Climate impact hotspot mapping at the regional to local level

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RU 4 | Topic 4

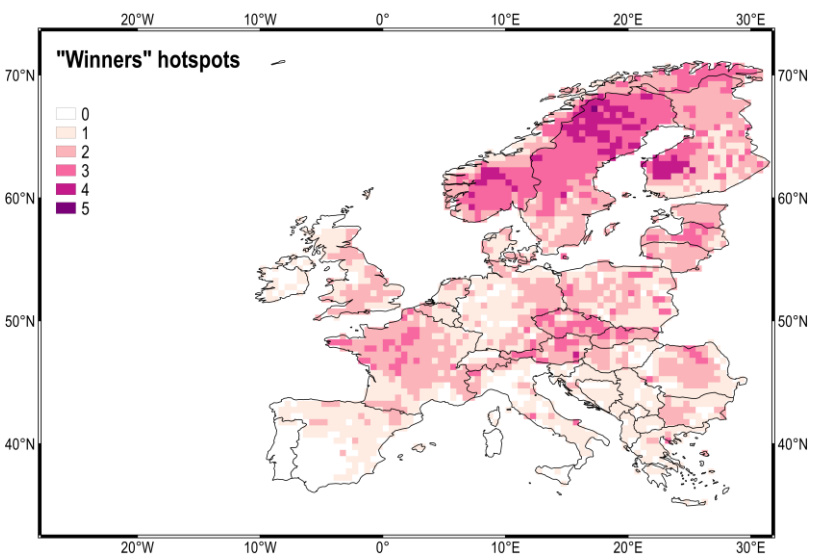
Climate impact “winners” and “losers” in a two degree world

Coordinated by GERICS (Prof. Jacob, PI)

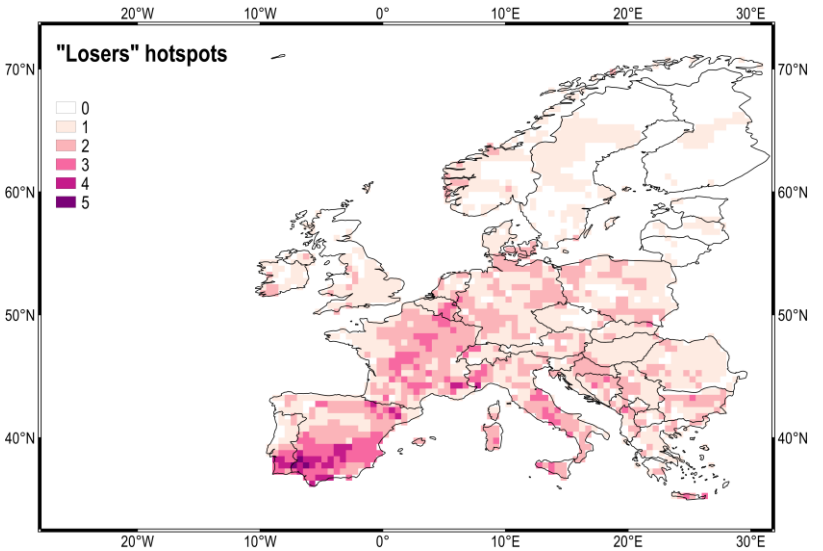
Identifying climate impact hotspots

Climate impact metric	Impact models used	Ensemble size
Hydrological drought (1 in 10 year return period low flow levels)	Two process models (E-Hype and LisFlood)	22
Floods (1 in 10 year return period)	Three process models (E-Hype, LisFlood, and VIC)	33
Cooling water	One process model (VIC)	5
Crop yield (winter wheat)	Two process models (EPIC, LPJmL)	10
Net primary production	Two process models (CLM4.0-CN, LPJmL)	10
Soil organic matter	Two process models (CLM4.0-CN, LPJmL)	10
Tourism summer VaR95	Regression model	9
Tourism winter VaR95	Regression model	9

Climate impact “winners” in a two degree world



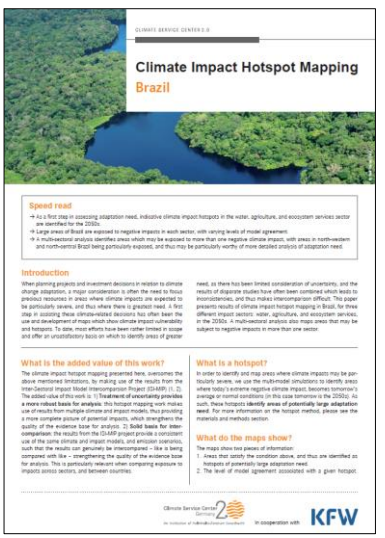
Climate impact “losers” in a two degree world

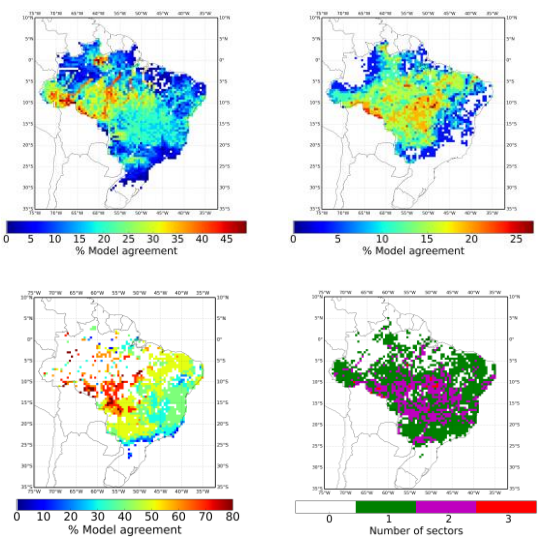


Significance

Selected for publication in EEA (2017) report ‘Climate change, impacts and vulnerability in Europe 2016’ → informs EU adaptation strategy

Climate impact hotspot mapping for the KfW





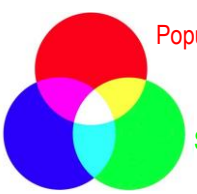
Visualizing changes in climate indices in a warmer world

Method

- Utilizes the RGB colorspace and additive mixing to provide a simple but rapid visualization of areas of overlap
- Criteria defined for identification of hotspots (meaningful changes)

Population density > 100/km^2

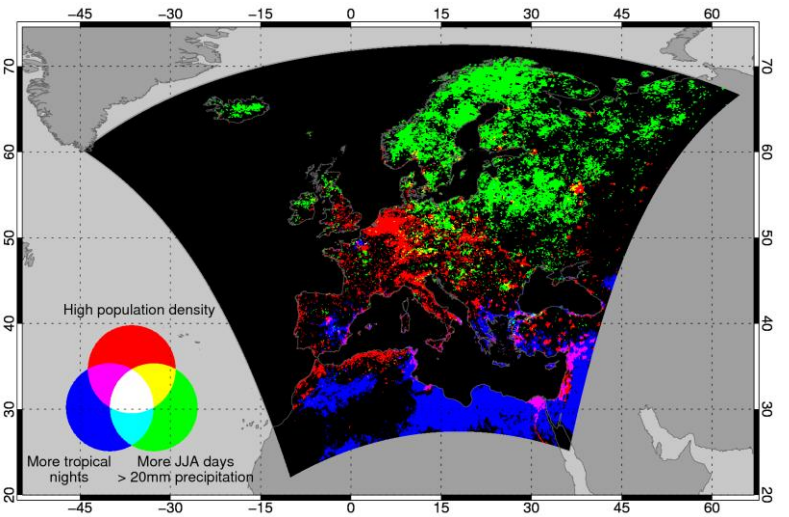
Number of tropical nights Δ > 2σ



Summer heavy rainfall days (R20mm) > 10% increase

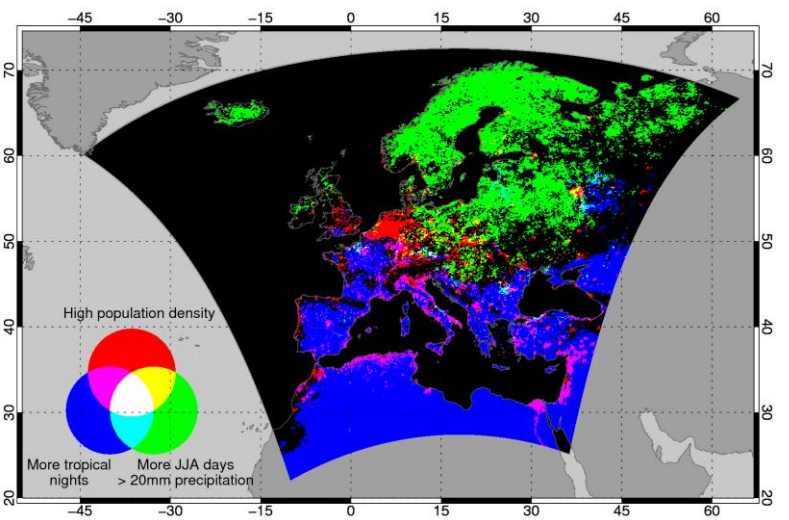
- Implemented with a large ensemble of EURO-CORDEX data (11km spatial resolution)
- Robust results: >66% simulations must agree that the criterion is satisifed for each climate index
- Applied in the context of differential changes in 1.5, 2, and 3 degrees C warmer worlds

Changes in a +1.5°C warmer world (w.r.t. pre-industrial)



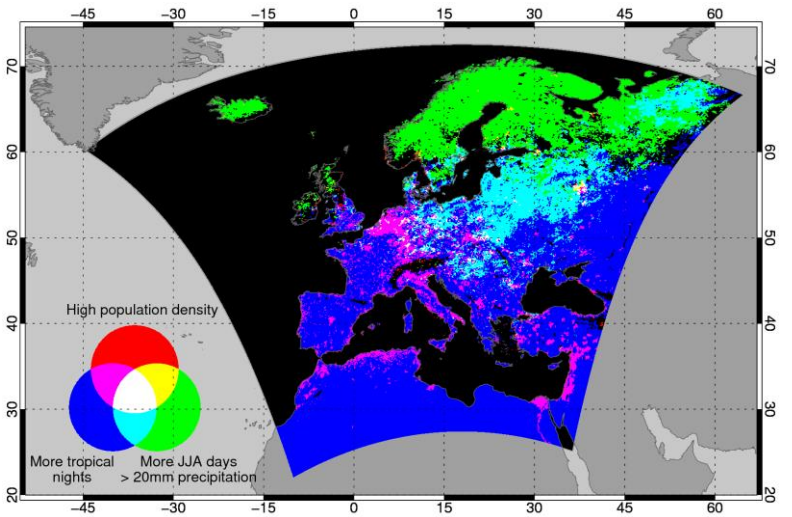
Source: Pfeifer *et al.* (2017) submitted

Changes in a +2.0°C warmer world (w.r.t. pre-industrial)



Source: Pfeifer *et al.* (2017) submitted

Changes in a +3.0°C warmer world (w.r.t. pre-industrial)



Source: Pfeifer *et al.* (2017) submitted

Papers

Pfeifer et al., 2015, Atmosphere
Pfeifer et al., 2017, submitted to Regional Environmental Change

Summary

- Performed one of the most comprehensive assessments of the coincidence of multiple climate impacts in Europe in a +2°C world
  - Innovative multi-model approach to the quantification of uncertainty builds towards robust knowledge
  - Strong north/south gradient in the spatial distribution of the “winners” and “losers”
  - Provides a starting point for more detailed analysis of cross-sectoral feedbacks and interactions for adaptation planning
- Apply state-of-the-art approaches to dealing with uncertainty in climate indices and climate impacts, made transparent to users in products
- Policy relevant work that has influence in ‘real world’ adaptation policy and planning

Supplementary slides

Identifying climate impact hotspots

Climate impact	"Winner" criterion	"Loser" criterion
Hydrological drought (1 in 10 year return period low flow levels)	>10% increase	>10% decrease
Floods (1 in 10 year return period)	>10% decrease	>10% increase
Cooling water	>10% decrease in the number of days when 23°C threshold is exceeded	>10% increase in the number of days when 23°C threshold is exceeded
Crop yield (winter wheat)	>10% increase	>10% decrease
Net primary production	>10% increase	>10% decrease
Soil organic matter	>10% increase	>10% decrease
Tourism summer VaR95	>10% decrease	>10% increase
Tourism winter VaR95	>10% decrease	>10% increase

RCM/GCM pairs used in IMPACT2C

RCM/GCM pair	Time period when GCM reaches 2°C above pre-industrial
RCP2.6	
SMHI-RCA4 / EC-EARTH-r12	2 degree period not reached (2070-2099 used)
CSC-REMO / MPI-ESM-LR-r1	2 degree period not reached (2070-2099 used)
RCP4.5	
CSC-REMO / MPI-ESM-LR-r1	2050-2079
SMHI-RCA4 / EC-EARTH-r12	2042-2071
SMHI-RCA4 / HadGEM2-ES-r1	2023-2052
IPSL.INERIS-WRF331F / IPSL-CM5A-MR-r1	2028-2057
KNMI-RACMO22E / EC-EARTH-r12	2042-2071
RCP8.5	
CSC-REMO / MPI-ESM-LR-r1	2030-2059
KNMI-RACMO22E / EC-EARTH-r1	2028-2057
SMHI-RCA4 / HadGEM2-ES-r1	2016-2045
SMHI-RCA4 / EC-EARTH-r12	2027-2056