“Where are we now?”

Integrating natural and social science perspectives and bridging research communities in the analysis of vulnerability of coastal ecosystems and communities to climate change

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LOICZ II Inaugural Open Science Meeting, Egmond aan Zee, Netherlands, 27-29 June 2005

Global environmental change

Humans have made unprecedented changes to ecosystems in recent decades to meet growing demands for food, fresh water, fiber and energy.

Human-induced global change is expected to increase the frequency, duration and magnitude of periods of abrupt change:

- **Melting of glaciers**
- **changes in freshwater availability**
- **altered rainfall patterns**
- **redirections of major currents**
- **increased erosion**
- **reoccurrence of floods and storms**
- **emergence of new diseases**
- **environmental degradation of coastal habitats**
- **loss of biodiversity**

The scale of present human activities is so extensive that the capacity of the planet's ecosystems to sustain present and future generations can no longer be taken for granted.

(Millenium Ecosystem Assessment Synthesis Report, 2005)

Social and economic changes

- During the last few decades many coastal areas have also been particularly affected by rapid social and economic changes including:
  - population growth and rapid urbanisation:
    - increasing concentration of populations in coastal zones
    - globally over one billion people (23% of world population) live within 100m elevation and 100km distance of the coast
    - populations are highly concentrated in large cities and coastal towns
  - large-scale commercial infrastructure, industrial aquaculture, and tourism development.
- Many drivers of change manifested at the coast are part of broader structures and processes.
- Individuals and communities are experiencing new kinds of vulnerabilities as a result of complex interactions with global environmental and socio-economic processes, such as climate change and economic globalisation.

Assessing coastal vulnerability: From IPCC Common Methodology to DINAS-COAST

- Based on the IPCC Common Methodology
- Sea level rise as only climate variable
- Identified locations particularly at risk
- Limited number of impact indicators:
  - people affected
  - people at risk
  - land loss
  - infrastructure loss
  - limited consideration of adaptation
  - estimation of protection costs
- Successive incremental methodological improvements

Understanding the vulnerability of coastal ecosystems & communities

Vulnerability research:

- **Human dimension of environmental change**
- **Powerfully anticipatory concept**
  - **knowledge of who might be vulnerable and why also entails a responsibility**
  - **proactive – policy linkages critical**
- **Focus on the perspectives and experiences of marginalised groups**
  - **participatory or action oriented research methods**
- **Document the agency and resilience of different groups**

Changing approaches to vulnerability assessment

- From impact assessment to vulnerability assessment
- Shifting focus from hazard to the social, economic and institutional context of vulnerability
- From vulnerable groups to vulnerable situations
- From science-driven to policy-driven
- Increased integration across sectors and disciplines
- Consideration of multi-scale (cross-level) processes
- From single stress to multiple stresses such as technology, food insecurity, climate change, environmental change, ‘dramatic’ and ‘everyday’ risks
- From passivity to agency (capabilities, coping, adaptation, resistance, resilience)
- Increasing emphasis on adaptive capacity and specific anticipatory adaptation measures
- Increasing integration of adaptation into wider policy processes

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Developing and advancing tools and methodologies

- Conceptual assessment frameworks
- Indicators and scenarios
- Knowledge elicitation and participatory methods
- Identifying people and places at risk (hotspots)

Understanding institutional organisation and social networks:

- Agency of individuals and communities
- Role and effectiveness
- Cross-level processes
- Social learning
- Build on local capacities and knowledge

Methodologies for vulnerability assessment

Downing and Spanger-Siegfried, 2005

Conceptual framework	Data base and indicators	Analysis of current vulnerability, climatic hazard and risk	Scenarios of future vulnerability, climatic hazards and risk	Outputs
Objectives				
To map influences on vulnerability, including ecological and socio-economic factors and actors, that helps guide selection of indicators and methods	Guided by conceptual framework, to compile a data base of vulnerability indictors over time, geographic resolution, and relevance for actors and vulnerable groups	To construct a base-line of current risk: • Describe social, economic and environmental vulnerability • Capture climatic hazards • Integrate vulnerability and hazard in risk assessment For specific vulnerable groups and regions	To extend the current risk assessment to the future: • Describe pathways of future social, economic and environmental vulnerability • Overlay scenarios of changes in climatic hazards • Integrate vulnerability and hazard in the assessment of future risk	To represent the vulnerability, hazard and integrated risk assessment for communication among the research team and to decision makers
Tools				
• Flow charting progs. such as MS Office, Visio • Mental mapping exercises and workshops • Qualitative modelling packages such as Stella, Fearlus	• Secondary data sources, statistical surveys • Interviews, role playing • Knowledge elicitation and decision trees • Environmental data through remote sensing and mapping (ESRI, Idrisi, GRASS) • Statistical models (SPSS, S-Plus, R, Excel)	• Radar plots and profiles • Sectoral impact models • GIS • Rule-based dynamic modelling • Statistical packages (R, Excel)	• Protocols for bottom-up creation of scenarios with stakeholders (Shell scenario group, participatory literature) • Socio-economic scenario tools, such as PoleStar • Global and regional climate scenario archives and downscaling tools • Probabilistic climate forecasts	• Print methods for brochures • Story telling software to integrate narrative, charts, maps and pictures • Integrated GIS interface or scripts

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Challenges in vulnerability research

- Plethora of local studies of vulnerability
  - Place-based and fragmented experience
  - Can we identify key lessons on how to reduce vulnerability?
- Scale linkages
  - between local manifestations of vulnerability and risk construction at more macro scales (unequal trade relations, global environmental change, national policy)
- Identify agency but also its limitations
- Production of tangible policy results to support sustainable development and resilience building
  - Need to act under a high degree of uncertainty
  - How are results communicated and produced?
  - Who are the beneficiaries and target groups of the research?
  - Need to identify generic approaches but avoid undesirable choices
- Consideration of interaction between multiple risks
  - Economic shocks, socio-economic change, environmental risks

Key areas for convergence with other scientific communities

Climate change impacts affect a wide range of natural, economic, political and social activities and processes. Hence, these challenges need to be addressed in a holistic and integrated manner at all scales and political levels and involving all sectors of society.

- **The disaster risk management community is increasingly adopting a more anticipatory and forward-looking approach, bringing it in-line with the longer-term perspective on future vulnerabilities of the climate change community.**
- **Climate change adaptation increasingly places emphasis on improving the capacity of governments and communities to address existing vulnerabilities to current climate variability and climatic extremes, brining it within the remit of the disaster risk management community.**
- **Poverty is both a condition and determinant of vulnerability. Poverty reduction is therefore an essential component of reducing vulnerability to natural hazards and climate change.**
- **Sustainable resource management and biodiversity is important for ecological resilience and livelihood security.**
- **Climate change adaptation and disaster risk management both need to be mainstreamed into sectoral activities and development processes.**

Future research needs to

- continue to develop and improve conceptual approaches to vulnerability assessment
- consider impacts from multiple and interacting environmental and/or socio-economic stresses
- identify hotspots and critical regions: defining and mapping vulnerability
- undertake analysis at scales relevant for coastal planning and management
- understand the environmental, social, economic and institutional causes of existing vulnerabilities to climate variability and climate-related hazards
- understand differential vulnerabilities to socio-economic and environmental change
- assess adaptation options and determine adaptive capacity
- increase the capacity of affected poor people and communities to cope with and adapt to climate change impacts

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LOICZ II Science Plan and Implementation Strategy:

Theme 1: Vulnerability of coastal systems and hazards to human societies

Theme A: Conceptual classification of coastal vulnerability

- **Develop regional indicators to identify ‘hot spots’ and to implement early warning systems.**
- **Describe risk distributions arising from global change by identifying changes in vulnerability and impacts on multiple spatial and temporal scales.**
- **Identify critical thresholds and adaptive capacities in relation to changes in the frequency and magnitude of extreme events.**
- **Assess smaller scale influences of pressures and economic drivers, such as land use change, agricultural practices and demography.**
- **Consider the co-evolution of environmental and social systems in an ecological economics perspective to investigate the interactions between ‘state’ changes in ecosystems and the vulnerability of social systems.**

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LOICZ II Science Plan and Implementation Strategy:

Theme 1: Vulnerability of coastal systems and hazards to human societies

Theme B: Integrated modelling of key biophysical processes and socioeconomic/anthropogenic influences in the coastal zone

- Combine top-down integrated assessments with bottom-up multi-agent systems (MAS).
- Contribute to the further development of existing tools including LOICZView.
- Undertake a global assessment of the key causal pressures of change in the coastal zone.
- Identify the range of environmental and human-induced drivers acting on local and regional to global scales.
- Generate awareness of the distribution and dynamics of risks and levels of uncertainty on hazards affecting goods and services at global, regional and local scales.
- On the regional scale particular attention will be paid to:
  - polar regions - to climate change and effects on ice cover;
  - temperate regions - to the phenomenon of eutrophication (nutrient fluxes), and
  - tropical regions - to soil erosion and changing sediment flows to the coast.

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LOICZ II Science Plan and Implementation Strategy:

Theme 1: Vulnerability of coastal systems and hazards to human societies

Theme C: Identification of management strategies

- **Present results to planners and policymakers to strengthen the science-policy linkage in coastal zone development:**
    - **Identify efficient and effective coping and adaptive strategies**
    - **Present region-specific recommendations for science-policy forums as a basis for regional collaboration and multi-lateral agreements for governance and management of coastal systems, and for the development of regional early warning systems.**

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Products and benefits

- **Development of multiple change and response scenarios.**
- **Development of vulnerability maps.**
- **Development of conceptual diagrams of the world's coastlines, identifying key features, threats/ vulnerability, and management strategies.**

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Thank you!

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