



# Climate of the 6th Century based on the Fully Forced Regional Climate Model COSMO - CLM over the Eastern Mediterranean and the Nile

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## Introduction

Understanding how past societies responded to extreme climate conditions is important for gaining insight into current and future climate. The Eastern Mediterranean (EM) and the Nile River basin (NR) are ideal areas for interdisciplinary natural scientific and historical studies and modelling experiments due to the abundance of proxy and historical data in the last millennium.

The 6<sup>th</sup> century AD is of particular interest from both a historical and scientific perspective, as it coincides with a period of prosperity for the Eastern Byzantine Empire and political stability, but which also experienced a plague pandemic and significant climate variability in parallel as a result of a major cluster of volcanic eruptions.

## Method

- The RCM COSMO-CLM is used in this study in an adjusted paleoclimate version, with orbital, solar, GHG, volcanic and land-use forcings.
- The new MPI-ESM-LR simulation 'Mythos' that is performed under the CMIP6 protocol (MPI-ESM-LR 'past2k') (Jungclaus et al., 2017) at ~1.875° resolution acts as the boundary data.

Table 1. COSMO-CLM setup

Parameter	Settings
Model version	COSMO-CLM v5.0_clm16
Interpolation	INT2LM v2.05_clm1
External Data	transient using MPI-ESM output
Driving model	MPI-ESM with CMIP6-PMIP4 settings
Grid size	0.44°
Period	500BCE - 1850CE

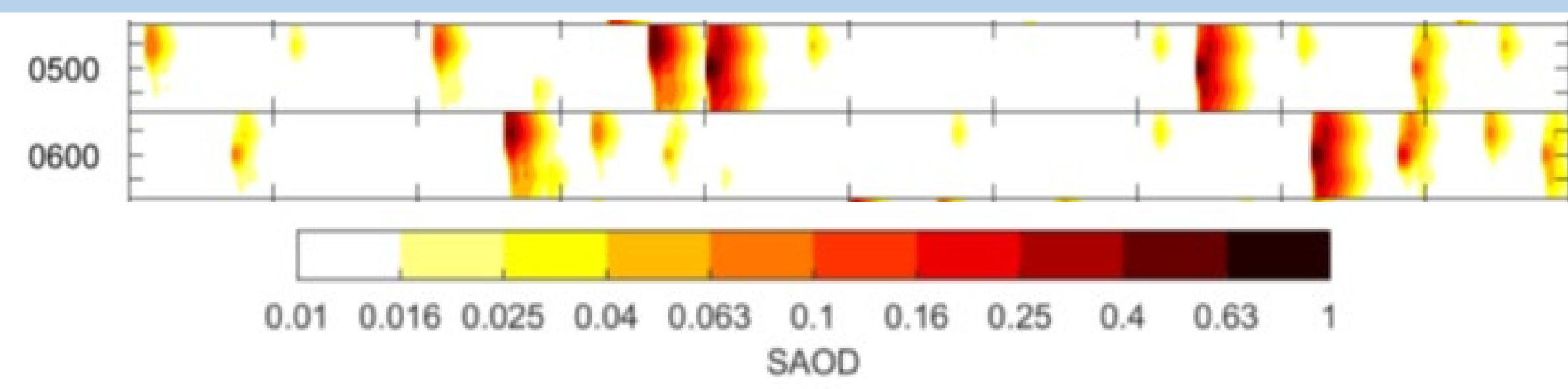


Figure 1. Stratospheric aerosol optical depth, representing the volcanic eruptions, during the 6th-7th century from Tooeha et al, 2016

## Results

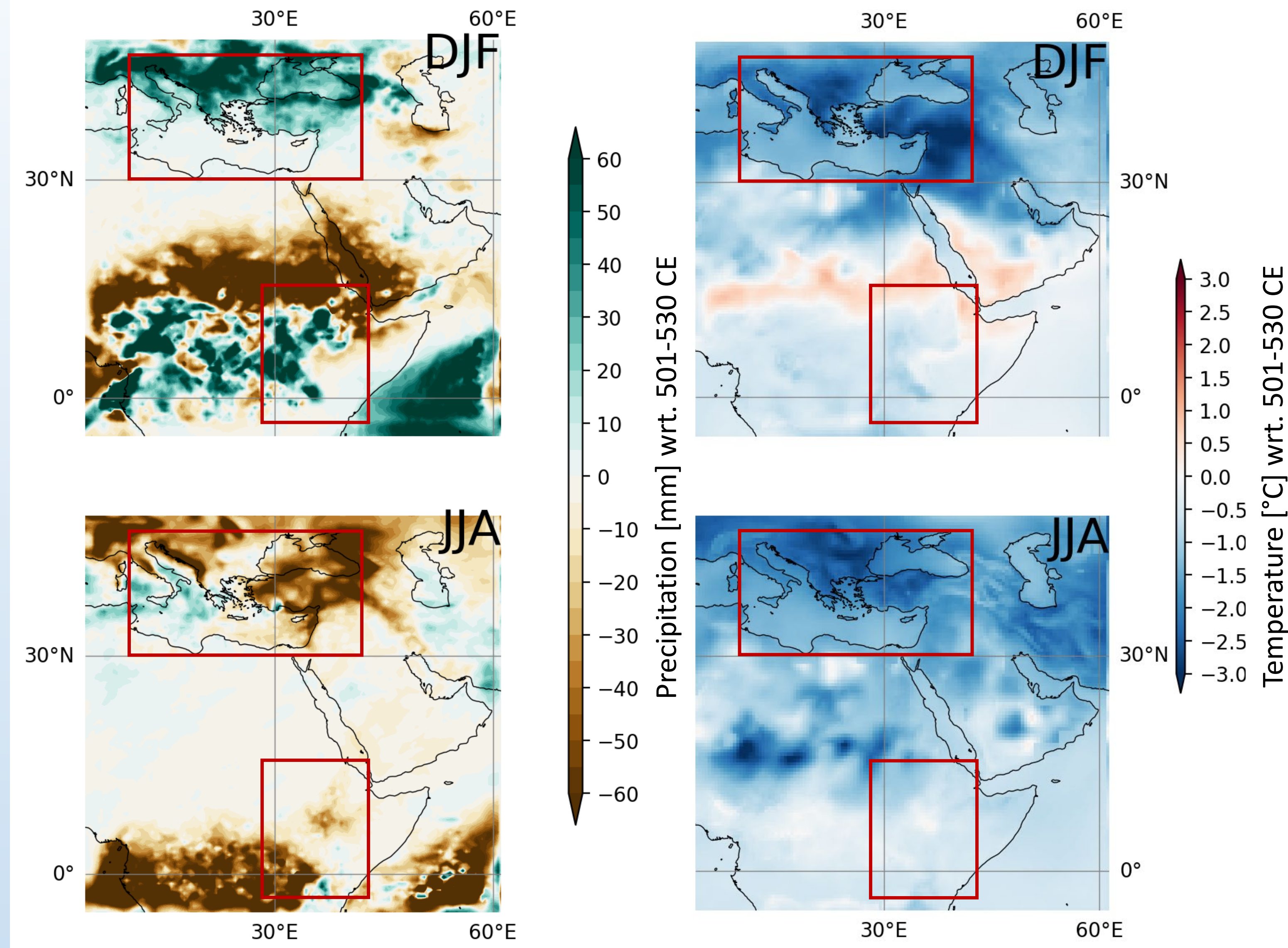


Figure 2. Seasonal total precipitation (left) and mean temperature (right) anomaly, 536-545CE

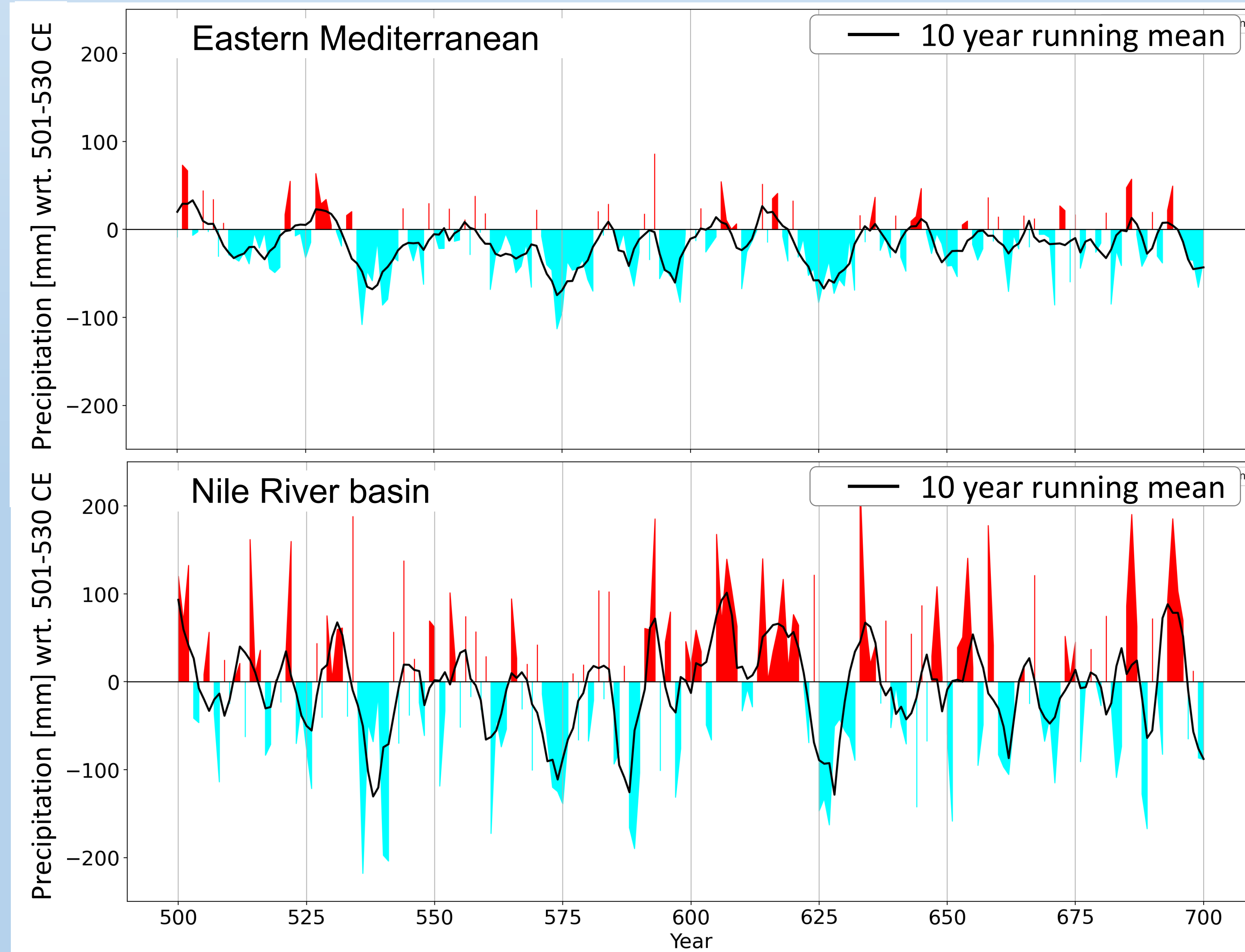


Figure 3. Annual total precipitation anomaly

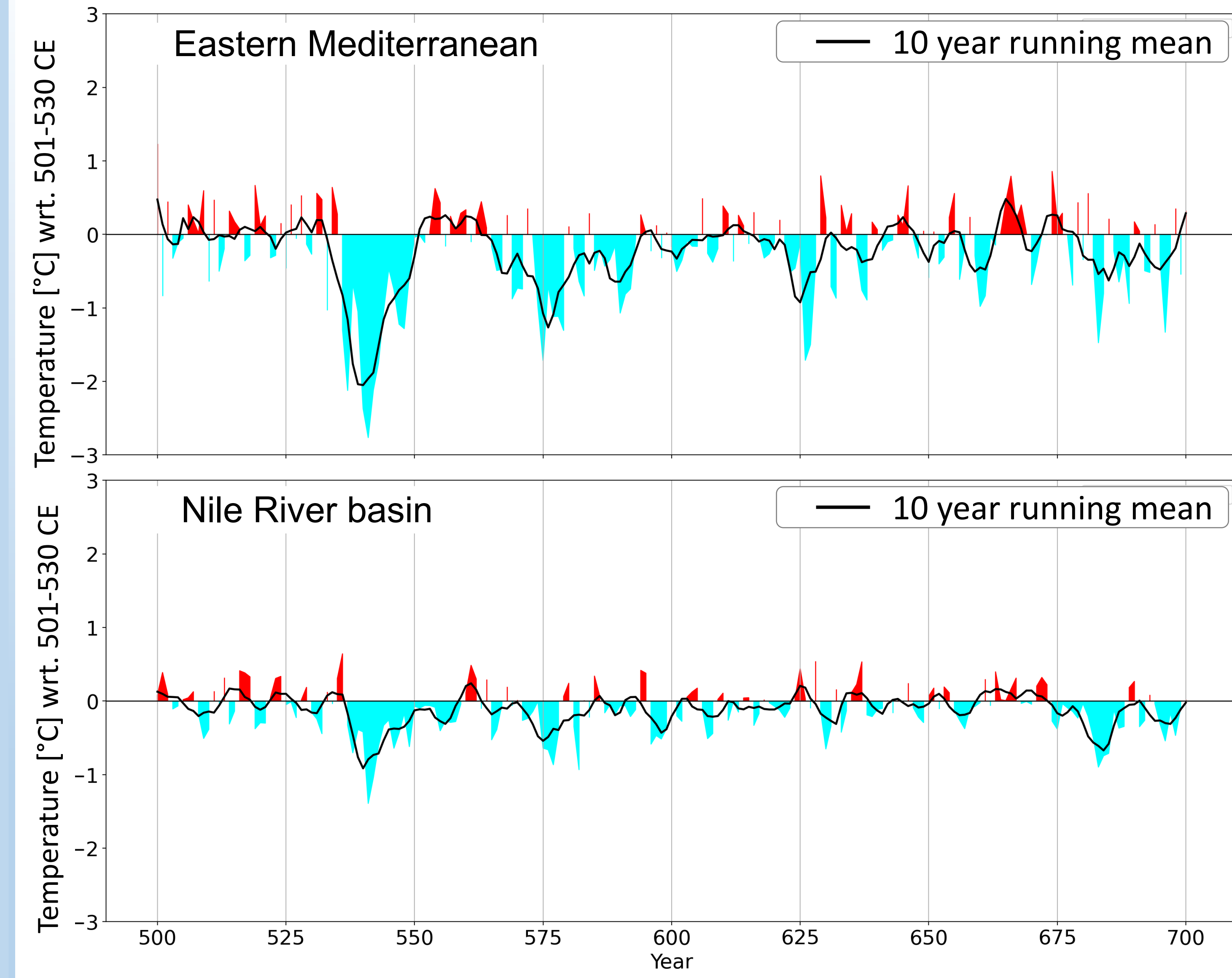


Figure 4. Annual temperature anomaly

## Conclusions

- Cooling over the Eastern Mediterranean in both winter and summer of period 536 – 545 CE, same pattern can be observed during the summers of Nile River basin. While in winters, the temperature decrease is not as obvious as it is in summers after the volcanic eruption of this period
- Followed by a wet winters and dry summers after the volcanic eruptions during 536 – 545 CE over the Eastern Mediterranean
- The Nile River basin experiences a dry summer during 536 – 545 CE

## References

Tooehy, M. and Sigl, M.: Volcanic stratospheric sulfur injections and aerosol optical depth from 500 BCE to 1900 CE, *Earth Syst. Sci. Data*.  
 Jungclaus, J. H et al. The PMIP4 contribution to CMIP6 – Part 3: The last millennium, scientific objective, and experimental design for the PMIP4 past1000 simulations, *Geoscientific Model Development*.

## Acknowledgement

This work used resources of the Deutsches Klimarechenzentrum (DKRZ) granted by its Scientific Steering Committee (WLA) under project bb1201.

