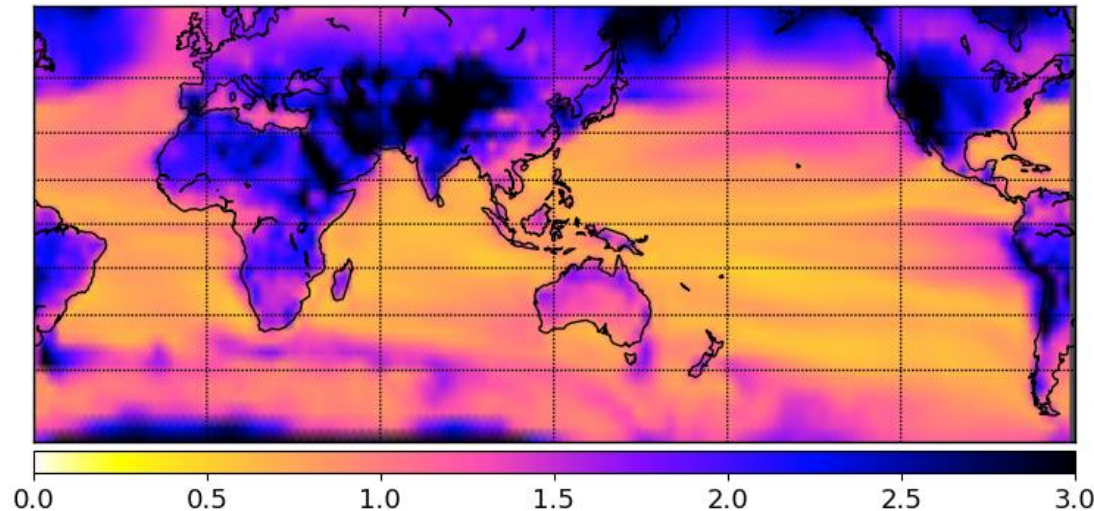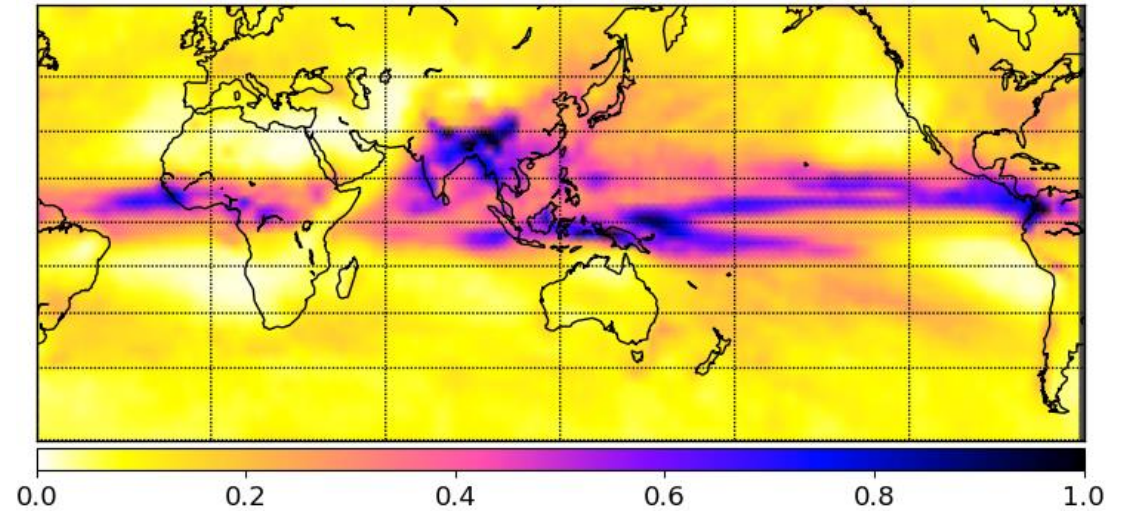# Can biases explain the intermodel spread of historical Indian monsoon rainfall change in CMIP6 ?

Marcellin Guilbert, Juliette Mignot, Pascal Terray
LOCEAN/IPSL, Paris, France
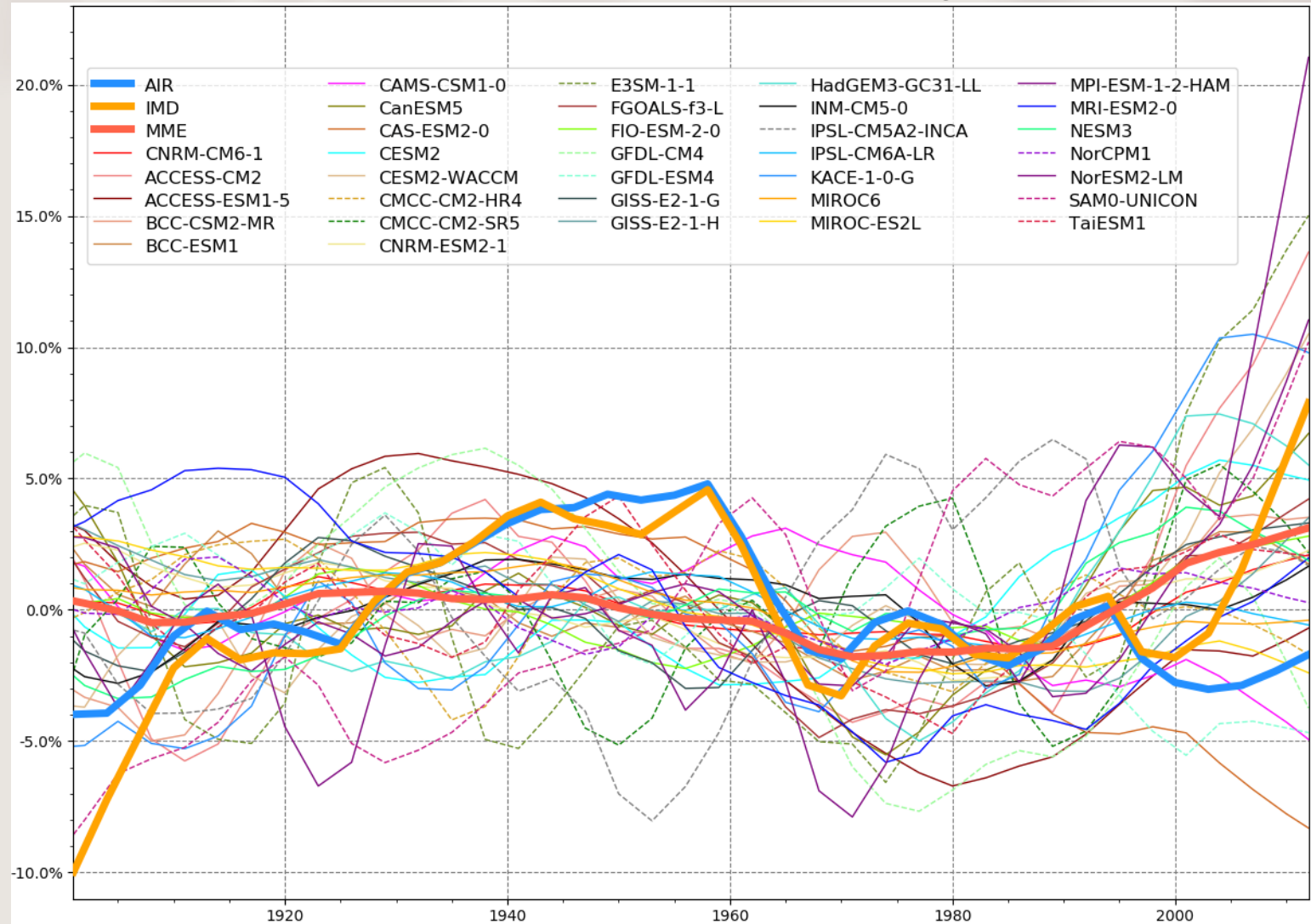
Intermodel spread of temperature bias in CMIP6 (K)

Intermodel spread of rainfall change in CMIP6 (mm/day)

Indian Monsoon rainfall in CMIP6

- 20% of humanity depends on it

- Stable intermodel spread until the 1990s

- Large increase of intermodel spread at the end of 21st century

- Even the observations differ at the end of the period

Evolution of Indian Monsoon Rainfall during 1900-2014

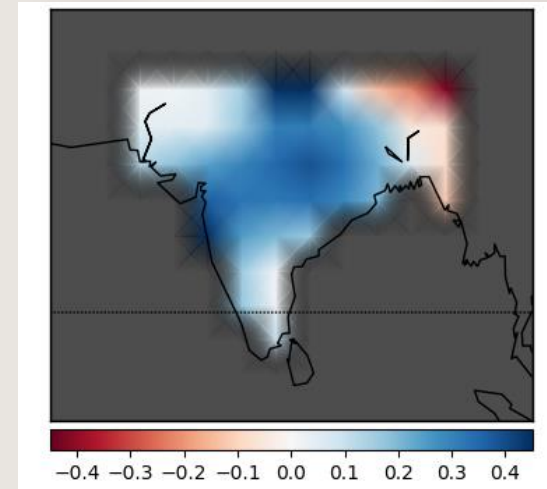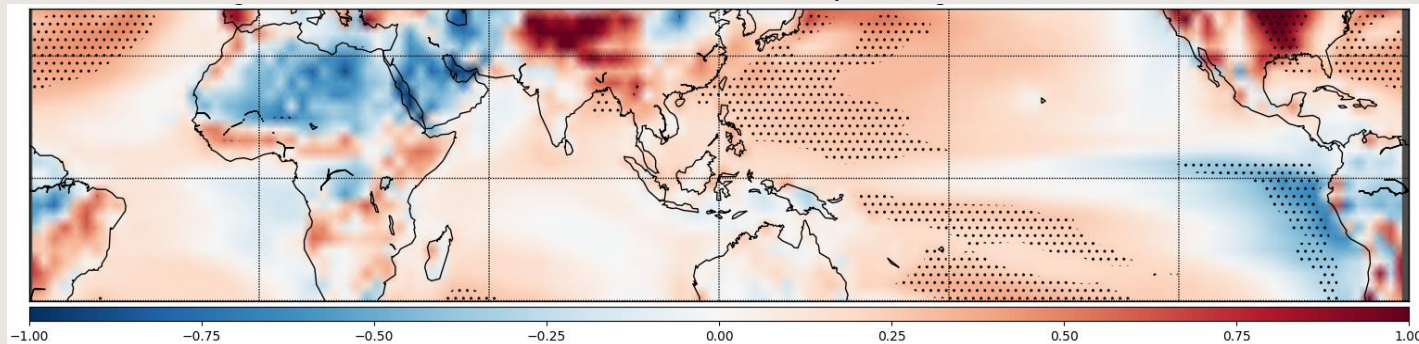# Pacific SST biases modulates the monsoon

- Method :
  - We used 34 CMIP6 models
  - Monsoon change is defined as : $\langle Rainfall \rangle_{JJAS}^{1979\text{-}2014}$ − $\langle Rainfall \rangle_{JJAS}^{1850\text{-}1879}$
  - Surface temperature bias is defined as : $\langle Ts \rangle_{JJAS}^{1979\text{-}2014}$ − $\langle Ts\ from\ observation \rangle_{JJAS}^{1979\text{-}2014}$

- Result :
  - Pattern of Ts bias : strong signal over the Pacific Ocean and deserts, no signal over Indian Ocean
  - Pattern of rainfall change : fairly uniform rainfall modulation on India

Mode 1 of Indian rainfall change, 40% of explained variance

Mode 1 of Ts bias, 10% of explained variance

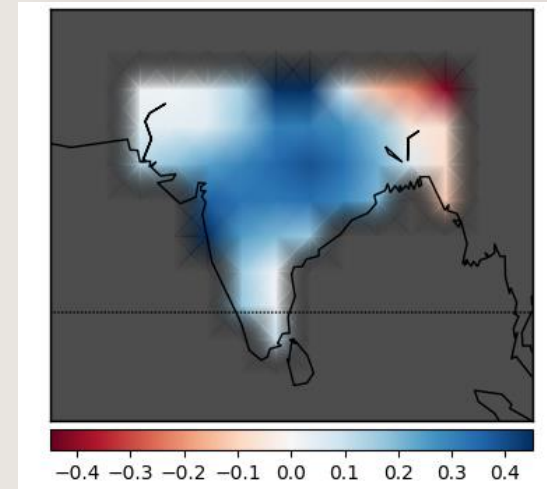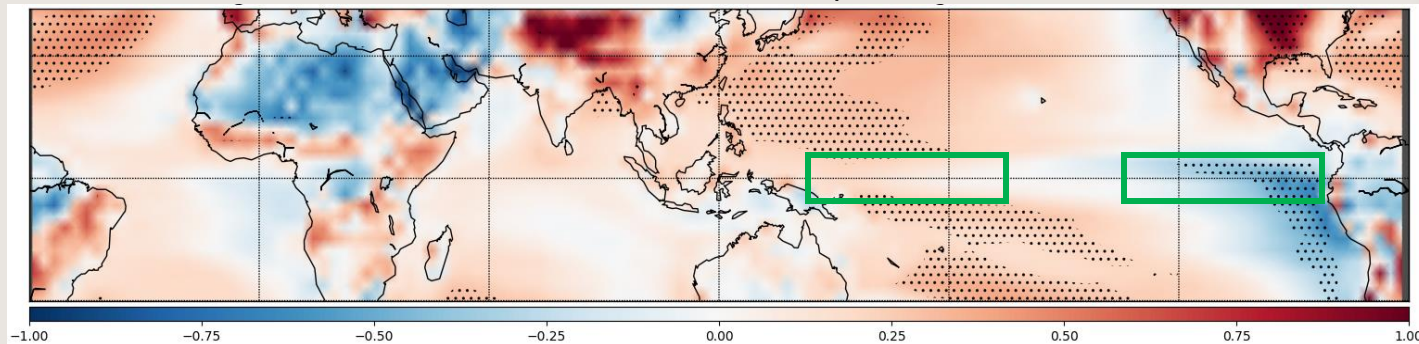# Pacific SST biases modulates the monsoon

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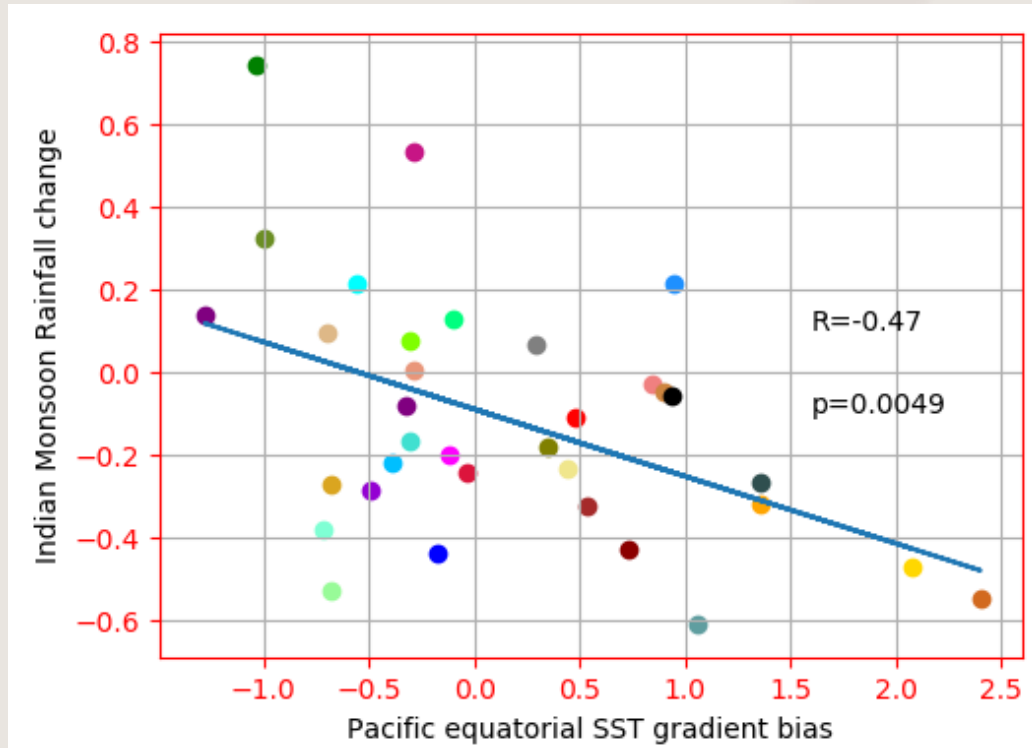
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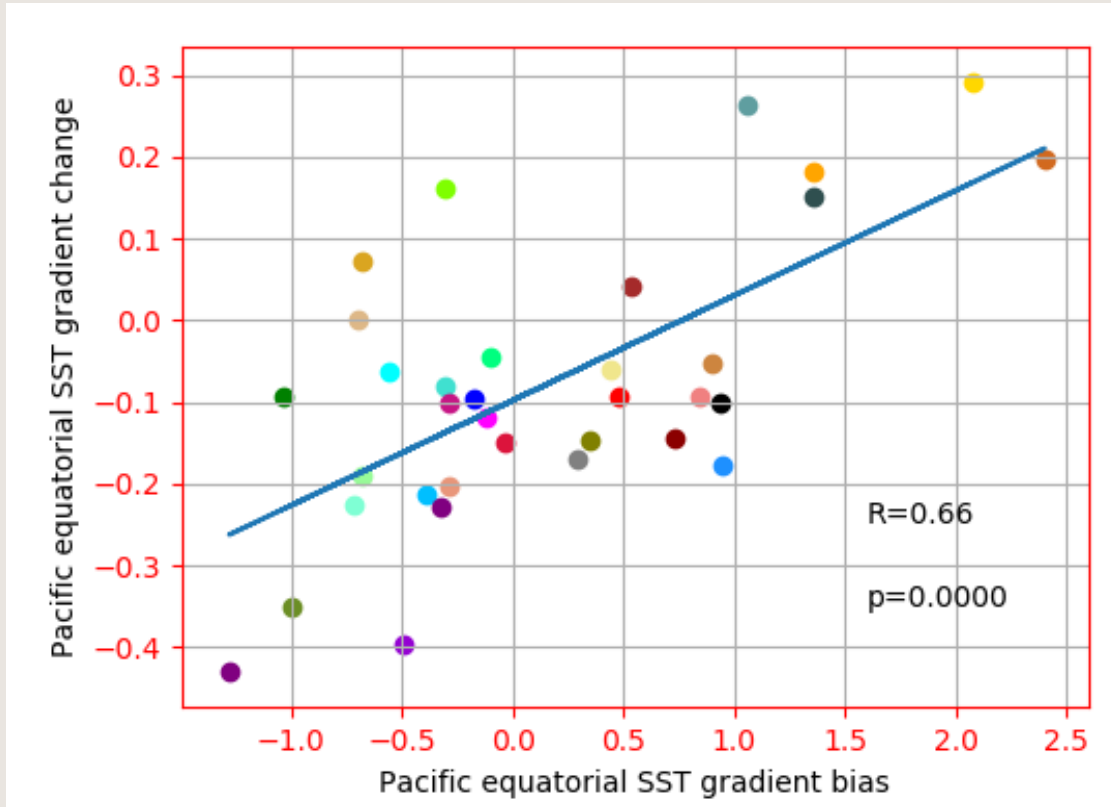# Pacific SST gradient bias modulates the monsoon :

El Nino/La Nina like SST bias in the Pacific Ocean

Reduced/increased Indian Monsoon rainfall

- How does this modulation takes place ?

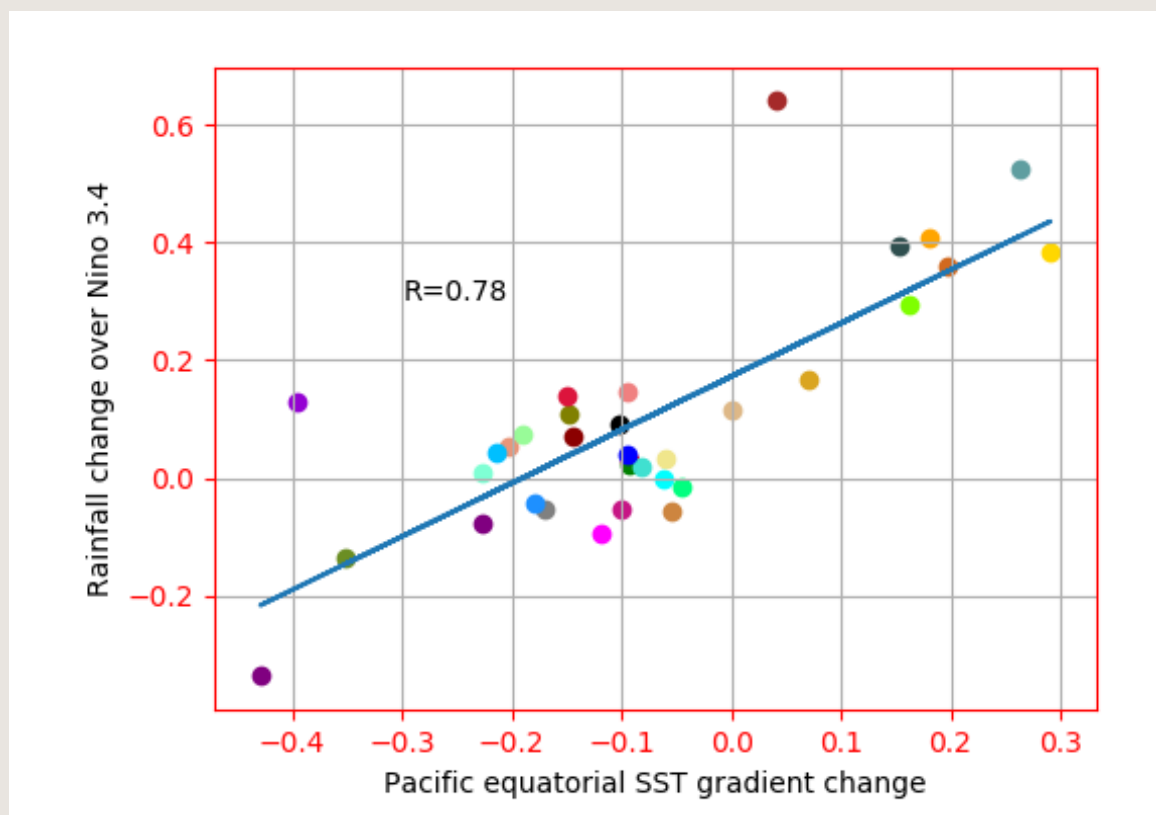# Step 1 : Pacific SST gradient bias modulates the Pacific SST gradient change

El Nino/La Nina like SST bias in the Pacific Ocean

El Nino/La Nina like SST change in the Pacific Ocean

Step 2 : Pacific SST gradient change shifts Walker Circulation
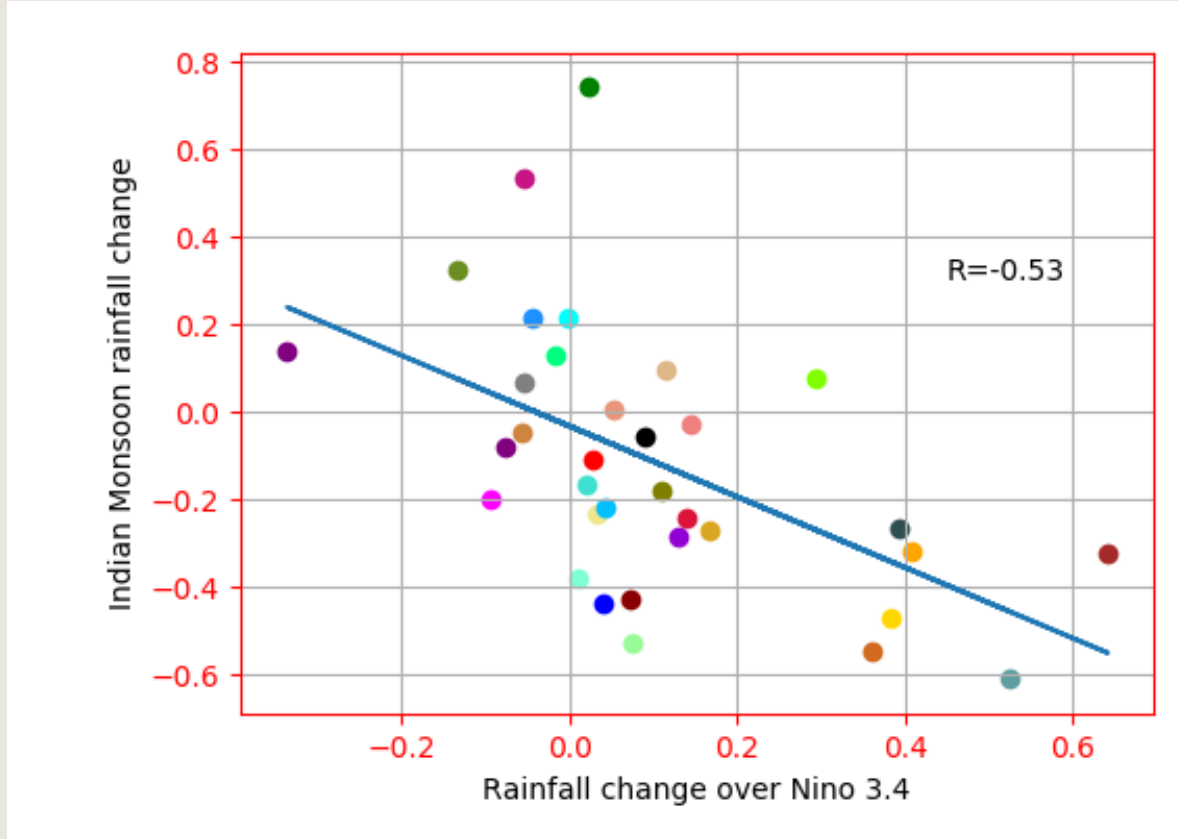

El Nino/La Nina like SST bias in the Pacific Ocean

El Nino/La Nina like SST change in the Pacific Ocean

Eastward/Westward shift of Walker Circulation

Step 3 : Walker circulation modulates Indian Monsoon rainfall

El Nino/La Nina like SST bias in the Pacific Ocean

↓

El Nino/La Nina like SST change in the Pacific Ocean

↓

Eastward/Westward shift of Walker Circulation

↓

Reduced/Increased Indian Monsoon rainfall

ENSO-Monsoon teleconnection

Conclusion

- Surface temperature biases modulate precipitation change in India fairly uniformly

- A relationship exists between the intermodel spread of Equatorial Pacific SST gradient bias and the historical change of Indian Monsoon rainfall

Thank you for your attention !

Do not hesitate to contact me for further details

marcellin.guilbert@locean.ipsl.fr