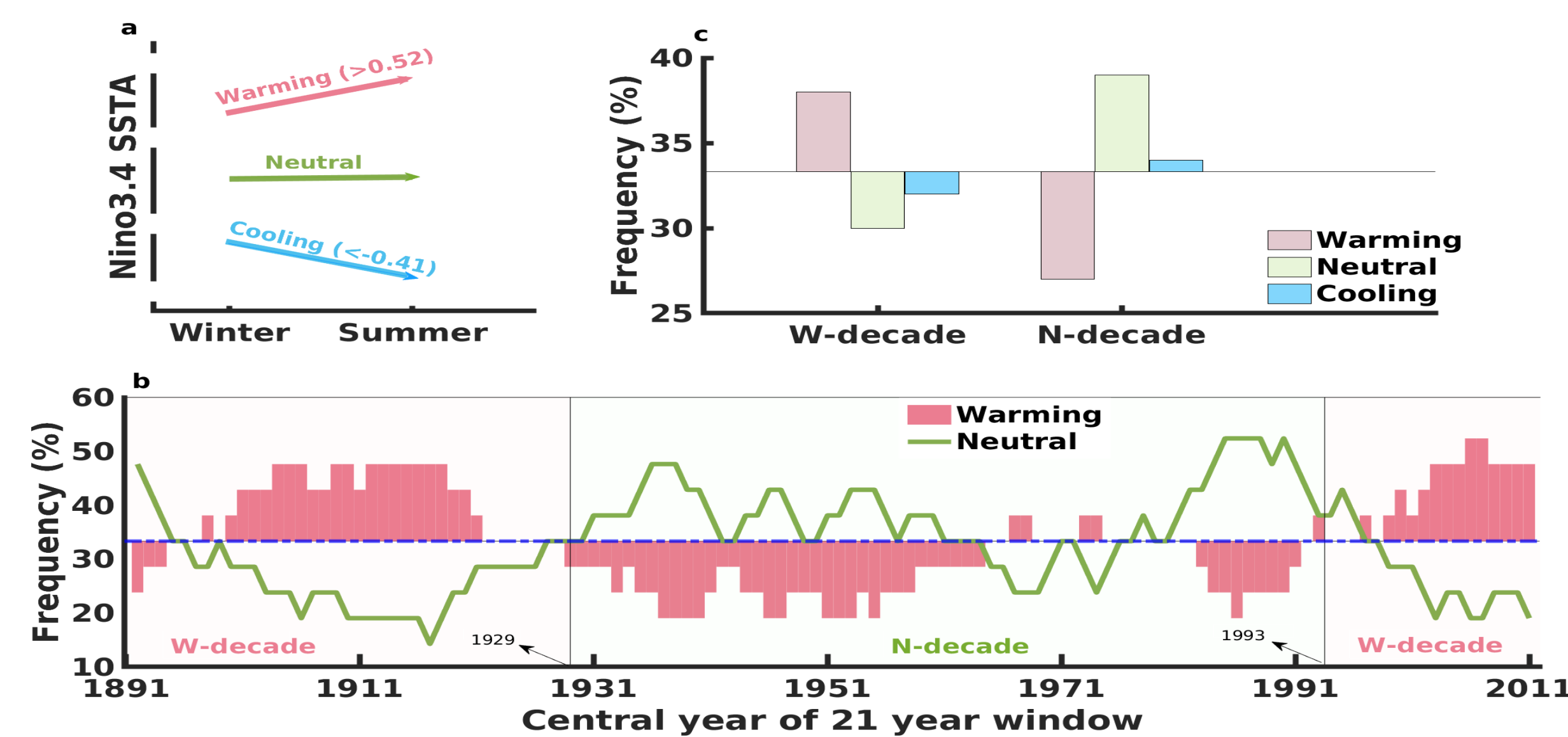


1. INTRODUCTION

- The stochastic atmospheric forcing from the "extra tropics" integrate in time and shape the low-frequency climate variability.
- ENSO is a dominant force of inter-annual "tropical" climate variability.
- Therefore, tropical-extra tropical interaction is crucial for understanding the decadal climate variability.
- Especially, the evolution of ENSO through seasons becomes an important field of study due to its impact on the global climate.

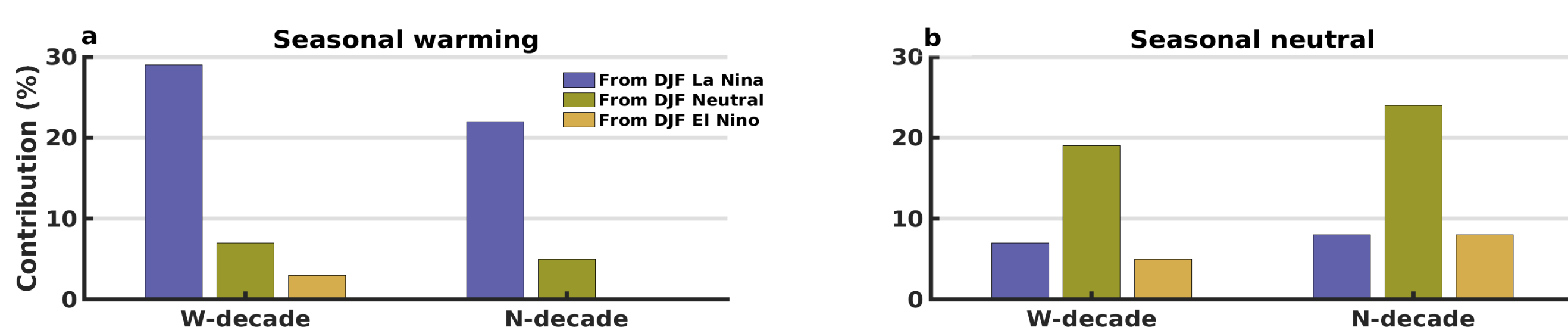
2. Seasonal ENSO transition frequencies

- The boreal winter-to-summer ENSO transition frequencies exhibits a multi-decadal cycle.
- Decades dominated by frequent seasonal warming (W-decades) are followed by decades with frequent neutral transitions (N-decades).

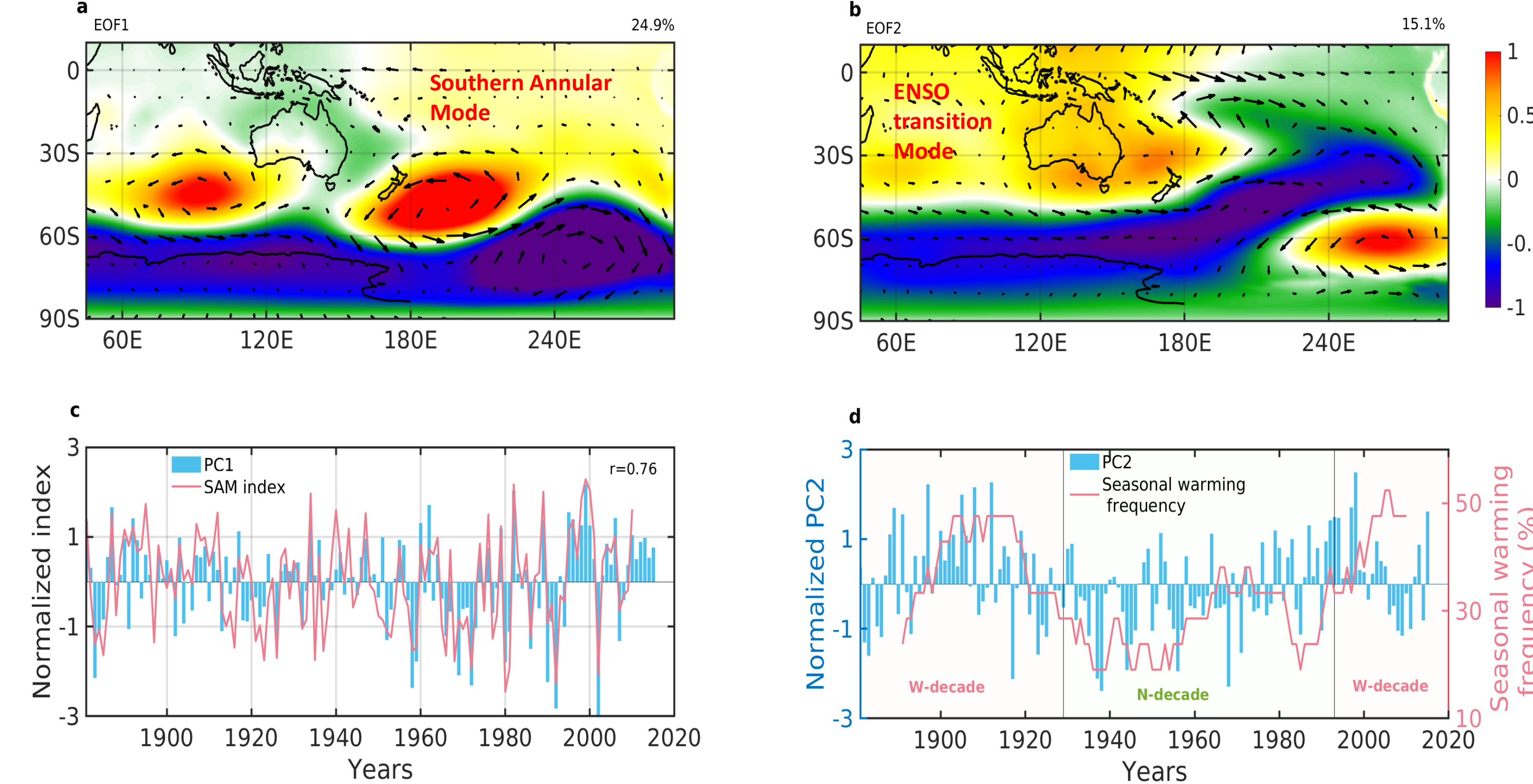


Given DJF La Nina (neutral) conditions, high probability of seasonal warming (neutral) transitions.

What could be leading to such clustering of seasonal ENSO transitions?

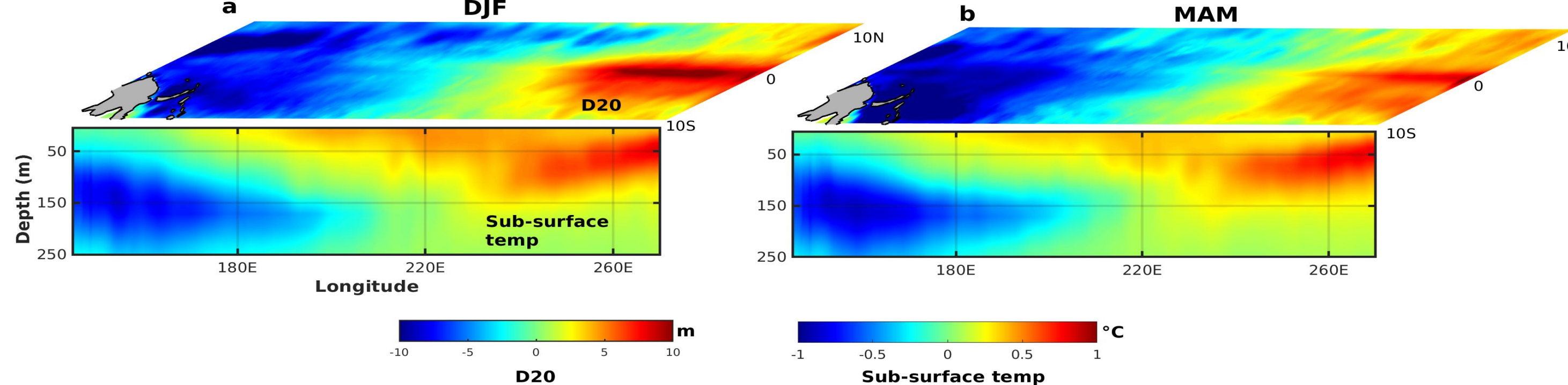


3. Boreal Spring Southern Hemisphere Climate Mode



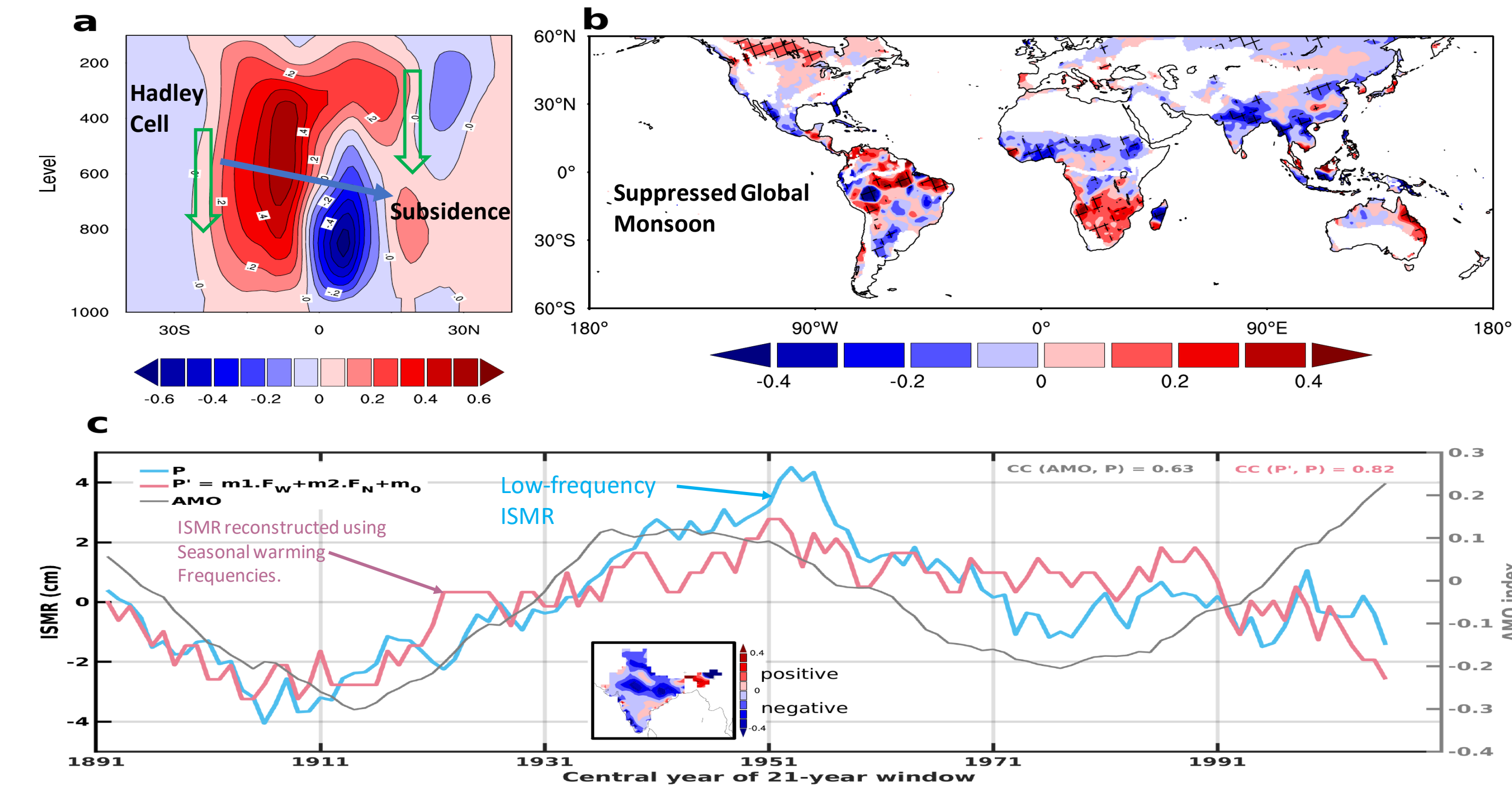
- During boreal spring, weak ocean-atmosphere coupling in the tropical Pacific.
- The boreal spring is the season when ENSO usually experiences transitions.
- EOF of sea-level pressure (SLP) of Southern Hemisphere is performed.
- The leading mode of variability in the Southern Hemisphere is the Southern Annular Mode (SAM).
- The second leading mode of variability is linked to ENSO transition frequencies.
- This mode (PC2) is essentially the ENSO transition mode (ETM).**

4. ETM connection to the sub-surface tropical Pacific Ocean



- During W-decades, thermocline is anomalously shallower (deeper) in the western (eastern) tropical Pacific Ocean.
- Moreover, during MAM, the thermocline becomes even shallower owing to clockwise surface wind associated with the ETM.

5. ETM association with the Global Monsoon



- During decades with frequent seasonal warmings (W-decade), global Hadley cell is weaker and global Monsoon is suppressed.
- The low-frequency variability of the Indian Summer Monsoon Rainfall (ISMR) is strongly related to the seasonal warming frequencies.
- Conclusions**
- Boreal winter-to-summer ENSO transition frequencies exhibit a prominent multi-decadal cycle.
- In the boreal spring season, a dominant mode of sea-level pressure in the Southern Hemisphere follows a similar decadal oscillation.
- This sea-level pressure mode regulates near-surface winds and modulates ENSO transition.
- Global monsoon is suppressed during decades with frequent seasonal warming transitions.



Email: shikhars@iisc.ac.in

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