



# Projected increases in population exposure to droughts

in the Iberian Peninsula under 1.5° and 2°C Global Warming Levels



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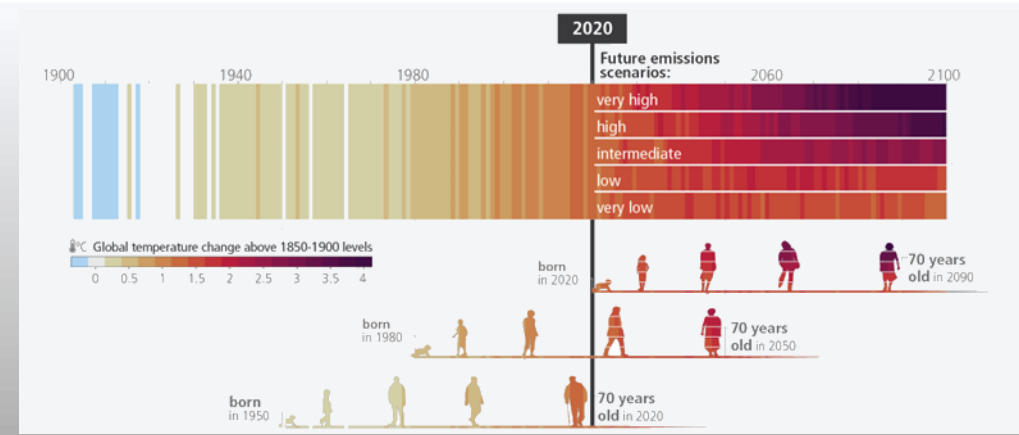


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# MOTIVATION

## EXTREME EVENTS UNDER CLIMATE CHANGE CONDITIONS



- Record-breaking natural hazards occur regularly throughout the world, leading to a variety of impacts
- Since 1970 there were more than 11000 reported disasters (2 million deaths and US\$ 3.64 trillion in losses)
- Droughts are one of the top disasters in terms of human losses, with uneven impacts throughout the world and a high likelihood that anthropogenic climate forcing will increase economic inequality between countries

**As global warming increases, the likelihood of further large-droughts also rises**

The generation born in 2020 will suffer far more than previous generations

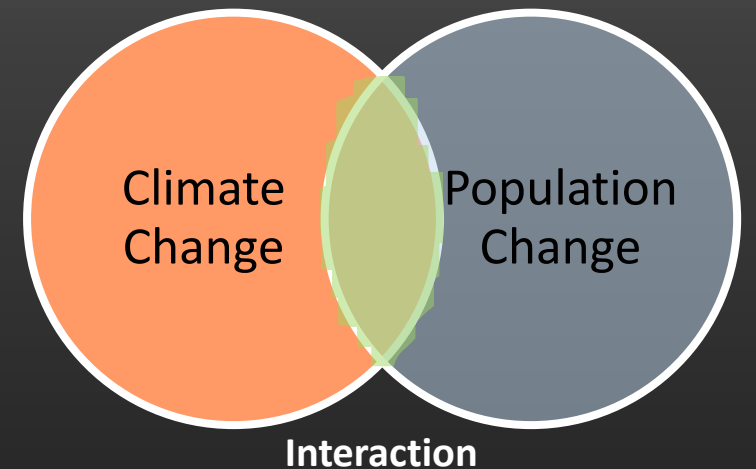
# GOAL

## RESEARCH QUESTIONS



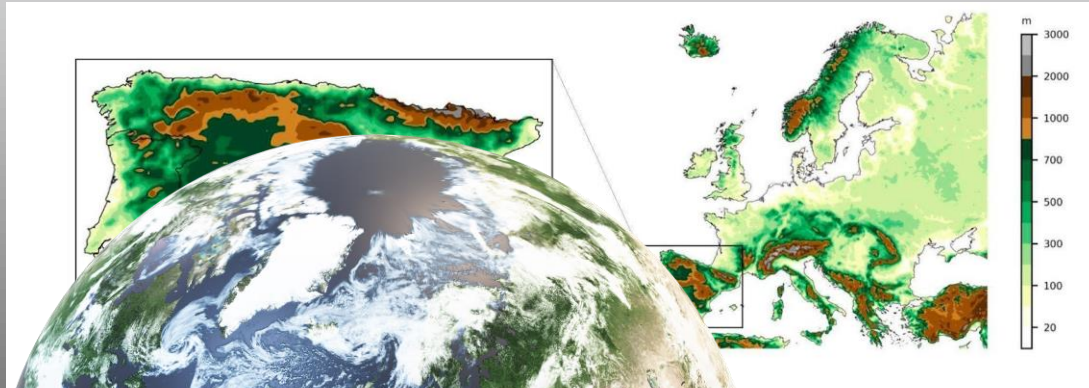
## What is the projected population exposure to droughts in the IP?

- Historical, 1.5° and 2°C Global Warming Levels (GWL) and End-of-the-Century
- **Extreme**, **Severe** and **Moderate** Drought
- RCP2.6, RCP4.5 and RCP8.5
- What is contributing more?



# DATA AND METHODS

## EURO-CORDEX



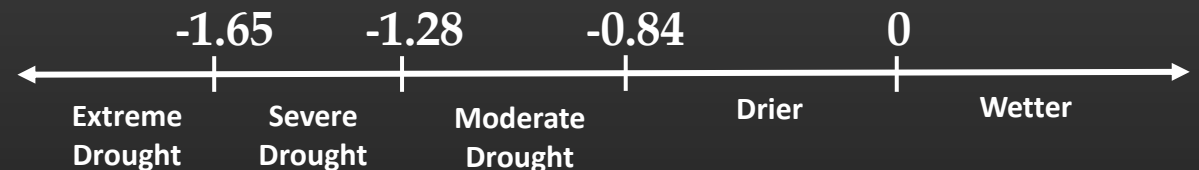
		W1.5	GWL2.0
		2029	2043
		2029	2043
		2019	2035
		2019	2035
		2019	2035
		2024	2037
		2024	2037
KNMI	ES	2024	2037
SMHI		2024	2037
MPI	REMO2009-MPI-ESM-LR (r1)	2016	2032
SMHI	RCA4-MPI-ESM-LR	2016	2032
GERICS	REMO2015-NCC-NorESM1-M	2033	2048
SMHI	RCA4-NCC-NorESM1-M	2033	2048

## Weighted multi-variable multi-model ensemble

- Horizontal resolution: 0.11° from CMIP5
- Historical period: 1971 to 2000
- Future: 2011 to 2100
- RCP2.6, RCP4.5, RCP8.5
- Daily total precipitation
- 2-metre maximum and minimum daily temperatures

## DROUGHTS

Computation of **SPI** and **SPEI**  
 (3-, 6-, 12-months)  
 Hargreaves equation  
 Gamma and log-logistic distribution functions  
 L-moment method and gaussian kernel function



(Agnew et al., 2000)

# DATA AND METHODS

## Population

- Population data for Portugal and Spain
  - The World Bank (before 2011)
  - Eurostat statistics
  - Eurostat EUROPOP2019

### Aggregated population

	Year							
	1985	2016	2019	2025	2030	2035	2040	2080
Population (million)	48.5	56.8	57.2	58.5	58.8	59.1	59.2	54.5

### Population exposure to drought

$$E = \frac{\sum_{i=1}^{30} \text{drought}_i \times P}{30}$$

$$\delta E = \frac{E_{\text{fut}} - E_{\text{hist}}}{E_{\text{hist}}} \times 100$$

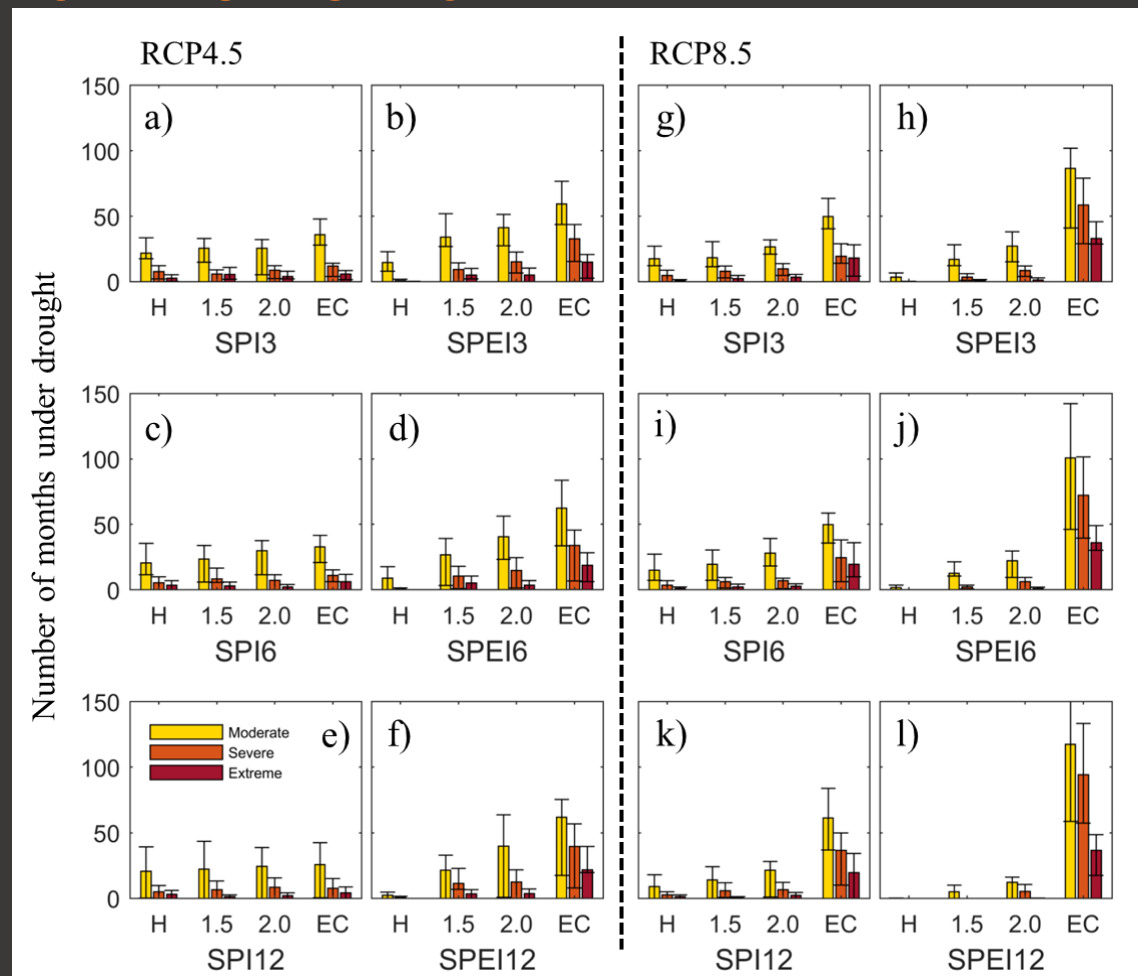
$$\Delta E = \underbrace{D_H \times \Delta P}_{\Psi_{\text{pop}}} + \underbrace{P_H \times \Delta D}_{\Psi_{\text{clim}}} + \underbrace{\Delta P \times \Delta D}_{\Psi_{\text{int}}}$$



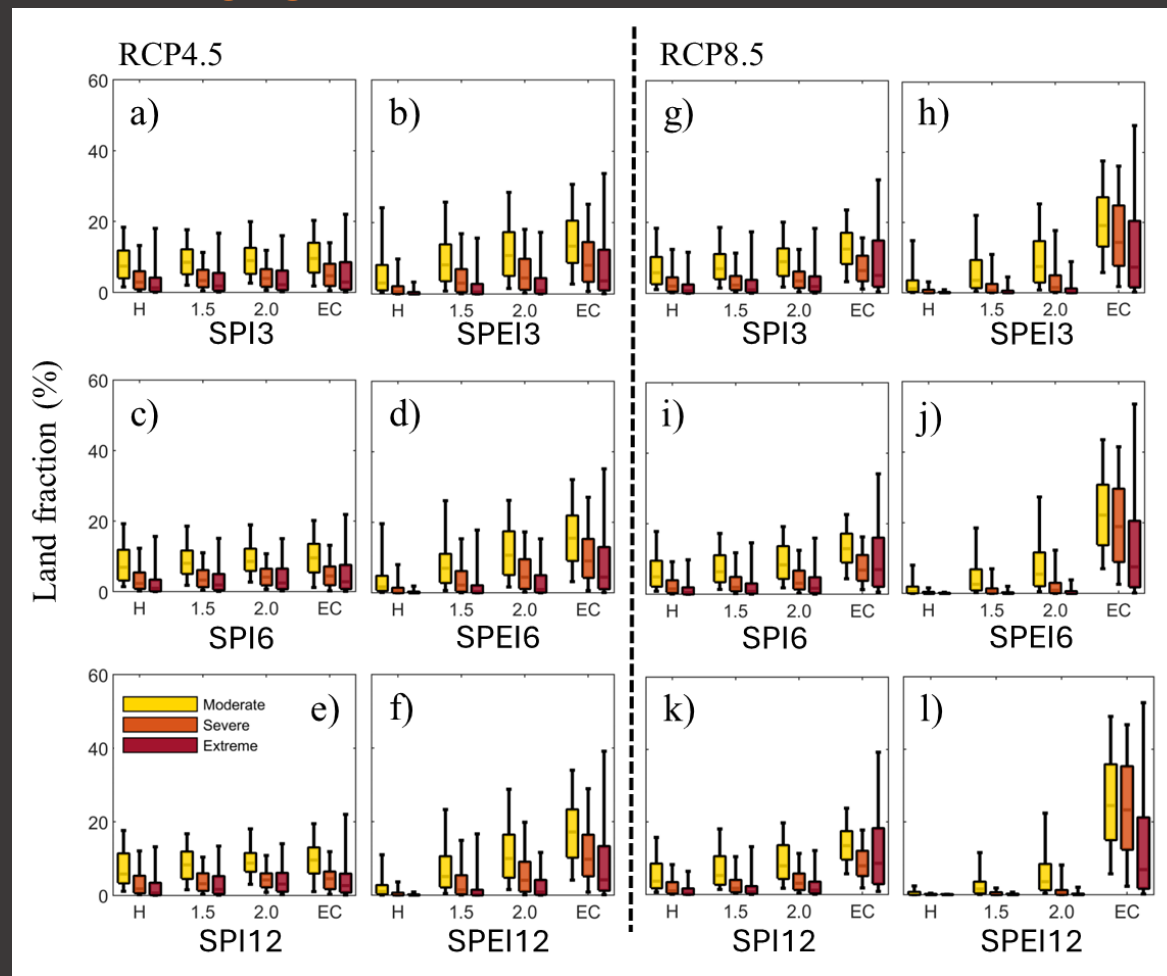
- Rise in the number of months under drought conditions with increasing GWL
- Substantial increase in the likelihood of more frequent and intense droughts
- Temperature's pivotal role

# RESULTS

## NUMBER OF MONTHS



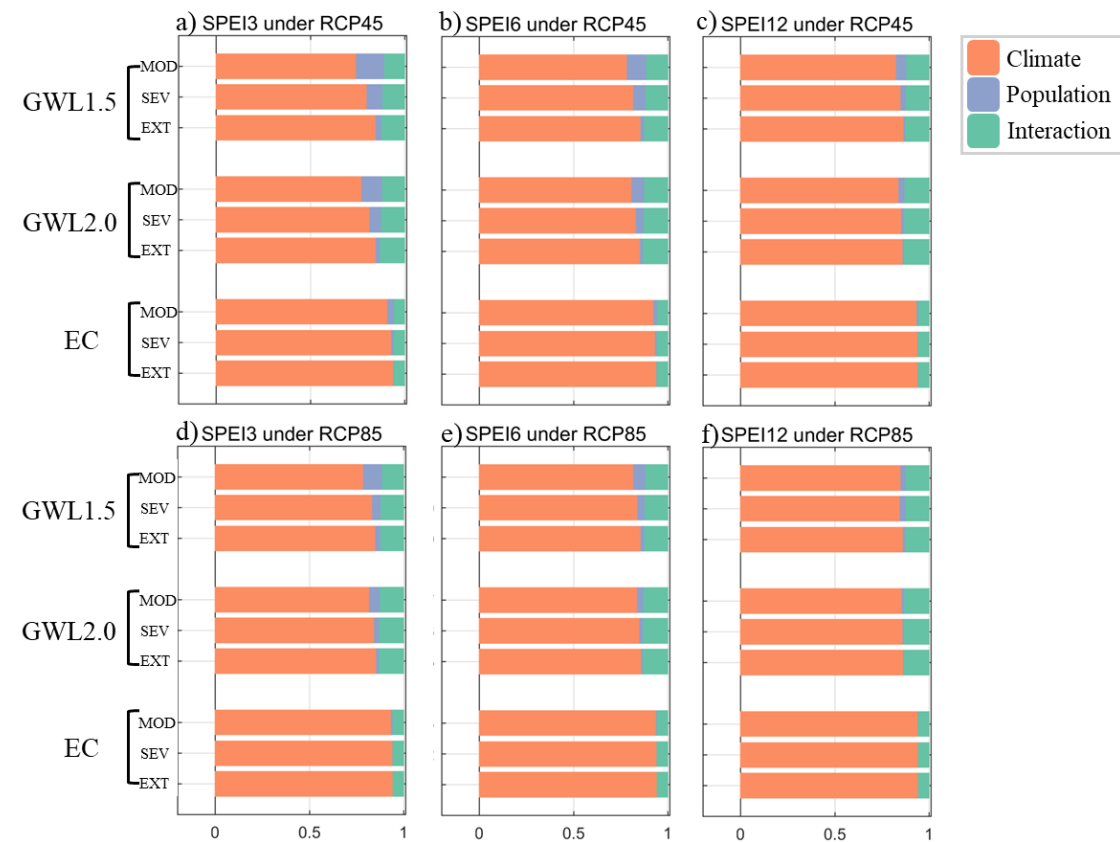
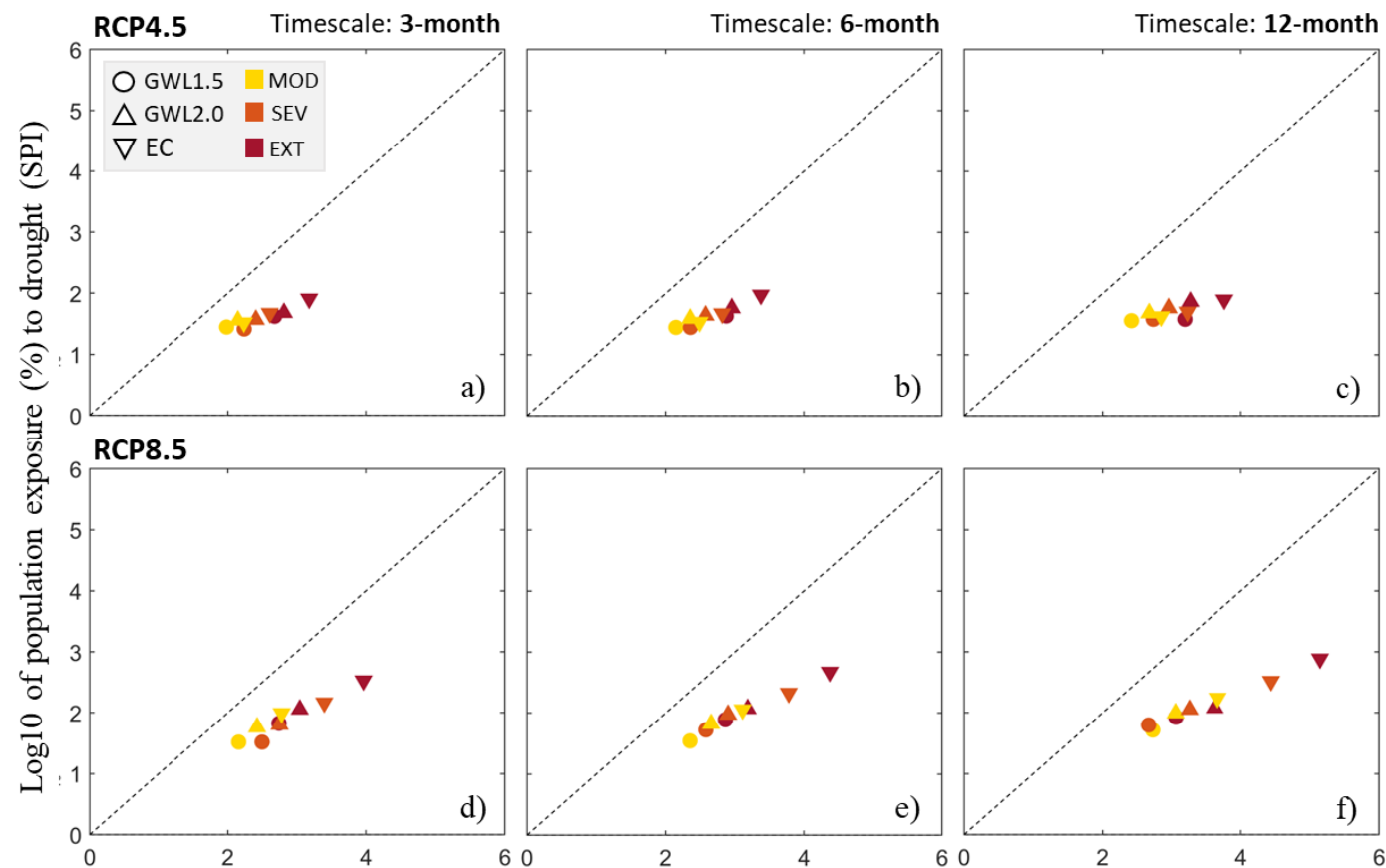
## LAND FRACTION



- Significant increase in population exposure to drought (RCP8.5 scenario and the GWL2.0)
- Climate change is the dominant factor
- More aggressive emission reduction efforts (RCP2.6) lead to a considerable reduction in population exposure compared to the highest emission scenarios (RCP4.5 and RCP8.5)

# RESULTS

## EXPOSURE



# FINAL REMARKS



- Escalating impacts associated with drought in the IP under different warming scenarios
- Climate change is clearly the dominant factor contributing to increased drought exposure
- Emphasis on the NEED TO LIMIT GLOBAL WARMING BELOW 1.5 °C to mitigate the adverse impacts on ecosystems and human populations
- The comprehensive assessment of drought conditions, considering both land fraction and population exposure, provides a robust foundation for informed decision-making and effective climate resilience strategies in the face of a changing climate



And what about the effects of **global warming** on **compound events**?



THANK YOU!



Any questions?

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An outlook into Iberia's population exposure to hot and dry extreme weather events at the end of the century

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