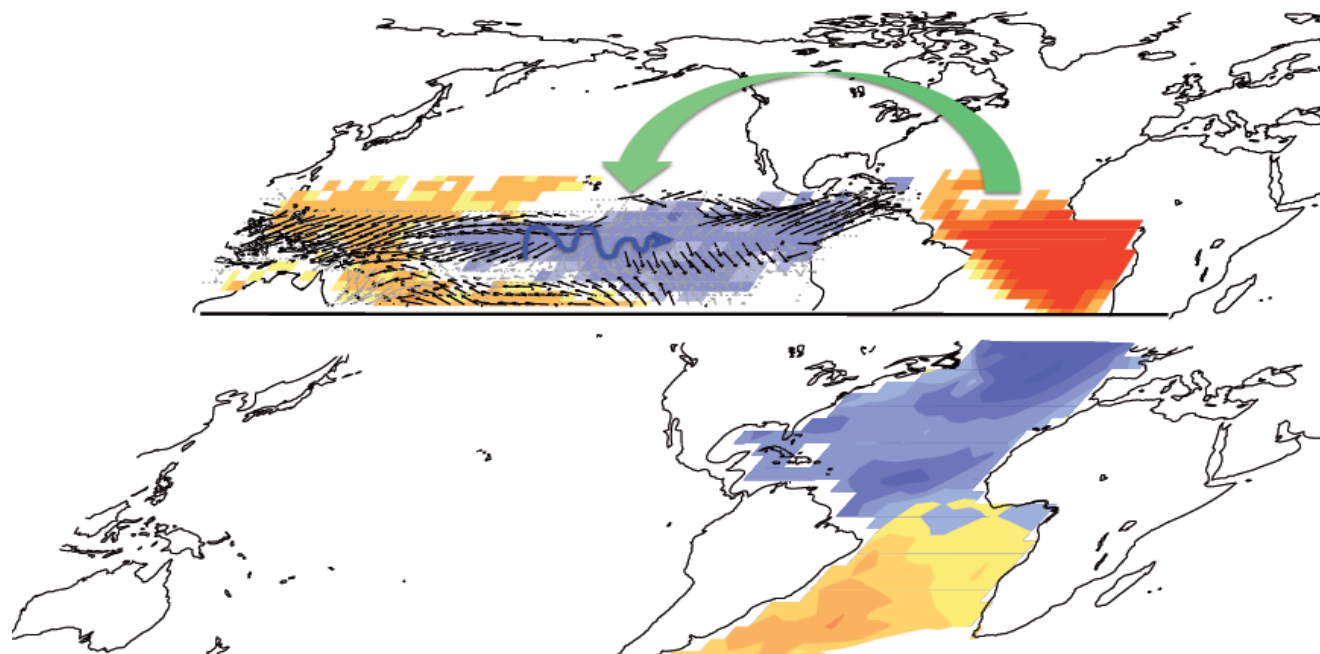


Atlantic opportunities for ENSO prediction



Marta Martín-Rey ⁽¹⁻²⁾, Belén Rodríguez-Fonseca ⁽¹⁻²⁾ and Irene Polo ⁽²⁻³⁾



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- (1) IGEO, centre-mixte UCM-CSIC, Madrid, Spain
- (2) Universidad Complutense de Madrid, UCM, Madrid, Spain
- (3) Department of Meteorology, University of Reading, Reading, UK



TROPA UCM



University of
Reading

Martín-Rey, M., B. Rodríguez-Fonseca, and I. Polo (2015), Atlantic opportunities for ENSO prediction, *Geophys. Res. Lett.*, 42, doi:10.1002/2015GL065062

MOTIVATION

The Atlantic Niños (Niñas) are able to favour the development of the Pacific Niños (Niños) after the 1970s...

reg Atl3 SST OBS JJAS 1949-1978

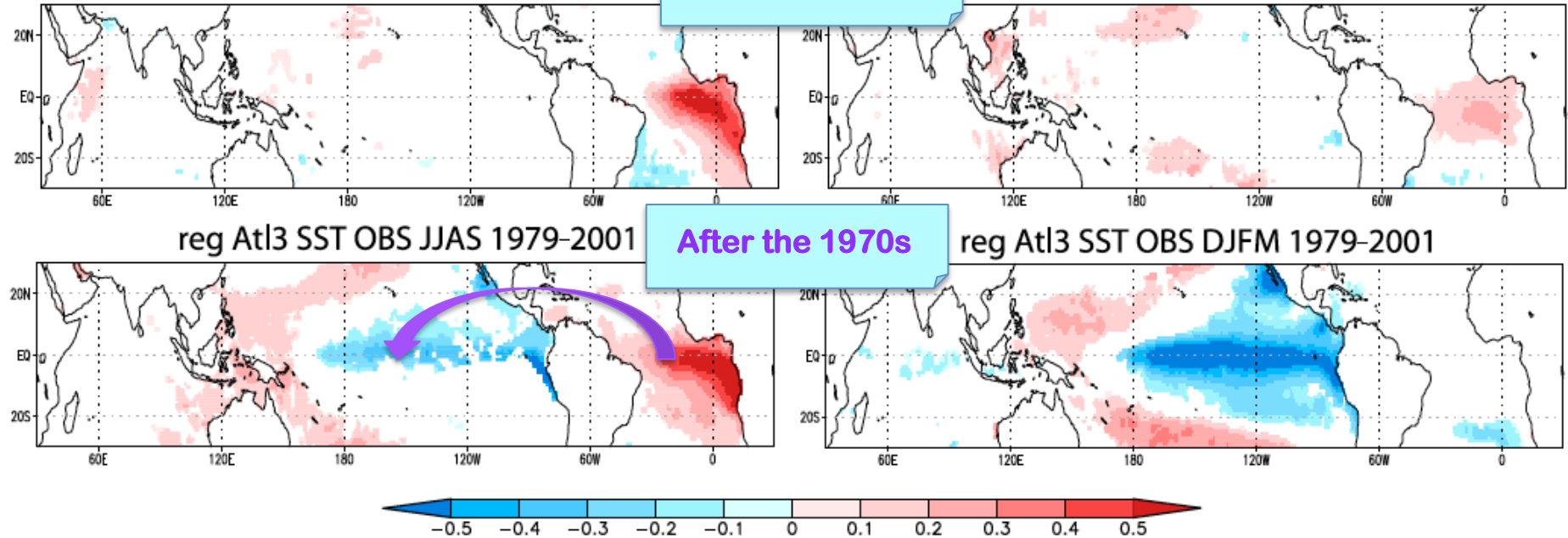
Before the 1970s

reg Atl3 SST OBS DJFM 1949-1978

reg Atl3 SST OBS JJAS 1979-2001

After the 1970s

reg Atl3 SST OBS DJFM 1979-2001



From Rodríguez-Fonseca et al. 2009, GRL

(Melice and Servain 2003; Keenlyside and Latif 2007; Polo et al. 2008; Jansen et al. 2009; Ding et al. 2012)

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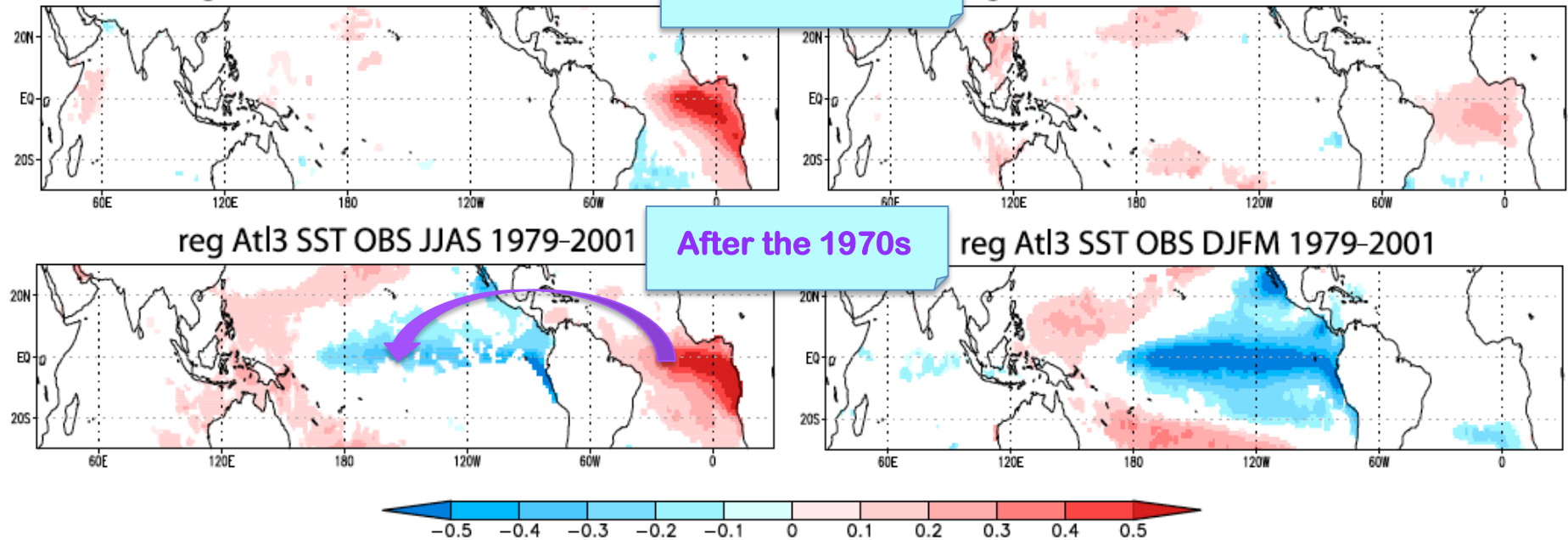
Before the 1970s

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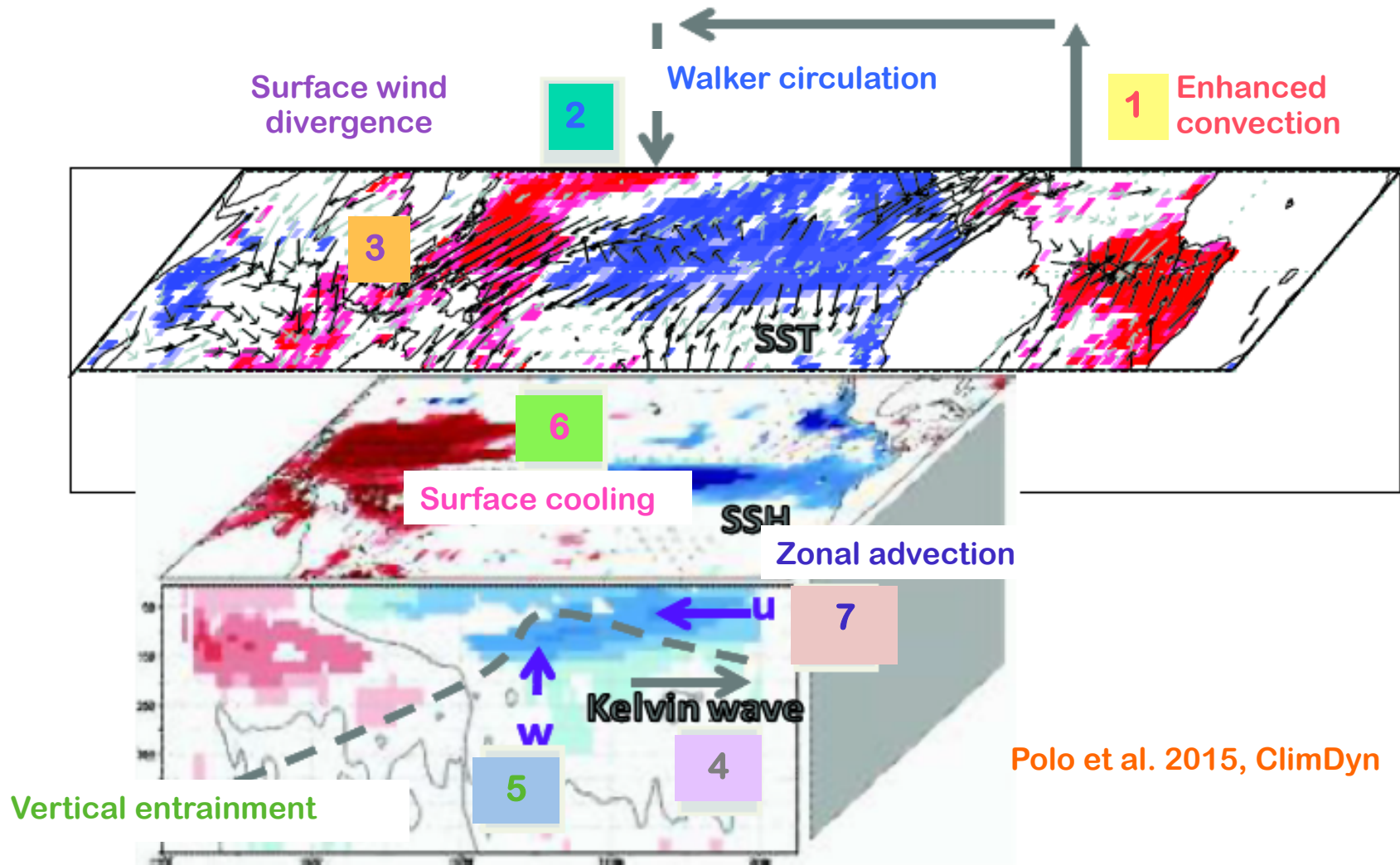
From Rodríguez-Fonseca et al. 2009, GRL

(Melice and Servain 2003; Keenlyside and Latif 2007; Polo et al. 2008; Jansen et al. 2009; Ding et al. 2012)

How is the influence of the tropical Atlantic SSTs on ENSO development?

MOTIVATION

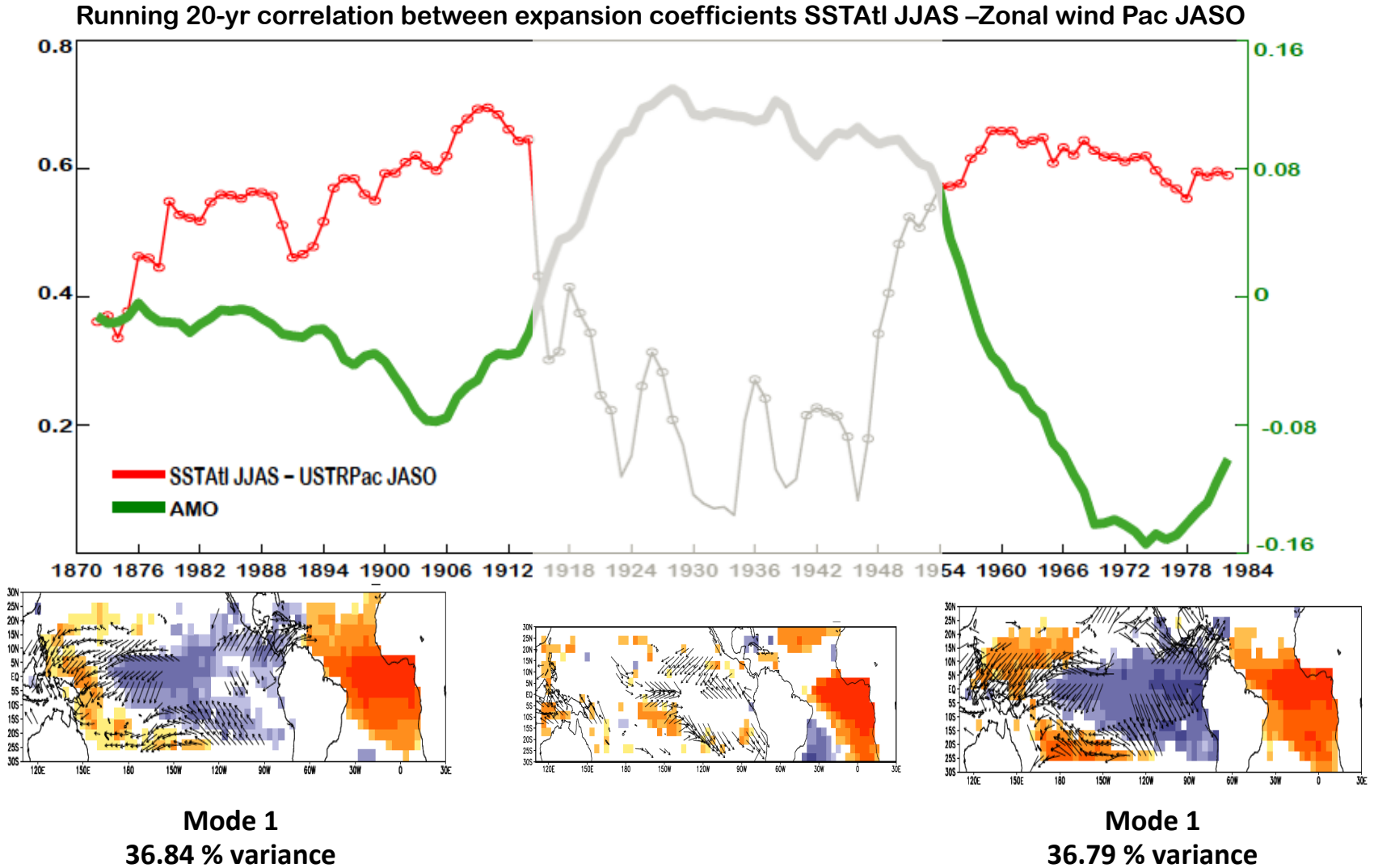
The Atlantic-Pacific connection is carried out through an air-sea coupled mechanism ...



Why does the Atlantic-Pacific connection only appear after the 1970s?

MOTIVATION

Atlantic-Pacific connection: a multidecadal modulated air-sea coupled mode



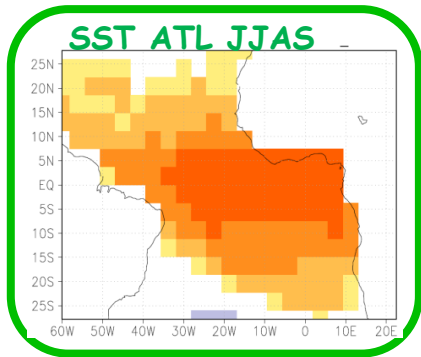
OBJECTIVE:

Could ENSO be predicted from the tropical Atlantic SST anomalies during previous summer?

METHODOLOGY

Statistical hindcast from EMMCA

X= PREDICTOR



Y= PREDICTANDS

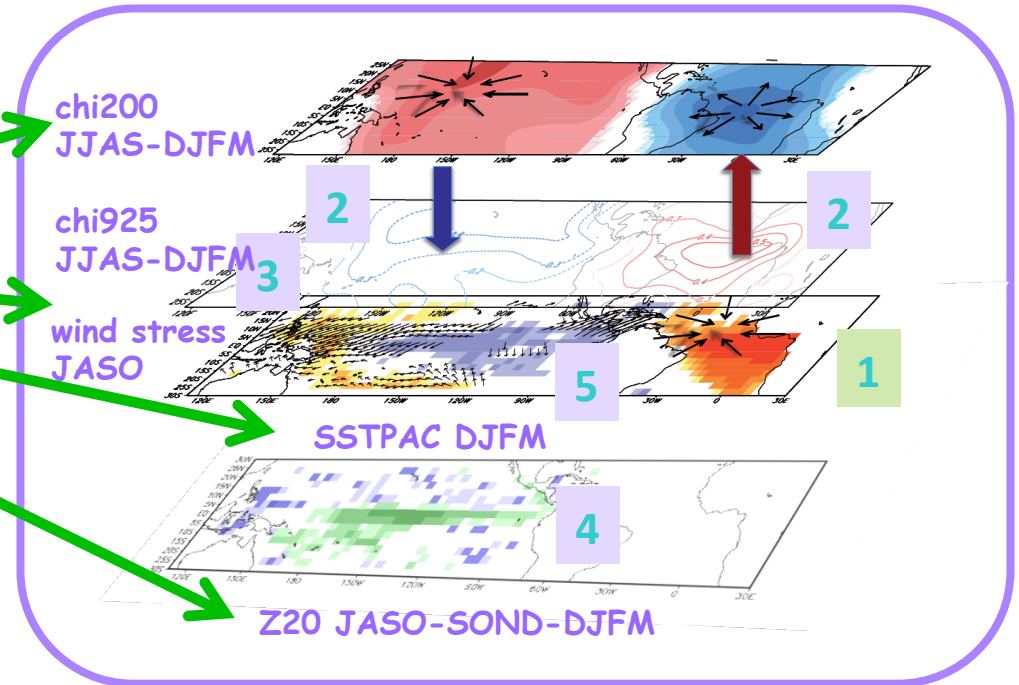
chi200
JJAS-DJFM

chi925
JJAS-DJFM

wind stress
JASO

SSTPAC DJFM

Z20 JASO-SOND-DJFM



CROSS-VALIDATION

Leave-one-out method (Dayan et al. 2013):
excluding the year i to predict

$$C_{ij} = Z_{li} * Y_{ji}$$

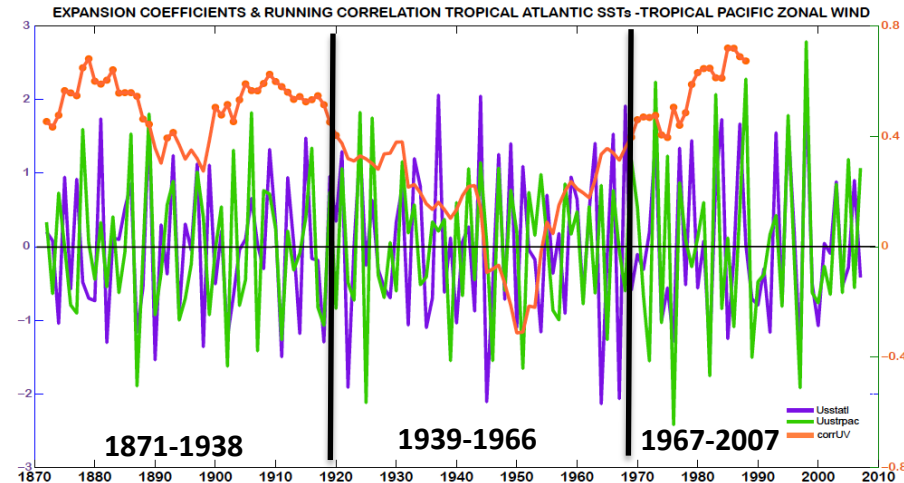
-Regression coefficient ψ contains the information of the relationship between the predictor and predictand field:

$$\psi^{\{i\}} = Q * (V * V^T)^{-1} * V * Y^T \quad i \notin [1, n_t - 1]$$

From ψ and the predictor, calculated the predictant field

$$\hat{Y}_l = \psi^{\{i\}} * Z_i$$

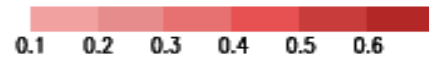
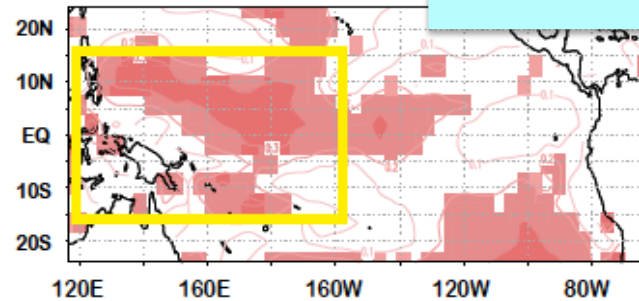
From Martin-Rey et al. 2014



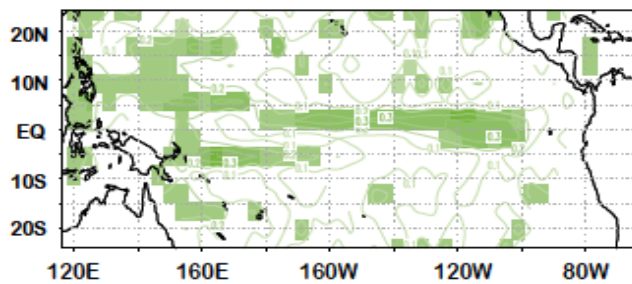
CORRELATION BETWEEN OBSERVATIONS AND PREDICTION

ZONAL WIND JASO

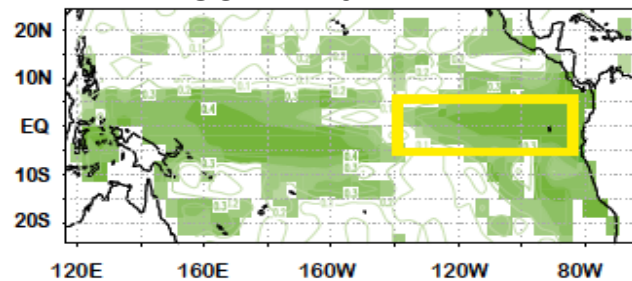
1871-1938



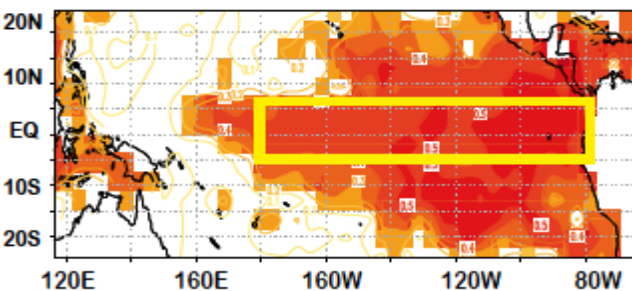
THERMOCLINE JASO



THERMOCLINE DJFM



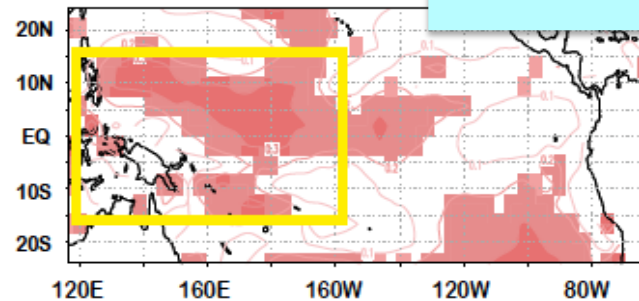
SST DJFM



CORRELATION BETWEEN OBSERVATIONS AND PREDICTION

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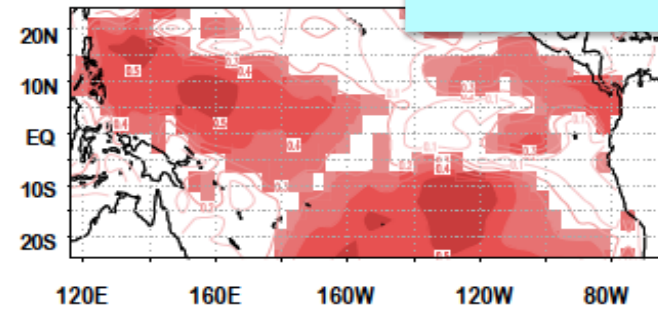
1871-1938



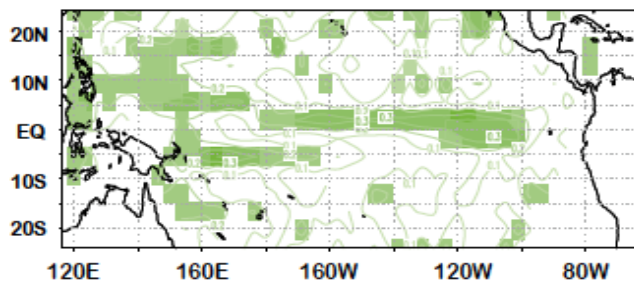
0.1 0.2 0.3 0.4 0.5 0.6

ZONAL WIND JASO

1967-2007

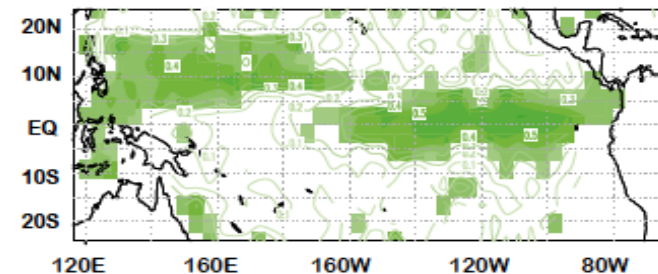


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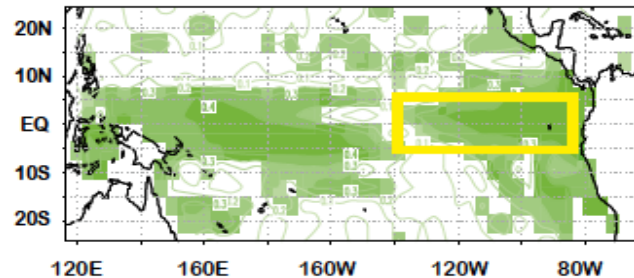


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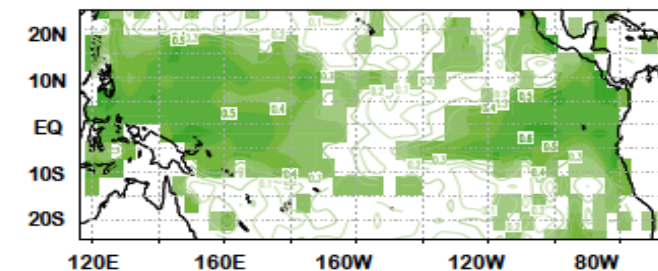
THERMOCLINE JASO



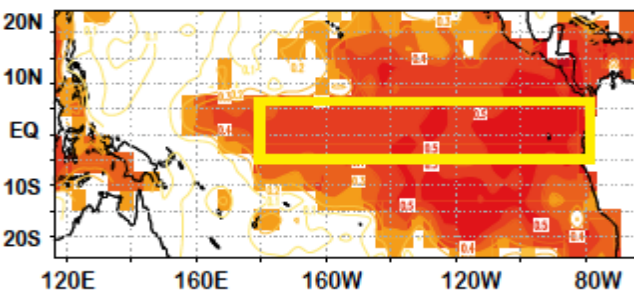
THERMOCLINE DJFM



THERMOCLINE DJFM

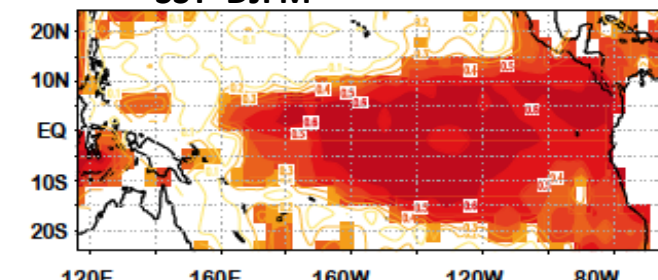


SST DJFM



0.1 0.2 0.3 0.4 0.5 0.6

SST DJFM



CORRELATION BETWEEN OBSERVATIONS AND PREDICTION

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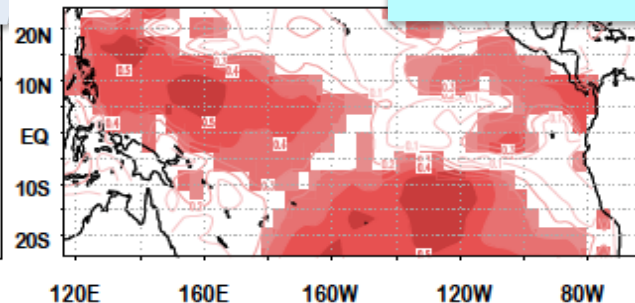
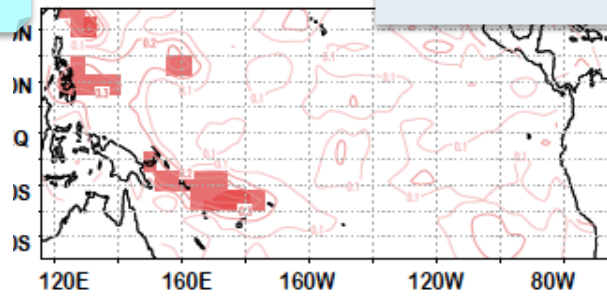
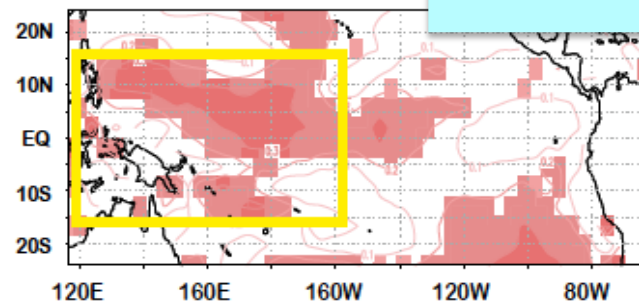
1871-1938

ZONAL WIND JASO

1939-1966

ZONAL WIND JASO

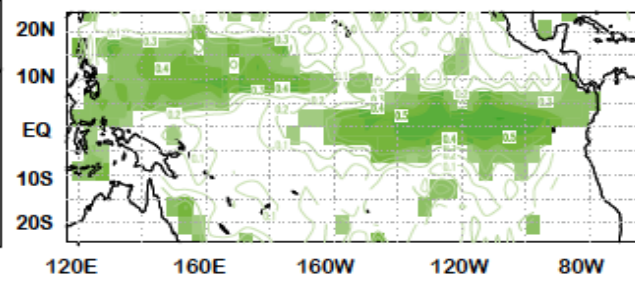
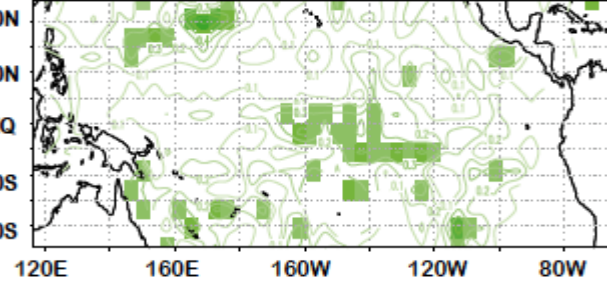
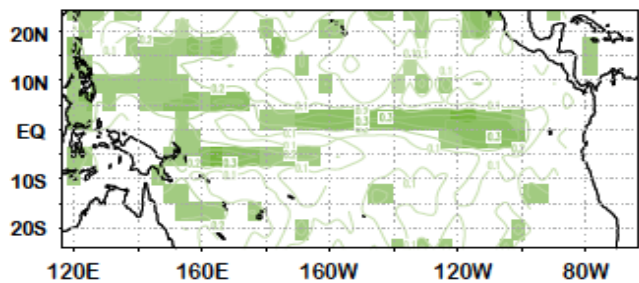
1967-2007



THERMOCLINE JASO

THERMOCLINE JASO

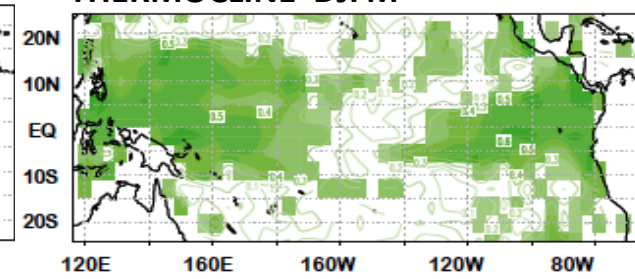
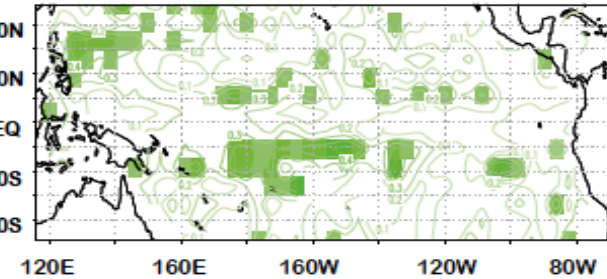
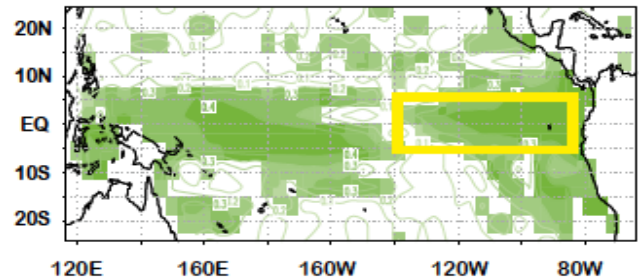
THERMOCLINE JASO



THERMOCLINE DJFM

THERMOCLINE DJFM

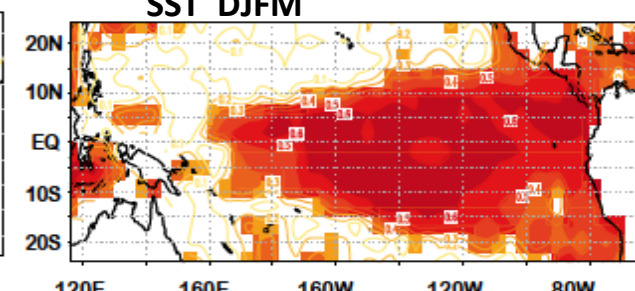
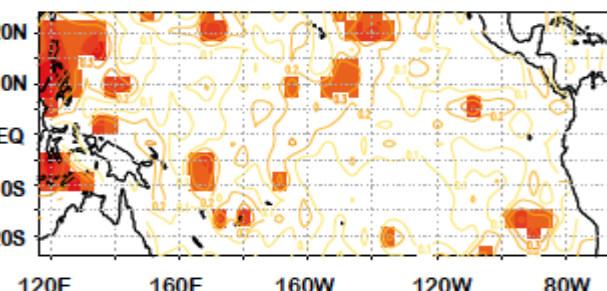
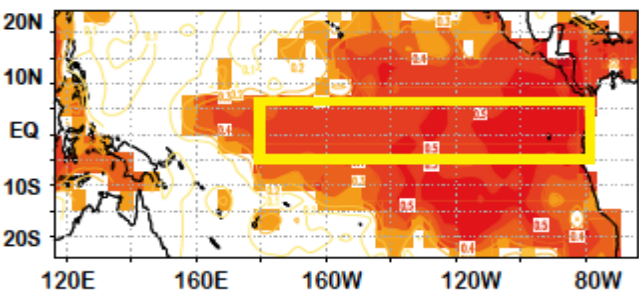
THERMOCLINE DJFM



SST DJFM

SST DJFM

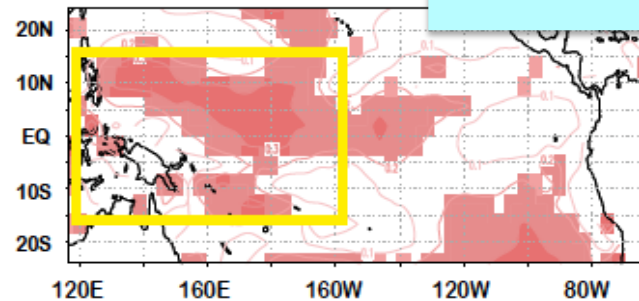
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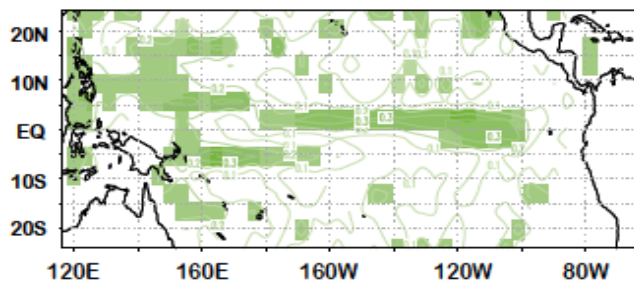
CORRELATION BETWEEN OBSERVATIONS AND PREDICTION

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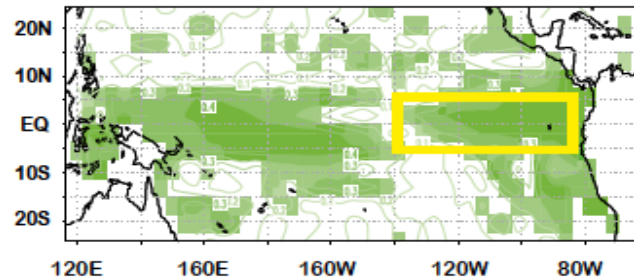
1871-1938



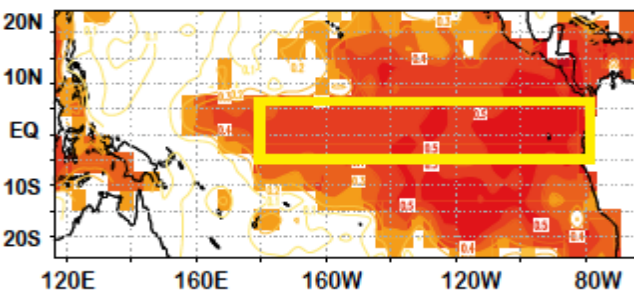
THERMOCLINE JASO



THERMOCLINE DJFM

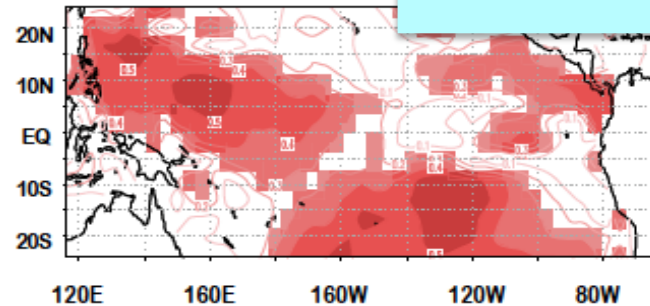


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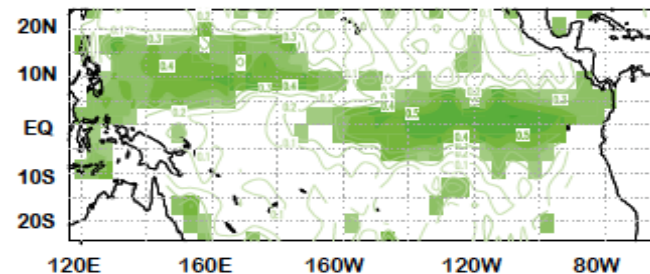


ZONAL WIND JASO

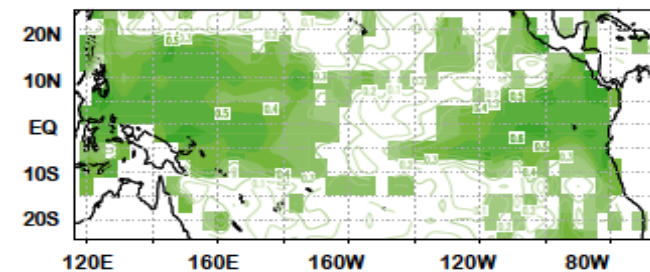
1967-2007



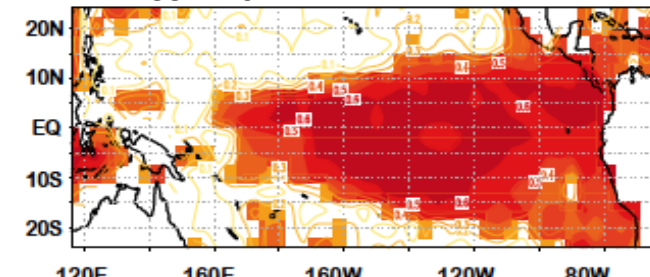
THERMOCLINE JASO



THERMOCLINE DJFM



SST DJFM



ENSO could be predicted
from tropical Atlantic SST
only during certain decades

Jansen et al. 2009;
Frauen and Dommenges 2012;
Keenlyside et al. 2013;

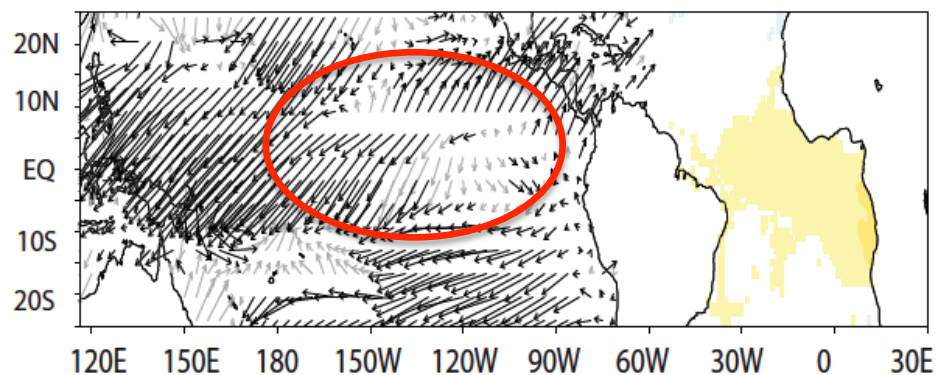
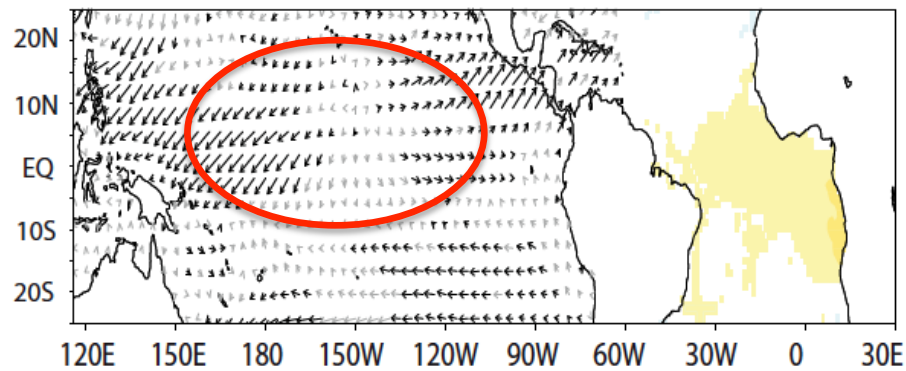
How are the ENSO predicted by
the Atlantic SST anomalies?

OBSERVATIONS

PREDICTION

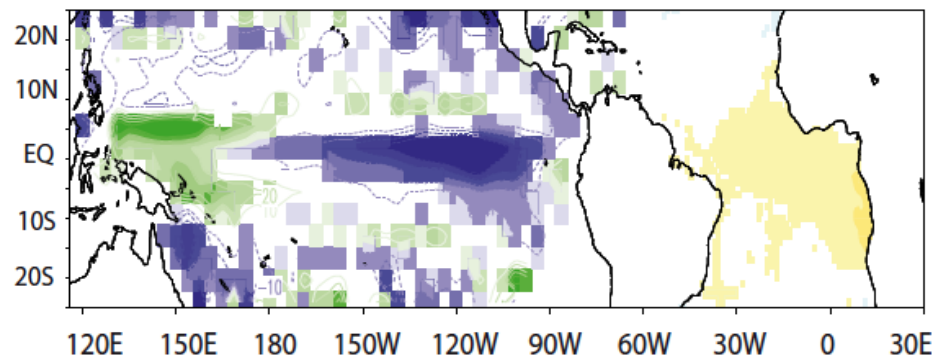
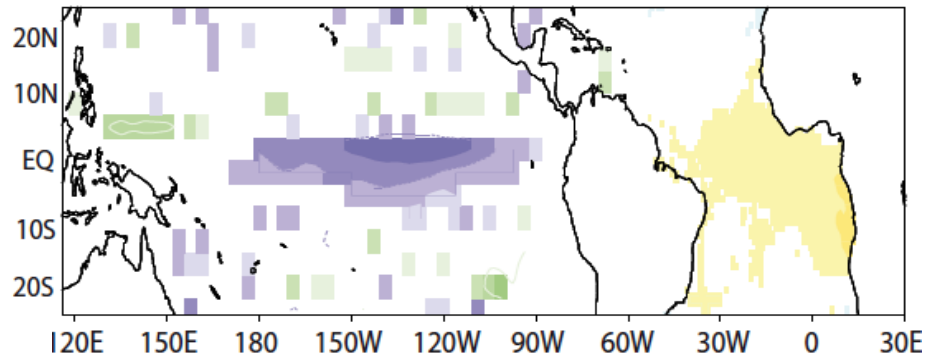
WIND STRESS JASO

WIND STRESS JASO



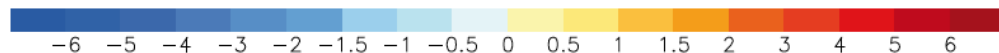
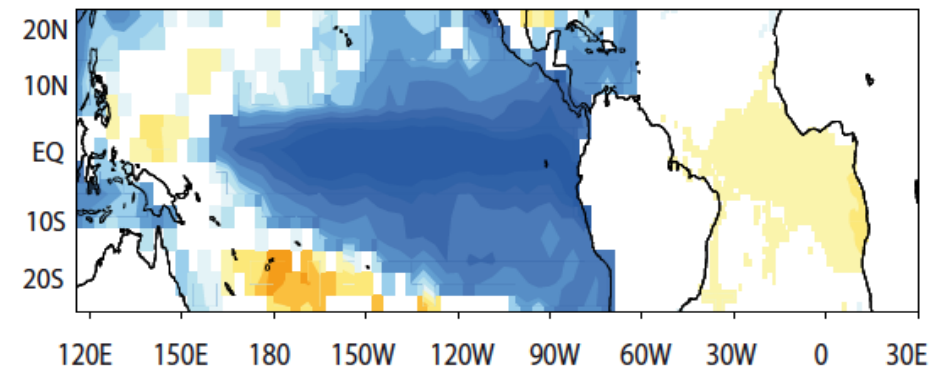
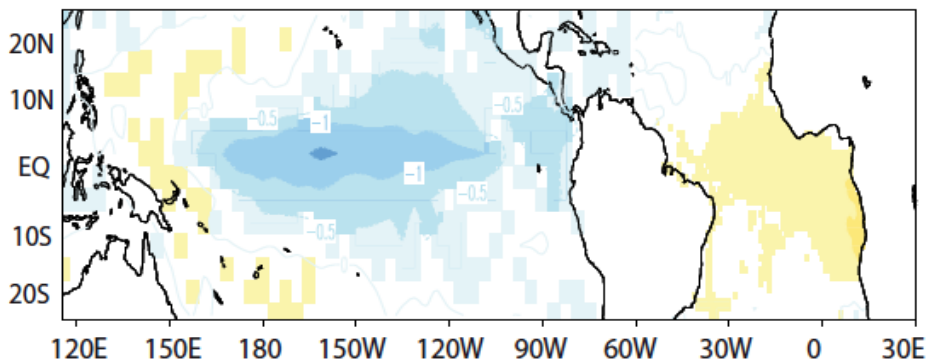
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SST DJFM

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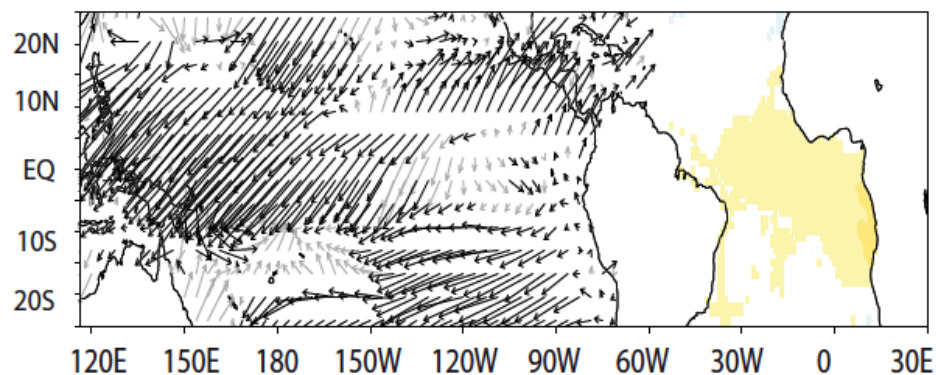
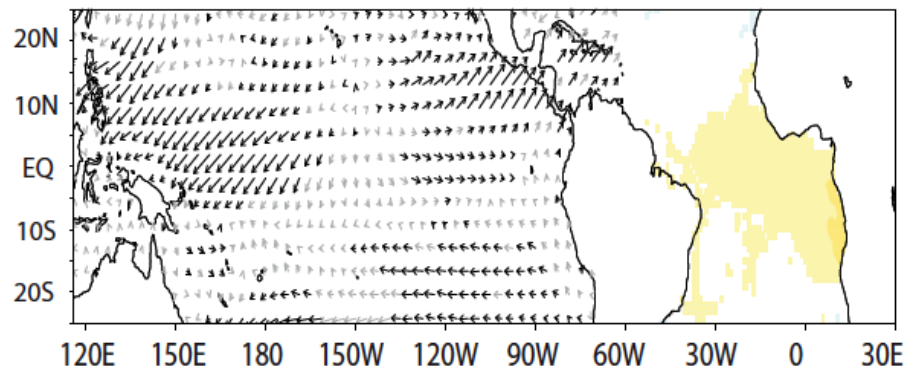


OBSERVATIONS

PREDICTION

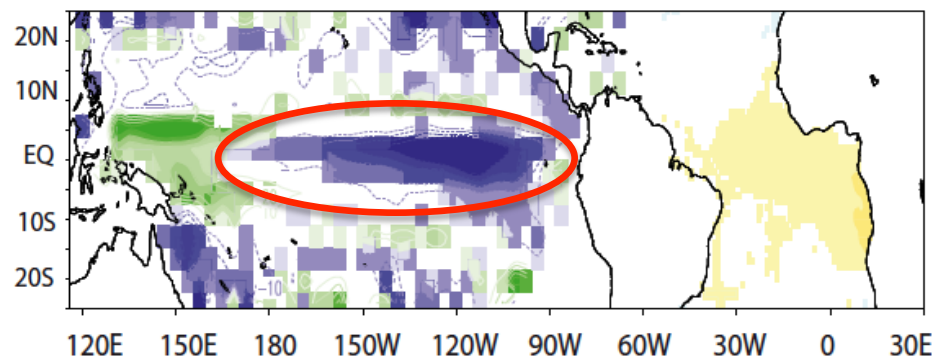
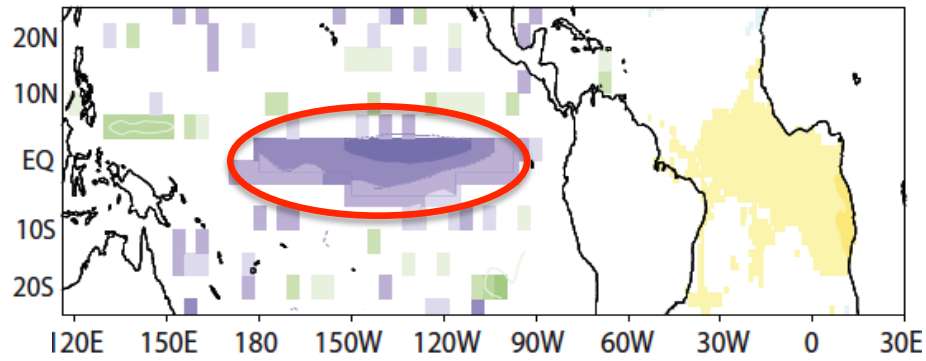
WIND STRESS JASO

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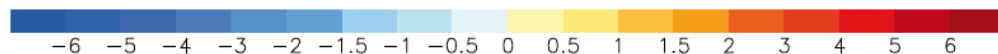
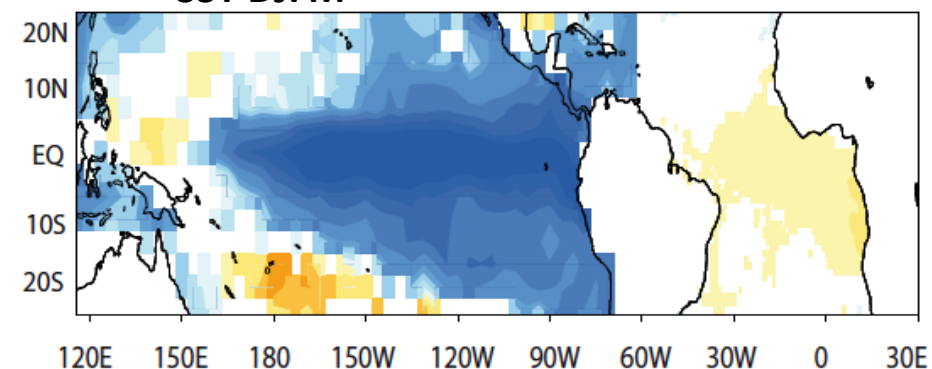
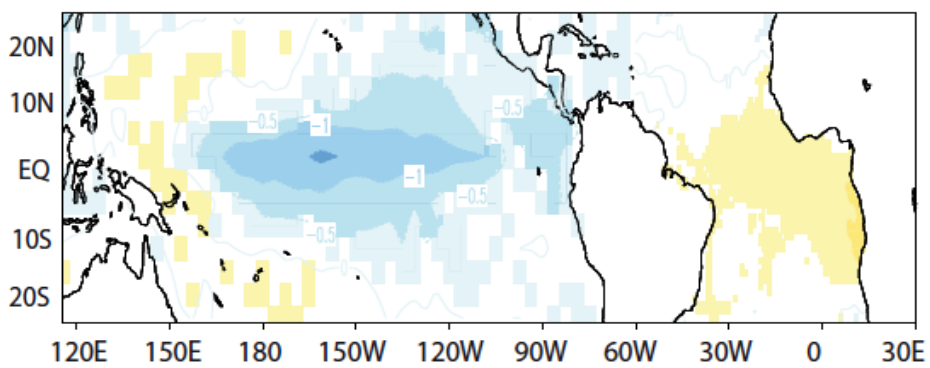
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SST DJFM

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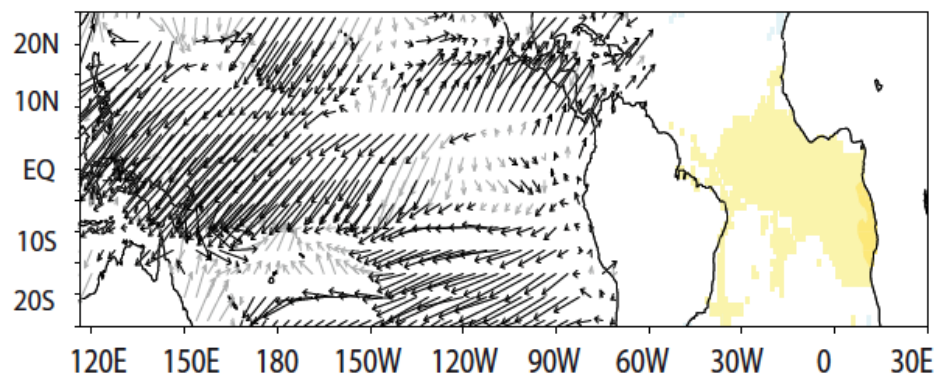
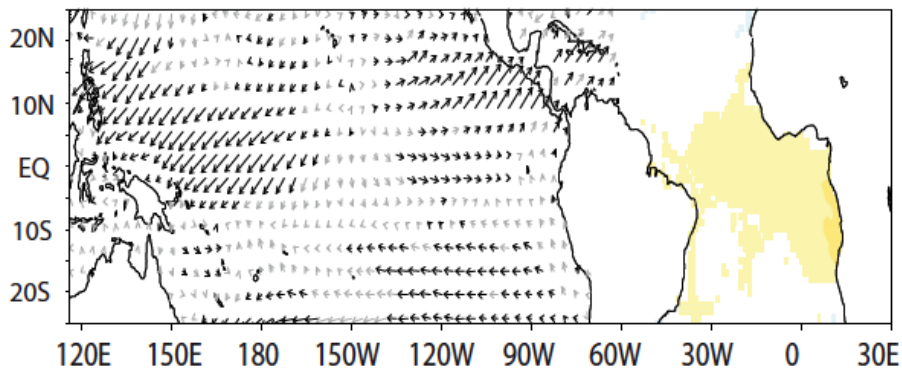


OBSERVATIONS

PREDICTION

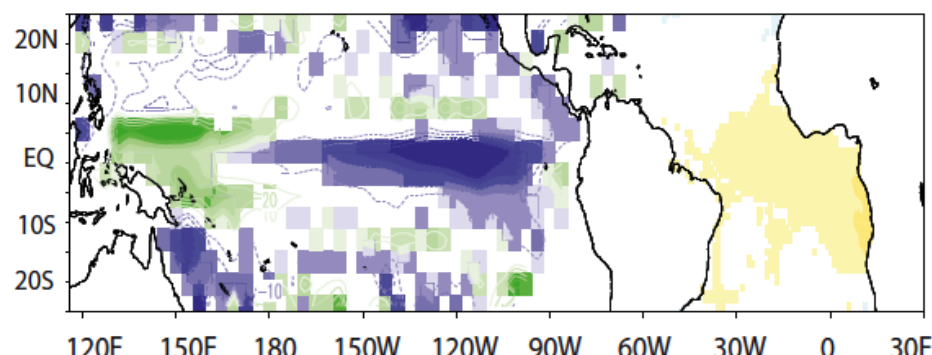
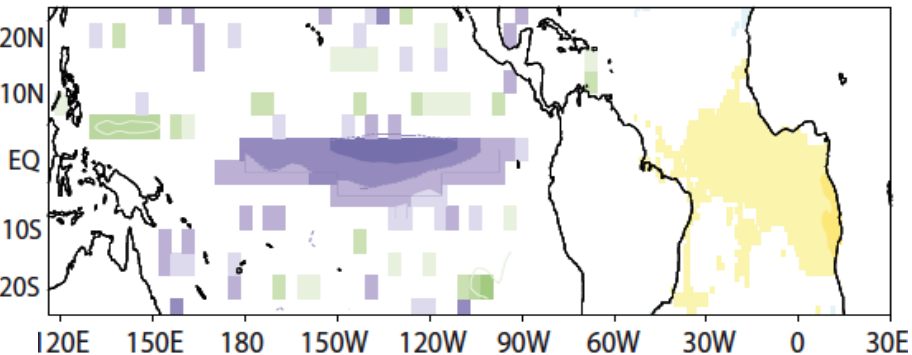
WIND STRESS JASO

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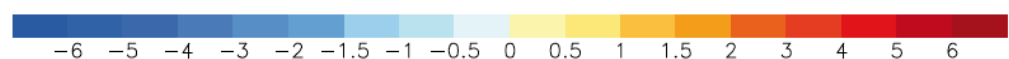
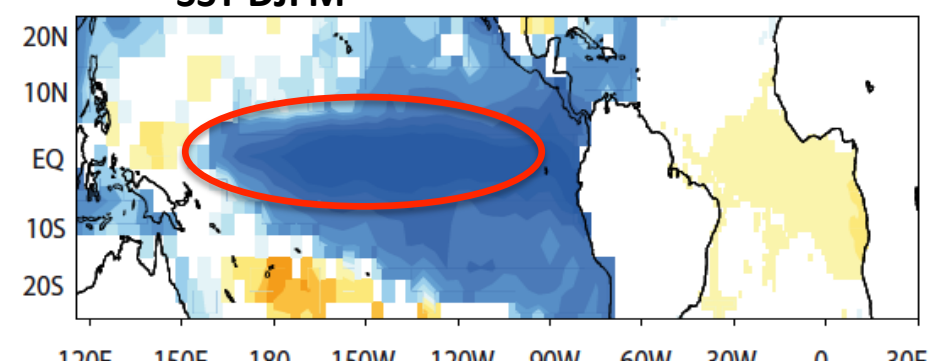
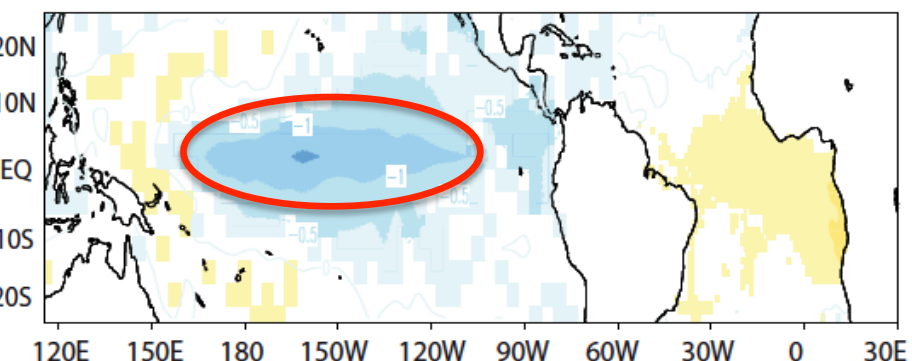
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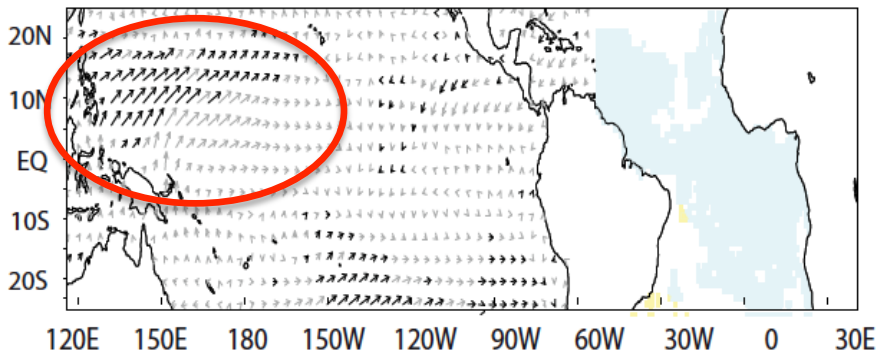
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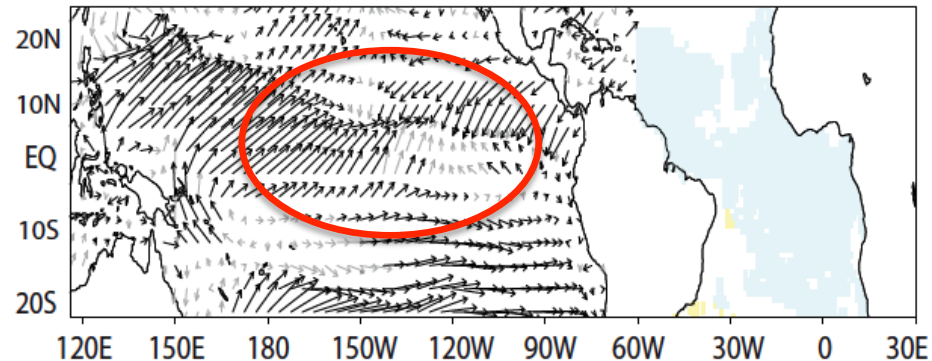
OBSERVATIONS

PREDICTION

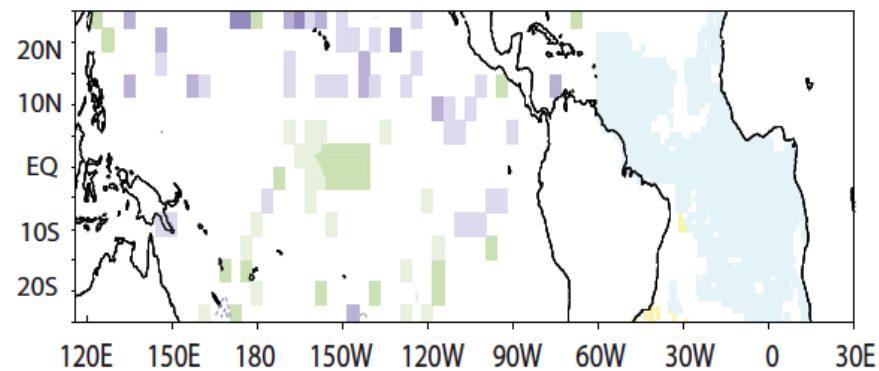
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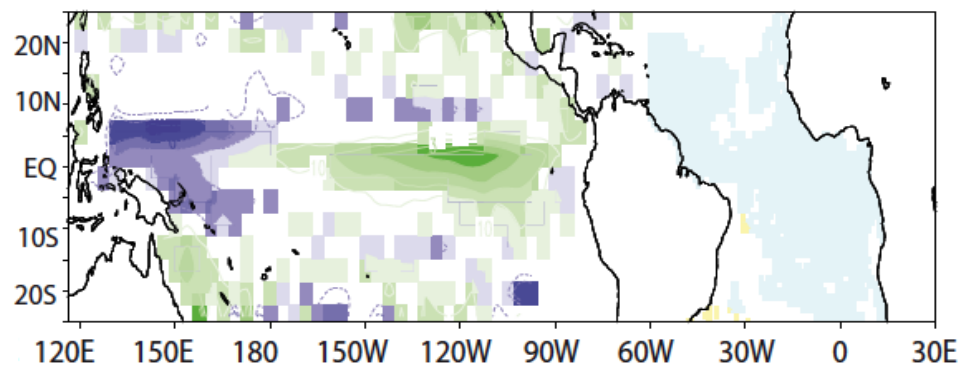
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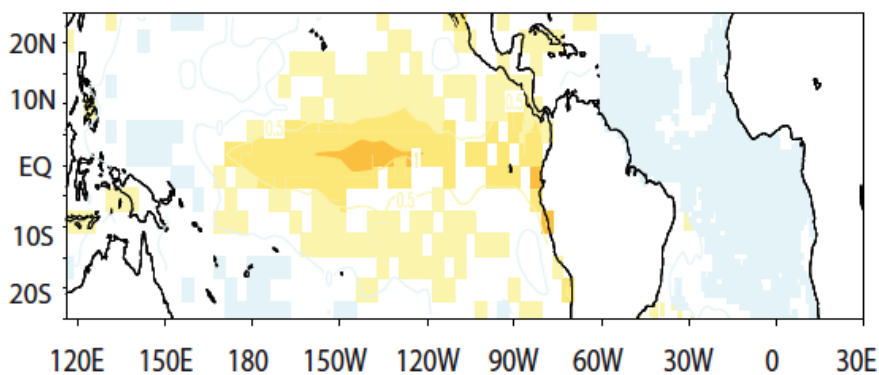
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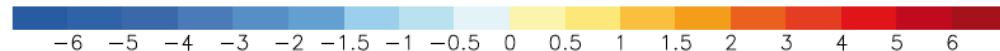
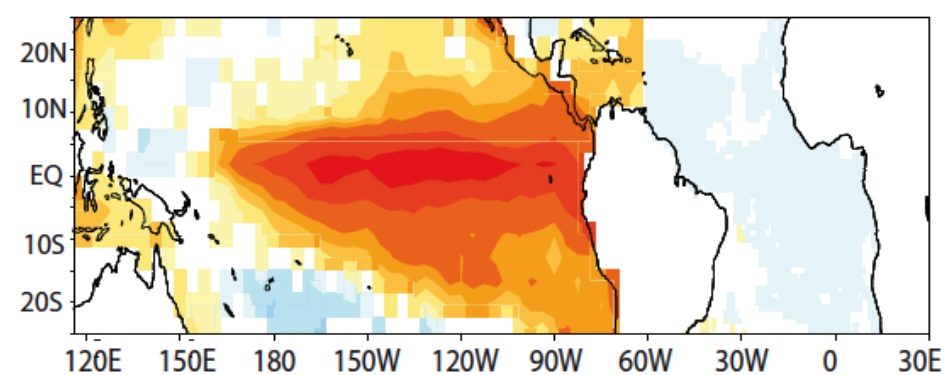
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SST DJFM



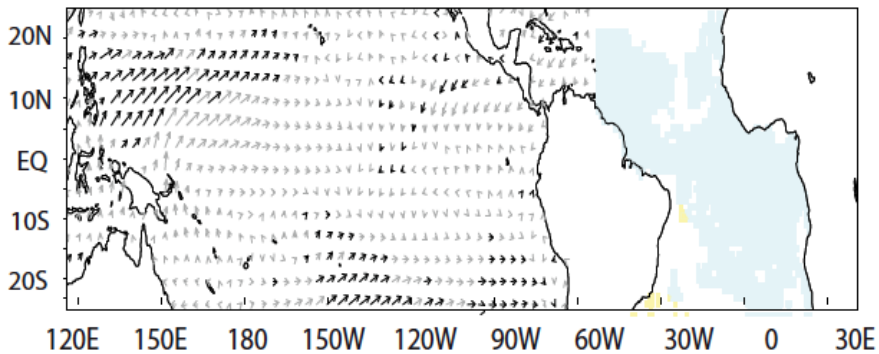
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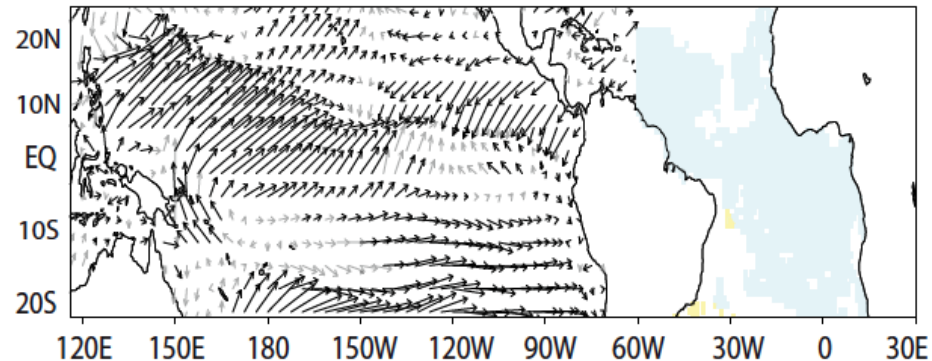
OBSERVATIONS

PREDICTION

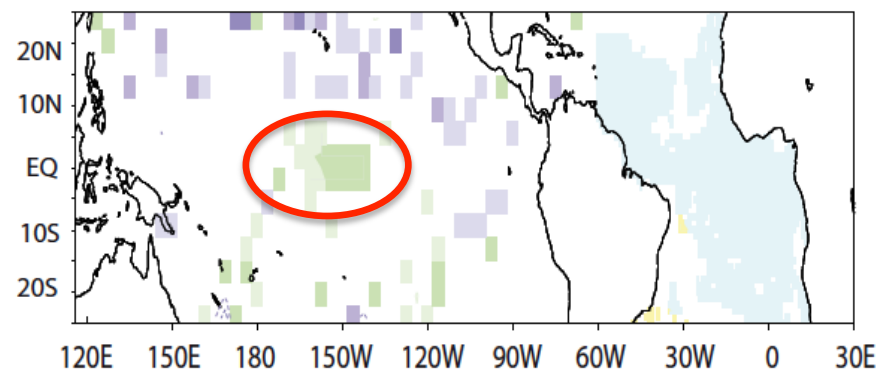
WIND STRESS JASO



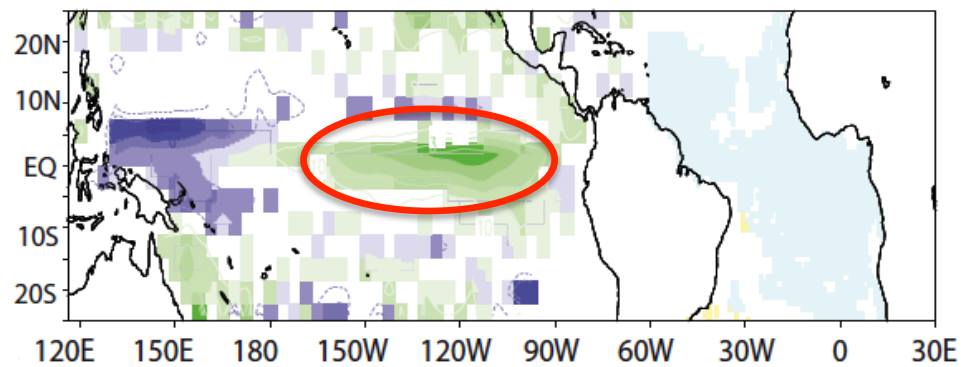
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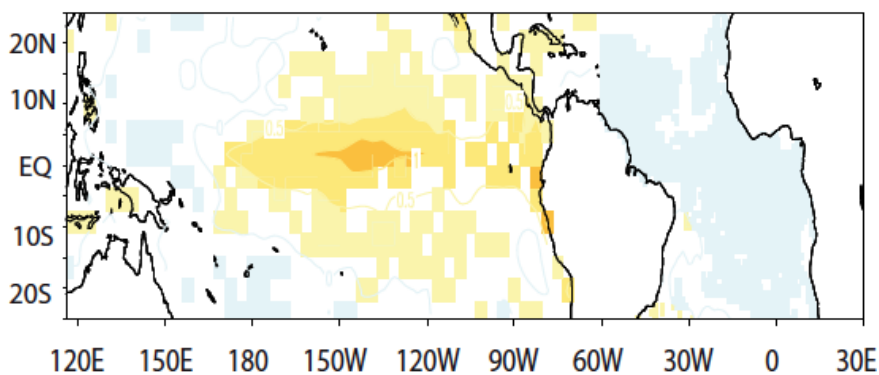
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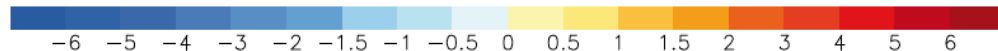
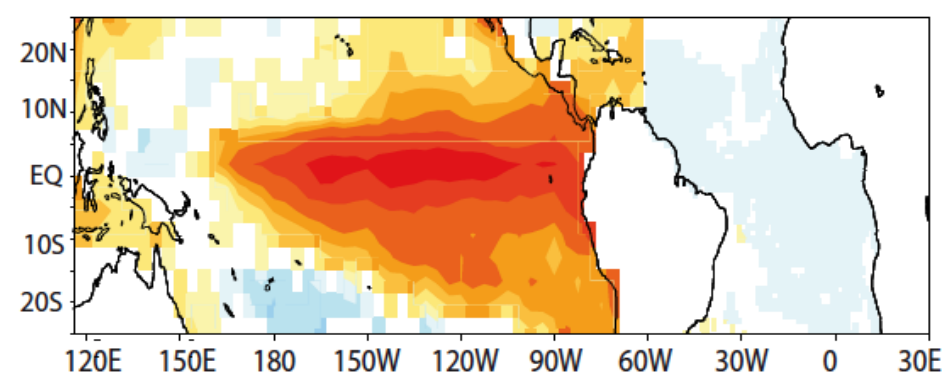
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SST DJFM



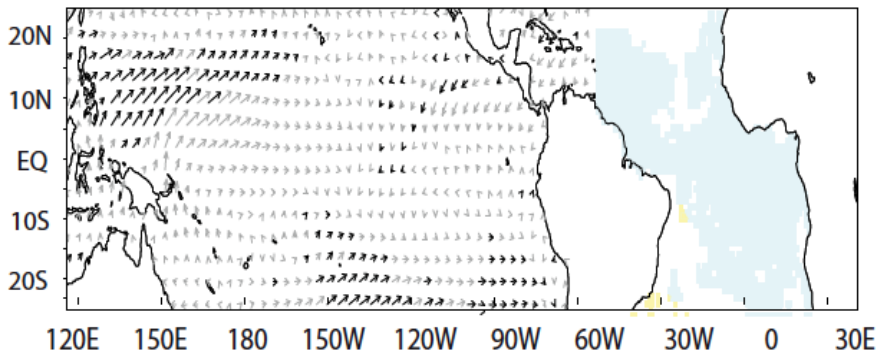
SST DJFM



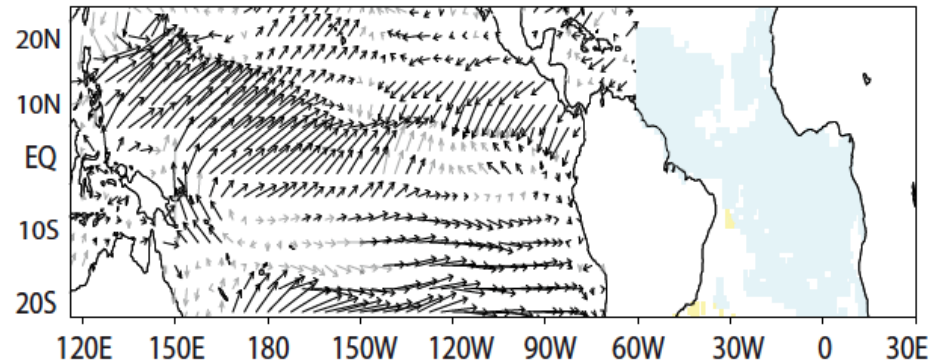
OBSERVATIONS

PREDICTION

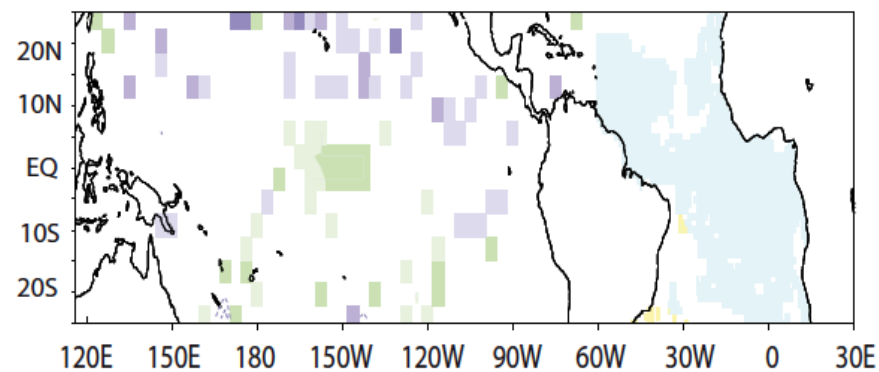
WIND STRESS JASO



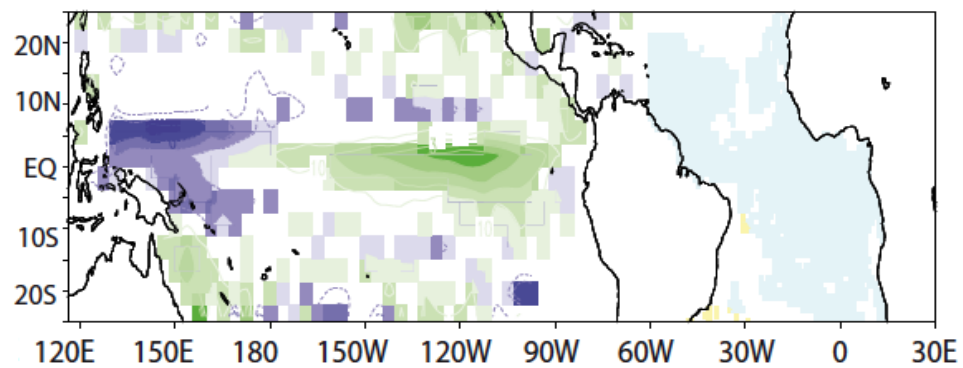
WIND STRESS JASO



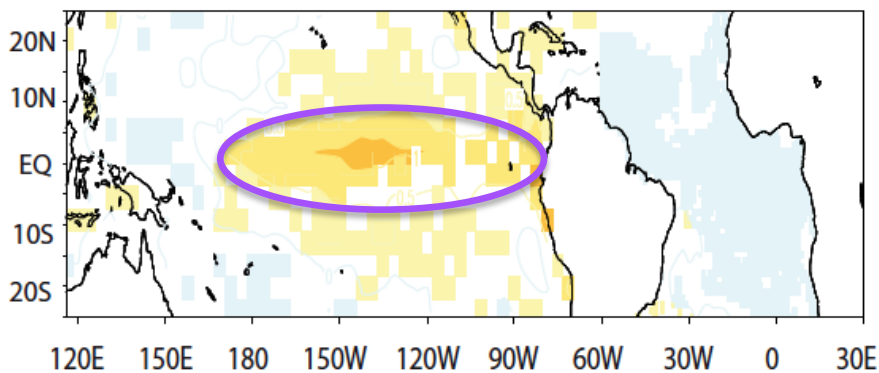
THERMOCLINE JASO



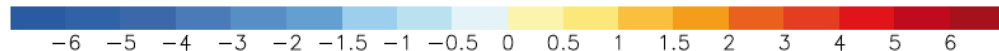
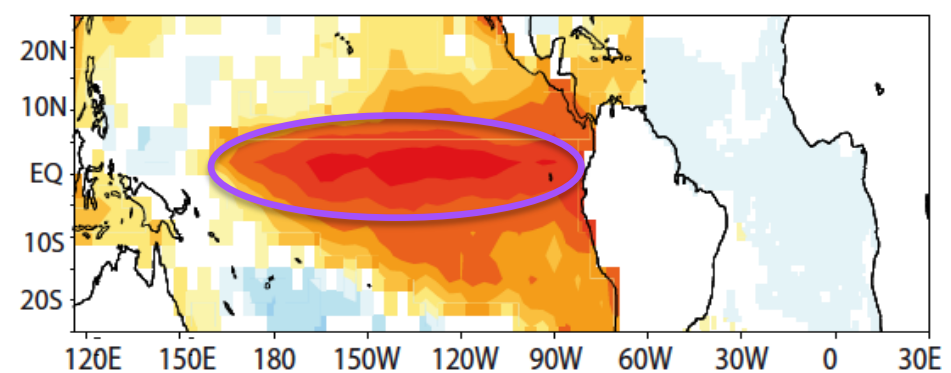
THERMOCLINE JASO



SST DJFM



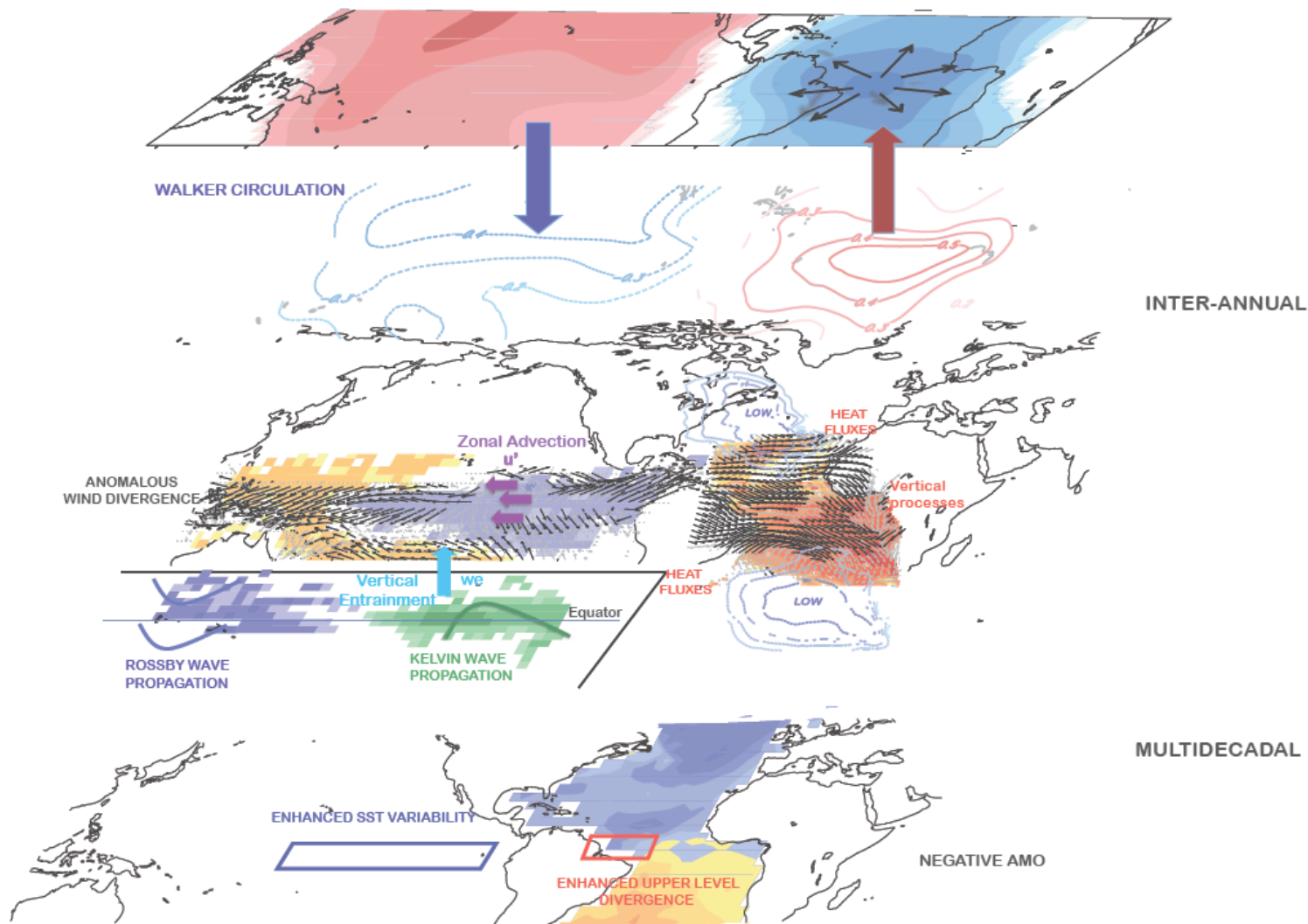
SST DJFM



CONCLUSIONS

- A statistical hindcast for ENSO phenomenon using the boreal summer tropical Atlantic SSTs as the predictor field is performed.
- The Atlantic SSTs act as a precursor for ENSO episodes only during the first and last decades of the 20th century.
- The hindcast fails during the period 1939-1966, putting forward the lack of ENSO predictability from Tropical Atlantic SST during those decades.
- For those periods with a predictive skill: The statistical hindcast tends to predict larger SST anomalies in ENSO phenomena than in observations

THANK YOU FOR YOUR ATTENTION



Martín del Rey, 2015, PhD Thesis, UCM

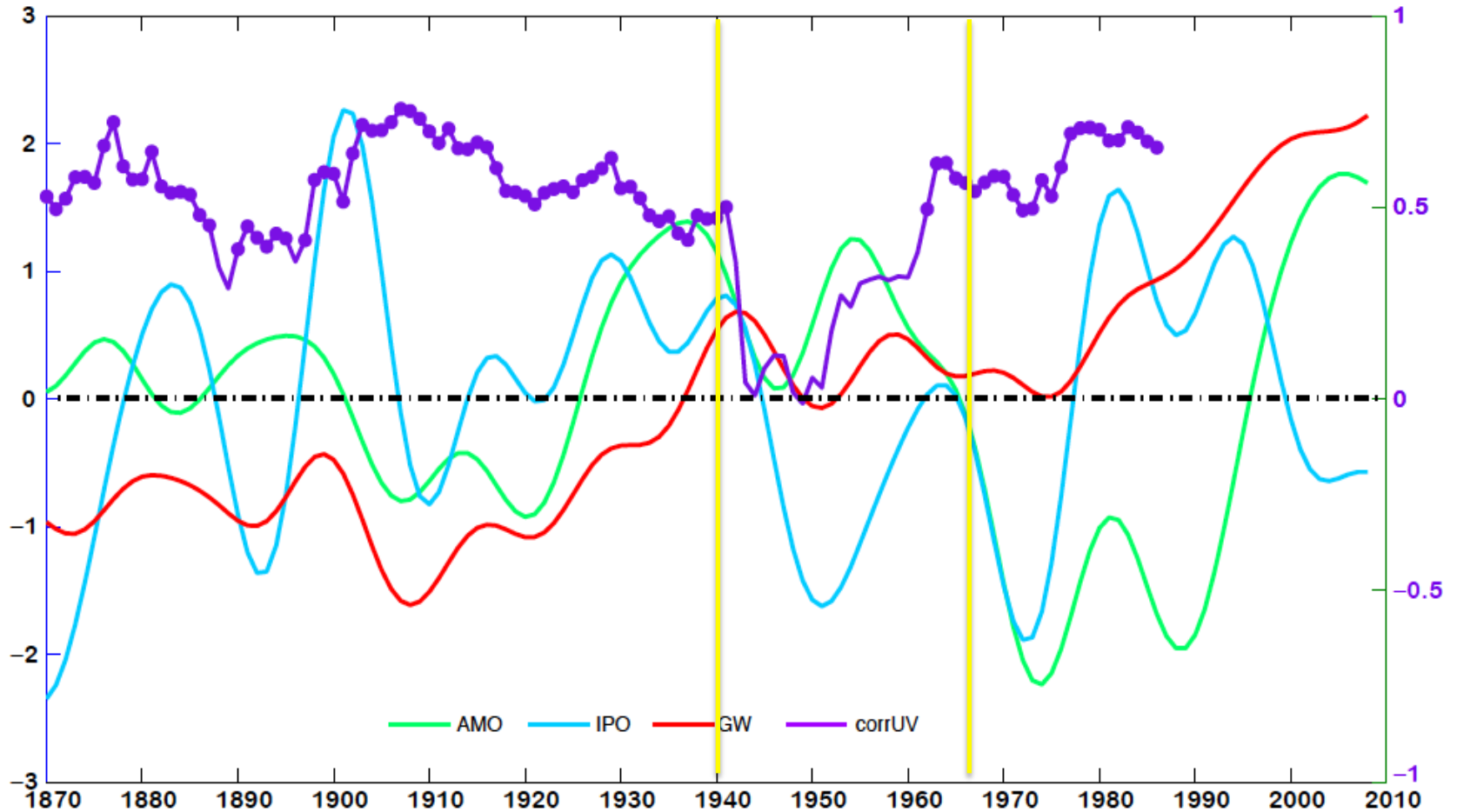
TROPA UCM

Acknowledgments:

MULCLIVAR (CGL2012A38923AC02A01) and PREFACE (ref.603521)

Martín-Rey, M., B. Rodríguez-Fonseca, and I. Polo (2015), Atlantic opportunities for ENSO prediction, *Geophys. Res. Lett.*, 42, doi:10.1002/2015GL065062

MULTIDECADAL MODULATION OF THE ATLANTIC-PACIFIC CONNECTION



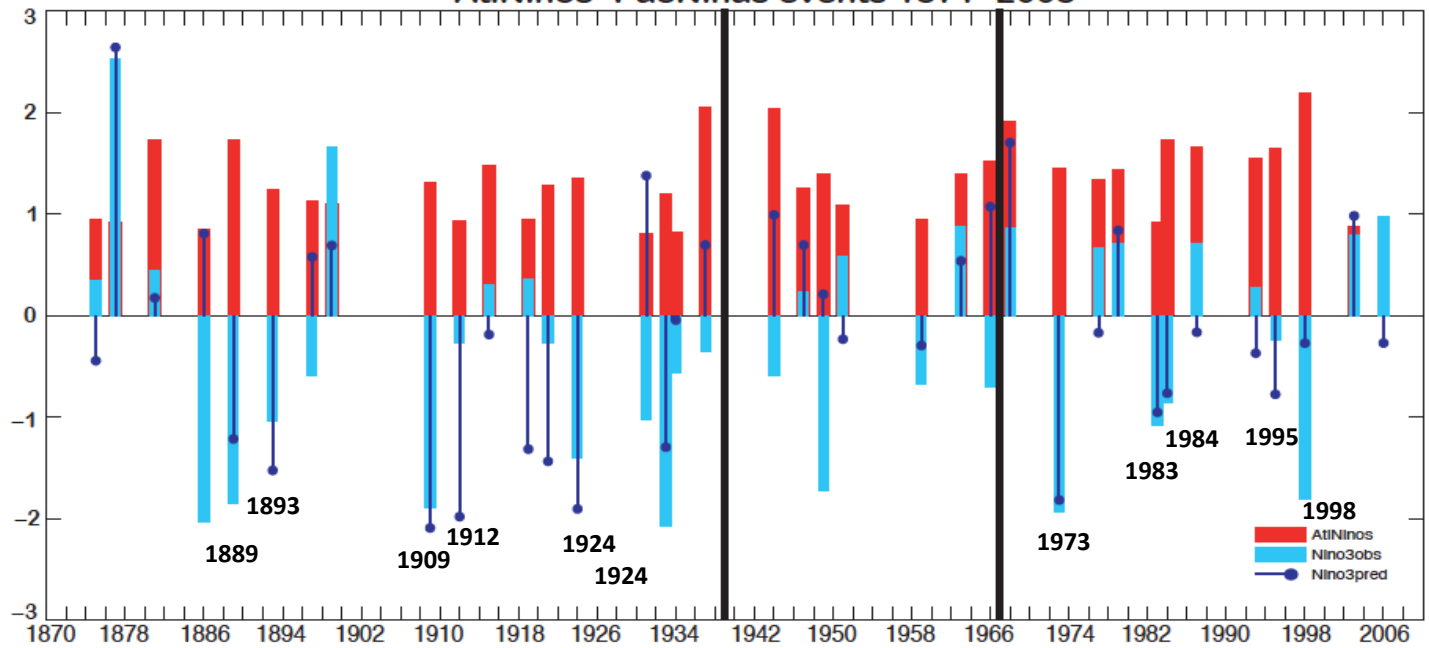
Atlantic-Pacific connection is active under:

IPO > 0

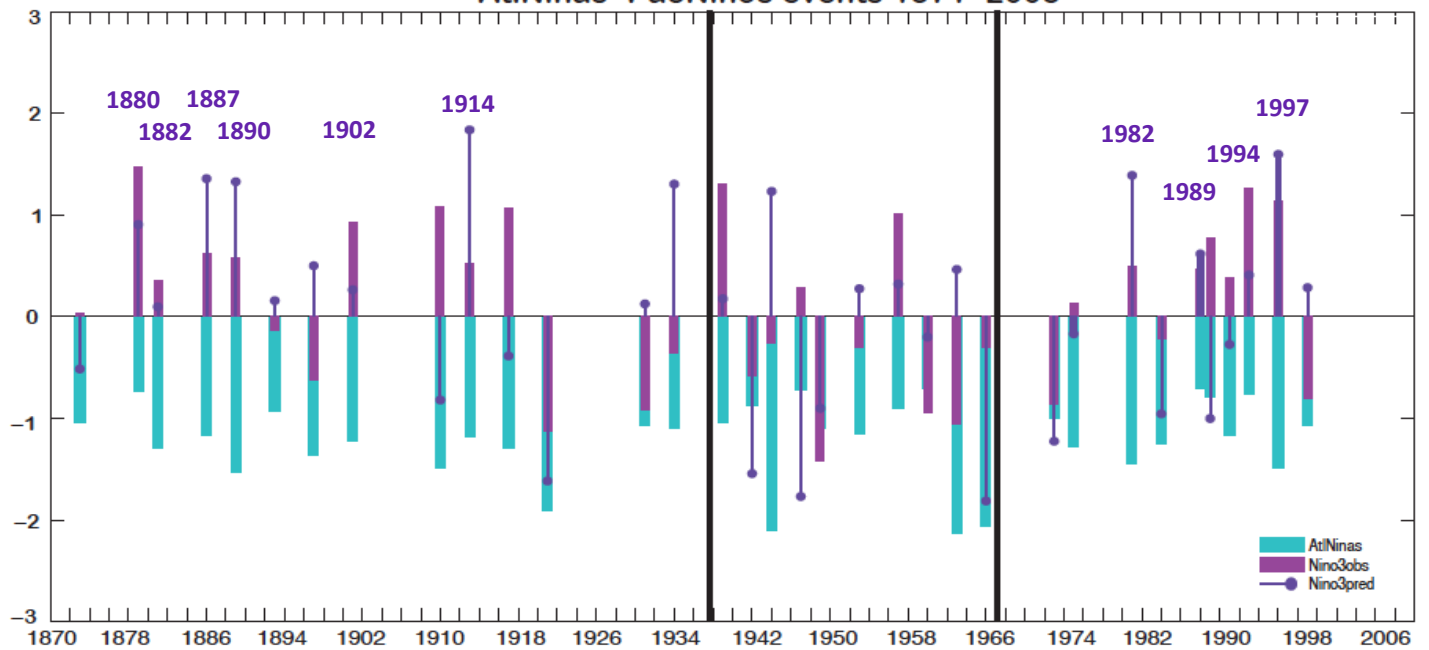
AMO < 0

GW > 0 (after the 1970s)

AtlNinos-PacNinos events 1871-2008



AtlNinos-PacNinos events 1871-2008



VARIANCE

	1871-1938		1939-1966		1967-2007	
	OBS	PRED	OBS	PRED	OBS	PRED
SSTE	0.75	3.91	0.55	0.75	0.72	3.62
USTR	0.06	0.01	0.06	0.01	0.07	0.03
Z20J	4.07	0.28	4.50	21.13	8.46	18.94
Z20D	6.72	20.46	5.73	6.84	8.67	38.40

CORRELATION

	1871-1938	1939-1966	1967-2007
SSTE	.57*	.09	.64*
USTR	.21*	.16	.50*
Z20J	.01	.39*	.28*
Z20D	.33*	.14	.56*

RMSE/STD

	1871-1938	1939-1966	1967-2007
SSTE	.90	1.17	.87
USTR	1.02	1.06	.89
Z20J	14.67	.93	.96
Z20D	.94	1.20	.88