Global Adaptation to Natural Hazards in Nationally Determined Contributions
Quantifying the extent of adaptation actions and their alignment with global natural hazard risk using disaster data and probabilistic risk modelling

Master Thesis

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Global Adaptation to Natural Hazards in Nationally Determined Contributions

Quantifying the extent of adaptation actions and their alignment with global natural hazard risk using disaster data and probabilistic risk modelling

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A thesis presented for the degree of Master of Science

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Abstract

Throughout the last 50 years, natural hazards have accounted for more than 2.4 tn US$ in economic losses, left 3.7 mio people dead and 7.6 bn affected. Under the UNFCCC, global institutional efforts exist to mitigate such adverse impacts via adaptation intentions specified in Nationally Determined Contributions (NDCs). Yet, the lack of systematic coverage and quantification of these adaptation intentions regarding alignment with empirical risk, scope, costs and benefits prevents identification of adaptation needs, gaps and comparability of efforts among countries.

Drawing on literature research, disaster data from EM-DAT and CLIMADA, a probabilistic risk model, the aim of this thesis is twofold: i) to quantify and contrast empirical monetary and human damages from storms, floods & droughts at national levels globally with respective adaptation intentions in UNFCCC documents; ii) to propose methods to quantitatively capture extent, costs and averted damage to humans of adaptation actions against those hazards at national to global scales.

First, it is shown that ample gaps in risk acknowledgement and adaptation efforts exist within NDCs, NAPAs and NAPs: Countries which specify adaptation measures account for only 2.8 % of global annual storm damage, 17.3 % of flood damage and 8.1 % of drought damage. The thesis points out that the 'UNFCCC picture' is incomplete and biased towards poorer countries, leading to an adaptation focus of countries most exposed to risk in relative terms (per wealth and population), while large monetary damages incurred by richer countries are systematically excluded. Adaptation costs to natural hazards are anecdotal in UNFCCC documents, amounting to 508 mio US$ for storms, 1’747 mio US$ for floods and 970 mio US$ for droughts, which is less than global annual AEDs from these hazards.

Second, it is verified that risks from natural hazards can be captured adequately with the used probabilistic risk model: Simulations of global monetary damages from tropical cyclones at national levels commonly lie in the same order of magnitude as reported by EM-DAT; global human damages (affected and killed people) from tropical cyclones can be modelled using the proposed physical intensity-vs.-impact relationships and vulnerability classifications. Regarding adaptation costs, methodological input is given on the potentials and limitations of an extrapolation approach to predict global costs of technical adaptation measures. Tackling adaptation benefits, it is shown via a case-study that the risk modelling approach can also be used to infer human benefits (averted casualties and deaths) from the implementation of people-centred adaptation measures.

The results of this research i) shed light on trends and gaps in adaptation efforts to natural hazards within the UNFCCC framework, providing a fact-base for need assessments and resource allocation; ii) give suggestions for improving modelling of risks, costs and human benefits of adaptation actions at coarse national scales under information scarcity.