



Sustaining Knowledge for a Changing Climate

Executive summary of recommendations for future research priorities submitted to EPSRC

Summary

The EPSRC funded Sustaining Knowledge for a Changing Climate (SKCC) project has for the last two years been working with the three-fold aims of:

1. Sustaining the researcher and end user community assembled around the BKCC programme.
2. Synthesising and disseminating results from BKCC to maximise impact.
3. Developing a coherent user-led plan for future research into the impacts of climate change on the built environment and infrastructure and development of adaptation solutions.

This has involved a series of open meetings, workshops and site visits, together with production of position papers, engagement of key stakeholders through a Stakeholder Steering Group, a major synthesis report, newsletters and email bulletins and maintenance of a web site.

This short report synthesises the insights gained from users and the research community on the necessary direction for future research on the impacts of climate change on the built environment and infrastructure and development of adaptation solutions. It is intended to advise EPSRC on what stakeholders and researchers have identified as priorities for the forthcoming Adaptation and Resilience to a Changing Climate (ARCC) programme. The development of the research priorities reported here has involved a wide-ranging consultative process, involving three workshops and input from the SKCC stakeholder committee.

The first phase of the BKCC programme made considerable progress in understanding the impacts of climate change on infrastructure, the built environment and utilities and in proposing adaptation responses. Meanwhile there have also been several additional significant research initiatives of relevance to climate impacts and adaptation focusing on the built environment. It became clear through the SKCC deliberations that not all of the information or methodological deficiencies identified by SKCC stakeholders necessarily require EPSRC research in order to address the identified stakeholder needs.

Within the SKCC project deliberations previous research advances and ongoing projects, as well as the appropriateness of research topics for EPSRC funding, have been taken into account when developing recommended priorities. Priorities for EPSRC research on climate change impacts and adaptation that now stand out are:

- Adaptation and adaptability of existing and new buildings
- Performance, vulnerability and resilience of critical infrastructure
- Sustainable management of water resource systems
- Functioning of the urban environment, land use and spatial planning

Inevitably, stakeholder and researchers recommendations were not restricted to these areas, and other aspects highlighted are mentioned in this report.

Numerous instances of good practice in stakeholder engagement were evident in the BKCC programme, but lack of awareness of BKCC outputs by many of the participants newly involved in the SKCC process demonstrates the need for more concerted dissemination efforts in future research. It is expected that all of the projects funded under ARCC will involve credible stakeholder engagement. Through consultation with stakeholders and the research community, we have identified mechanisms for stakeholder engagement, networking and dissemination that merit support as part of ARCC.

Recent research advances on climate change in the built environment

Future research in ARCC must build upon rather than duplicate recent and ongoing research initiatives.

The BKCC programme progressed understanding of the potential impacts of climate change upon infrastructure, the built environment and utilities. BKCC involved the following nine EPSRC funded projects:

- CRANIUM: Climate change Risk Assessment: New Impact and Uncertainty Methods
- BETWIXT: Construction of climate scenarios for the built environment, transport and utilities
- EHF: Engineering Historic Futures: Adaptation of Historic Environments to Moisture-Related Climate Change
- AUDACIOUS: Adaptable Urban Drainage - Addressing Change in Intensity, Occurrence and Uncertainty of Stormwater
- GENESIS: Climate Change Impacts assessment on the Electricity Supply Industry and Utilities
- ASCCUE: Adaptation Strategies for Climate Change in the Urban Environment
- BIONICS: Biological & Engineering Impacts of Climate Change on Slopes
- BESEECH: Economic & Social Information for Examining the Effects of Climate Change
- Impact of Climate Change on UK Air Transport

The BKCC programme therefore represented a broad, but not exhaustive, coverage of the research challenges to the built environment, infrastructure and utilities posed by climate change. The results of the BKCC research are summarised in Walsh *et al.* (2007). Yet the science of climate change is rapidly advancing and the challenges of adaptation to climate change across a host of sectors are only beginning to be understood.

In addition recent EPSRC funded work includes two projects investigating the impact of and adaptation to the urban heat island effect: SCORCHIO: Sustainable Cities: Options for Responding to Climate cHange Impacts and Outcomes (EP/E017428/1) and LUCID: The Development of a Local Urban Climate Model and its Application to the Intelligent Development of Cities (EP/E016448/1). The broad aim of the CREW consortium (Community Resilience to Extreme Weather) (EP/F037422/1) is to develop a set of web-based tools for mapping likely future extreme weather events, for assessing their impacts under a range of scenarios, and to evaluate and offer a range of coping measures. EPSRC also jointly funds the Flood Risk Management Research Consortium (EP/F020511/1), which is addressing flood risk management in a holistic way to ensure appropriate and successful integration of management options; and the Tyndall Centre cities programme which is developing an integrated assessment facility for examining mitigation and adaptation at the city scale.

Climate impact studies conducted in BKCC were based on climate predictions from UKCIP02 scenarios. Rapid advances are being made in the representation of uncertainties in climate scenarios. This year UKCIP will publish its “UK 21st Century Climate Scenarios” or UKCIP08 for short. UKCIP08 will provide statistical distributions to represent uncertainties in key climate projects. Work in the CRANIUM project begun to explore the use of probabilistic scenarios and methods for analysing the implications of climate uncertainties. EPSRC has recently funded five projects using probabilistic scenarios: “Use of Probabilistic Climate Data to Future-Proof Design Decisions in the Buildings Sector” (EP/F038151/1); “The use of probabilistic climate scenarios in building environmental performance simulation” (EP/F038224/1); “Decision support for building adaptation in a low-carbon climate change future” (EP/F038240/1); “Coincident Probabilistic climate change weather data for a Sustainable Built Environment: COPSE” (EP/F038178) and “The Use of Probabilistic Climate Scenarios in Decision Making for Adaptation of Building and Property Drainage” (EP/F038143/1). These projects will deal with the use of probabilistic information to support decision making within the built environment, including those related to adaptation of buildings to projected changes in climate and aspects of the mitigation agenda

Sustaining Knowledge for a Changing Climate

Sustaining Knowledge for a Changing Climate (SKCC) was initiated by EPSRC to build on the collaborative group of researchers and stakeholders established during the Building Knowledge for a Changing Climate programme. SKCC ran from April 2006 to March 2008 (see Figure 1), with the two-year period being roughly divided into two phases of activity. The first year focused upon synthesis and dissemination of results from the BKCC programme. Activities included the production and circulation of a report (Walsh *et al.* 2007) summarising the BKCC results in a format accessible to end users and a one day conference to disseminate the BKCC results to end users. Based on a suggestion from the SKCC stakeholder steering committee a very short ‘So What?’ document was produced and widely distributed that summarised the key findings and main achievements of each BKCC project and highlighted what implications the outcomes may have on policy and practice. In addition four site visits for researchers, practitioners/end users took place to look at existing examples of buildings and infrastructures, examine their vulnerability to climate change and to discuss examples of adaptations. A number of cross-cutting areas where significant gaps in research exist were also considered through desk-based studies and workshops for researchers and stakeholders. These activities lead to position papers on the following topic areas:

- i. use of probabilistic scenarios in impacts assessment and adaptation studies;
- ii. evaluation of adaptation options across sectors;
- iii. linking adaptation and mitigation;
- iv. impacts and adaptation of the existing and new building stock.

The second year of the programme looked towards the next phase of EPSRC funded climate impacts and adaptation research. The results of this process are reported below.

Throughout the SKCC programme there has been regular communication with and dissemination to researchers and stakeholders through the website, newsletters and email bulletins. Summaries of all the events and activities that have taken place are available on the website: www.k4cc.org.

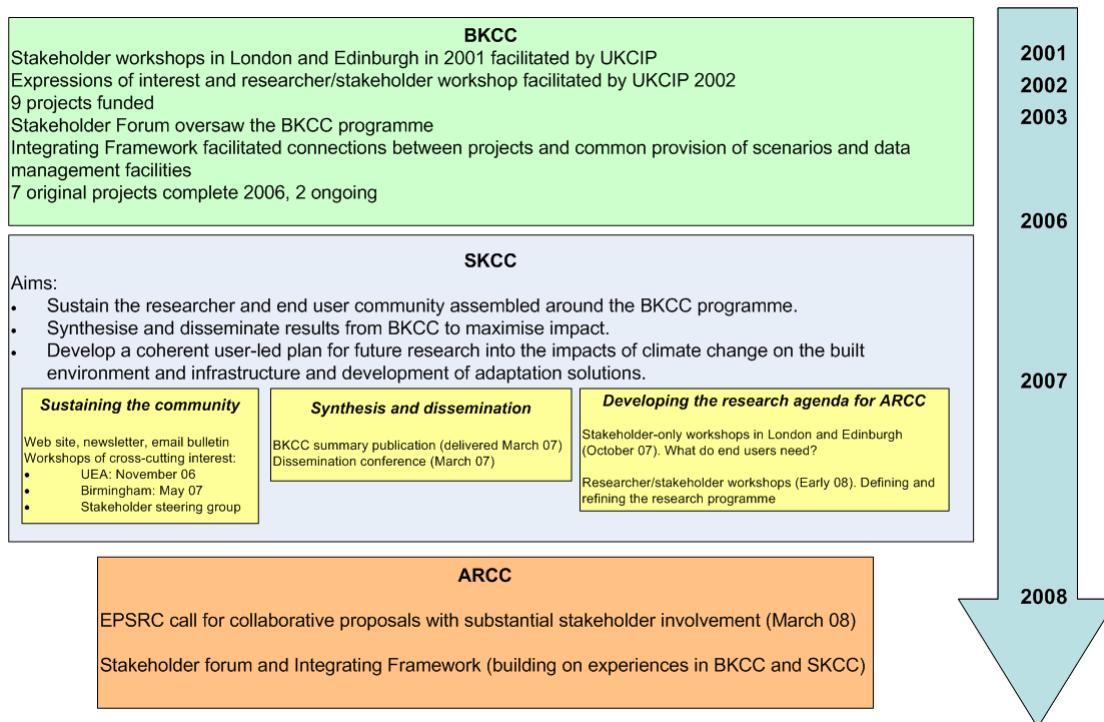


Figure 1: Summary of the BKCC-SKCC-ARCC process

Research priorities emerging from the stakeholder and researcher workshops

The first two workshops to develop research priorities, held in Edinburgh and London on 1st and 12th October 2007, were open only to stakeholders drawn from industry, government and NGOs. Academics were not invited so that discussion could, in the first instance, focus upon stakeholder needs. A total of 111 stakeholders attended. The final, two-day workshop, held in Birmingham on the 28th/29th January 2008, involved a majority of academic researchers. At this final meeting (attended by 92 delegates), the outcomes from the two stakeholder workshops were presented as a basis for converting these user needs into research themes and priorities, in the context of existing research initiatives and an appraisal of the significance of the research challenges and their appropriateness for EPSRC research.

Detailed reports on these workshops are available on the SKCC web site. The priorities below have been established on the basis of the prioritisation process at the end of the final workshop, with clustering proposals put forward at that workshop into coherent topic areas.

Priority area: Adaption and adaptability of existing and new buildings

Development and analysis of options for adaptation of existing and new buildings to various impacts of climate change e.g. heat, flooding, water scarcity, windstorm, subsidence. Development of performance requirements, and design and assessment methods e.g. for durability, structural safety and comfort. Development of new design methods for buildings that are adaptable to climate change.

Notes:

1. Adaptation to climate change will often have implications for the greenhouse gas emissions from building so projects may also consider these implications, but projects primarily on energy-efficient buildings were considered to be outside the scope of ARCC.

2. It is essential that future research in this priority area should complement rather than duplicate recently EPSRC funded on building codes for design (e.g. Use of Probabilistic Climate Data to Future-Proof Design Decisions in the Buildings Sector: EP/F038151/1); internal temperature and energy use in buildings (e.g. The use of probabilistic climate scenarios in building environmental performance simulation: EP/F038224/1); effects of building construction, type of building and how buildings, spaces and roads are sited in the city and urban areas on heat and human comfort (SCORCHIO: Sustainable Cities: Options for Responding to Climate cHange Impacts and Outcomes: EP/E017428/1); how buildings respond to and contribute to the local microclimate (The Development of a Local Urban Climate Model and its Application to the Intelligent Development of Cities (LUCID): EP/E016448/1)

Priority area: Performance, vulnerability and resilience of critical infrastructure

Systems approaches for assessing and reducing climate risks to critical infrastructure, including transport, energy, water and telecommunications infrastructures. Identification of critical vulnerabilities and thresholds of response especially to extreme events. Analysis of uncertainties in extremes and system responses. New methods for analysis of spatial dependency in systems. Development of decision support tools for infrastructure managers. Analysis of climate risks in the context of other long term changes e.g. changes in demand and system modification to mitigate greenhouse gas emissions.

Priority area: Sustainable management of water resource systems

Integration of technologies, behaviour change and governance arrangements to deliver secure and sustainable water supplies in the context of a changing climate and economic growth. Development of integrated systems models and tools for phased, adaptive decision-making for the water environment. Integration of drought, flood, water quality, and land use models to support improved water resources decision-making.

Notes:

1. Advances in this area should complement UKWIR funded research on the impacts of climate change on the water sector.
2. Substantial research on fluvial, coastal and urban flooding is funded in the Flood Risk Management Research Consortium (EP/F020511/1), so new research need only address these issues insofar as they form part of an integrated approach to water management.

Priority area: Functioning of the urban environment, land use and spatial planning

Frameworks and tools for supporting spatial planning decision making through analysis of vulnerability and resilience to multiple climate impacts. Identification of conflicts and synergies. Development of new understanding of the effects of land-use types at various scales in the context of climate change. Improved understanding of the impacts of climate change on urban greenspace functions. Analysis of environmental quality and urban ecosystem health in the context of a changing climate.

Notes:

1. Advances in this area should complement the projects funded in the EPSRC Sustainable Urban Environment programme and in the Cities Programme of the Tyndall Centre for Climate Change Research.

Other research themes

The research priorities emerging from the stakeholder and researcher workshop are a reflection of the participants' interests. Lower priority research themes also emerged from the workshops. In a number of cases these reflected overarching research issues (e.g. capacity building, extremes, objectives and targets, social impacts and health) which may be more effectively addressed as part of the other 'higher priority' research themes or as a supportive effort similar to some of those undertaken within BKCC (e.g. BESEECH project). Others identified, such as those related to transport and electricity infrastructure could be addressed as part of the critical infrastructure priority research theme.

There were other research areas that were not developed further at the final stakeholder-researcher workshop but were identified at the stakeholder workshops. These include such areas as appraisal of adaptation, performance of materials (old and new), benefits of climate change, socio-economic change and adaptation behaviour. Historic buildings were quite strongly identified and highlighted within the stakeholder workshops but not explicitly developed within the stakeholder-researcher workshop, becoming incorporated within the 'existing buildings' theme.

Networking and dissemination process

The BKCC portfolio of research projects introduced several innovative ways of working together that both researchers and stakeholders considered essential to its effective running. Foremost, each BKCC project had substantial stakeholder involvement that was demonstrable at proposal stage and continued through the life of the project. In addition, two mechanisms – an Integrating Framework and a Stakeholder Forum – were established to facilitate integration and stakeholder interaction across the BKCC programme. They were designed to encourage the use of common tools and case studies, to share data, and to improve understanding of the multidisciplinary research challenges raised by the need to adapt to a changing climate.

The workshops held in SKCC provided an opportunity to review these mechanisms and suggestions in the following areas were made:

1. Effective dissemination

Stakeholders who attended the workshops were not universally aware of the state of the art of research knowledge in the relevant sectors. This is to be expected, and the workshops were, incidentally, a useful opportunity to further disseminate research. However, the importance of better dissemination was repeatedly stressed. BKCC developed successful dissemination mechanisms, with the help of the Stakeholder Forum, but the breadth of dissemination to the non-academic community was inevitably limited. An on-line searchable database of projects was suggested and researchers were encouraged to present their work at practitioner meetings. Some devoted time built into the project timescale was suggested, with communication plans to be written at the same time as research plans during the initiation of projects.

Responsibility for improving the situation with regard to dissemination is shared between the academic and practitioner communities. It was questioned whether stakeholder organisations have the capacity and skilled staff to make use of new research. Technical writers and communication professionals may be beneficial. The need to 'translate' material before dissemination and to use clear vocabulary avoiding unnecessary jargon was stressed. User-friendly publications linked to regulations and standards or tailored to particular target audiences would widen awareness and

update of research findings. Documents written from the stakeholder's perspective for example similar to the 'So What?' document (described above) are essential. Case studies provide valuable examples for dissemination purposes. These are particularly needed at a strategic scale (city, catchment, network etc.) where examples are fragmentary. Case studies also serve to demonstrate that the results or research provide a reliable and practical basis for decision making.

Dissemination to the general public could be improved by effective timing of information releases e.g. event related such as at times of flooding. Mechanisms such as science festivals and different media for example, television, radio, podcasts, wikis and blogs could be used.

2. Training and Development

Dissemination needs to include training, giving professionals and practitioners the skills to act, instead of just knowledge of the issues. The professional institutions have a key role in dissemination and cultivating the professional skills of their members. A training steering committee could be implemented. Research findings need to be integrated into the education of professionals and university students.

3. Stakeholder Interaction

Stakeholders are essential in research projects in many ways including: knowledge of the problems being investigated; data requirements and availability; keeping researchers informed about the policy context of their work; influencing research to include stakeholder relevant results; and effective dissemination of research findings. In order to be most effective stakeholders need to be involved from the outset of projects. The objectives and expectations of both the researchers and stakeholders need to be clear and the stakeholders' role should include dissemination. The problem of continuity of personnel throughout projects was highlighted and the benefits of including some of the stakeholders involved in BKCC were stressed.

4. Integration of Research

From the outset of any programme of research integrated management and administration are required. These will enable central data acquisition and management, avoid duplication of work, and help to minimise the impact of any changes in personnel. A matrix of activity that highlights deliverables, events and timescales would be useful for the programme. A database of other relevant research in the UK would be useful. Accessing information on international projects was considered to be a considerable challenge, whilst there was recognition of the value that could be gained from experiences in other countries. Again the use of common case studies across projects was highlighted.

It is recommended that in the ARCC programme considerable attention be paid by EPSRC and academics in collaboration with stakeholders to the aspects of networking and dissemination mentioned above.

References

Walsh, C.L., Hall, J.W., Street, R.B., Blanksby, J., Cassar, M., Ekins, P., Glendinning, S., Goodess, C., Handley, J., Noland, R. and Watson, S.J. *Building Knowledge for a Changing Climate: collaborative research to understand the impacts of climate change on infrastructure, the built environment and utilities, and to enable sustainable adaptation solutions*. Newcastle University, March 2007.