



Including climatic variability in stochastic rainfall for flood catastrophe modelling

The effect of ENSO and SOI in China

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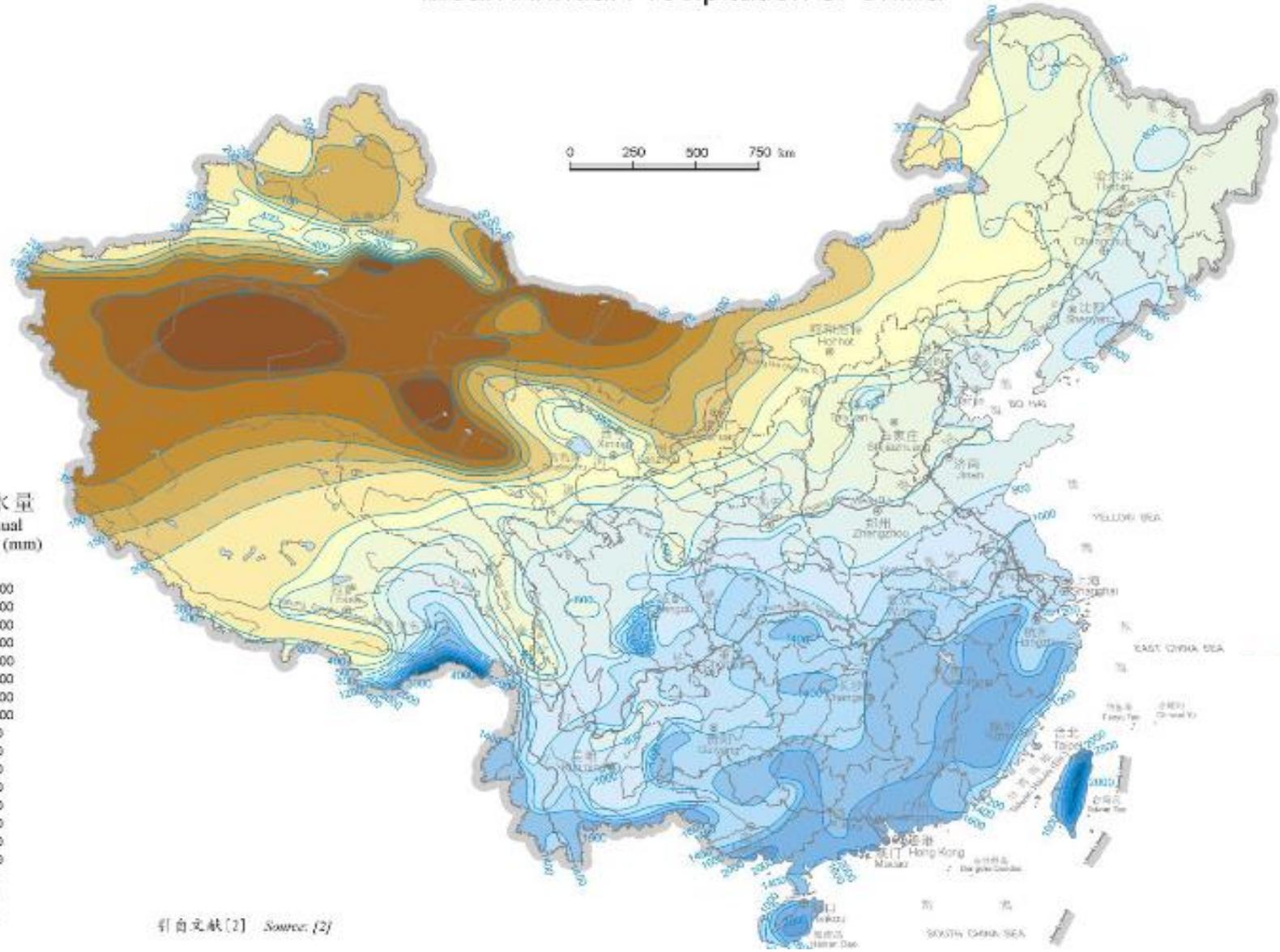
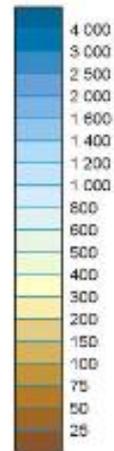


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GOALS

- Provide a **continuous** simulation input (10k yrs) set to describe **extreme events**
- Preserve the observed **climatology** and **space-time correlation** structure
- Combine a stochastic set of **tropical cyclone** (TC) rainfall with **nonTC** rainfall stochastic continuous simulation
- Link nonTC rainfall amounts to **hydroclimatic indices** (e.g. **ENSO** and **SOI**)

年均降水量
Mean Annual
Precipitation (mm)

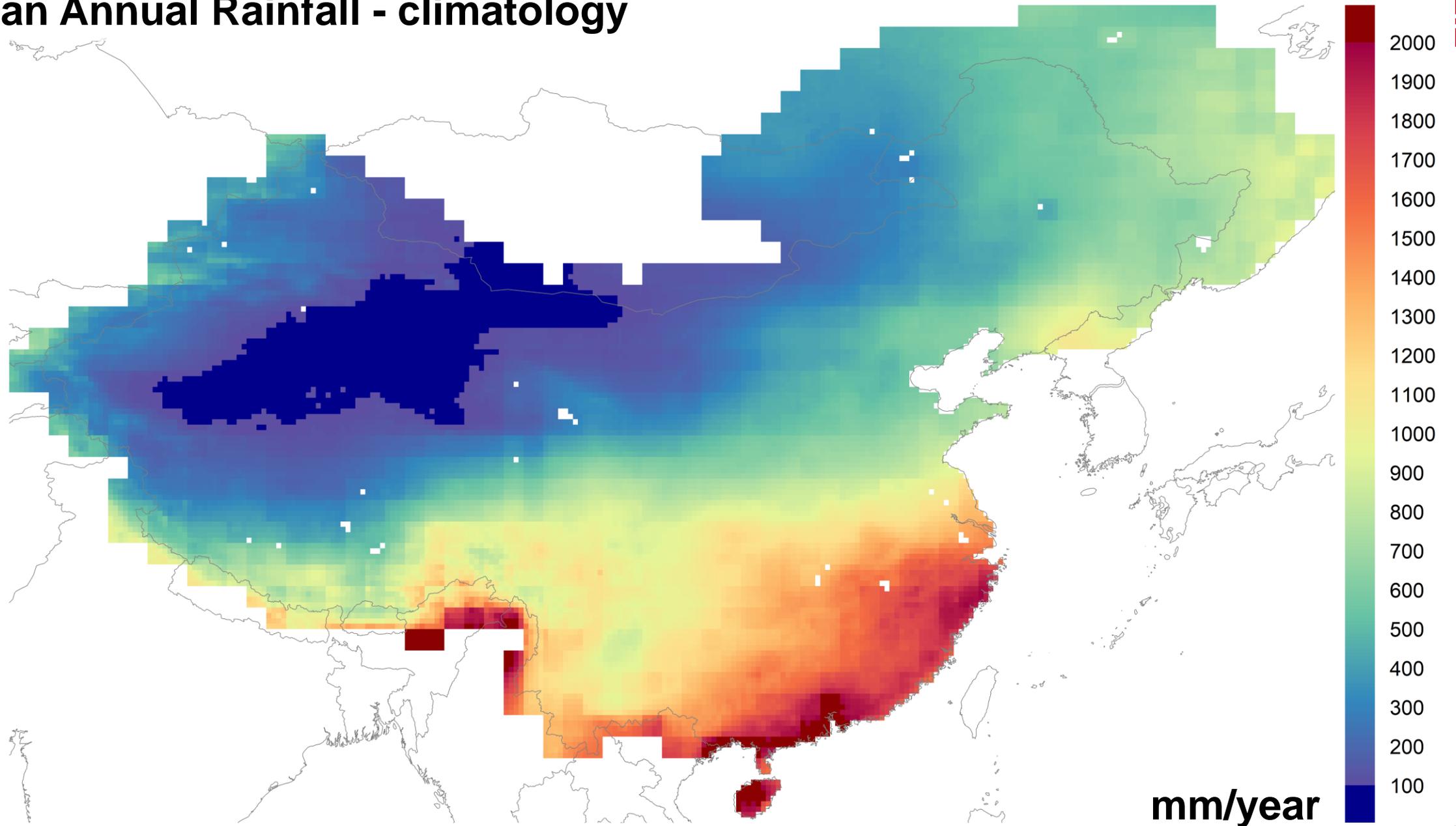


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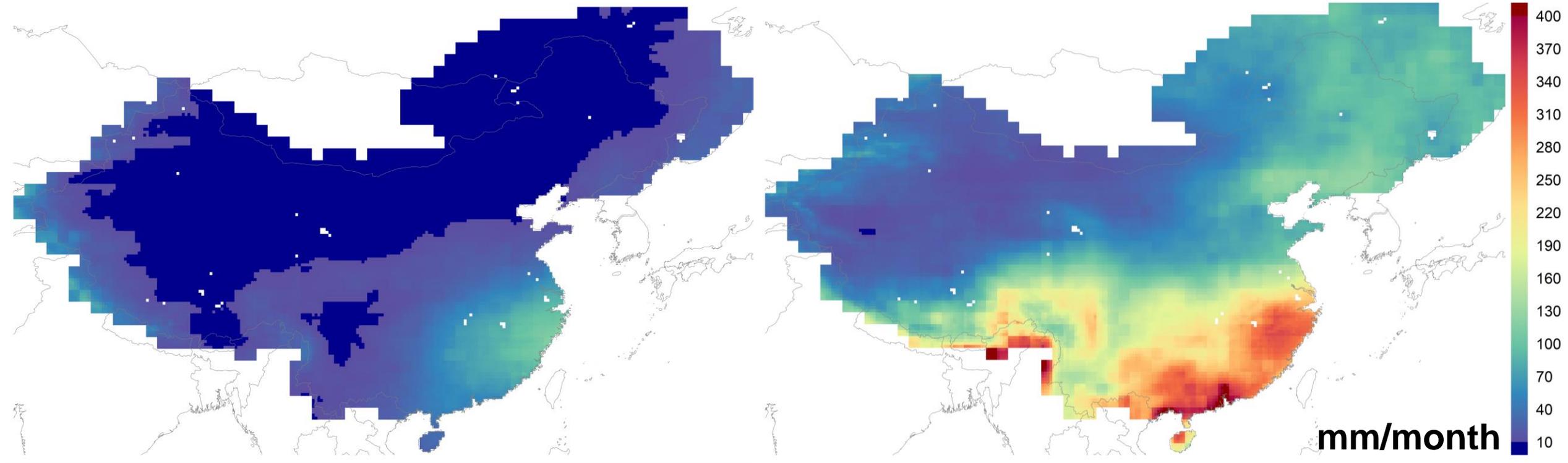
Source: Atlas of Natural
Disaster Risk of China



Mean Annual Rainfall - climatology



Strong seasonality



FEBRUARY

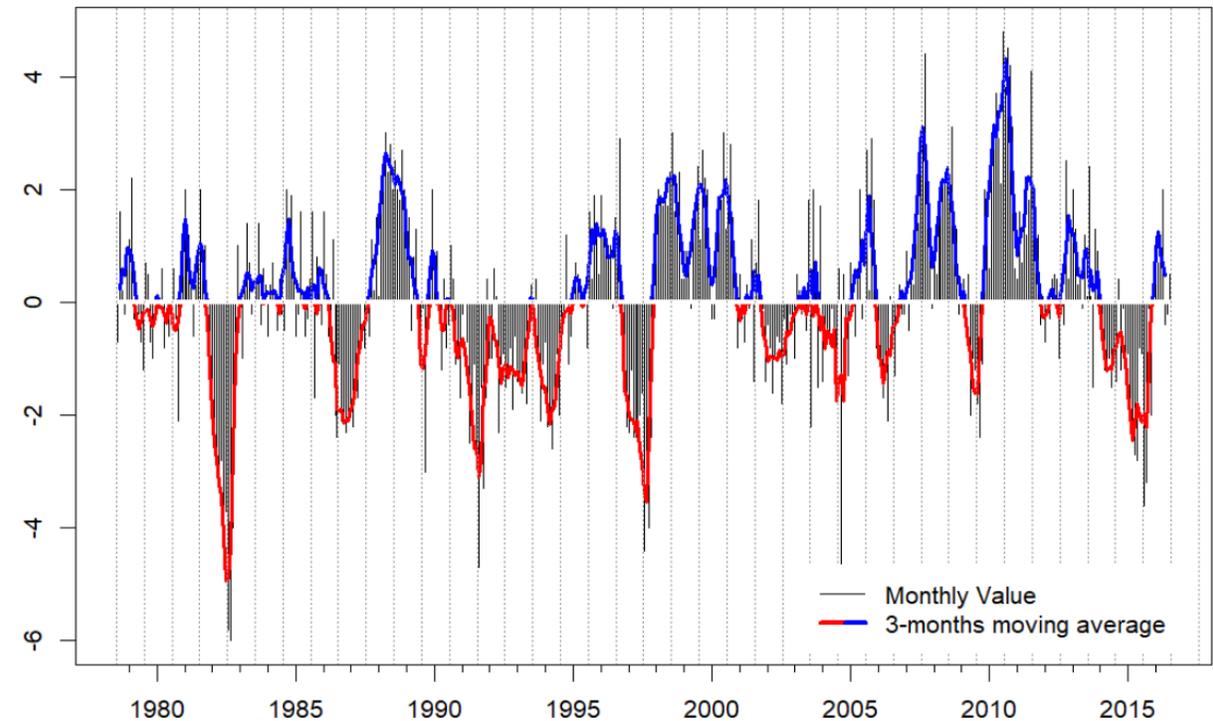
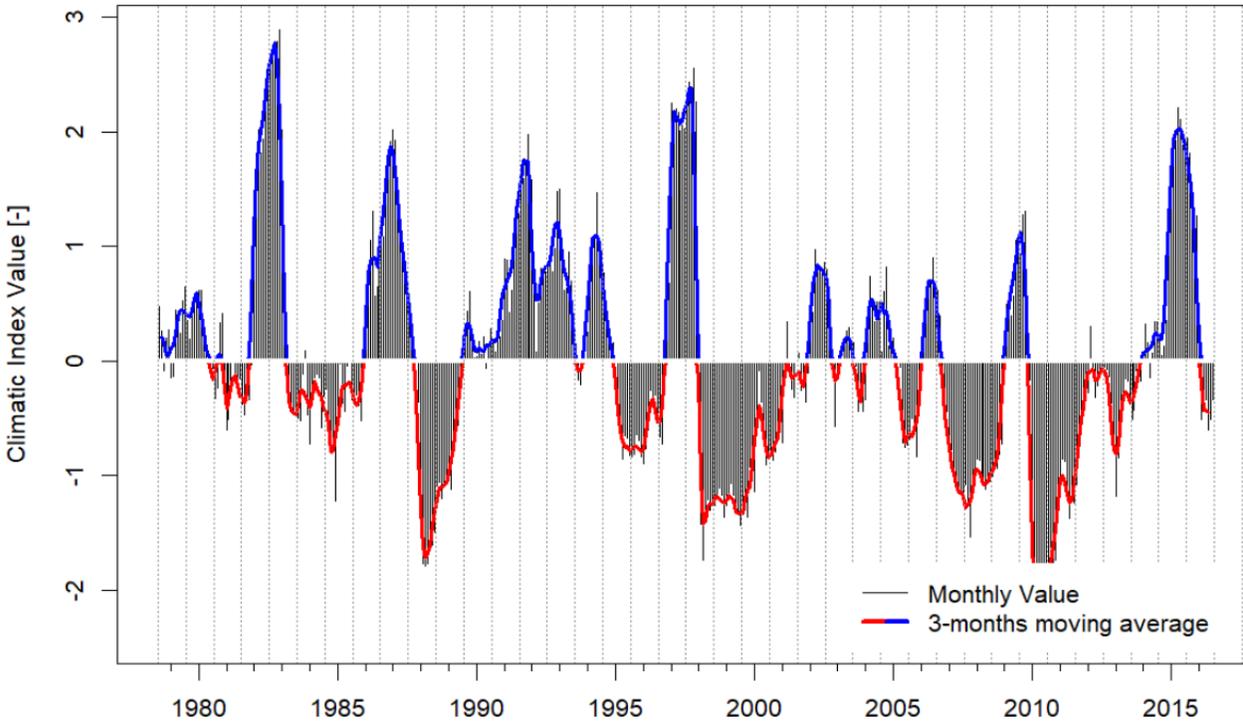
JUNE

Mean Monthly Rainfalls - climatologies

Potential indices

El Niño-Southern Oscillation (Multivariate ENSO Index v2)

Southern Oscillation Index (SOI)



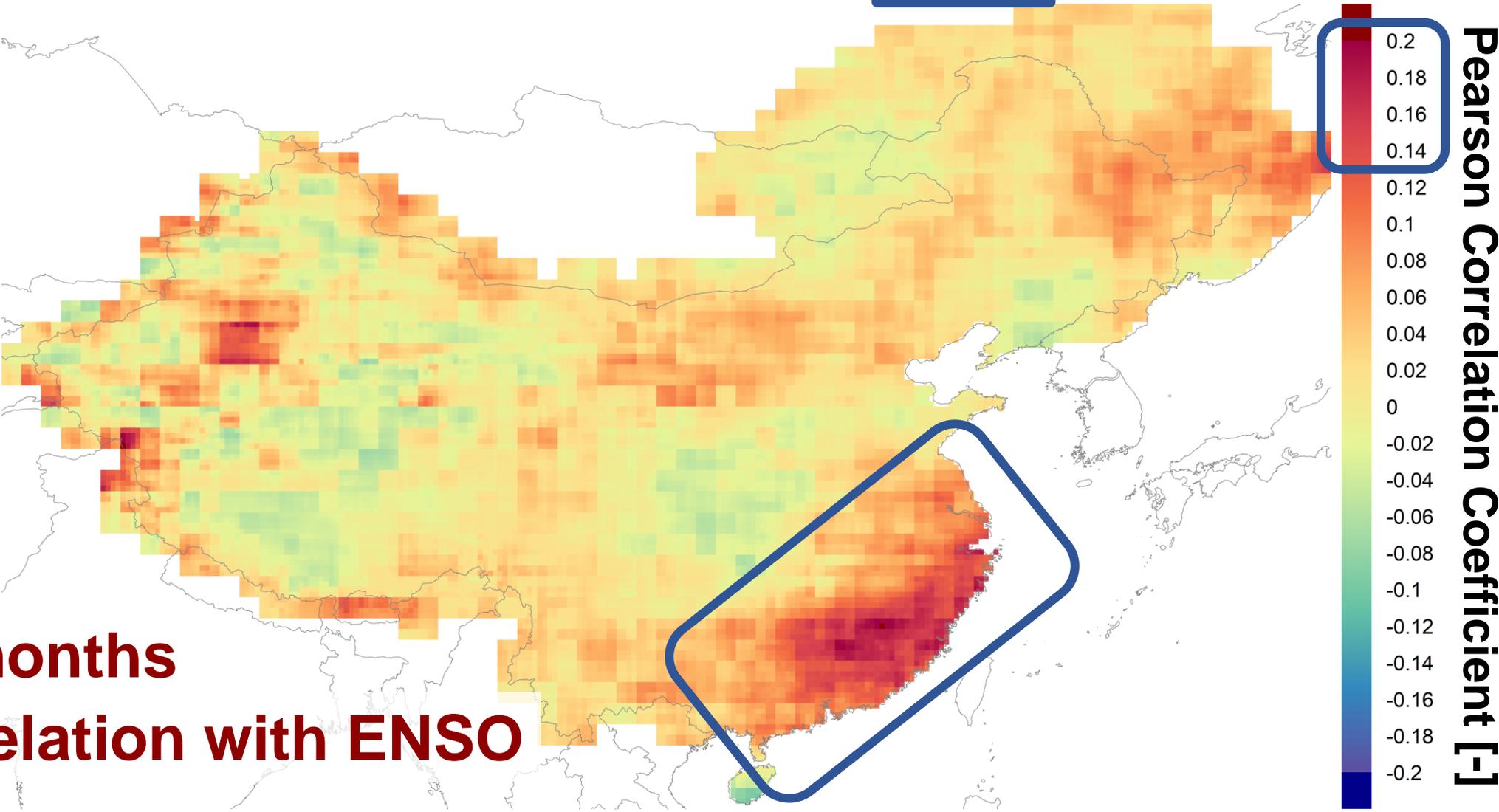
ENSO

SOI

Results – correlations of monthly rainfall amounts



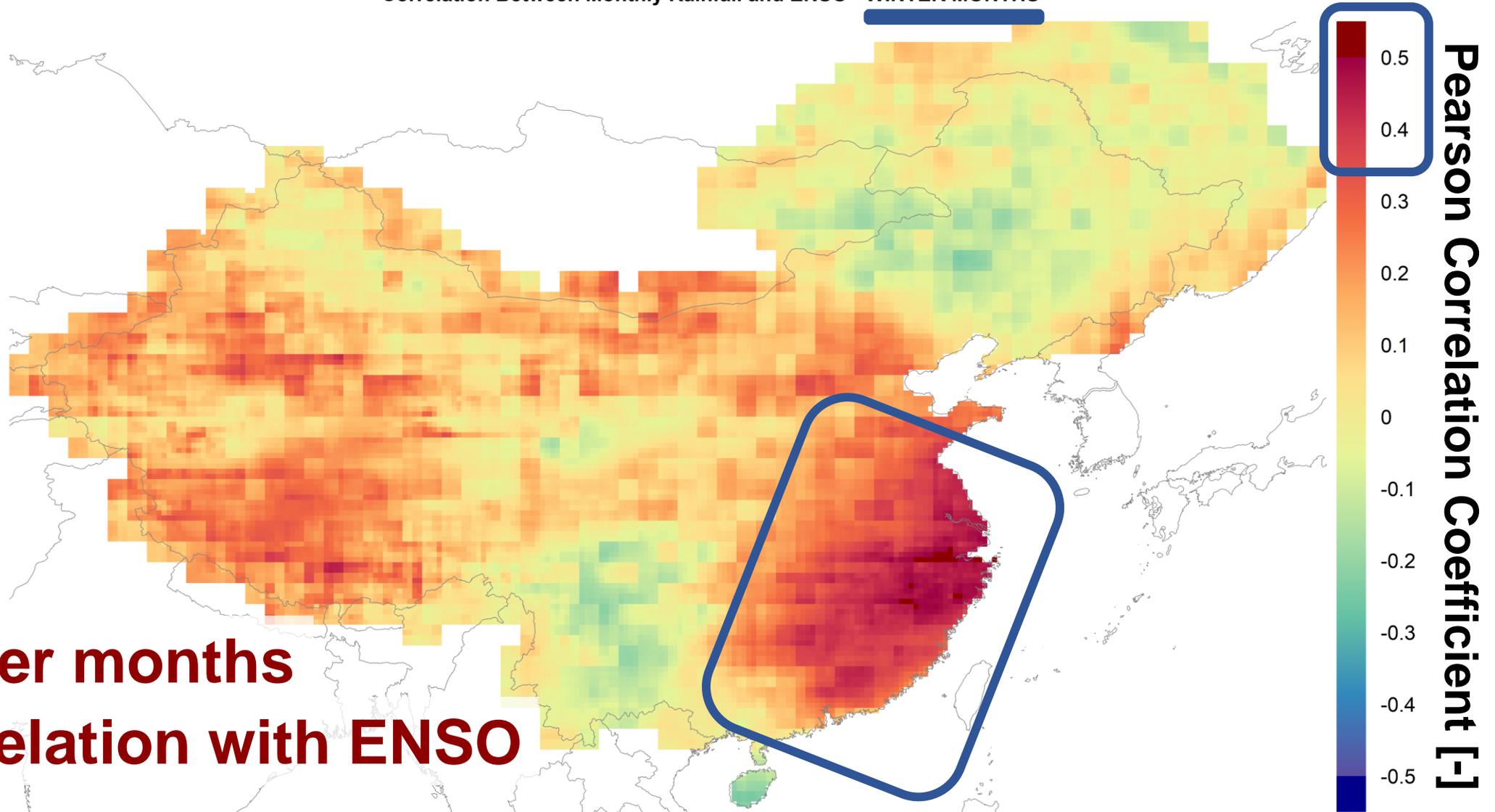
Correlation Between Monthly Rainfall and ENSO - ALL MONTHS



**All months
Correlation with ENSO**

Results – correlations of monthly rainfall amounts

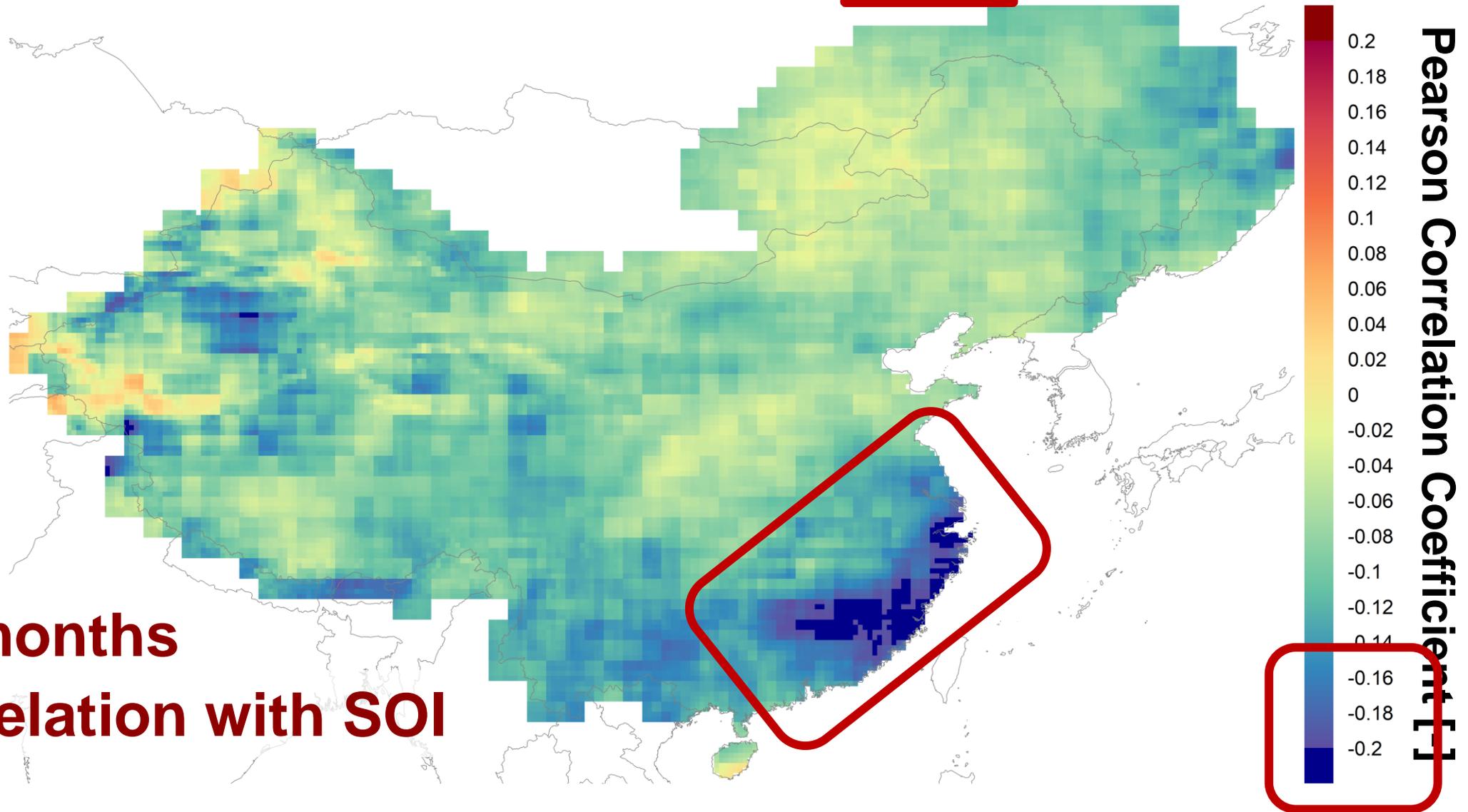
Correlation Between Monthly Rainfall and ENSO - WINTER MONTHS



**Winter months
Correlation with ENSO**

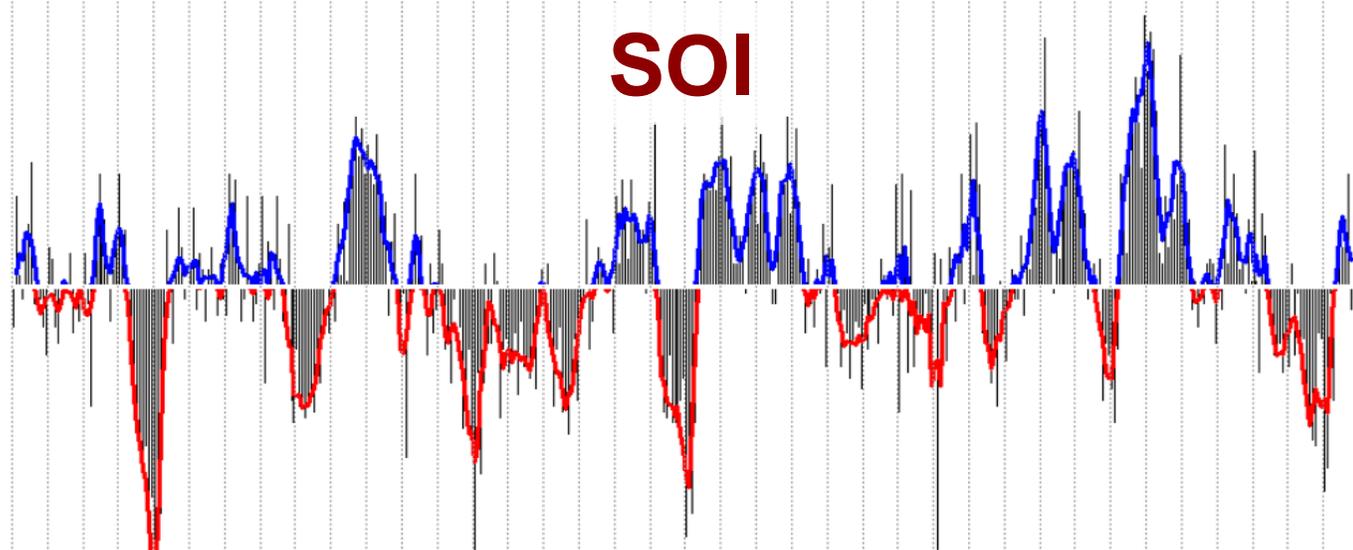
Results – correlations of monthly rainfall amounts

Correlation Between Monthly Rainfall and SOI - ALL MONTHS

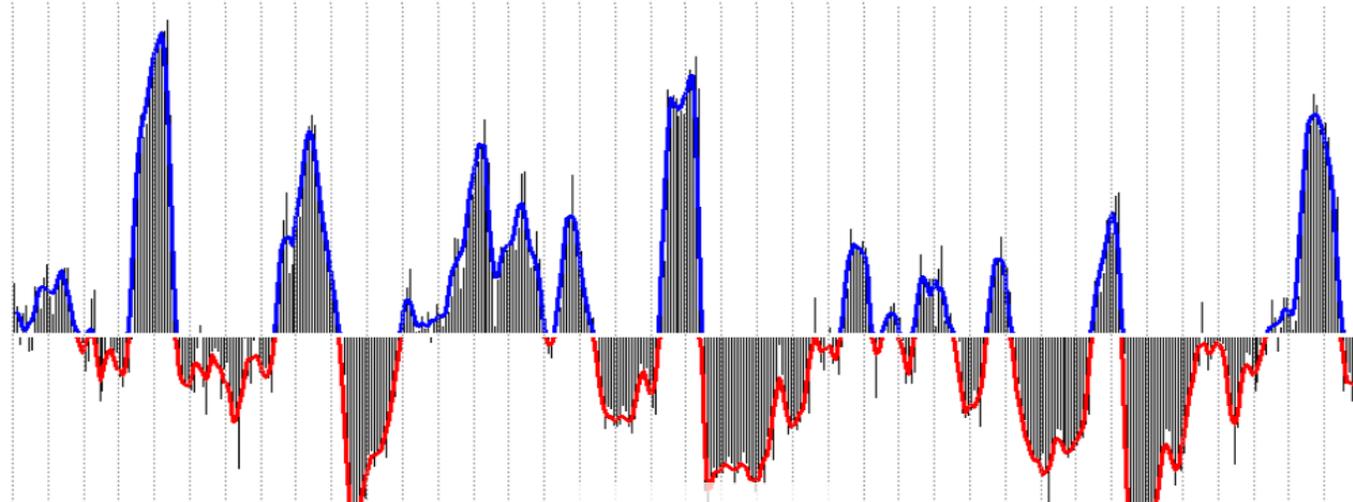


**All months
Correlation with SOI**

SOI



ENSO



— Monthly Value
 — 3-months moving average

1980 1985 1990 1995 2000 2005 2010 2015

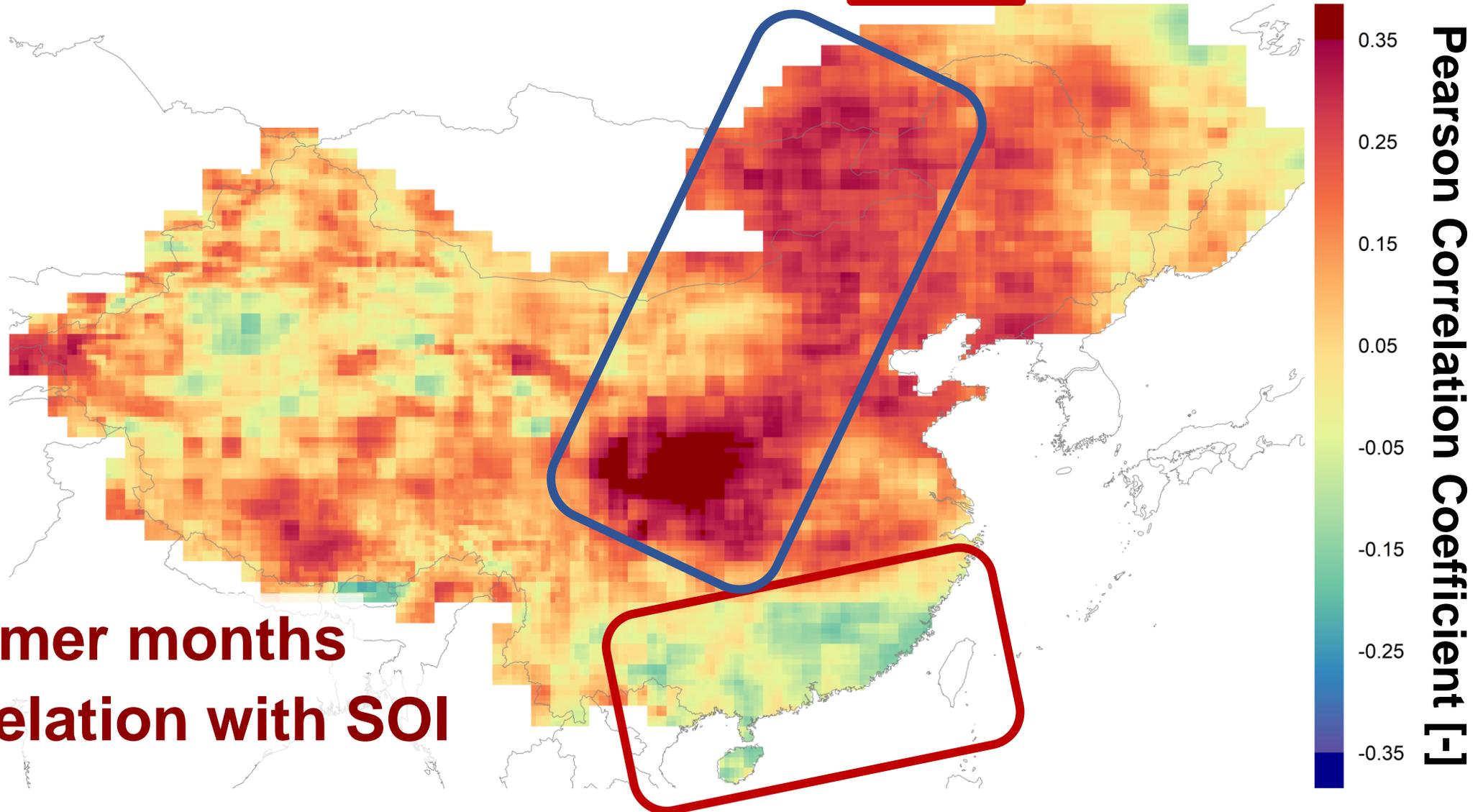
CS
 ALL MONTHS

- **SOI and ENSO are correlated** (they describe roughly the same phenomena)
- But of **opposite sign!**
- **Spatial patterns** of correlation with rainfall should be similar
- It seems **SOI correlation with summer rainfall is much higher**



Results – correlations of monthly rainfall amounts

Correlation Between Monthly Rainfall and SOI - SUMMER MONTHS



**Summer months
Correlation with SOI**

How do we include it in the stochastic rainfall?

- Monthly rainfall amounts per season are decomposed using PCA
- Stochastic rainfall is simulated generating independent PC time series, and then temporally disaggregating to sub-daily time scales
- We impose a correlation of some PCs with stochastic climatic indices
- Stochastic climatic indices are synthetically generated time series that conserve the statistical properties and autocorrelation structure of observed ENSO and SOI

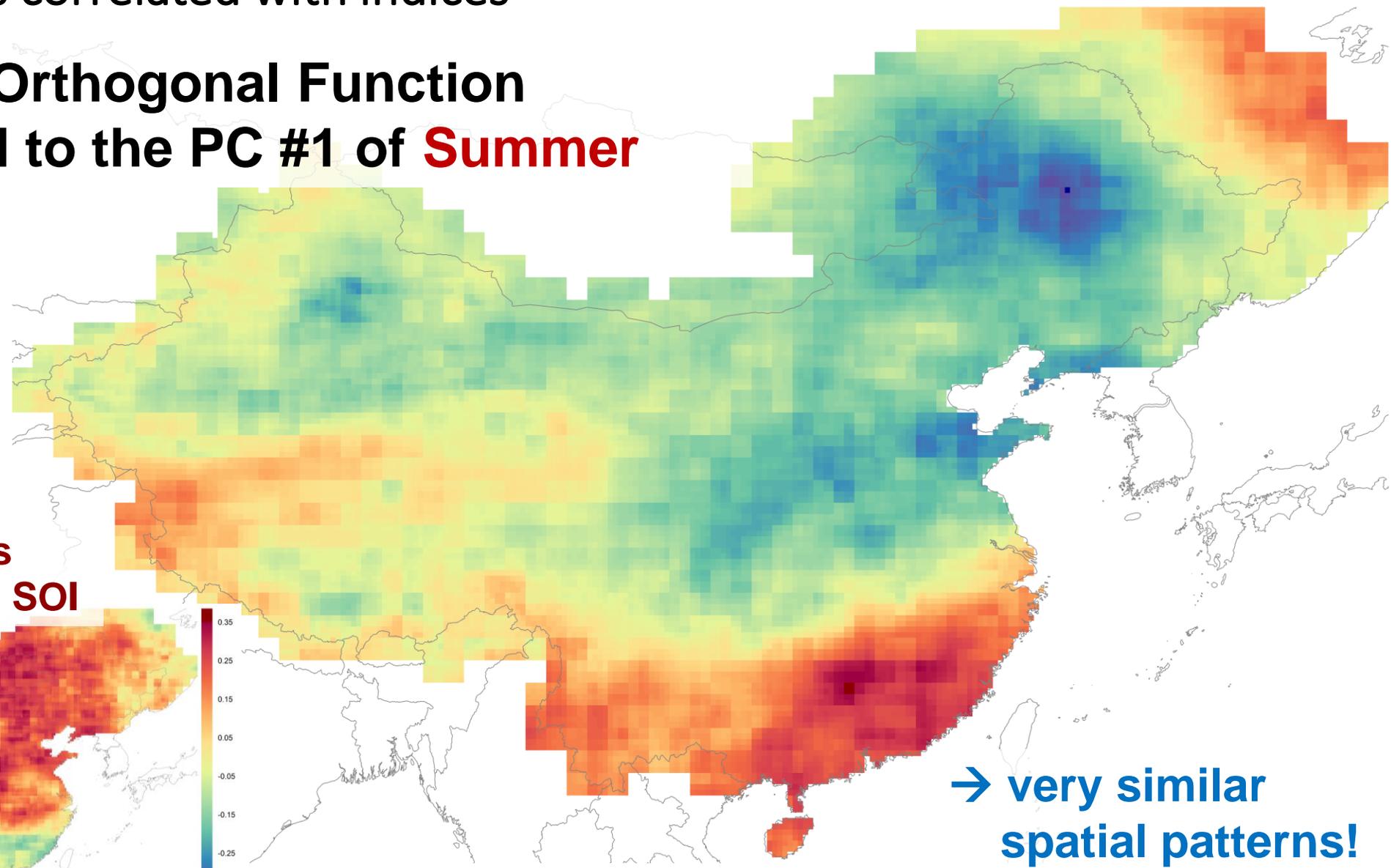
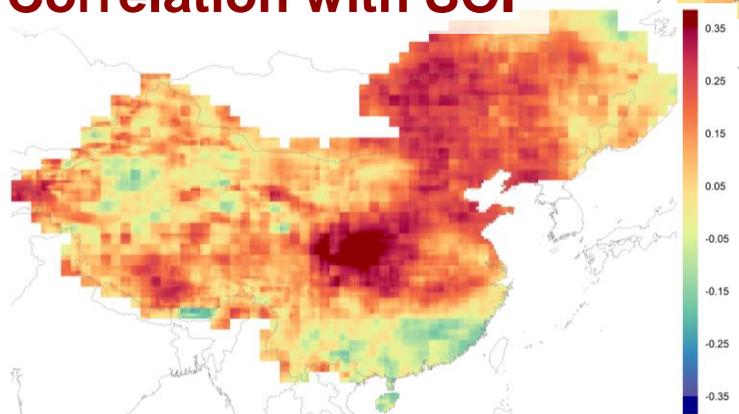
Results – PCs correlated with indices

- Summer rainfall shows the highest pixel-by-pixel correlation with Southern Oscillation Index (SOI)
- We find a **significant correlation** between the time series of the **Summer PC #1** and **SOI** of $r = -0.43$

Results – PCs correlated with indices

Empirical Orthogonal Function associated to the PC #1 of Summer

Summer months
Correlation with SOI



→ very similar spatial patterns!

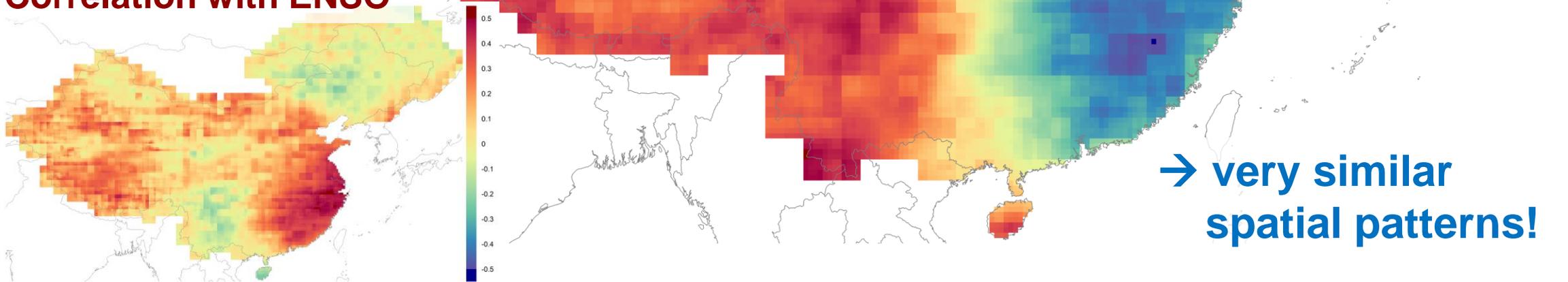
Results – PCs correlated with indices

- Summer rainfall shows the highest pixel-by-pixel correlation with Southern Oscillation Index (SOI)
- We find a **significant correlation** between the time series of the **Summer PC #1** and **SOI** of $r = -0.43$
- Winter rainfall shows the highest pixel-by-pixel correlation with ENSO
- We find a **significant correlation** between the time series of the **Winter PC #1** and **ENSO** of $r = -0.49$

Results – PCs correlated with indices

Empirical Orthogonal Function associated to the PC #1 of Winter

Winter months
Correlation with ENSO



→ very similar spatial patterns!



Thank you!

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