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Agroscope

Spatial and temporal patterns of agriculturally relevant extreme events in Europe

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DG Lunchtime Session, 20.09.2016

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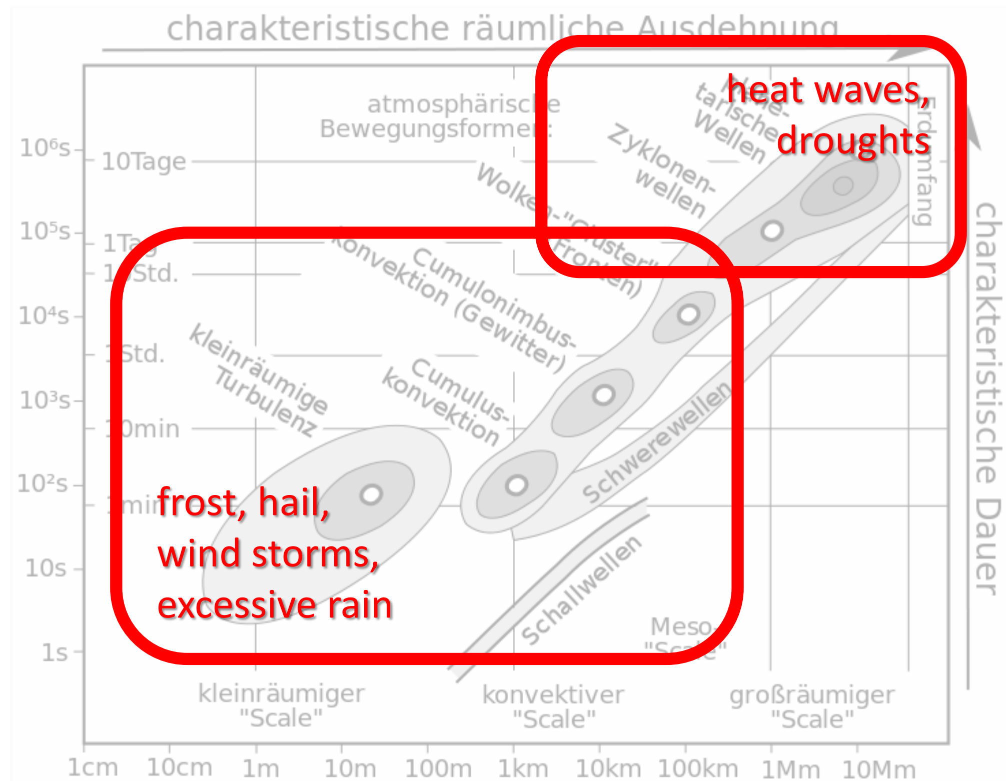
agriculture facing extreme climatic events

Agriculturally relevant extremes

- frost
- hail
- wind storms
- excessive rain
- heat waves
- droughts



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Indices

Type of event	Index	Range	Reference
Drought	$ARID = 1 - \frac{T_a}{T_p}$	[0, 1]	Woli et al. (2012)
	Prob. leaf growth inhibition = $ARID$ > threshold_{LGI}	[0, 1]	
	Prob. root growth inhibition = $ARID$ > threshold_{RGI}	[0, 1]	
	$FU = -\frac{\sum P}{\sum ET_0} + \left[1 + \left(\frac{\sum P}{\sum ET_0}\right)^w\right]^{(1/w)}$	[0, 1]	Fu (1981); Zhang et al. (2008)
Heat	$HSI = \begin{cases} 1 & \text{if } T_{eff} \geq T_{lim} \\ \frac{T_{eff} - T_{cr}}{T_{lim} - T_{cr}} & \text{if } T_{cr} \leq T_{eff} < T_{lim} \\ 0 & \text{if } T_{eff} < T_{cr} \end{cases}$	[0, 1]	Deryng et al. (2014)
	Prob. hot days = Prob. $T_{max} > T_{cr}$	[0, 1]	

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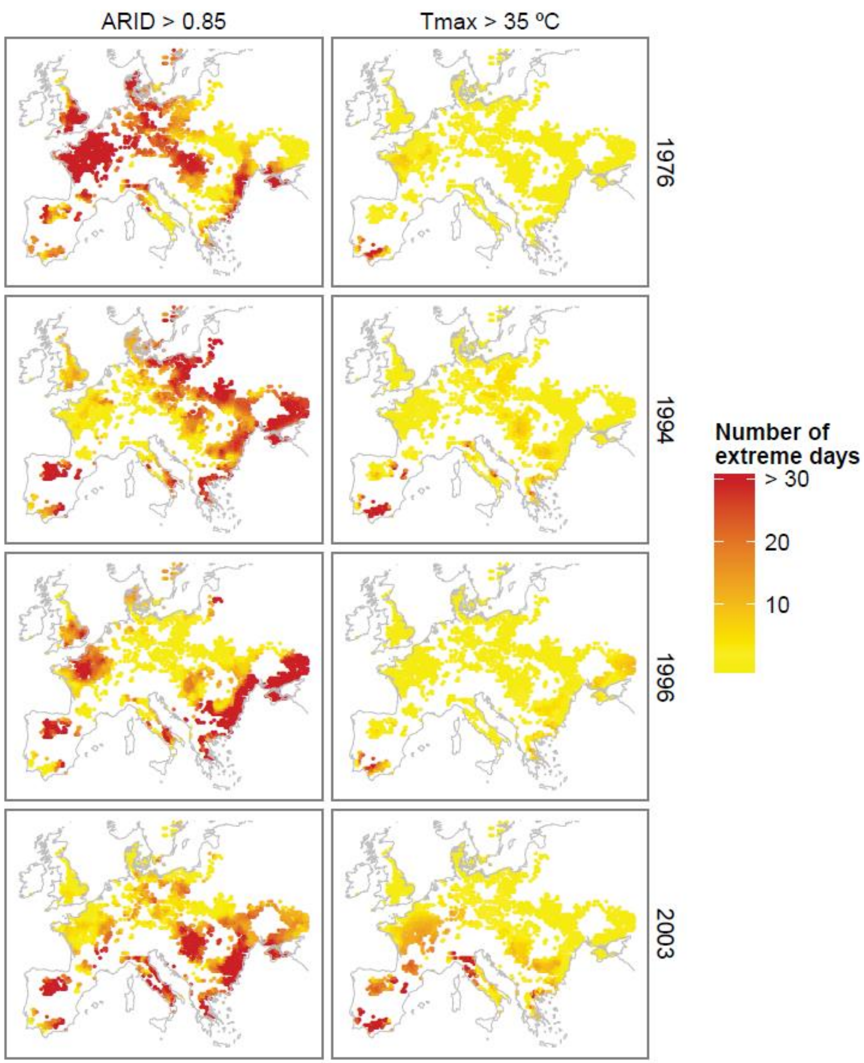
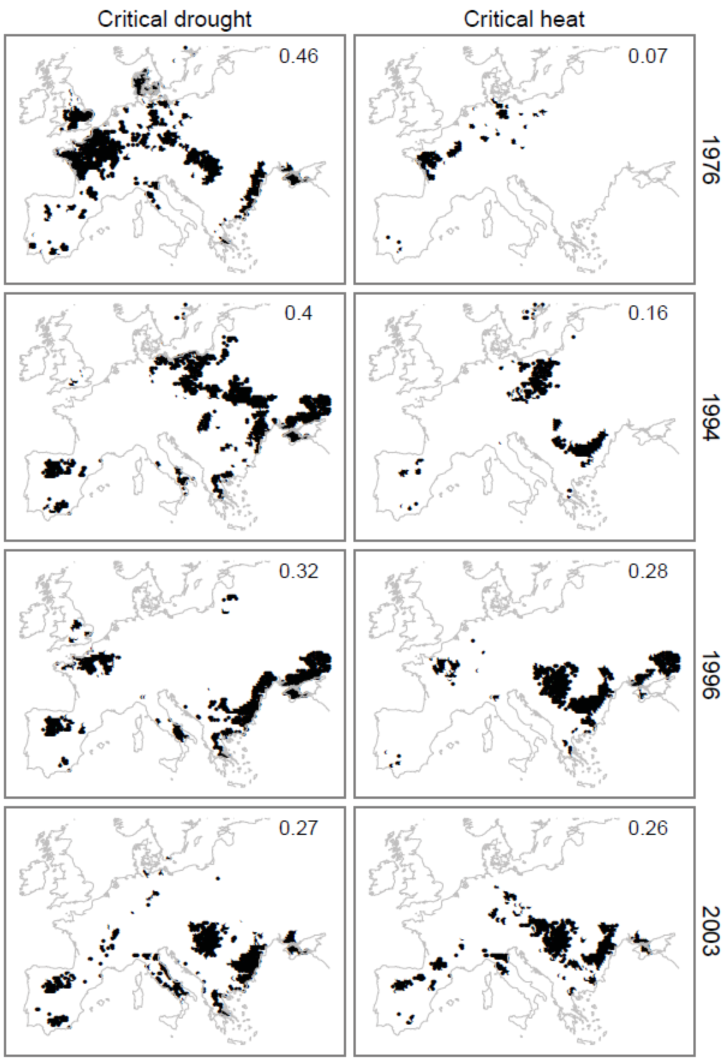
Spatial analysis





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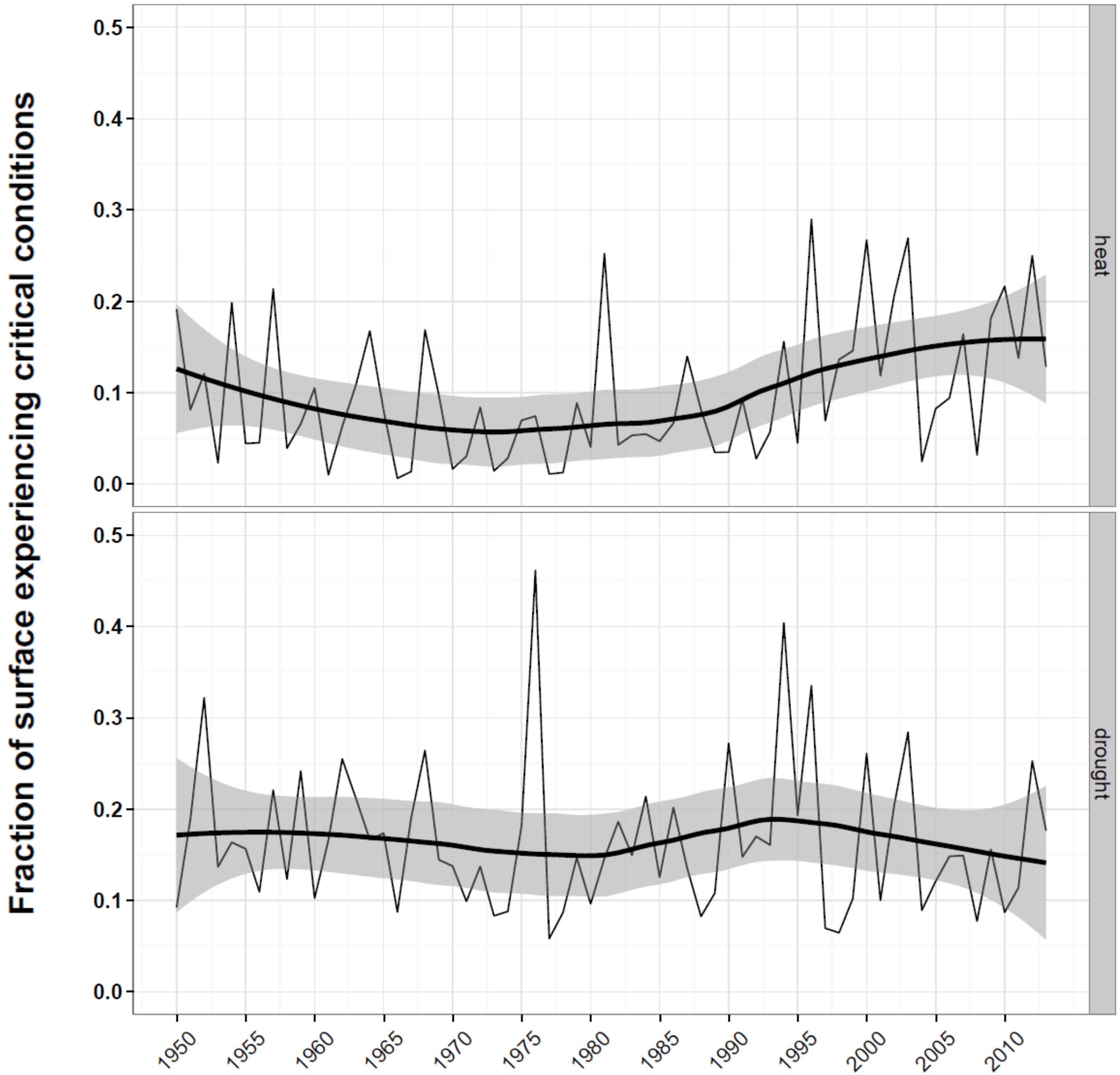
Spatial analysis



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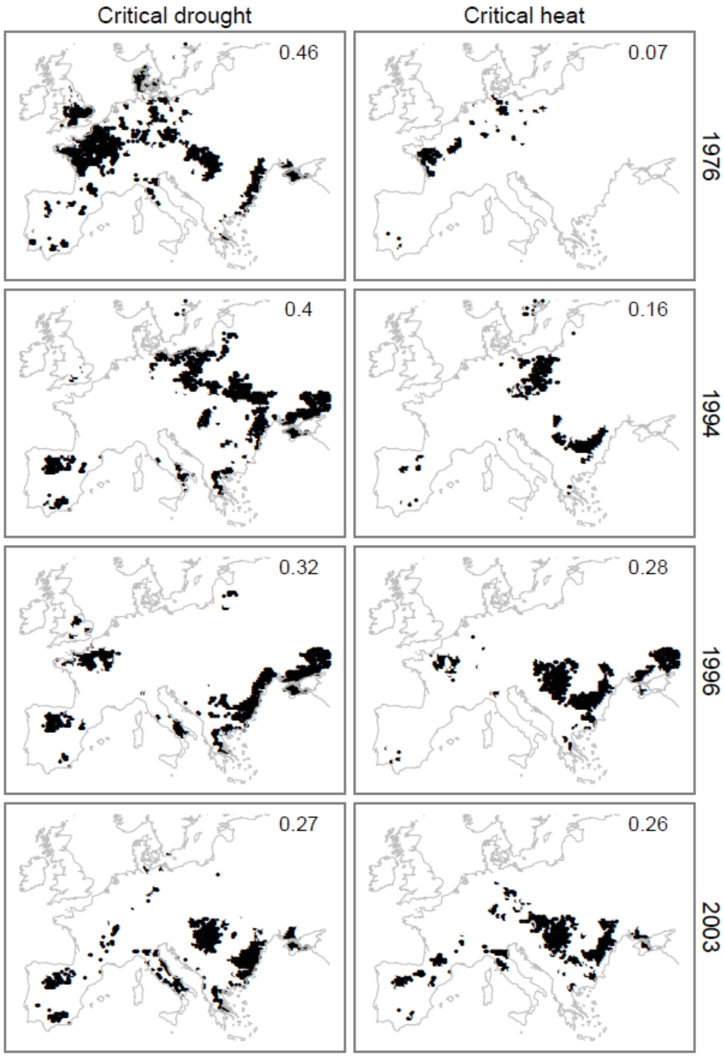
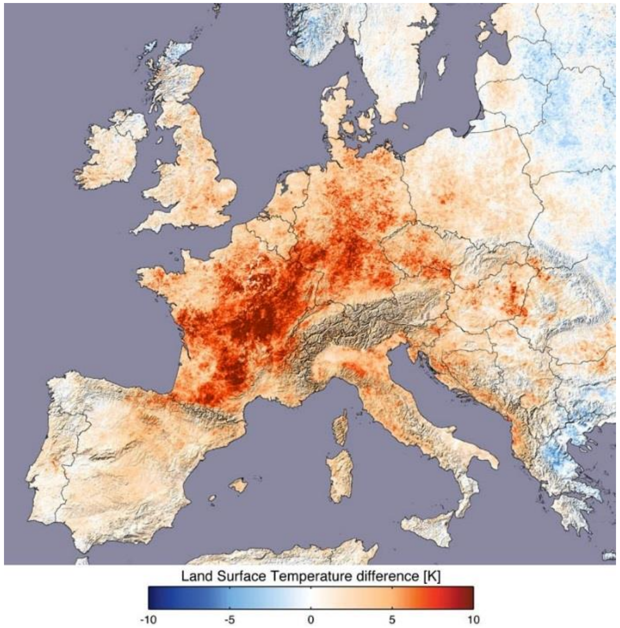
Spatial analysis





Spatial analysis

IPCC Fourth Assessment Report: Climate Change 2007

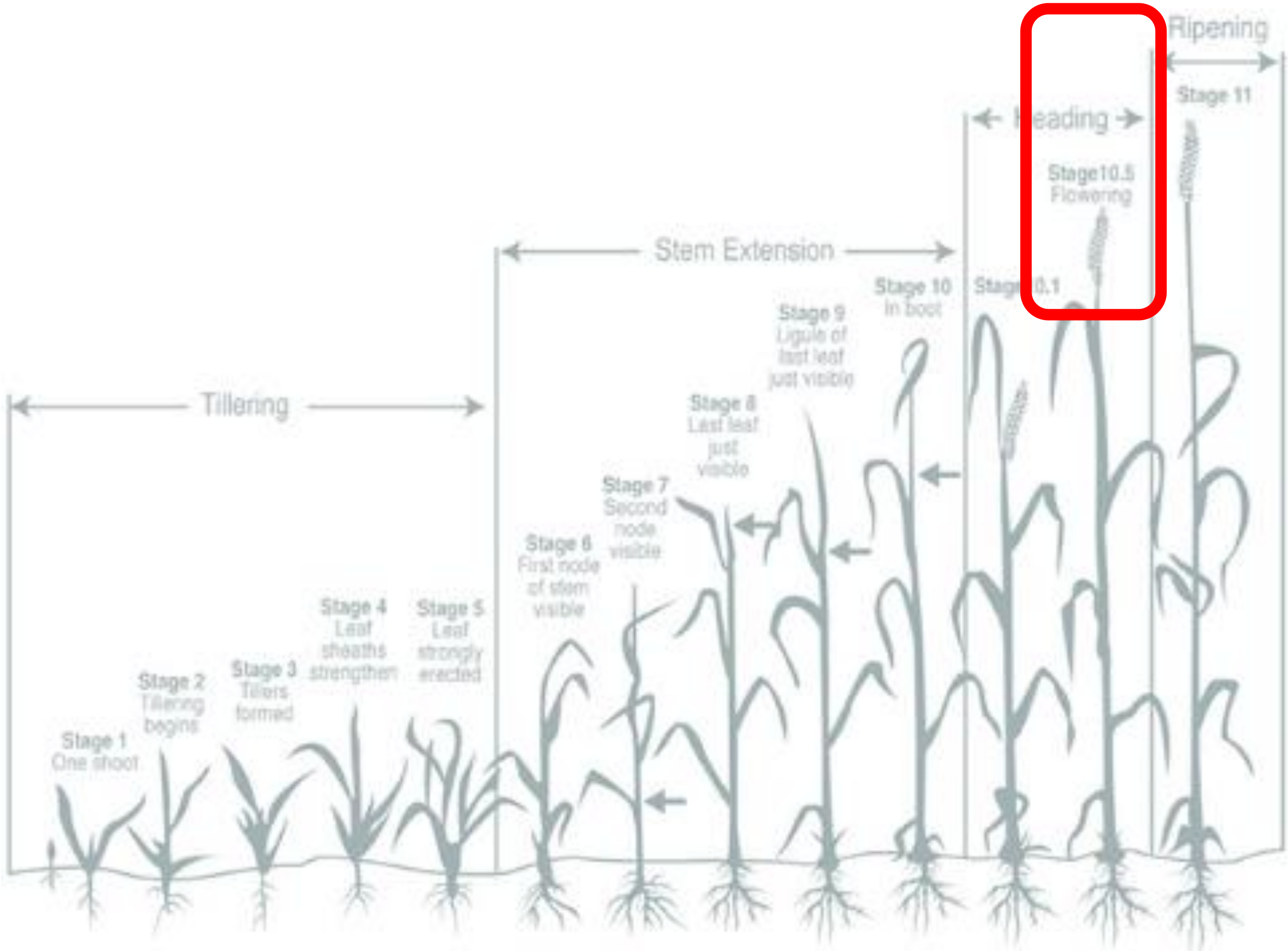
Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability

C1.2.2 European heatwave impact on the agricultural sector (Chapter 5, Box 5.1)

Europe experienced a particularly extreme climate event during the summer of 2003, with temperatures up to 6°C above long-term means, and precipitation deficits up to 300 mm (see Trenberth et al., 2007). A record drop in crop yield of 36% occurred in Italy for maize grown in the Po valley, where extremely high temperatures prevailed (Ciais et al., 2005). In France, compared to 2002, the maize grain crop was reduced by 30% and fruit harvests declined by 25%. Winter crops (wheat) had nearly achieved maturity by the time of the heatwave and therefore suffered less yield reduction (21% decline in France) than summer crops (e.g., maize, fruit trees and vines) undergoing maximum foliar development (Ciais et al., 2005). Forage production was reduced on average by 30% in France and hay and silage stocks for winter were partly used during the summer (COPA COGECA, 2003a). Wine production in Europe was the lowest in 10 years (COPA COGECA, 2003b). The (uninsured) economic losses for the agriculture sector in the European Union were estimated at ¤13 billion, with the largest losses in France (¤4 billion) (Sénat, 2004).

Crop development

sensitive time



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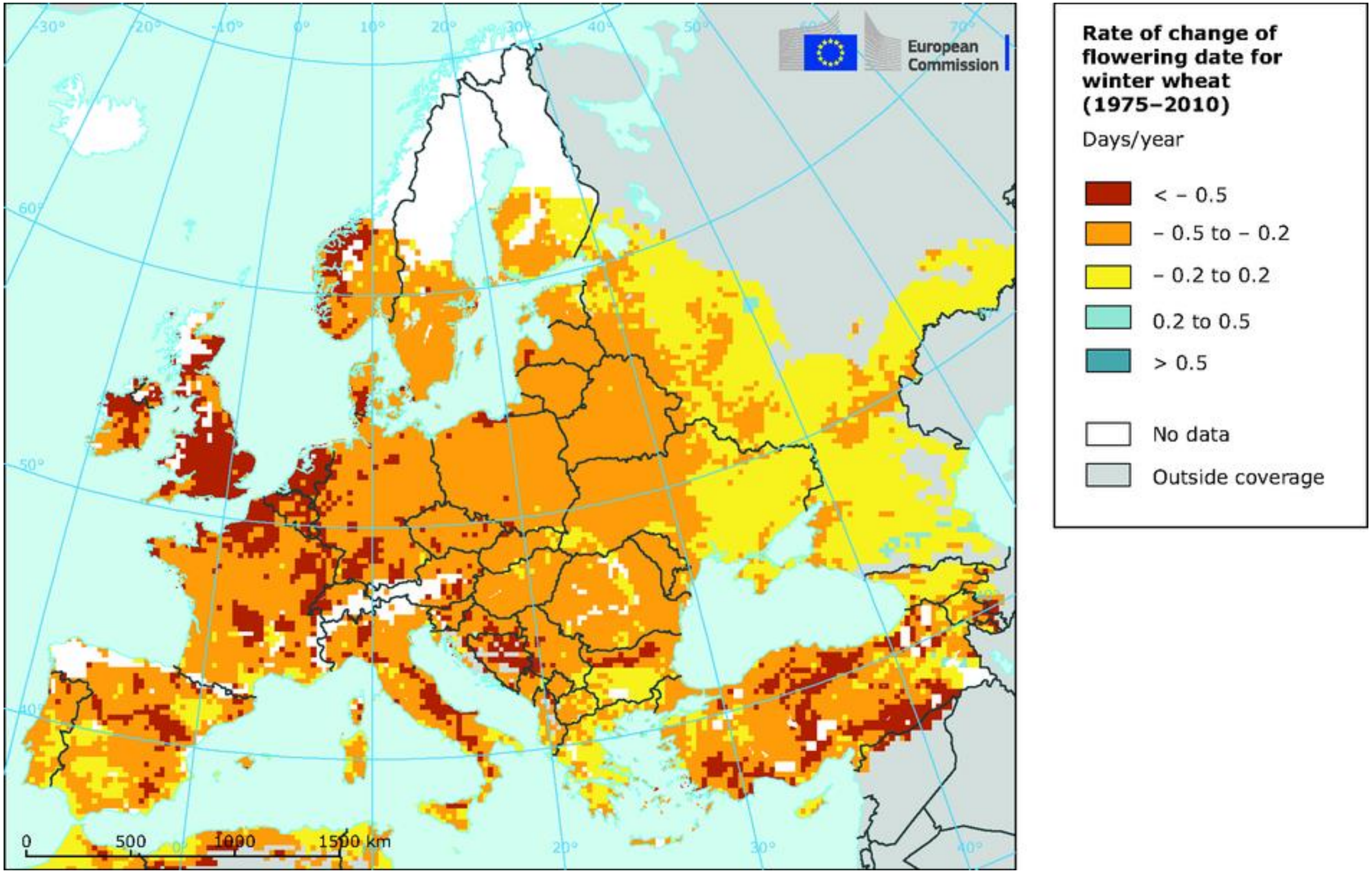
Change in phenology



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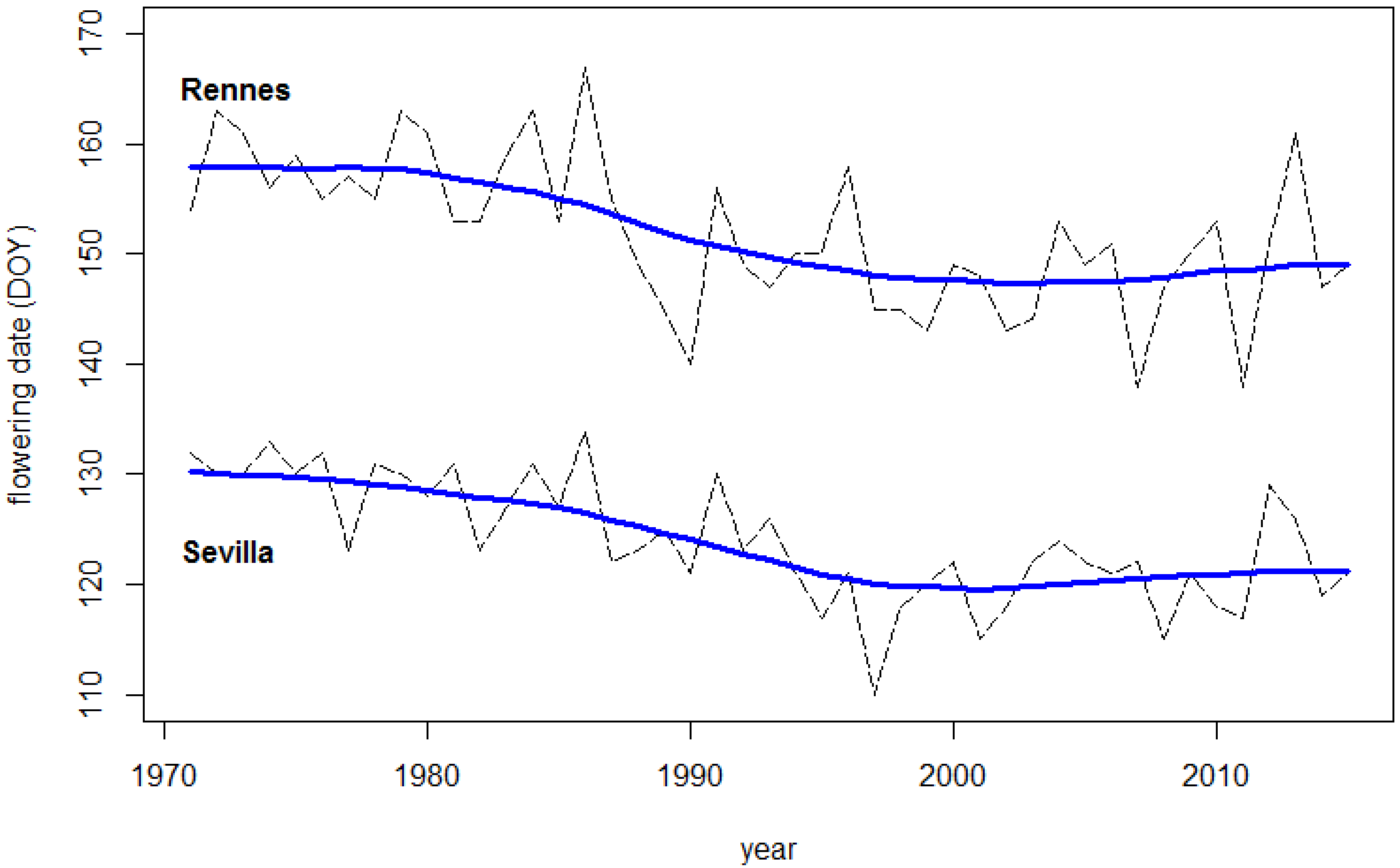
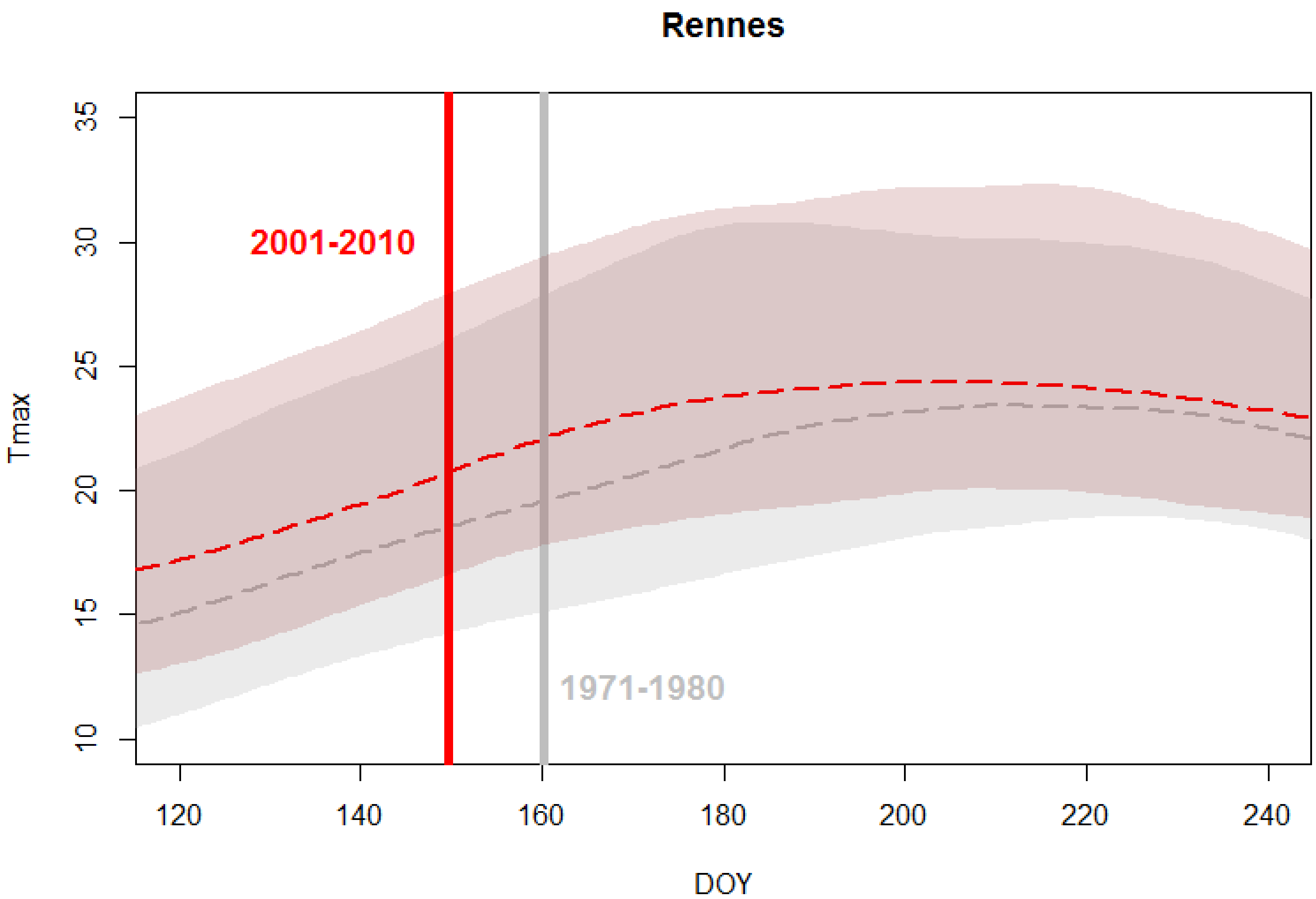
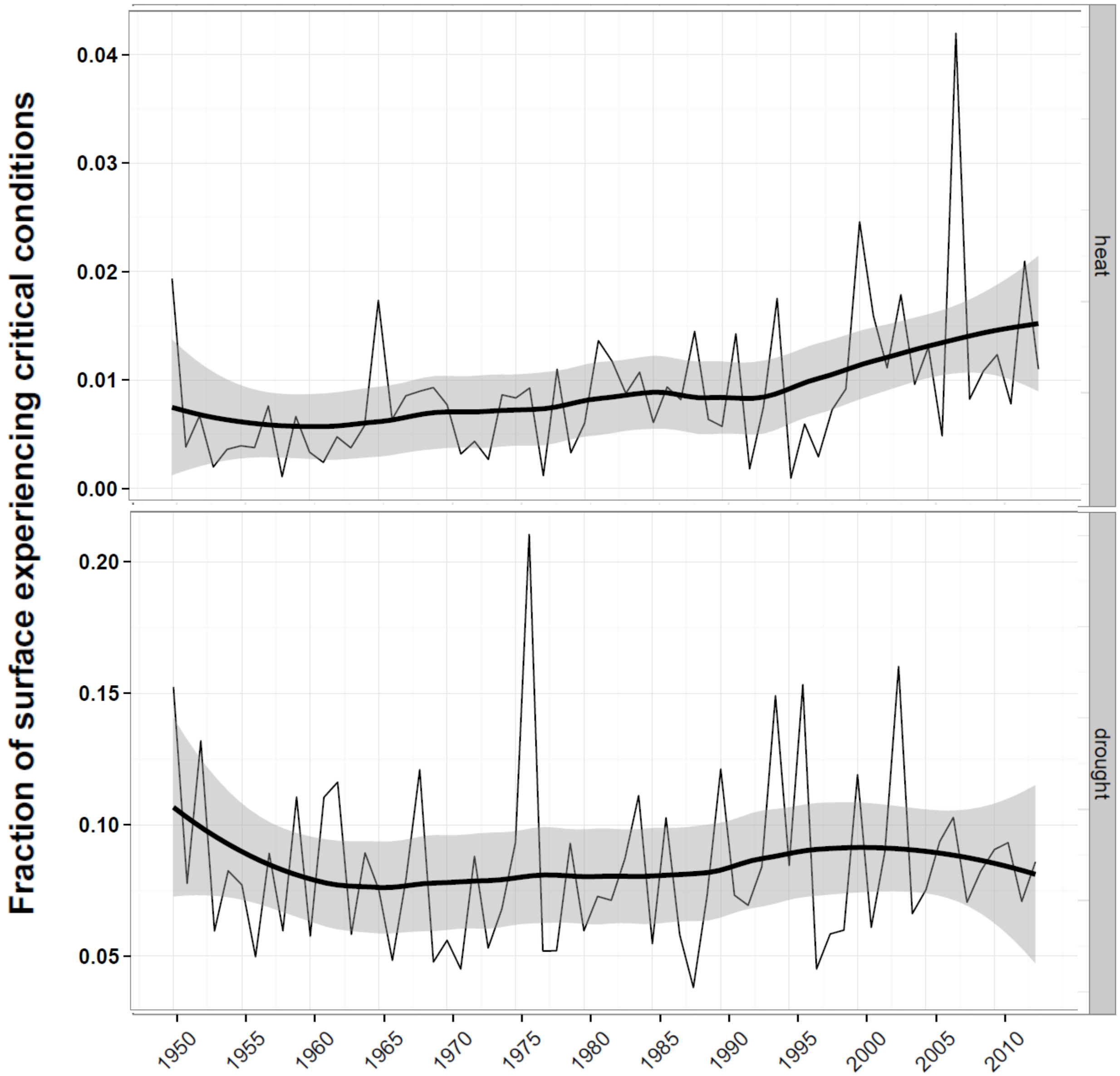
Change in phenology



Phenology & critical temperatures



Spatial analysis



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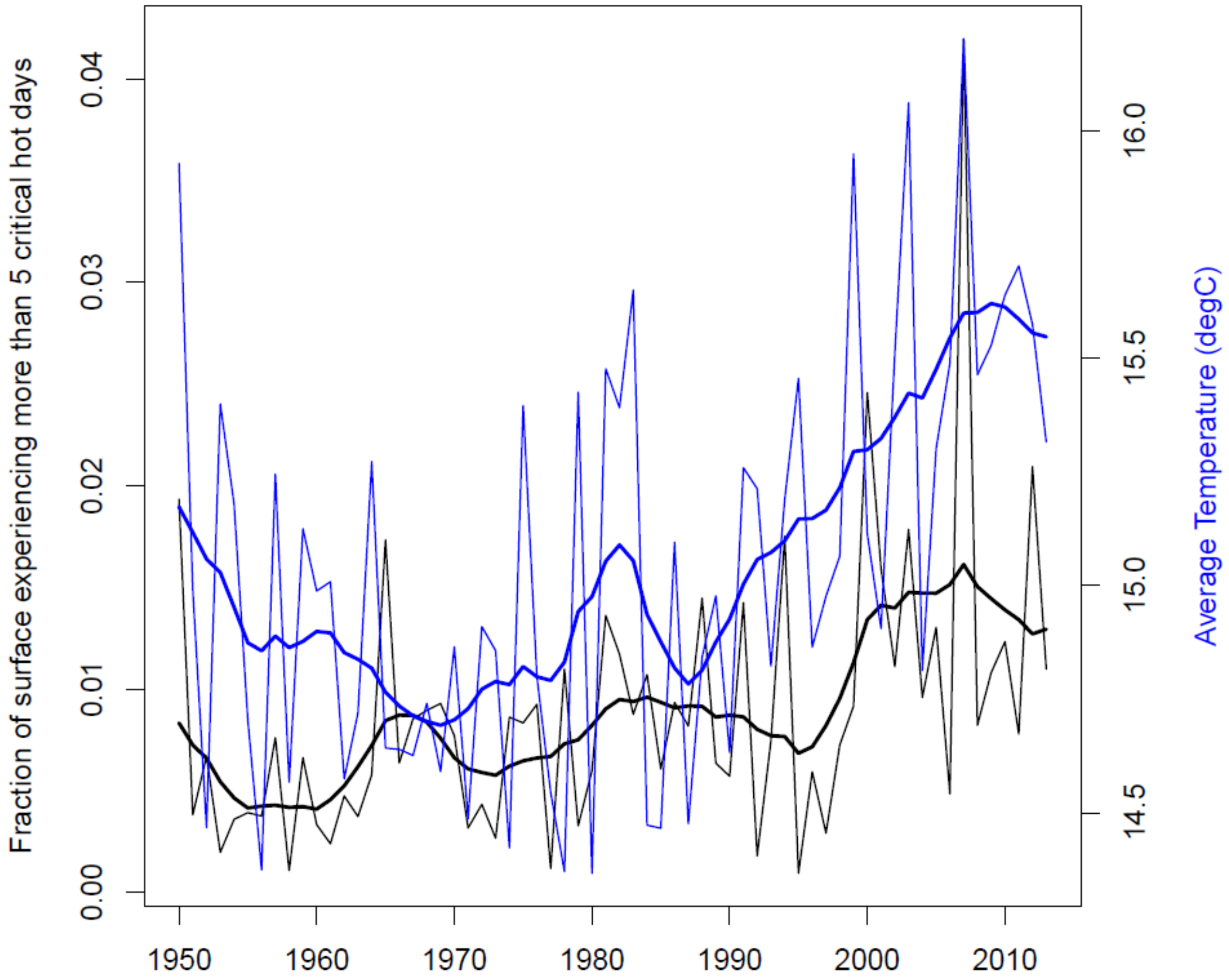

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webXTREME

screenshot - Dizionario ing... | webXTREME

modextreme.org/webxtreme/

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webXTREME

Welcome to webXTREME!
(web-based tool for the assessment of extreme years)

This tab provides a short user guide how to use this web application, an overview of the core functionalities, and key references related to the main computations

About this App | Data Upload | Soil Moisture Budget Computation | Occurrence of Extreme Conditions

Given time series of daily precipitation (RAIN, mm), minimum (AIRTMIN, °C) and maximum temperature (AIRTMAX, °C), and (as an option) reference e the number of occurrences per year of extreme temperatures (heat and cold shocks) and extreme aridity. The latter is based on the use of the Agricu et al., 2012), which is defined as the ratio between actual transpiration (T) and the reference evapotranspiration (ET0):

$$ARID = 1 - \frac{T}{ET0}$$

and ranges from 0 (no water deficit) to 1 (most extreme aridity, T = 0).

By providing appropriate thresholds in the tab 'Occurrence of Extreme Conditions', the following criteria can be specified by the user:

- Heat shocks:

$$AIRTMAX > AIRTMAX_{crit} \text{ where } AIRTMAX_{crit} \in [30.0, 50.0]\ ^\circ\mathrm{C}$$

- Cold shocks:

$$AIRTMIN < AIRTMIN_{crit} \text{ where } AIRTMIN_{crit} \in [-20.0, 5.0]\ ^\circ\mathrm{C}$$

- Extreme aridity:

$$ARID > ARID_{crit} \text{ where } ARID_{crit} \in [0.5, 1.0]$$

The criteria are evaluated with respect to the time of the year ('Start Date' – 'End Date') defined by the user in the same tab.

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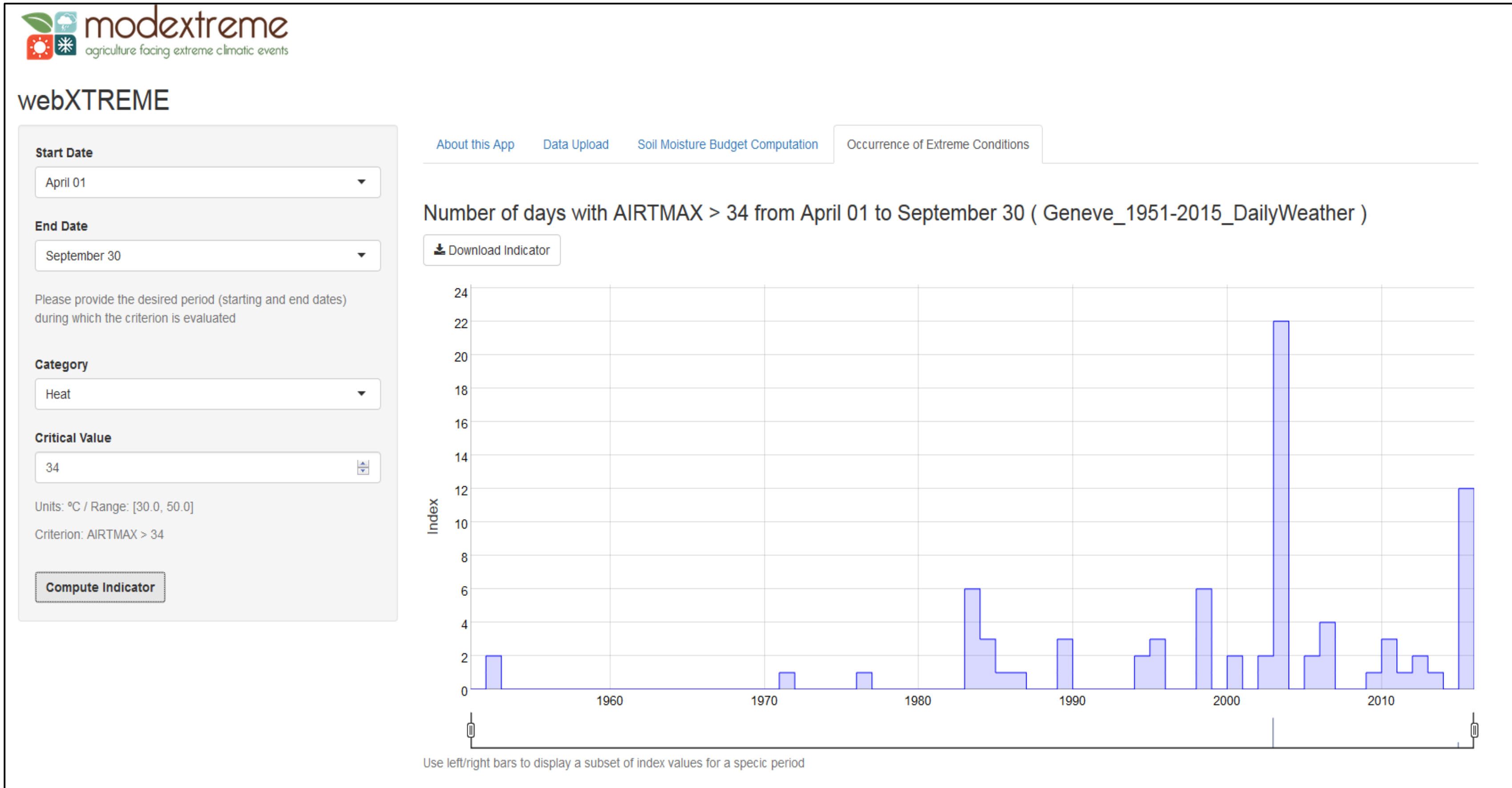
webXTREME



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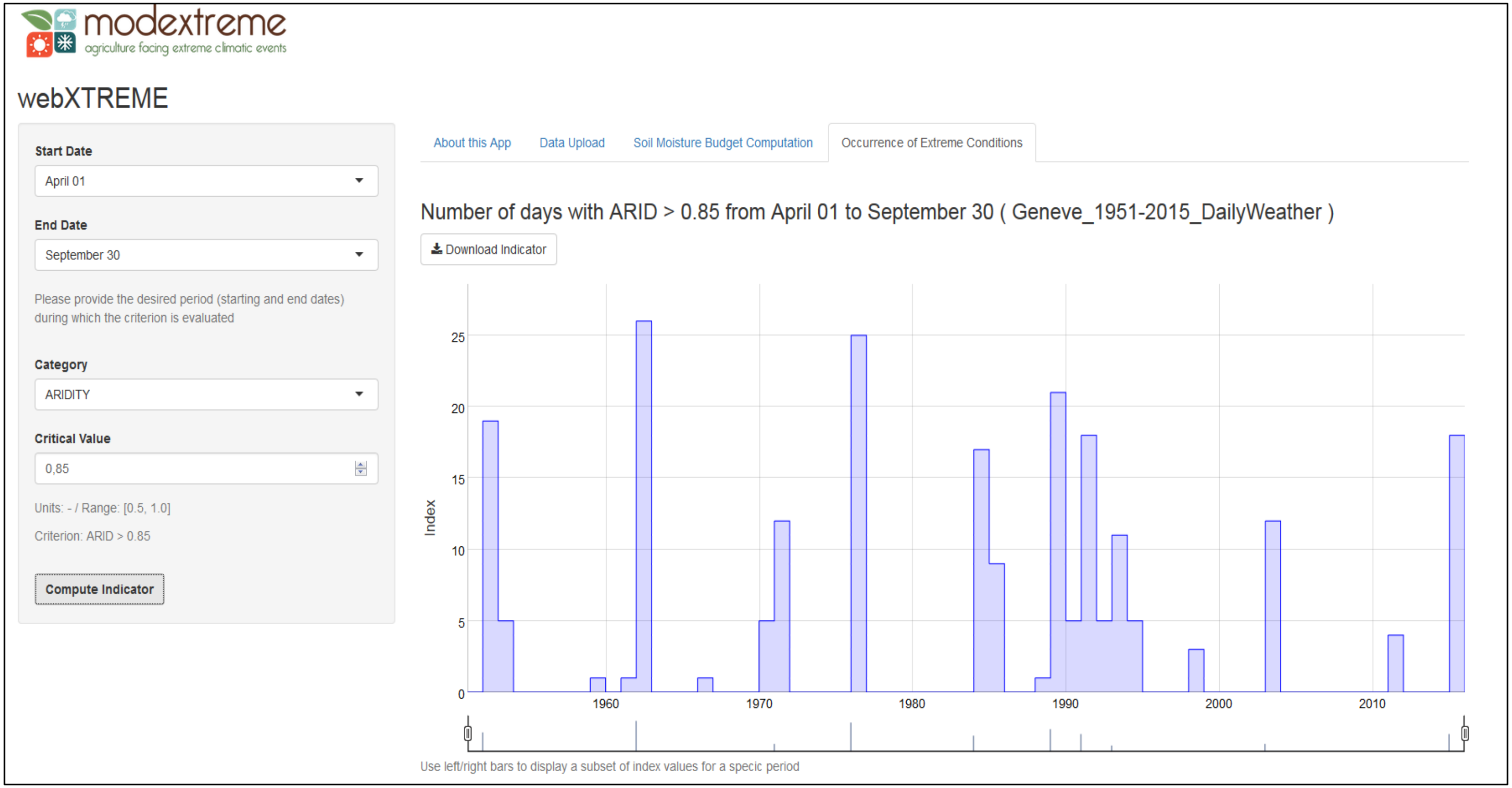

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