

# Effects of climate change on droughts in the Valais region under the new CH2018 scenarios

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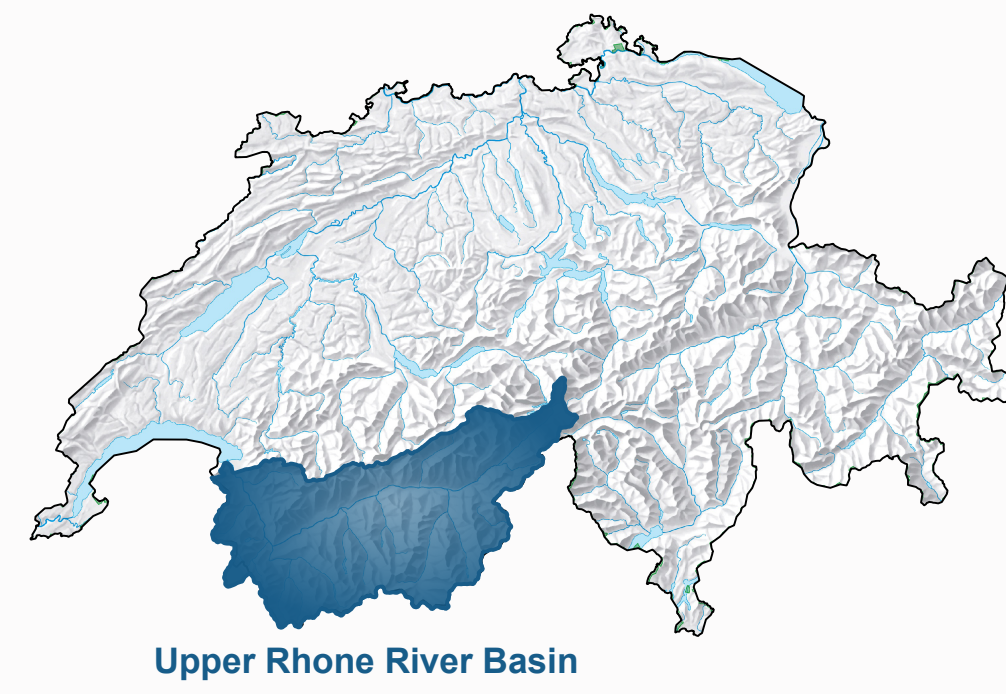
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## INTRODUCTION

The use of **drought indices** helps to detect and monitor events at different timescales.

Moreover, **climate change** is susceptible to alter the rainfall deficiency patterns and thus **impact on the occurrence of drought events**.

What are the effects of climate change on the drought indices at the Rhone River Basin?

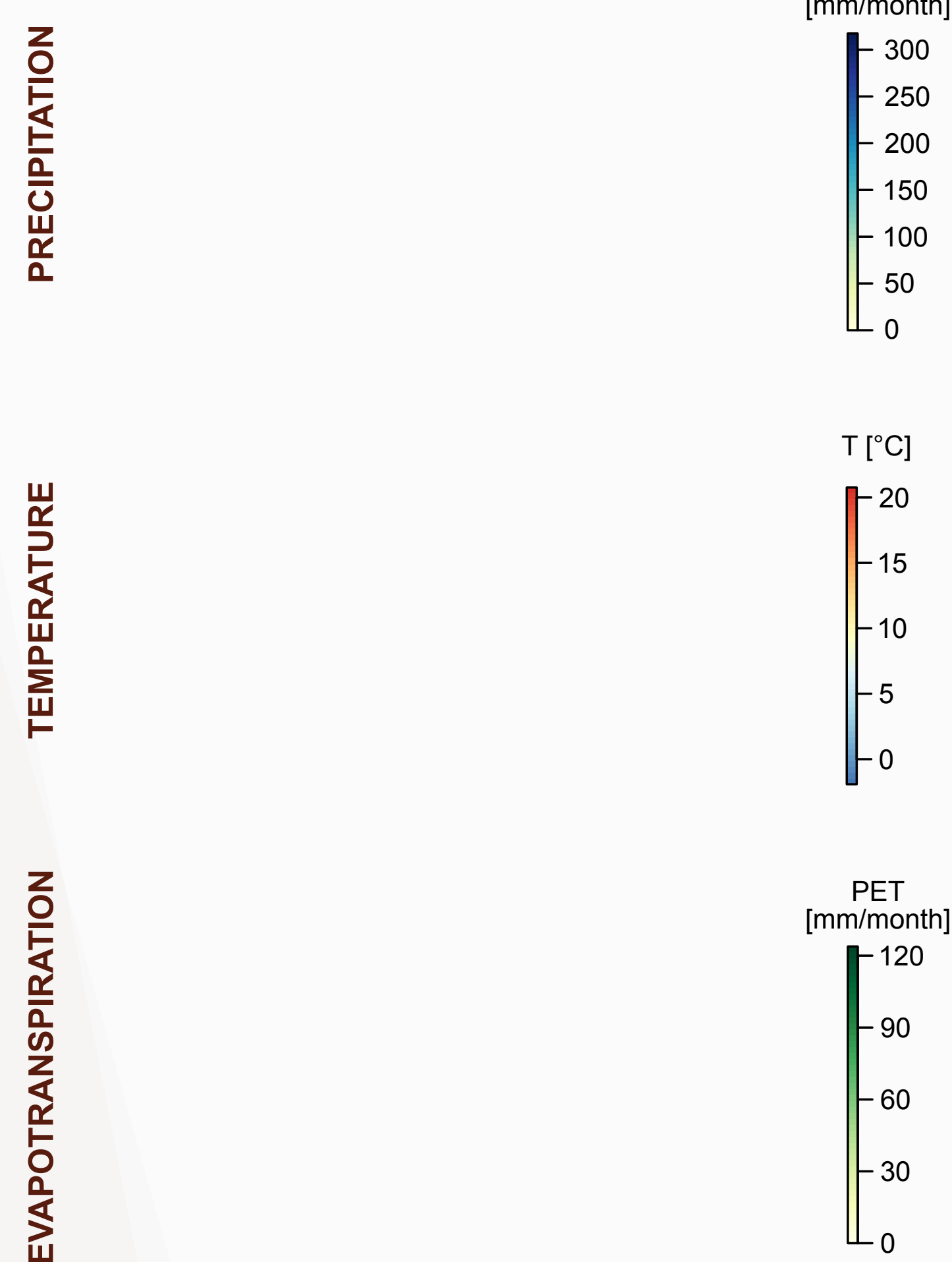


Upper Rhone River Basin

## METHOD

### I RECOLLECTION OF PROJECTED DATA (P, T, PET)

- Projections from the **CH2018 scenarios** (Swiss Climate Scenarios CH2018, 2018).
- Three emissions scenarios (**RCP 2.6, RCP 4.5, RCP 8.5**) and 21 climate models.
- **Gridded data** (2 km x 2 km) with 1473 pixels for the Rhone River Basin
- Period: **1981 - 2100**.
- Extraction of **Precipitation (P)** and **Temperature (T)** projections.
- Estimation of the **Potential Evapotranspiration (PET)** series according to the Thornthwaite equations.



Projected P, T and PET data for June 2032 according to the SMHI-RCA-CCCMA model and the RCP8.5 scenario.

### II CALCULATION OF THE STANDARDIZED EVAPOTRANSPIRATION INDEX (SPEI)

The SPEI uses P and PET data to quantify its deficit for **multiple timescales**. It enables to detect drought events by defining their **magnitude, intensity and duration**. SPEI values are calculated at **each pixel** of the grid (reference period: 1981-2010).

SPEI	Classification
≥ 2.0	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-0.99 to 0.99	Near normal
-1.49 to -1.0	Moderately dry
-1.99 to -1.5	Severely dry
≤ -2.0	Extremely dry

Classification of drought conditions according to the SPEI values.



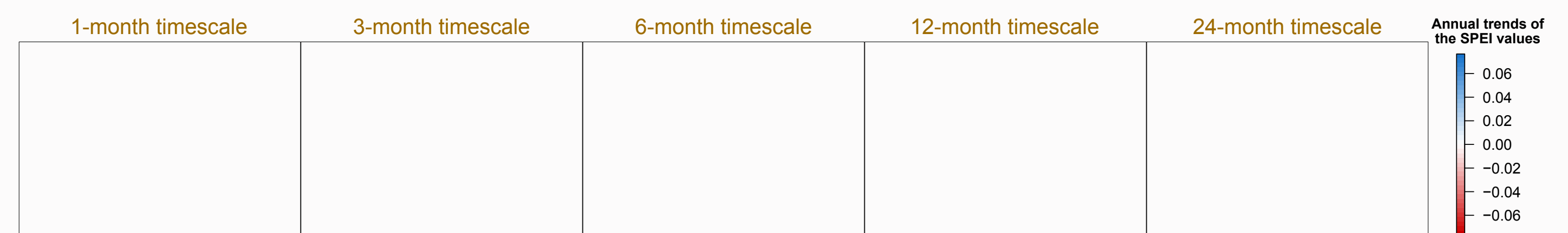
Projected SPEI-12 values for June 2032 according to the SMHI-RCA-CCCMA model and the RCP8.5 scenario.

### III TREND ANALYSIS OF THE SPEI SERIES

The Mann-Kendall test (Gilbert, 1987) is used to identify **statistically significant annual trends** ( $\alpha=0.05$ ) in the series of SPEI values at each pixel (for different timescales). **Positive trends** indicate that climatic conditions become **wetter** with time, while **negative trends** indicate **drier** conditions.

## RESULTS

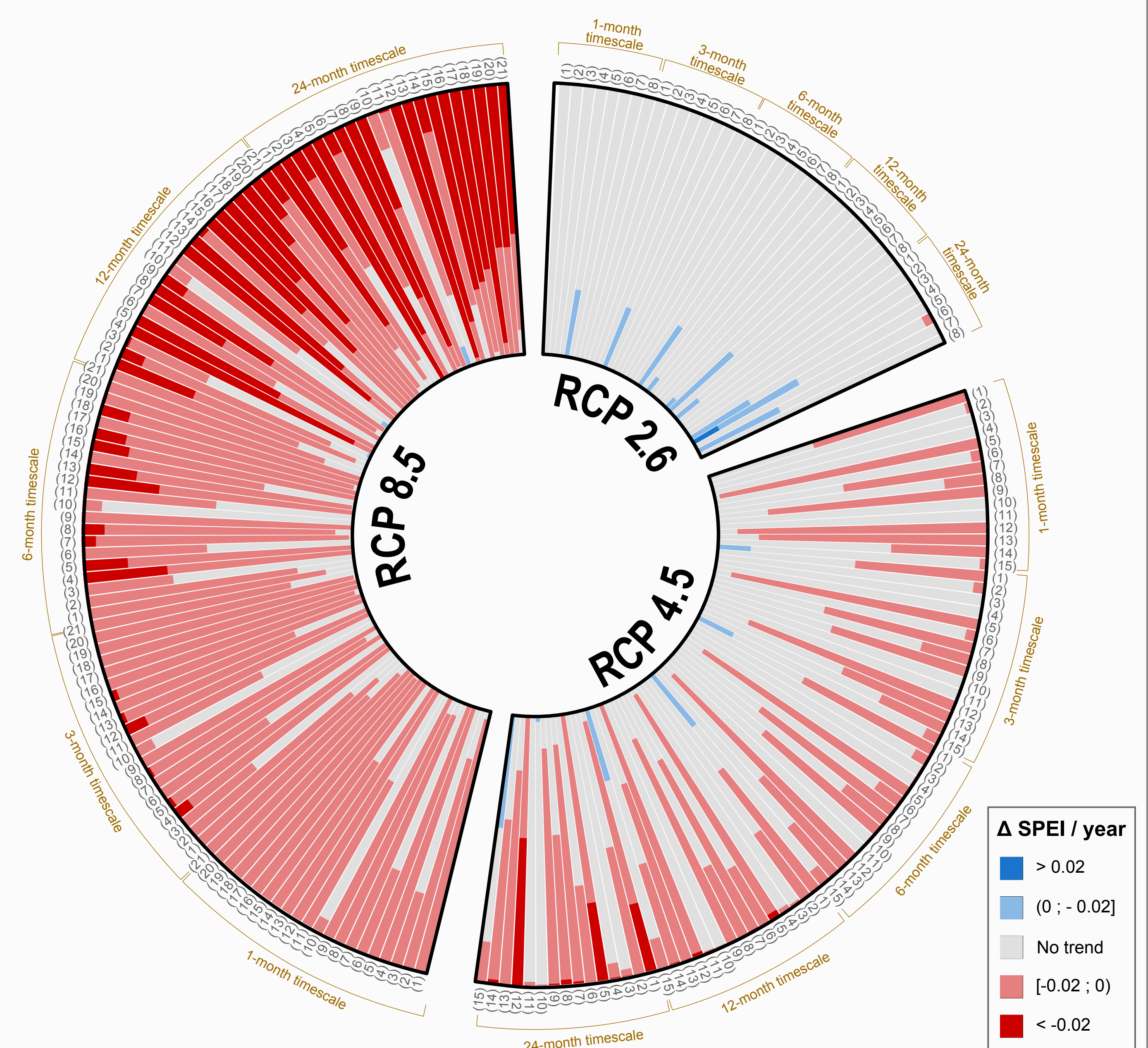
### Trends of the SPEI values between 2010 and 2100



Variation of the SPEI annual trends with the timescale, for the SMHI-RCA-CCCMA model and the RCP 8.5 scenario.

In the following histogram, each bar represents the number of pixels with **increasing** (blue), **decreasing** (red) or **no significant trend** (grey) of the SPEI values calculated for the entire period 2010-2100.

The histogram bars are classified by **RCP scenario**, **timescale** and (climate model).

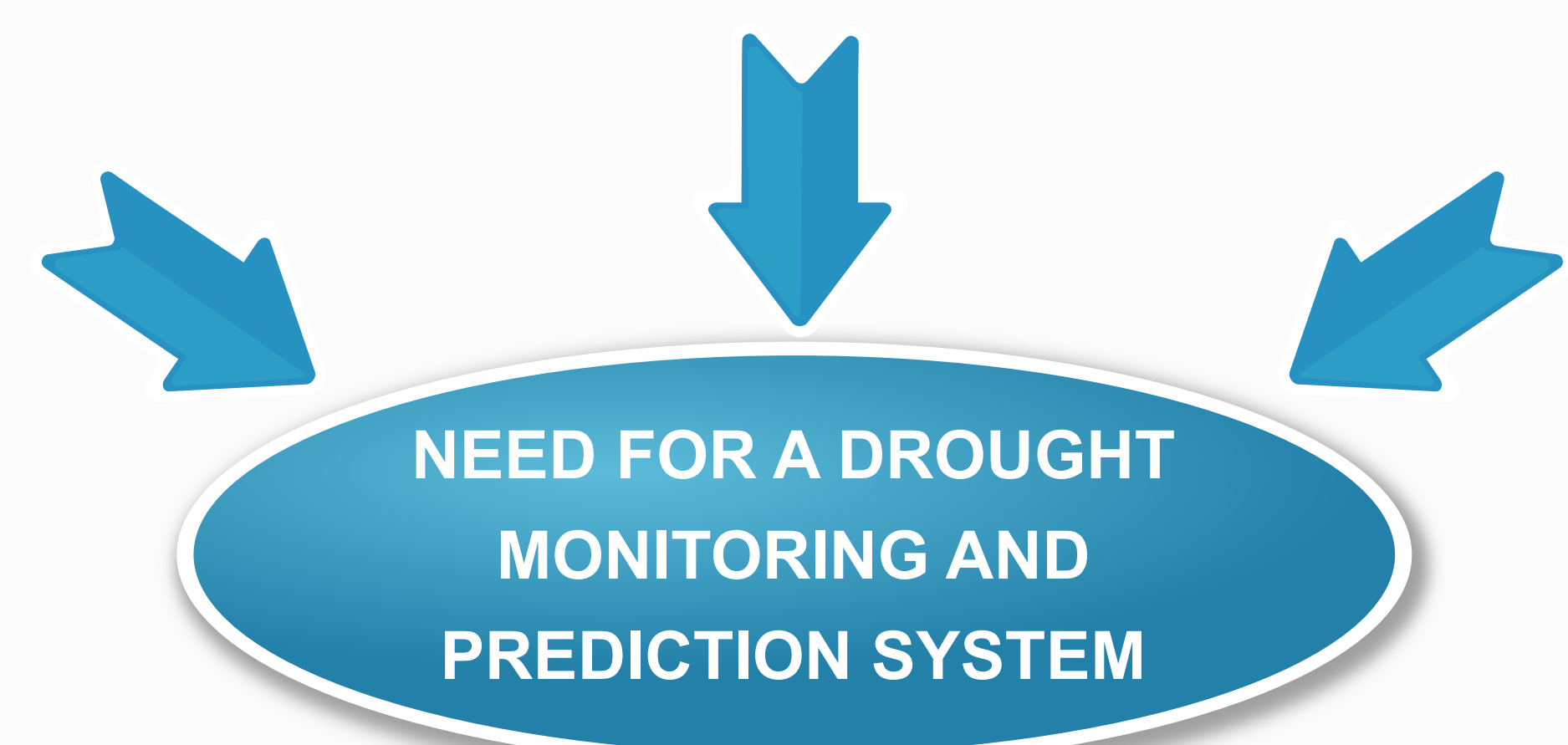


#### CLIMATE MODELS:

- |                        |                         |                           |
|------------------------|-------------------------|---------------------------|
| (1) KNMI-RACMO-HADGEM  | (8) SMHI-RCA-NORESM     | (15) SMHI-RCA-IPSL        |
| (2) MPCSC-REMO1-MPIESM | (9) CLMCOM-CCLM4-MPIESM | (16) CLMCOM-CCLM4-HADGEM  |
| (3) MPCSC-REMO2-MPIESM | (10) DMI-HIRHAM-ECEARTH | (17) CLMCOM-CCLM5-ECEARTH |
| (4) SMHI-RCA-ECEARTH   | (11) KNMI-RACMO-ECEARTH | (18) CLMCOM-CCLM5-HADGEM  |
| (5) SMHI-RCA-HADGEM    | (12) SMHI-RCA-CCCMA     | (19) CLMCOM-CCLM5-MIROC   |
| (6) SMHI-RCA-MIROC     | (13) SMHI-RCA-CSIRO     | (20) CLMCOM-CCLM5-MPIESM  |
| (7) SMHI-RCA-MPIESM    | (14) SMHI-RCA-GFDL      | (21) ICTP-REGCM-HADGEM    |

## CONCLUSIONS

This study shows **negative trends of the SPEI index** in the Upper Rhone River Basin (in particular for the **RCP 4.5** and **RCP 8.5** scenarios), which reveals a **deterioration of climatic conditions** in the 21<sup>st</sup> century that may result in drier periods and an increasing risk of drought occurrence.



#### References

- Gilbert, R.O., 1987: Statistical methods for environmental pollution monitoring. Wiley, New York.
- Swiss Climate Scenarios CH2018, 2018 ([www.climate-scenarios.ch](http://www.climate-scenarios.ch)).
- Vicente-Serrano, S.M., Beguería, S. & López-Moreno, J.I., 2010: A multi-scalar drought index sensitive to global warming: The Standardized Precipitation Evapotranspiration Index - SPEI. Journal of Climate 23: 16961718.