

# Quantifying Indirect Economic Losses from Extreme Events to Inform Global and Local Adaptation Strategies

## 摘要

气候变化增加了极端天气气候事件发生的范围、频率和强度，带来巨大的经济损失。现有极端事件归因研究主要侧重于对人员和实物资产造成的直接经济损失，往往忽略了波及整个供应链的更广泛的间接损失。本文将灾害数据与归因研究相结合，并采用全球多区域混合投入产出模型来评估人类活动引起的气候变化造成的直接和间接经济损失。研究结果显示，全球干旱、洪涝、风暴事件每年可归因直接损失为 668.9 亿美元，可归因间接损失为 827.7 亿美元，约占灾害损失的 47%。国际贸易和产业关联放大了国外极端事件对国内的影响，中国总归因损失的 15% 源于国外灾害。本研究确定了最需要气候适应投资的风险脆弱行业和地区。研究还表明，对海外适应措施的投资可以间接减轻当地的影响，强调了全球经济应对气候变化的相互关联性。

## 关键词

极端天气气候事件；经济影响；影响归因；气候变化适应；多区域投入产出分析

## Abstract

Extreme weather events, increasingly influenced by anthropogenic climate change, are inflicting substantial economic impacts globally. Existing research on climate change attribution for extreme events has primarily focused on direct economic losses to people and physical assets, often neglecting the broader indirect losses that ripple through the entire supply chain. Here, we combined disaster data with attribution studies and employ a global multi-regional hybrid input-output model to assess both direct and indirect economic losses attributable to anthropogenic climate change. Our findings reveal annual direct attributable losses of 66.89 billion and indirect losses of 82.77 billion, together accounting for approximately 47% of the total losses. International trade and industry linkages significantly amplify the domestic impact of international extreme events, with 15% of China's total attributable losses stemming from disasters abroad. Our assessment identifies risk-vulnerable sectors and regions where climate adaptation investments are most needed. Our study also suggests the investments in overseas adaptation measures can indirectly mitigate local impacts, emphasizing the interconnected nature of global economic resilience against climate change.

## Keywords

Extreme weather events; Economic impact; Impact attribution; Climate adaptation; Multi-regional input-output analysis

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