

Abstract

We explore the cause of 2011 shift in Madden-Julian Oscillation variance during Dec.-Feb. from 1979 to 2023. The results are as follows:

- Known factors and long-term results do not fully explain the shift. Explanations involving Pacific Meridional Mode (PMM) and typical atmospheric patterns from stream function EOF have been excluded.**
- Mechanistic simulations show the observed SST shift could be a responsible forcing but its origin needs further study.**

Introduction

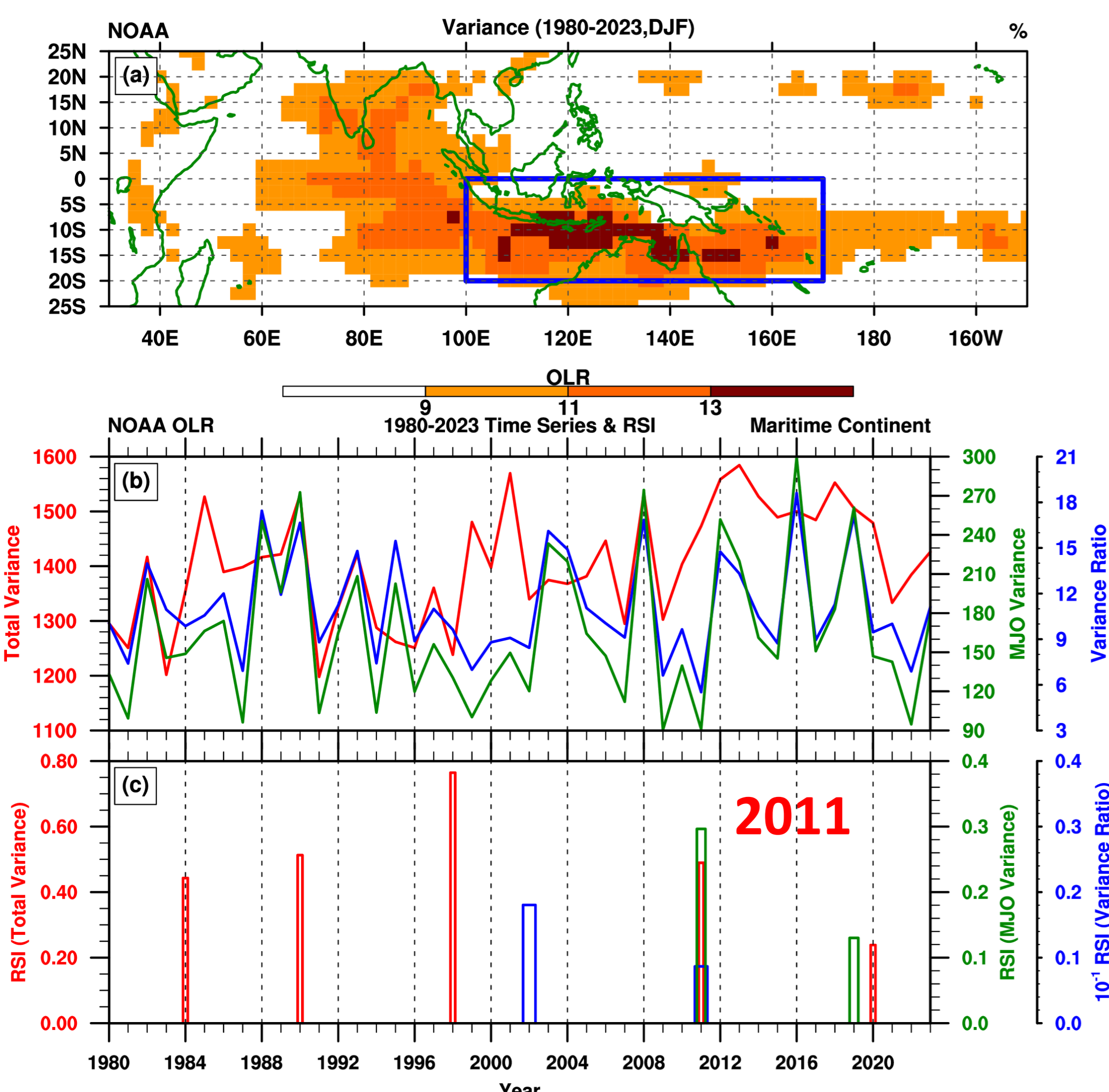


Fig.1 In the Maritime Continent region, a significant regime shift in MJO variance (from OLR) was detected in 2011 (1979-2023, DJF). Source: Li-Chiang Jiang.

Result 1: Observations do not match PMM or long-term modes

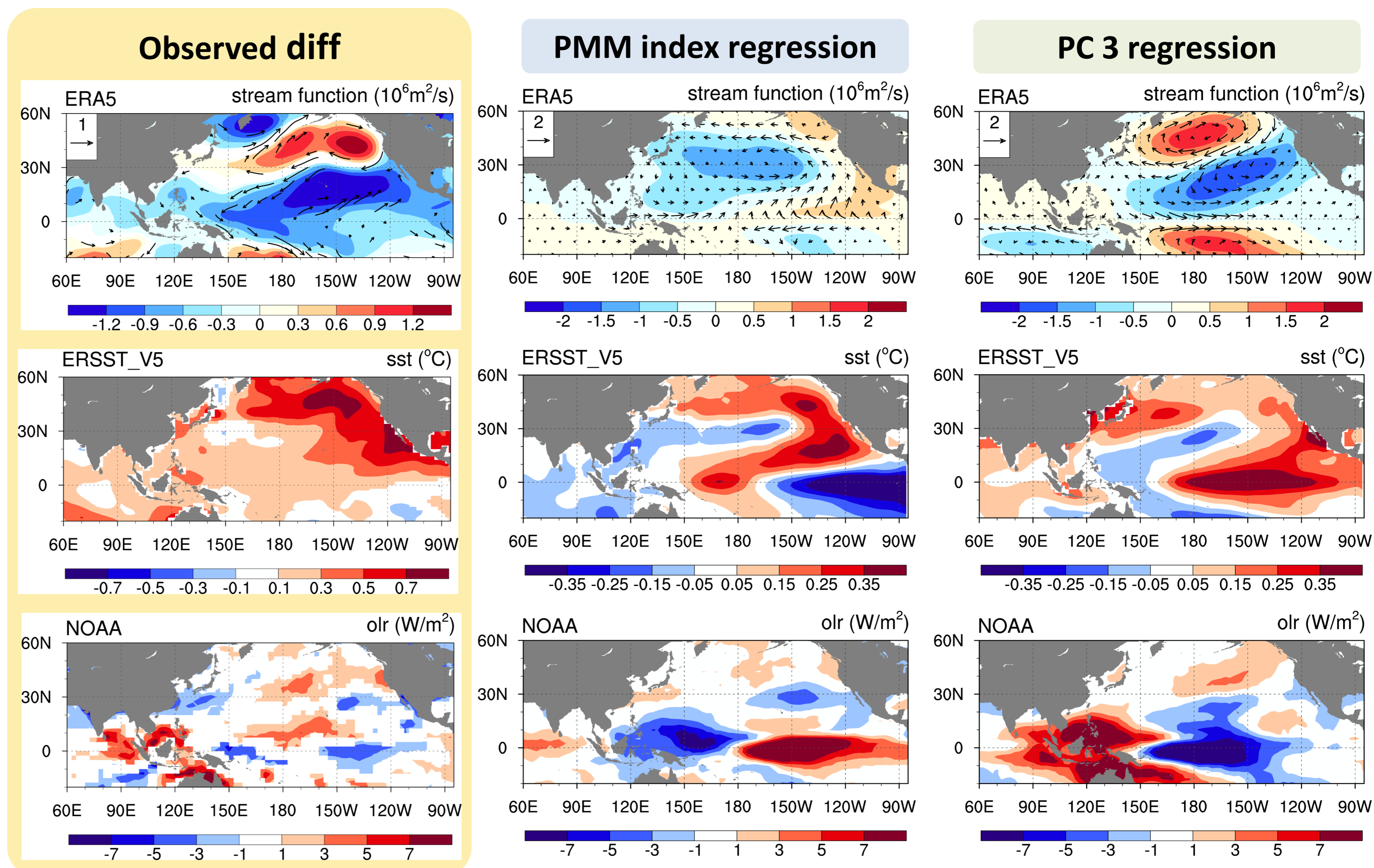
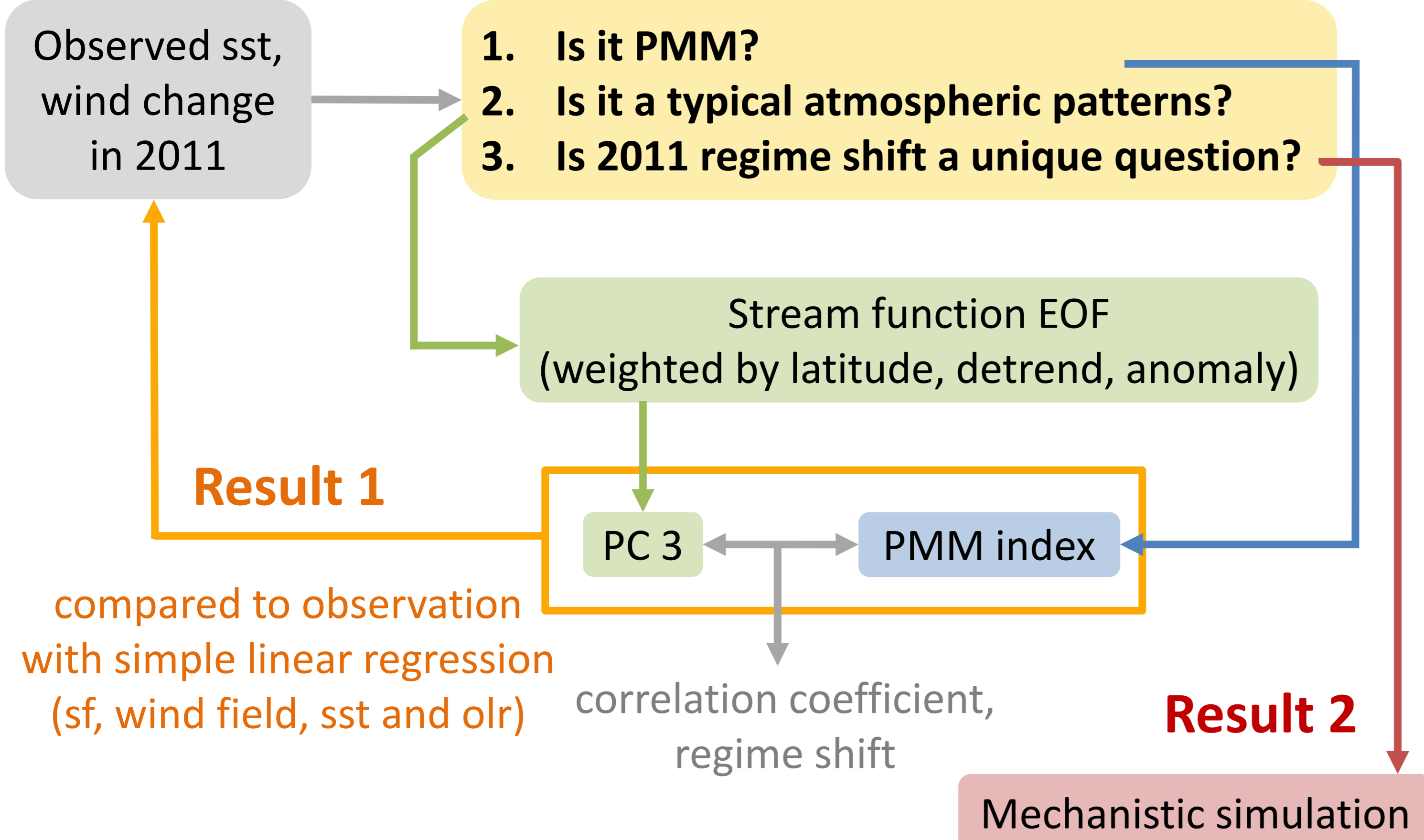


Fig.2 Observed DJF average differences (2011 ± 12 years), compared with PMM index and PC3 regression on 925mb stream function, wind field, SST, and OLR.

Data & Methods

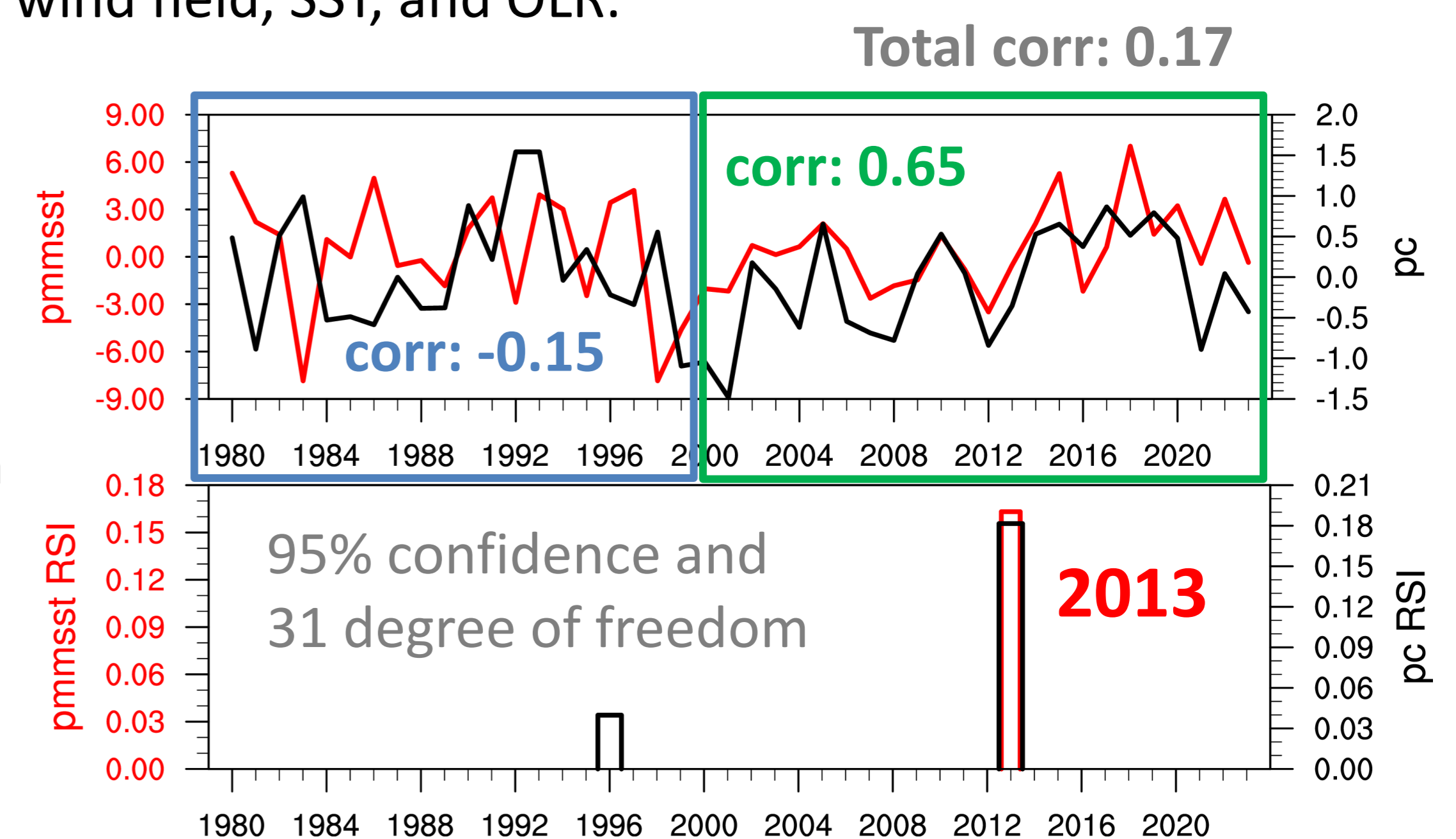
Data	ERA5	ERSST_V5	NOAA	
Type	Reanalysis	Observation	Observation	Index
Variables	SF, UV wind	SST	OLR	PMM SST
Resolution	Spatial	0.25° x 0.25°	2° x 2°	2.5° x 2.5°
	Temporal	1979 to 2023 Monthly (DJF)		



experimental design

RUN	Time	SSTA region
Control	1999-2011 DJF average	global
Global	DJF average differences (2011 ± 12 years)	global
Northeast Pacific (positive)		0N-40N, 100W-170W
North Pacific (positive)		40N-60N, 120E-120W

Fig.3 Correlation between the DJF mean PMM index and PC3, and regime shifts from 1979 to 2023 by sequential algorithm (S. N. Rodionov, 2004)



Result 2: Mechanistic simulations

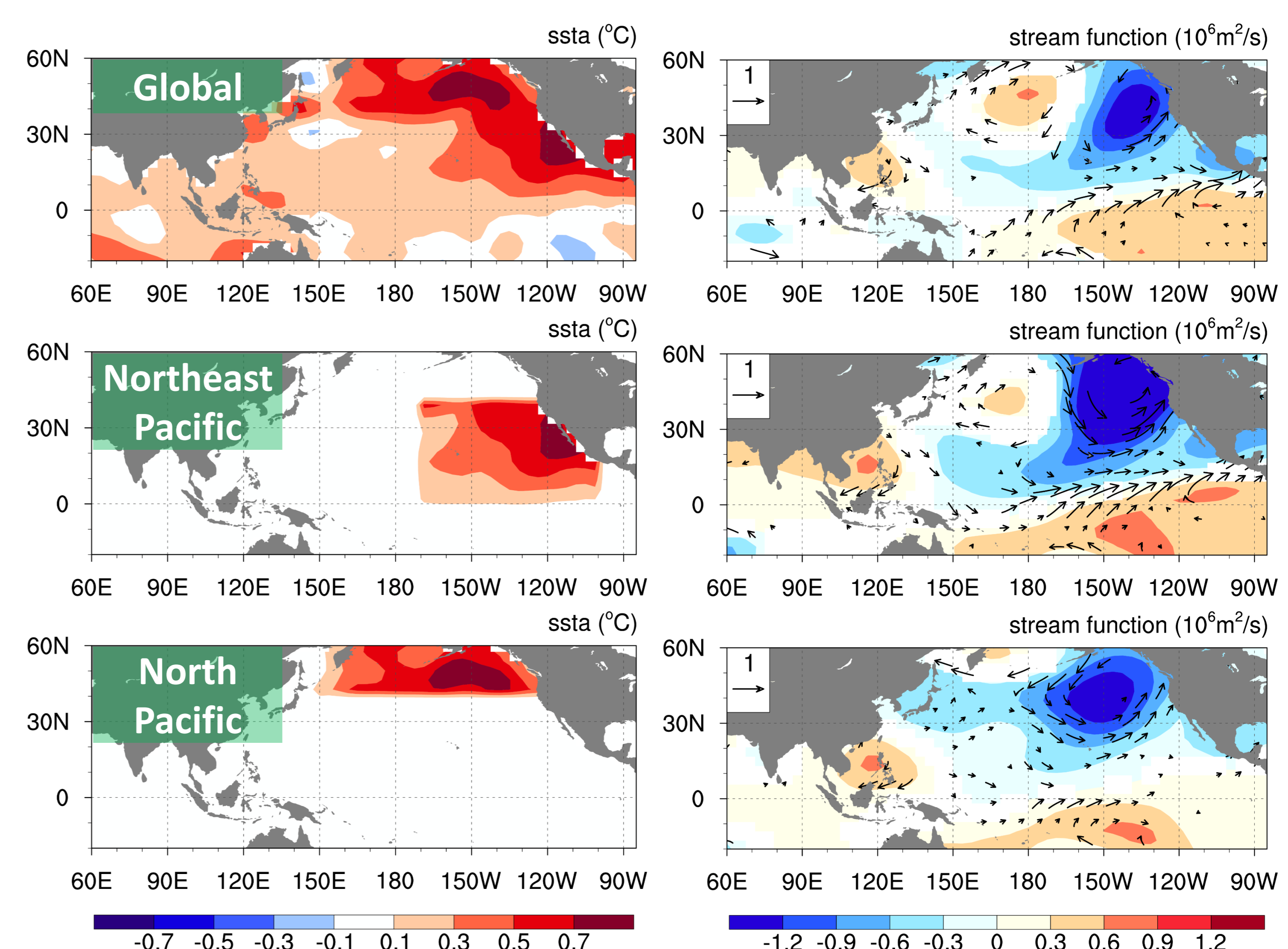


Fig.4 Using SST anomalies from different regions for atmospheric simulations with SPEEDY model, the 925mb stream function and wind field are evaluated at a 90% confidence level.