Such models are now being developed but need matching improvements in observations to validate them.

Taken together, better observations and improved regional climate models will deliver much needed estimates of future renewable resources. Thus the requirements identified in the Section *Monitoring the climate system* are needed to quantify future renewable energy resources.

Next steps

DECC intends to fund new analysis of observations and modelling within the MOHC Climate Programme (2012 to 2015), aimed at improving wind and solar predictions for UK and NW Europe, which have direct policy relevance for DECC and OGDs. New work on marine parameters will also be considered.

Environmental impact of renewable energy – wind, marine and biomass

What we need

An understanding of the environmental impact of proposed developments is vital to successful planning applications to allow new energy infrastructure to be built. Data on environmental impacts are in some cases sparse for both on-shore and off-shore developments (particularly concerning impacts of wind turbines on wildlife), and this lack of evidence can delay the planning process.

What we are doing to meet this need

DECC is working to improve the availability of such data, collected using a variety of methods: visual observations from boats and aircraft, acoustic monitoring to detect whale vocalisations, and following tagged animals by satellite. The aim is to understand how animals respond to the installation and operation of devices, and to identify areas where development cannot be permitted e.g. because of legal requirements to protect certain species.

The Marine Energy Action Plan, announced in March 2010, recommended that DECC, with OGDs, identify appropriate environmental data collection methodologies etc. for Strategic Environmental Assessments.

Next steps

DECC will continue to work with Defra and contractors to implement the recommendations of the Marine Energy Action Plan.

Post-installation monitoring, for instance to monitor habitat restoration after development of a pipeline or windfarm, is not, at present, required, but DECC is participating in a project to identify good practice, which may potentially use Earth observations.

Biofuels are to be subject to a sustainability strategy, under development within DECC. One of its aims will be to prevent deforestation, and loss of biodiversity, resulting from the cultivation of biofuels. Thus the development of technologies for monitoring REDD and LULUCF (see earlier sections) also have applications for biofuels policies.



Figure 6: An offshore wind farm

Annexes

Annex 1: The Essential Climate Variables (ECVs)

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	<p>Surface:⁸ Air temperature, Wind speed and direction, Water vapour, Pressure, Precipitation, Surface radiation budget.</p> <p>Upper-air:⁹ Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget (including solar irradiance).</p> <p>Composition: Carbon dioxide, Methane, and other long-lived greenhouse gases¹⁰, Ozone and Aerosol, supported by their precursors¹¹</p>
Oceanic	<p>Surface:¹² Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Surface current, Ocean colour, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton.</p> <p>Sub-surface: Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers.</p>
Terrestrial	River discharge, Water use, Groundwater, Lakes, Snow cover, Glaciers and ice caps, Ice sheets, Permafrost, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Above-ground biomass, Soil carbon, Fire disturbance, Soil moisture.

Annex 2: Implementation Plan – the actions required by DECC to secure adequate observations

Organisation/Programme		Action Required	By Whom	Timescale
UNFCCC/SBSTA	SBSTA (Subsidiary Body for Scientific and Technical Advice) has a standing agenda item called “Research and Systematic Observations”. This has resulted in COP Decisions and SBSTA recommendations relating to improvement of systematic observations,	Attendance at meetings and preparatory work eg reviewing documents, drafting position papers with EU colleagues.	Science and Innovation Group, DECC (SIG)	Twice yearly meetings (June and December) and preparatory work in-between
GCOS and its secretariat	<p>GCOS is a joint undertaking of the World Meteorological Organisation (WMO) and other international bodies. Its goal is to provide comprehensive information on the total climate system, It includes both in-situ and remote sensing components. It provides an operational framework for integrating, and enhancing as needed, observational systems of participating countries and organizations into a comprehensive system focussed on the requirements for climate issues. One of its achievements has been to define the Essential Climate Variables or ECVs which are both essential and feasible for climate science.</p> <p>The GCOS Secretariat consists of a</p>	<p>Ensure UK expertise is available (eg by letting consultancy contracts) to the secretariat if required.</p> <p>Reviewing GCOS outputs (eg commenting on draft plans)</p> <p>Ensure GCOS Focal Point responsibilities are undertaken</p>	<p>SIG</p> <p>SIG</p> <p>SIG, in conjunction with Met Office</p>	<p>On-going</p> <p>Occasionally, as required</p> <p>Occasionally, as required</p>

	<p>small number of staff based in WMO HQ in Geneva, mostly experts on loan from their permanent employers. DECC has supported GCOS by funding a UK expert to work for GCOS. DECC should remain alert to the need to make unique UK expertise available to this vital organisation.</p> <p>All Parties to the UNFCCC are asked to nominate a GCOS Focal Point who will deal with GCOS issues within their country. In the UK the Met Office partially provide this role but close working with DECC is required.</p>			
<p>GCOS Co-operation Mechanism</p>	<p>A recurring theme within the COP Decisions and SBSTA recommendations addressing systematic observations has been the need for developed countries to provide assistance to developing countries to help them make the required observations. To take this forward, some countries have formed a GCOS Donor Co-operation Mechanism to try to identify resources and encourage their deployment. The UK is represented by either DECC or the Met Office.</p>	<p>Report on UK activities to the wider community and participate in efforts to identify new funding</p>	<p>SIG if not Met Office</p>	<p>The members meet approximately once a year</p>

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IPCC	Greenhouse Gas Emissions Inventory Programme	Ensure treatment of EO data is properly reflected in international methodological development	SIG; UK representative on the IPCC Task Force Bureau	Several meetings annually
GEOSS	The Group on Earth Observations (or GEO) is coordinating international efforts to build a Global Earth Observation System of Systems (GEOSS). This “system of systems” is intended to support policymakers and decision-makers. The work of GEOSS is categorised into nine “themes” including “Climate” and “Energy”. Defra provide the UK lead on GEOSS and include DECC in their consultations. The benefits which DECC could derive from GEOSS in furthering its energy security and low carbon objectives need to be explored.	Work with Defra and other UK players to formulate UK position, especially in preparation for plenaries and ministerials. Look into the GEOSS Energy Theme for opportunities for DECC to benefit from it and influence its direction	SIG in conjunction with other DECC colleagues SIG in conjunction with other DECC colleagues	Annual plenary or ministerial, usually in November Ongoing
GFOI	Global Forest Observations Initiative	Develop international guidance to facilitate use of EO data in estimating deforestation and forest degradation	DECC, Defra, BIS; NERC UK representative on the IPCC Task Force Bureau	Several meetings annually
WMO	The WMO’s activities include climate. The Met Office routinely represents the UK at WMO, including the WMO’s World Climate Programme. Many UK experts are involved in, and indeed steer, the	Input to UK position at Executive Council on climate matters	SIG	Annually

	<p>research and monitoring programmes. DECC input is not usually required.</p> <p>The one exception is in preparation for the annual meeting of WMO's Executive Council (on which the UK is represented) and for the WMO's supreme decision-making body Congress, which meets every four years, and which all WMO members can attend. DECC is routinely consulted about issues to be discussed at these, DECC attendance at Congress may be required as discussions there can mirror those going on in the UNFCCC.</p>	<p>on the agenda</p> <p>Input to, and attend, Congress</p>	<p>SIG</p>	<p>Every 4 years</p>
GFCS	<p>WMO is establishing a Global Framework for Climate Services (GFCS), whose purpose is to strengthen the provision and use of climate predictions, products and information worldwide. The Met Office lead for the UK in responding to the emerging proposals, in consultation with DECC and DfID. This has the potential to be a very significant development addressing a number of needs, including enhanced observations of the climate system. The International Climate Fund may be a suitable source of funding to implement the Framework and thus co-ordination between Departments is required.</p>	<p>Review taskforce proposals and contribute to UK position</p> <p>Post-WMO Executive Council (EC), monitor WMO proposals, respond to Met Office consultations as needed.</p> <p>Liaise with DECC and Dfid colleagues to secure ICF Funding for observational activities within</p>	<p>SIG</p> <p>SIG</p> <p>SIG</p>	<p>In run-up to Congress (May 2011) and as needed thereafter</p> <p>On-going</p> <p>On-going</p>

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		GFCS		
EC Expert Group on Science "EGSci"	This is one of a number of Expert Groups which formulate European negotiating positions in readiness for UNFCCC negotiations. This group addresses the "Research and Systematic Observations" agenda item and scientific issues arising under other agenda items. DECC provides the UK representation and is particularly influential.	Provide UK position and influence others in formulating EC position Assist presidency in writing position papers	SIG	On-going, to timetable set by UNFCCC/SBSTA
GMES	GMES is a major programme, funded by the European Commission and European Space Agency, to make available a wide variety of environmental information services. Its aim is to improve Europe's response to ever growing challenges of global safety and climate change, by developing a sustained and reliable Earth observation system of its own. Within the UK Defra lead on GMES. They have established "Network Groups" covering the atmospheric, land, marine and climate domains. They bring together researchers and users to discuss priorities with a view to influencing the direction of GMES. DECC participates in all of them as and when appropriate. DECC has actively influenced the developing GMES Climate Service, and	Provide DECC views on the development and priorities of the GMES and ensure DECC EO requirements are met, especially for SST data to maintain continuity from (A)ATSR series, and the developing climate service.	SIG	On-going

	<p>it is also expected that an ongoing GMES Service funded from operational GMES budgets will follow, and that this will cost approximately €50M per annum to run.</p> <p>DECC needs to continue to follow developments, to ensure that this substantial investment delivers outputs which are relevant to the evidence base needed for climate and energy policy-making.</p>			
EUMETSAT	<p>DECC does not usually have direct dealings with EUMETSAT, whose purpose is to deliver weather and climate-related satellite data and products, where the UK is represented by the Met Office. However, as one of the UK partners funding the EUMETSAT satellite programme JASON-3 (see section 3.1), DECC has a stake in this important instrument which makes accurate measurements of sea-level. The Met Office manages the arrangements with EUMETSAT and is the point of contact for UK stakeholders.</p>	<p>Direct contact rarely required – see JASON-3 below</p>	n/a	
ESA	<p>DECC has a direct relationship with ESA through the DECC-funded AATSR instrument flying on the ESA satellite ENVISAT (see above). An Instrument Mission Implementation Agreement sets out the commitments of the two parties. DECC fulfils its commitments via a number of contracts funded from</p>	<p>Fulfil commitments enshrined in AATSR Instrument Mission Implementation Agreement by maintaining contracts to monitor AATSR</p>	SIG	

	<p>the SIG research programme.</p> <p>More recently, ESA has embarked upon a broader programme of climate-related work, with the launch of its Climate Change Initiative. This is a substantial programme to bring pre-existing satellite datasets up to climate quality and hence serve as ECVs. The UK's expertise in this area has been recognised with extensive UK involvement in the contracts awarded so far. DECC needs to ensure that future contracts continue to be awarded according to scientific merit, and that its own research programme makes full use of these emerging datasets.</p> <p>More opportunities may arise to develop the climate science evidence base at the ESA Harwell Centre, which was established in 2009.</p>	<p>performance, validate data etc.</p> <p>Ensure ESA Climate Change Initiative continues to maximise use of UK expertise and delivers ECVs</p> <p>Ensure DECC-funded research makes optimal use of emerging ECVs from Climate Change Initiative</p>	<p>SIG in conjunction with UK Space Agency</p> <p>SIG</p>	
UK GHG Inventory	Greenhouse Gas Inventory reported annually to the UNFCCC and the EU	Incorporate EO data from additional sites in verification estimates	SIG Inventory team and contractors	Annual
UKSA	The UKSA was set up in 2010. Its remit includes co-ordinating UK civil space activity, and supporting academic research. It is still developing its ways of working. In October 2010 it convened a meeting of its stakeholders to establish what they wanted of it, at which DECC was represented. DECC needs to	Respond to UKSA's efforts to understand DECC's data needs and shape its programme	SIG in conjunction with other DECC colleagues	

	continue to work with UKSA so that UKSA has a clear understanding of DECC's needs for Earth Observations and can negotiate for these in international fora.			
LWEC EOF	LWEC has recently merged with the Environmental Research Funders' Forum (ERFF) and its Environmental Observations Framework (EOF) , and with the Global Environmental Change Committee and its Observations sub-group . How the combined organisation will work in practice is yet to be finalised. However the EOF has done valuable work in identifying and documenting (in a catalogue) all the environmental observations undertaken within, or funded from, the UK. It provides a valuable forum to bring together all UK parties interested in environmental observations, to identify shared interests and efficiencies. DECC is represented on the Management Group of the EOF.	Continue to sit on the EOF's Management Group, guide its outputs to be useful to DECC and use its resources, eg observations catalogue, where relevant to DECC's policies	SIG in conjunction with other DECC colleagues	
NERC	Various NERC Centres and Facilities undertake Earth Observation activities. DECC discusses shared interests with NERC in a number of fora (eg both are members of LWEC and LWEC/EOF).	Collaborate with NERC over mutually beneficial programmes, eg ARGO Influence NERC's programmes by responding to NERC's	SIG SIG	

DECC Earth Observation Strategy

		consultations especially any relating to observations strategy		
NCEO	The NCEO is a “distributed” centre, led from Reading University but involving a number of other UK institutions. It provides NERC with national capability in Earth Observation science.	Indirectly via NERC	SIG	
Met Office Hadley Centre	The MOHC has a particular strength in its ability to understand and use observational data to support its climate modelling work. It is very well-placed to provide expert advice to the global community about which observations are needed, and their interpretation. As a co-funder of MOHC, DECC should ensure this valuable expertise continues to exist and to benefit other programmes.	Ensure MOHC’s particular strength in using observations in conjunction with models is used to optimum advantage to identify the most valuable observations, and that their expertise is available to the international community	SIG	

Annex 3: Glossary of terms

AATSR: Advanced Along Track Scanning Radiometer. A sea surface temperature measuring instrument currently aboard the ENVISAT satellite.

BIS: Department for Business Innovation & Skills

DECC: Department of Energy & Climate Change <http://www.decc.gov.uk>

DFID: Department for International Development

EOF: Environmental Observation Framework, <http://www.ukeof.org.uk/>

ESA: European Space Agency, <http://www.esa.int/esaCP/index.html>

EUMETSAT: European organisation for the exploitation of meteorological satellites, <http://www.eumetsat.int/Home/index.htm>

FCPF: Forest Carbon Partnership Facility, <http://www.forestcarbonpartnership.org/fcp/>

GCOS: Global Climate Observation Systems, <http://www.wmo.int/pages/prog/gcos/index.php>

GEO: Group on Earth Observation, <http://www.earthobservations.org/index.shtml>

GEOSS: Global Earth Observation System of Systems, <http://www.earthobservations.org/geoss.shtml>

GFCS: Global Framework for Climate Services

GFOI: Global Forest Observations Initiative, <http://www.space.gov.au/Pages/GlobalForestObservationInitiative-SatelliteDataStrategy.aspx>

GMES: Global Monitoring for Environment & Security, <http://www.gmes.info/>

LULUCF: Land use, land use change and forestry

LWEC: Living with Environmental Change, <http://www.lwec.org.uk/>

MOHC: Met Office Hadley Centre, <http://www.metoffice.gov.uk/climate-change/resources/hadley>

NCEO: National Centre for Earth Observation, <http://www.nceo.ac.uk/>

NERC: Natural Environment Research Council, <http://www.nerc.ac.uk/>

REDD+: Reducing emissions from deforestation and forest degradation

SBSTA: Subsidiary Body for Scientific & Technical Advice, <http://unfccc.int/bodies/body/6399.php>

SIG: Science and Innovation Group, DECC

SLSTR: Sea & land surface radiometer. An instrument to be launched in 2013 aboard ESA's Sentinel satellite.

UKCP09: Latest UK climate change projections, <http://ukclimateprojections.defra.gov.uk/>

UKSA: UK Space Agency, <http://www.bis.gov.uk/ukspaceagency>

UNFCCC: United Nations Framework Convention on Climate Change, <http://unfccc.int/2860.php>

WMO: World Meteorological Organisation, http://www.wmo.int/pages/index_en.html

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