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BC O'Neil; M Oppenheimer; R Warren; Robert Scholes; E "et al"

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IPCC reasons for concern regarding climate change risks

Brian C. O'Neill[1]*, Michael Oppenheimer[2], Rachel Warren[3], Stephane Hallegatte[4], Robert E. Kopp[5], Hans O. Pörtner[6], Robert Scholes[7], Joern Birkmann[8], Wendy Foden[9], Rachel Licker[2], Katharine J. Mach[10], Phillippe Marbaix[11], Michael D. Mastrandrea[10], Jeff Price[3], Kiyoshi Takahashi[12], Jean-Pascal van Ypersele[11] and Gary Yohe[13]

The reasons for concern framework communicates scientific understanding about risks in relation to varying levels of climate change. The framework, now a cornerstone of the IPCC assessments, aggregates global risks into five categories as a function of global mean temperature change. We review the framework's conceptual basis and the risk judgments made in the most recent IPCC report, confirming those judgments in most cases in the light of more recent literature and identifying their limitations. We point to extensions of the framework that offer complementary climate change metrics to global mean temperature change and better account for possible changes in social and ecological system vulnerability. Further research should systematically evaluate risks under alternative scenarios of future climatic and societal conditions.

The reasons for concern (RFC) framework was developed in the IPCC Third Assessment Report (AR3) to inform discussions relevant to implementation of Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC). Article 2 presents the Convention's long-term objective of avoiding "dangerous anthropogenic interference with the climate system". The RFC framework and the associated Burning Embers diagram illustrating authors' risk judgments have since been widely discussed and used to inform policy decisions. For example, they informed a recent dialog between Parties to the UNFCCC and experts[1,2] on the adequacy of the long-term goal of avoiding a warming of 2 °C relative to pre-industrial temperatures, contributing to a strengthening of that goal in the recent Paris Agreement[3]. Elaborations of the Burning Embers diagram have been used to represent climate impacts and risks at the regional level[4] and for specific systems (for example, ocean systems[5]).

This Review summarizes the conceptual basis for the RFCs (Box 1) and offers an explanation of the reasoning behind associated risk judgments that is complementary to, but goes beyond, the treatment in the IPCC Fifth Assessment Report[6] (AR5). We focus explicitly on the evidence base for transitions from one risk level to the next, incorporate post-AR5 literature in those discussions, and offer thoughts about limitations of the subjective judgments behind each RFC. We also improve the synthesis of RFC-related material across AR5, and in turn provide both a clearer connection to evidence from AR5 that supports the RFC judgments, as well as a comparison of the RFCs to similar approaches employing metrics other than global mean temperature change (GMT) for characterizing risk. Perhaps most importantly, we consider improvements in the framework, particularly emphasizing the dynamic nature of exposure and vulnerability, two key components of risk not sufficiently covered in the current approach.

Reasons for concern

Risk judgments for each RFC are based on the key risk criteria (Box 1) but the relative importance of each varies across RFCs depending on the quality and quantity of information available in the literature. It is also not possible to rely on a single quantitative metric of risk for a given RFC since each one aggregates over a number of different risks. An enhanced Burning Embers diagram (Fig. 1) summarizes the evidence, indicating both individual risks that play important roles in identifying particular risk transitions, as well as overarching key risks relevant in broader terms to each RFC (Table 1). These overarching key risk categories were developed in AR5[6] from risks identified as being of high concern by chapter authors from across IPCC Working Group (WG) II (Supplementary Section 1). Unless otherwise specified, we refer to GMT relative to pre-industrial temperatures (1850–1900). Note that conversions from units used in AR5 can give the appearance of overly precise temperature levels (Supplementary Section 2).

RFC1: Risks to unique and threatened systems. Unique and threatened systems encompass ecological and human systems that (i) have restricted geographic ranges constrained by climate-related conditions and (ii) have high endemism or other distinctive properties. Many of these systems also face exceptional

[1]National Center for Atmospheric Research, Boulder, Colorado 80305, USA. [2]Department of Geosciences and the Woodrow Wilson School of Public and International Affairs, Princeton University, Princeton, New Jersey 08544, USA. [3]Tyndall Centre for Climate Change, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK. [4]Climate Change Group, World Bank, Washington DC 20433, USA. [5]Department of Earth and Planetary Sciences, Rutgers Energy Institute and Institute of Earth, Ocean and Atmospheric Sciences, Rutgers University, New Brunswick, New Jersey 08901, USA. [6]Marine Biology/Ecological and Evolutionary Physiology, Alfred-Wegener-Institute, Bremerhaven D-27570, Germany. [7]University of the Witwatersrand, Johannesburg 2050, South Africa. [8]Institute of Spatial and Regional Planning, University of Stuttgart, Stuttgart 70569, Germany. [9]Department of Botany and Zoology, University of Stellenbosch, Stellenbosch, South Africa. [10]Carnegie Institution for Science, Department of Global Ecology, Stanford, California 94305, USA. [11]Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve B-1348, Belgium. [12]National Institute for Environmental Studies, Tsukuba 305-8506, Japan. [13]Department of Economics, Wesleyan University, Middletown, Connecticut 06459, USA. *e-mail: boneill@ucar.edu

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Erratum: IPCC reasons for concern regarding climate change risks

Brian C. O'Neill, Michael Oppenheimer, Rachel Warren, Stephane Hallegatte, Robert E. Kopp, Hans O. Pörtner, Robert Scholes, Joern Birkmann, Wendy Foden, Rachel Licker, Katharine J. Mach, Phillippe Marbaix, Michael D. Mastrandrea, Jeff Price, Kiyoshi Takahashi, Jean-Pascal van Ypersele and Gary Yohe

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In the print version of this Review, references 6, 9, 10, 19, 22, 26, 32, 35, 36, 46, 54, 68–71, 74, 79, 100, 101 and 102 contained errors. These errors have been corrected in the online version.

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