Pacific Decadal Oscillation and oxygen decline in the eastern tropical Pacific Ocean

Olaf Duteil

GEOMAR, Kiel, Germany

GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

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future ocean
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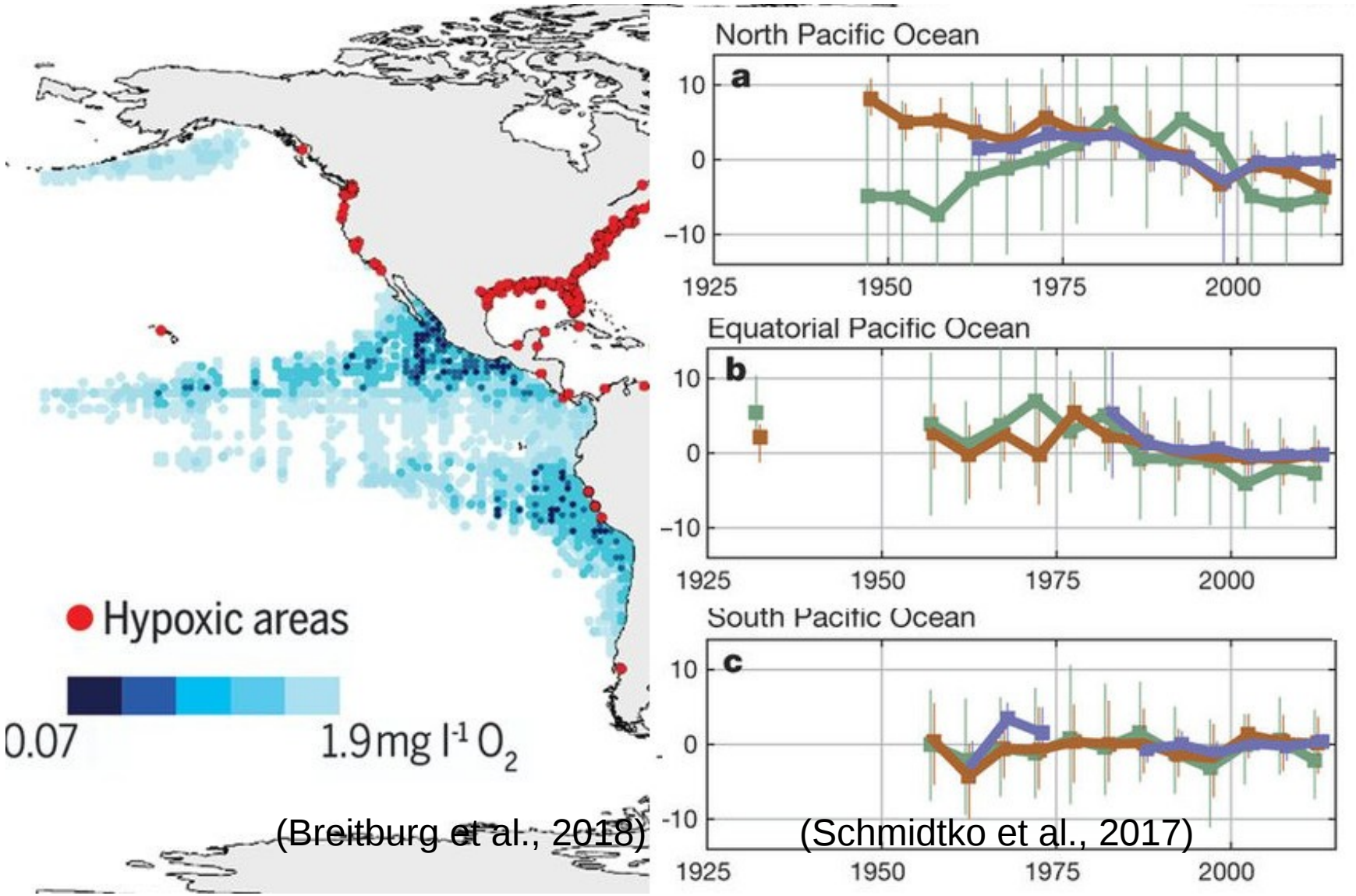
Suboxic regions of the Pacific Ocean

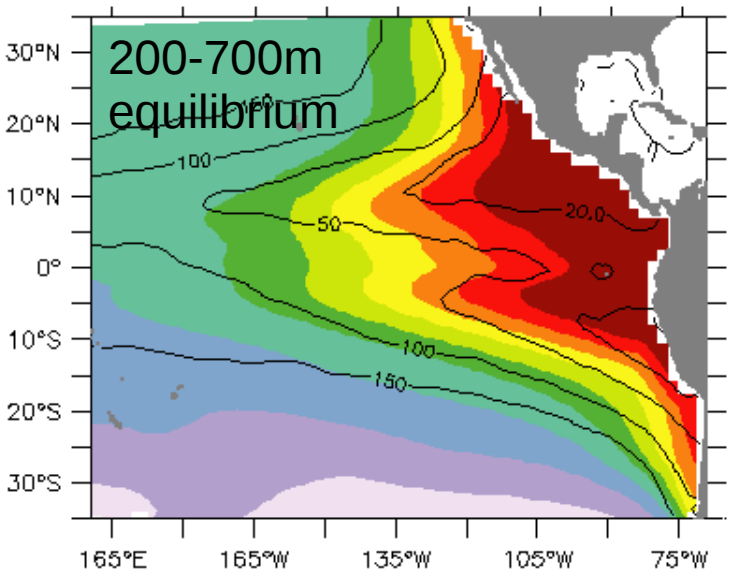


(Breitburg et al., 2018)

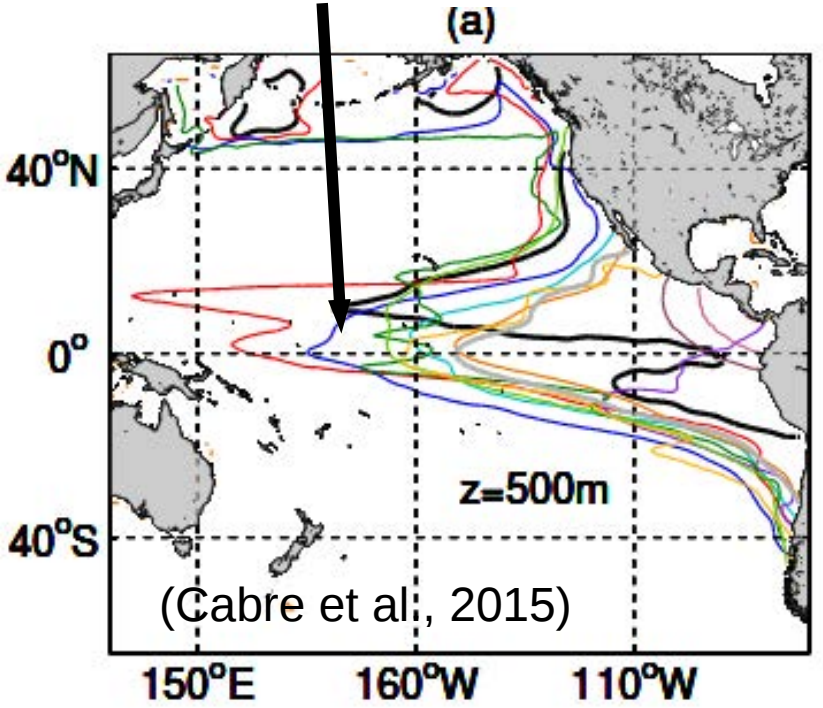
(Schmidtko et al., 2017)

1- mechanisms controlling the mean O2 state
2- role of the Pacific Decadal Oscillation

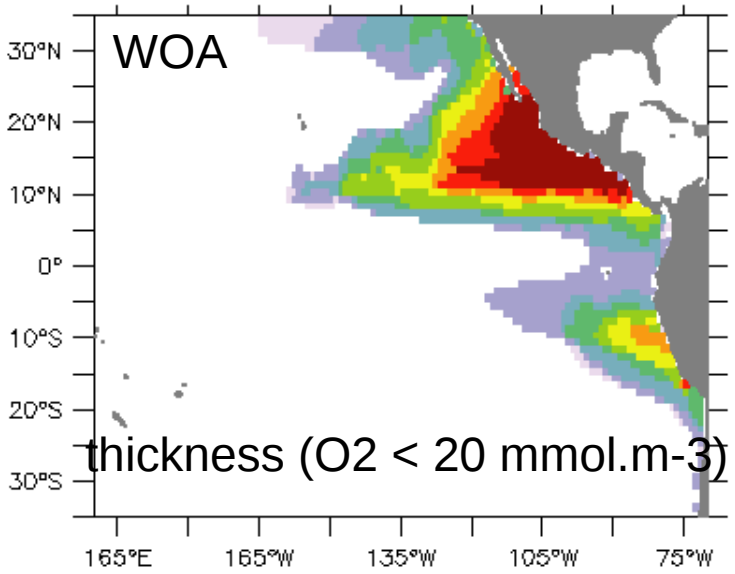
1. Mean state: oxygen

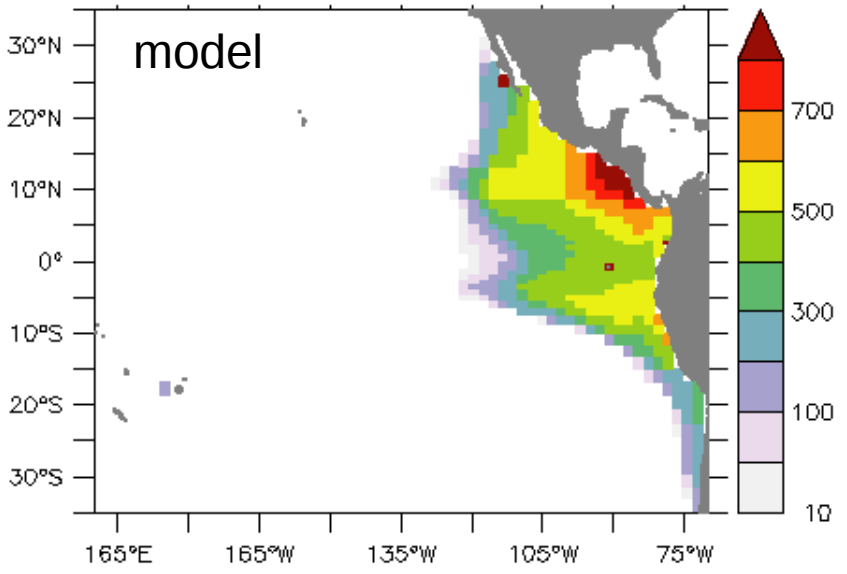


Too little equatorial O2 : “typical bias”

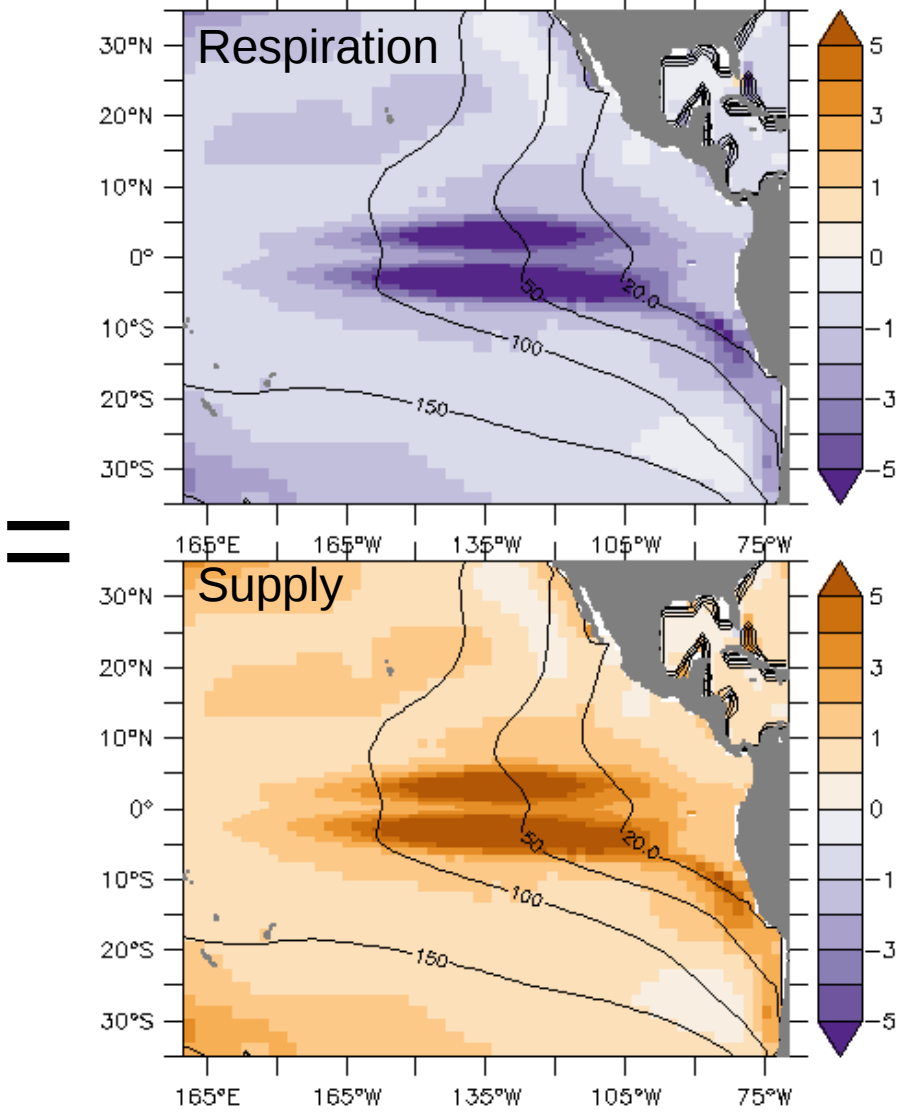


(Cabre et al., 2015)





1. Mean state : mechanisms



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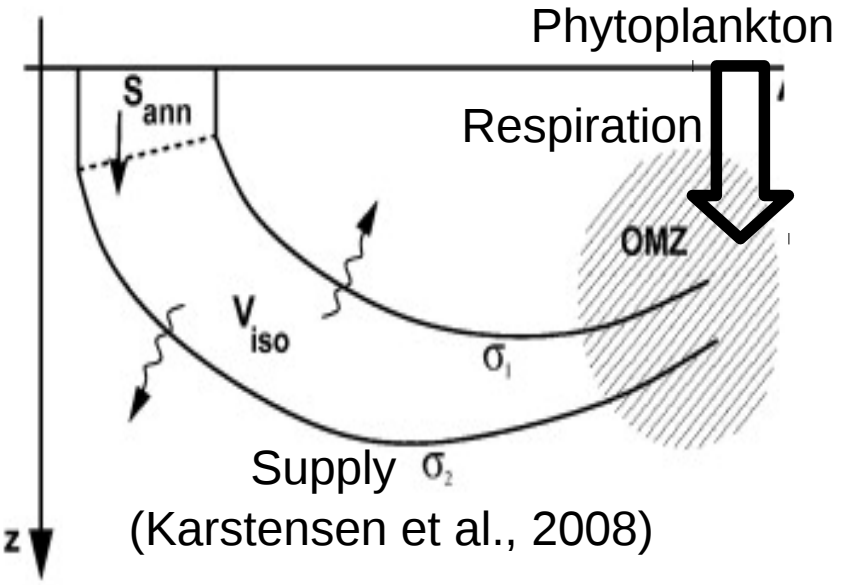
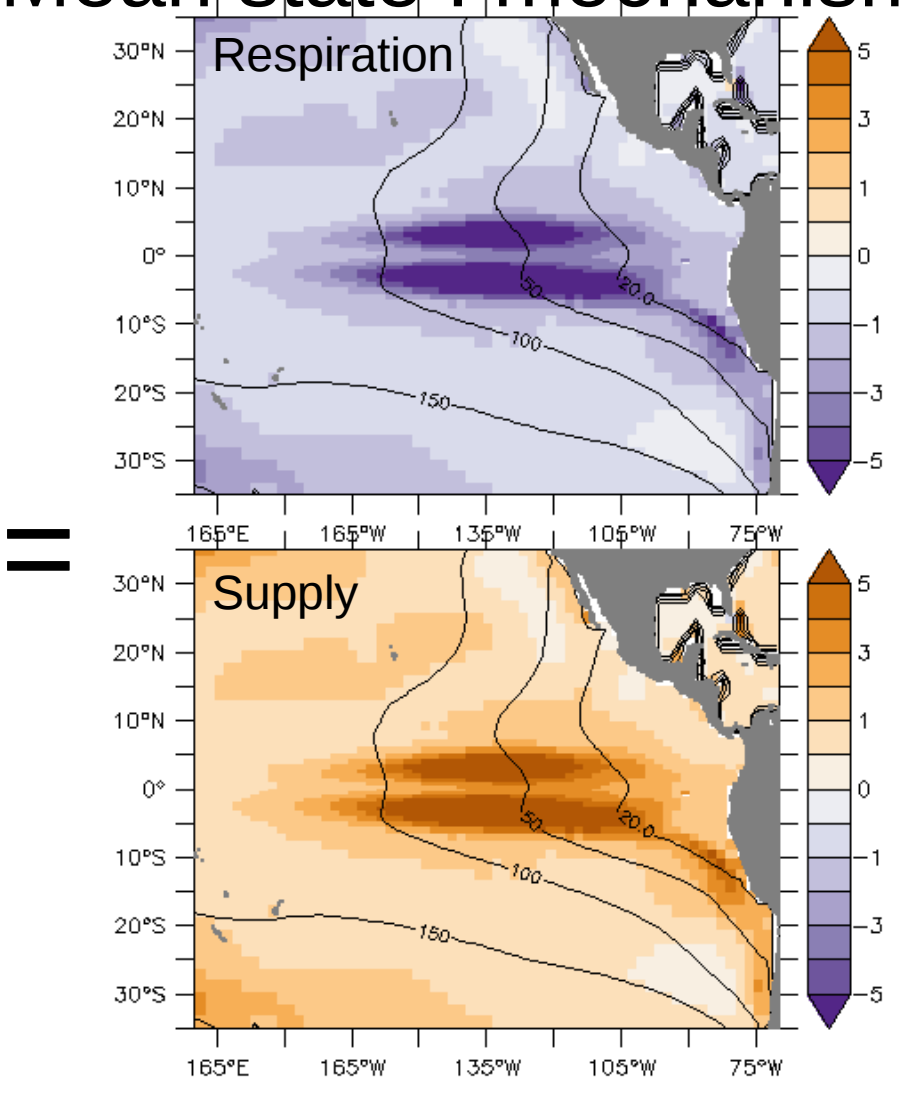


(Karstensen et al., 2008)

1. Mean state : mechanisms



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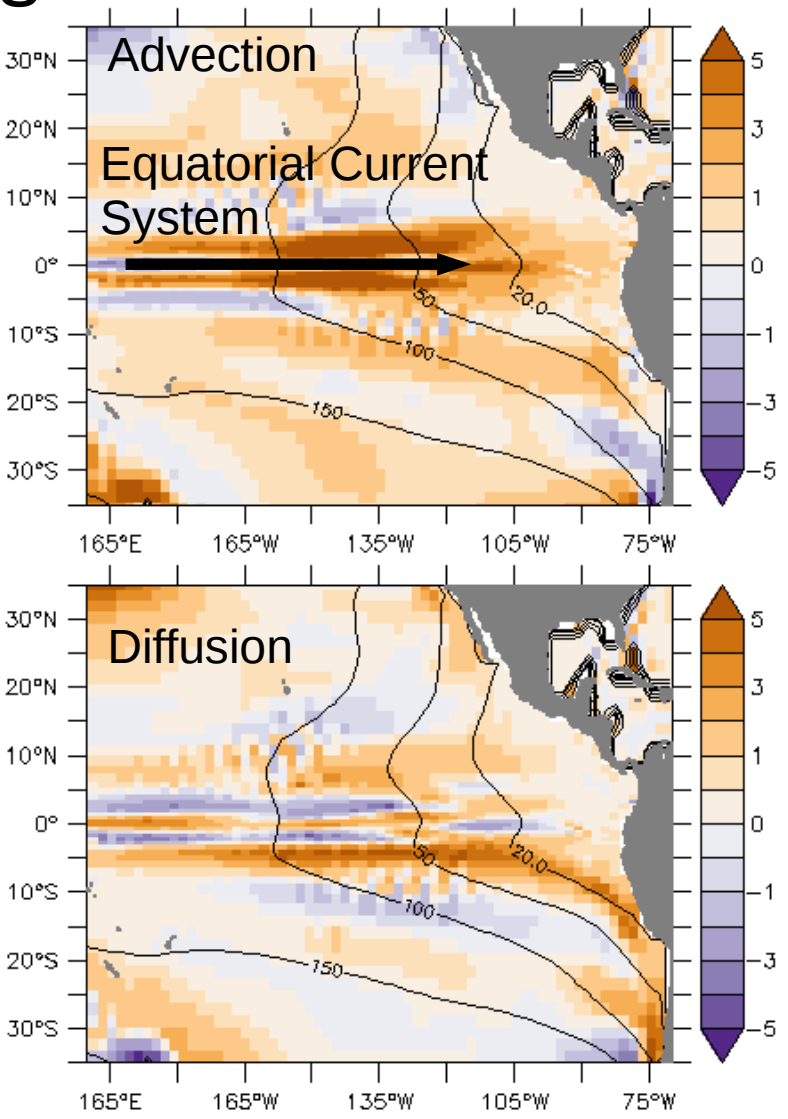
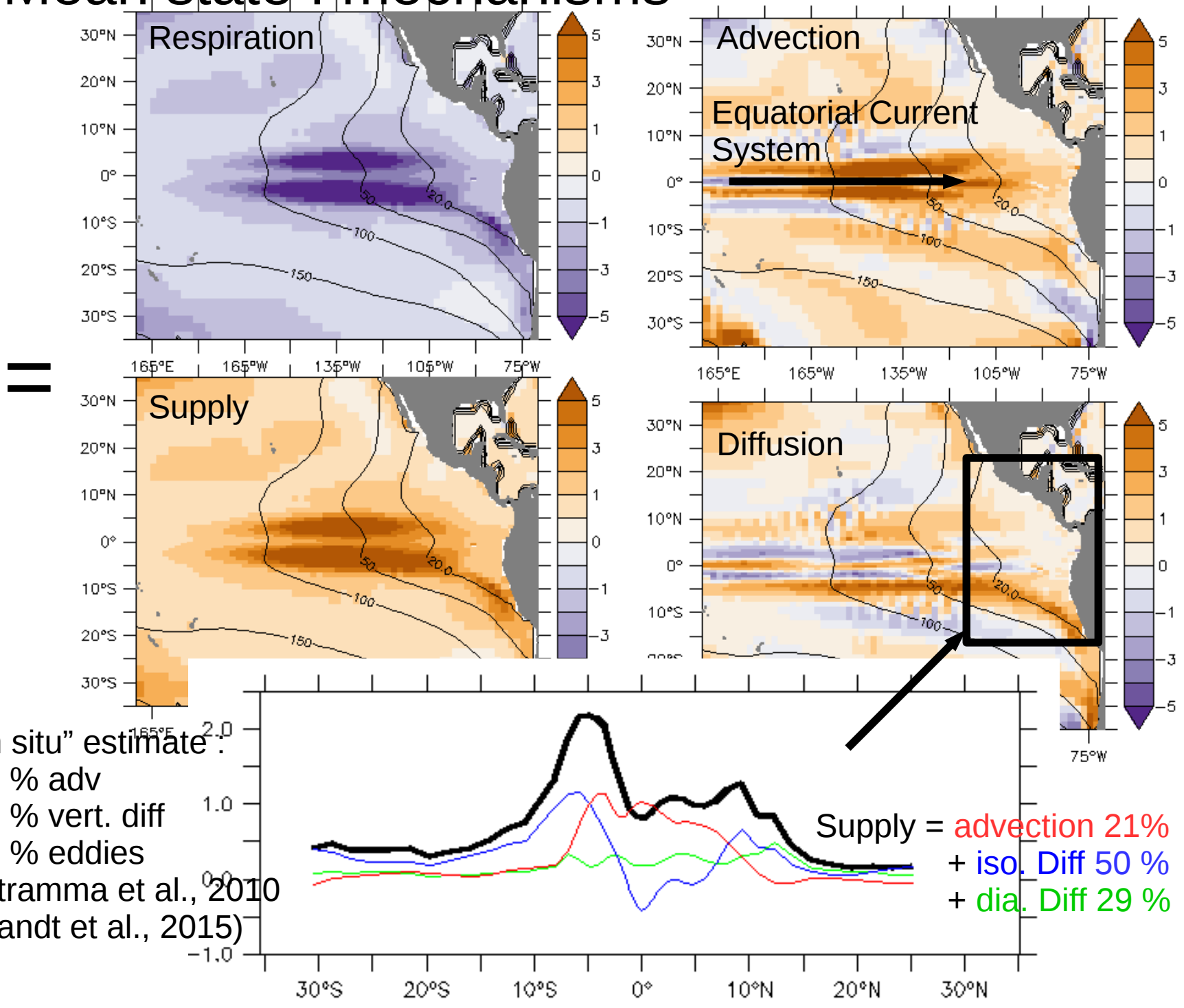


1. Mean state : mechanisms

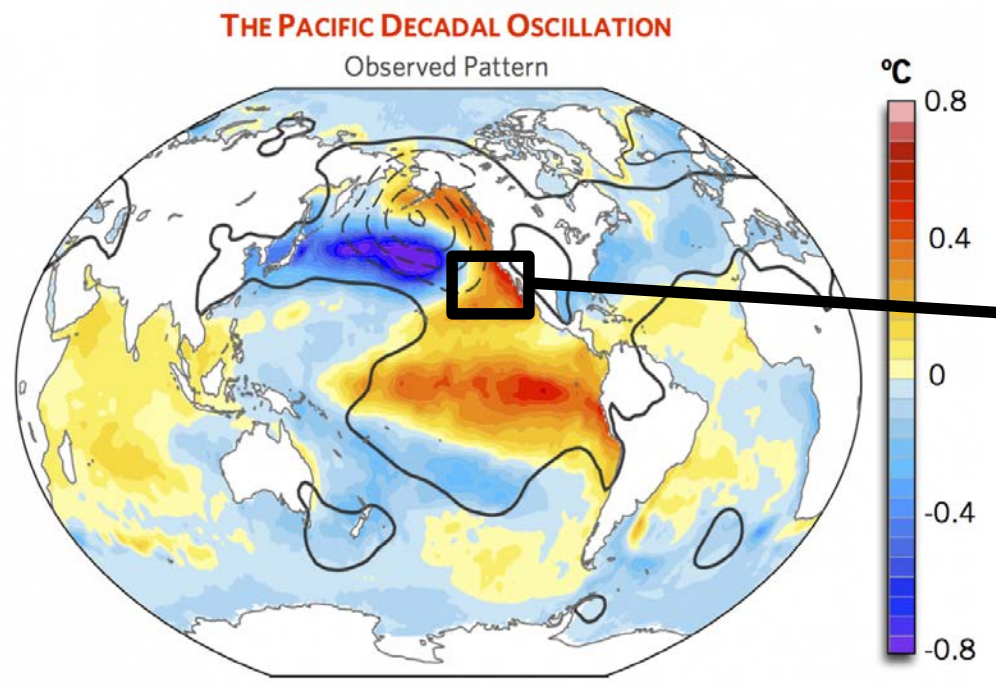


"In situ" estimate :
33 % adv
22 % vert. diff
45 % eddies
(Stramma et al., 2010
Brandt et al., 2015)

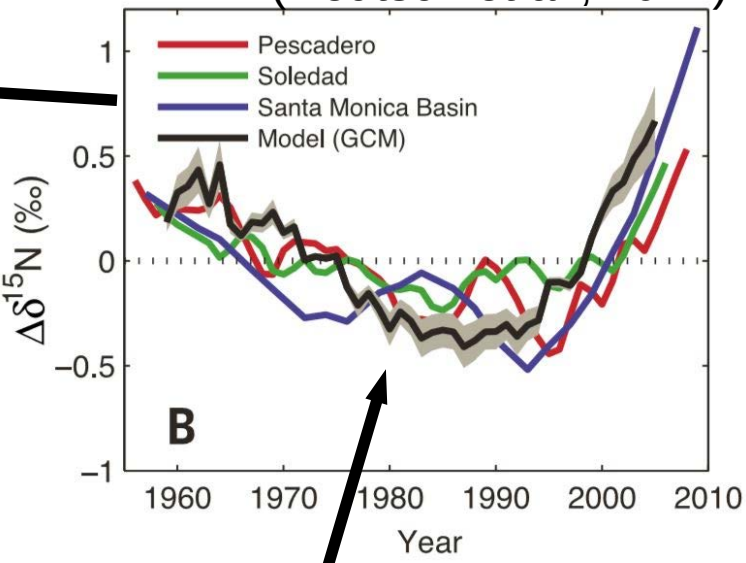
Supply = advection 21%
+ iso. Diff 50 %
+ dia. Diff 29 %

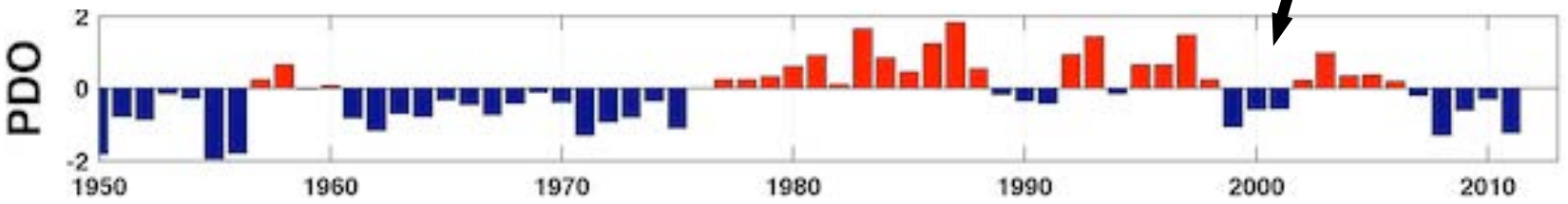
2. PDO and north Pacific Ocean oxygen

leading pattern of SST variability north of 20°N in the Pacific Ocean (Mantua et al., 1997)

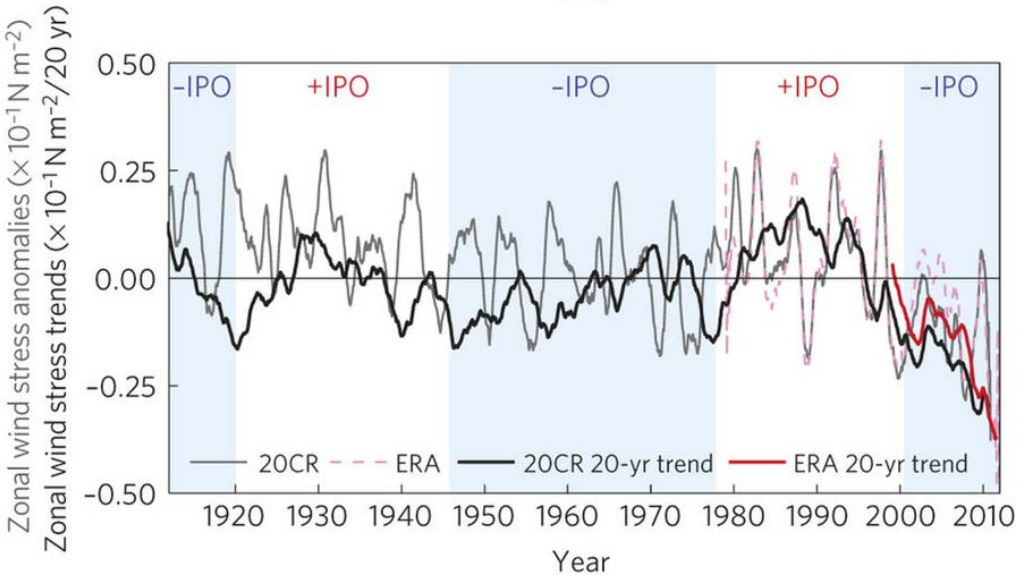


(Deutsch et al., 2014)

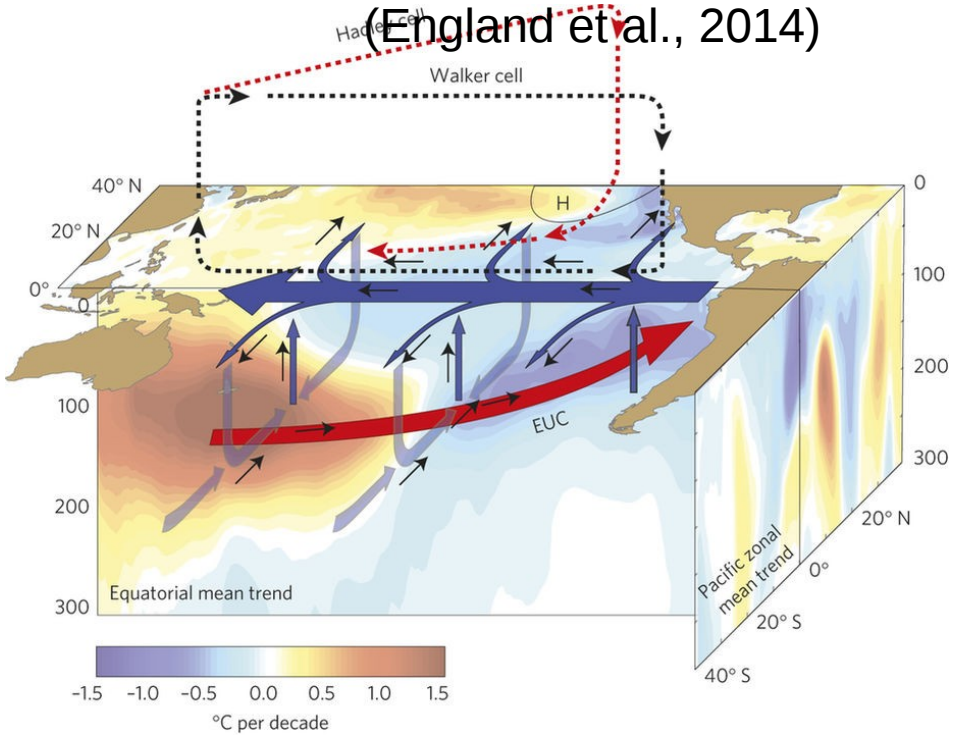




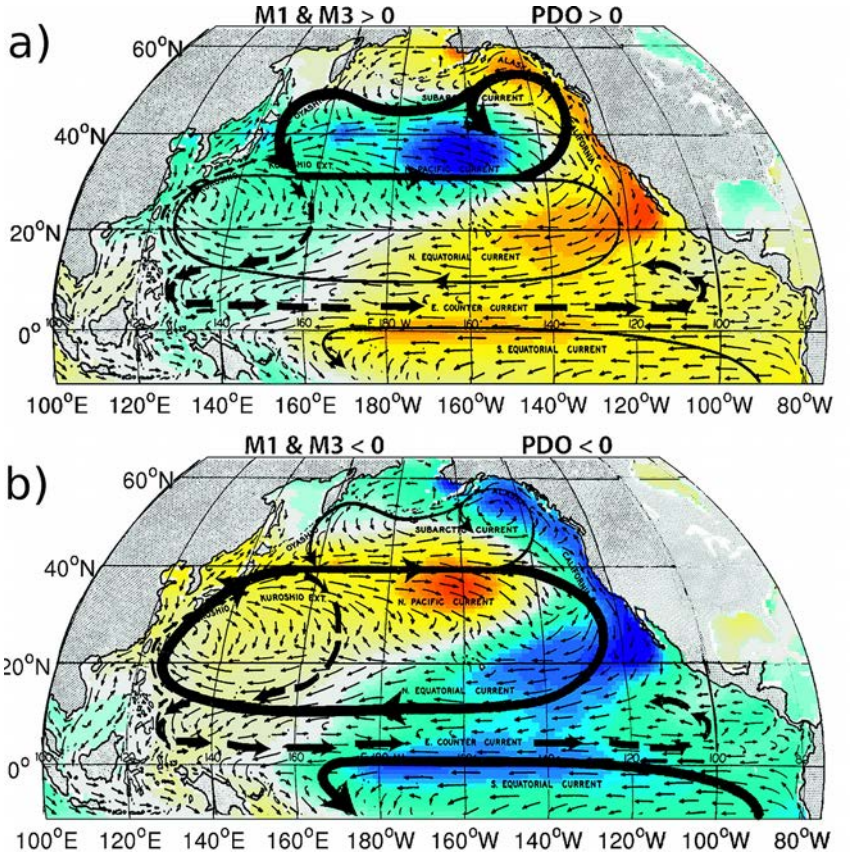
2. PDO and circulation



(England et al., 2014)



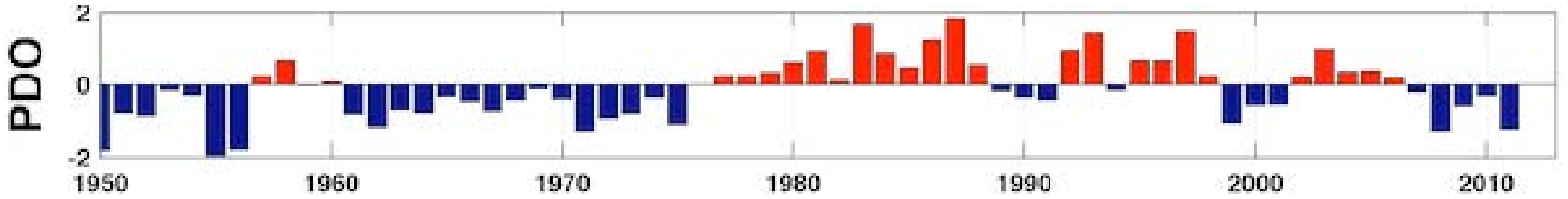
(Messie and Chavez, 2011)

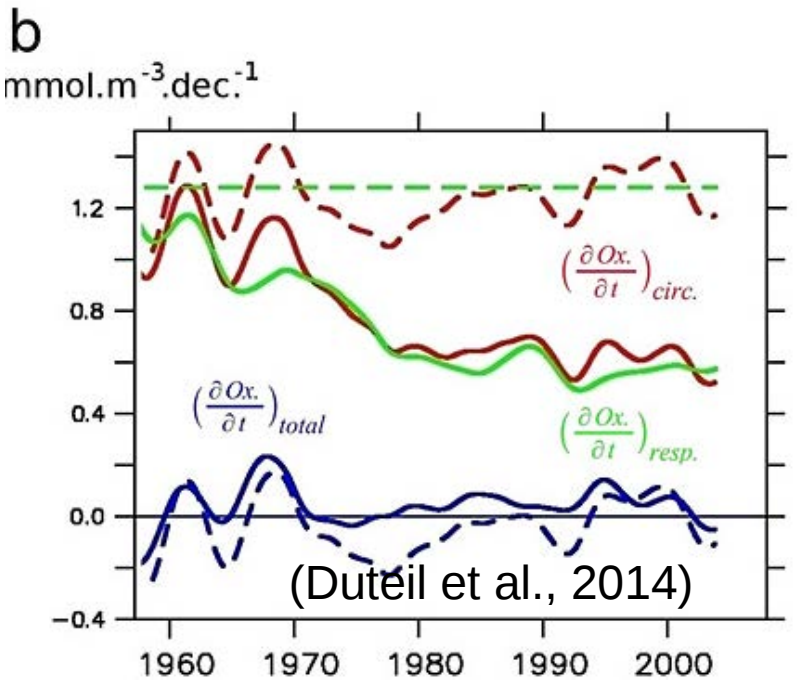


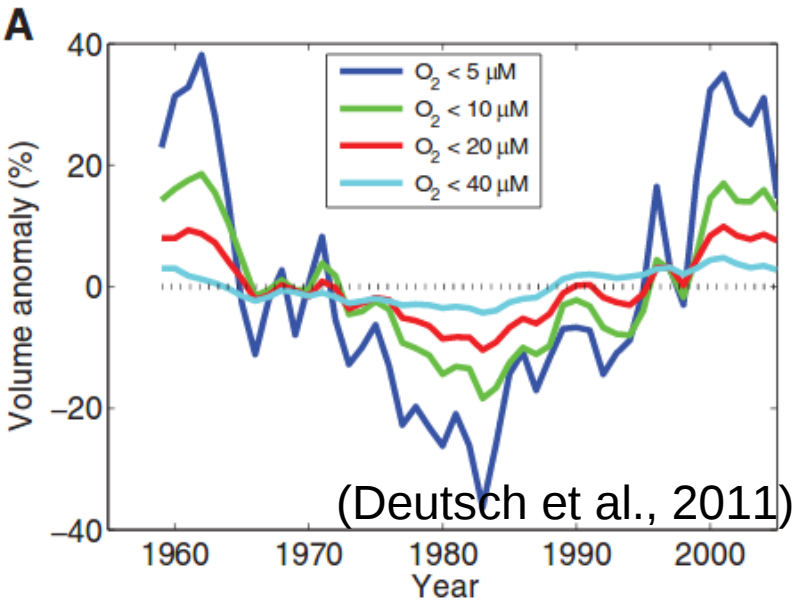
2. modeling strategy – hindcasts

Spinup (equilibrium)
Climatological forcings

Hindcast (e.g 1948 – 2007)
Interannual forcings





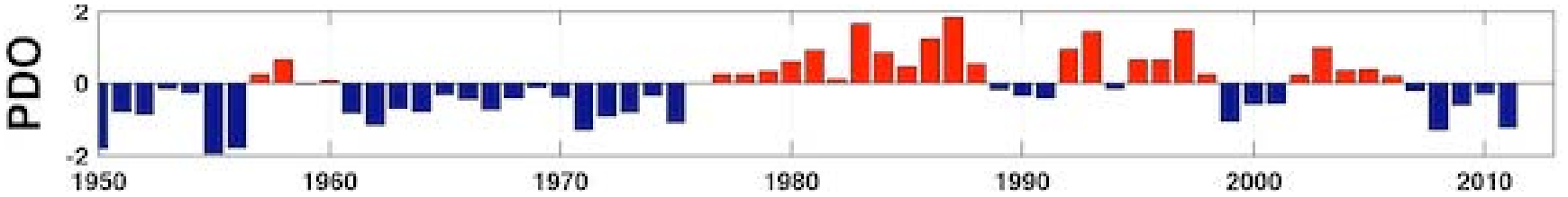


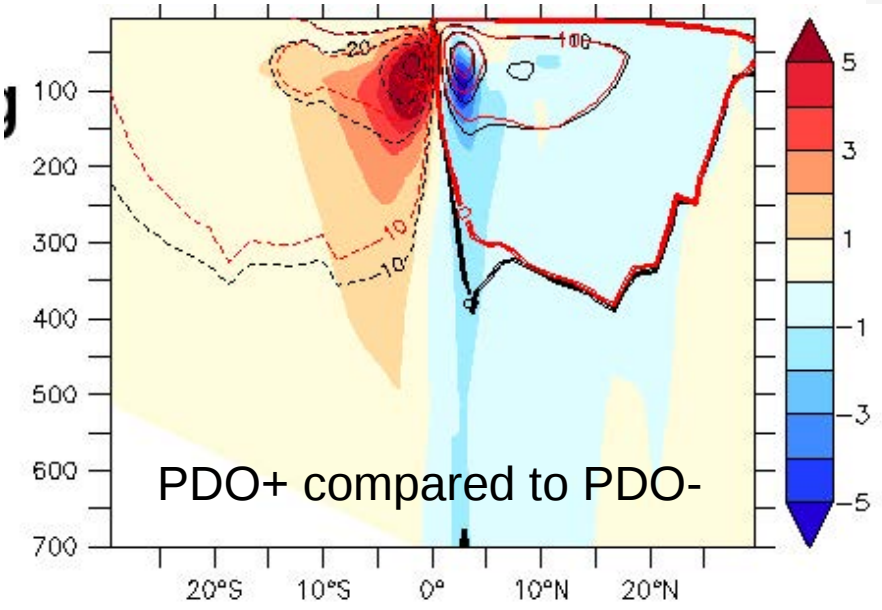
Pb : low frequency of PDO / short time serie

2. modeling strategy – composites

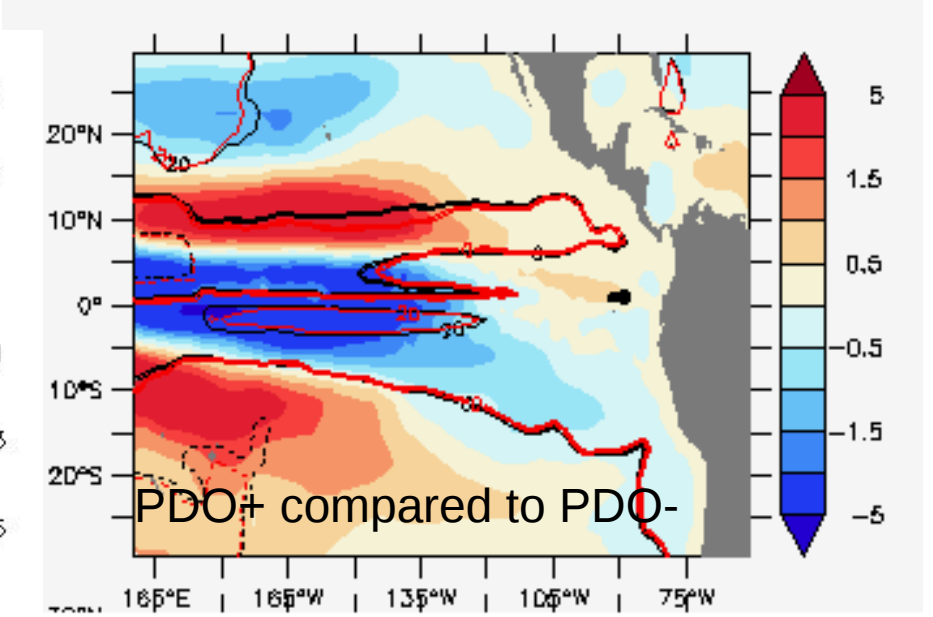
Spinup (equilibrium)
Climatological forcings

50y
Climatological forcings PDO+/-



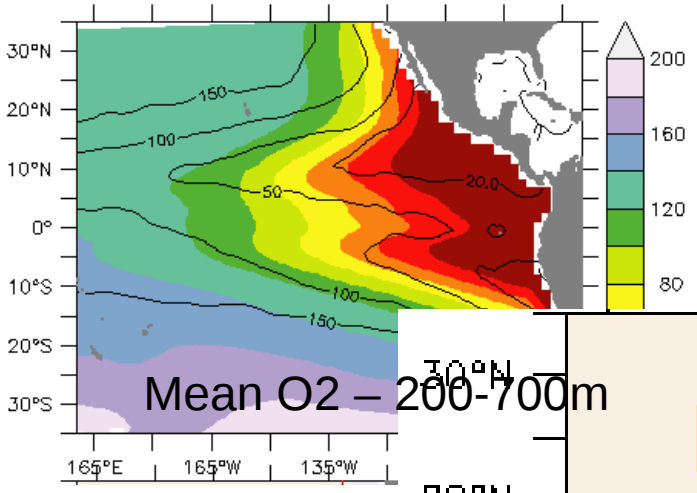


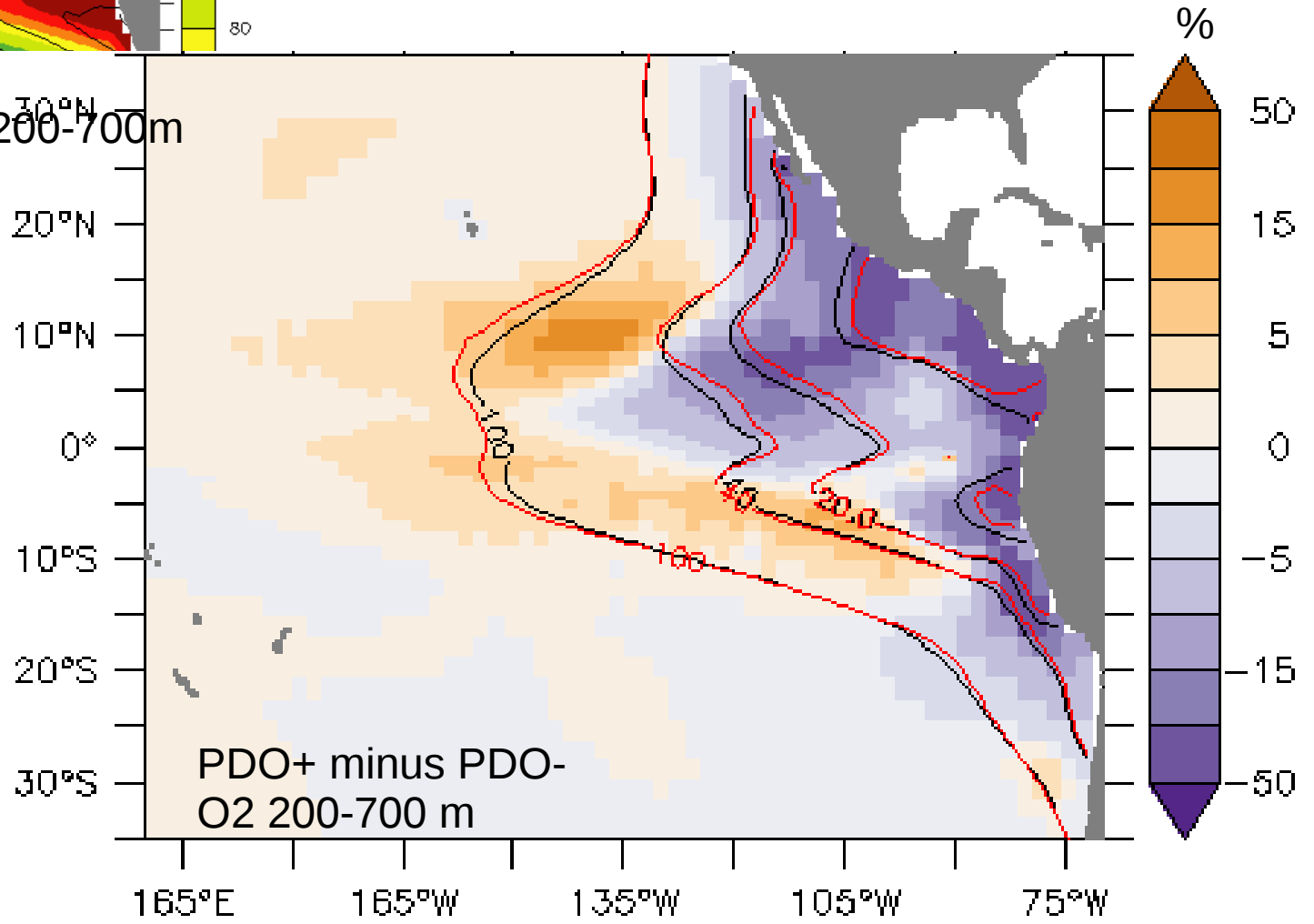
Weaker overturning



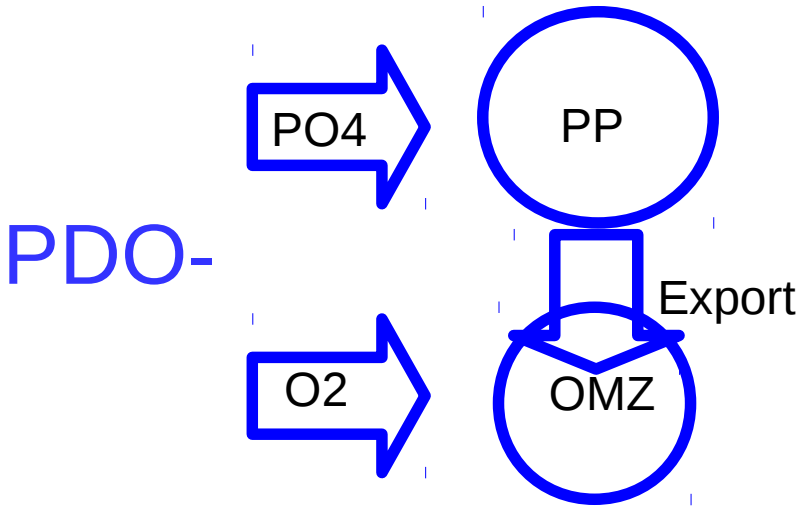
Weaker gyres

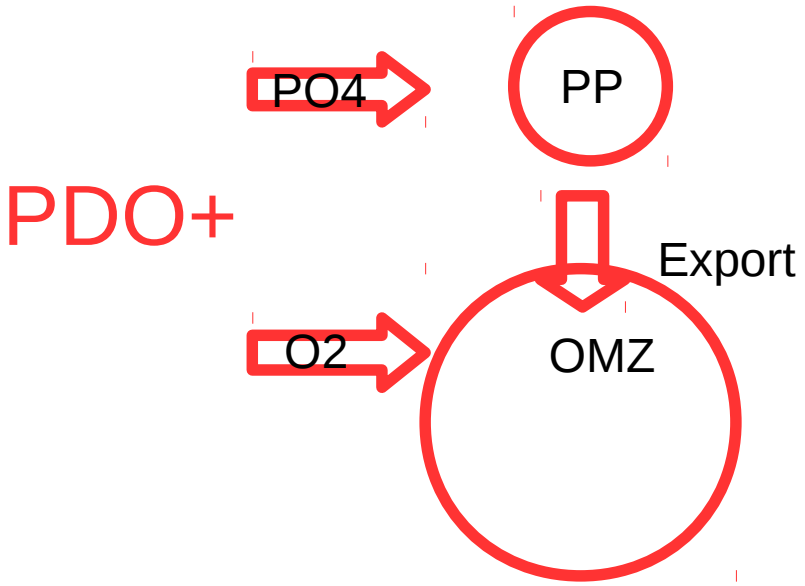
2. PDO+ compared to PDO- : oxygen concentration

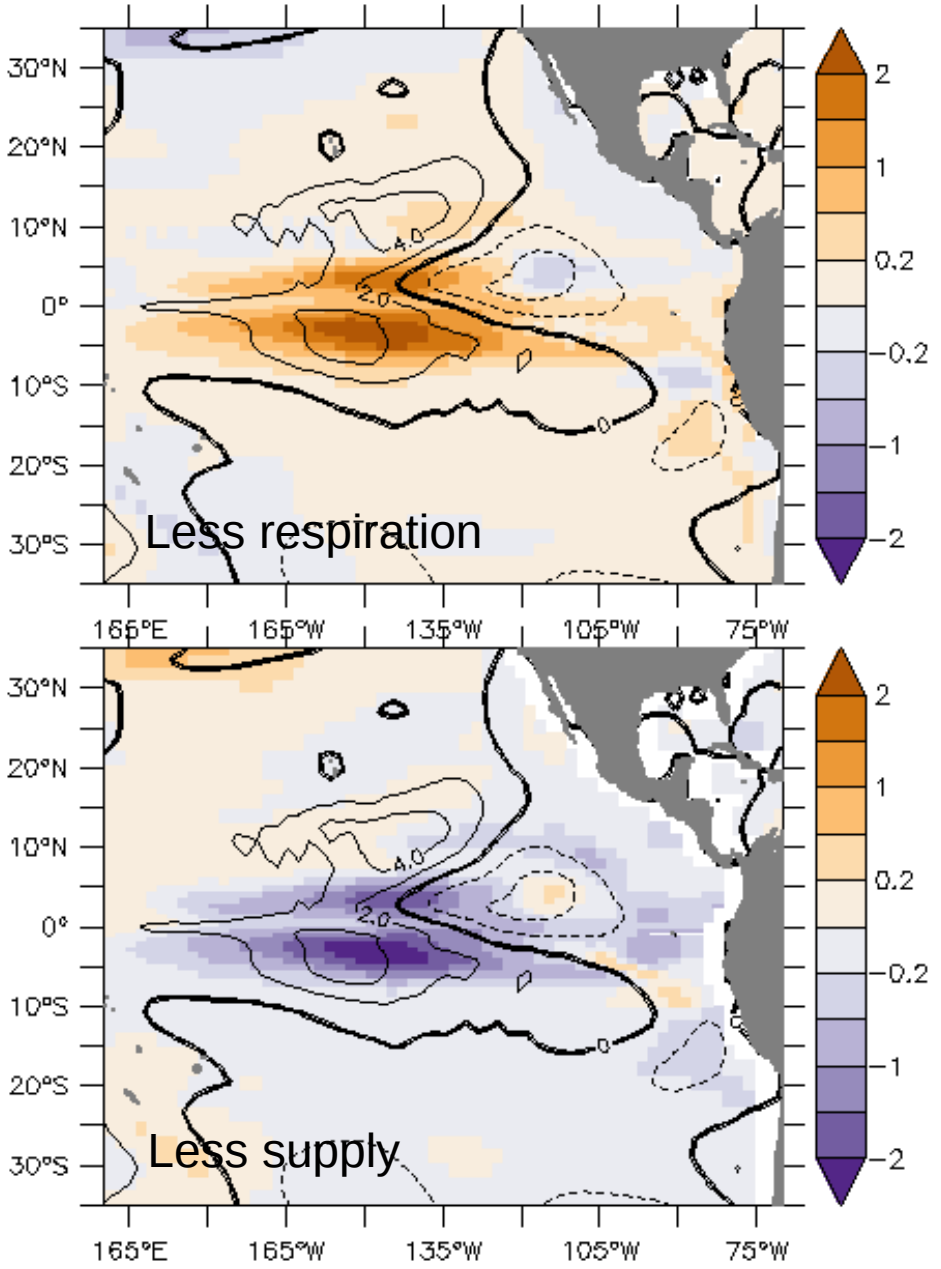




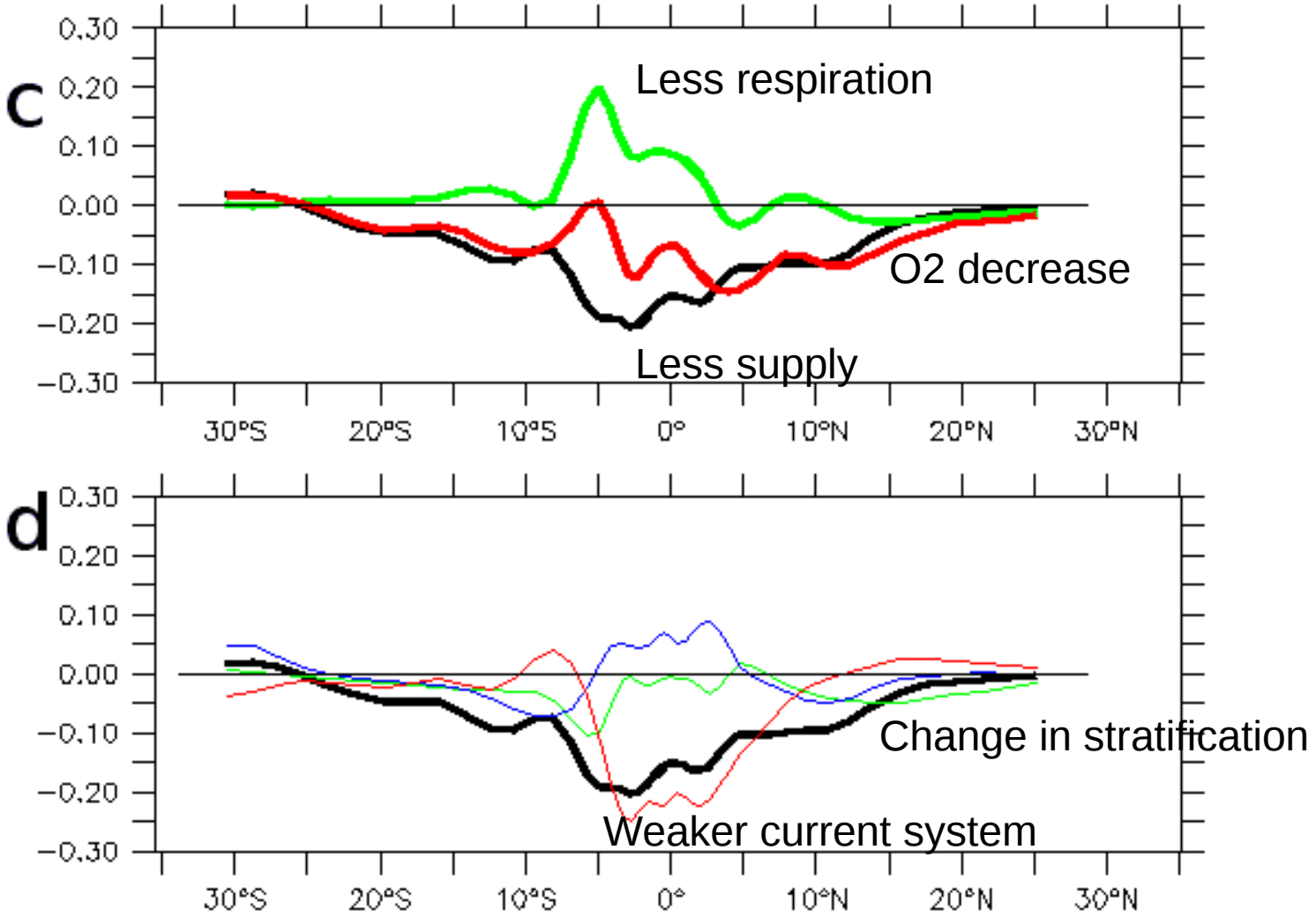
2. PDO+ compared to PDO- : mechanisms



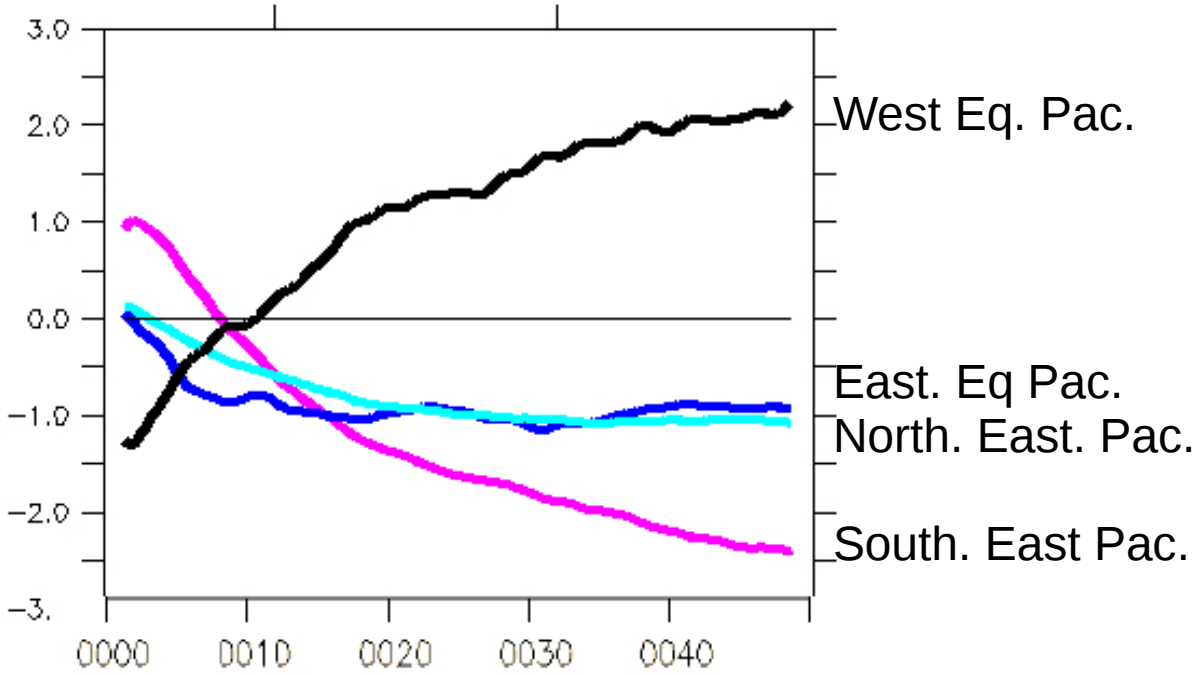


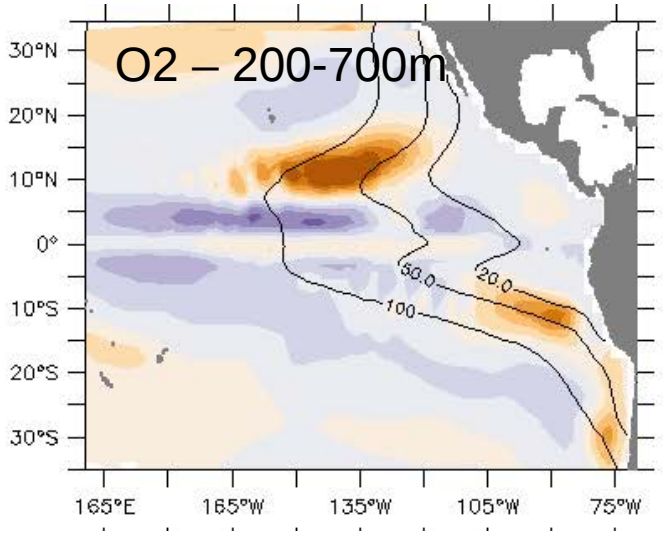


2. PDO+ compared to PDO- : mechanisms

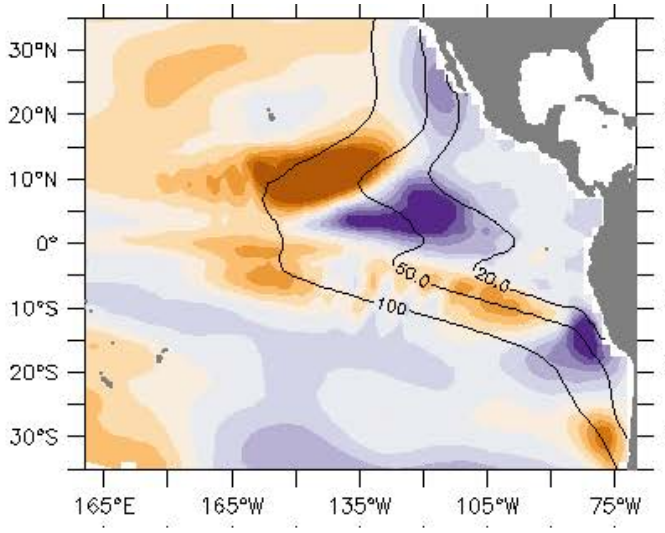


2. PDO+ compared to PDO- : adjustment

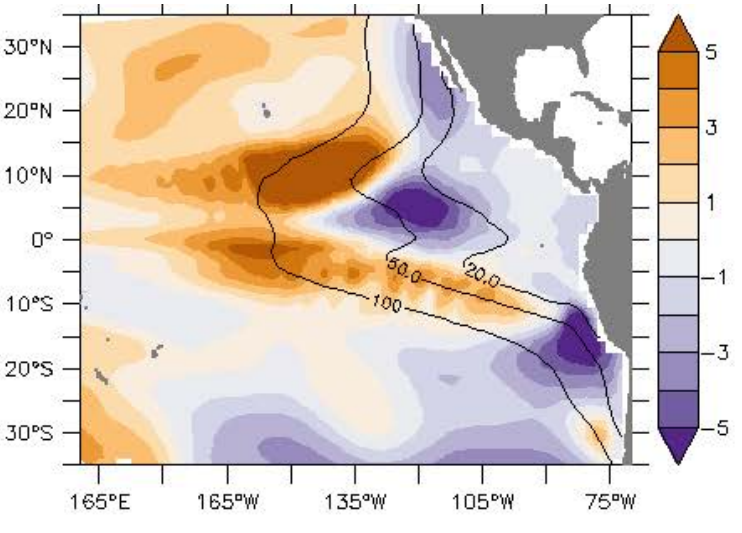




2 years

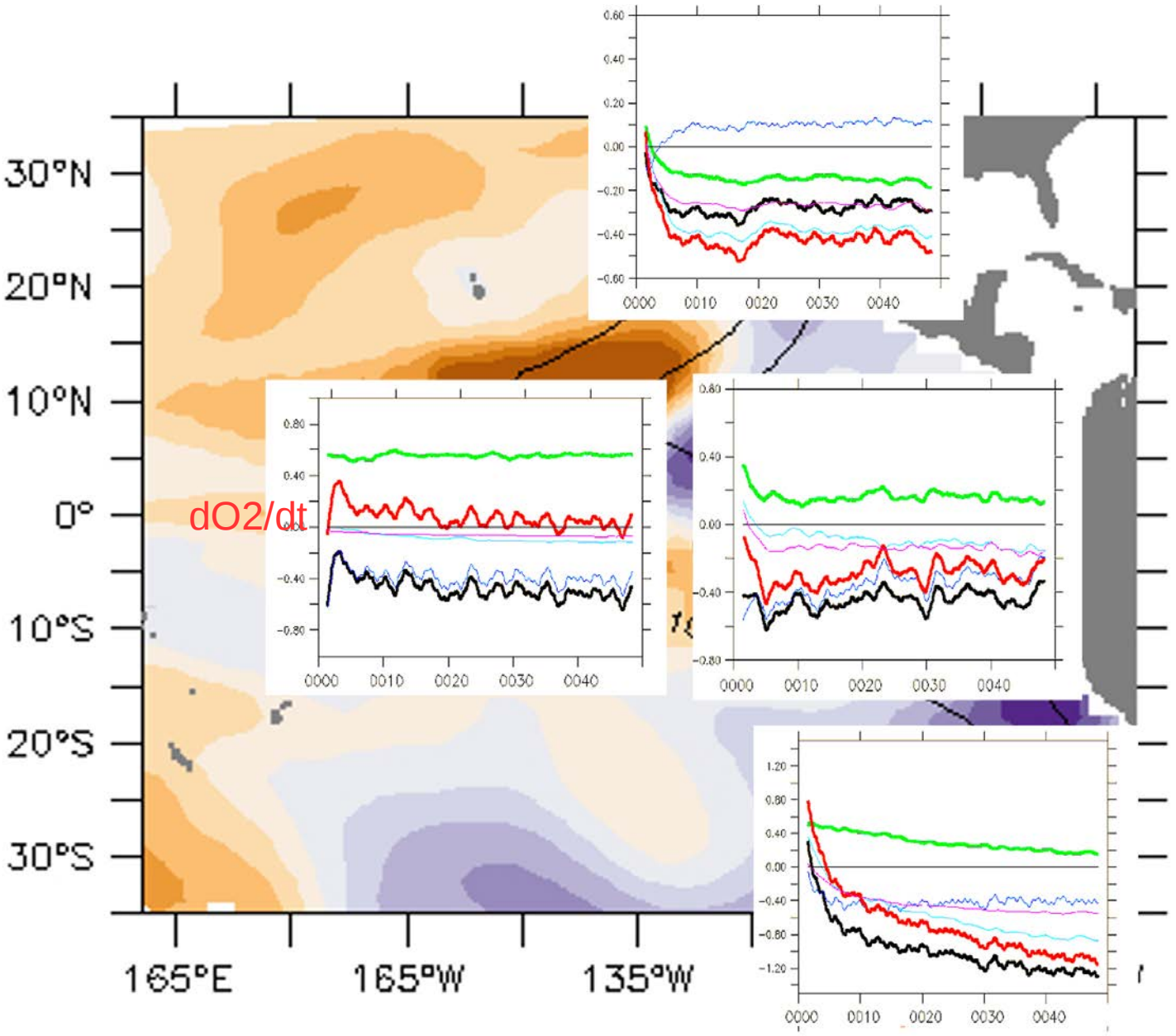


10 years



20 years

2. Variability : PDO+ compared to PDO-



West Eq.
- 1- respiration
- 2- advection

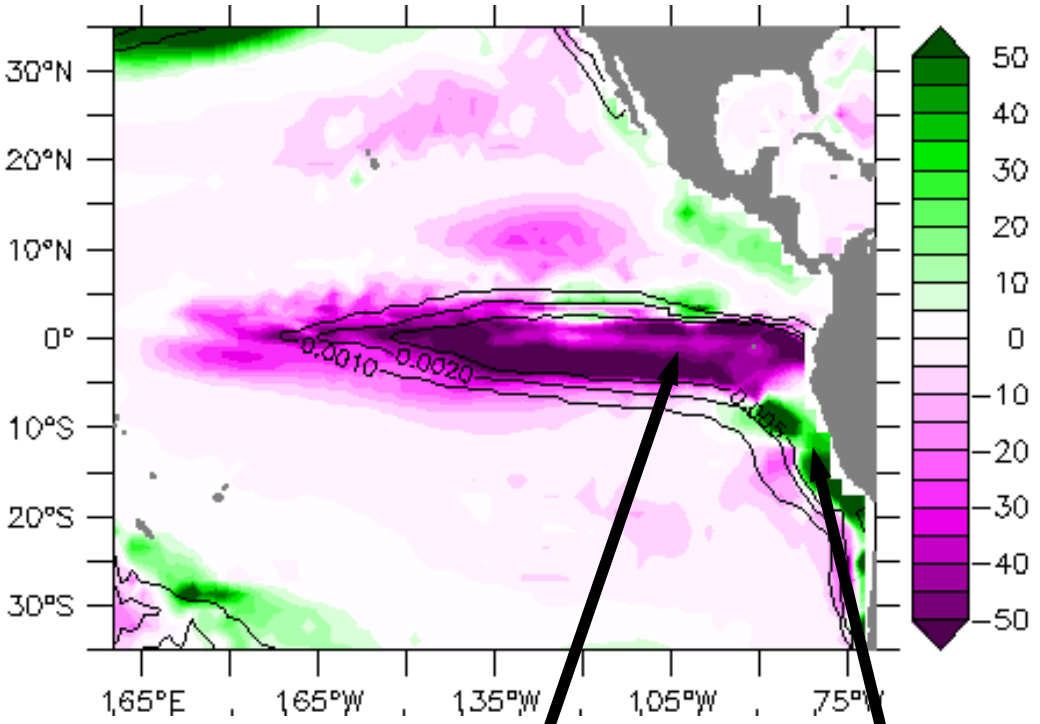
East Eq. SUB20
- 1- advection
- 2- respiration
- 3- mixing
- 4- total diff

North SUB20
- 1- total diff
- 2- mixing
- 3- advection
- 4- respiration

South SUB20
- 1- total diff
- 2- mixing
- 3-advection
- 4- respiration

Changes in O2supply are responsible of the variability !

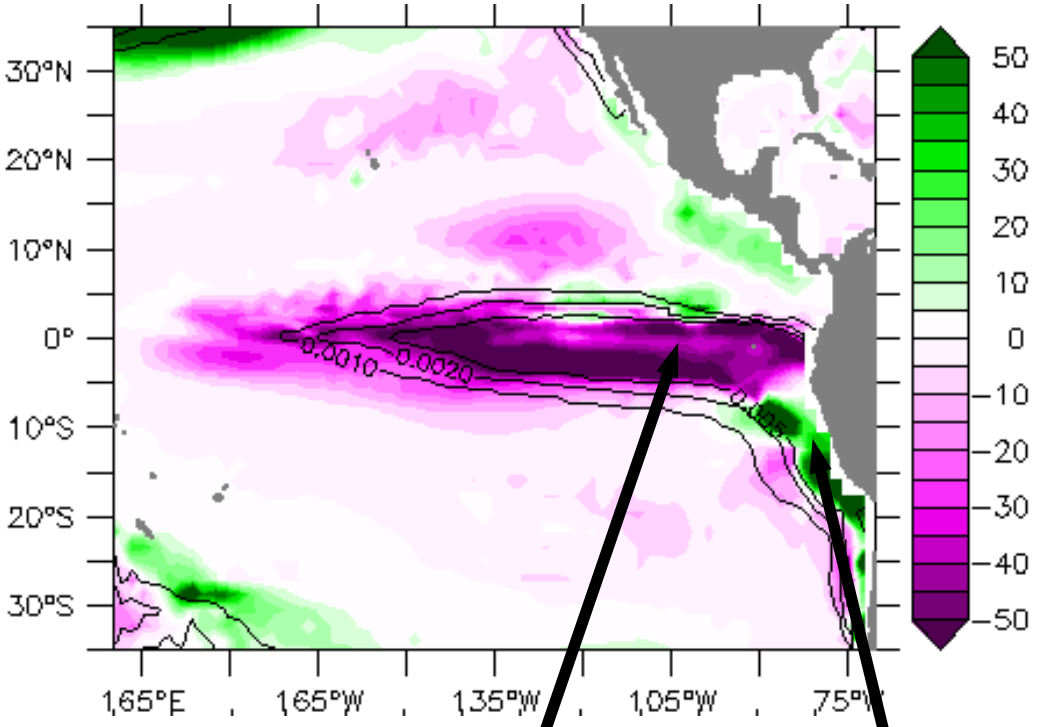
2. PDO+ compared to PDO- : upwelling systems



Productivity and respiration decrease : weaker circulation

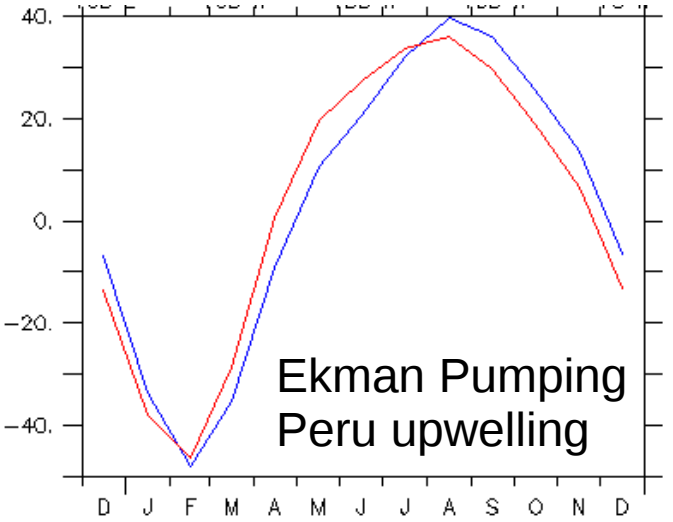
Increase ?

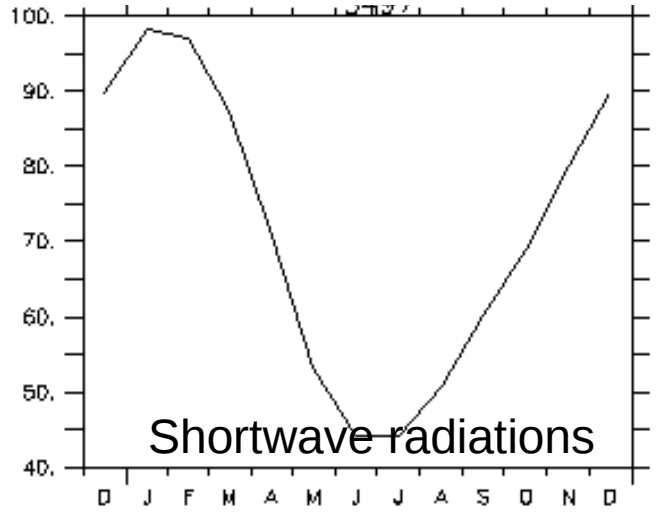
2. PDO+ compared to PDO- : upwelling systems



Productivity and respiration decrease :
weaker circulation / more stratified

Increase

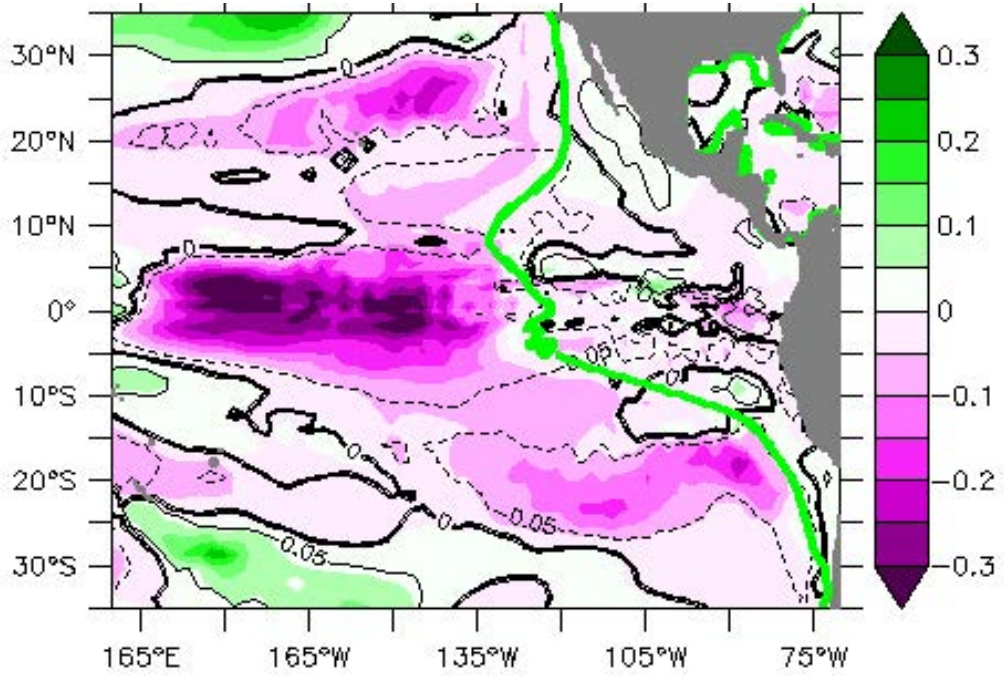




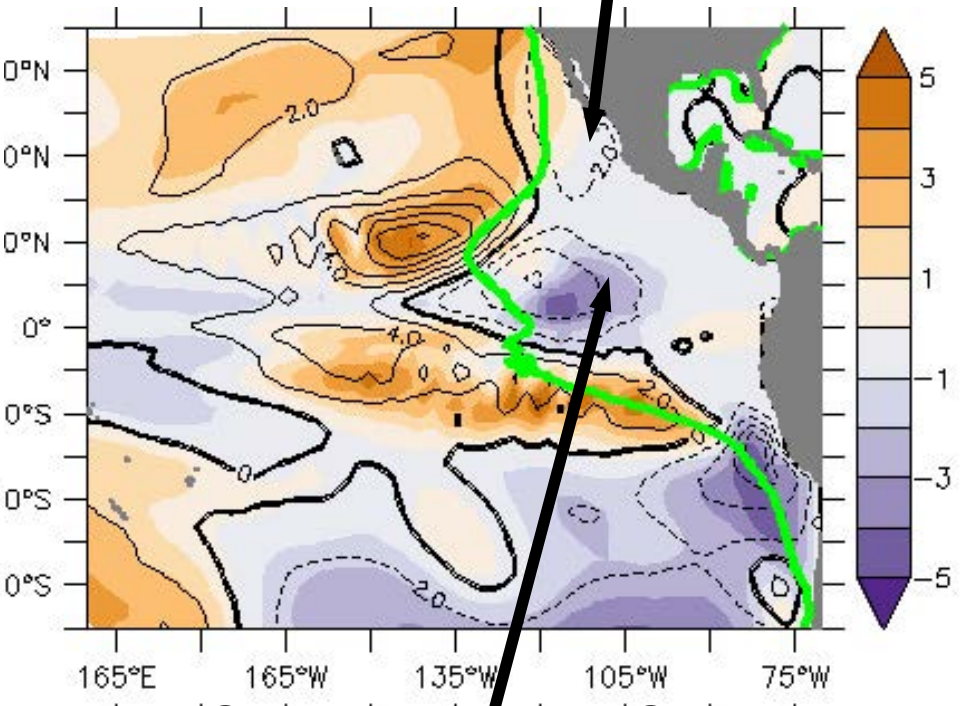
Circulation and local forcings are important !

2. PDO+ compared to PDO- : upwelling systems

Major role of the local changes



PDO+ compared to PDO-
Productivity

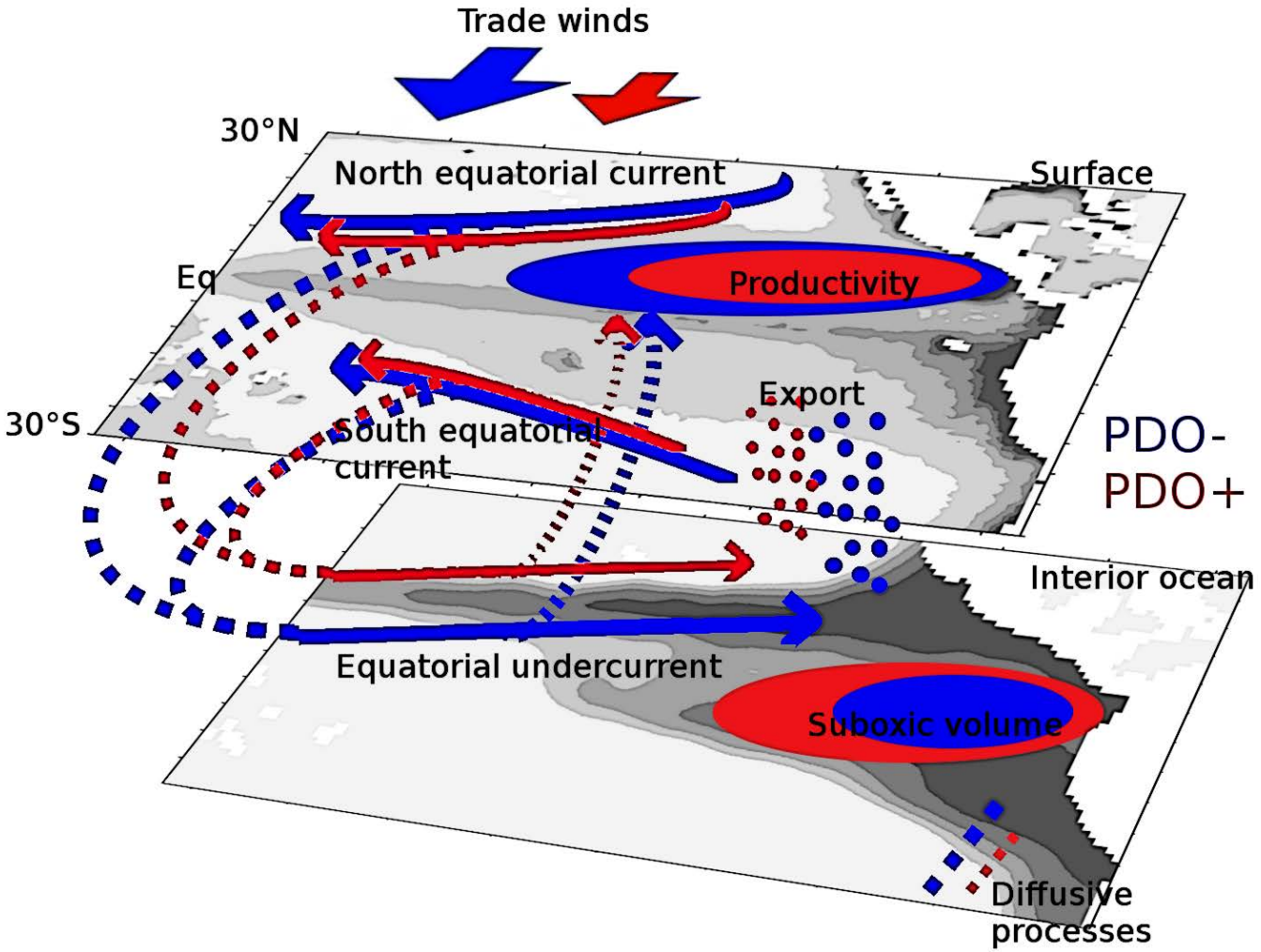


PDO+ compared to PDO-
Oxygen

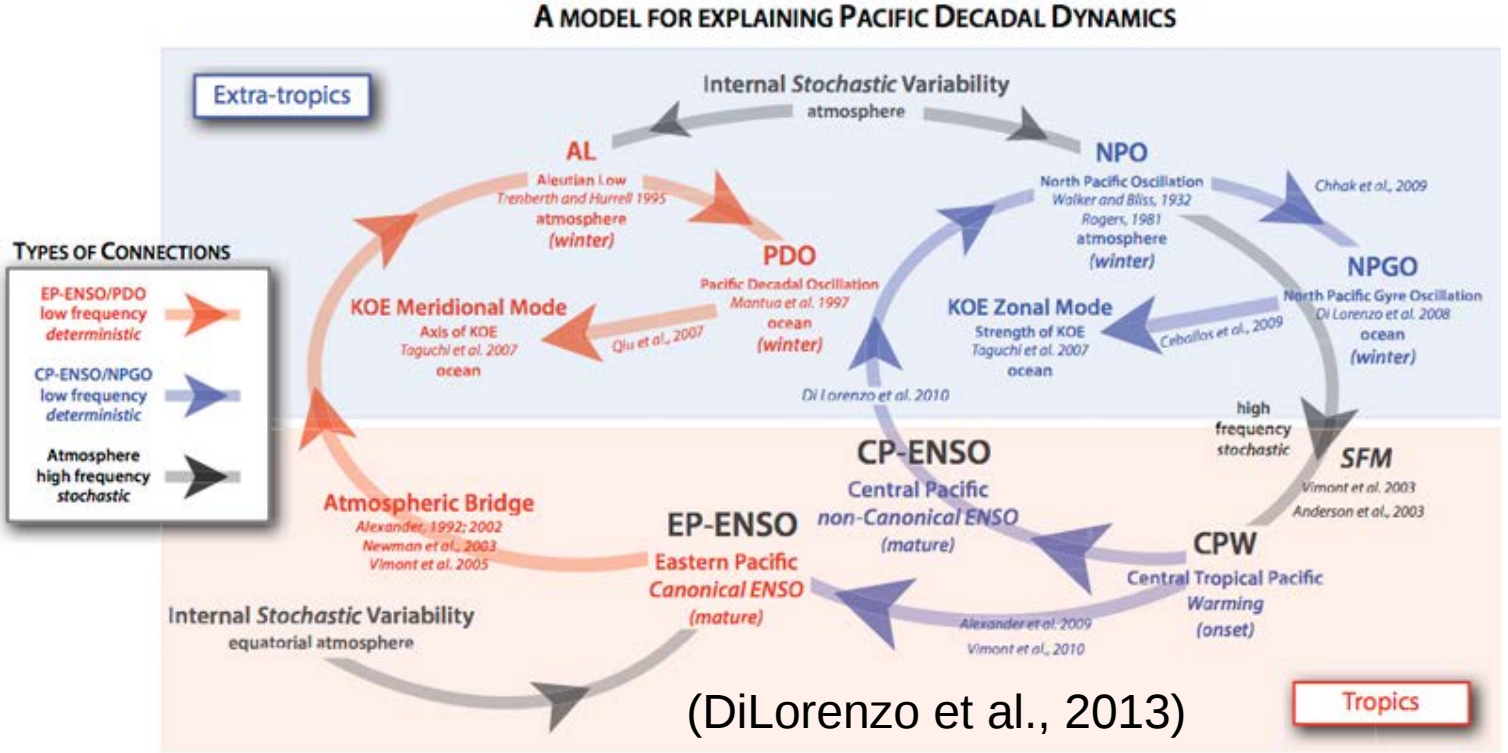
major role of large scale circulation

Conclusion

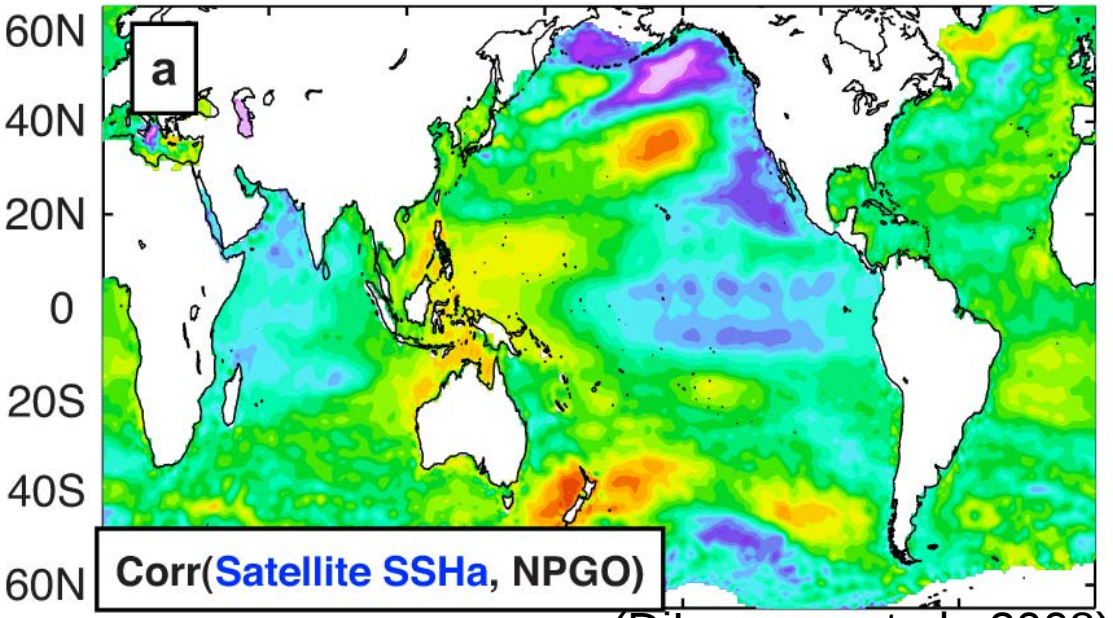
- mostly advective processes at the equator
- major role of diffusive processes in the northern and southern suboxic regions
- PDO+ : + 7% suboxic regions compared to PDO-
- large scale circulation / local changes in the upwelling systems ?



Climate modes in the Pacific Ocean



(DiLorenzo et al., 2013)



(DiLorenzo et al., 2008)