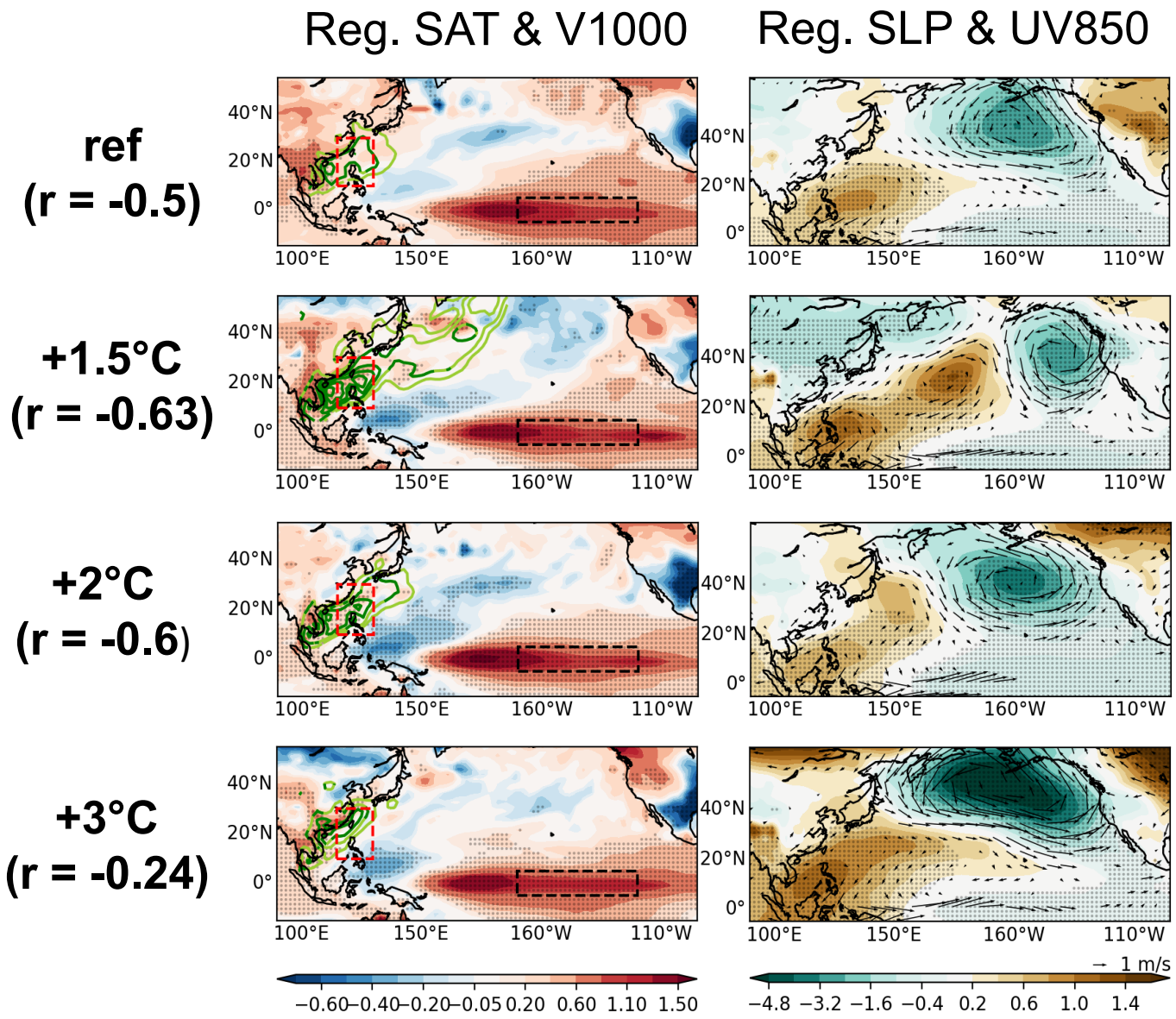
Forced changes in the relationship between ENSO and the East Asian winter monsoon under global warming

Zixuan Jia[1] (s1872969@ed.ac.uk)
Massimo Bollasina[1], **Oliver Wild**[2], **Ruth Doherty**[1], **Chaofan Li**[3]

[1]School of Geosciences, University of Edinburgh, UK
[2]Lancaster Environment Centre, Lancaster University, UK
[3]Center for Monsoon System Research, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

Jia et al ., 2020: in revision for GRL

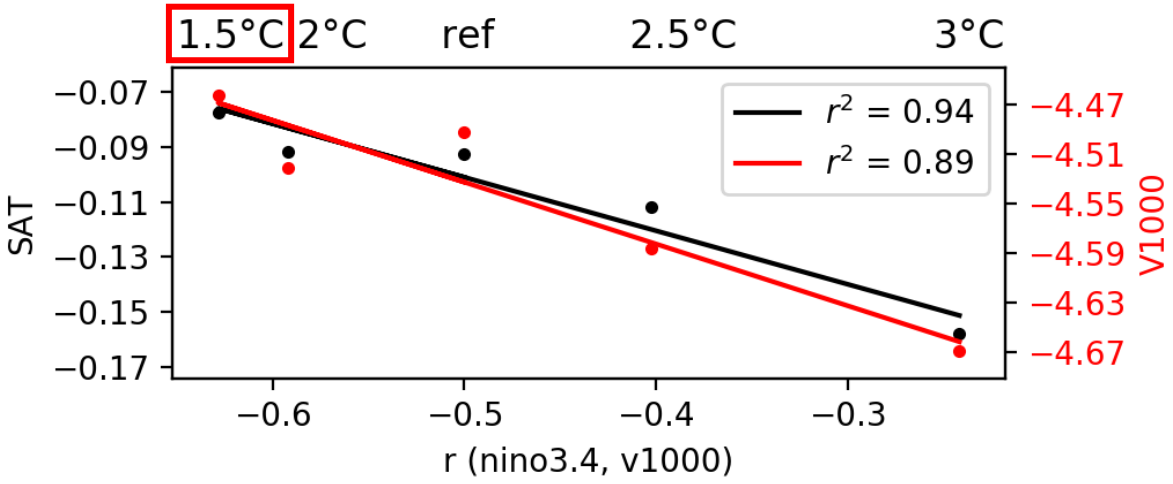
Strong modulation by external forcing in the 21st century



- The forced component of the ENSO-EAWM relationship increases from present-day to **+1.5°C**, then weakens until +3°C
- The core El Niño SST warm anomaly intensifies with global warming; shifts westward and meridionally expands above **+1.5°C**
- The anomalous surface anticyclone over the western Pacific strengthens at **+1.5°C**; moves northwestward with additional warming

Strong link with the mean state of both ENSO and the EAWM

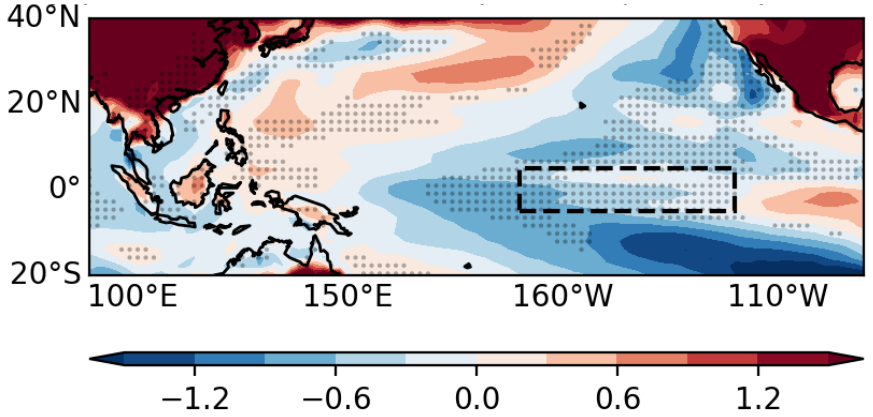
- Scatterplot of the r (Niño 3.4, V1000) versus two-position indices for the reference and four warming periods



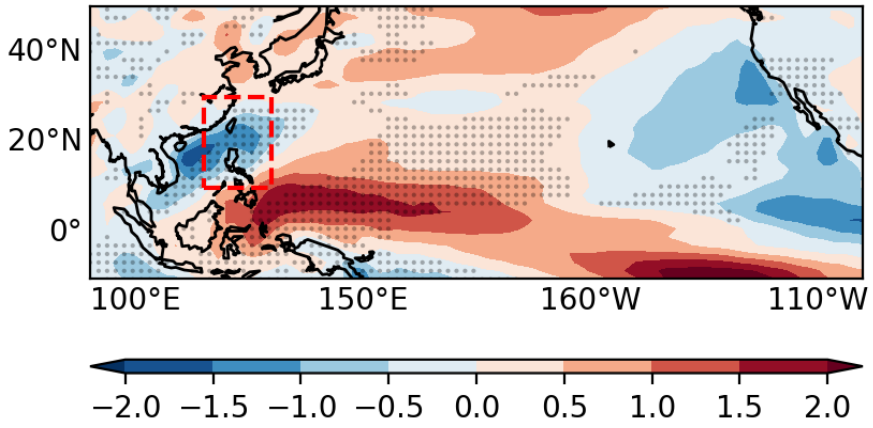
A weaker ENSO-EAWM correlation significantly associated with

- **larger mean cooling over the central Pacific**
- **stronger northerlies over the South China Sea**

Reg. SAT onto the r (Niño3.4, V1000)



Reg. V1000 onto the r (Niño3.4, V1000)



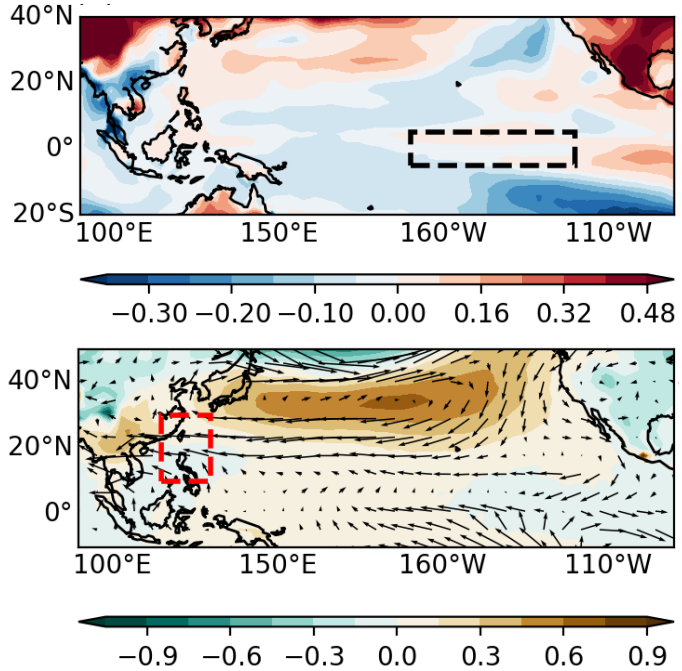
Physical pathways underlying the changes in the ENSO-EAWM link

Clim. SAT

Clim. SST & UV850

1.5 °C-ref

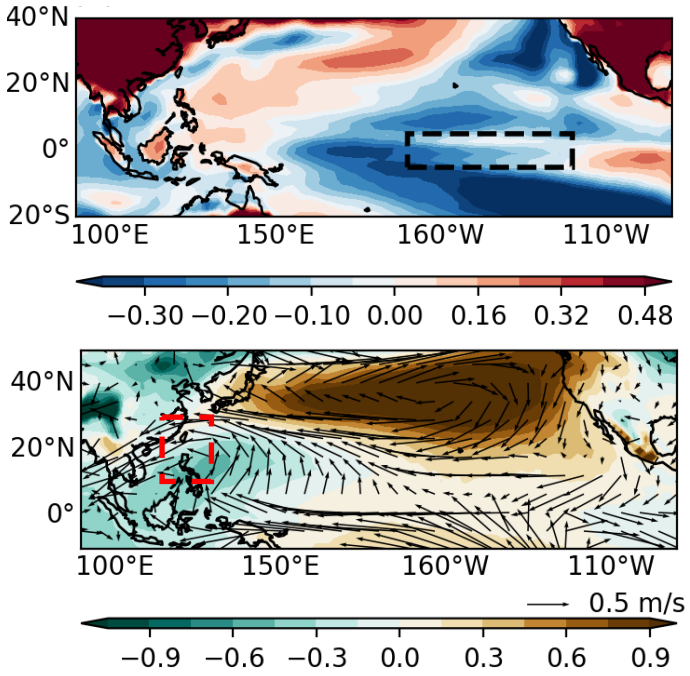
(r⬆)



Increased East Asian aerosols:
cooling (opposes the greenhouse gases warming) and anticyclonic circulation -> southeasterlies over the South China Sea -> weaker climatological EAWM winds -> the EAWM is more susceptible to ENSO modulation

3°C-1.5°C

(r⬇)



Changes in the mean state via coupled atmosphere-ocean feedbacks:
enhanced SST warming in the eastern equatorial Pacific -> stronger climatological EAWM winds

Changes in the ENSO variability:
westward extension of the ENSO pattern -> weaker ENSO signal over East Asia