Tyndall Centre for Climate Change Research

Defining and experiencing dangerous climate change

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Understanding what constitutes dangerous climate change is of increasing importance for scientific analysis and for policy debate.[1] Both activities have thus far focused on what we term external definitions of danger. We argue that it is not possible, however, to make progress on defining dangerous climate change or in developing sustainable responses without recognising the central role played by perceptions of danger. There are therefore competing perspectives on dangerous climate change, what we term 'external' and 'internal' definitions of risk. External definitions are usually based on risk analysis of system characteristics of the physical or social world. Internal definitions of danger recognise that to be real, danger has to be either experienced or to be perceived – it is the individual or collective experience or perception of insecurity or lack of safety that constitutes the danger. A robust policy response must appreciate both external and internal definitions of danger.

The Delhi Declaration on Climate Change and Sustainable Development[2], which emerged in October 2002 from the Eighth Conference of the Parties to the United Nations Framework Convention on Climate Change (FCCC) reiterates the need to avoid dangerous climate change as the FCCC's ultimate objective.[3] According to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), however, deciding what constitutes dangerous climate change is a value judgement beyond the remit of the IPCC and perhaps of science itself.[4] Indeed, there is no universally established methodology or process for deciding what constitutes a dangerous level of climate change, and for whom.[5] Nonetheless, implicitly or explicitly, researchers have suggested arbitrary thresholds in climate change, or in the impacts of climate change, which they themselves designate as dangerous, undesirable or to be avoided. Some contrasting examples are shown in Box 1.

BOX 1: Examples of external definitions of dangerous climate change

Danger measured through threshold in physical vulnerability

- Large-scale eradication of coral reef systems [6]
- Disintegration of the West Antarctic Ice Sheet [7]
- Breakdown of the thermohaline circulation [8]
- Qualitative modification of crucial climate-system patterns such as ENSO, NAO [9]
- Climate change exceeding the rate at which biomes can migrate [10]

Danger measured through threshold in social vulnerability

- Irrigation demand exceeding 50 per cent of annual seasonal water usage for agriculture in northern Victoria, Australia [11]
- Depopulation of sovereign atoll countries [12]
- Additional millions of people at risk from water shortage, malaria, hunger and coastal flooding [13]
- Destabilisation of international order by environmental refugees and emergence of conflicts [14]
- World impacts exceeding a threshold percentage of GDP [15]

The research process leading to these various definitions of danger has followed two different paradigms. The more frequently followed paradigm utilises what we term 'top-down' methods.[16] This framework (upper left triangle in Figure 1) follows an essentially linear approach and quantifies indicators of physical vulnerability based on scenarios of future socio-economic change that are used as inputs to a series of hierarchical models. These types

of assessments typically define danger, either globally or locally, in terms of physical measures (e.g., affected crop yield or water availability), threats to the continued function of some part of the non-human world, or in terms of people at risk or reduction in economic welfare. The scenarios used often assume no adaptation will take place as the danger threshold is approached. Sometimes a single adaptation action is assumed and modelled, while a few analyses assume adaptation occurs simply on the basis of rational choice.[17]

The 'bottom-up' approach (as shown by the bottom left triangle in Figure 1) focuses on the social vulnerability of individuals or groups to both existing climate variability and climatic change. This approach tests social and economic theories of the determinants of vulnerability across a region or between socio-economic groups, leading to social indicators of danger and vulnerability such as poverty, lack of access to health or other services, or lack of empowerment.[18] This approach also uses reasoning by analogy, i.e., learning from past experience of how communities have coped with extreme events.[19] In contrast to 'top-down' methods, recognising adaptive capacity is usually implicit in such approaches.

There are also a few attempts to integrate these two approaches to try to derive a more holistic definition of vulnerability for the purposes of adaptation to a changing climate.[20] While recognising the scientific value and policy relevance of these research efforts, we note that all these definitions of danger remain 'external' in the sense that they are observed or modelled according to judgements of individual or collectives of scientists.

But danger can also be defined in terms of insecurity or lack of safety. So, for example, in the context of climate change it is the perceived insecurity arising from realised or anticipated impacts associated with changing extreme weather events, and often immediate threats to life and livelihood, which are of greatest concern to individuals or, collectively, to society. This definition of dangerous climate change is therefore based on psychological, social, moral, institutional and cultural processes that influence perceptions of individuals and societies about what constitutes danger.[21] The perceptions of danger are determined by personal experience, values, information and trust (Figure 1).

These external and internal definitions of dangerous climate change interact with each other. Perceptions of what is dangerous are, to an extent, informed by a technical analysis of risk (external definition), for example as provided by the IPCC in the form of a state-of-the-art assessment of the science of climate change. The amount of information, the legitimacy of who gives the information and the other determinants shown in Figure 1, will transform this external definition into perception of what constitutes dangerous climate change (internal definition). Information on the risk of an individual's house being flooded or discussion about the widespread collapse of coral reefs, for example, do much to formulate perceptions of danger. Conversely, societal or individual perceptions of what constitutes dangerous climate change will have an impact on the way it is researched and externally defined, hence the arrows between the two definitions in Figure 1. A further dimension of this analysis is the role of expectations and how external definitions of danger can change individual behaviour. The prediction that an atoll country would become effectively uninhabitable through reduced land area and water availability, for example, could change behaviour such that resources would be over-exploited making the uninhabitability more likely and the prediction self-fulfilling.[22]

These examples show that definitions of dangerous climate change are socially constructed and involve deeply reflexive processes[23] made up of the interplay between external and internal definitions. Thus climate change science exhibits the classic characteristics of strong uncertainty and of a 'post-normal' science in terms of framing and execution of links to public policy.[24]

Understanding the assumptions implicit in external definitions of dangerous climate change and their implications for perceptions of danger is important for developing a holistic understanding of climate risk management. The internal perceptions of danger have been considerably under-researched in the area of climate change, but the distinction between danger as an 'objective' measure and danger as experienced is well recognised in other areas. In the analysis of the causes and consequences of famine, for example, both external and internal definitions are recognised – the external definitions are often related to food availability while internal definitions relate to perceptions of danger which trigger displacement migration or other extreme coping behaviour.[25] Similarly, in identifying poverty as the basis for social welfare policy, material aspects of poverty are easily quantified to externally define a poverty line, whereas marginalisation and social exclusion derive from how poverty is actually experienced.[26] Comparable distinctions are also made in various areas of public health.[27] In these other areas of societal concern the emphasis on external or internal definitions leads to widely divergent public policy responses. Climate change research needs to learn from these insights if we are to embrace a risk analysis culture[28] to address the problem.

There are a number of methods that can be applied to elicit individual perceptions of risk and dangerous climate change. One approach involves observing behaviour in relation to risk, which in the language of economic decision-making is known as revealed preference.[29] For example, are people moving away from houses in flood-prone areas because of concerns that these could have a higher likelihood of being flooded as a result of climate change? Alternative established psychological risk perception theories, such as social amplification of risk[30] and cultural theory[31] can be applied to the study of dangerous climate change. Ultimately, in an era of postnormal science, we believe in the validity and importance of both internal and external definitions of danger, and further believe that these should be analysed jointly within participatory integrated assessment frameworks.[32]

Externally defined concepts of dangerous climate change, whether implicitly or explicitly formed, are being widely used. We argue that internal definitions of dangerous climate change – 'danger as experienced' – warrants as much attention as external definitions – 'danger as defined'. Because less attention has been given to internal definitions, we have suggested some methods for considering this. The reflexivity between external and internal definitions in particular suggests participatory integrated assessment as a tool of unique insight for identifying what level of climate change might be regarded as dangerous by different communities and constituencies. Defining long-term targets for the Framework Convention will require an appreciation of these different perspectives of danger. We also expect these approaches to contribute to a more holistic, just and democratic management of climate risk.

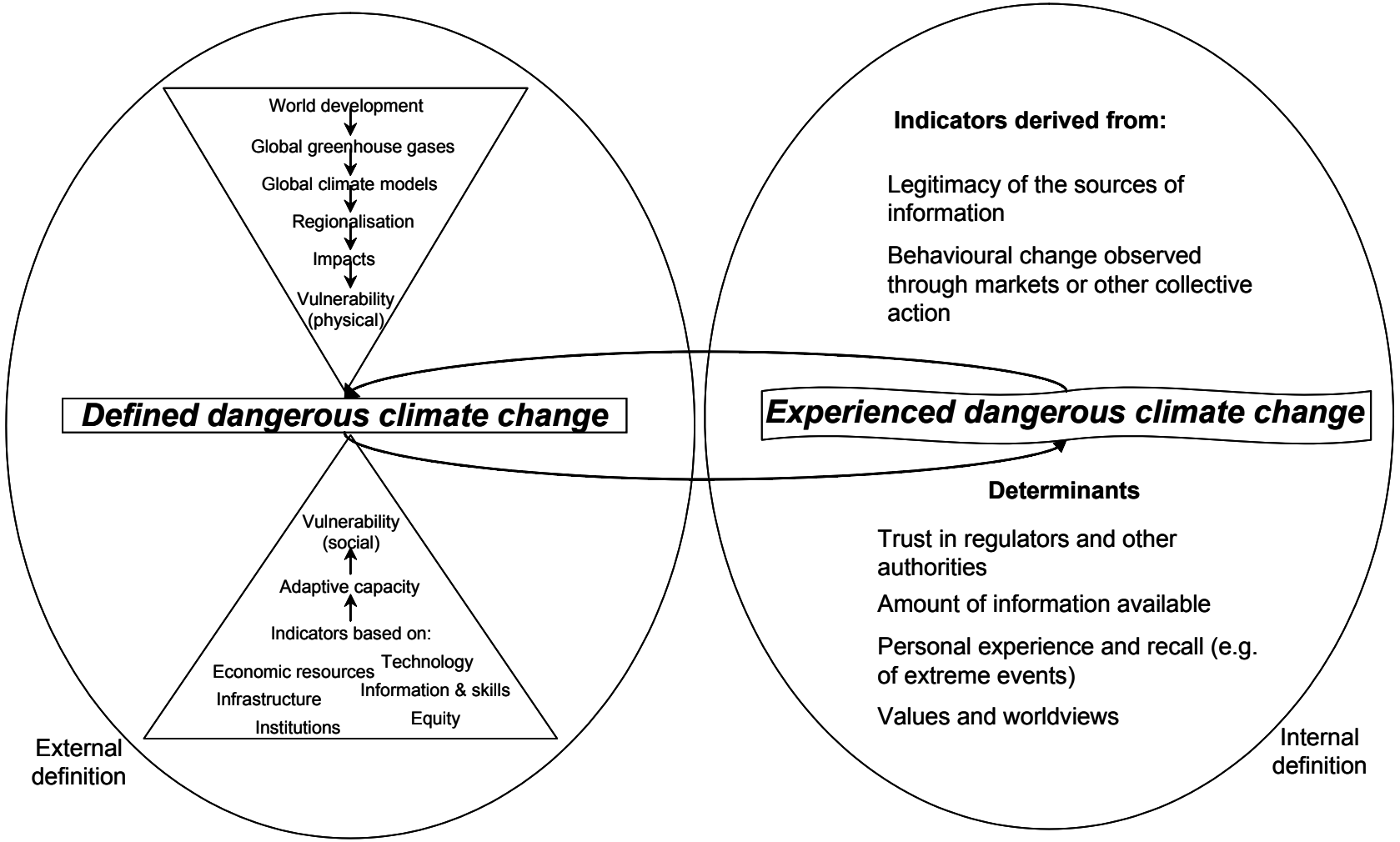

Figure 1. Components of external and internal definitions of dangerous climate change

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[1] cf. Schneider, S. (2001) What is 'dangerous' climate change? *Nature* **411**, 17-19; Schneider, S. (2002) Can we estimate the likelihood of climatic changes at 2100? *Climatic Change* **52**, 441-451.

[2] http://unfccc.int/

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[5] cf. US President George W. Bush speech on global climate change: "no one can say with any certainty what constitutes a dangerous level of warming, and therefore what level must be avoided". http://www.whitehouse.gov/news/releases/2001/06/20010611-2.html

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The inter-disciplinary Tyndall Centre for Climate Change Research undertakes integrated research into the long-term consequences of climate change for society and into the development of sustainable responses that governments, business-leaders and decision-makers can evaluate and implement. Achieving these objectives brings together UK climate scientists, social scientists, engineers and economists in a unique collaborative research effort.

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The Tyndall Centre is named after the 19th century UK scientist John Tyndall, who was the first to prove the Earth's natural greenhouse effect and suggested that slight changes in atmospheric composition could bring about climate variations. In addition, he was committed to improving the quality of science education and knowledge.

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