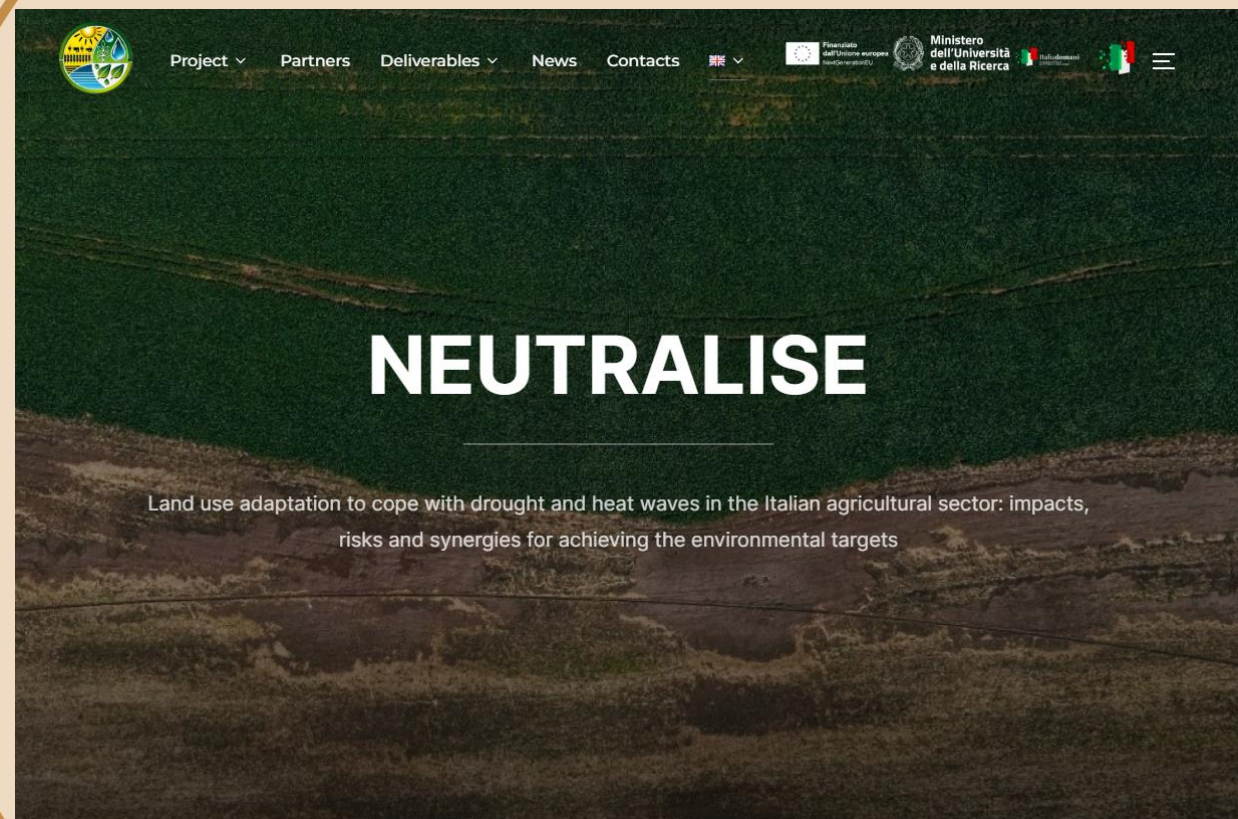


Missione 4 Istruzione e Ricerca

**Analisi della siccità in
rapporto all'agricoltura
italiana, quarant'anni di
osservazioni e
prospettive future**



Missione 4 Istruzione e Ricerca

Edmondo Di Giuseppe

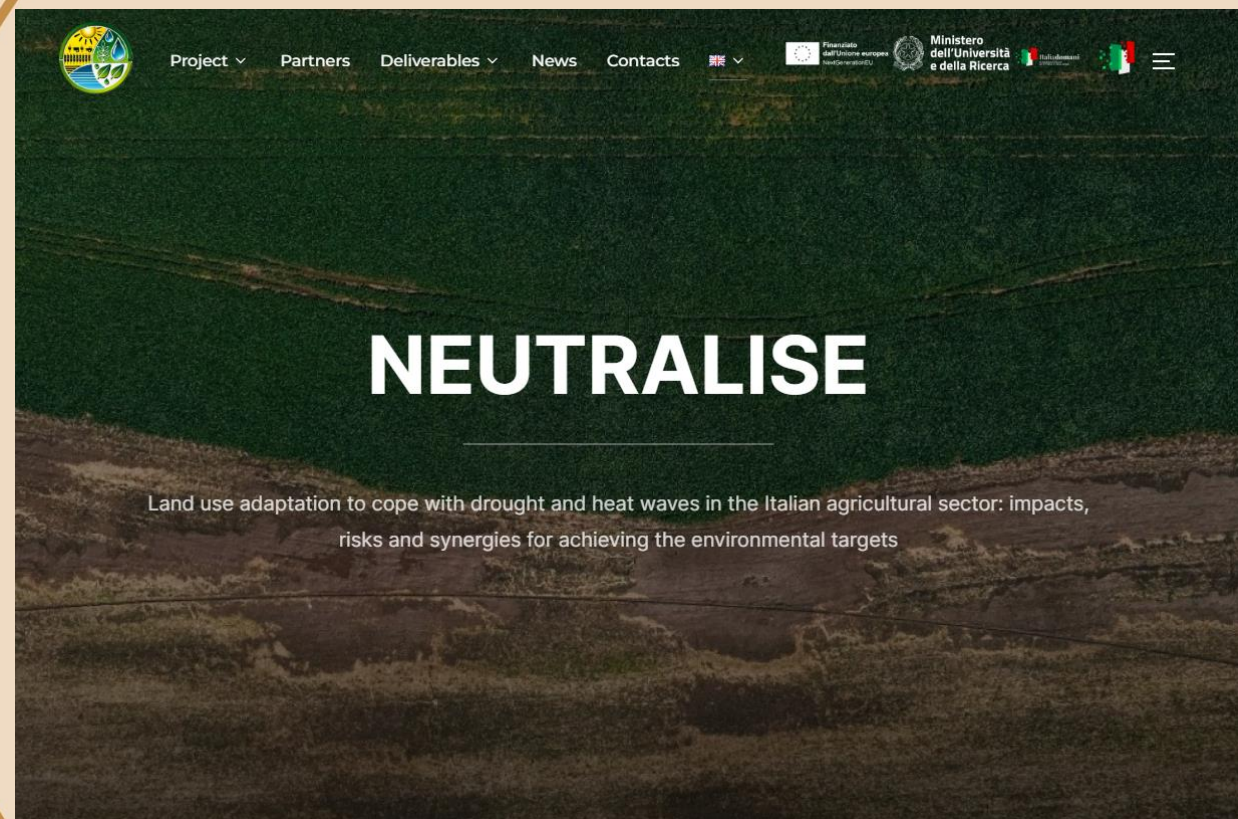
Sara Quaresima

Arianna Di Paola

Marina Baldi

Massimiliano Pasqui

Marco Simonetti





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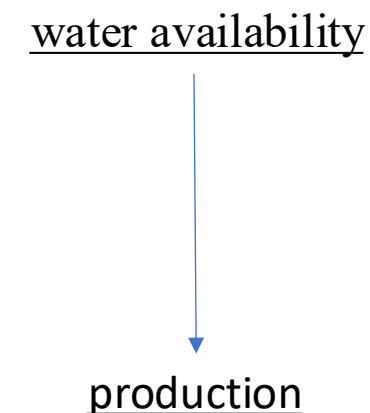


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- **Climate Analysis**
 - Variables of interest for AGRITALIM**
 - Negative anomalies of precipitation**
 - Excessive levels of temperatures**
 - Climate data**
 - Map of 773 Agricultural regions**
- **Agricultural Drought**
 - Definition**
 - SPEI**
- **Hot-spots identification**
 - Agricultural regions under drought stress in the last 40 years**
- **The trend of water stress events in the last 40 years**

Variables of interest for AGRITALIM

- « Vegetation growth is expected to become more **water-constrained** in a warmer climate »
- Precipitation and Temperature (*single effects or a combination of ?*)
- 6-month aggregation delineating *growing seasons*:
 - **Winter** (from October,1 to March,31)
 - **Summer** (from April,1 to September,30)
- Period from **1981** to **2023**





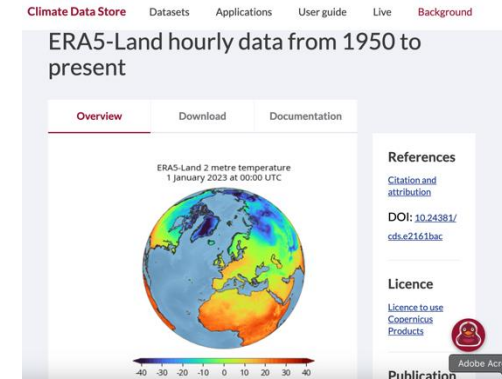
Climate Data

ERA5-Land data set from the [C3S Climate Data Store](#)

Climate reanalysis combines model data with observations

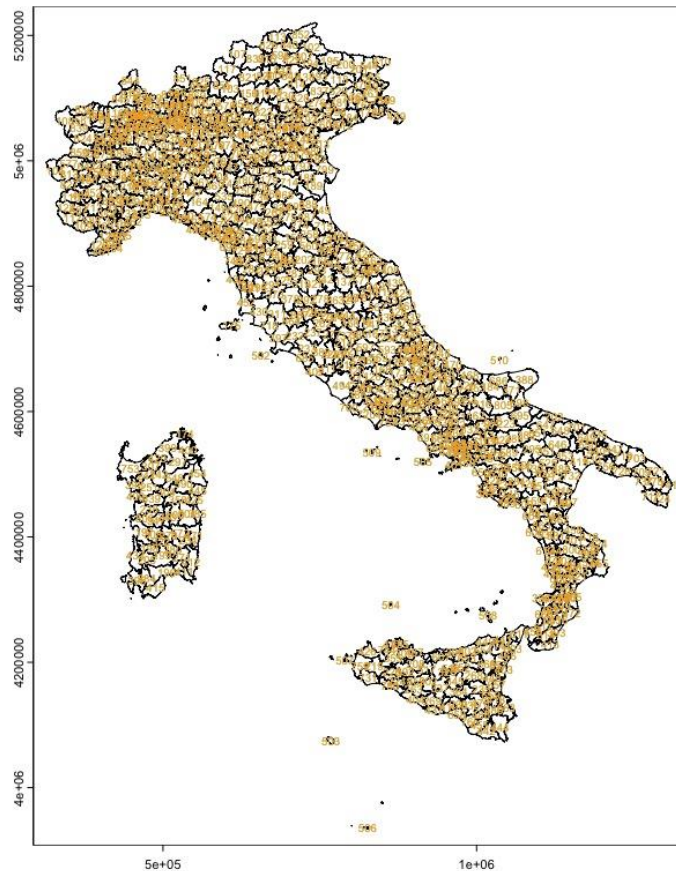
ERA5-Land describes the evolution of the water and energy cycles over land

ERA5-Land can be used to analyse **trends** and **anomalies**
(*Muñoz-Sabater et al. 2021*)





Map of 773 Agricultural regions



- The areas of interest are delineated on the basis of **INEA Land Values Database**, which is a collection of data recording the changes in land values since 1992.
- Due to changes at the territorial level, such as abolition, aggregation, or the establishment of new municipalities/provinces, the **number and composition of agricultural regions have been revised**.
- The **shape file** of revised agricultural regions is freely available for downloading from **Quaresima, Sara (2024)**.



Critical years for the Winter growing season

	Year	NagrReg
1	1990	739
2	2002	702
3	1989	676
4	2012	457
5	2007	394
6	2022	238
7	1995	232
8	1992	214
9	1996	190
10	2000	185

Critical years for the Summer growing season

	Year	NagrReg
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5	1993	335
6	2021	323
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10	1997	271

Number of agricultural regions involved in
drought episodes (including Severe and Extreme)



Drought definitions

meteorological

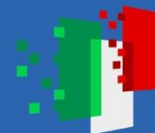
agricultural

hydrological

socioeconomic

depending on the duration of the reduction in the amount of precipitation and how is the contribution of the variables that affect evapotranspiration, such as temperature, humidity, and wind (Mishra, A.K.; Singh, V.P., 2010)

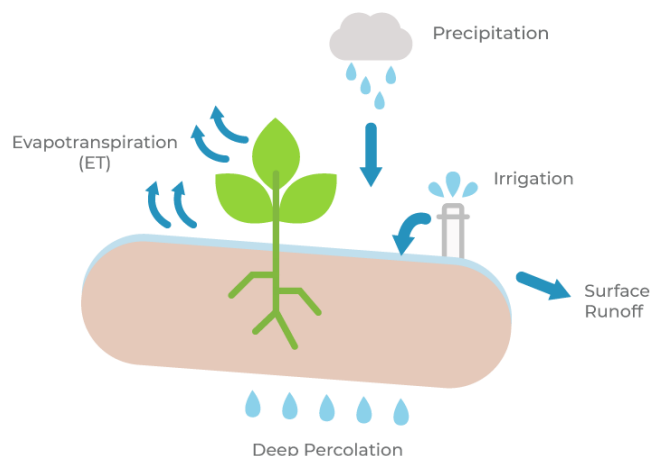
Agricultural drought is mostly linked to soil moisture conditions that respond to precipitation anomalies on a relatively short scale



SPEI – Standardized Precipitation Evapotranspiration Index

- *Precipitation deficit and/or excessive heat*

PET - Potential Evapotranspiration

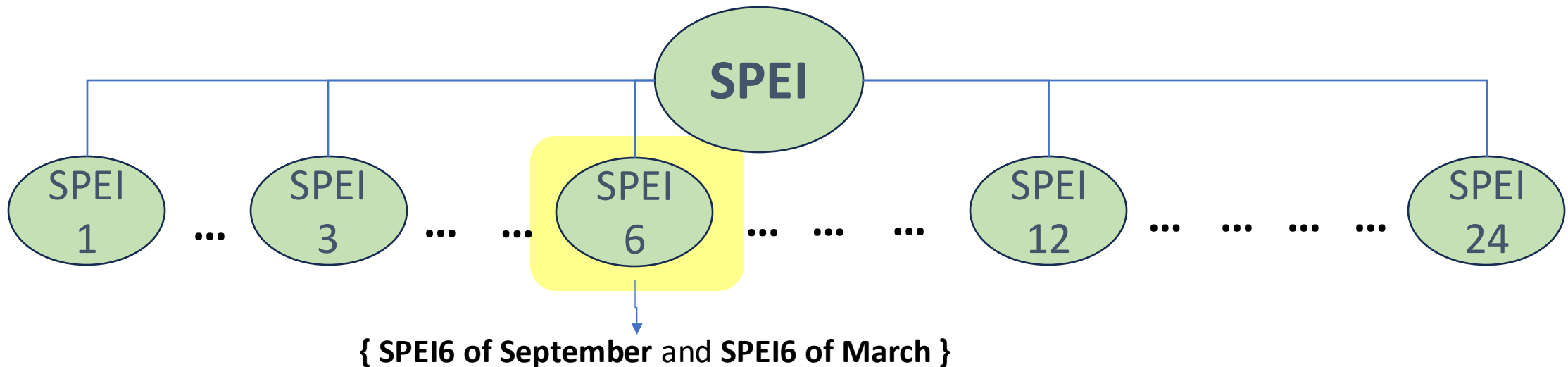


- Proxy of atmospheric demand for water
- Calculated via the FAO's **Penman-Monteith equation** described in Allen and Food and Agriculture Organization of the United Nations (1998)
- To close the water balance, we nullified the nocturnal evapotranspiration and aggregated the precipitation data over 6-month periods



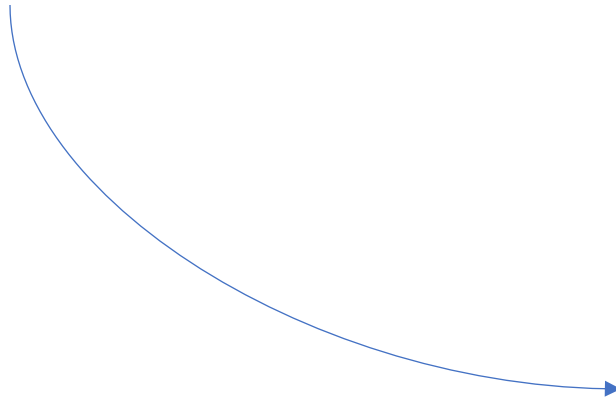
SPEI – Standardized Precipitation Evapotranspiration Index

- Used to monitor both **short-term water supplies** and **long-term water resources** because of the possibility of being scale-free, i.e., calculated for various time scales

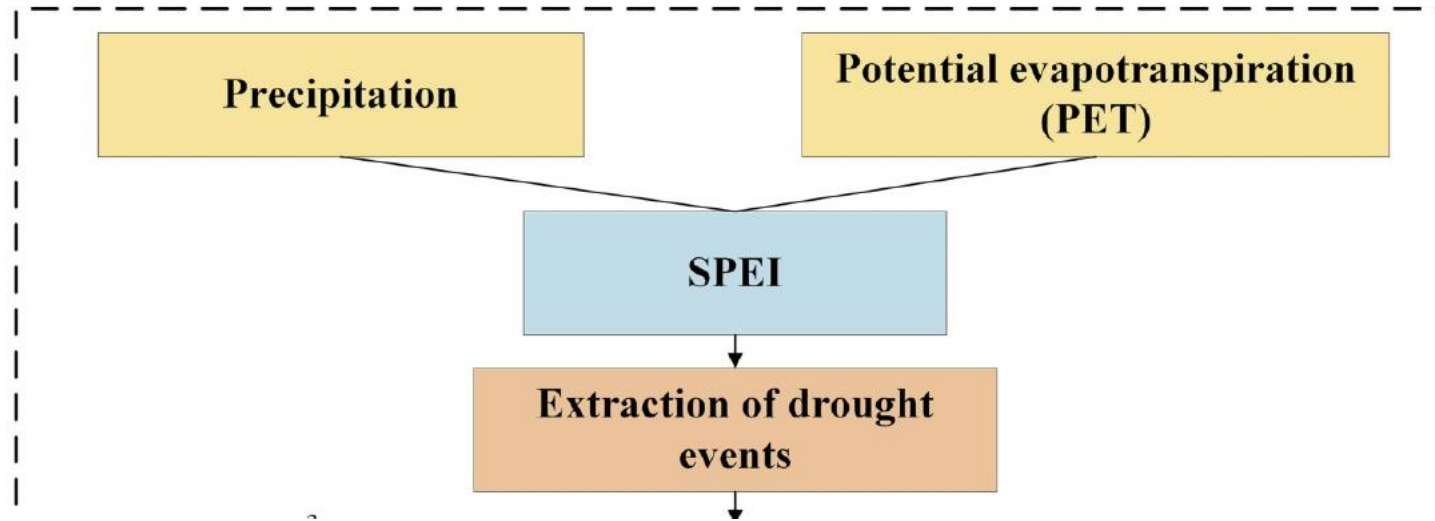




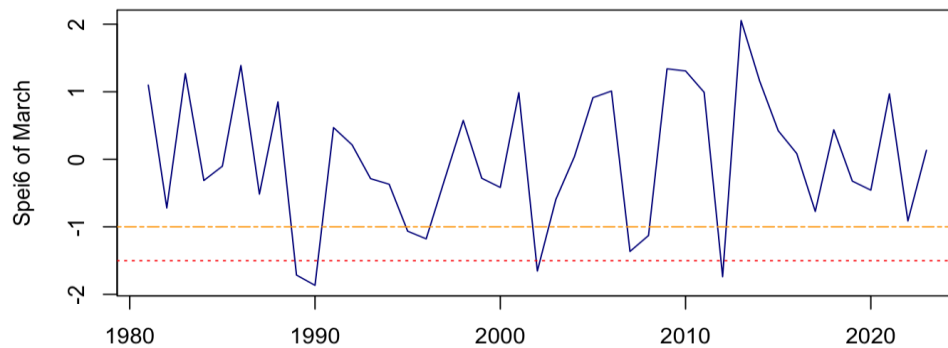
SPEI



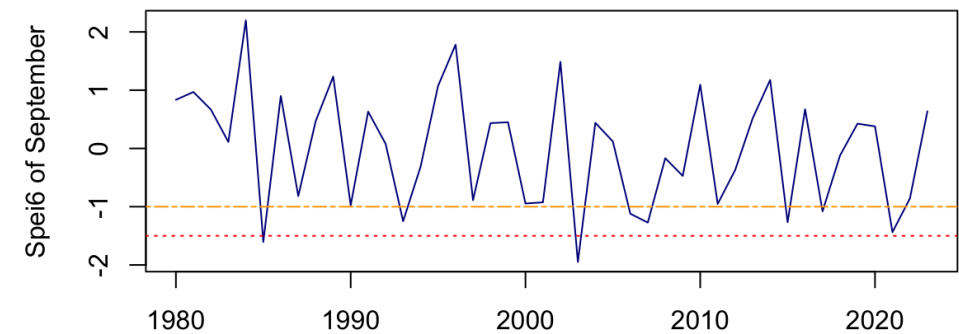
CATEGORIES		SPEI Values	
	Extreme drought	< -2.00	
	Severe drought	-1.99 to -1.50	
	Moderate drought	-1.49 to -1.00	
	Near normal	-0.99 to 0.99	
	Moderately wet	1.00 to 1.49	
	Severely wet	1.50 to 1.99	
	Extremely wet	> 2.00	



AR-277 (COLLINE DEL TEVERE DI BASCHI)



AR-277 (COLLINE DEL TEVERE DI BASCHI)

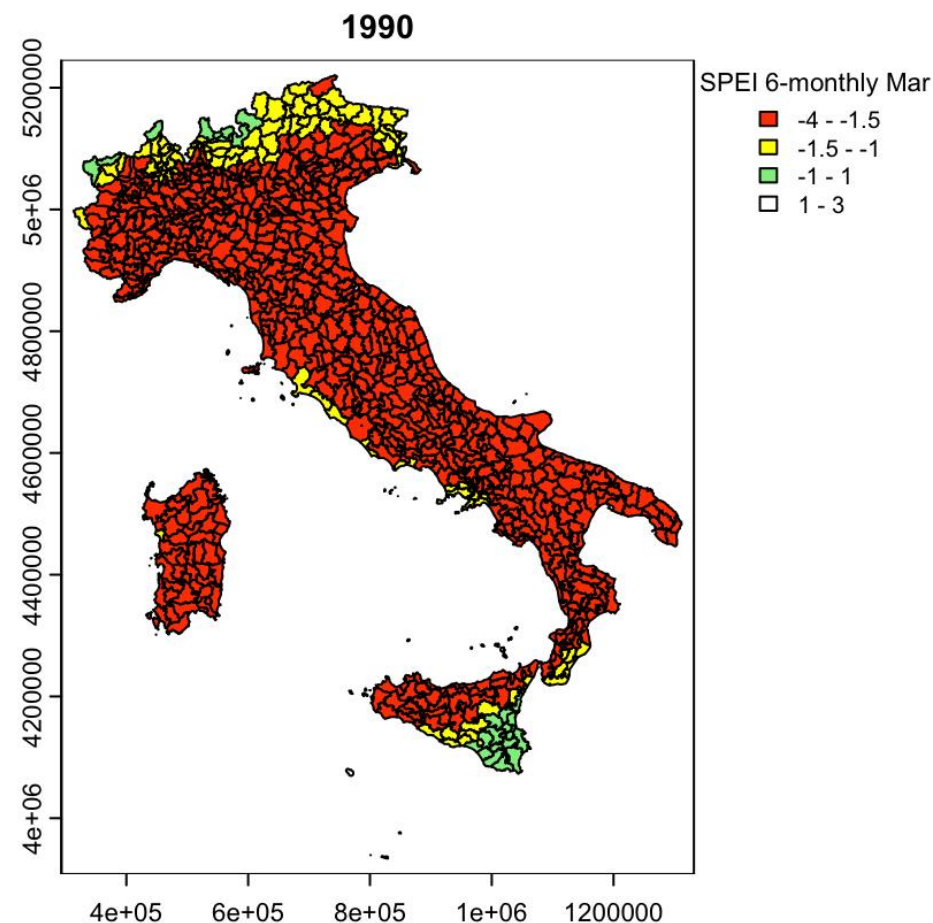




Critical years for the Winter growing season

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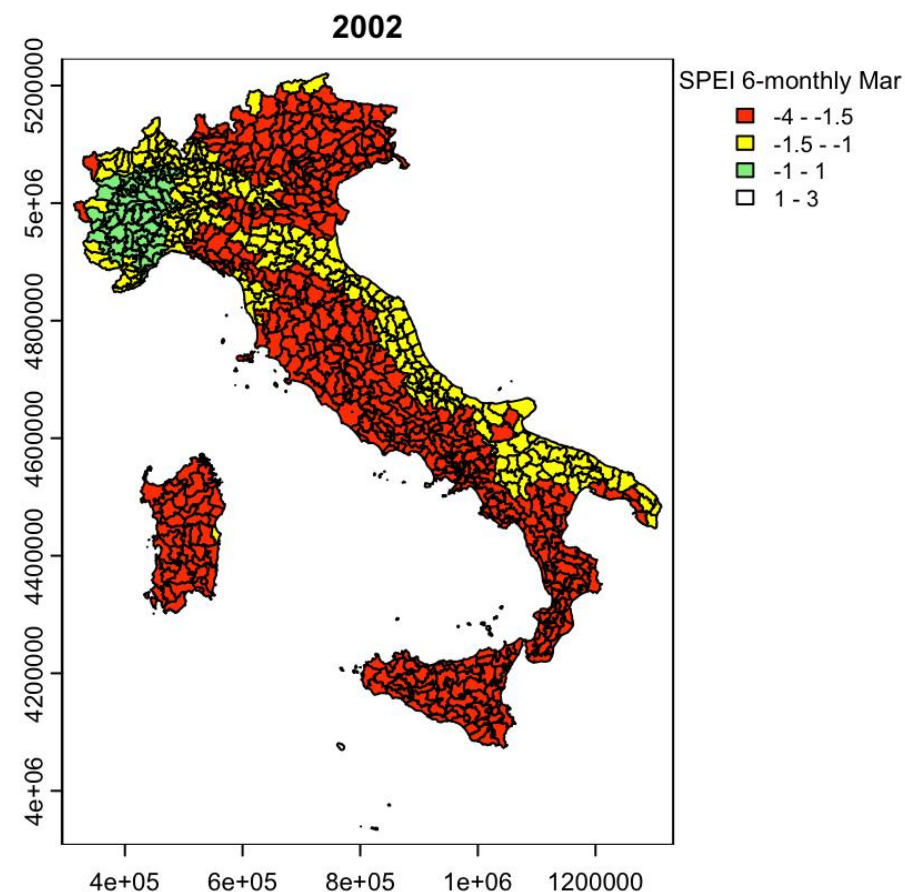
Number of agricultural regions involved in drought episodes (including Severe and Extreme)



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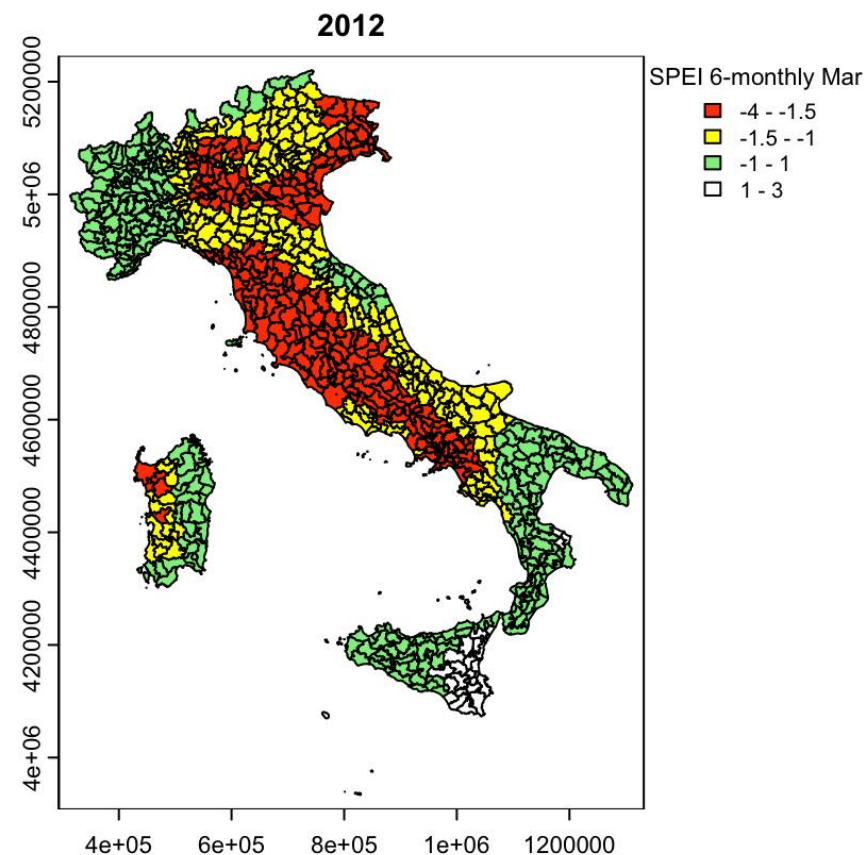
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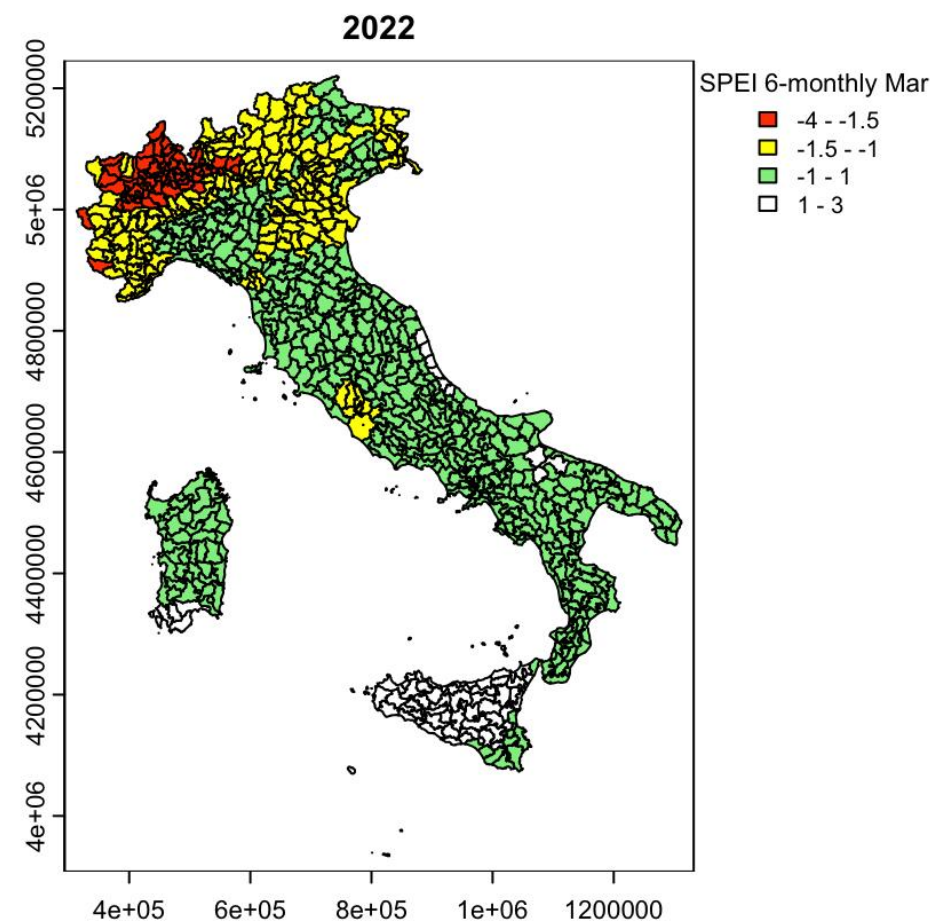
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Number of agricultural regions involved in
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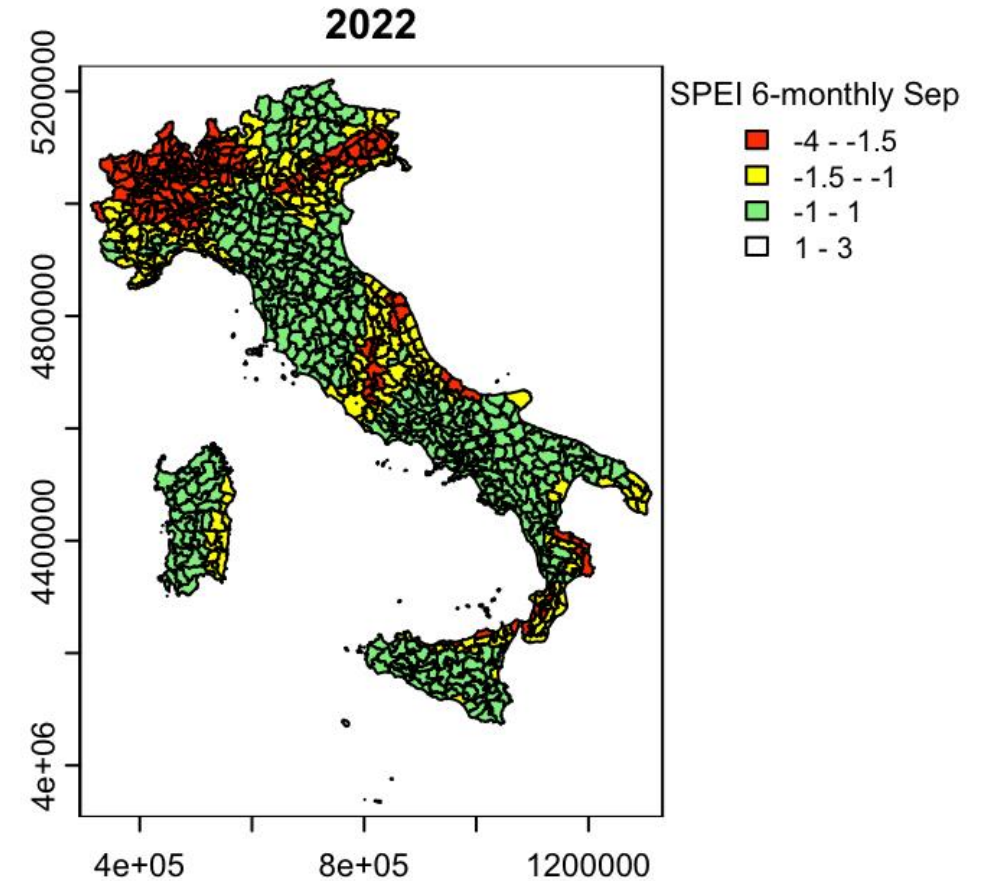
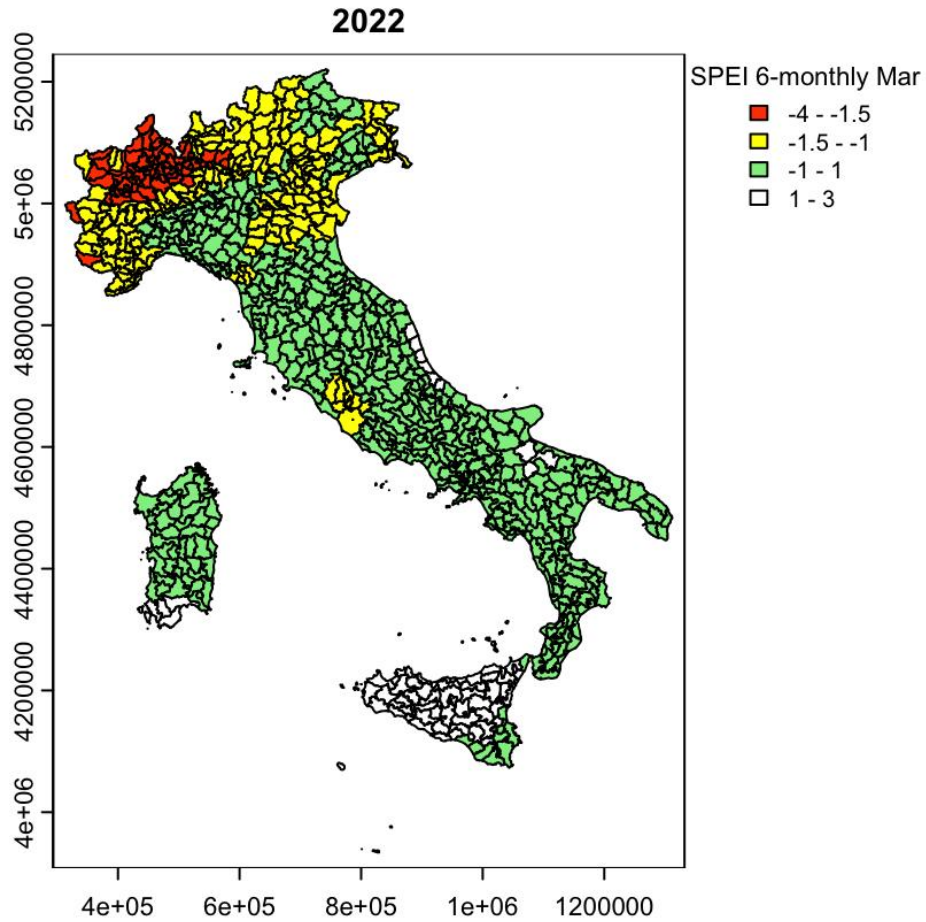
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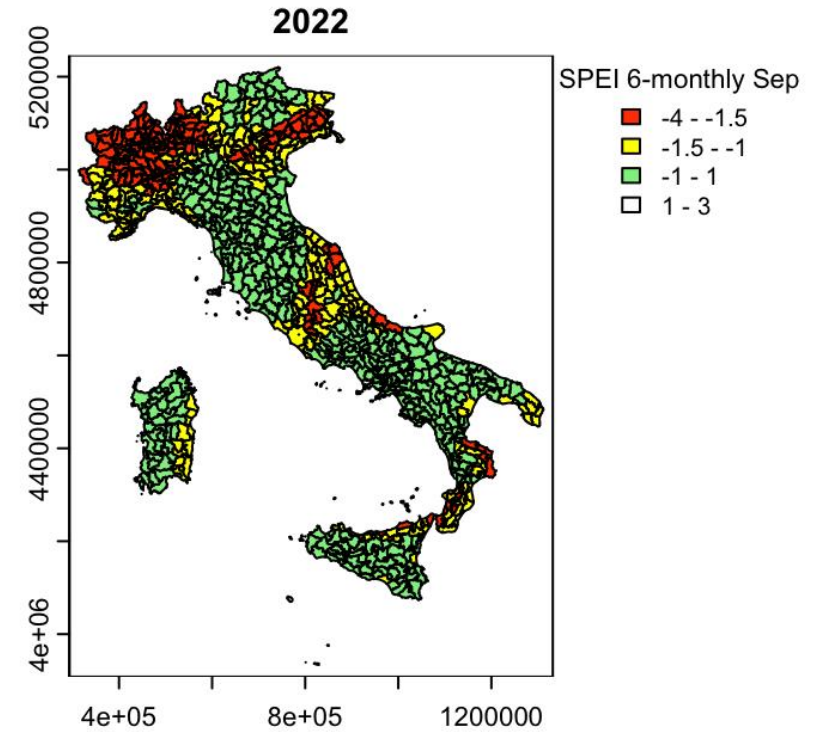
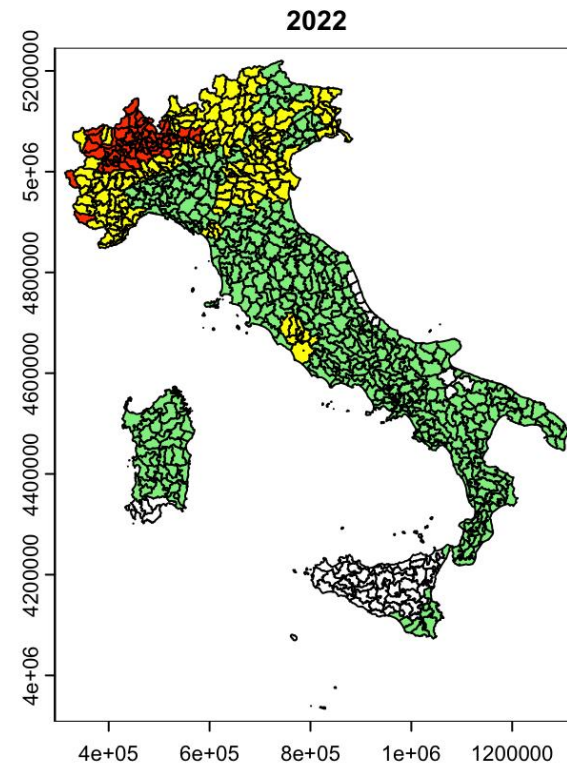
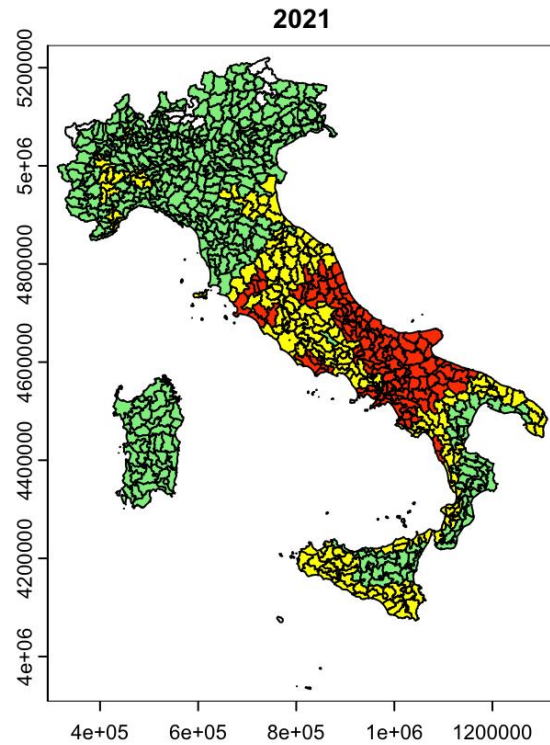
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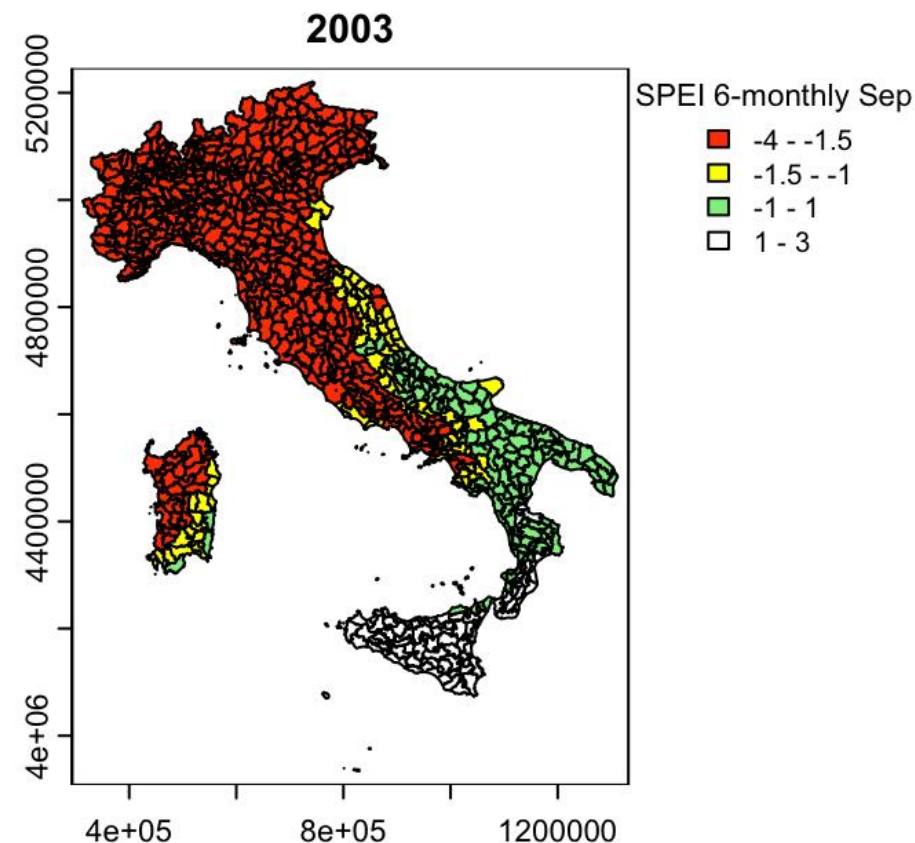
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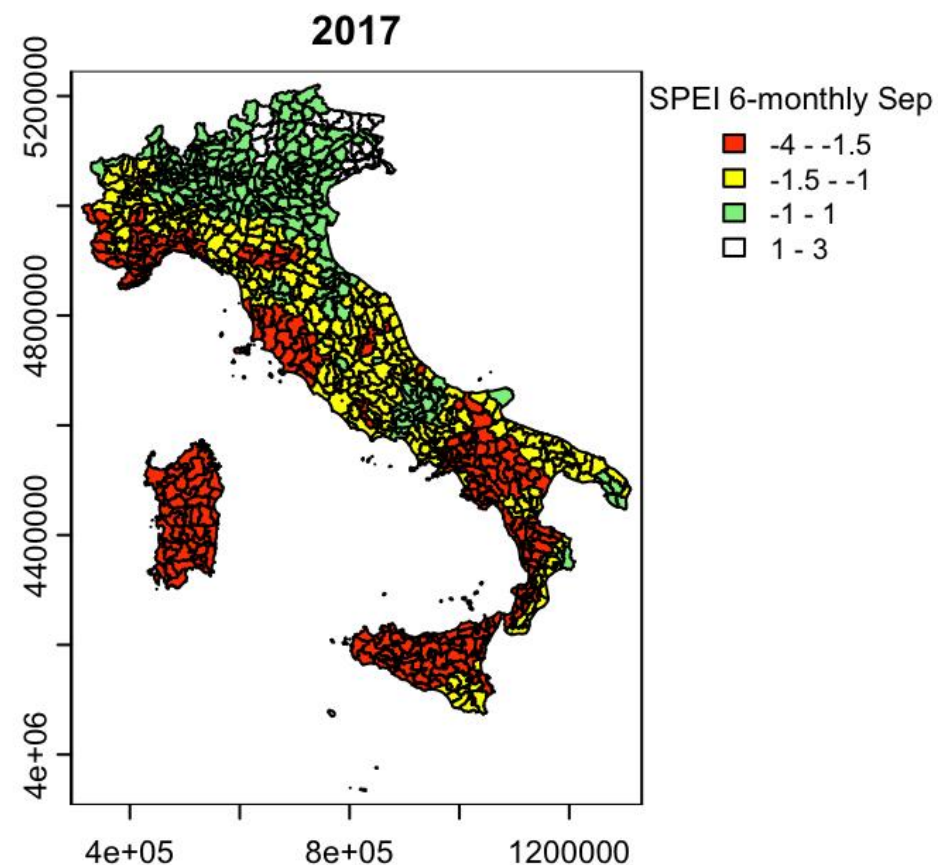
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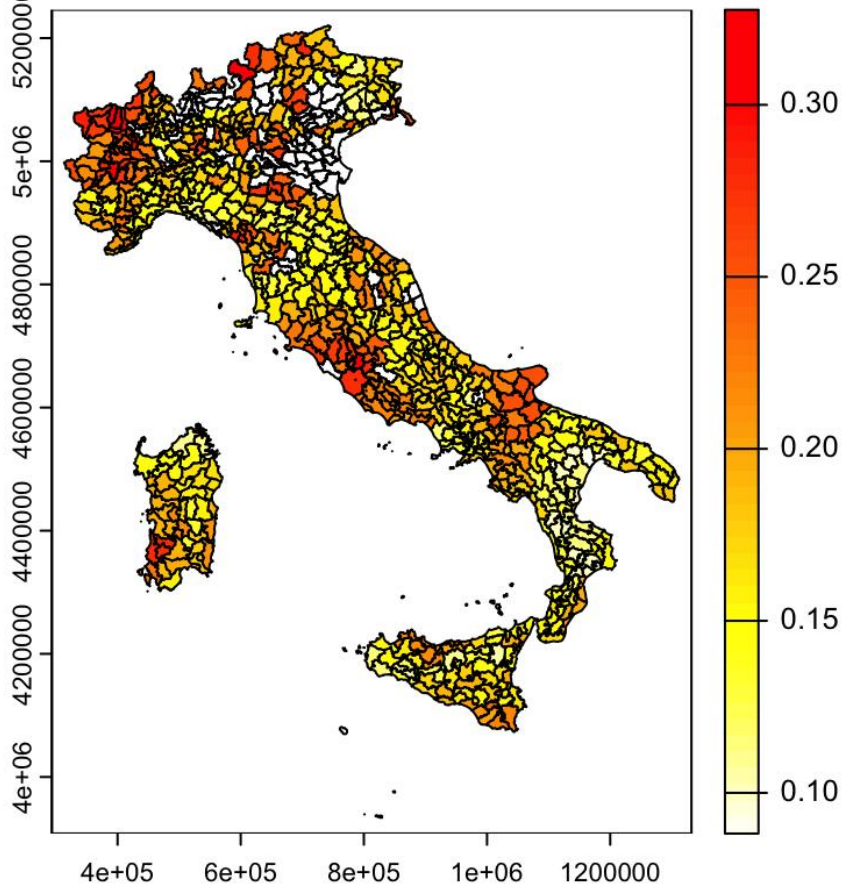


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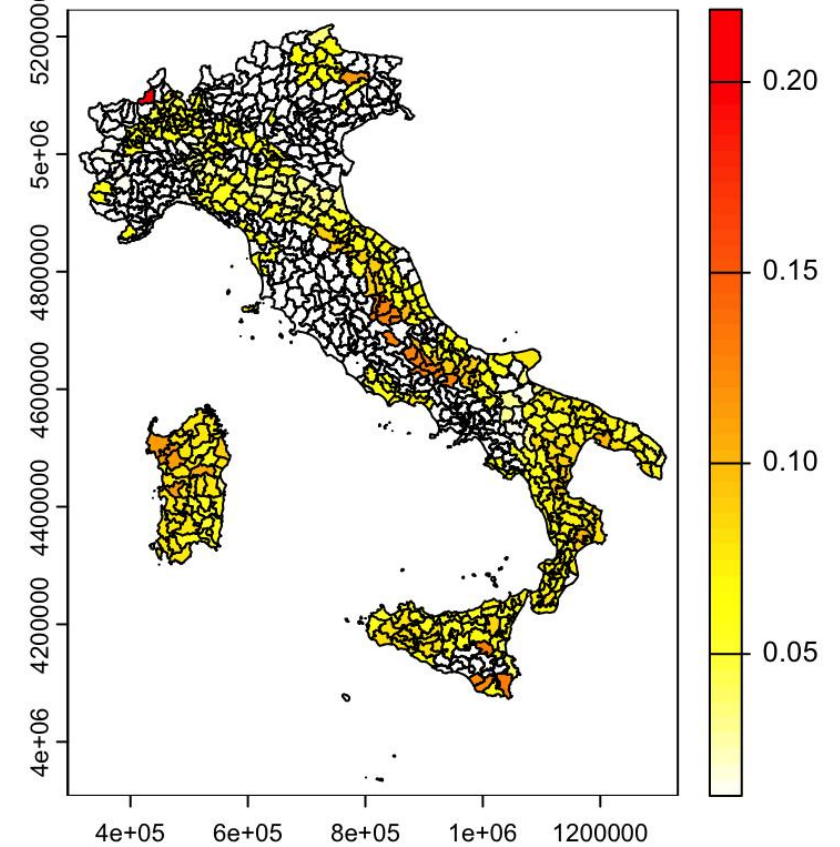
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Intensity of drought events below -1 (Winter)



Probability of
occurrence of
drought episodes

Intensity of drought events below -1.5 (Winter)





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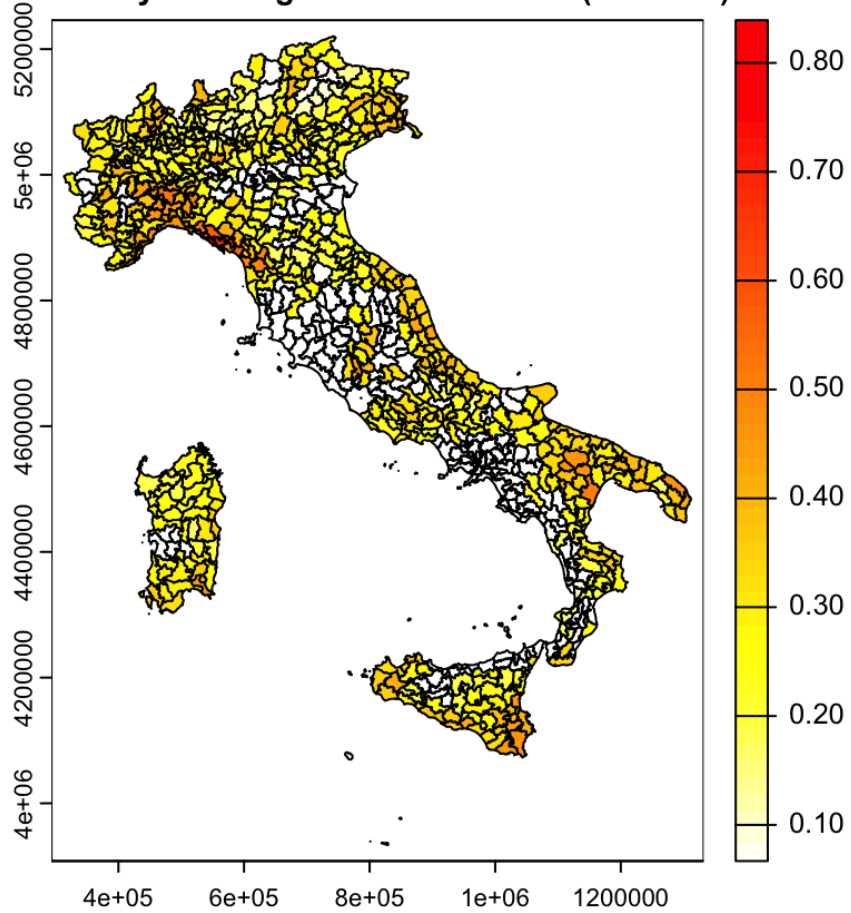


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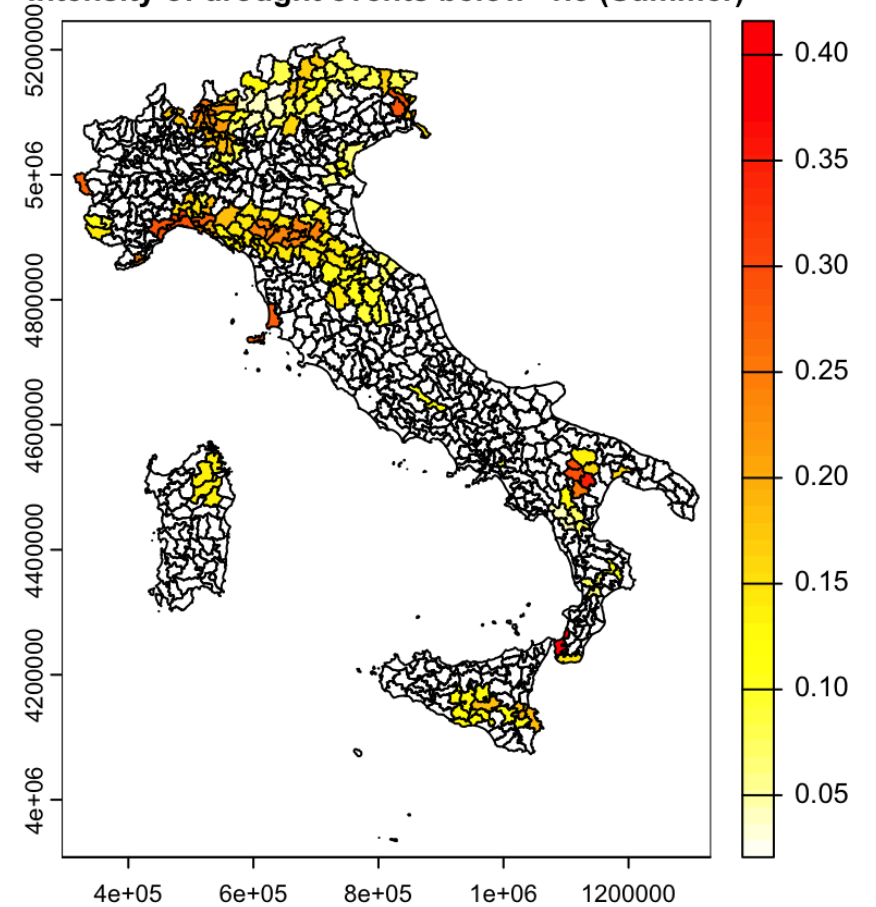
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Intensity of drought events below -1 (Summer)



Probability of
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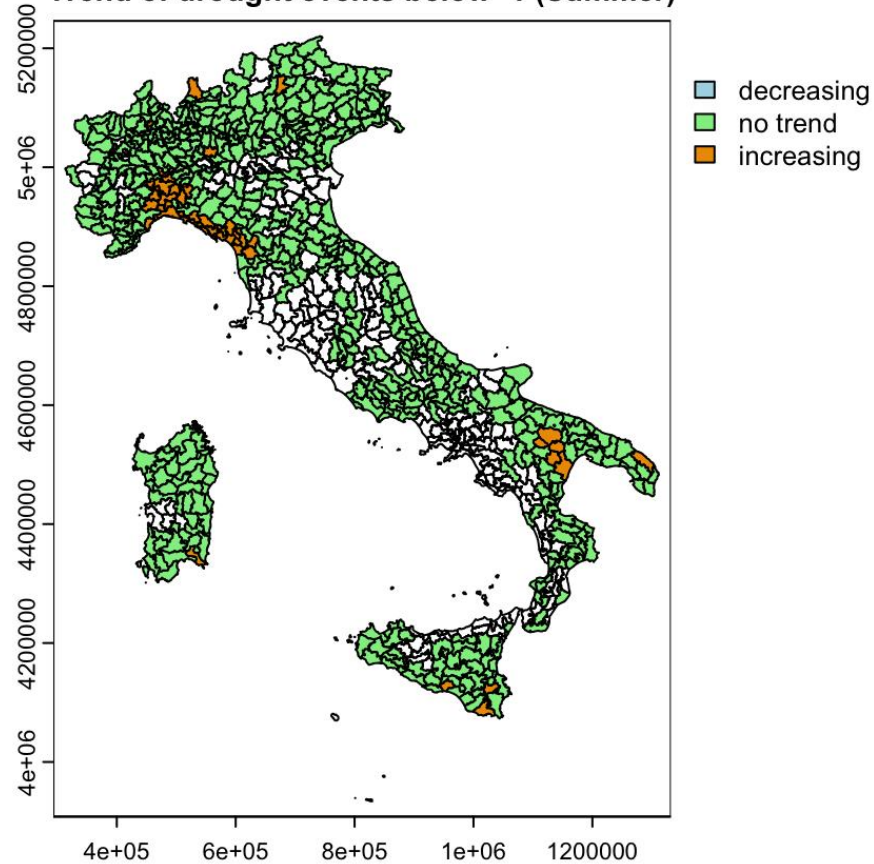
Intensity of drought events below -1.5 (Summer)



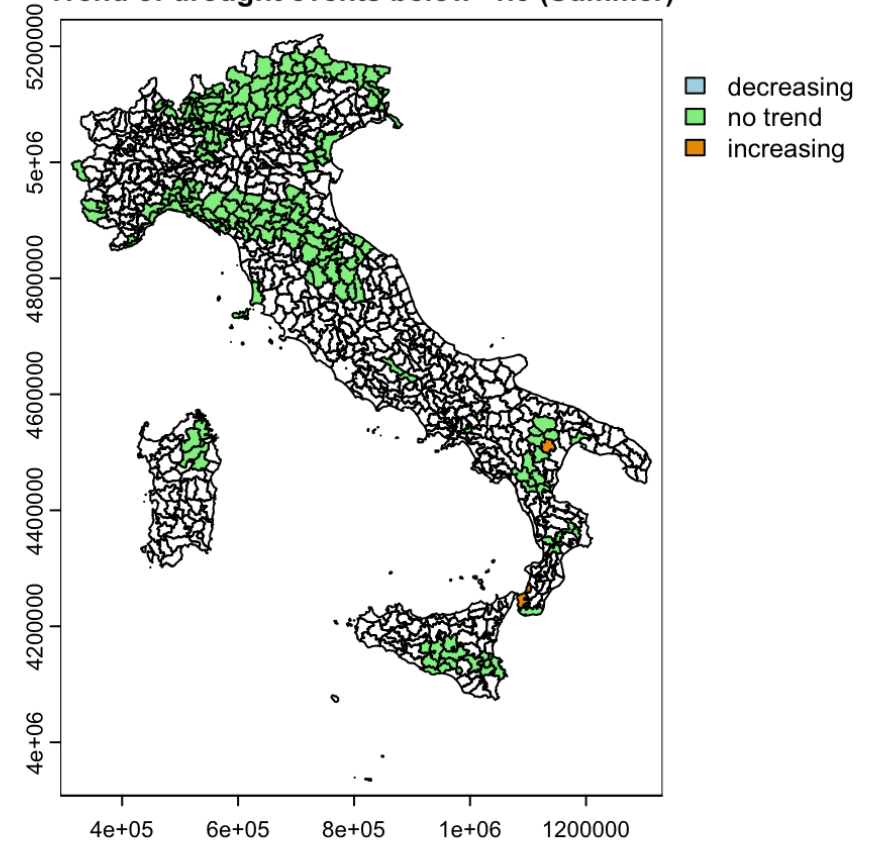


Trend of drought episodes

Trend of drought events below -1 (Summer)



Trend of drought events below -1.5 (Summer)





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Remarks

- ❖ The sequence of critical years for crops (duration)
- ❖ Dynamic settings (Network analysis)



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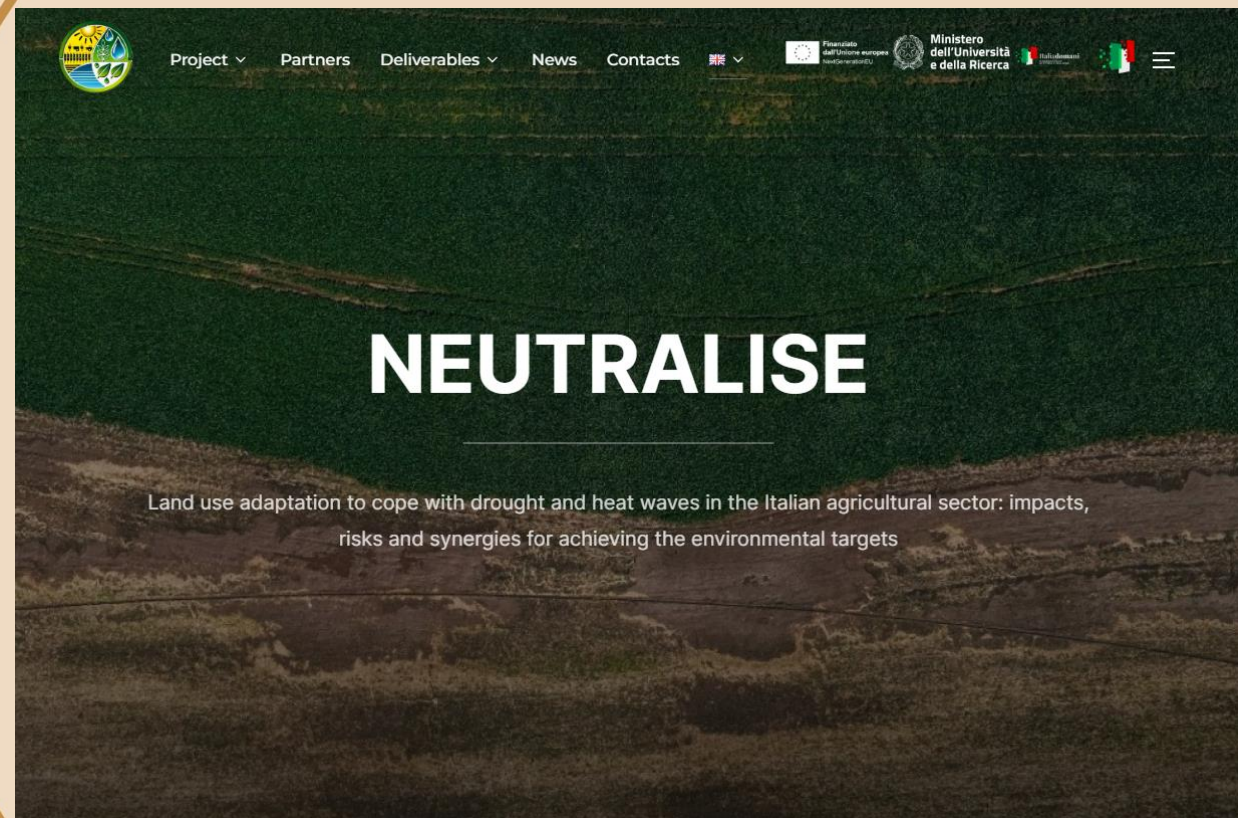


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Thanks for your
attention





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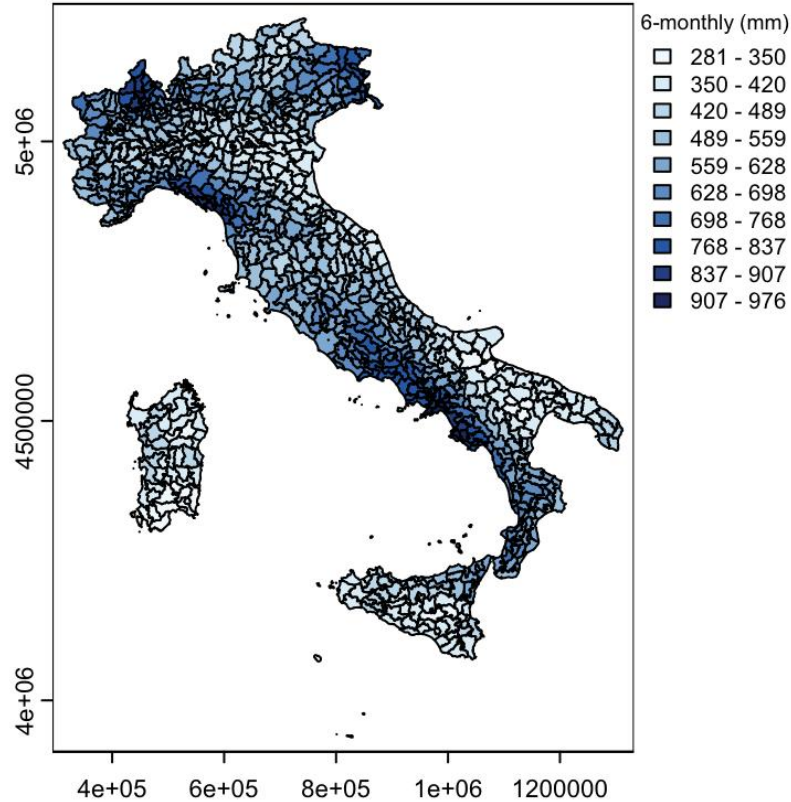
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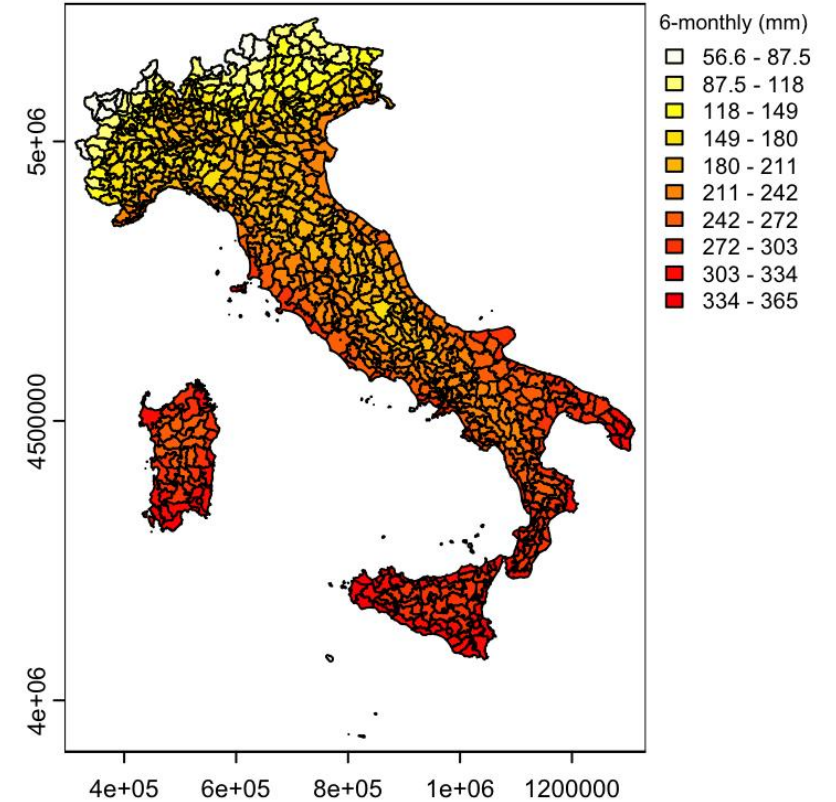
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Precipitation & PET

Averaged Precipitation over 1981-2023 (Winter)



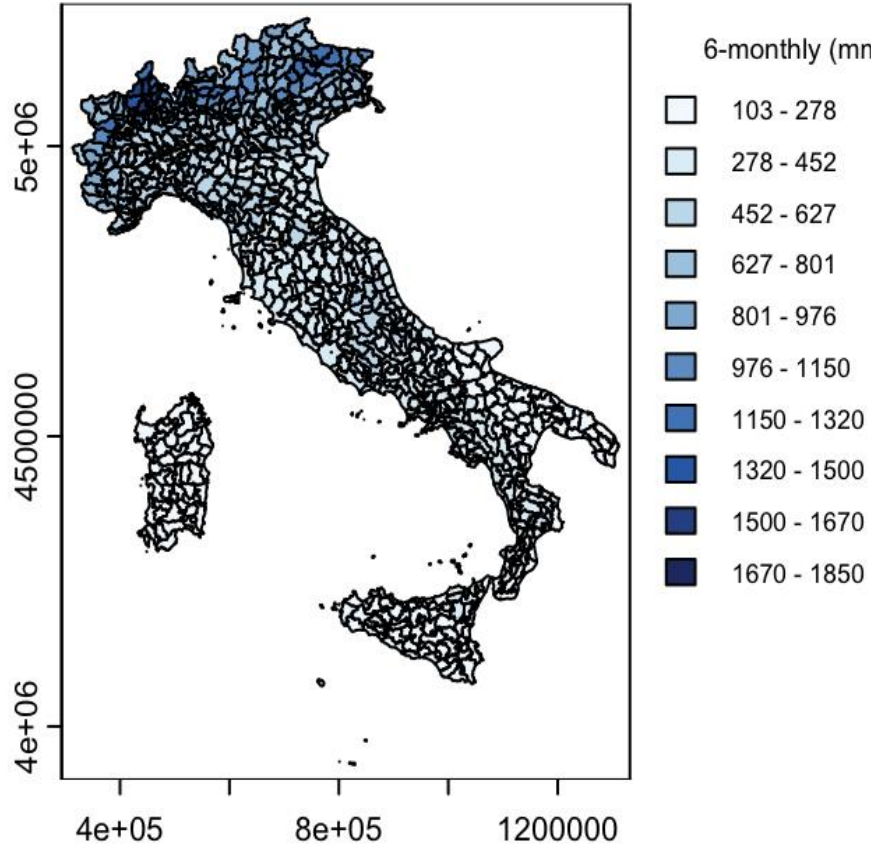
Averaged PET over 1981-2023 (Winter)



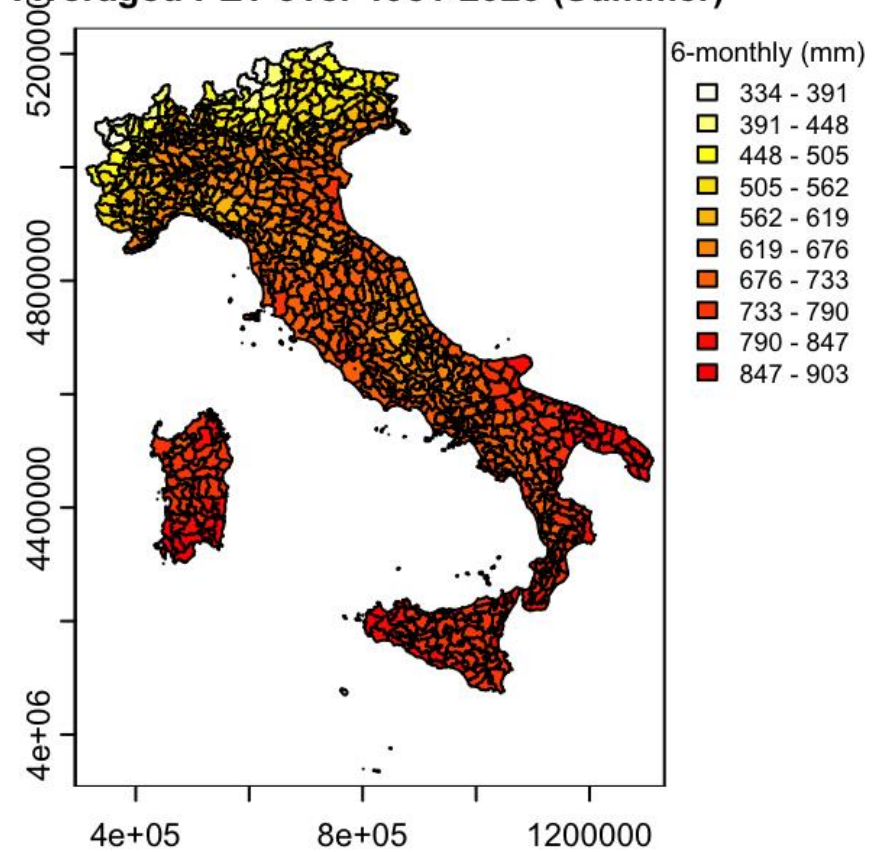


Precipitation & PET

Averaged Precipitation over 1981-2023 (Summer)



Averaged PET over 1981-2023 (Summer)





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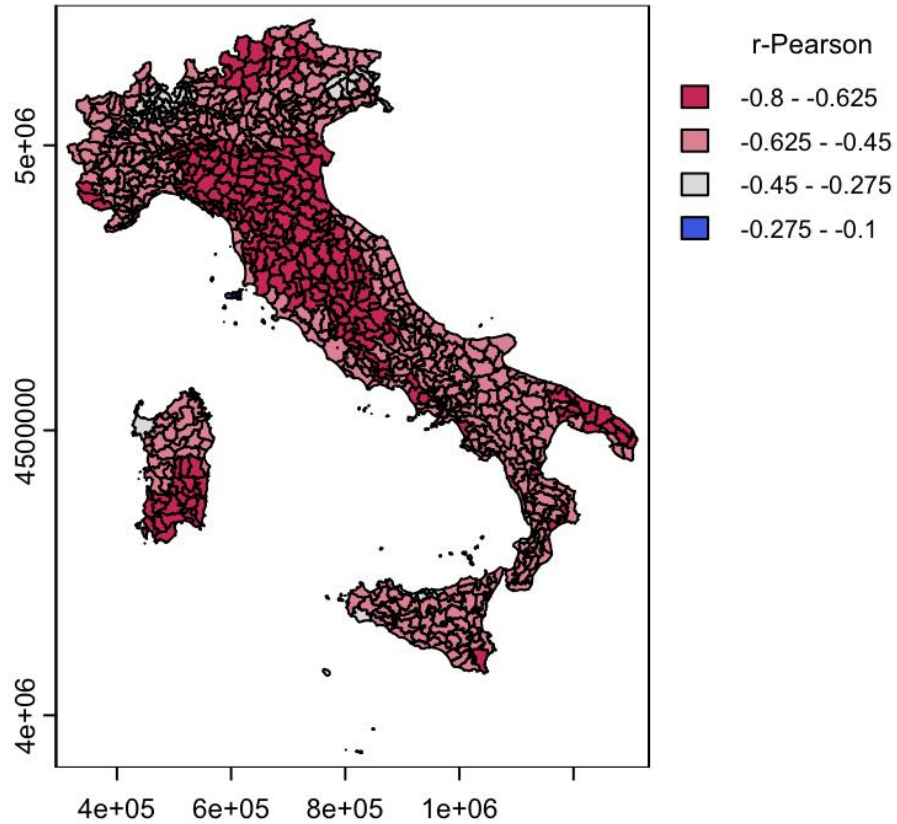
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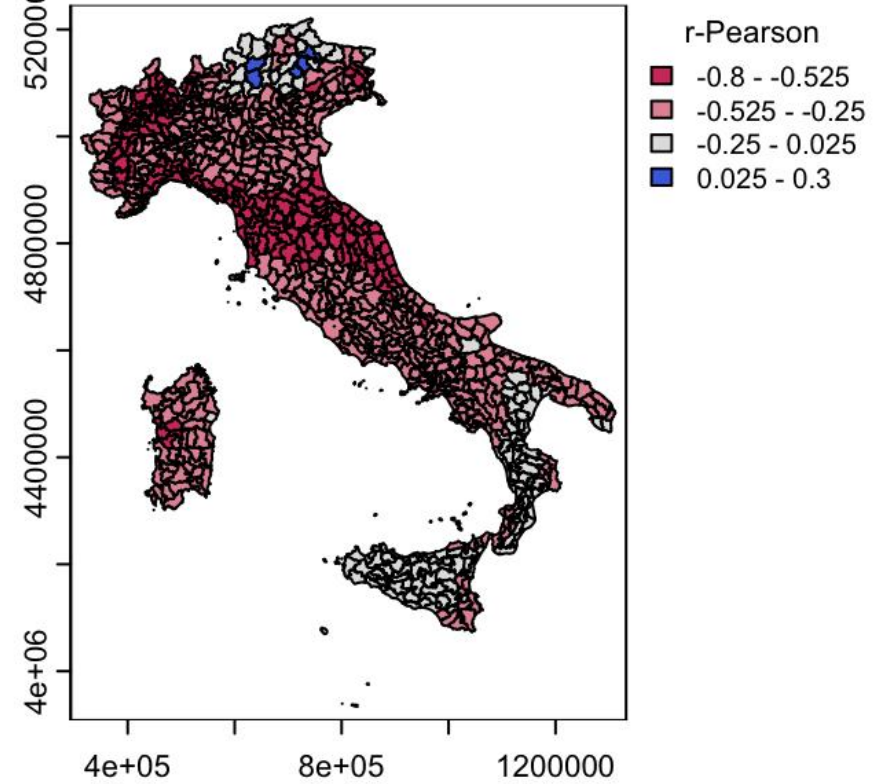
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Correlation Precipitation - PET

PREC - PET correlation (Winter)



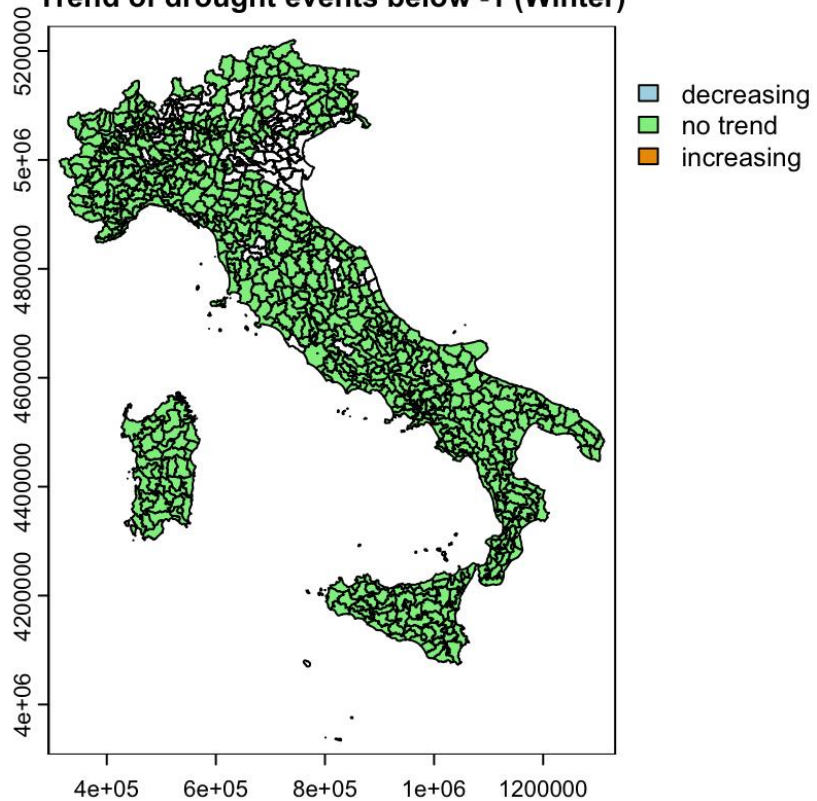
PREC - PET correlation (Summer)



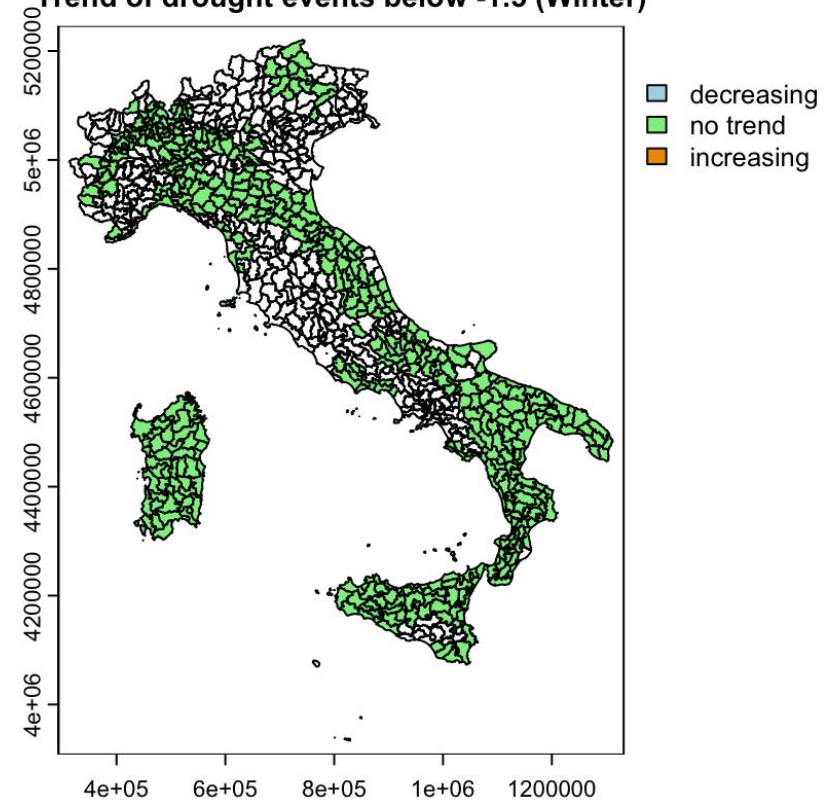


Trend of drought episodes

Trend of drought events below -1 (Winter)



Trend of drought events below -1.5 (Winter)





Severe and Extreme droughts (Summer)

	Year	NagrReg
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5	1993	335
6	2021	323
7	2001	303
8	1985	292
9	2007	276
10	1997	271



	Year	NagrReg
1	2003	485
2	2017	254
3	2022	156
4	2011	150
5	2021	119
6	2007	97
7	1985	88
8	2001	59
9	2006	59
10	1997	51

Number of agricultural regions involved in drought episodes (including Severe and Extreme)

Number of agricultural regions involved in drought episodes (only Severe and Extreme)



Severe and Extreme droughts (Winter)

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8	1992	214
9	1996	190
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3	2002	483
4	2012	236
5	2007	131
6	1992	68
7	2022	62
8	2000	54
9	1995	44
10	1987	40

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Number of agricultural regions involved in drought episodes (only Severe and Extreme)