Compound climate extremes and exposed population in Africa using CORDEX-CORE projections

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Introduction

- Africa is considered to be one of the most vulnerable continents due to its high exposure and low adaptive capacity related to climate change (Niang et al., 2014).

- The African continent exhibits the second largest population after Asia with high rates of population growth, which is projected to double by the middle of this century (UN DESA).

- Exposure to multiple and compound climate-related risks is projected to increase even for lower global warming (Hoegh-Guldberg et al., 2018).

- Compound climate events are the combination of multiple drivers and/or hazards that contributes to societal or environmental risk (Zscheischler et al., 2018).

- Sector relevance
  - Heatwaves: Agriculture, health, infrastructure
  - Droughts: Agriculture
  - Extreme precipitation: Agriculture, infrastructure
Model data and indices

- **Regional climate projections from CORDEX-CORE AFRICA**
  - REMO (2015) generating daily data with a spatial resolution of 0.22° (~25 km)
  - Time periods 1971-2000 (historical) and 2070-2099 (RCP8.5)
  - Two different forcing data MPI-ESM-LR and NorESM1-M

- **Population data**
  - Global Population Projection Grids Based on Shared Socioeconomic Pathways (SSPs), (Jones and Neill, 2017)
    -> SSP3 (2090) consistent with RCP8.5 (Liu et al., 2017)

- **Indices**
  - Heatwaves: *Number of periods of three or more consecutive days with daily maximum temperature above the 95th percentile of the reference period 1971–2000, but with at least 25°C* (Liu et al., 2017)
  - Droughts: *Number of periods of five or more consecutive days with daily precipitation below 1 mm*
  - Extreme Precipitation: *Wet days (≥ 1 mm) with precipitation higher than the 95 percentile of the reference periods 1971-2000*

- **Compound event**
  Simultaneous occurrence of two hazards (e.g. heatwave/droughts or heatwave/extreme precipitation) at the same day
Heatwaves

Emission scenario RCP8.5

Increase in frequency, max. duration and intensity
Droughts – Dry spells

Emission scenario RCP8.5

Increase/decrease in freq., mainly increase max. duration
Extreme precipitation

Emission scenario RCP8.5

Annual 95th pctl days 1971-2000

Change annual 95th pctl days 2070-2099/1971-2000

Change 95th pctl 2070-2099/1971-2000

Increase/decrease in freq., mainly increase in intensity
Compound event (CE) – heatwave and drought (RCP8.5)

- Annual number of CE per year 1971-2000
- Annual change number of CE per year 2070-2099/1971-2000
- Change max duration of CE 1971-2000

Increase in freq. and max. duration with different regional strengths
Compound event (CE) – heatwave and extreme precipitation (RCP8.5)

Increase in freq. and max. duration with different regional strengths
Compound events (RCP8.5) and exposed population

Population 2015 per grid box

Heatwave and drought
Annual change 2070-2099/1971-2000

Heatwave and extreme precipitation
Period change 2070-2099/1971-2000

Coincidence of strong population growth and strong increase of CE
Summary and outlook

- Increase in CE regarding their frequency, duration, and intensity in RCP8.5 for the end of the century
- Regional differences of CE in the incidence as well as in their intensity
- Hotspots where strong population growth and strong increase of CE coincide are:
  - heatwave and droughts: DR Congo, surrounding region of Lake Victoria and Madagascar
  - heatwave and extreme precipitation: DR Congo, south-eastern Africa and Madagascar

Next steps

- Usage of the whole CORDEX-CORE database to apply the ensemble approach
- Analysing the low emission scenario RCP2.6 together with other SSPs
- Time window phasing analysis of CE
Thank you for your attention!
Droughts – Dry days

Emission scenario RCP8.5

Mainly increase in freq. and max. cons. dry days for sub-Saharan regions