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Climate justice and economic flood damage in the Anthropocene

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Floods are the world's most frequent and damaging natural hazard, and their impacts are projected to intensify under climate change. Yet the relationship between economic flood damage (EFD), greenhouse gas emissions, and economic development remains poorly quantified in global climate-justice debates. Here, we analyse 2,032 flood events across 132 countries (1990–2022) to assess disparities between direct tangible flood losses, historical CO emissions, and GDP. We show that South and Southeast Asia experience a disproportionate share of global EFD, despite contributing minimally to cumulative emissions and having comparatively weak GDP, revealing pronounced inequities in the distribution of climate-related losses.

We evaluate inequality by linking EFD to the GINI index, finding that high-inequality regions (e.g., South America, Sub-Saharan Africa) consistently exhibit elevated EFD. Using negative binomial regression, we quantify the influence of CO responsibility and economic capacity on flood losses. Building on the principle of Common But Differentiated Responsibilities and Respective Capabilities (CBDR-RC), we propose a dual-threshold framework based on (1) historical CO emissions per capita and (2) average GDP per capita. This yields a transparent mechanism for a *flood-focused Loss and Damage Fund (LDF)*.

Our results indicate that 59 countries should be eligible for LDF support, including 100% of LICs, and that 38 countries—primarily high-income and OECD members—should be prioritised as fund contributors. We identify an additional 35 "grey-zone" countries whose rising GDP and emissions challenge static interpretations of climate responsibility.

This study provides the first global, event-level assessment linking flood damages to equity and historical responsibility. It offers a reproducible methodology and a policy-ready framework to operationalise climate justice in loss-and-damage finance, strengthening the scientific basis for negotiations at COP and informing equitable global adaptation strategies.