

# Changes in the occurrence of extreme events at different levels of global warming

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PIK RD II Climate Impacts and Vulnerabilities

## DATA: MULTI-MODEL CLIMATE IMPACT SIMULATIONS

generated in the second round of the Inter-Sectoral Impact Model Intercomparison Project ISIMIP2b. The impact models are forced by climate simulations from three different GCMs (pre-industrial + historical climate + future projections for RCP2.6 and RCP6.0). Socio-economic are assumed to vary according to historical observations (e.g. land use patterns) and held fixed at 2005 levels for the future projections.

## DEFINITION OF EXTREME EVENTS

Event category	Event type	Definition of area affected
River Flood (8)	<b>Confined</b> (topography)	Daily discharge (0.5 x 0.5 resolution) > the pre-industrial 100-year return levels; inundation areas calculated by CaMaFlood.
Tropical cyclone (1)	<b>Confined</b> (extent of wind field)	Fraction of the grid cell exposed to 1-minute sustained hurricane-force winds (>64 kt).
Crop failure (3)	<b>Confined</b> (land-use patterns)	Fraction of the grid cell where maize, wheat, soy or rice is grown and yields fall below the 2.5th percentile of the pre-industrial distribution
Wildfire (5)	<b>Confined</b> (land-use patterns)	Annual aggregate of monthly burnt area fractions simulated by the global vegetation models.
Drought (8)	<b>Extensive</b> (large-scale weather patterns)	Entire grid cell where monthly soil moisture falls below the 2.5th percentile of the pre-industrial distribution for at least 7 consecutive months.
Heat wave (1)	<b>Extensive</b> (large-scale weather patterns)	Combination of a relative indicator for dangerous heat based on temperature and an absolute indicator based on temperature and humidity

## CHANGE IN AREA AFFECTED IN RESPONSE TO GLOBAL MEAN TEMPERATURE CHANGE

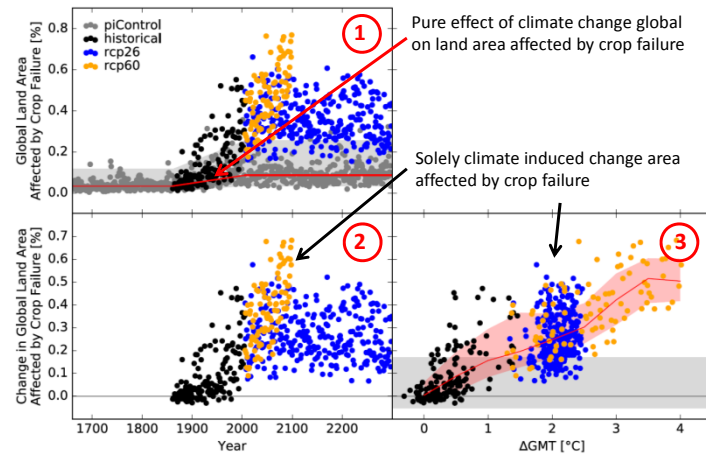


Fig. 1: Derivation of the pure effect of climate change on global land area affected by extreme events; illustration for crop failure simulated by the crop model GEPIC for the global climate model IPSL-CM5A-LR. Step 1: Annual fractions of global land area affected per year. Step 2: Climate induced changes calculated as the difference between scenario data and a smoothed version of the pre-industrial climate reference run (red line). Step 3: Climate induced changes from step 2 plotted against global mean temperature change. Red line described the median.

## RESULTS: CHANGES IN GLOBAL LAND AREA AFFECTED

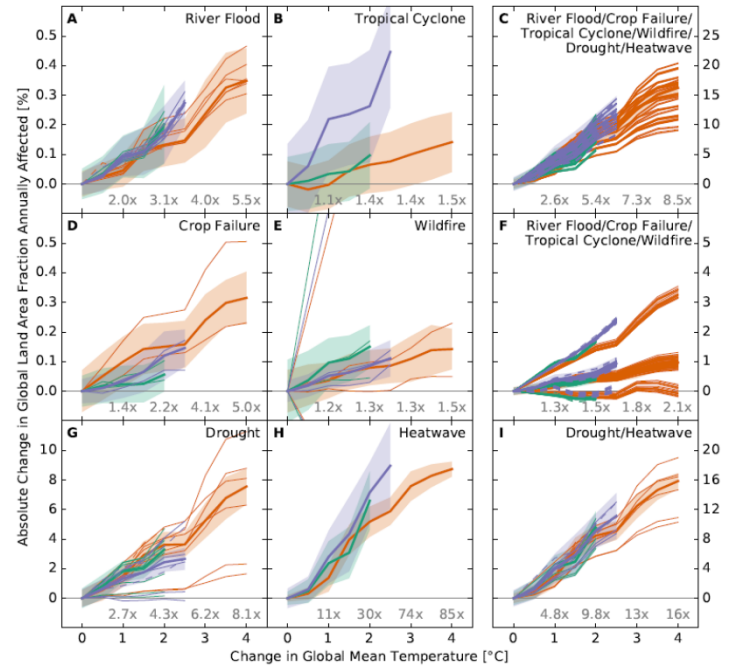


Fig. 2: Change global land area affected by extremes at different levels of global warming. Thin lines: Changes derived from individual climate model-impact model combinations. Thick lines: Multi-impact model median. Shaded areas: Inter-annual variability of the global land area affected. Brown, green and blue represent results for IPSL-CM5A-LR, GFDL-ESM2M and MIROC5, respectively.

## RESULTS: CHANGES IN NATIONAL LAND AREA AFFECTED

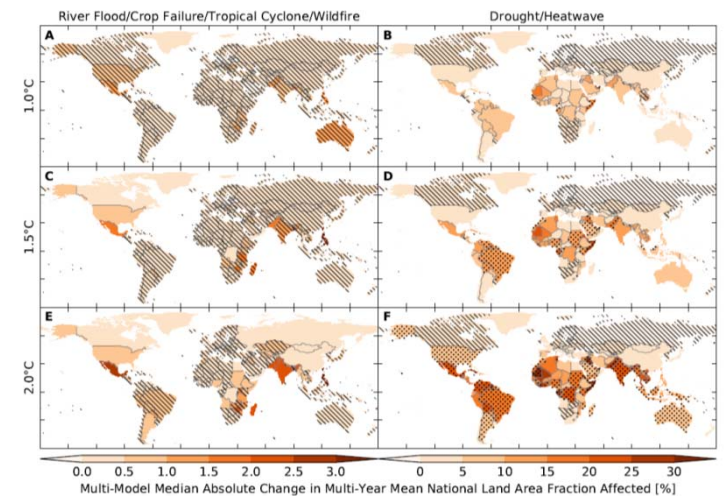


Fig. 3: Change in annual national land area affected by extremes. Color: Multi-model median changes in multi-year mean annual national land area fraction affected. Stippling: Multi-year mean change > 2σ of the year-to-year variability pre-industrial conditions for at least 80% of all GCM-impact model combinations and ≥ 80% of all GCM-impact model combinations agree on sign of the change (large robust change). Hatching: Multi-year mean change < 2σ of the year-to-year variability under pre-industrial conditions for at least 80% of all GCM-impact model combinations (change is not large and this is a robust finding).