

Climate Services Science: Researchers' Ambitions

Key/important research areas to meet user needs

- Research into data platforms and formats
- Research into delivery mechanisms, e.g. delivering web tools
 - The effectiveness of delivery mechanisms
- Understanding what information climate or other decision-makers use and how they make decisions
- Where do they currently get the information from?
- Robustness of the decision-relevant information today
- Research into what makes climate information (and other services) valuable? Useable? Actionable? Compatible?
- What do users of climate services want to achieve?
 - Why would they use climate services?
 - Clever means of using climate information/soft knowledge
- How is climate information (and other services) being used?
 - How could they be used better?
 - Understanding vulnerability/sensitivity
 - Using various statistical (e.g., Bayesian statistics) and modelling methods
 - Combining qualitative and quantitative information, skill and judgement in an informed way
- Social and decision sciences
 - Effective communication of climate and other information
 - Understanding behaviour change and practice
 - Research into interpretation of robustness, accuracy and uncertainty
- Scoping research for understanding current and future users' requirements
- The value of the climate services and the outcome of the use of those services
- Research into standards

Key research areas

- Better use of observations for multiple purposes (e.g., motivation, vulnerability assessment, model validation esp. extremes)
- Integrating research in climate services into ongoing research in seasonal and weather forecasting services
- Evaluating existing practice
- Action research
- Targeting the research into what users want – 'weather' (variability and extremes)
 - Can we extract more of this type of information from current and on-going models
- Post-processing of model data to make it useful, e.g. bias correction
- Can bias correction, downscaling or post-processing add value (i.e. better address users' requirements)?
- Review, understand and evaluate how current climate information is being used
- How do different users (policy, industrial / organisational / sectoral levels) interpret and act on the uncertainty of climate change risks (both those associated with long-term climate change, and with variability and extreme events)?
- Implications of availability and access to climate services for inequity
 - Who benefits, who can be involved, who can access?

If funds were unlimited, how would you respond to user needs?

Current resources available

- Do we have the right people now to understand user needs? Who decides/evaluates who the 'right' people are?
- Is there sufficient research capacity available now to respond to user needs?

In both cases, there is probably only limited capability available now. These questions need research in their own right in the first instance to understand users' needs and then developing and delivering training/education programmes to build capacity to respond to users' requirements.

Specific areas of funding

- Need for an information hub to start building the infrastructure for a climate services science community:
 - To involve both scientists and users
 - Physical unit and/or virtual internet-based environment
 - Face-to-face contact still important
 - Will help in the co-production of knowledge
- Need for a national database
 - Need funds to collate information and make it freely available
 - Includes current baseline information and information on future climate
 - Integrates climate risks and vulnerability indicators
 - Will help scope specific information requirements

A major barrier is the insufficient baseline data available (UK and globally) so use funds to collate available data (inter-operable, comparable, consistent)

Research areas required

- Collection of data, particularly non-climate information
- Adaptation indicators
- Real-time monitoring/observing/evaluating (over a range of temporal/spatial scales)
- Validation of models
- Funding to support users' action and feedback

Increase capacity amongst users

- Allocate funding to expert users who then are engaged in the identification and delivery of research areas/projects
 - May encourage users to invest
 - In short-term could kick-start collaborative efforts
- Fund and emphasise KE activities throughout projects
 - KE coordination to help build and sustain capacity and facilitate links

Outputs from research

- All freely available and promoted (e.g. pay for publication of scientific papers, etc.)
 - Will encourage greater usage
 - Will help remove IP issues
- Time implications of dissemination need to be covered by funding
- Maintain all outputs over time
- Data: improve accessibility, make available at hierarchy of levels, aid visualisation

- Tailored tools/information to aid understanding and interpretation

Knowledge Exchange

- Fund KE coaches to explain concepts and identify potential outputs
- Embed climate services science experts across sectors/professions/next generation to educate and inform
- Mainstream information

Fund users to implement research outputs and provide feedback

- Use case studies (and learning examples)
- Monitor effects of changes resulting from research (attribution studies)
- Process needs to be included in original research proposal aims
- Centrally coordinated
- Need initial work to ensure approach is feasible

Way forward

- Fund lots of innovative projects to try everything knowing the success rate will be small. Would help cover the uncertainty of not knowing future user needs, help researchers horizon scan, and could drive innovation. On the negative side, insufficient research capacity to do this now and to broad an approach could act as a barrier to encouraging user involvement.
Or
- Specific targeting of knowledge gaps

Multi-disciplinary approach is favoured way forward with small, single-focussed projects to fill gaps as required. The challenge then is to aid interpretation of research outputs recognising there will never be full agreement.

Short and long-term projects required depending on type of decisions being addressed.

Need flexibility into the future so don't close off any options too early

What information do researchers (providers) need from users? What would researchers want/need to ask users?

Better understand users' needs – need for social scientists (decision, risk analysis and communications)

- From generic perspective – needs of various users – understanding the decision space of range of users
 - Sector risks relative to non-climate risks
 - Which sectors are the needs for climate services large?
 - To what are they vulnerable? Hazards? Risks
 - What is their perception of their vulnerability?
 - 'Things' of interest
 - Business drivers/regulatory drivers/environmental health/third party drivers
 - What keeps them awake at night
 - What is their risk appetite?
 - Relative importance of managing different risks
 - Penalties for not managing those risks
 - What is the timeframe for decisions and policies?
 - For how long will the decision / policy (and therefore the climate information) be valid /useful?

- How does climate information fit into their decision-making processes (non-climate)
 - How climate services plug into decision-making processes?
 - What outcomes are they trying to achieve – issues “business” objective
 - Expectations for the climate information (and other services)
 - How users make decisions? Aspire to make decisions?
 - Why decisions are made in specific ways?
 - Who makes decisions (power structure)?
- Do users need informed responses to specific questions (e.g., do users want hierarchical / highlight messages?)
- Foresight – scoping of future needs
- Current and changing technical capacity of users – capacity to ingest information
 - Different for practitioners and policy makers than for impacts (users) science (also quite varied)
 - Capacity to ingest results from interdisciplinary research
 - How you consume/deliver result/info - targeted info
 - Understanding audience. What are their routines/processes
 - Changing questions (with time and different uses) will need to be addressed
- What are the funds/resources available to support use of climate services? Sources of funding?
- What are the capacity and willingness of users (providers and purveyors) to be engaged in climate services and climate services science?
 - What are effective mechanisms for engagement – possibility for feedback – sustained/capacity?
 - Capacity to be engaged in research (interactive and co-production)
 - Desired degree of engagement? Understanding the role of users, providers and purveyors in the knowledge chain and benefits
 - Needs for, and benefits from, joint engagement – users, providers and purveyors
 - Does a user want increased capacity themselves or do they just want information?
- Breadth of voice being heard and spoken – influential (loudest) voice is often the one that is heard
 - Is there a need for framework for understanding breadth of voice - filter/sort/group – common requirements
- Difficult to engage with evolving breadth of users so are their representatives with whom engagement would result in broader users being heard?
 - Need for intermediaries?
 - Effective feedback mechanisms
 - Need for networking (and decision-making science) engagement?
 - Embedded from the start
 - Knowledge circulation
- Potential for users to redevelop their decision-making frameworks/models – rethinking how they could use climate services

With a spectrum of climate services being provided – different sources and different needs

- Have they already used climate information?
- Where are users’ currently getting their climate information (and other services)
 - Why are they using it? Does it meet their needs?
 - What do they trust and what are qualities they look for in a trusted source/purveyor?
 - How are they accessing and using that information (or other services)?

Understanding the technical aspects of the climate information users need:

- Timing (temporal scale and resolution, when is the information needed, etc.)
- Spatial scales and domain
- What variables are important to the end user?

- Variability and extremes – not just variables
- Five-day rainfall, thresholds (characteristics)

From a research perspective what would a successful climate services and climate services science programme look like?

Success criteria

- There is a demand for what was on offer (i.e., users are using the data and taking up the services on offer and coming back for more).
- Strive for ‘Excellence with impact’. In this work excellence without impact is not valued and impact is only of use when it is based on excellent science.
- Climate information providers are confident to talk to ‘end users’ directly and do not feel they have to go through intermediaries.
- Catalysis more multidisciplinary PhDs, MSc and undergraduate programmes, and would generate momentum and allow expansion.
- There would be module on climate risk in lots of degree courses, in continuing professional development courses and those developed by professional institutions.

Funding

- Multiple funding streams from both the public and private sector.
 - Clarity about who is responsible for the delivery and funding of climate service activity.
 - The length of funding might vary depending on whether it was for long term baseline activities or whether it was for more ad hoc projects.
 - Long term funding of a climate services programme would allow learning and relationships to develop and mature, bearing fruit.

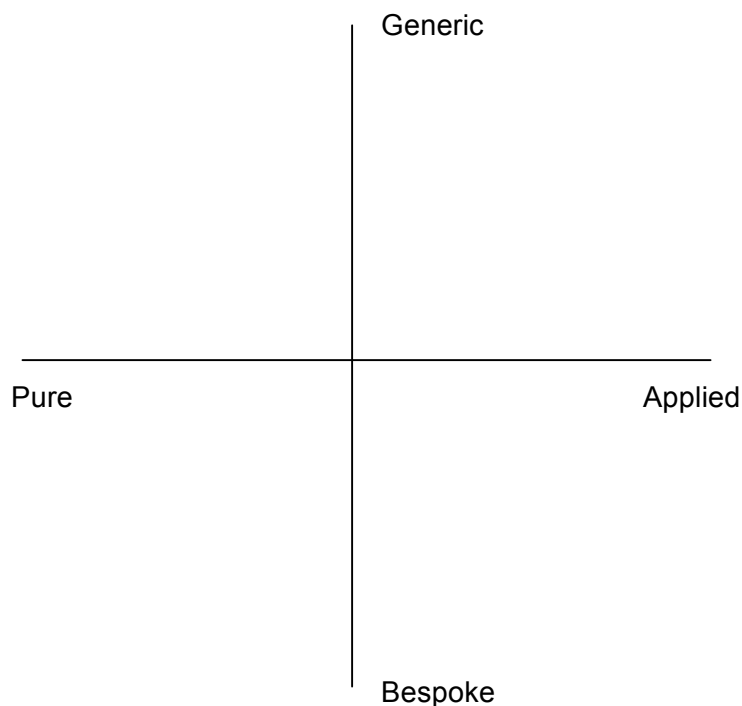
Types of projects supported

Two spectrums were identified to illustrate the climate services and climate services science landscape.

Generic-----Bespoke

Pure research -----Applied research

These spectra could be combined to form 4 quadrants.



- A successful community would have projects in each of the 4 quadrants and they would be well connected. The individual projects would be part of an overarching programme and the value of the programme would be greater than the value of the individual projects added up.
- The communication and dissemination aspect of the work would be highly valued and there would be a meaningful balance between the efforts allocated to this as to those allocated for the actual research (as appropriate to the location of the work on the pure/applied spectrum).

Currently generic data/information provision is largely supplied by government and research council funding and bespoke material by private consultancy.

- In the future, climate service activity would fit more in the middle of the spectrum (e.g., through provision of demonstration projects for different sectors, scales and regions to illustrate the application of climate information that can be quoted and used widely. ENSEMBLES 'shared responsibility' management principle was considered good as it meant that the work of the project depended on impacts and climate scientists having to work together and share ideas and approaches.
- The more specific the question for which the climate service is required the greater the range of different answers that are possible.
 - Is there a way to provide more 'standardise' information or general 'truths' about the climate information or the 'correct' or 'approved' or 'recommended' procedure to follow (i.e. if you follow this approach you have done as well as anyone can expect at this time).
 - Could have a UK Climate services help desk to support this.

Starting with available information

- Understand and recognise the value of climate information for existing users.
 - Perhaps the MET Office operational data could be made freely available to everyone (as well as other model data). This would allow users to become familiar with the information / data, evaluate it and come to their own conclusions about its use and value.

Standards

- A successful climate services community could be setting standards for information quality and appropriate use.
 - This would require the simultaneous setting up of regulations and certification which might have the danger of leading to 'tick box' culture where people do the bare minimum to get by.
 - Could be seen as a longer term goal with an intermediate step being to provide information on the range of opinion about information quality, certainty and uses to allow users to have as clear a picture as possible about its uses and limitations.
 - What is 'good enough' information for climate service products?

Co-production of knowledge

A successful climate services community would have knowledge co-produced engaging users and providers with the research informing climate decision making directly and the results, including products and services, being available in a form the intended end-user communities 'can actually use'.

- It is also important to evaluate 'usability' both as the research team and with the users' perspectives. Evaluation should be seen as an opportunity for learning and ensuring learning gets incorporated in the next stages.
- Support from the top (through the way PhD's, research programmes are funded, demand from government agencies, etc.), as well as bottom-up pressure (users) and experience of what works well to enable effective multi-disciplinary climate services and climate services science
- Need for a better understanding of the nuances of who are the users, purveyors and providers of climate services and the range of needs.
 - A spectrum of users was suggested but this then became a network as a spectrum was too linear.
 - It was suggested that people only engage meaningfully with their near neighbours in the network i.e. those with similar mindsets and drivers. A sign of a successful community would be that this comfort in engagement was dispersed across the network.

Meeting academic requirements and making the most of climate services science

Any research undertaken needs to fit within the existing academic demands (e.g., through supporting the development of peer-reviewed research)

- Also having capability to bring in the more applied experience so that is isn't lost and that good work gets noted and accredited to individuals to support their professional development (either through an equivalent system to what already exists or something more appropriate?).
- Could have a special issue of Nature Climate Change?