

# Climate impact hotspot mapping at the regional to local level

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

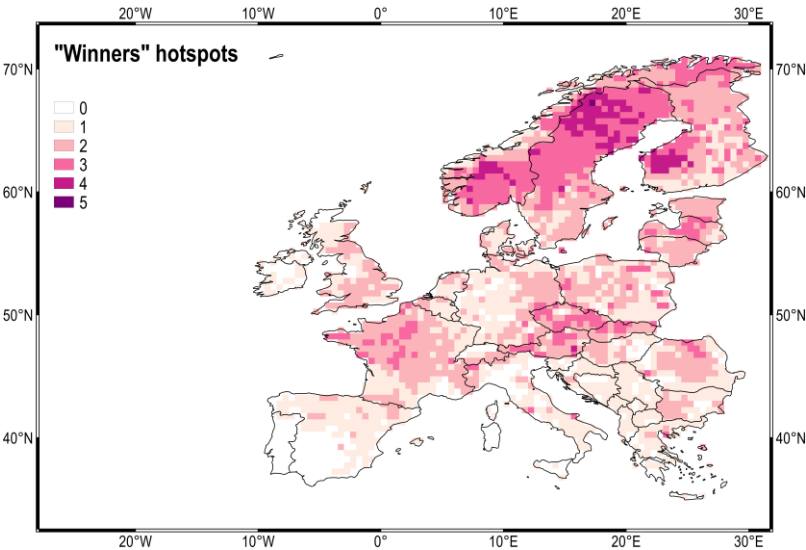


Coordinated by GERICS (Prof. Jacob, PI)

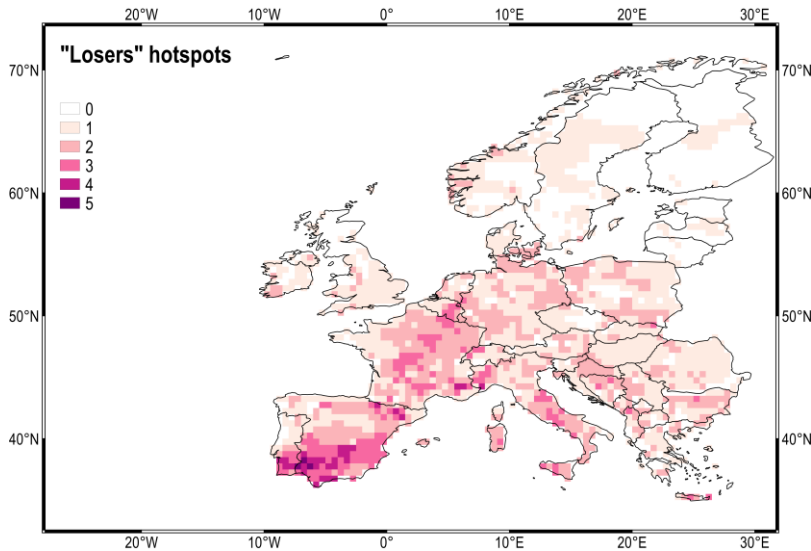
■ Identifying climate impact hotspots

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

CLIMATE SERVICE CENTER 2  
Climate Impact Hotspot Mapping  
Brazil

**Speed read**

- As a first step in assessing adaptation need, indicative climate impact hotspots in the water, agriculture, and ecosystem services sector are identified for the 2050s.
- Large areas of Brazil are exposed to negative impacts in each sector, with varying levels of model agreement.
- A multi-sector analysis identifies areas which may be exposed to more than one negative climate impact, with areas in north-eastern and north-central Brazil being particularly exposed, and thus may be particularly worthy of more detailed analysis of adaptation need.

**Introduction**

When planning projects and investment decisions in relation to climate change adaptation, a major consideration is often the need to focus projects/resources in areas where climate impacts are expected to be particularly severe, and thus where there is greatest need. A first step in supporting these climate-related decisions has often been the use and development of maps which show climate impact vulnerability and hotspots. To date, most efforts have been either limited to single or a few sectors, or have been based on a limited number of models and/or on a non-scientific basis on which to identify areas of greater need, as there has been limited consideration of uncertainty, and the results of disparate studies have often been combined which leads to inconsistencies, and thus makes interpretation difficult. This paper presents results of climate impact hotspot mapping in Brazil, for three different impact sectors: water, agriculture, and ecosystem services, in the 2050s. A multi-sector analysis also maps areas that may be subject to negative impacts in more than one sector.

**What is the added value of this work?**

The climate impact hotspot mapping presented here, synthesizes the above mentioned information, by making use of the results from the multi-sector impact model intercomparison project (2040-1), (2). The added value of this work is: 1) Treatment of uncertainty provides a more robust basis for analysis; this hotspot mapping work makes use of results from multiple climate and impact models, thus providing a more complete picture of potential impacts, which strengthens the quality of the evidence base for analysis; 2) Solid basis for decision comparison: the results from the (2)IMP project provide a consistent use of the same climate and impact models, and analysis techniques, such that the results can generally be interpreted - like a being compared with like - strengthening the quality of the evidence base for analysis. This particularly relevant when comparing exposure to impacts across sectors, and between countries.

**What is a hotspot?**

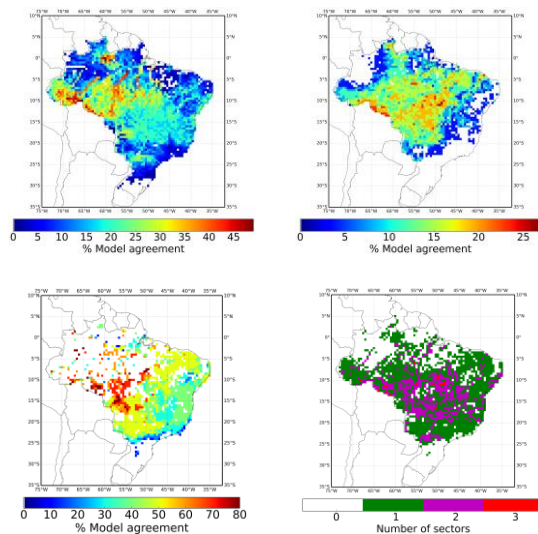
In order to identify and map areas where climate impacts may be particularly severe, we use the multi-model simulations to identify areas where today's extreme negative climate impacts, becoming tomorrow's average or normal conditions in this case between the 2020s, as such, these hotspots identify areas of potentially large adaptation need. For more information on the hotspot method, please see the materials and methods section.

**What do the maps show?**

The maps show two areas of information:

- 1) Areas that are exposed to the negative impacts, and thus are identified as hotspots of potentially large adaptation need.
- 2) The level of model agreement associated with a given hotspot.

Climate Service Center 2  
in cooperation with KfW

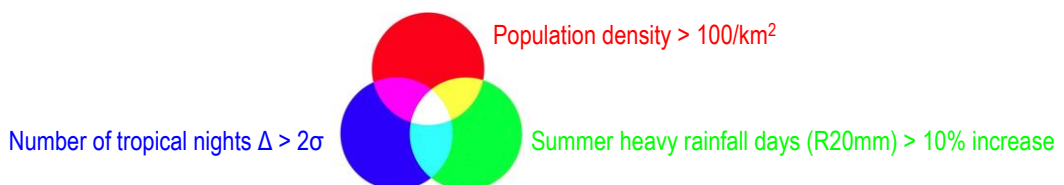




# Visualizing changes in climate indices in a warmer world

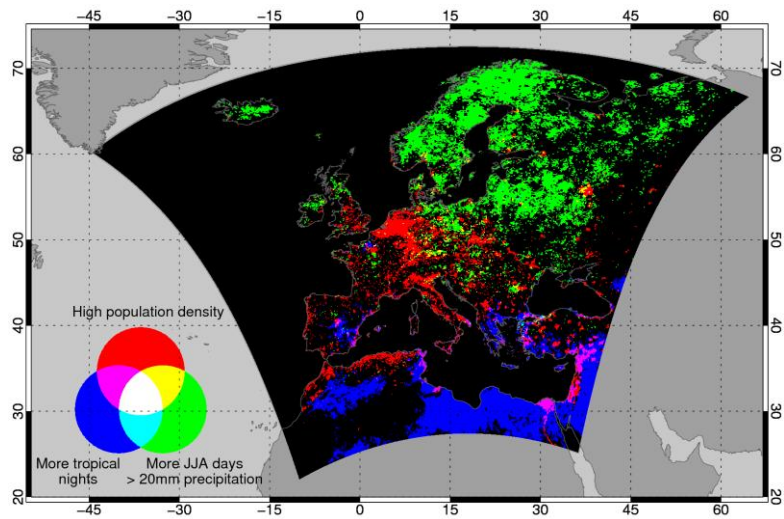
## Method

- 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)



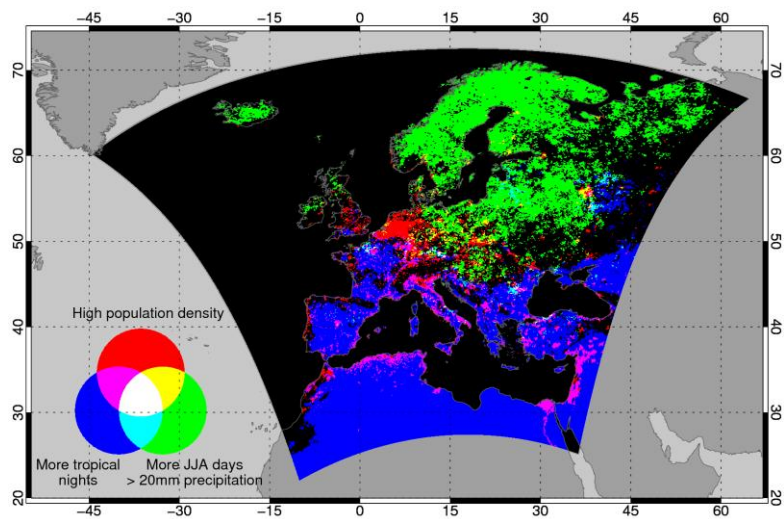
- Implemented with a large ensemble of EURO-CORDEX data (11km spatial resolution)
- Robust results: >66% simulations must agree that the criterion is satisfied for each climate index
- Applied in the context of differential changes in 1.5, 2, and 3 degrees C warmer worlds

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



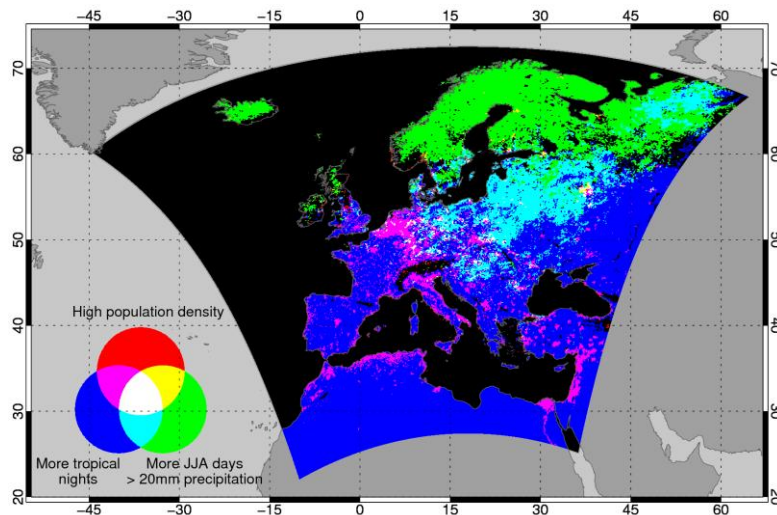
Source: Pfeifer *et al.* (2017) submitted

## ■ 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
<b>Hydrological drought</b> (1 in 10 year return period low flow levels)	>10% increase	>10% decrease
<b>Floods</b> (1 in 10 year return period)	>10% decrease	>10% increase
<b>Cooling water</b>	>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
<b>Crop yield</b> (winter wheat)	>10% increase	>10% decrease
<b>Net primary production</b>	>10% increase	>10% decrease
<b>Soil organic matter</b>	>10% increase	>10% decrease
<b>Tourism summer VaR95</b>	>10% decrease	>10% increase
<b>Tourism winter VaR95</b>	>10% decrease	>10% increase

# RCM/GCM pairs used in IMPACT2C

RCM/GCM pair	Time period when GCM reaches 2°C above pre-industrial
<b>RCP2.6</b>	
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)
<b>RCP4.5</b>	
CSC-REMO / MPI-ESM-LR-r1	2050-2079
SMHI-RCA4 / EC-EARTH-r12	2042-2071
SMHI-RCA4 / HadGEM2-ES-r1	2023-2052
IPSL-INNERIS-WRF331F / IPSL-CM5A-MR-r1	2028-2057
KNMI-RACMO22E / EC-EARTH-r12	2042-2071
<b>RCP8.5</b>	
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