QUEST-GSI: Catchment-scale impacts of climate change
### The issue...

#### Global mean annual temperature change relative to 1980-1999 (°C)

<table>
<thead>
<tr>
<th>WATER</th>
<th>ECO SYSTEMS</th>
<th>FOOD</th>
<th>COASTS</th>
<th>HEALTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased water availability in moist tropics and high latitudes</td>
<td>Up to 30% of species at increasing risk of extinction</td>
<td>Tendencies for cereal productivity to decrease in low latitudes</td>
<td>Increased damage from floods and storms</td>
<td>Increasing burden from malnutrition, diarrhoeal, cardio-respiratory, and infectious diseases</td>
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<tr>
<td>Decreasing water availability and increasing drought in mid-latitudes and semi-arid low latitudes</td>
<td>Most corals bleached</td>
<td>Productivity of all cereals decreases in low latitudes</td>
<td>Millions more people could experience coastal flooding each year</td>
<td>Increased morbidity and mortality from heat waves, floods, and droughts</td>
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<tr>
<td>Hundreds of millions of people exposed to increased water stress</td>
<td>Widespread coral mortality</td>
<td>Tendencies for some cereal productivity to increase at mid- to high latitudes</td>
<td>About 30% of global coastal wetlands lost</td>
<td>Changed distribution of some disease vectors</td>
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<td></td>
<td>Terrestrial biosphere tends toward a net carbon source as:</td>
<td>Cereal productivity to decrease in some regions</td>
<td></td>
<td>Substantial burden on health services</td>
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<tr>
<td></td>
<td>~15%</td>
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<td>~40% of ecosystems affected</td>
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<td>Ecosystem changes due to weakening of the meridional overturning circulation</td>
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IPCC AR4
  US President Barack Obama (March 27, 2009)

• EU target of 20% cut in greenhouse gas emissions by 2020.
  EC President Jose Manuel Barroso (Jan. 23, 2008)

• “Scientists warn that a cut of at least 30% is required to prevent a climatic catastrophe”
  Tony Juniper, Director of Friends of the Earth

  *in fact, we do not know in a systematic way what the effects of a 16%, 20%, or 30% cut in emissions would be*
1) What are the global-scale implications of climate change?
   - where are the hot-spots?
   - how do impacts vary with forcing?

2) What effects do climate policy have on the impacts of climate change?
   - relationship between policy and cost?
Climate policy and impacts

- No climate policy
- With policy targets

What are the avoided impacts?

Van Vuuren (2007)
OVERALL AIMS:

• To examine, map quantitatively and assess the implications of different rates and degrees of climate change for a wide range of ecosystem services across the global domain.

• To provide a framework for assessing the impacts of specific climate policies.

(i) A geographically-explicit, global-scale assessment of specific scenarios and policies (e.g. SRES scenarios, 2°C target).

(ii) Construction of climate impact response functions (CIRFs) for rapid assessment of implications of multiple scenarios.
• Define coordinated and consistent set of climate, land-cover and socio-economic scenarios;

• Refine and link existing global-domain impacts models;

• Develop procedures for aggregating and synthesising across scales and sectors;

• Apply models and indicators to defined scenarios, and identify “risks” and “hot-spots”;

• Develop CIRFs from impact models.
An interdisciplinary consortium

- University of Reading (lead)
- University of East Anglia
- University of Aberdeen
- University of Leeds
- University College London
- University of Southampton
- LSHTM
- Centre for Ecology and Hydrology
- Hadley Centre
- CEFAS
Impact sectors

Water resources
Coastal flooding
Fluvial flooding
Crop productivity
Ecosystem productivity
Carbon storage in soils
Aquatic productivity

Food security
Hunger
Ill-health
Key science questions

Characterising scenario uncertainty

Characterising impact model uncertainty

Linkages between sectors

Characterising adaptation

Linking impacts with vulnerability
• critical importance of freshwater to other sectors: food/crop production, human health, energy, flooding/drought, aquatic ecosystems/fisheries, biodiversity
QUEST-GSI
Catchment-scale impacts

- to quantify the impact (and uncertainty therein) of a common set of climate scenarios on water resources at the catchment scale
catchment-scale studies

- basins represent a range of physical and human environments

Liard (Mackenzie)
McMaster University, Canada

Changjiang (Yangtze)
Changjiang Water Resources Commission

Huangfuchuan (Yellow)
National Climate Centre, China

Grande (Parana)
Universidade Federal do Rio Grande do Sul, Brazil

Okavango
Rhodes University, South Africa

Mitano (Nile)
UCL

Mekong
UCL

catchment-scale studies
adaptation strategies to climate change will generally be developed at the catchment scale…

sand dam and large-diameter collector well in NE Botswana (Limpopo Basin)
informing adaptation?

- to relate projections of hydrological change to adaptive capacity

catchment-scale studies
• more explicit representation of basin hydrology
• locally derived development scenarios
• to test global-scale projections of hydrological change and vulnerability
QUEST-GSI workshop aims:

• to resolve most effective and appropriate means of disseminating research outcomes
• to discuss emerging results with stakeholders