

Decadal Variability in the Frequency and Duration of El Niño and La Niña Events: Comparison Between CESM2 and CCSM4

Yuko M. Okumura and Tianyi Sun

University of Texas at Austin Institute for Geophysics (UTIG)

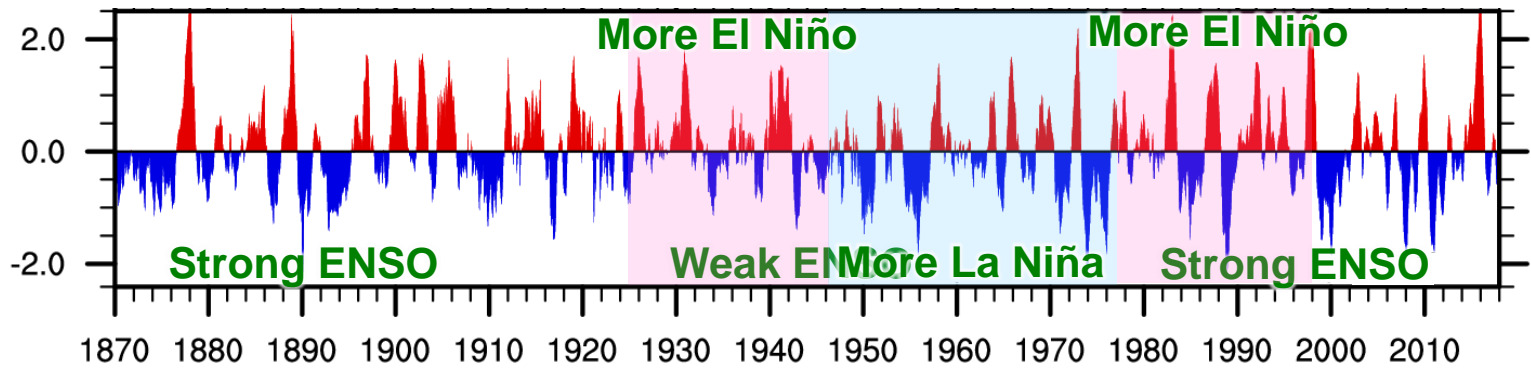


Okumura, Y. M., Sun, T., and Wu, X., 2017: Asymmetric modulation of El Niño and La Niña and the linkage to tropical Pacific decadal variability. *J. Climate*, 30(12), 4705-4733.

Sun, T., and Okumura, Y. M., 2019: Impact of tropical Pacific decadal variability on the El Niño-Southern Oscillation. In preparation.

Decadal modulation of ENSO

Niño-3.4 Index (HadISST, 1870-2018)

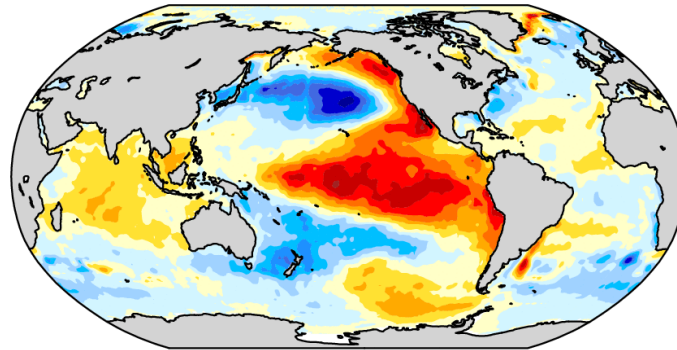


Relative frequency of El Niño and La Niña events



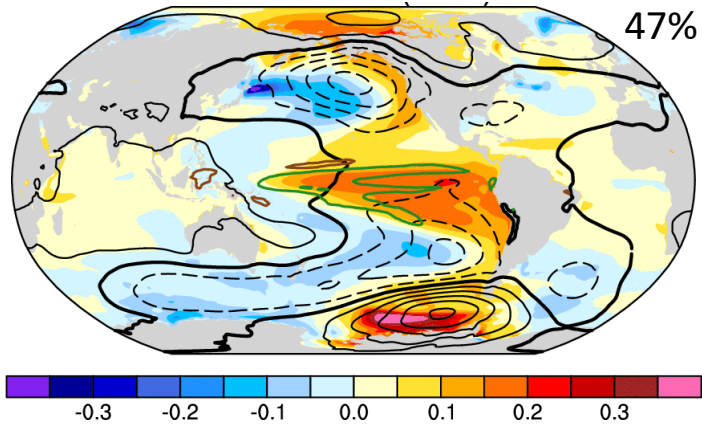
Kiem et al. (2003)
Verdon and Franks (2006)

Interdecadal Pacific Oscillation (IPO)



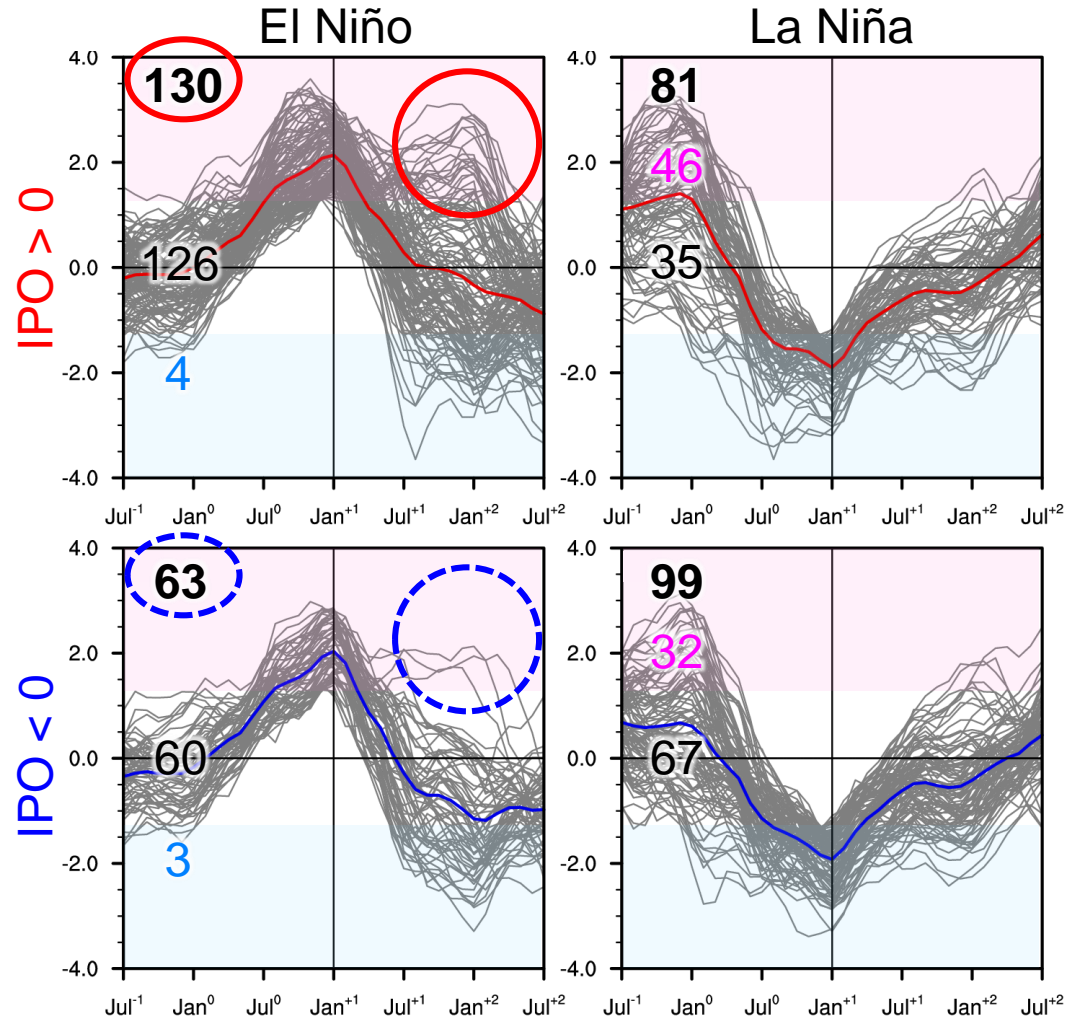
CCSM4: IPO – Frequency and duration of El Niño

IPO in 1300-yr CCSM4
PI Control Simulation



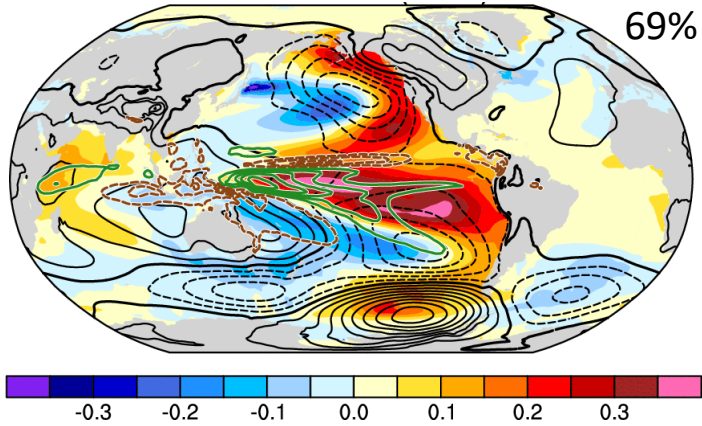
Dec Niño-3.4 SST
 $>+1\sigma \rightarrow$ El Niño
 $<-1\sigma \rightarrow$ La Niña
 $(\sigma=1.27^\circ \text{ C})$

Niño-3.4 Index

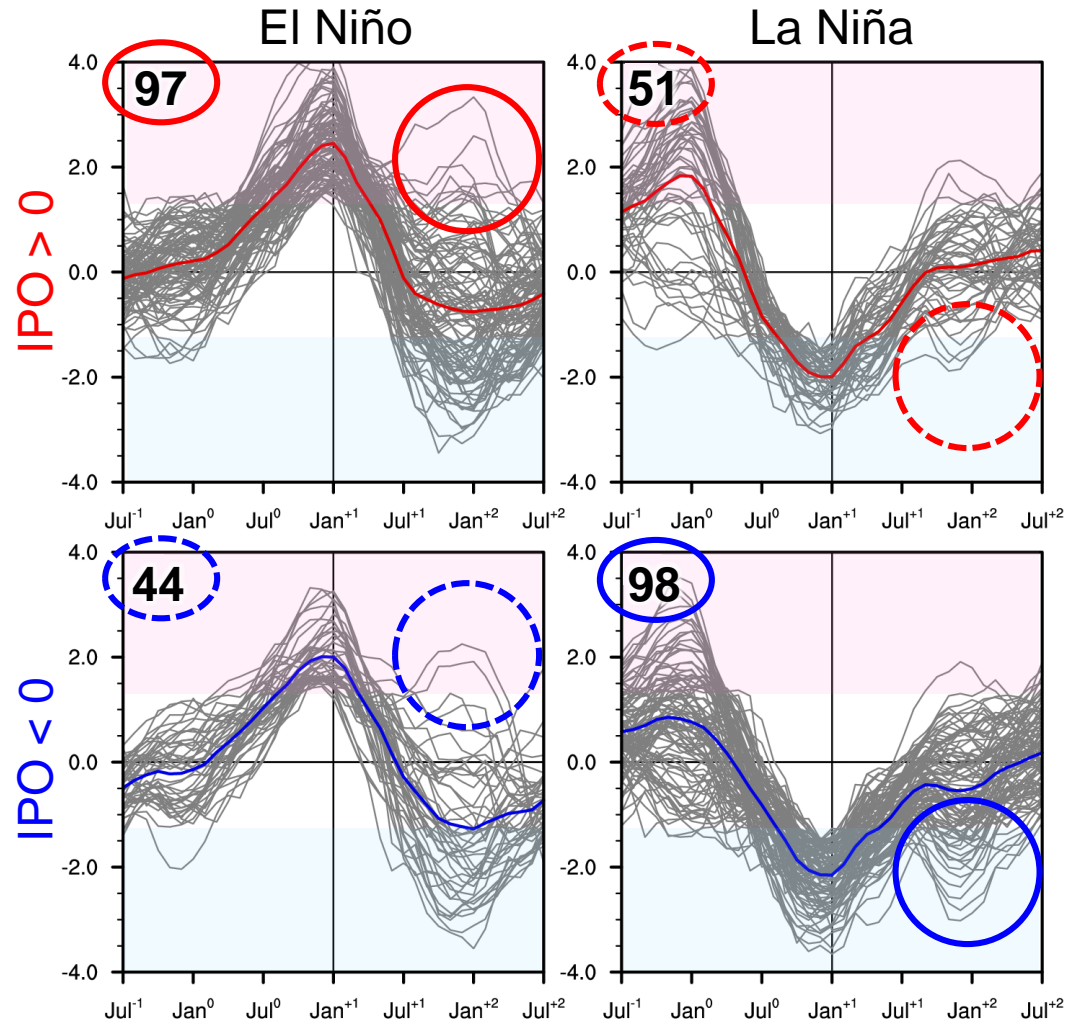


CESM2: IPO – Frequency and duration of El Niño and La Niña

IPO in 1000-yr CESM2
PI Control Simulation



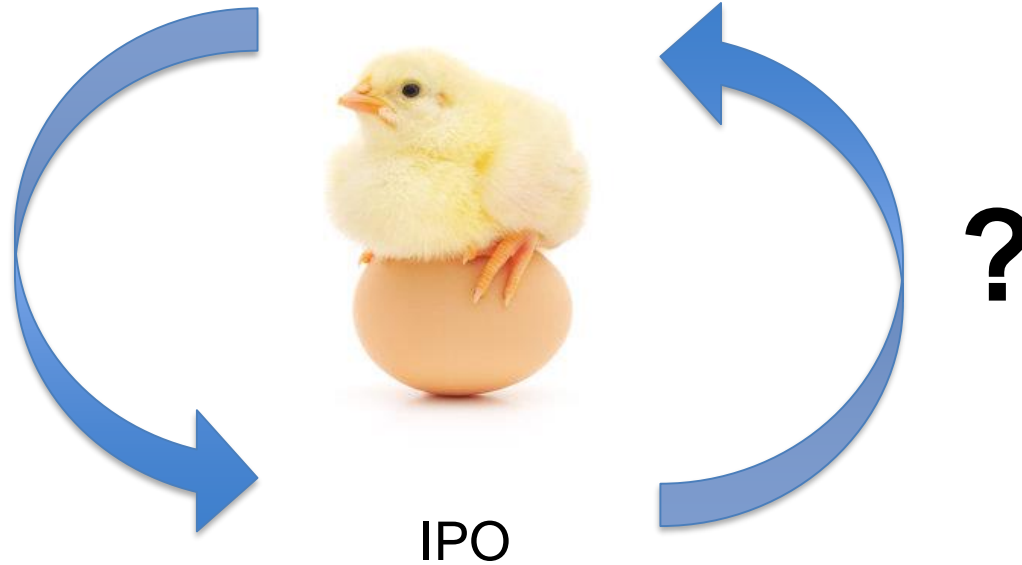
Niño-3.4 Index



Which comes first?

Frequency and duration of El Niño and La Niña events

e.g., Vimont (2005)

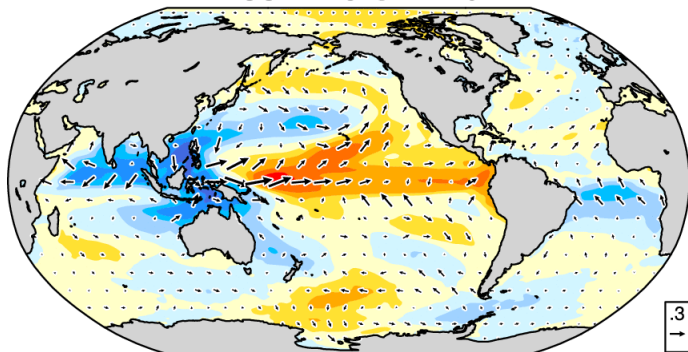


What triggers ENSO events?

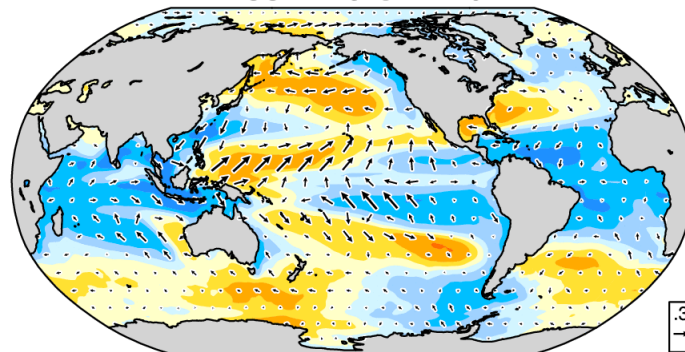
1300-yr CCSM4 PI Control Simulation

Feb-Apr Surface Temperature/Wind Correlation with Dec Nino-3.4

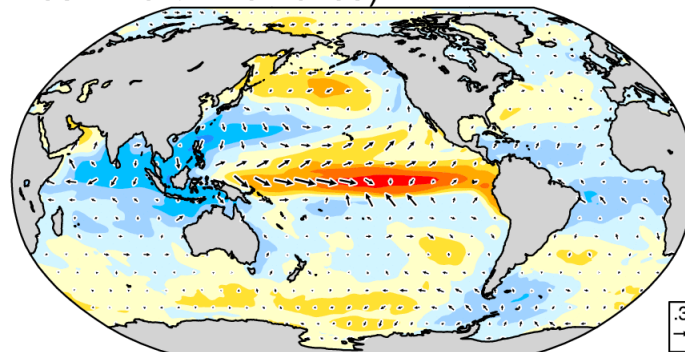
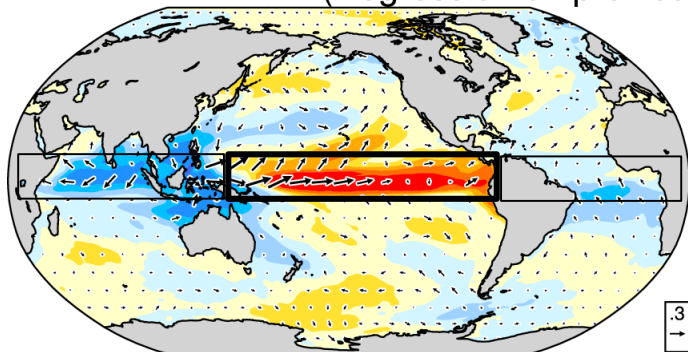
Dec Nino-3.4 > 0



Dec Nino-3.4 < 0

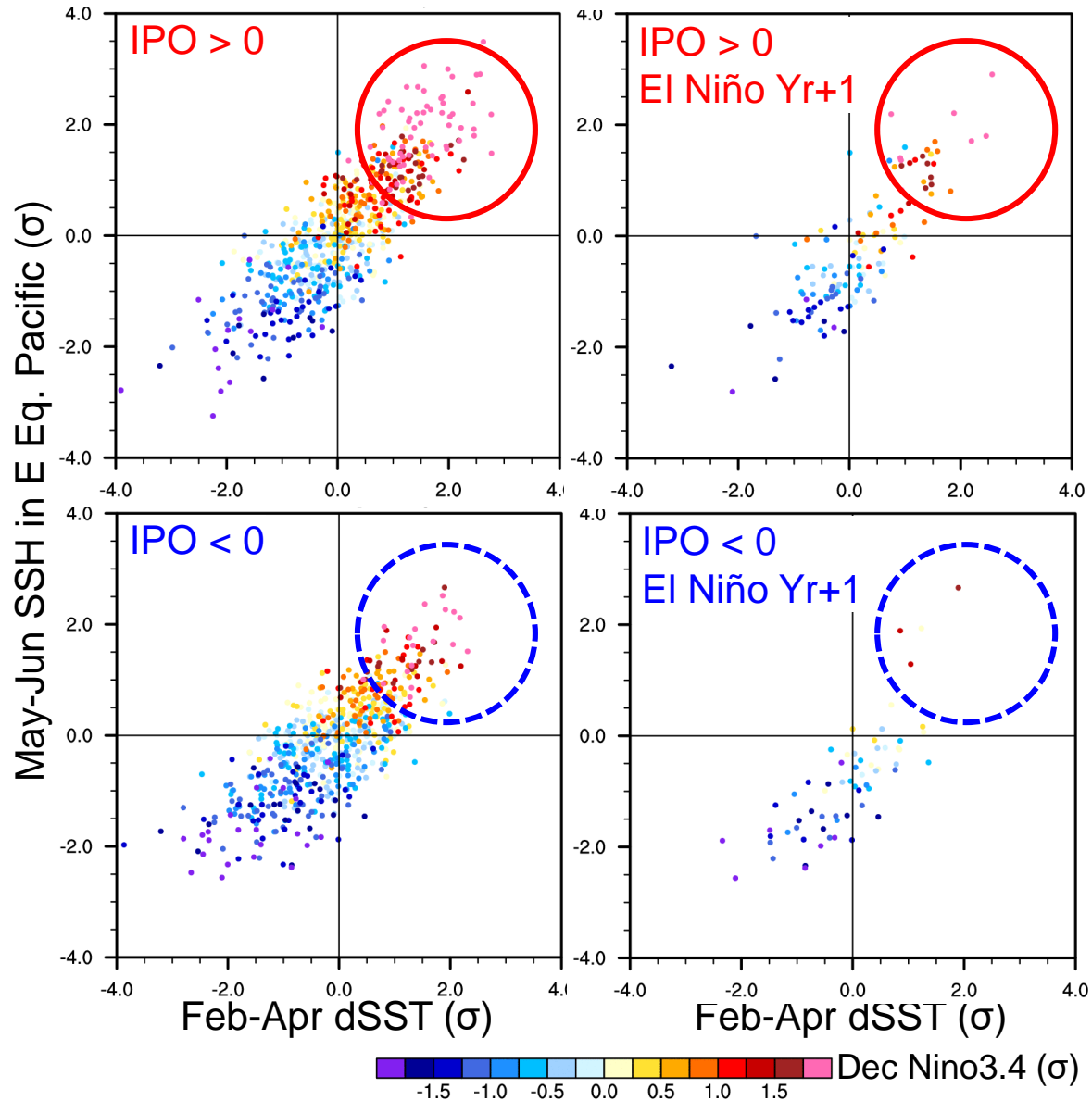


(Regression on previous Dec Nino-3.4 removed)

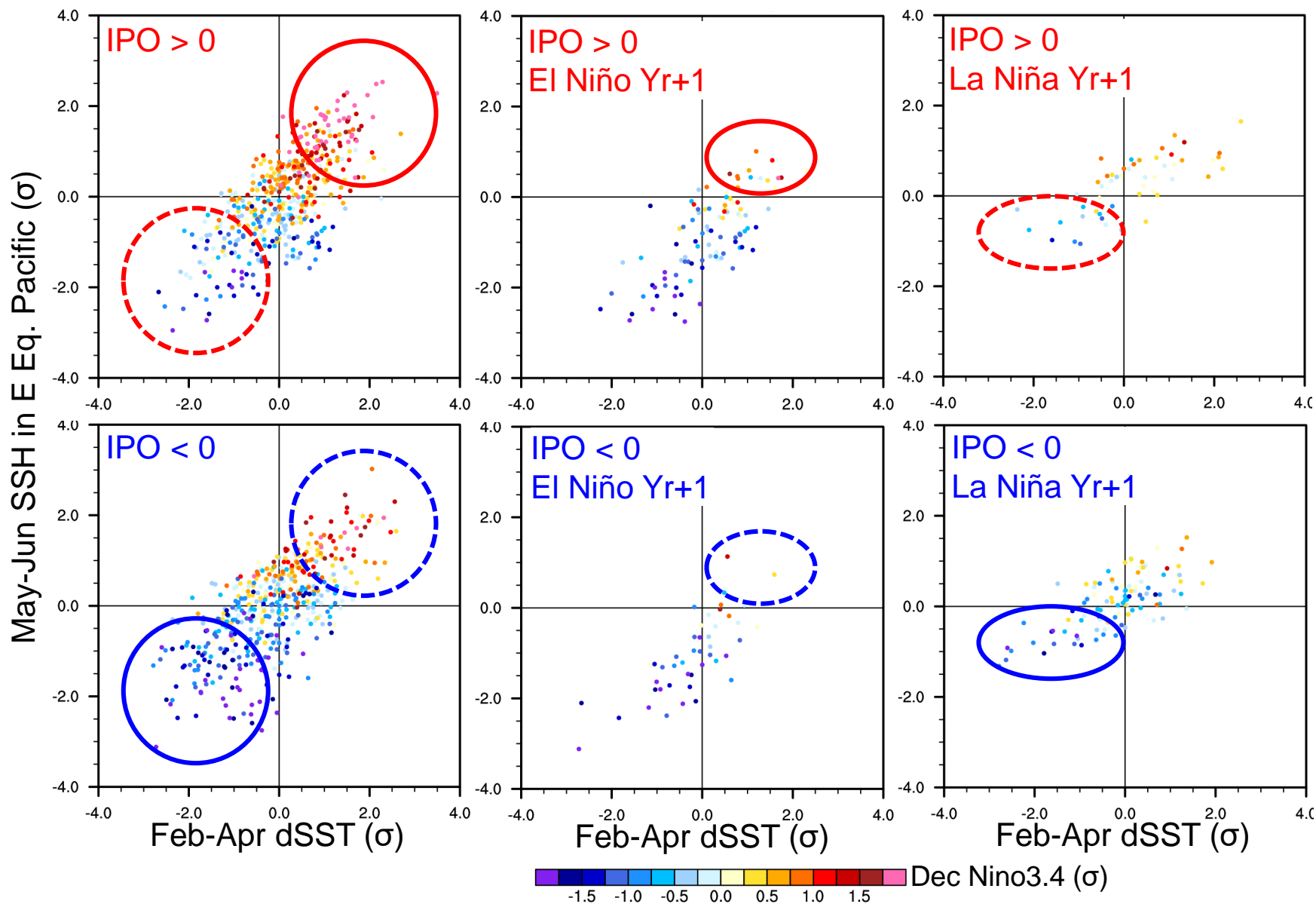


dSST = **Pacific** - Indian/Atlantic

CCSM4: Role of interbasin SST gradient

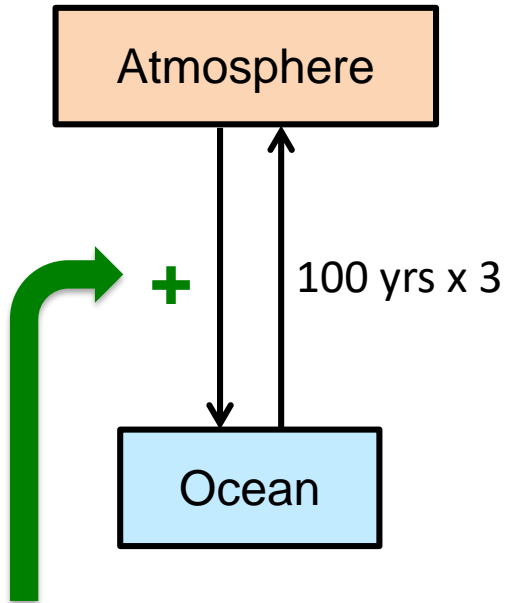


CESM2: Role of interbasin SST gradient

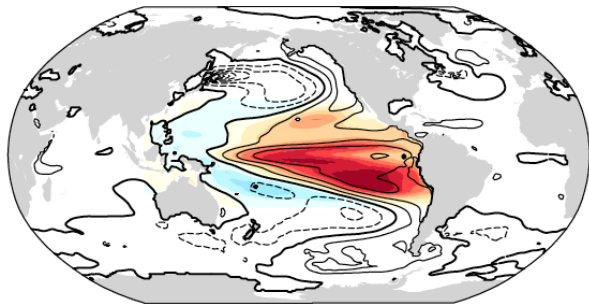


Does the IPO really affect ENSO?

CCSM4 experiments



IPO surface heat flux forcing



-1.2 -0.8 -0.4 0.0 0.4 0.8 1.2

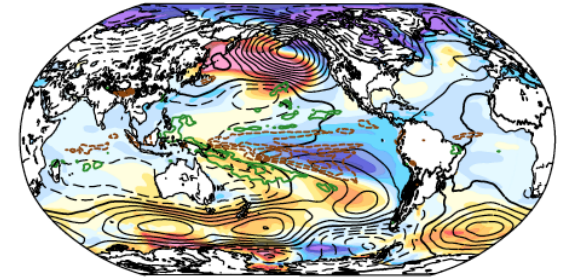
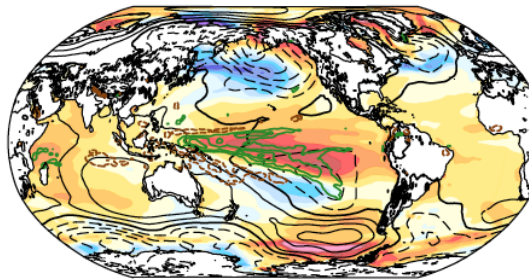
$\sim 1.4 \text{ Wm}^{-2}$ for 1σ

Mean Response

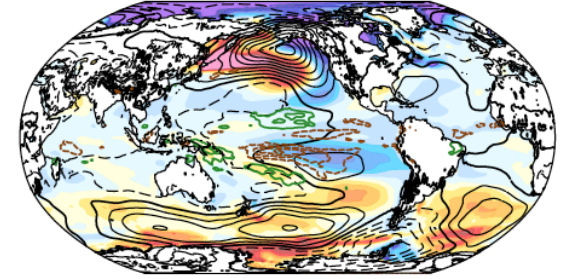
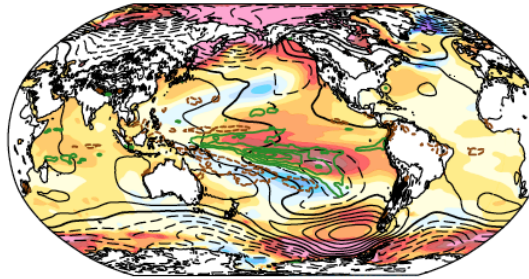
+2 σ IPO

-2 σ IPO

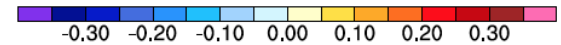
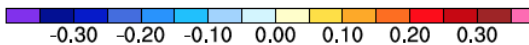
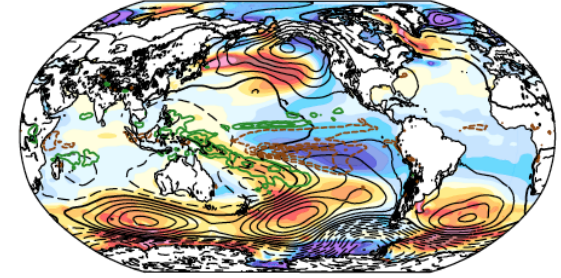
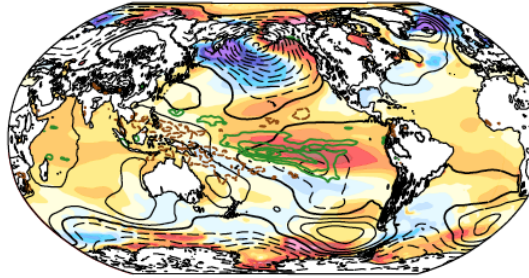
Member 1



Member 2

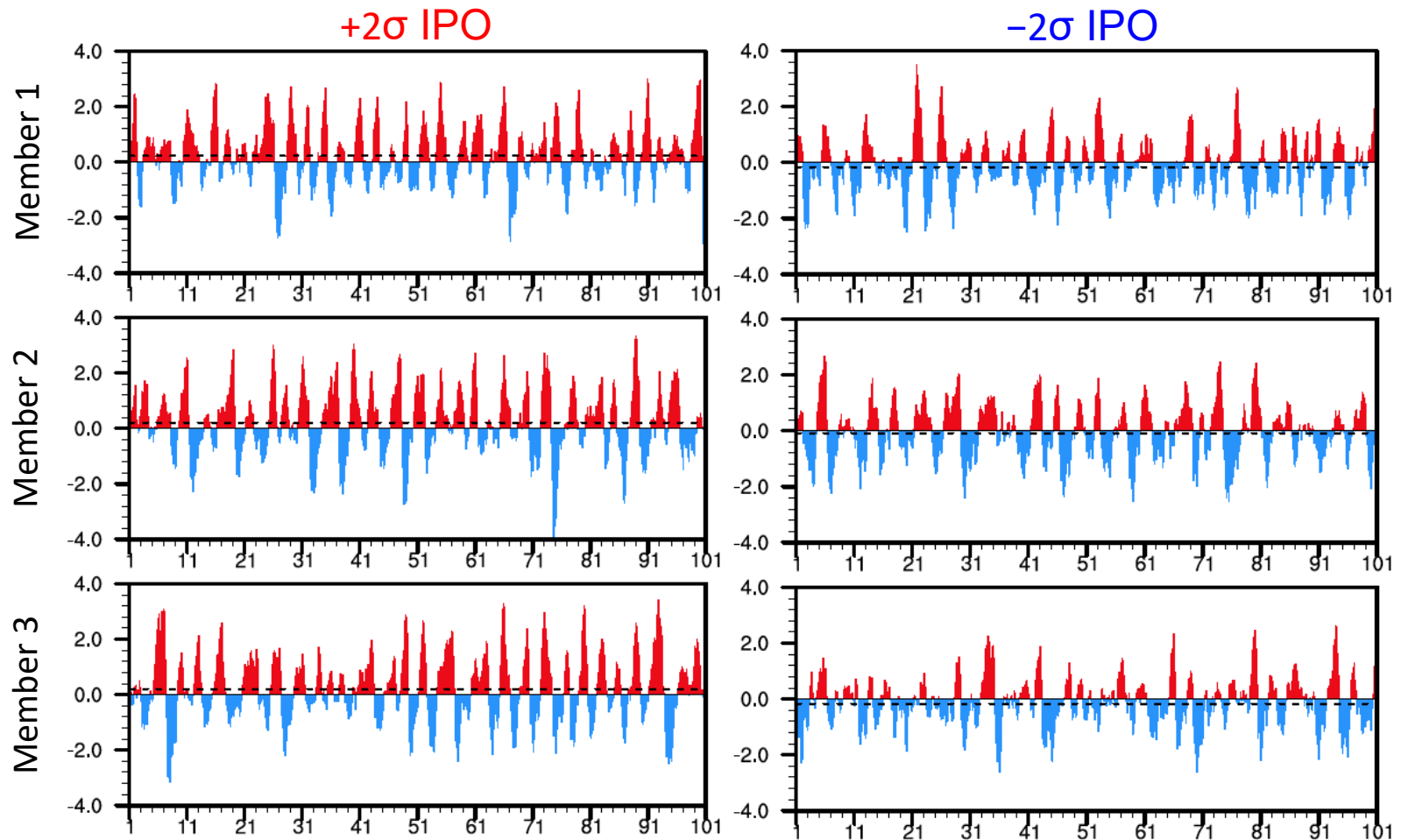


Member 3



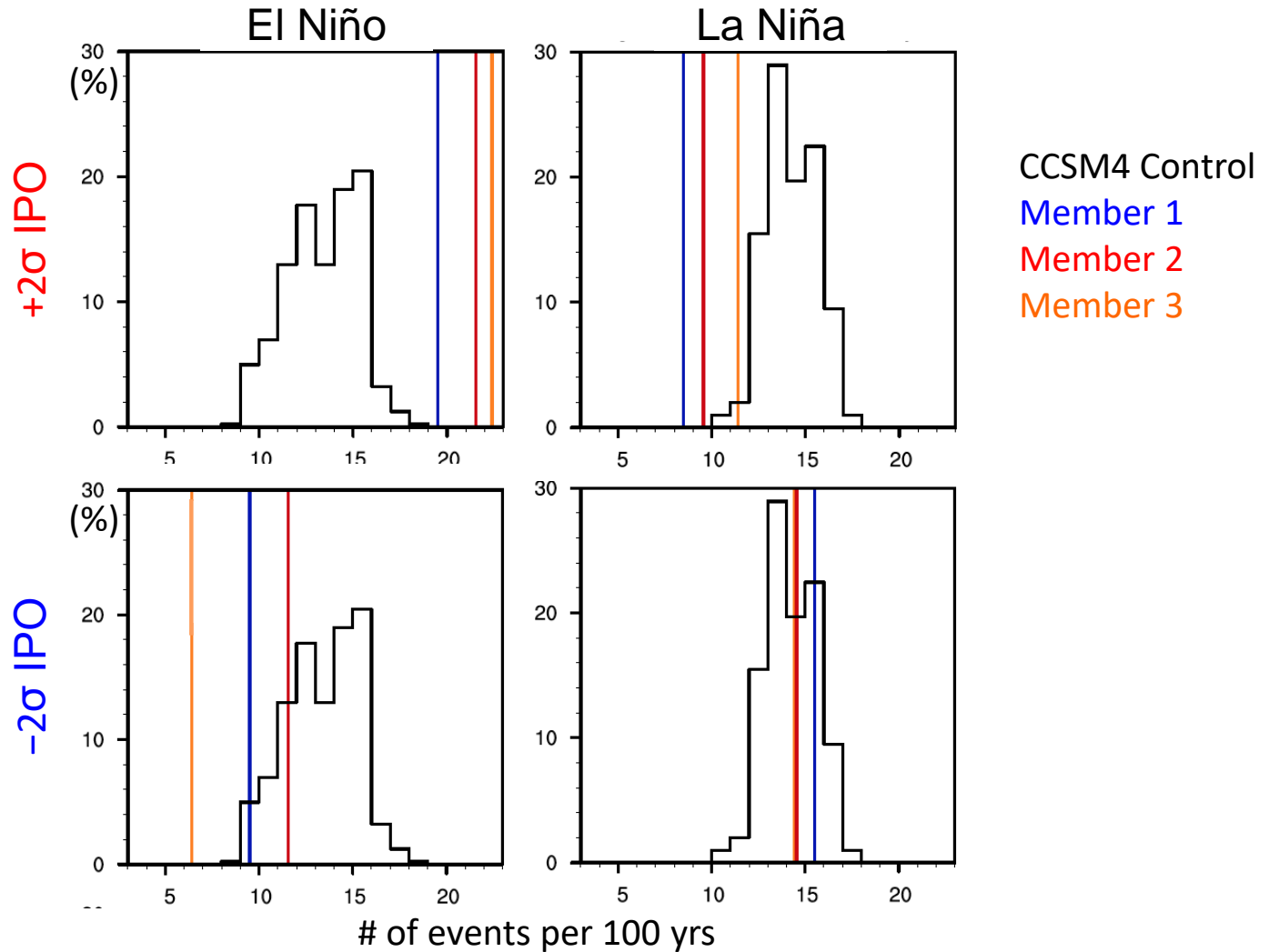
Does the IPO affect the frequency of ENSO events?

Niño-3.4 Index

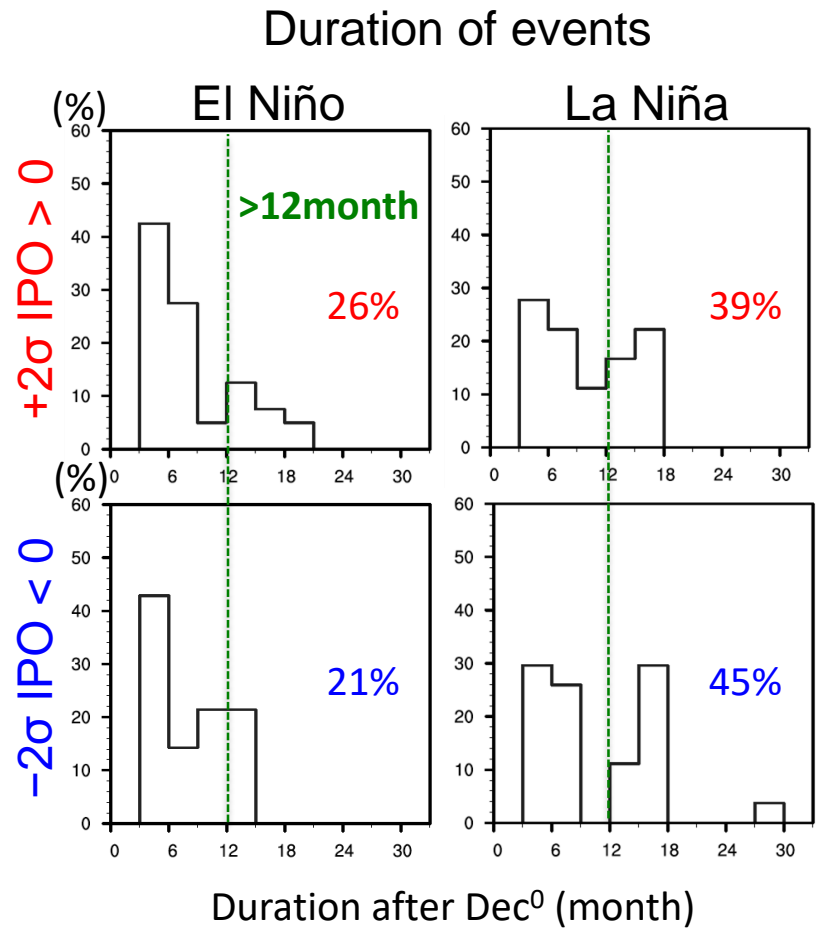
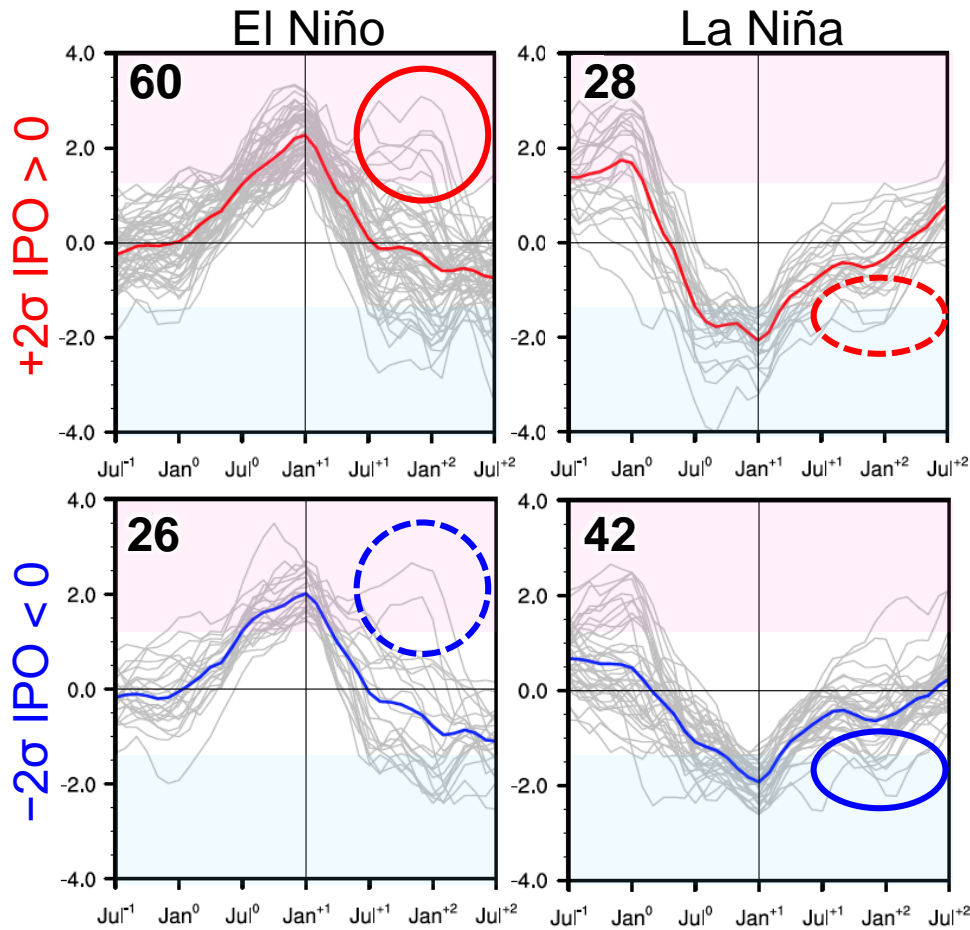


Does the IPO affect the frequency of ENSO events?

Frequency of events



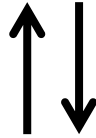
Does the IPO affect the duration of ENSO events?



* Members 1-3 are combined (300 yrs)

Summary

Frequency & Duration
of El Nino



IPO in CCSM4

Frequency & Duration
of El Nino and La Nina



IPO in CESM2

Interbasin
SST
Gradient

