# FOREST DEGRADATION ASSESSMENT BASED ON TREND ANALYSIS OF MOD44B TREE COVER AND OF HISTORICAL CLIMATE DATA: A CASE STUDY IN THE MEDITERRANEAN BASIN

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# BACKGROUND

Mediterranean forests are an important regional asset, but they are currently subject to threats driven mainly by climate change and increasing demography.

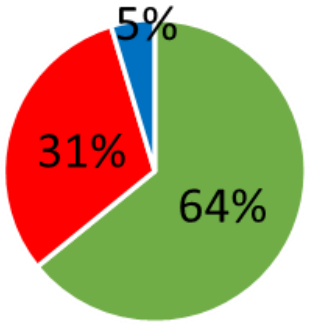
The primary goal of this research was to detect forest change over the last 20 years in Sardinia, one of the main centers of remaining biodiversity in the Mediterranean basin

The secondary was to detect any possible relationship with some of the most important climate variables.

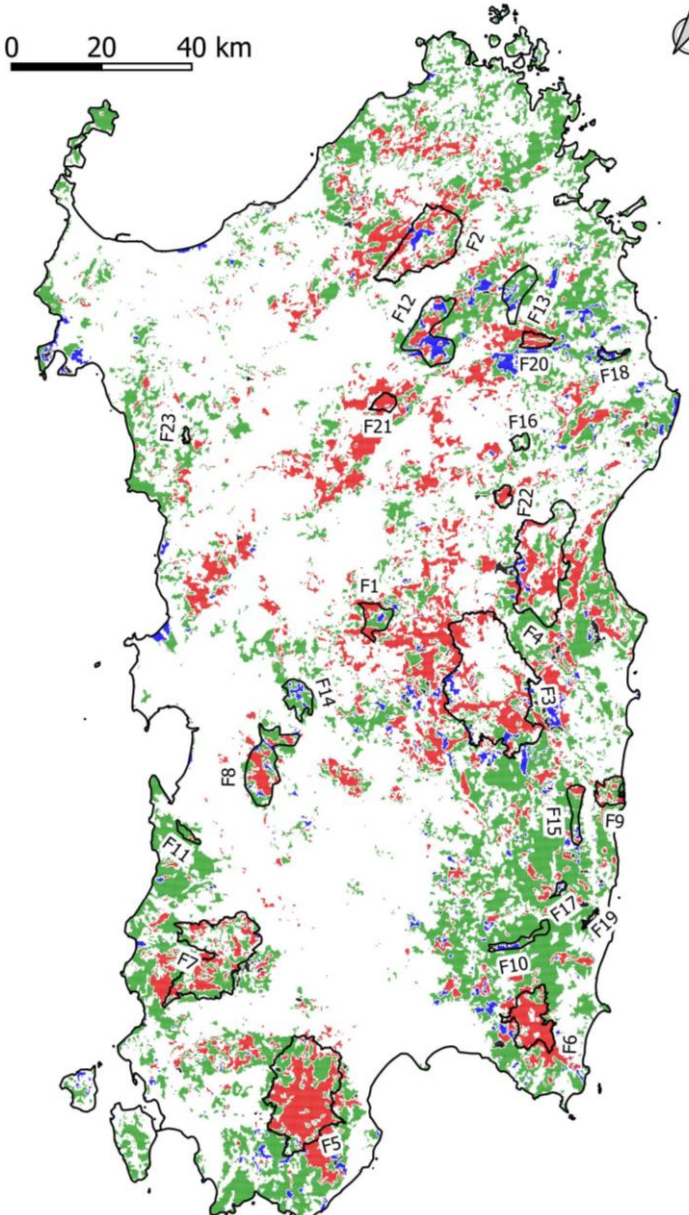
Marganai Forest – Sardinia
22/09/2017

# METHODS 1/2

The relatively low urbanization and human activity had already made the island of Sardinia (24100 km2), located in the middle of the Mediterranean basin, an excellent reference condition for hydrological studies on past and future climate change.



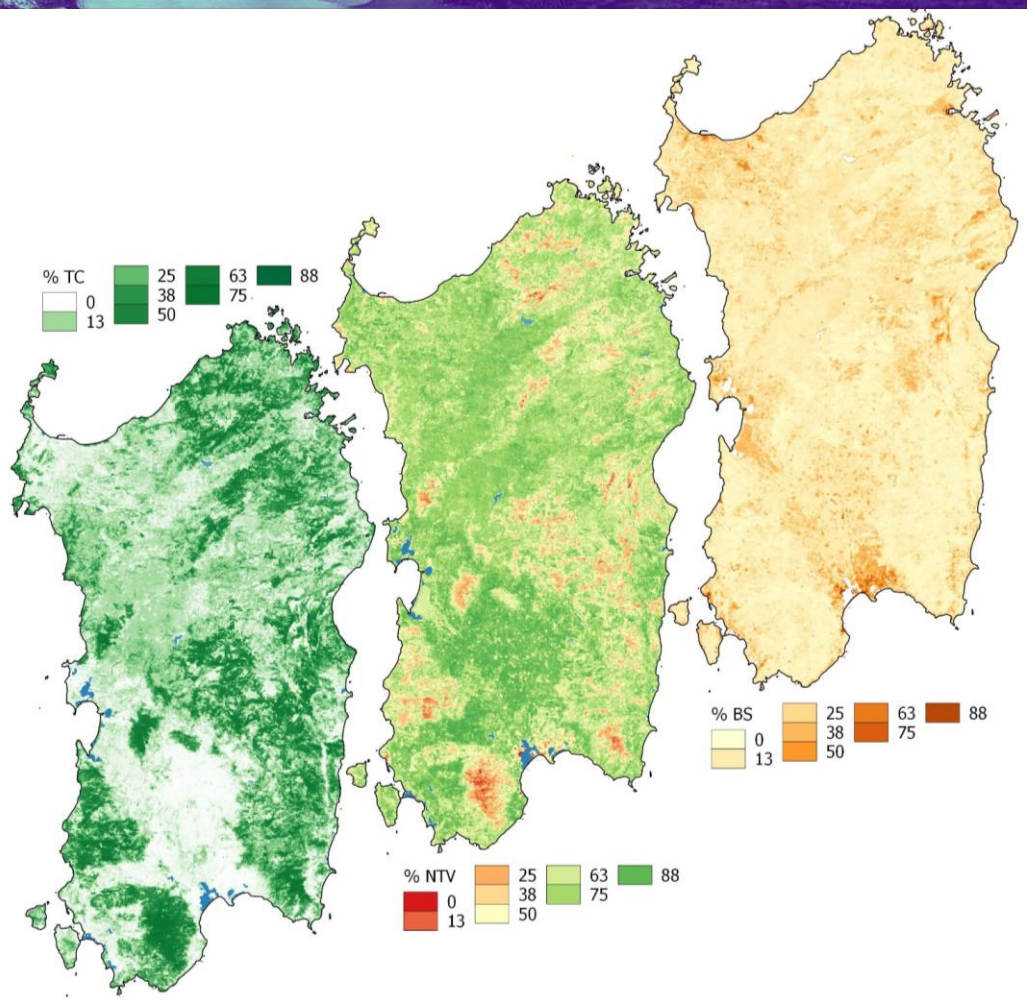

**Forest Type**
- Broad leaved Forest (BLF)
- Coniferous Forest (CF)
- Bushy Sclerophyllous Vegetation (BSV)



# METHODS 2/2

Evaluation of long-term trends for:

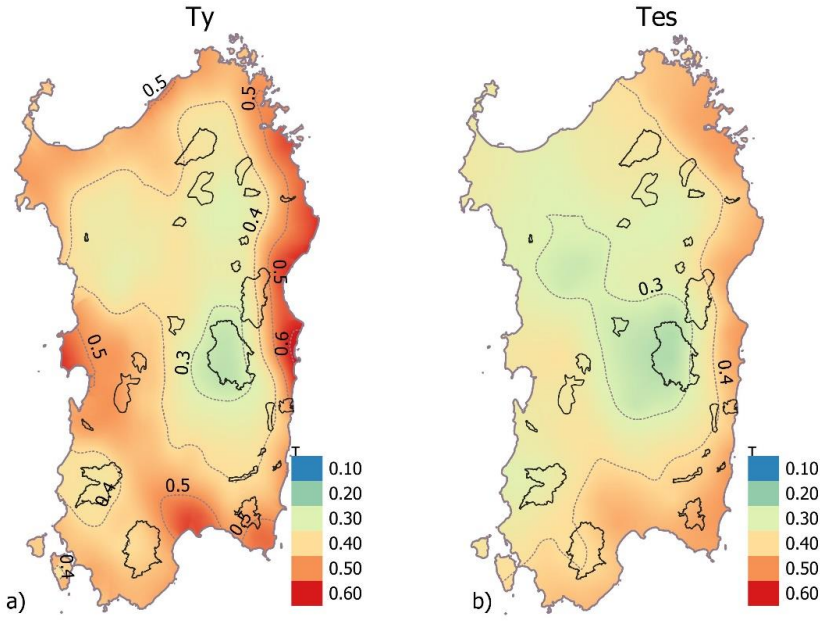
- **Tree Cover Percentage**: yearly product (2000-2020) from **MOD44B** Version 6-Vegetation Continuous Fields (VCF);
- **Precipitation:** daily precipitation (1922-2019) from Sardinian rain gauge stations;
- **Air temperature**: ERA 5 reanalysis dataset from 1980-2019 (monthly);
- **Vapor pressure deficit:** 1980-2019 monthly from ERA5 dataset analysis;

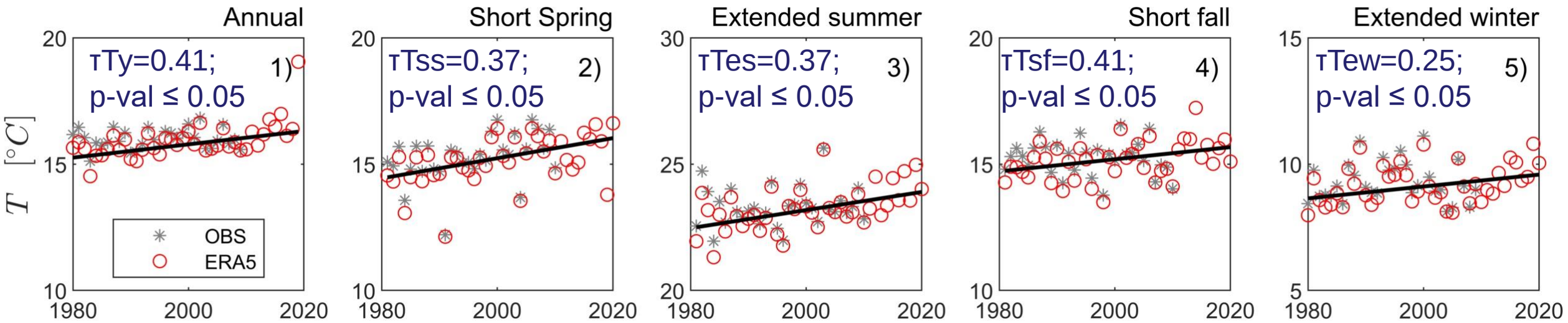



Time series were statistically analyzed on an annual and seasonal base. Trends were estimated using the ***Mann-Kendall non-parametric test*** (*Kendall, 1938*), while the slope of linear trend has been estimated with the ***Theil-Sen method*** (*Sen, 1968; Theil, 1992*).

# AIR TEMPERATURE

Monthly near surface air temperature data from the ERA5 reanalysis dataset for the 40-year period 1980–2019 period were used to evaluate more recent trend in air temperature and to calculate the vapour pressure deficit over time.



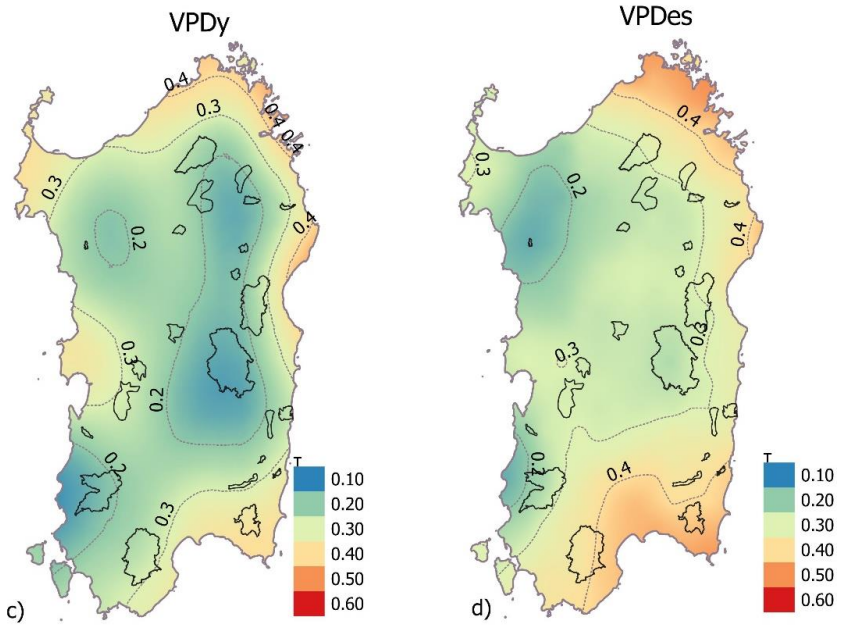



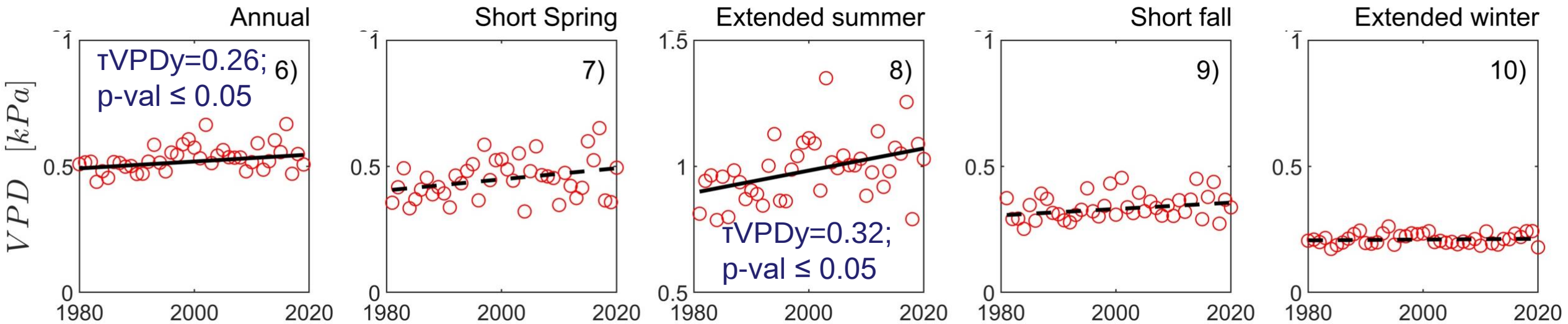
# VAPOR PRESSURE DEFICIT

VPD has been calculated by using the ERA5 monthly near surface air temperature (T ) and dew point (Td), from the following equation (Barkhordarian et al., 2019):

$$VPD = c_1 * \exp\left(\frac{c_2 * T}{c_3 + T}\right) - c_1 * \exp\left(\frac{c_2 * Td}{c_3 + Td}\right)$$

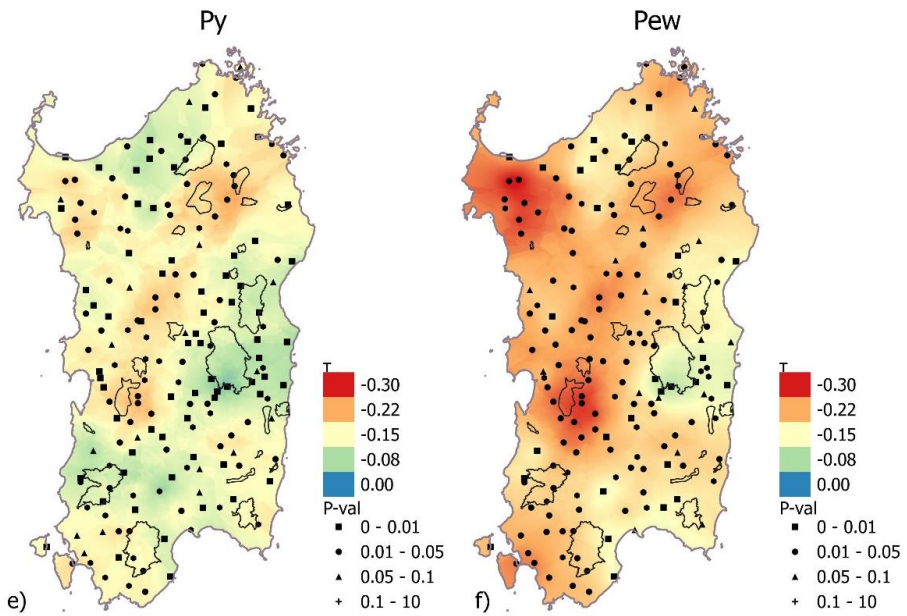
$c_1$=0.611 Kpa, $c_2$=17.5, $c_3$=240.978°C.

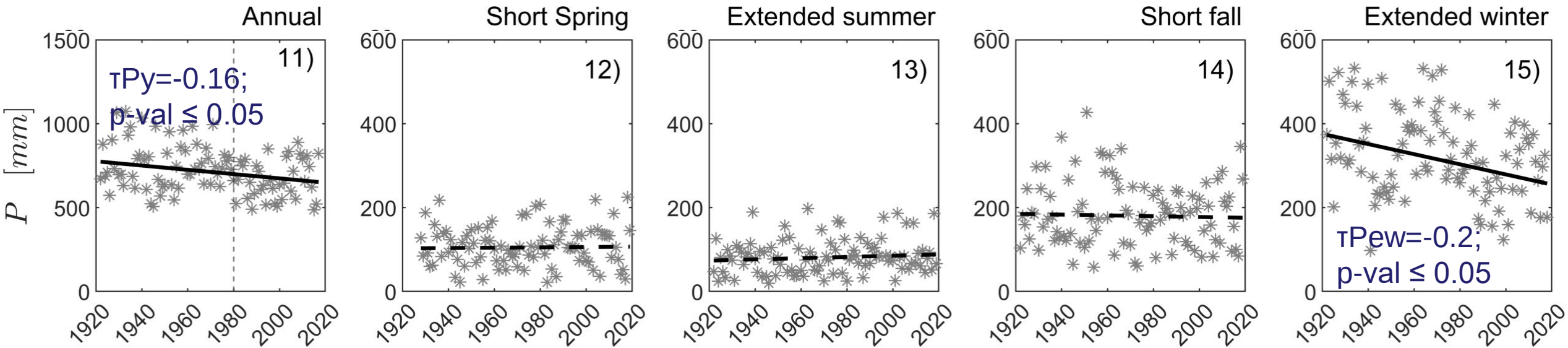


# PRECIPITATION

The statistical analysis of precipitation has been done by analyzing data coming from 179 rain-gauge stations for the period 1922-2018. Selected rain gauge have at least 60 complete years of data.



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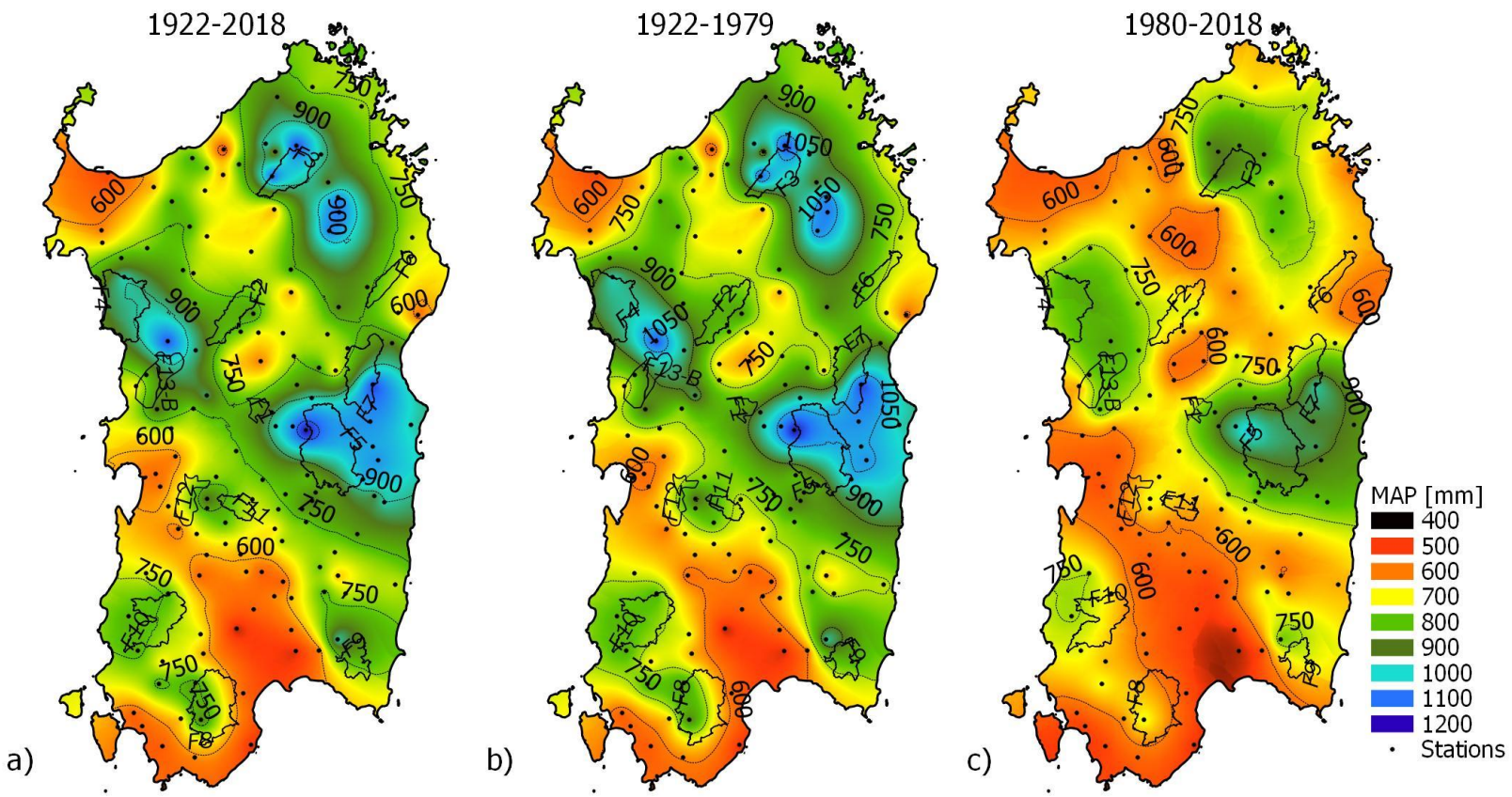
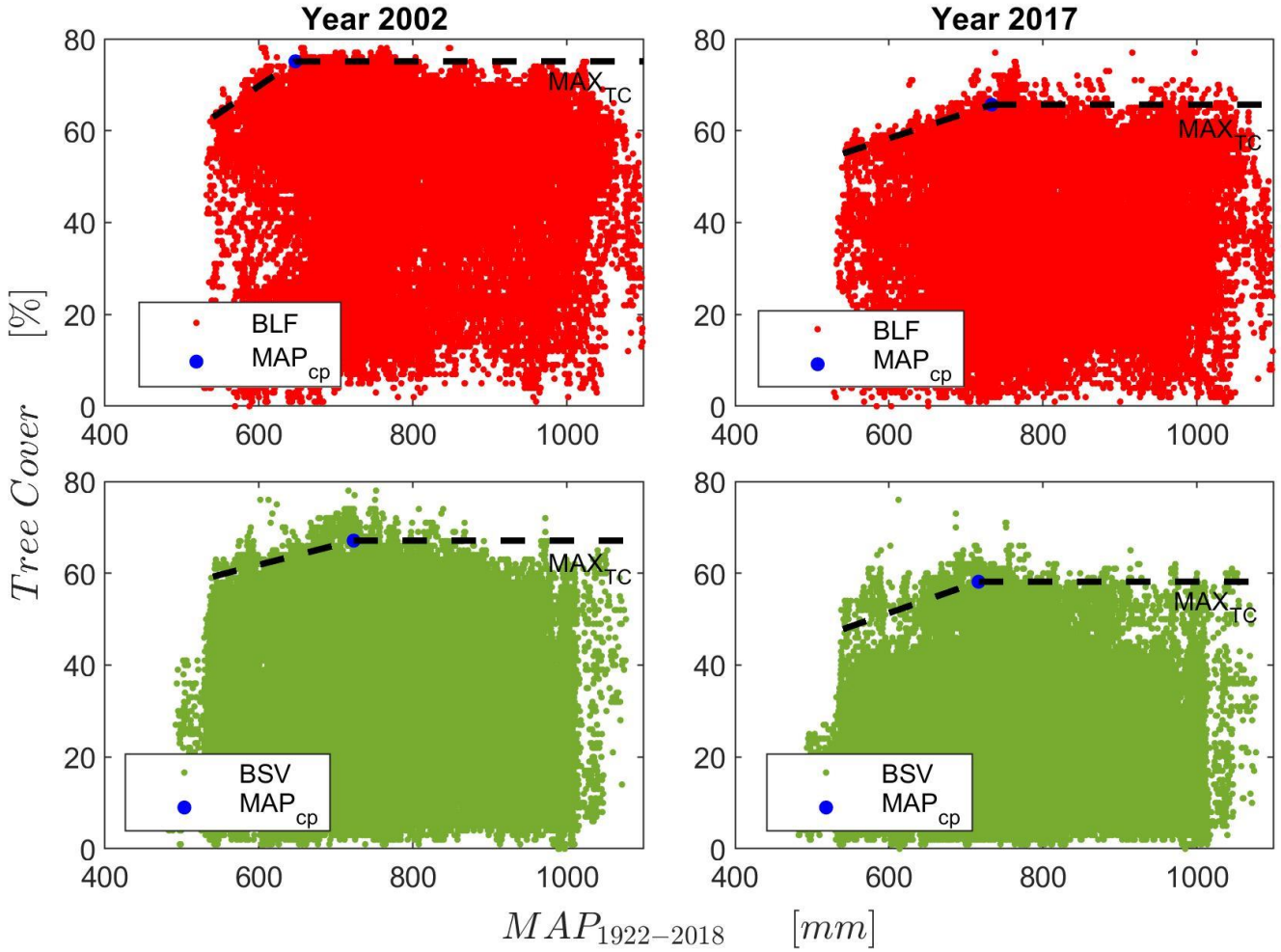



| MAP [mm/y] | < 700 | > 700 |
|---|---|---|
| 1922-1980 | 26% | 74% |
| 1980-2018 | 62% | 38% |

# RELATIONSHIP BETWEEN TREE COVER AND $MAP_{1922\text{-}2018}$




The value of $MAP_{cp}$ during the 2000 -2019 period is:

- 665.66 ± 70.30 mm $MAP_{1922\text{-}2018}$ for BLF
- 842 ± 126.26 mm $MAP_{1922\text{-}2018}$ for BSV

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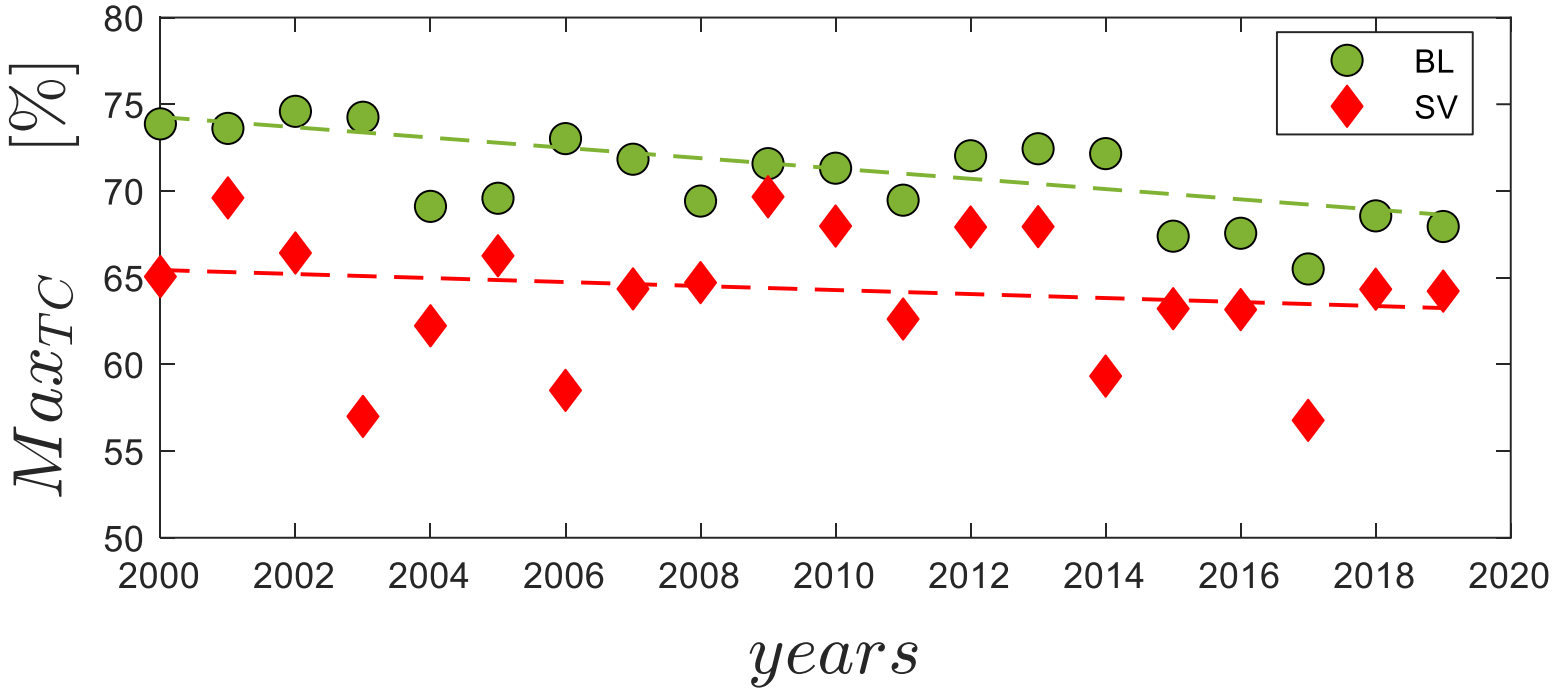
# RESULTS

Maximum tree cover of broad-leaved vegetation:

- $\tau_{MAXTC}$ = -0.49
- P-value<0.005
- $\beta_{MAX\_TC}$ = -0.3 %/y

Maximum tree cover of Sclerophyllous vegetation:

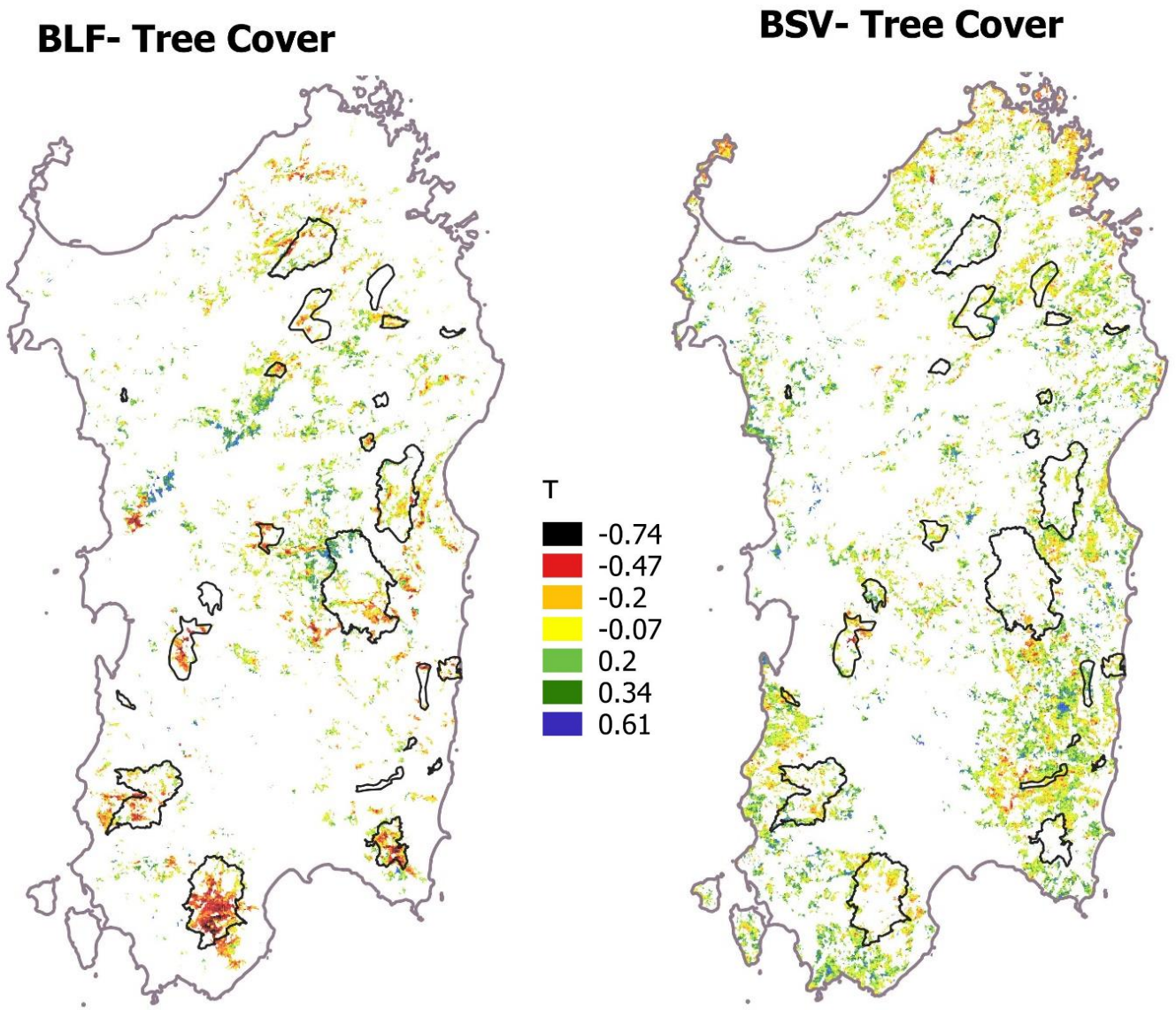
- $\tau_{MAXTC}$ = -0.14
- pvalue= 0.38
- $\beta_{MAX\_TC}$ = -0.11%/y



# RESULTS

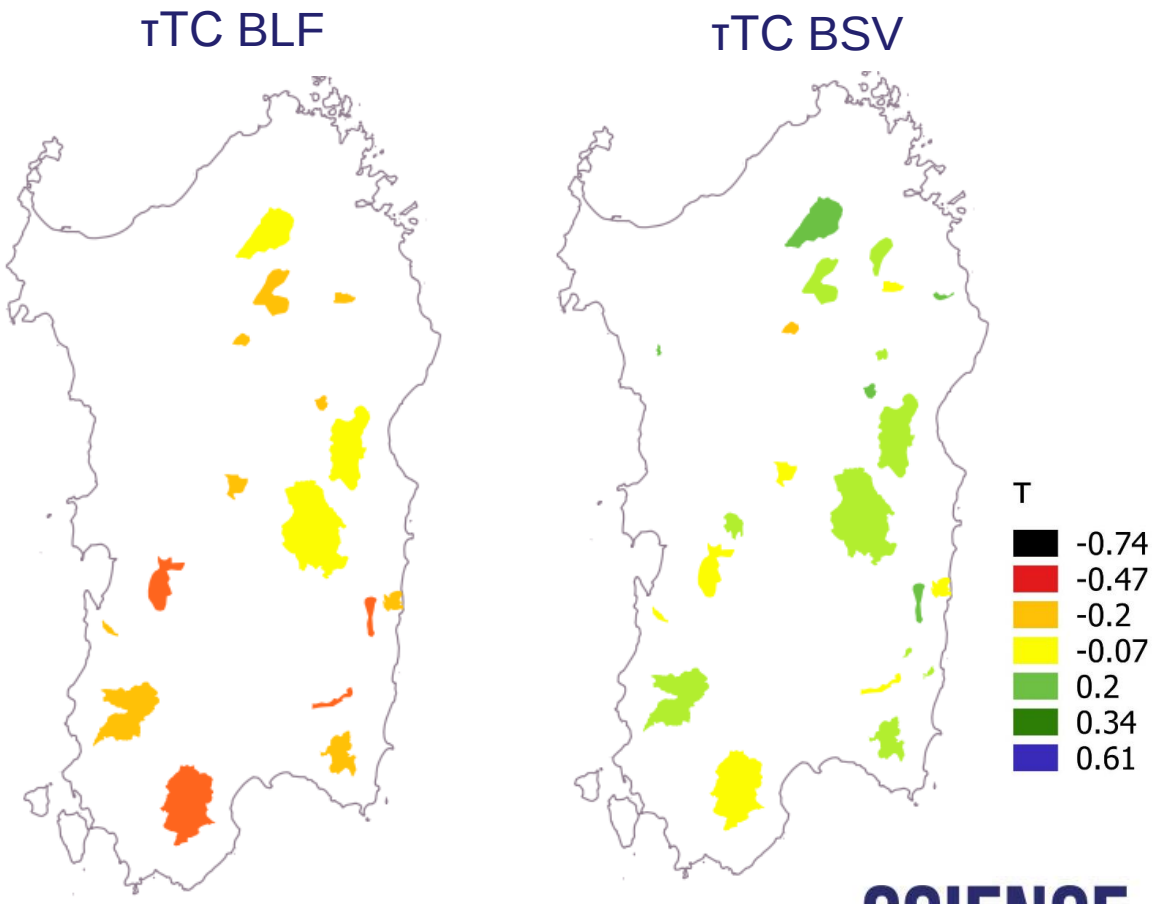
- The 58.07 % of the observing plots show no trend in tree cover;
- The 30.8 % of the observing plots show a positive trend in tree cover;
- The 11.1 % of the observing plots a negative trend in tree cover;

The 70.5% of the plots that shows a significant negative trend in TC (β mean slope of -0.72 %TC*y-1) are classified as broad -leaved forest and are mainly located in the southern part of the island. Negative trend in TC is countered by an increase in vegetation with a height of less than 5m.



# ANALYSIS AT THE FOREST SCALE

The correlation between τTC and the climatic variables within each forest, has been measured using the Pearson's correlation coefficient.



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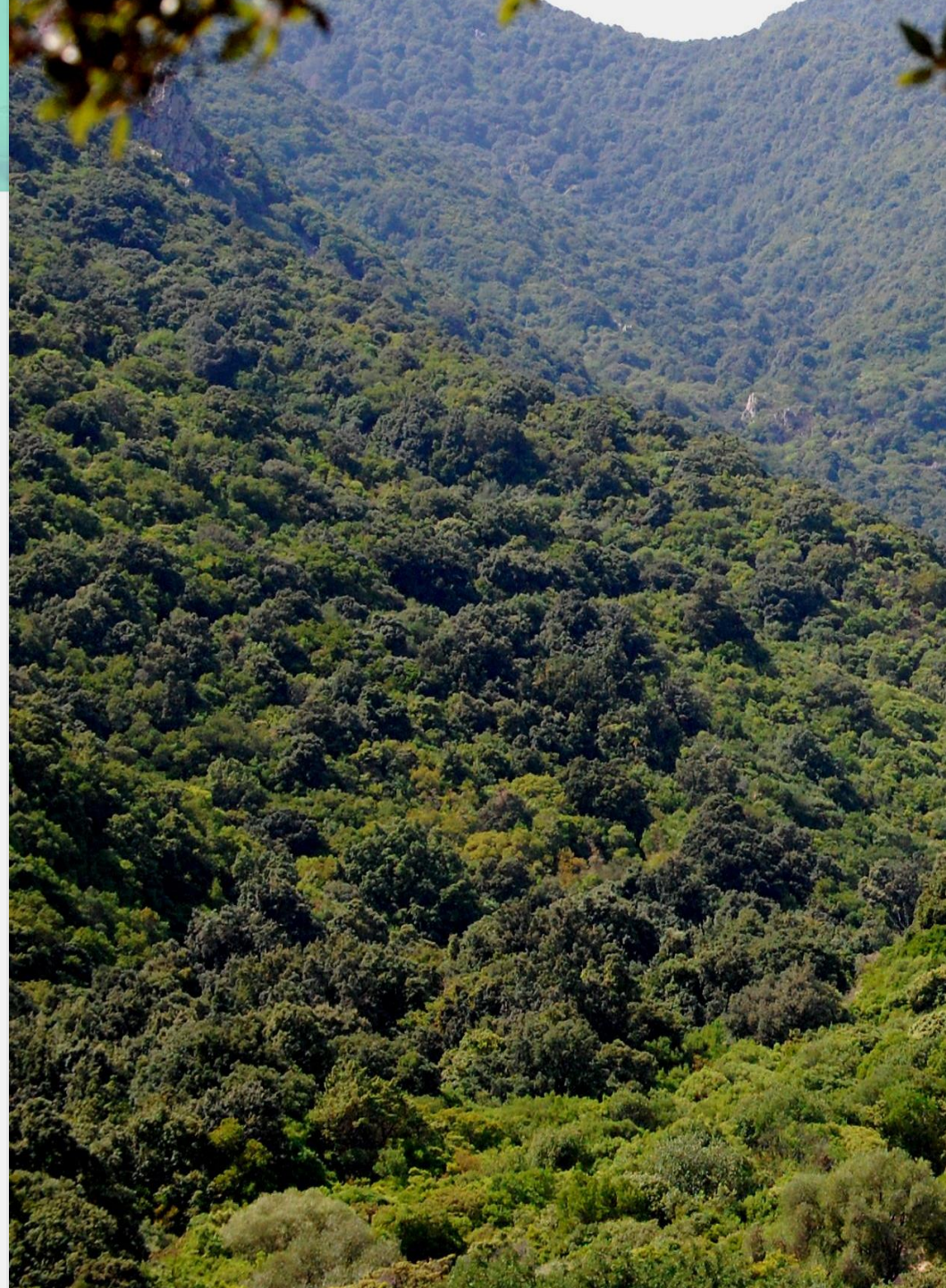
# CONCLUSION

MOD44B dataset has been used to estimate the long-term trend of tree cover over Sardinia's island.

Results shows that in the last 40 years Sardinia has experienced a simultaneous increase in air temperatures and VPD combined with reductions in both total precipitation and winter precipitation, and that the areas with **$MAP_{1980\text{-}2018}$ lower than 700 mm have become the 61.5 % of the entire island**.

In the presence of a decreasing trend in precipitation opposed to an increasing trend in VPD and air temperature the broad-leaved forests respond by reducing the TC and increasing the NTC. On the contrary, BSV shows an increase in TC.



# THANK YOU

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