Impacts of Climate Change on the Severn Estuary
Inaugural Meeting of the Research Advisory Group

Monday 29th January 2007,
Create Centre, Bristol

REPORT COMPILED BY THE MARINE AND COASTAL ENVIRONMENT RESEARCH GROUP, CARDIFF UNIVERISTY AND THE SEVERN ESTUARY PARTNERSHIP

CONTENTS

GOALS OF WORKSHOP:
To raise awareness, network scientists & professionals, improve climate change planning

AIMS OF WORKSHOP:
- To identify research priorities for the marine impacts of climate change on the Severn Estuary.
- To explore how research activity on the estuary could be better integrated and related to the needs of government and public, and disseminated as part of an ongoing Research Advisory Group.
- To be an opportunity for networking, getting better informed and obtaining input of views from both scientists and professionals.

Table 1 Workshop programme

Time	Event	Person
1030-1045	**Welcome**	Dr Hance Smith Dr Rhoda Ballinger, Natasha Barker, SEP
1045-1115	**Impacts of Climate Change on the Severn Estuary**	Dr Tim Stojanovic, Cardiff University
1115-1130	**Refreshment Break**	
1130-1145	**Thames Estuary Partnership Research Forum**	Tim Reader Environment Agency
1145-1215	**Planning and Management Perspective**	Laurie Newton, UKCIP Roger Wade, EA
1215-1245	**The Science Perspective**	Dr Ted Bryant, University of Woolagong Prof. Simon Haslett, Bath Spa University
1245-1345	**Lunch**	
1330-1345	**Briefing**	Dr Rhoda Ballinger
1345-1445	**Parallel Meetings:** **A. Applied Science** **B. Evidence Based-Policymaking**	A. Drs Hance Smith / Tim Stojanovic B. Dr Rhoda Ballinger / Natasha Barker
1445-1500	**Coffee Break**	
1500-1600	**Plenary** **Linking Research with Strategic Planning Goals**	Rhoda
1600-1615	**Interactive Session** **Running the Advisory Group and the Way Forward**	Dr Rhoda Ballinger/ Natasha Barker, SEP

SUMMARY OF MEETING

WELCOME
Dr Hance Smith (Cardiff University) chaired the morning session.

Dr Rhoda Ballinger (Cardiff University) introduced the aims of the workshop in the context of the Interreg COREPOINT COastal REsearch and POlicy INTegration) project. This project is promoting best practice in Integrated Coastal Zone Management across North West Europe and is focusing on the interface between research and policy for coastal zone decision-making.

Natasha Barker (Severn Estuary Partnership) provided a short background to the value of the Severn Estuary, role of the Severn Estuary Partnership and importance of addressing climate change impacts and adaptation options: the Severn Estuary is one of the largest low-lying catchments with the largest tidal range in Europe. It has approximately 3 million people living around it, where 80% of the shoreline is artificially defended.

IMPACTS OF CLIMATE CHANGE ON THE SEVERN ESTUARY

Dr Tim Stojanovic, Cardiff University
(See Appendix 3 for pdf of presentation)

Tim gave a detailed presentation on climate change issues and a vision for a Severn Estuary Climate Change Advisory Group.
The aims of a potential Research Advisory Group were outlined in the context of national actions (e.g. Stern Review, Nottingham Declaration).
Climate Change impacts (6), adaptation and mitigation issues were detailed and delegates asked to rank them on a feedback form:

1. Regional climate change around the estuary
2. Sea level change
3. Storminess and sediments
4. Impacts of coastal ecology and ecosystems
5. Impacts on environmental systems
6. Vulnerability assessment
7. Adaptation
8. Mitigation
9. Integrated assessments.

Tim drew delegates' attention to the database of over 450 citations on climate change and Severn Estuary related research papers which Cardiff University has prepared, to be available free to the workshop delegates. A contacts list of >250 (potentially) interested parties has also been drawn up.
The advantages of forming an Advisory Group (AG) were outlined for scientists, planners & managers and the Severn Estuary.
The possible structure of an AG was illustrated, noting that there are 12 universities, 14 local authorities and 3 Environment Agency regions around the estuary.

PRESENTATIONS

THAMES ESTUARY PARTNERSHIP RESEARCH FORUM

Tim Reader, Environment agency & Chairman of the Thames Estuary Partnership Research Forum

(See Appendix 3 for pdf of presentation)

Tim described the work of the Thames Estuary Research Forum and its associated research network. As the network had not focused on a specific theme/research topic, he explained that it had experienced difficulties in momentum since the end of the European funding stream, which had enabled the setting up of the forum. However, it had produced useful outputs including:

- State of the Estuary report
- Research database
- Research agenda
- Supported the Thames Estuary Forum – the 'lifeblood' of the Thames Estuary Partnership.

His experience led to the following recommendations for the Severn Estuary:

- Ongoing momentum of an Research Advisory Group requires staff co-ordination
- The new Thames Estuary Partnership 'Friends Group' was designed to provide supporting funding
- Don't raise expectations beyond means
- Good to take the climate change angle – this theme could help to re-energise the Thames Research Forum.

PLANNING AND MANAGEMENT PERSPECTIVES

Laurie Newton, UK Climate Impacts Partnership (UKCIP)

(See Appendix 3 for pdf of presentation)

UKCIP was founded in 1997 at the University of Oxford to look at the impacts of climate change. Capacity building is at the core of its work. Laurie outlined how local authorities in England are responding to the climate change challenge in practical and policy terms. Many local authorities (in England) have signed up to the Nottingham Declaration, a voluntary pledge to exhibit their concern. A 2nd version of the Declaration was prepared in 2005 with greater emphasis on adaptation and commitment with action plans on a 2-year voluntary basis. The UKCIP target is for 200 Councils to be signed up by the end of 2006; there are 187 at the moment. Local Authorities are seen to be important due to:

- Managing their estates
- Service providers
- Community leaders

The Nottingham Declaration supports authority-wide action, but the local authorities are driven by comprehensive performance assessments in which climate change is not a major driver. It is therefore difficult for them to obtain funding for climate change work. The Energy Saving Trust host the Nottingham Declaration partnership website at the moment. UKCIP provide training to local authority staff. Laurie indicated how local authorities operate on relatively short planning horizons whilst some of the climate change impacts require longer-term pre-emptive action. Information about climate change needs to be or more local relevance e.g. through qualitative risk assessments.

The Local Government Association (for England) is soon to launch a Climate Change Commission. The drivers for local authority actions may change with the Local Government White Paper 'Strong and Prosperous Communities' at the end of 2006 leading to 200 national indicators from which they can chose 35 locally to achieve national targets. Defra are lobbying for climate change indicators.

THE SEVERN ESTUARY AND CLIMATE CHANGE: MANAGEMENT ISSUES

Roger Wade, Environment Agency

(See Appendix 3 for pdf of presentation)

Roger, who had been involved in the early stages of the development of the Strategy for the Severn Estuary and formation of the Severn Estuary Partnership, illustrated the likely direct and indirect impacts of climate change on the Severn Estuary.

Direct impacts:

- Flood risk management and coastal erosion with a 20-80cm increase in sea level.
- Habitat management
- Water resources

Indirect impacts:

- Renewable energy
- Aggregates (new build and knock-on effects)
- Leisure

Within this context he made the following points:

- Have we got enough local data and ground truth?
- The flooding costs could be huge e.g. from £1 billion to £20 billion national cost by 2080 which will put the 'flood defence' industry at the same level as education and defence.
- Information was quoted from the *Foresight* report
- We need a strategy for the whole of the Severn, being progressed through the *Coastal Habitat Management Plan (CHAMP)* and *Shoreline Management Plan* processes.
- The EA have a 100 year strategy for flood risk between Newport & Chepstow
- The EA have 10 year trends for birds but need local figures
- Low summer flow could decrease by a further 50% leading to saline intrusion in fresh water supplies (e.g. major abstraction for Bristol above Gloucester).
- Renewable energy needs may demand compromised habitat protection
- Health issues and tourism.

Next steps were recommended, including the need to:

- Develop indicators to really monitor what is happening
- Scope potential impacts e.g. at Avonmouth
- Map structures and assets at risk
- Develop and implement strategic planning
- Ensure consultation and working in partnership.

SCIENCE PERSPECTIVE

Professor Simon Haslett, Bath Spa University

(See Appendix 3 for pdf of presentation)

Simon described the circumstances around the 1607 storm surge/tsunami that caused significant flooding around the Severn Estuary on 30th January 1607. He felt that a Research Advisory Group would help scientists make links with the government agencies and NGOs to help drive research forwards. He indicated that many academics are field scientists instead of modellers. Evidence surrounding the 1607 flood includes:

- Configuration of the shoreline – the natural shoreline would be different
- Salt marshes and peat bogs would have surrounded the estuary 400 years ago
- Norman churches built in the 'Medieval warm period' were covered by sand dunes.
- The Levels are below high tide…we have a 'fossil surface'
- Scientists have cored 30m into the bedrock to expose the sub-surface sediments in the Levels to reveal shoreline evolution
- Salt marsh has accreted vertically due to vegetation and horizontally due to sediment. In the inner estuary (upstream) there is high sediment therefore as sea level increases sedimentation will too. In the outer estuary (downstream) around Clevedon and Weston-Super-Mare less sediment means salt marsh areas are more likely to drown.

Dr Ted Bryant, University of Woolagong (Australia) indicated that 2200 people drowned in the 1607 flood and presented evidence of why it could have been a tsunami:

- There were less storms then than now
- There was no other storm damage reported
- It has been estimated (Horsborough, 2007) that a tide of 7.86m OD ½ hour after high tide could flood 520km coast and 200km2 around the outer Bristol Channel & Severn Estuary.
- The inclination of boulders (e.g. at Dunraven Bay, S Wales and at Sudbrook) and large boulders near Severn Bridge indicate large waves; storm surges are higher out to sea so one would expect larger floods out to sea. A 25m storm surge, 7 times bigger than the 50 year return period would have been required for this, but a 3-4m tsunami could have had the same impact as it increases in height upstream.
- The sluice gate keepers were probably wiped out by the storm therefore it was several days before they were opened e.g. Kingston Seymour flooding stayed 5ft high for 5 days.

The implications of this research provide an insight to the potential impact of climate change impacts with increased storminess and sea level rise. Our existing defences would be overtopped if there were a similar event. It has been estimated by Robert Muir-Wood that based on a 5ft-water ponding (that was initially higher) there would be a £30 billion cost to society. Climate warming is likely to bring more storms. Sea level was 1m lower in 1607.

PARALLEL DISCUSSIONS

Rhoda Ballinger chaired the afternoon session and introduced the purpose of the afternoon and the two parallel sessions. In particular, the afternoon was to provide an opportunity for detailed discussion of:

- The research community's needs & aspirations on coastal climate change
- Policy makers needs for climate change implications
- Synergies between priorities for coastal climate research from researchers & policy makers
- The development of a Severn Climate Change Advisory Group

The break-out sessions aimed to focus on specific topics relating to coastal climate change and the Severn Estuary, relevant to the two cohorts. The scientists and policy makers separately addressed their activities and needs for climate change information & co-operation. The researchers and scientists focused on the research community's needs and aspirations and, in particular, the priorities for climate change research around the Severn Estuary. The policy-makers, in contrast, focused on the needs of evidence-based policy and, in particular, policy-makers needs for climate change information.

A EVIDENCE-BASED POLICY-MAKING

Convenors: Dr Rhoda Ballinger and Natasha Barker

The following section is a summary of points taken from flip-charts and additional notes based on the discussions within the break-out session involving policy-makers and practitioners:

Who is interested in climate change information?

The following list is compiled from those organisations which were represented in this break-out session:

- Welsh Assembly Government – what research exists, gaps, funding needs, what can WAG do
- CCW & NE – habitat response, impact of climate change on habitats and species over next 100 years, strategic overview of the estuary,
- SWCIP – adaptation & mitigation, input to regional spatial strategy & other key policies
- WWF (NGOs) – energy, strategy, action plans, development control, local service provision, mitigation, how will climate change affect Development Strategies
- Local Authorities – catchment plans, flood risk plans, asset management, energy, adaptation and mitigation, data and information specific to Severn to inform planning, access to non-technical information
- Environment Agency – scientific communication, science to influence Defra, flood risk management, data not modelling, monitoring and observation

There is a need for more monitoring to secure evidence to raise public engagement. More government funding is needed to spur action.

Why do we need coastal climate change information?

The following needs for coastal climate change information were highlighted by the participants:

- Local data & monitoring, particularly to assess cumulative effects and provide local interpretation for EA flood risk assessments
- Policy development e.g. development in flood risk areas (PPS25 & TAN15)
- Development control advise from the experts – issue awareness
- Raise public awareness
- Manage risk and define levels
- Sea defences maintenance/other options
- Renewable energy options and impacts e.g. wind turbines and bird surveys
- Space for essential needs e.g. crematoriums in low lying land
- Sustainable and appropriate building design
- Communication of information, accessibility & interpretation (e.g. 'Making Space for Water')
- Longer planning timeframes (SMP 0-20, 20-50, 50-100 but political 5 years)
- SPA designation need for bird monitoring not just of numbers but the scale of change/impact on bird movements.
- Transferring data into information, knowledge and capacity.

Information Needs

The following information requirements were raised by participants:

- Sea level change – clear information and level of defence needed
- Temperature – land use policy
- Water chemistry & geomorphology – coastal squeeze
- Local data, easy to access and understand
- Welsh and English specific references – balanced for Severn Estuary
- Understanding *how* the estuary is going to change, assessing against now and looking at future scenarios including the detailed implications
- Studies by consultants to be made more widely available as they are often the mechanism used by government agencies to link with scientists.
- Visualisation of how the estuary is going to change
- How will climate change affect Development Strategies

B APPLIED SCIENCE

Convenors: Dr Hance Smith & Dr Tim Stojanovic, Cardiff University

A. Review of Current Research Activity relating to the Estuary

The following table summarises the current research activity outlined in the break-out session.

Table 2 Current Research Activity relating to the Severn Estuary

Initiative or University/Department	Research Area	Contact	Comments
Severn Estuary Levels Research Committee	Archaeology	Richard Brunning	
Glamorgan, Environmental Research Unit	ICZM	Dr Simon Jones	ICZM, Conservation and Coastal Management on the Severn Estuary
	Coastal and Marine Palynology	Dr Anthony J Harris	
	Science Communication	Dr Rob Morgan	
	Coastal Geomorphology	Dr Alan Williams	
Cardiff, Marine and Coastal Environment Research Group	Coastal Surveys including hydrographic surveying	Dr Chris Wooldridge Dr Rupert Perkins Mr Ian Fryett	
	Science Policy Integration	Dr Rhoda Ballinger Dr Hance Smith	COREPOINT Project SPICOSA Project (Major EU projects on coastal science and policy)
	Marine & coastal ecology	Dr Rupert Perkins	
Bath Spa	Coastal Geomorphology	Prof. Simon Haslett	
	Long Term Environmental Change		
Reading	Coastal Geomorphology/ Geoarcheology	Prof. John Allen	
Bristol	Global Climate Change		
Cardiff University	Grab Samples	Dr Chris Metham	
National Museum of Wales	Historical and Cultural Studies on the Estuary		Ports, Shipping, archaeology
Met Office, Hadley Centre	Climate	David Griggs	
Bristol Port Company	Bathymetry		3 monthly Bathymetric data
Associated British Ports, South Wales	Bathymetry		
University of West of England, Severn Estuary Research Group	Fish Populations	Dr David Bird	Need for more funding for ongoing monitoring
	Biomonitoring of Pollutants	Dr David Bird	In particular invertebrates
Cardiff University, Institute of Sustainability, Energy and Environmental Management	Modelling of Sediment Transport	Prof. Roger Falconer	
	Bacteria-Sediment interactions	Prof. Roger Falconer	
National Oceanographic Centre (Southampton), Centre for Coastal Processes Engineering and Management	Erodibility of fine grain sediments	Carl Ames	
	Morphology/Evolution of Sandbanks	Paul Carling D. Jones	
	Vulnerability of Coastal Systems	Dr Daffyd Lloyd Jones Prof. Rob Nicholls	
	Response of Coastal Systems to Climate Change	Dr Daffyd Lloyd Jones Prof. Rob Nicholls	
University of West of England, Geography Department	Long term environmental Change	Dr Chris Spencer	Ground truthing with present day, implications for measuring climate change
	Monitoring Sediments Plankton	Dr Chris Spencer	

Table 2 contd.

Initiative or University/Department	Research Area	Contact	Comments
University of Bristol	Climate Change Impacts and Coastal Flooding	Prof. Paul Bates	
	Flood Inundation Models Scenario Models	Prof. Paul Bates	3 year postdoctoral research post focusing on Severn Estuary Sponsored by
UKCIP	Climate Change Scenarios Precipitation, Storm Surge, Sea Surface Temperature	Richard Westaway	Models from Hadley Centre in 2008 will be 1. Ensemble Models 2. Risk Based 3. Marine Scenario with 25km grid
South West Climate Change Impact Partnership			
Marine Climate Change Impact Partnership	Report Card		
Swansea Institute	Morphological Change 1. Linear Shoreline Evolution 2. Beach Evolution Risk Analysis	Dr Mike Phillips	Linear models of Shoreline Evolution Case Study data on beaches in Penarth, Gower and Tenby

Other current research activity/resources:
Reference was made to the following key resources:

- Severn Barrage Studies, 1977
- Bristol Channel Marine Aggregates and Constraints Study (Welsh Assembly Government, 2005)

In addition the work of Bob Kirby, R. Uncles and Prof. Allan T Williams over a number of years has built up a considerable knowledge base on the Severn Estuary.

B. Research Priorities

At present, little integrated data collection is conducted for the estuary in comparison with other UK estuaries:
e.g. NERC project on the Humber
e.g. Environment Agency Project on the Mersey

Where the data does exist it is difficult to access for research institutions
e.g. National Flood and Coastal Defence Database

Prof. Falconer used the example of data requirements to run deterministic models for the estuary. This is not currently possible for the most dynamic estuary in the UK due to data limitations

Sediments are one key unifying issue on the estuary (and their re-entrainment in the system through developments such as the barrage or renewables)

Legacy of contamination
Benthic species
Major cadmium pollution (amongst the most significant in EU estuaries)

The respondents felt that there were five key areas requiring urgent work

- Downscaling of climate change assessment for the estuary
- Assessments of the state of the whole estuary
- Social and economic assessment of climate change impacts
- Impacts on tourism around the estuary (linked with priorities for Welsh Assembly Government)
- Mapping of assets at risk from climate change

In addition the noted the role of Applied research in Impact Assessment, including:

Remote Sensing
GIS of monitoring activities
Development of time-series and better use of established monitoring information
Offshore Habitat Mapping
In order to form a baseline for impact assessments c/f recreation, renewables, aggregates.

A number of climate change assessment tools have been developed or are in place (e.g. Thames 21 Project) but need to be applied to the Severn Estuary. Therefore Knowledge Transfer bids may form an appropriate source of funding to develop this kind of work

C. Developing Research Bids and Current Funding

It was stressed that any bid to the research councils (NERC/ESRC) will have to focus on the unique aspects of the estuary in order to be successful. Amongst these are:

Physical Geography
Size and dynamic range of the estuary
Short, steep catchments, e.g. Ebbw Vale

High percentage Intertidal area
This is linked with estuaries' ecological importance
Wading birds and other biota such as fish and plankton

Human Geography
Aggregates resource
A big resource in terms of its significance to South Wales and W.England and close into the shore
Three Nuclear Power Stations (each with good sea temperature records)
Renewable Energy
Significant potential resource in terms of Tidal Barrage proposal and other small-scale renewable energy projects

Any bid will also have to justify how the Severn Estuary Research Advisory Group on Climate Change is a distinctive contribution.

It was recommended that funding for Climate Change research based on commercial or industrial resources could be targeted from a number of priority areas:

- Aggregates
- Renewable Energy
- Severn Barrage
- Sustainable Development
- Tourism

The group suggested that interaction between Scientists and Practitioners is required for:

1. Co-ordination and Better Availability of Monitoring Data
2. Data Management to enable the above (Metadata, Data Access, Copyright)
3. Involvement of Scientific Research in Integrated Assessment of Risks
4. Various Human Uses of the Estuary acting as drivers for the funding and undertaking of research

DISCUSSION

The following notes provide an overview of the afternoon's plenary discussion.

Data issues:
The participants stressed the need for there to be:

- improvements with regard to data access – Reference was made to the Freedom of Information Act with government information and commercial (e.g. LIDAR data)
- more monitoring needed e.g. gaps in bird surveys and the cumulative impacts in areas such as energy proposals and development

Information needs, access and availability:

- Needs to be easily digestible & quickly accessible & specific to the Severn
- Room to explore knowledge transfer between the data held by private companies and business (example cited – ABP's reluctance to provide data on the Severn)
- Privately held data is not forthcoming
- CCW noted that under the Freedom of Information Act they have large amounts of information available; for example, when they receive consultations or scoping documents, this information that is submitted by consultants is then available to the public (there are exceptions to this and other data that they hold, e.g. LIDAR data has to be bought)
- Those managing nature conservation sites need to know scale of climate change and impacts on sites and species
- Need processes to smooth transfer of data and information
- Consultants, with vast amounts of Severn-related data and information need to be engaged

Local Authority issues:

- Local authorities need to pose questions to highlight research needs
- Local Authority needs are wider than just development planning, need to consider Community Planning process, Community Strategies. Climate change should be worked into the priorities of community strategies.
- Differences and similarities between Welsh and English LA approach to climate change e.g. Nottingham Declaration
- Mitigation focus of elected member group in Wales
- How will climate change affect LA services or areas
- Need to consider the range of Local Authority technical officers that could/should be involved in the Research Advisory Group, for example, Policy Officers, Flood Engineers, Drainage Engineers, emergency planners.
- Many of these need to be need to be involved in the community planning process INCLUDING Councillors.
- Mismatch of information needs and interests of technical officers and elected members
- Development control – need climate change facts and figures relevant to the estuary– accessible clear and quickly- stronger evidence needed

Funding issues:

- Tourism, renewables, aggregates
- Major industrial areas e.g. Avonmouth
- Potential of Crown Estate funding (remarketing of bids e.g. climate change branding of projects)
- COREPOINT 2 possibilities
- EU Framework 7 funds for the period 2007 – 2013
- EU SPICOSA project possibilities for the Severn
- Future collaborative estuary project was suggested by Prof. Faulkner, e.g. possibility of linking 2 or 3 Local Authorities and at least 3 estuaries, e.g. Med. or Baltic
- Defra Climate Challenge / Communicating Climate Change (England) – Natasha Barker to keep the group updated with developments with regard to this funding pot
- Strong need to convey the uniqueness of the estuary when seeking scientific funding was reiterated (stated by scientist)
- Research Councils want projects that meet their needs and some of the elements being looked at by the research advisory group wouldn't be compatible

Other points:

- many of the tools and datasets already exist, identified within the 2100 Thames project
- CFMPS, SMPs, Community Plans, River Basin Management Plans – different policy timescales, and need different scientific/research inputs
- It is important to note when looking at policy makers needs, who's asking and why they are asking
- Public awareness and risk needs to be explored, helpful if people defined levels of risk, risk scenarios to be produced for the Severn
- Emphasis that the designations that the Severn has e.g. SAC, are estuary wide
- Tools for assessing policy – key output
- Posing the policy /practitioner questions – including in bids
- Use of right terminology
- Accept varying science / practitioners drivers and rewards - innovate
- Note that the Welsh Assembly Government have established a climate change cross-sector group
- Need to deal with increasing policy divergence between England and Wales
- Other plans being developed that need inputs:-
    - Severn Estuary CHaMP 2008
    - Severn Estuary SMP2 2010
    - River Basin Management Plans (WFD) 2012
    - Catchment Flood Management Plans

RUNNING THE ADVISORY GROUP & THE WAY FORWARD

Natasha Barker emphasised how the Severn Estuary would be at the frontline of receiving the impacts of climate change. She sought confirmation from participants that an estuary-wide approach to the problems was valuable and asked for completion of the feedback forms to guide the way forward.

It was pointed out that establishing an advisory group would involve consideration of:

- Purpose
- Representation/membership
- Modus operandi (frequency of meetings, terms of reference, reporting, leadership etc)
- Funding (Knowledge-Transfer partnerships, Defra, EC Framework 7 & Interreg etc)
- Links to other groups

Hance Smith summed up the day, emphasising that the resources that science offers are needed to ensure that human use & the environment are compatible.

APPENDIX I CLIMATE CHANGE ISSUES: FEEDBACK FORM ANALYSIS

16 forms from workshop delegates were received and analysed. The table below (Table 3) summarises the respondents' views in relation to their top climate change-related priorities. Although the topics are highly inter-related and, therefore, somewhat difficult to isolate and rank, it is clear that the respondents were concerned with most of the topics listed. In particular, there were most votes for 'vulnerability assessment' (9), followed closely by the priorities for physical climate change topics, notably topics 1, 2 and 3 (storminess, sea level change and climate change itself).

Table 3 Delegates climate change priorities

Topic no.	Topic	Score rating[1]				Comments
		1	2	3	Summary (total no. votes)	
1	Climate change	2	2	2	6	Key factors that can be used in predictive models Rainfall intensity values (range); wind (speed & direction) to generate waves and cause/exacerbate erosion. The Severn Estuary is particularly vulnerable to climate change and extreme weather events.
2	Sea level change	4	2	1	7	The key challenge facing all coastal areas in future. Driver for increasing flood risk and storm surges. Much defended land around the estuary with high value assets What impacts will there be in terms of flooding and coastal damage and how we adapt to this. Information currently provided by Defra (see PPS25/TAN 15 Wales). We must ensure that we are aware of the latest publications.
3	Storminess & sediments	2	3	2	7	Possibilities of massive economic impacts Need increased information on risk – what is the increased storm risk and what does this mean for stability? Sea level change/rise will increase flood risk as will the projected increase in storminess and foreshore erosion. This automatically impacts on 4, 5 and to some extent 1 and 2. Particular interest in sediment transport and flooding and computer modelling of these processes. There are huge assets vulnerable to flooding along the Severn.
4	Ecological impacts	1	1	2	4	What are we loosing and gaining in the Severn? Which species are expected to move? How does this affect the use of resources? How well can species adapt? What mitigation issues can be implemented? What happens when a habitat or biodiversity is fundamentally altered? Underpins biodiversity and conservation. Medium to long-term monitoring required.

[1] Delegates were requested to rank their top three issues in order of importance and to provide additional comments.

Table 3 contd.

Topic no.	Topic	Score rating				Comments
5	Environmental systems		2		2	Changing species compositions will alter ecosystems and their management. How does this relate to the Water Framework Directive?
6	Vulnerability assessment	2	5	2	9	This considers 4 & 5 and leads to 7. Such include coverage of issues 1 – 3 above Linked to 2 & 3 above – what are the impacts given SLR and increased storminess and how do we assess vulnerability? Including impact on tourism (important in Severn) Impact on vulnerable communities What is the expected economic loss? How many people will be affected? Where are the extra resources to come from? Which amenities/ industries are going to be lost? Future planning issues? Communication of risk (as probability x impact) is not always easy to do
7	Adaptation		1	4	5	This relies on information on all topics to be able to plan ahead and for policy-making across wide areas of the levels. This enables appropriate response and management and includes 8 and 9. CBA most pressing need, followed by institutional capacity and then strategic policy. CBA is crucial. Stern's report looks at this internationally, but local councils and businesses need to understand if before they will adapt. Will this require more energy? How do we respond to these changes at various levels (national, regional, local, organisation etc.)?
8	Mitigation	5		1	6	What resources are available to Wales and which ones are most effective for energy generation? Which ones are most detrimental? Cumulative effects? To include climate change and non-climate changes How can we provide 'green energy'? Pressure for a barrage might come from Central Govt (in view of depletion of North Sea oil & gas) – this would cause an immediate large impact on the estuary environment. This topic is highly important as many large companies are planning to invest in this field.
9	Integrated assessments	3			3	Integrated approach needed to ensure balanced consideration of issues, including environmental impact. Need to integrated English and Welsh assessments.

Additional issues:

The table below (Table 4) lists additional issues highlighted by the respondents. These include additional areas for study and specific practitioner needs as well as recommendations for improved data and information management, communication, education and awareness. Within the comments there was a clear view that better communication between all users, including academics, consultants and policy-makers is required, with better access to the key information in digestible form (and using non-technical language) for decision-makers. In this context, the need for the RAG process to engage with a wider range of local authority personnel was mentioned. Additionally, the need to disseminate information to the general public was seen as a priority in order to facilitate suitable mitigation and adaptation.

Table 4 Additional issues highlighted within respondents' comments[2]

Further study:
- Collection of field data is vital and this needs to be funded. Therefor, importance of credible evidence collection needs to be communicated to decision-makers (without unreasonable time constraints)
- Increased local biotic and abiotic monitoring
- On and offshore energy production
- Tide locking on tidal tributaries (particularly if barrage changes the tidal regime)
- What is projected reality for Severn (as opposed to other places) in view of its geography, aspects etc.

Skills and knowledge requirements
- Skills and knowledge in order to adapt existing infrastructure and buildings. Do we have the skills and knowledge in the region?

Practitioner needs:
- How does information feed into SEA?
- Links between scientific information and development control decisions
- There are substantial consented areas and areas for redevelopment in the Levels – are these threatened?

Data & information management
- Identify what information is required an who has the interested and for what purpose
- Access and analysis of long-term data sets
- Collation of all data sources – metadata.

Communication
- Communication between all 'users', including consultants, academics and practitioners.
- Communication of science to practitioners (knowledge-transfer) as there is a noticeable divide between science and decision-making.
- Provide access to relevant non-technical information for non-scientists, including planners
- Ensure clarity of the conclusions & recommendations

Education and public awareness
- Education and public awareness – people need to be informed and educated into the potential effects of climate change so they move to hopefully make the outcome less detrimental
- Communication to the public of uncertainty
- There is a need to set issues in their historical context

Finance
- Need for financial incentives to facilitate proactive (not reactive) adaptation

Approach required
- There is a need to take the precautionary approach
- When considering what types of information is needed you need to get the right people in local authorities (e.g. flood drainage people, development control, emergency management etc.) – there is a need for a broader range of people.

[2] Headings in italics added by report's author.

How can Scientific Research be better linked to regional and local plans, regulation and policy?

The following table (Table 5) summarises the respondents' suggestions for linking science, planning and policy. Many of the themes highlighted in the previous table are reiterated and developed. The comments relating to improved communication and information management are particularly noteworthy. In this context, several respondents mentioned the workshop itself and the role of a future Research Advisory Group.

Table 5 Respondents suggestions for achieving a better link between scientific research, planning and policy[3]

Future research
- Involvement of stakeholders and end-users is essential to direct research.
- Research needs to be area-specific, but with co-ordination so that all areas are sufficiently covered.
- Research must have a purpose

Suggested links to explore
- Link to community planning
- Scientific and policy communities need to work very closely together to ensure that research is relevant and timely for local / regional strategies (through SEP and SWCCIP).

Information management
- Different organisations seem to have different bits of information – this needs to be assembled in ONE place and be updated regularly.

General communication
- Better communication at all levels and between agencies and at transnational scales.
- Better communication between both sides and realistic targets set and adhered to.

Communication of research & knowledge
- What research is taking place needs to be communicated better.
- Need to 'advertise' what research, data and information is currently available.
- Need to produce concise, locally relevant, policy-relevant summary of the problems, risks, scenarios and feasible options.

Format of research / knowledge communication
- Research needs to be in an easily understood language and in an accessible format.
- How can planners find Severn geographically specific and mapped information?
- Make sure any advice uses the right terminology for Welsh (all) authorities
- Through dissemination of knowledge at appropriate levels, not just academic journals or specific consultancy reports, but through an appropriate forum (SEP) to wider users.

RAG
- The RAG could have an important role in highlighting research needs and linking researchers to make joint funding applications.
- By setting up a small group of academics, regulatory authorities and local authorities to plan integrated studies.
- The day was good in terms of scientists sharing their work with policy makers. It would be good to have a session the other way round (e.g. development control, flood drainage etc. people) sharing their work/needs with the scientists.

Other comments
- All new developments in North Somerset must use 15% of all energy from local, sustainable sources.

[3] Headings in italics added by report's author.

How can practitioner needs for climate change information match with scientific progress?
This would hopefully, be achieved through wider dissemination of knowledge at appropriate levels and through communication between all users.

Further data, information and communication needs were stated by respondents (Table 6). Additionally, several delegates highlighted issues associated with the science of climate change. These included the issue associated with the funding of non-innovative science which is essential to inform policy and decision-making. Further issues associated with the uncertainty, probabilistic and rapidly changing nature of the science were also stressed.

Table 6 Respondents suggestions [4]

Data and information needs
- Data needs to be widely available
- Planners do not know what specific information relating to the Severn there is.
- What is available to practitioners needs to be clear so that data gaps still outstanding can be identified and funding distribution evenly.

Science issues
- It was noted that funding of projects by the National Research Councils needs to be innovative science. However, much of the data required by agencies does not fit this. How can this be tackled and is there a possibility of agency funding?
- Some practitioners seem to want exact figures of sea level rise etc. – which is NOT available.
- Uncertainties seem to be increasing with more research (e.g. Greenland melting)/
- Practitioners need to recognise that only probabilistic estimate can be given and these will be subject to change.

Communication
- Need better ongoing dialogue in this fast-changing arena between policy and scientific community.
- Knowledge – transfer partnerships
- Communication is a key issue. More scientists need to engage with use communication and undertake applied science that is actually useful on the ground (but which is not necessarily 'ground-breaking' science)
- Practitioners need to discuss with academics and agree what needs to be done, over what time scales, who should be responsible for what and identify where budgets (monies) may be available.

Communication and dissemination
- Through this type of workshop
- Clearer visual representation using a range of scenarios. Scientific studies represented by GIS mapping, for example.
- Better communication through newsletters and funding proposals.

RAG
- Hold a decision-maker only session to tease out needs (local authority; Defra, WAG etc.)

[4] Headings in italics added by report's author.

Further Comments

Additional comments relating to decision-making, policy and research needs as well as to the potential future operation of the RAG were provided by respondents (Table 7). These and earlier comments provide considerable direction for the future development of the RAG.

Table 7 Respondents further comments[5]

Decision-making and policy needs

- Acknowledge that we are not going to get all hard answers and will probably need to take a risk-based approach, supported by evidence / projections.
- From the discussion, there seems to be a lot of focus on planning decisions, but this is not the only extent of LA decision-making. May be focus on community planning processes rather than land use planning processes?
- Many local authorities are only at the start of looking at how they adapt to climate change so a more detailed exercise could be undertaken with them to look at data needs across departments.
- To what extent are climate change issues feeding into and influencing SEA and development decision-making?
- There is a need to turn the general information on climate change into specifics for decision-making on the Severn and if these are to constrain development/activities there is a need for robust, detailed information that will stand up to scrutiny/opposing views (e.g., at inquiry).

Research needs

- Environment Agency is heavy tied in to Defra / WAG policy. There is a need to be sure that research is taken on board by these bodies.
- Are we monitoring key impacts in the Severn specifically?

RAG

- This type of event is extremely useful and should be an evolutionary process.
- The next meeting should be held in Wales.
- Need to consider what work can be accomplished via email correspondence.
- RAG is a useful partnership for the Severn Estuary and one, which may help with the above issues.
- Any outcomes of the SEP RAG / eventual projects need to be communicated to wider region and to the public. There is a need to use existing channels to do this (e.g. SWCCIP) to help to do this effectively.
- Suggest that all attendees be emailed with a copy of the meeting notes.

Other comments

- As time passes, we have to maximise sustainable, locally produced energy.

[5] Headings in italics added by report's author.

APPENDIX II WORKSHOP PARTICIPANTS

Laurie Newton, UKCIP
Richard Westaway, UKCIP
Victoria Paris, Welsh Assembly Government
Sarah Hendel-Blackford, South West Climate Change Impacts Partnership
Bill Donovan, Environment Agency
Tim Reeder, Environment Agency
Peter Coxhill, Environment Agency Midlands
Alan Rafaelt, Environment Agency South West
Rhys Morgan, Environment Agency Wales
Roger Wade, Environment Agency Wales
Adrian Philpott, Environment Agency Wales
Nicola Rimmington, Countryside Council for Wales
Adrian Jowitt, Natural England
Lorraine Hudson, Bristol City Council
Liz Lambert, Cardiff City Council
Carl Touhig, Newport City Council
Sian Davies, Monmouthshire County Council
Rob Niblett, Gloucestershire County Council
Gillian Ellis-King, South Gloucestershire Council
Steve Hodges, North Somerset Council
Natasha Barker, Severn Estuary Partnership
Dr Daffydd Lloyd-Jones, National Oceanographic Centre
Prof. Simon Haslett, Bath Spa University
Prof. Paul Bates, University of Bristol
Dr. David Bird, University of the West of England
Dr. Chris Spencer, University of the West of England
Dr. John Hunt, University of Gloucestershire
Prof. Roger Falconer, Cardiff University
Dr. Robert Morgan, University of Glamorgan
Dr. Mike Philips, Swansea Institute of Higher Education
Prof. Ted Bryant, University of Woolagong
Nicky Starkey, WWF Cymru

Apologies:
Prof John Allen, University of Reading
Nigel Gibbons, Forest of Dea
David Griggs, Hadley Centre
Prof Colin Taylor, University of Bristol
Prof John Shepherd, Southampton Oceanography Centre
Prof Mike Hulme, Tyndall Centre
Charles Green, Crown Estate
Alistair Chapman, Forest of Dean
Dave Jennings, Coastal Manager, Vale of Glamorgan
Prof. Alan Williams, University of Glamorgan
Prof. Geoff Hammond, University of Bath

APPENDIX II PRESENTATION SLIDES

Impacts of Climate Change on the Severn Estuary
Dr Tim Stojanovic, Cardiff University

The Severn Estuary Partnership
Natasha Barker, SEP

Thames Estuary Partnership Research Forum
Tim Reader, Environment agency & Chairman of the Thames Estuary Partnership Research Forum

Planning and Management Perspectives
Laurie Newton, UK Climate Impacts Partnership (UKCIP)

The Severn Estuary and climate change: management issues
Roger Wade, Environment Agency

Science Perspective
Professor Simon Haslett, Bath Spa University
Dr Ted Bryant, University of Woolagong (Australia)

A Research Advisory Group on Impacts of Climate Change for the Severn Estuary

Dr Tim Stojanovic
Cardiff University
January 2007

his project has received European Regional Development Funding ough the INTERREG III B Community Initiative

Aims

- **Why a Research Advisory Group?**
  - **Regional/Local focus**
- **Aims and Goals**
  - **Research Priorities**
  - **Research Bids**
  - **Plans, Policies and Projects supported by science**
- **Current Sectoral, Ad hoc, Project by Project Approach**
  - **many agencies, many datasets**

The National View

- **UK Climate Impact Change Partnership**
- **Marine Climate Change Impacts Partnership**
- **Nottingham Declaration**
- **Stern Review**

"Some of the most widely expected adverse impacts in the UK include:

- **an increased risk of flooding and coastal erosion**
- **increased pressure on drainage systems**
- **possible increased winter storm damage**
- **habitat and species loss**
- **summer water shortages and low stream flows**
- **increased subsidence risk in subsidence-prone areas**
- **increasing thermal discomfort in buildings; and health issues in summer"**

Severn Estuary & Climate Change

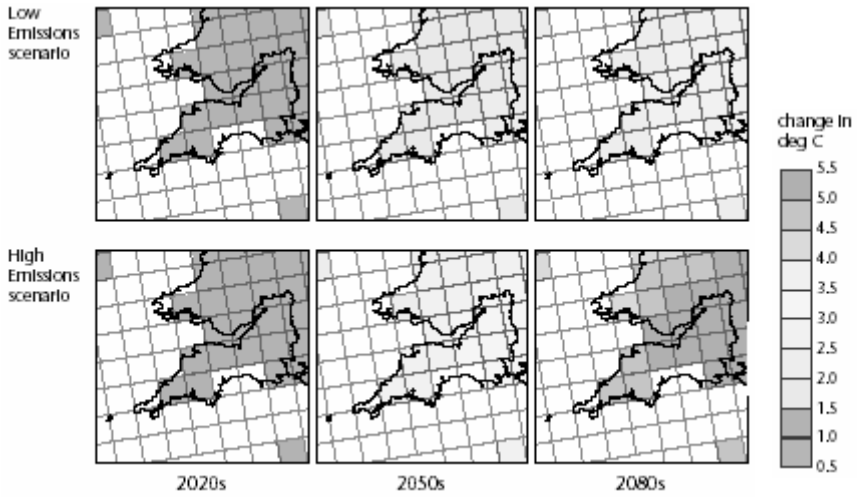
- **Impacts (1-6)**
- **Adaptation (7)**
- **Mitigation (8)**

his project has received European Regional Development Funding ough the INTERREG III B Community Initiative

1. Regional Climate Change

Climate

- Rainfall
- Wind
- Temperature
- Extreme Weather



UKCIP Predictions; Summer Temperature

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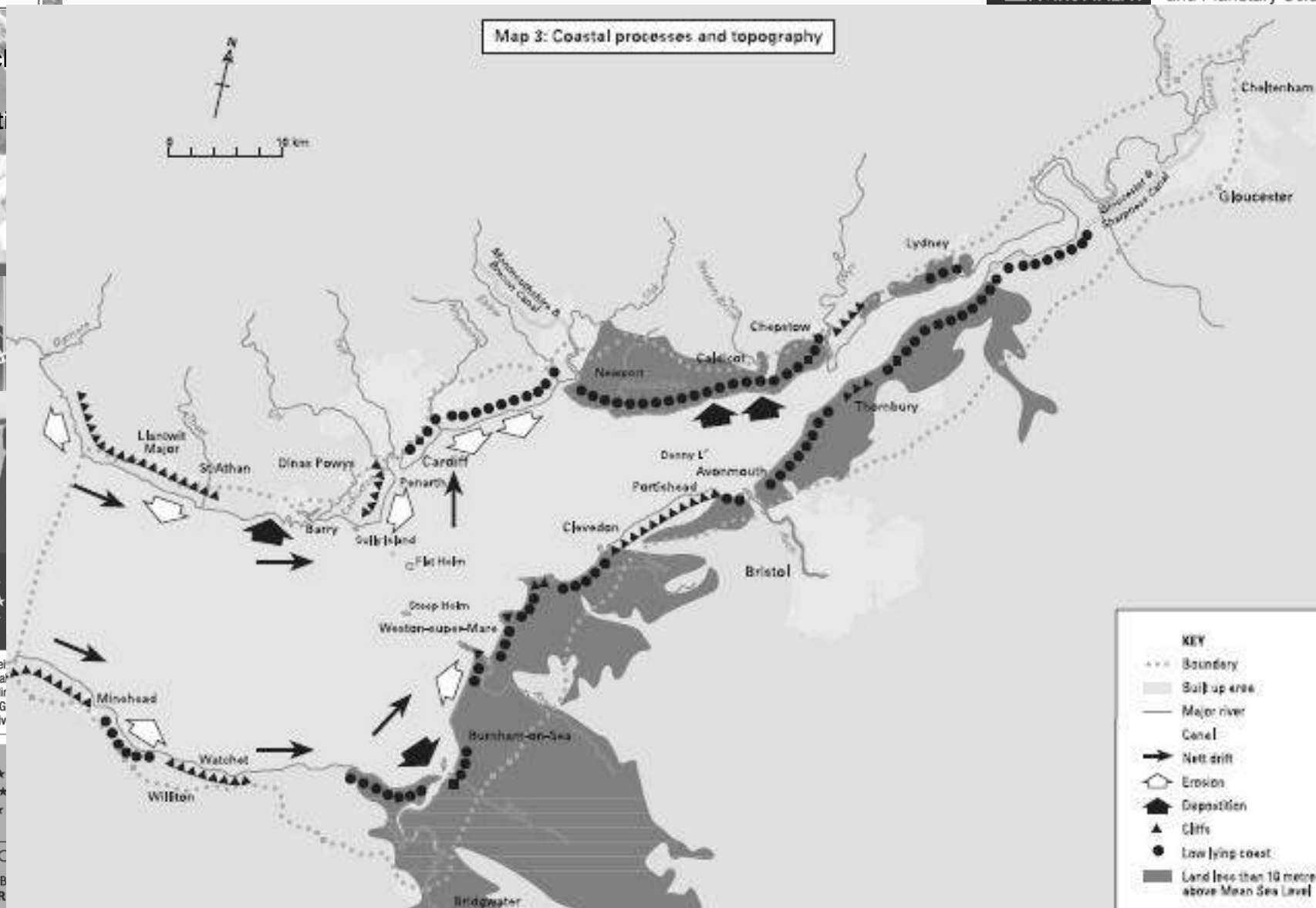
2. Sea Level Change



3. Storminess/Sediments? (Flooding and Erosion)

- Wave Climate
- Wave Height
- Storm Frequency

- Morphology
- Sediment Budgets
- Coastal Geohazards

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4. Coastal ecology and ecosystems

- Species range, distribution and organisation
- Habitat Loss
- Ecosystem services and functions (Nutrient recycling, biomass productivity)

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5. Environmental Systems

- **Nutrient cycles**

- **Fisheries and Aquaculture**

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6. Vulnerability Assessment

- **Impacts on Amenities**
  - **e.g.Recreation & Tourism**
- **Impacts on Built Structures**
- **Impacts on coastal settlement/heritage/ land-use and marine industries**
  - **e.g. Ports & Shipping**

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7. Adaptation to Climate Change

- 7.1 Shoreline Management
- 7.2 Coast Defence and Managed Retreat
- 7.3 Strategic Policy (including zoning)
- 7.4 Infrastructure and Marine Engineering
- 7.5 Cost Benefit Analysis of adaptation strategies
- 7.6 Institutional capacity for adaptation & mitigation

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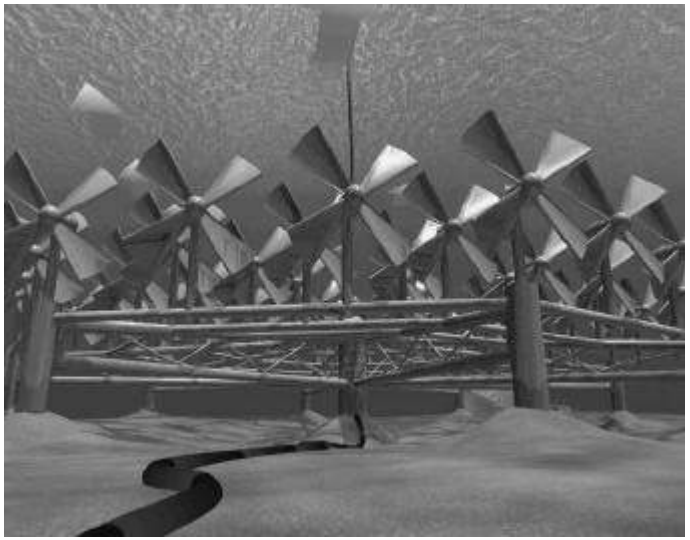
8. Mitigation: Energy Policy

Marine Renewables:

- Tide
- Wind
- Wave
- Current



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9. Integrated Assessment

Risk- Sensitivity- Adaptation.

Science

- Vulnerability Assessment of Coastal Areas
- Development Scenarios
- Models

Policy and Planning

- Local Plans
- Sectoral Plans and Projects
- Severn Estuary Strategy

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A Way Forward

Advantages for Scientists

- **Facilitate Networking and Collaboration between Researchers and Practitioners**
- **Mechanism for proposing joint bids for scientific funding**
- **Science/R&D Collaborations between academia and government agencies**
- **Opportunity for Researchers to fulfil Communicating Science goals within research contracts**
- **Identification of Research Priorities and Actions**
- **Identification of Research Synergies**
- **Focal point for discussion of research issues**

Advantages for Planners and Managers

- Chance to influence science agenda
- Steer on the relevance of research outcomes
- Consensus on Climate Change Research Agenda for the Severn
- Adaptive approach to management
- Highlight answers to coastal issues
- Develop a unified Research Agenda that will meet the needs of *all stakeholders*.
- Identify funding and resources, attract new sources of funding
- Link Research with strategic Planning Goals and Management needs

Advantages for the Severn Estuary

Integrated Approach

- Networking by Research Officer
  - (until Nov 2007- then Chair from members?)
- Sponsored Conference on Climate Change & SEP Forum
- Research database [450]
- Contacts List [250]
- Identify gaps in knowledge base

Goals

- Monitoring Progress with Research Agenda
- Public Visibility and Accountability
- Resourcing
  - Student Dissertation Titles
  - Exchange Programmes between scientists & practitioners

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Structure of a Research Advisory Group

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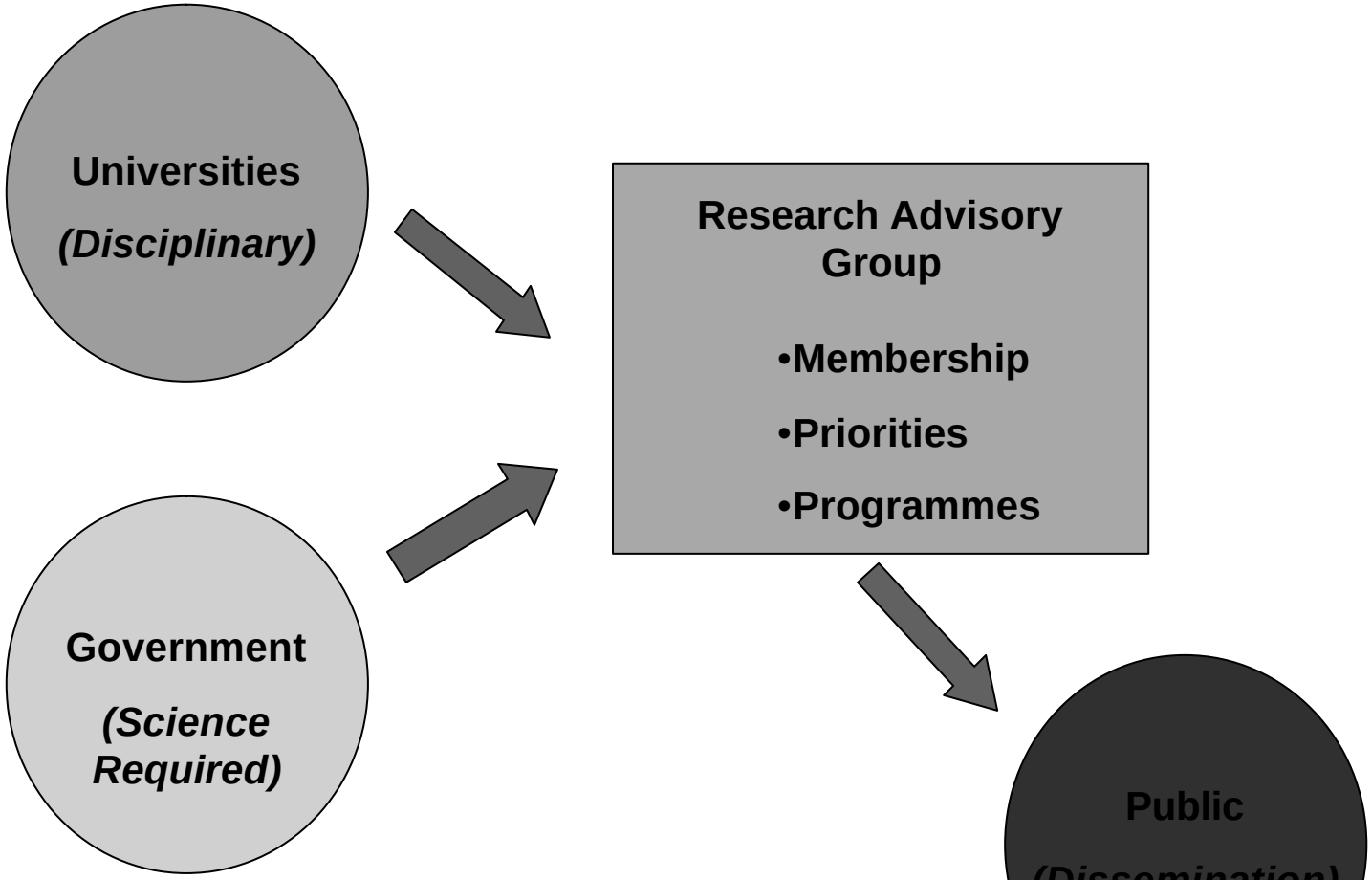

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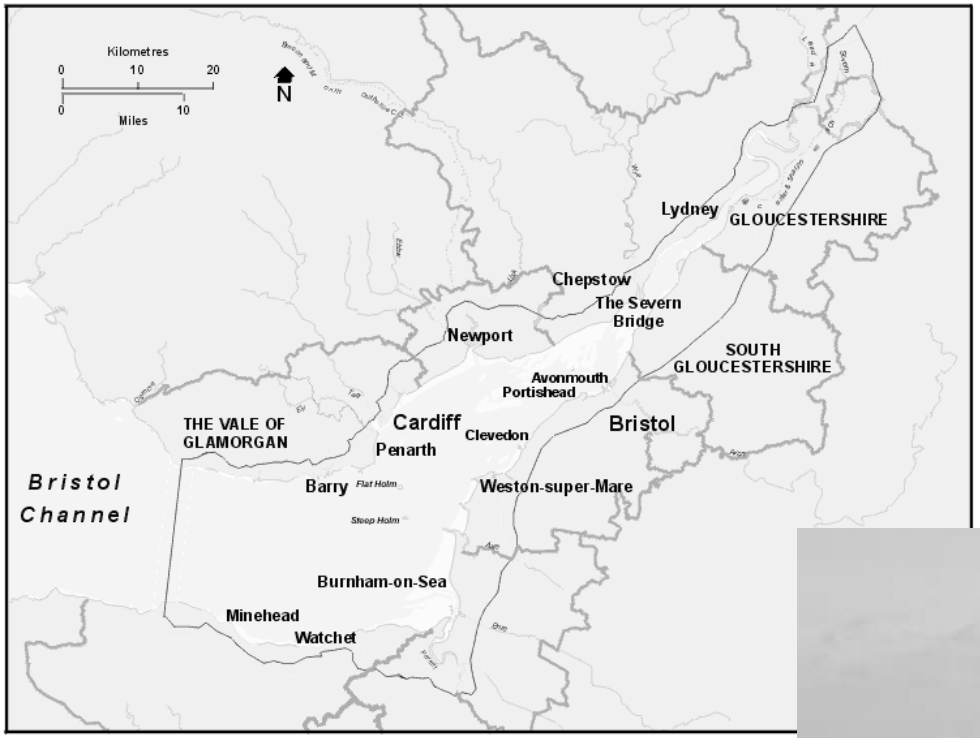
Elements

- Steering Group, with Chair
  - Research Group
    - Topic Groups
      - Regional Expertise & Lay knowledge
        - External Links (SWCCIP, UKCIP, Wales)

Severn Estuary



- 14 Local Authorities
- 3 Environment Agenc Regions
- c.12 Universities
- Britain's largest Coastal Plain Estuary

- Urban
- High-Energy Tides and Rivers
- Low lying, soft coast

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The Thames Estuary Research Forum

Tim Reeder, Environment Agency

his project has received European Regional Development Funding ough the INTERREG III B Community Initiative

Planning & Management for Climate Change (1)

Laurie Newton, UKCIP

his project has received European Regional Development Funding ough the INTERREG III B Community Initiative

Planning & Management for Climate Change (2)

Roger Wade, Environment Agency

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Scientific Research & Climate Change on the Severn Estuary

Dr Ted Bryant, University of Wollongong
Professor Simon Haslett, Bath Spa University

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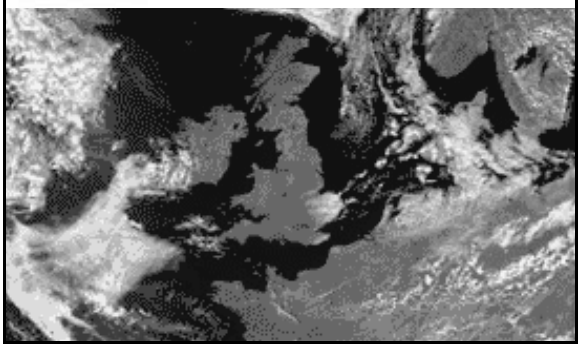
Research Strategy Development

Introduction (2)

The vision of a Research Advisory Group for the Severn Estuary

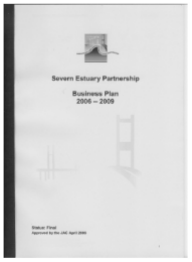
Natasha Barker, Severn Estuary Partnership Officer



What is ICZM?

A process that brings together all those involved in the development, management and use of the coast to help ensure future management takes place in an integrated and informed way. In essence, ICZM is about the sustainable management of the coastal zone.

Welsh Assembly Government 'Making the Most of the Wales Coast'
ICZM Strategy for Wales, 2006



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The Way Forward

Dr Rhoda Ballinger, Cardiff University
Natasha Barker, Severn Estuary Partnership

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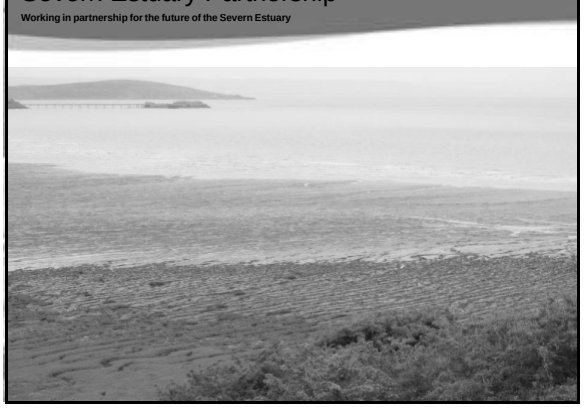
Severn Estuary Partnership

Working in partnership for the future of the Severn Estuary

Figure 2.2 Basic organisational structure of the Severn Estuary Partnership

Severn Estuary Partnership

Working in partnership for the future of the Severn Estuary



Thames Estuary Partnership

Tim Reeder

Chair Thames Estuary Research Forum

Thames Estuary Partnership

Thames Estuary Partnership's Aim:

Brings together local authorities, national agencies, industry and voluntary bodies to work together for the good of the Thames Estuary.

Thames Estuary Partnership

Boundary:

Thames Estuary Partnership

Partners:

Hundreds of organisations, across many different sectors, advise and guide the work of the Partnership…..including:

Anglian Water	London Tourist Board
Cleanaway	Medway Council
Cory Environmental	National Farmers Union
English Nature	Port of London Authority
Environment Agency	RSPB
Essex County Council	Thames21
Greater London Authority	Thames Water
Kent County Council	Thurrock Council
Kent & Essex Sea Fisheries Committee	University College London

Thames Estuary Partnership

Management Group:

- Directors and trustees
- Sets strategic direction
- Supports staff and operations
- Provides core funding

English Nature
Environment Agency
Essex County Council
Kent County Council
Port of London Authority
University College London
Thames Water
RSPB

Thames Estuary Partnership

Structure:

The Partnership is organised around a set of topic-based Action Groups, through which actions are implemented.

- **BiodiversityAction Group** - Tidal Thames Habitat Action Plan
- **Dredging Liaison Group** - Information Exchange System
- **Thames Education Network** - Education Action Plan & Training
- **Fisheries Action Group** - Greater Thames Estuary conference
- **Thames Archaeological Steering Group** - Arch Research Framework
- **Thames Estuary Research Forum** - Audit & Student Projects
- **Planning & Environment Action Group** - Thames Strategy East
- **Recreation Action Group** - Thames Recreation Study & Open Days
- **Water Information Network –** Sharing information

Thames Estuary Partnership

Thames Estuary Research Forum's Aim

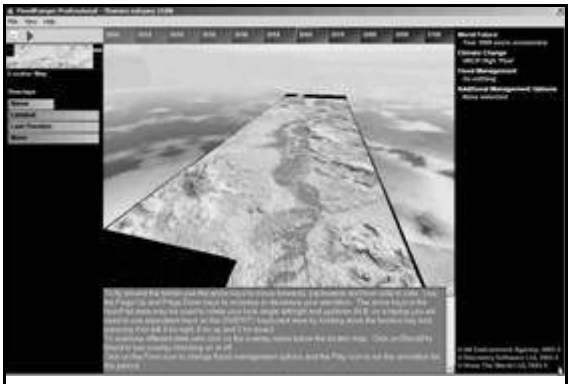
- Provide a research network
- Improve knowledge guided by clearly defined research needs
- Improve communication between academic institutions and relevant authorities across the Thames
- Provide the direction and focus for Thames research projects

Thames Estuary Partnership

Successes & Problems

- Research agenda and database
- State of Estuary Report
- Annual Forum
- Funding for core staff - funding opportunities
- Potential partnerships & integration
- How to achieve wide engagement

Thames Estuary Partnership



Thames Estuary Partnership

Adaptation to climate change – a local authority approach

Climate Change in the Severn Estuary workshop

Bristol, 29th January 2007

UK Climate Impacts Programme

Who we are

The UK Climate Impacts Programme (UKCIP)

"helps organisations to assess how they might be affected by climate change, so that they can prepare for its impacts".

- **Set up by UK Government in 1997**
- **funded by Defra**
- **based at University of Oxford**

Works through:

- **stakeholder-led research**
- **partnerships**
- **programmes, and**
- **capacity building**

Provides common tools and datasets. All freely available on request, or over the internet

UK Climate Impacts Programme

Nottingham Declaration on Climate Change

- **The Nottingham Declaration is a voluntary pledge to address the issues of climate change. It represents a high-level, broad statement of commitment that any council can make to its own community.**
- **100 Councils signed the First Nottingham Declaration on Climate Change launched in 2000**
- **Second National Councils' Conference on Climate Change was held December 2005 to launch new version of the Nottingham Declaration**
- **Target 200 campaign aimed to sign up 200 councils by end of 2006 – more than 180 have signed to date**
- **The Nottingham Declaration Action Pack was released July 2006**
- **UKCIP contributing to the adaptation strand**

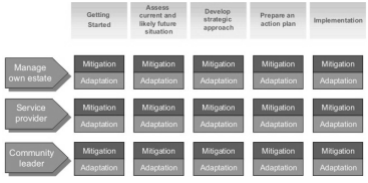
UK Climate Impacts Programme

Nottingham Declaration Action Pack

- The purpose of the Pack is to provide online guidance for the production of LA (or LSP) climate change action plans
- Ambition to become the standard resource for guiding local authority responses to climate change
- Provides a project management framework with clear milestones
- Offers the potential for auditing progress
- Flexible and adaptable allowing both comprehensive, authority-wide approaches, or focus on specific service areas or corporate functions
- Provides links to other useful resources

UK Climate Impacts Programme

Using the Nottingham Declaration Action Pack



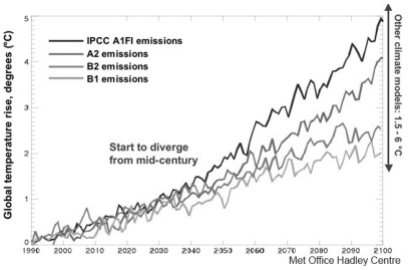
- The structure of NDAP supports authority-wide climate action plans, but it is designed for flexibility
- You can enter at different points in the process, building on any existing work, or picking the 'low-hanging fruit' – issues of particular concern for your authority

UK Climate Impacts Programme

UK Climate Impacts Programme

UK Climate Impacts Programme

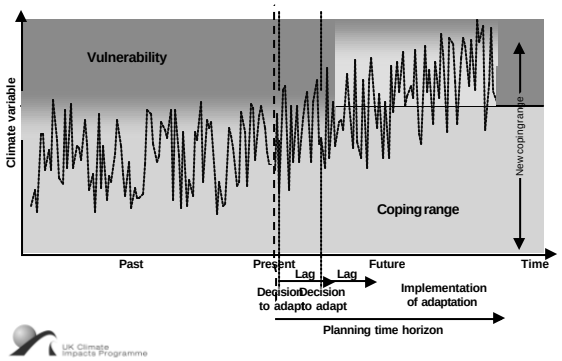
Climate change is unavoidable



UK Climate Impacts Programme

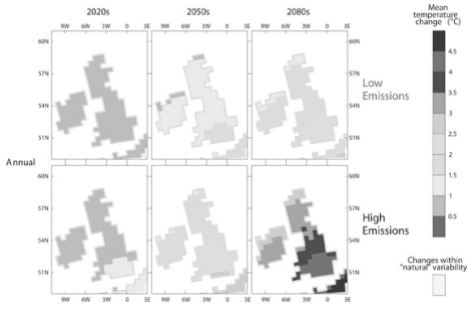
Maps

Climate, vulnerability and adaptation



UK Climate Impacts Programme

Projected changes to annual average temperature in UK



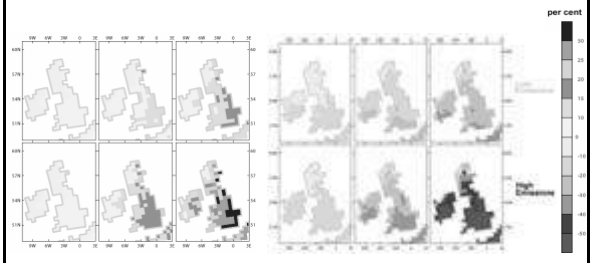
UK Climate Impacts Programme

Tyndall Centre for Climate Change Research

defra

Met Office Hadley Centre

Projected changes to seasonal average precipitation in UK



Winter **Summer**

UK Climate Impacts Programme

Tyndall Centre for Climate Change Research

defra

Met Office Hadley Centre

Bringing home local climate risks

Scope potential climate impacts

- Scenarios of climate change can seem remote – in terms of both location and timing
- One approach to bringing climate risks closer to home is to develop a Local Climate Impacts Profile (LCLIP) which uses both formal and informal information to build up a picture of local vulnerabilities to climate risks

UK Climate Impacts Programme

A Local Climate Impacts Profile: LCLIP

- **Section 1: Past climate and impacts (electronic download)**
  - **Historic climate data can be drawn from Met Office aggregated data from UK weather stations**
- **Section 2: Current weather and impacts**
  - **A record of more recent weather related events in the locality and their impacts - assembled from informal and formal local sources**
  - **Arrangements to record and publish current weather-related events in the locality and their impacts - assembled from informal and formal local sources including Local Authority service areas, local media, etc**
- **Section 3: Future climate (electronic download)**
  - **Near-term climate data drawn from 'UKCIP02' (and 'UKCIP08' in due course) at a suitable local spatial scale**
  - **Longer-term climate data for later in the century from 'UKCIP02' (and 'UKCIP08' in due course) at a suitable local spatial scale**

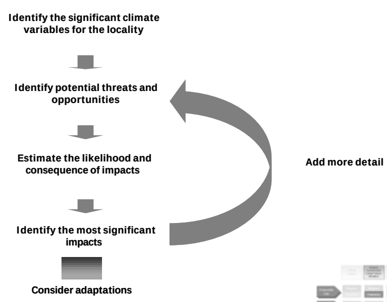
Factors to consider in identifying climate impacts

Scope potential climate impacts

- **People:** implications for workforce, customers/clients and changing lifestyles
- **Demand:** changing demand for services
- **Premises:** impacts on building design, construction, maintenance and facilities management
- **Process:** impacts on the processes of service delivery
- **Finance:** implications for investment, insurance and stakeholder reputation
- **Logistics:** vulnerability of supply chain, utilities and transport infrastructure
- **Management implications:** how will climate risks and impacts be managed effectively?

Scoping impacts is an iterative process

Scope potential climate impacts



Pre-screening

Scope potential climate impacts

Before embarking on the scoping process it is worth asking:

- Is the operation currently affected by weather or climate, either directly or indirectly?
- Does the operation involve taking decisions with long-term consequences (decades or longer) for land-use, built assets or people?
- Does the operation involve infrastructure or business areas that are sensitive to changes in weather or climate?
- Is the operation vulnerable to disruption of external factors such as utility supplies and transport infrastructure?
- Is it critical to the aims and objectives of the operation to maintain continuity of service during extreme events?

Identifying potential climate impacts

Scope potential climate impacts

Assessing climate impacts on LA services

Service area			
Completed by:		Date:	

Climate variables	Impacts	Threat (t) / opportunity (o) / ambiguous (a)	Notes
Changes in annual or seasonal means			
Hotter summers			
People - Clients			
Drier summers			
- Staff			
Warmer winters			
Wetter winters			
Process			
Rising sea levels			
Finance			
Extreme events			
Heavier downpours			
People - Clients			
Heat waves			
- Staff			
Combined			
Indirect -- Logistics			
Process			
Finance			

Example impacts on care homes

Scope potential climate impacts

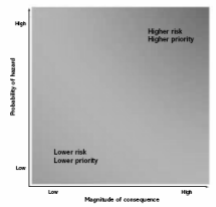
Assessing climate impacts on LA services

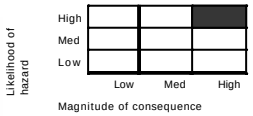
Service area	Care homes for the elderly		
Completed by:		Date:	

Climate variables	Impact	Threat (t) / opportunity (o) / ambiguous (a)	Notes
Changes in annual or seasonal means			
Hotter summers			
People - Clients	Difficulty maintaining comfortable internal temperatures during summer	**t**	The elderly are particularly vulnerable to high temperatures, particularly at night. Likely to be most extreme during heat waves (see below)
	May offer more opportunities for out door activities	**o**	May be need for shading to take advantage of this opportunity
- Staff	Difficulty maintaining comfortable internal temperatures during summer	**t**	
	Potentially greater risks to outdoor workers	**t**	Likely to be most extreme in heat waves (see below)

Estimating the likelihood and consequence of impacts

Scope potential climate impacts





Example

Residential care for the elderly

Impact: Heatwave

Receptor: Elderly residents

Potential consequence: Death

Timescale: Short/medium/long

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Stage outputs

Scope potential climate impacts

The final output from scoping stage should be:

- A prioritised list of climate impacts that need to be considered for adaptation

Output from intermediate steps within the stage:

- List of significant climate variables for your locality
- List of threats and opportunities presented by climate impacts
- Likelihood-consequent matrices assessing the significance of climate risks
- Prioritised list of climate risks
- Comparison of climate and other risks

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Two types of adaptation responses

Evaluate alternative adaptation options

Building Adaptive Capacity (BAC)

- **undertaking research, institutional change, education and training,**
- **creating standards and legislation, management, and resources**
- **developing policies, plans, strategies**

Delivering Actual Adaptation (DAA)

- **building flood defences or managing retreat**
- **putting more nails in a roof tile, increasing the diameter of a drain**
- **creating 'siesta' times in a business or locality**

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Develop adaptation responses

Evaluate alternative adaptation options

- **Do nothing** -- this may be an appropriate response to low priority impacts or situations where climate risks are outweighed by non-climate factors
- **No regret --** options will deliver benefits that exceed their costs, whatever the extent of climate change
- **Win-win --** options are ones that contribute to desired outcomes (be they environmental, social or economic), and also improve your ability to adapt to climate risks
- **Avoid actions that will make it more difficult to cope with climate risks in the future**

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Stage outputs

Evaluate alternative adaptation options

- List of key issues and preferred adaptation responses for your corporate estate (with appropriate justifications)
- List of key issues and preferred adaptation responses for a service sector (with appropriate justification)
- Suggested changes to managerial processes to ensure that local authority functions are effectively climate proofed
- List of key issues and preferred adaptation measures for the local strategic partnership (with appropriate justification), together with proposals for assigning responsibilities to the various partner organisations

UK Climate Impacts Programme

www.nottinghamdeclaration.org.uk

www.ukcip.org.uk

UK Climate Impacts Programme

The Severn Estuary and Climate Change- Management Issues

Severn Estuary Research Meeting
Dr Roger Wade
Environment Agency Wales.

My talk……

- Direct Impacts of climate change
  - Flood Risk Management/ Coastal erosion
  - Habitats
  - Water resources
- Indirect impacts
  - Renewable energy resource
  - Aggregates (new build)
  - Leisure.

The changes…

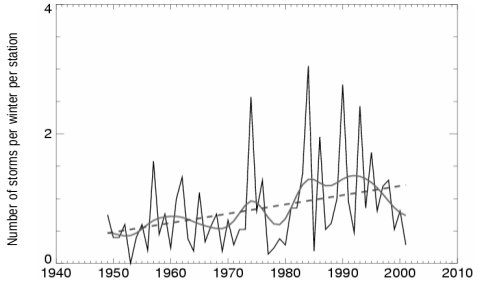
THE WELSH CLIMATE IS CHANGING

by 2080 it will be

warmer	by 1.1 - 2.9 °C
wetter in winter	by 7 - 24 %
drier in summer	by 7 - 14 %

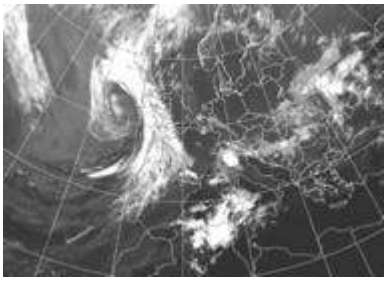
and more extreme
more variable from year to year (e.g. more drought years)
more rain in frequent and violent storms
more severe gales
and sea level will rise by 18-79 cm

Winter storms over the UK 1949-2001



Source: Lisa Alexander, Hadley Centre

Increased storminess



9-10 August 2004 Dying Hurricane Alex, heavy storms and summer floods in UK. This storm sank Pink Lady 300 miles from the Scilly Isles.

Damage from Flooding- 2080 at 700ppm CO2 and 550ppm CO2.

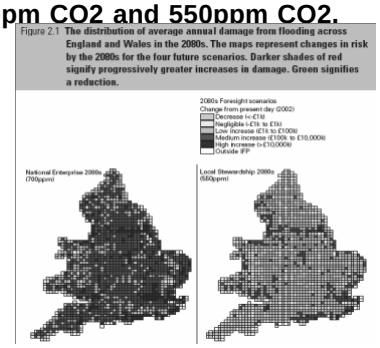
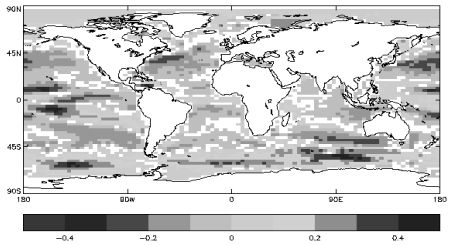


Figure 2.1 **The distribution of average annual damage from flooding across England and Wales in the 2080s. The maps represent changes in risk by the 2080s for the four future scenarios. Darker shades of red signify progressively greater increases in damage. Green signifies a reduction.**

Coastal Erosion-High Emissions 2080.

Figure 2.2 **Coastal erosion under the World Markets/ High emissions scenario in the 2080s.**

Changes in wave height (m) estimated using HadCM3 winds



Source: Hadley Centre

Shoreline Management Plans and Coastal Habitat management Plans (CHAMPS)-

- **Key Documents to feed into strategies**
- **SMP's 1st- 2000, 2nd - before 2010.**
  - **Look at coastal processes- erosion and accretion, wave etc.**
  - **Need to include existing developments in recommendations**
- **Champs- to be published 2007- predicting net loss from tidal squeeze etc.**
  - **Predict and record losses and gains in habitats chart trendds**
  - **To direct measures for habitat conservation &creation**
- **Processes studied in Champs include: wave energetics, chart trends, Sediment budget, Geomorphology.**

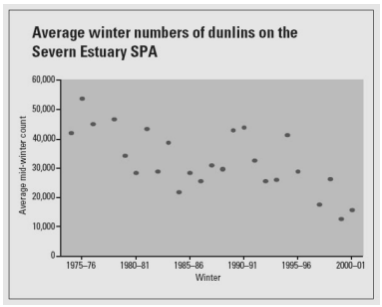
Newport-Chepstow Strategy Flood Risk for 100 Years.

Table 2.6: Shoreline Management Plan Policies, (Ref XXX)

Policy Unit	Management Unit	Existing (0-20yrs)	Short Term (20-50yrs)	Long Term (50-100yrs)
MU4 River Usk	4/4	HL	HL	HL
	4/5	HL	HL	HL
MU5 Uskmouth	5/1	HL (local RL)	HL	HL or RL
	5/2	HL	HL (local RL)	HL or RL
MU6 Caldicot Levels	6/1	HL	HL	HL or RL
	6/2	HL	HL	HL or RL
	6/3	HL	HL	HL or RL
MU7 Severn Crossing	7/1	DN (Local HL)	DN (Local HL or RL)	DN (Local HL or RL)
	7/2	HL or DN	HL or RL	HL or RL

HL = Hold the Line
RL = Retreat the Line
DN = Do Nothing

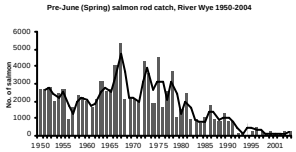
Changes in bird numbers



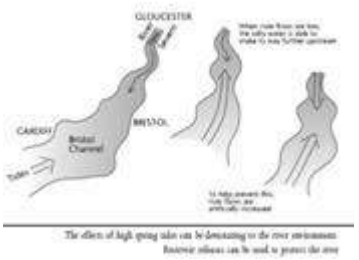
What is in or out?

- **Ten year trends %**
- **Dunlin -23**
- **Bewick Swan -75**
- **Whooper Swan 22**
- **Shellduck -59**
- **Redshank -1**
- **Gadwall 82**

Fewer Salmon numbers

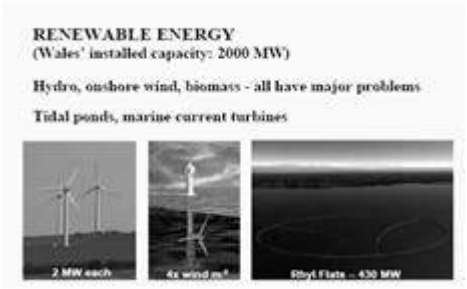


Water resources- Lower Summer flows?

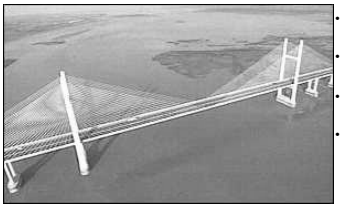


- Salt ingress
- Dredging costs
- Oxygen depletion
- Salmon Migration

Renewable Energy- Barrage ???



Aggregates dredging



- Domestic energy reduction = new houses= aggregates
- Welsh demand largely from Bristol Channel
- Possible erosion to beaches and cliffs
- Further pressure inland

Warmer- good for holidays?

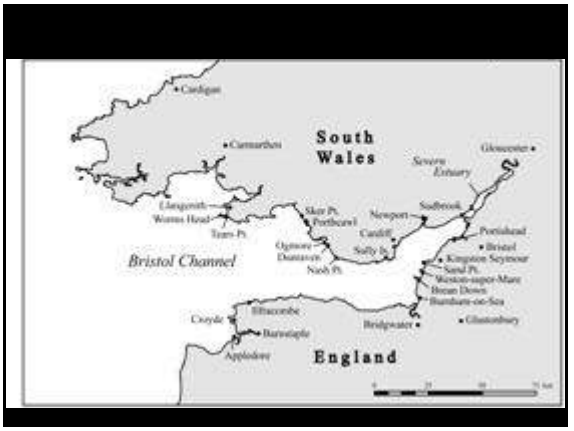
Next Steps.

- Develop indicators (e.g., waves, loss of habitat, surges, birds, saline intrusion)
- Scope potential climate change impacts
  - infrastructure: harbours, Industry, paths, defences, outfalls.
  - Water quality, species diversity
  - social behaviour: recreational activities
- Map structures and assets at risk
- Future-proof maintained/planned structures
- Consultation and partnership

Scientific research and impacts of climate change on the Severn Estuary.

Professor Simon Haslett (Bath Spa University) and Dr Ted Bryant (University of Wollongong)

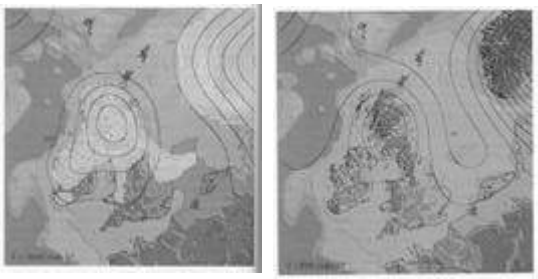
Bath Spa University



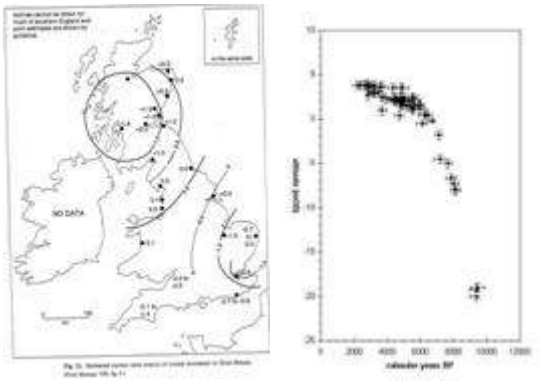
Conditions in the Last Glacial

North of the Severn Estuary?

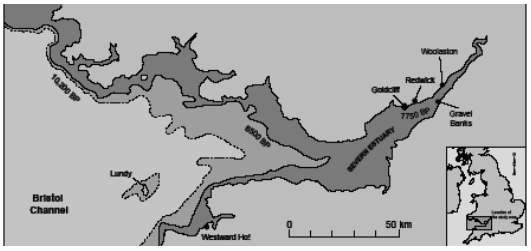
South of the Severn Estuary?

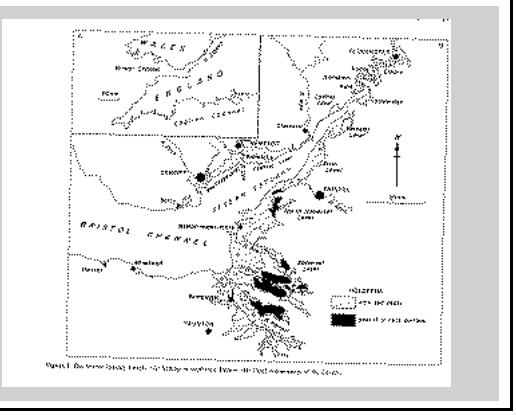


Lambeck's (1995) models

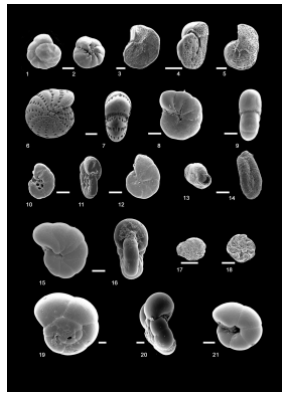


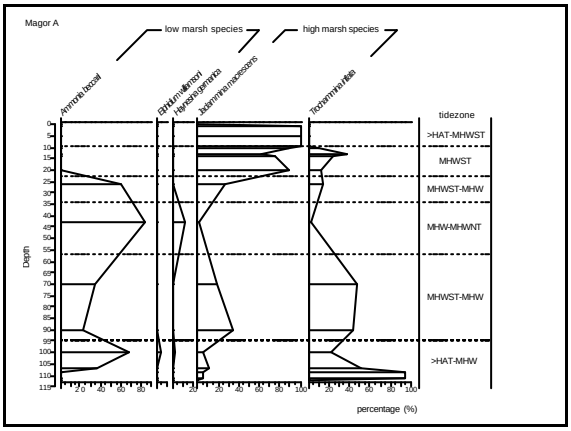
From Brunning (2006)





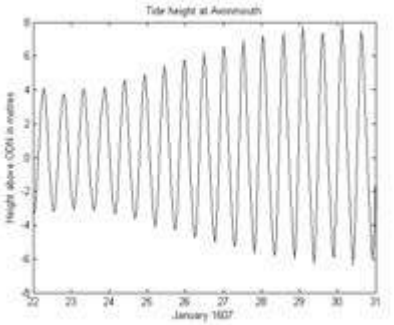
Coring in the Severn Levels.



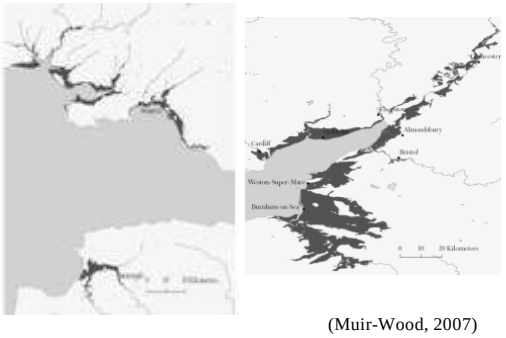


Severn Estuary salt marshes

The tidal amplitude on 30 January 1607 was 7.86 m AOD, which occurred at 0900 local time (Horsburgh, 2007)



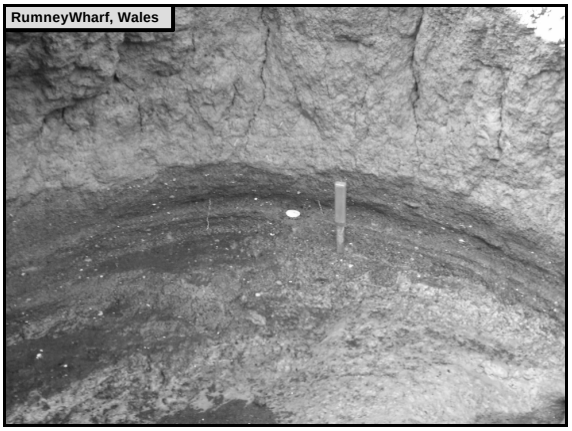
Areas of Flooding in 1607



(Muir-Wood, 2007)

RumneyWharf, Wales

RumneyWharf, Wales



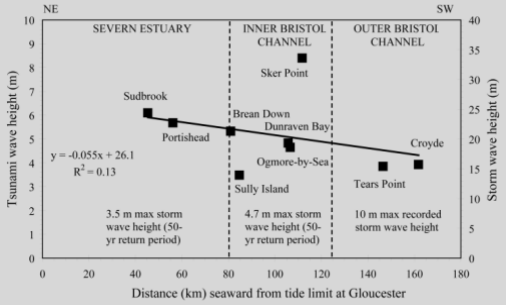
Dunraven Bay, Wales

Sudbrook, Wales

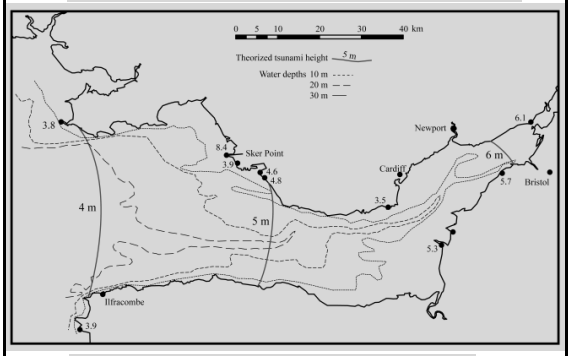
Maximum heights of tsunami and storm waves required to transport boulders in Bristol Channel

Area	Site	rock density	a-axis (m)	b-axis (m)	c-axis (m)	volume (m^3)	weight (tonnes)	Height of tsunami- H_t (m)	Height of storm wave- H_{storm} (m)
Severn Estuary	Sudbrook	2.32	4.45	3.60	0.70	11.2	25.6	**6.1**	**24.4**
	Portishead	2.32	2.60	2.50	0.23	1.5	3.4	**5.7**	**22.7**
Inner Bristol Channel	Brean Down	2.61	5.15	4.75	2.10	51.4	132.0	**5.3**	**21.3**
	Sully Island	2.32	2.15	1.57	0.26	0.9	2.3	**3.7**	**14.9**
	Dunraven Bay	2.61	2.94	2.76	0.64	5.2	13.3	**4.8**	**19.3**
	Ogmore-by-Se	2.61	4.85	3.10	1.05	15.8	40.6	**4.6**	**18.6**
	Sker Point	2.75	4.40	4.10	0.85	15.3	41.5	**8.4**	**33.6**
Outer Bristol Channel	Tears Point	2.61	2.14	2.05	0.42	1.8	4.7	**3.8**	**15.4**
	Croyde	2.68	3.01	2.30	0.65	4.5	11.8	**3.9**	**15.7**

Can plot hypothesised tsunami and storm wave heights throughout Bristol Channel. Some of the largest boulders are being moved at the mouth of the Severn Estuary. They require storm wave heights up to 7 times the 50-yr return period of maximum storm waves.



The required tsunami wave heights are plotted here.



Tsunami fit the pattern of boulder size better than storm waves.


End of Presentation