Vortices near the Equator in the Pacific from ECCO2 simulations

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Motivations

Vortex characteristics studies from altimetric observations outside the tropics :

- Morrow et al 2004 in southwest Indian, southeast Atlantic and northeast Pacific
- Isern-Fontanet et al 2005 in Mediterranean sea
- Chelton et al, 2007 for a global description of eddies : westward propagation at approximatively the phase speed of non-dispersive baroclinic Rosseby waves. Poleward /Equatorward deflection of cyclonic/Anticyclonic eddies

Near the Equator ?

- Tropical Instability Vortices (Kennan and Flament, 1999)
- Smaller vortices? Their characteristics?

➡ **Lagrangian study from ECCO2 model data**

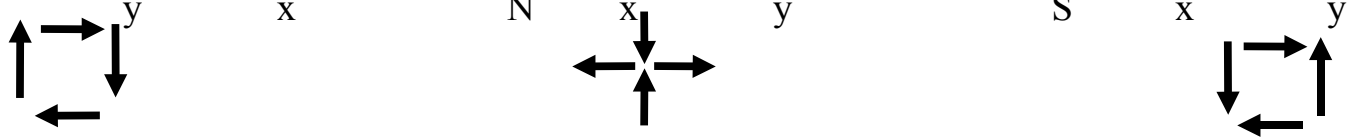
Data and method (1)

<u>Data</u> : Cube84, daily surface velocity fields over 15 years
Soon : 1/16th resolution

<u>Vortex identification</u> : **Okubo-Weiss parameter** (Okubo, 1970 Weiss, 1991)

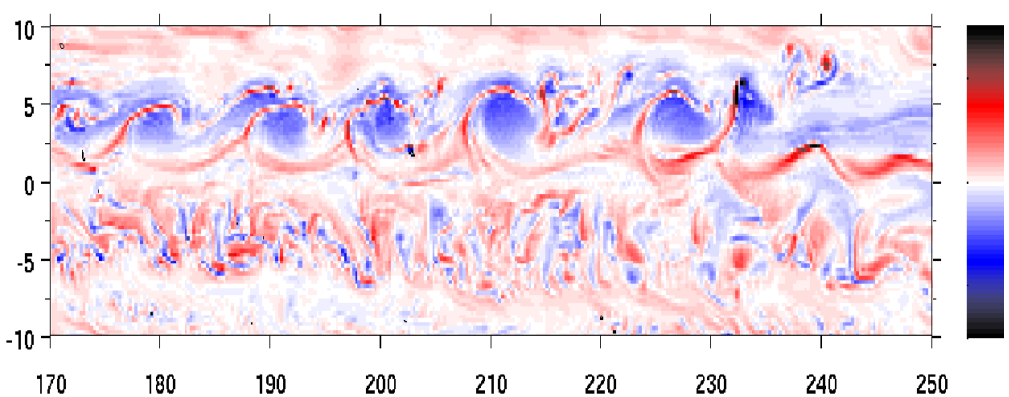
$Q = W^2 - S^2$ comparison between **vorticity W** and **strain** $\mathbf{S = S_N + S_S}$

$W = \partial_y u - \partial_x v$ $\quad S_N = \partial_x u - \partial_y v$ $\quad S_S = \partial_x v + \partial_y u$

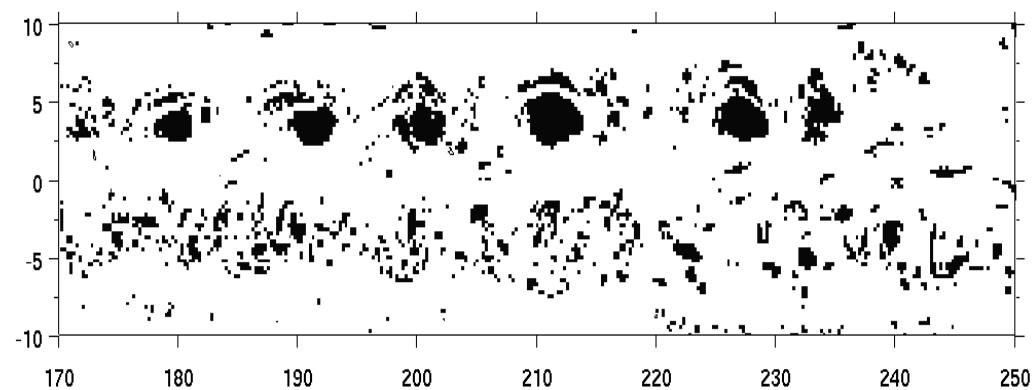


Vortex cores caracterised by strong positives values of Q

➡ Vortex = contours in which $Q > 1 \times 10^{-11}$



Vorticity on December 1st , 1999



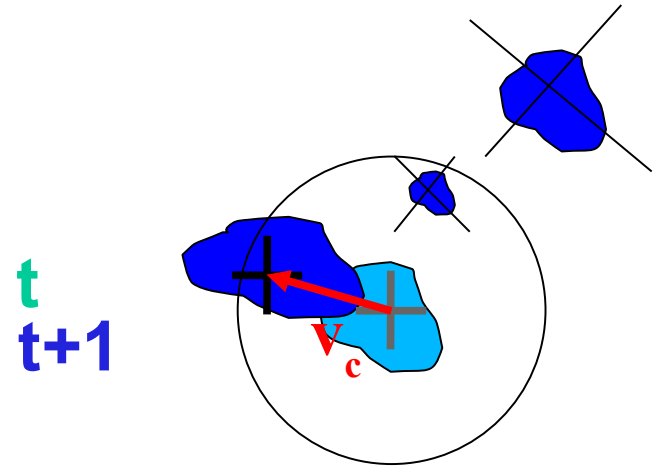
In black : regions where $Q > 1 \times 10^{-11}$

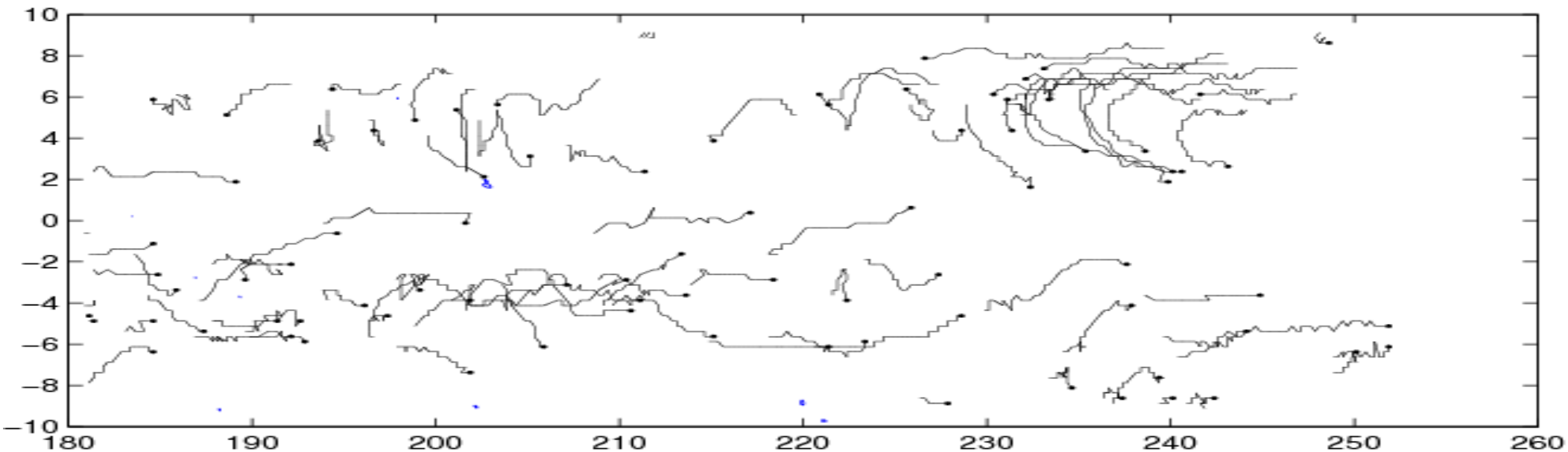
Vortex properties considered : size **s**, vorticity **w**

Data and method (2)

Tracking

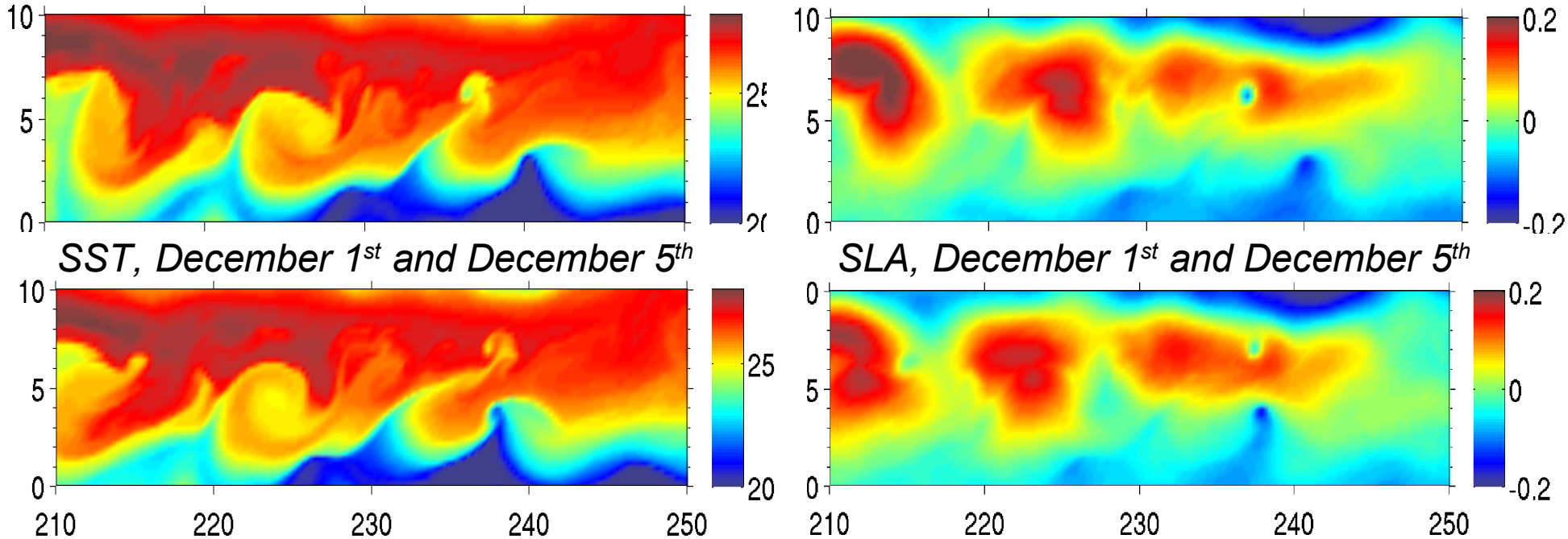
- $v_c < 100$ km/day
- $(s_{t+1}-s_t)/s_t < 0.6$
- $(w_{t+1}-w_t)/w_t < 0.6$



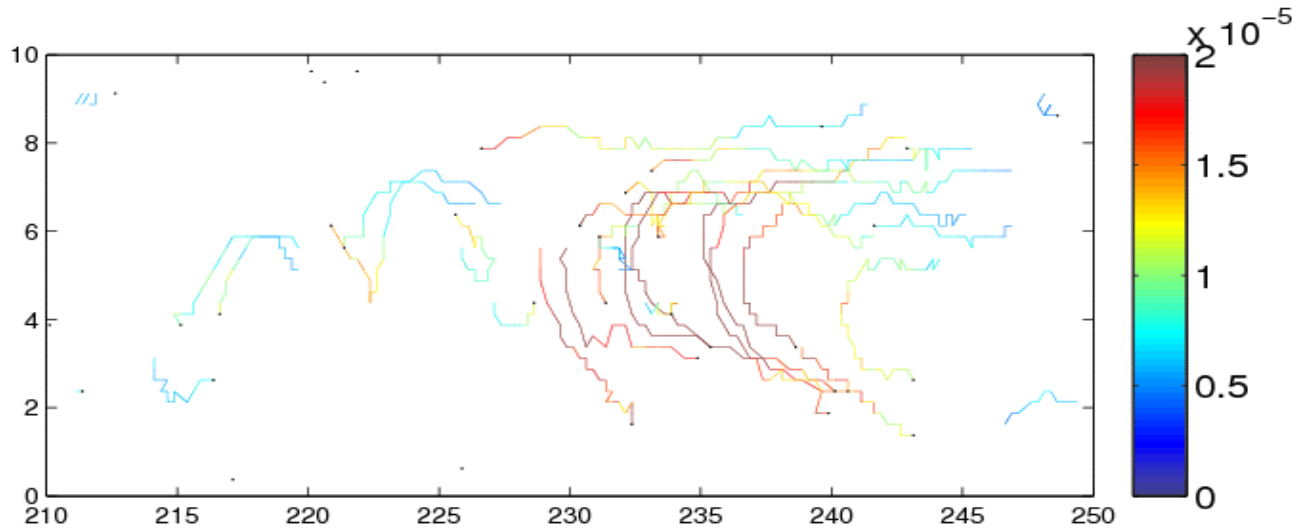


Long life (>20 days) cyclonic vortices tracked over 1 year

Future work : vortices associated to the Tropical Instability Waves

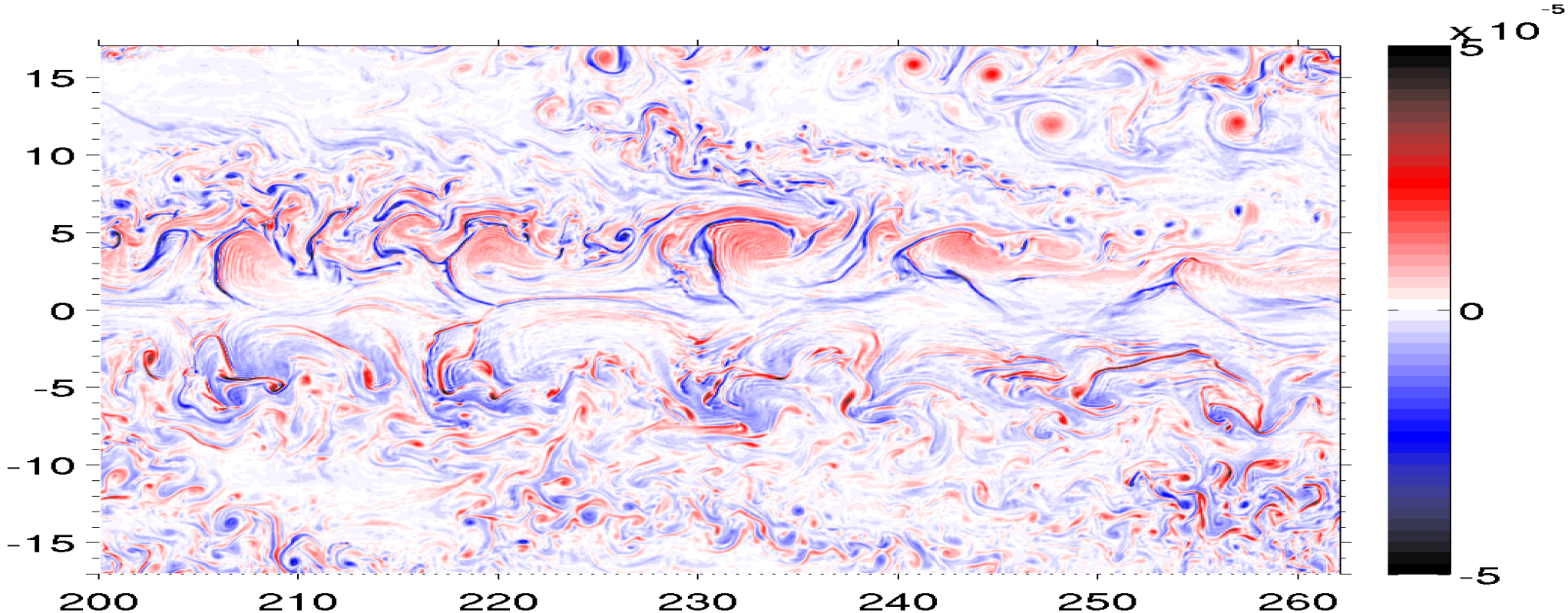


~1 cyclonic vortex / largeTIV
Small time scales (3-5 days)
Strong vorticity (>3x10^{-5} s^{-1})
Important meridional motions



Tracked cyclonic vortices over 1 year. Color : vorticity

With 1/16th resolution ...



Vorticity in a 1/16th resolution simulation

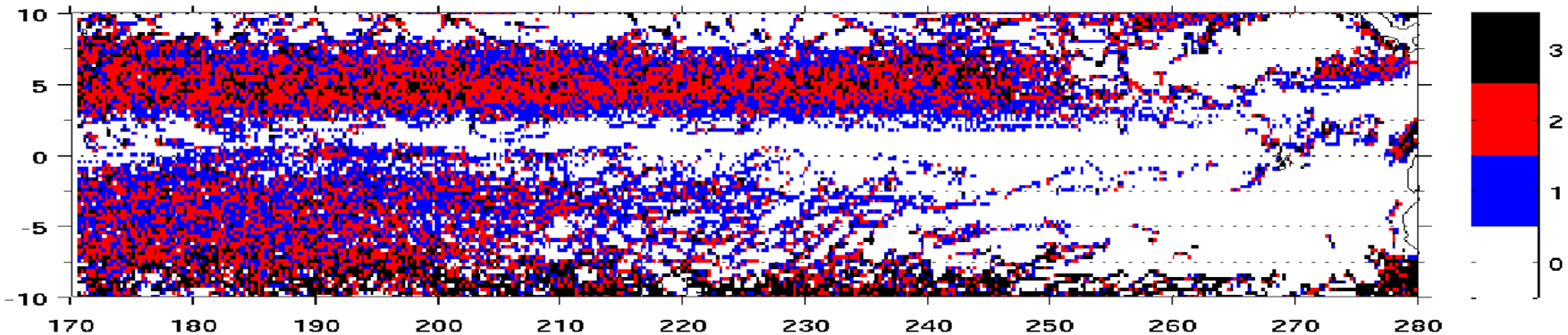
➡ More cyclonic and anticyclonic small vortices to track ...

Perspectives

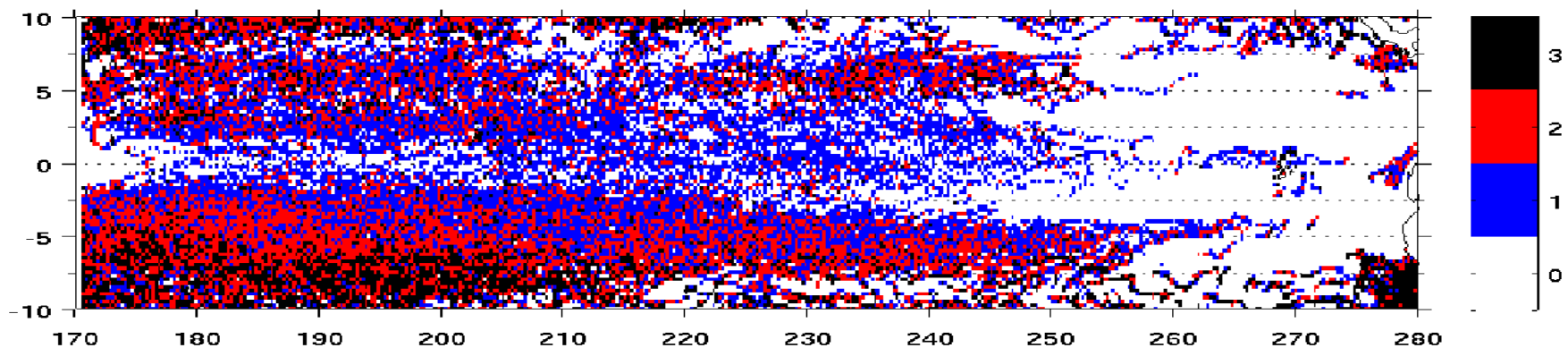
- **Small scale vortices associated to the TIW activity :**
  - Their characteristics / TIV ?
  - Their role ?
  - Nutrients & cold water transport ?

- **SWOT will partially track such eddies. Useful information ?**

Overview in the tropical Pacific



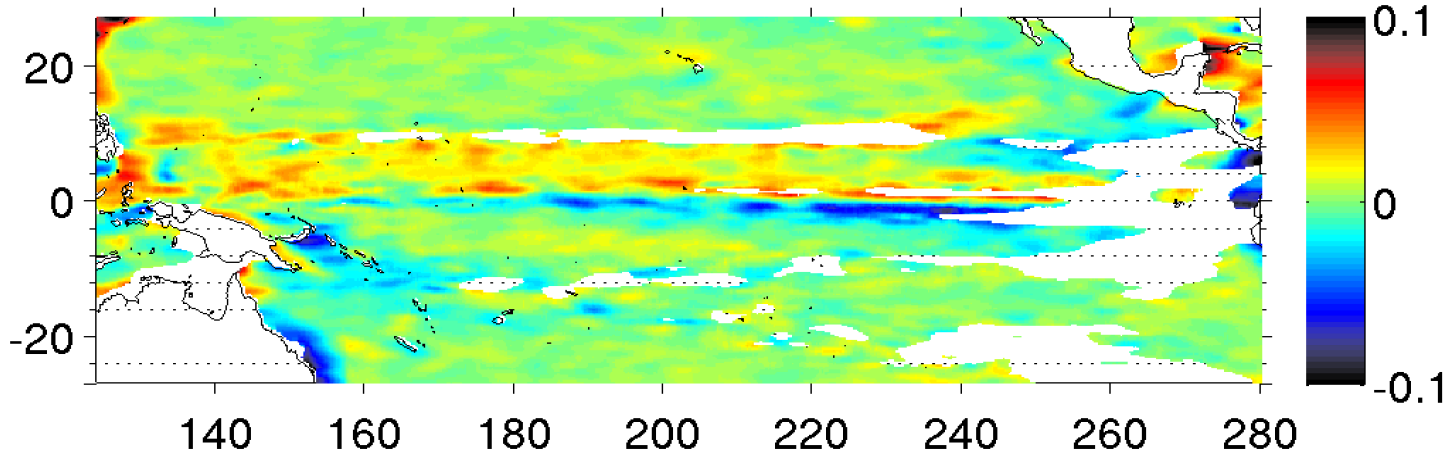
Number of clockwise vortex centers observed in each grid points over the 15 years.



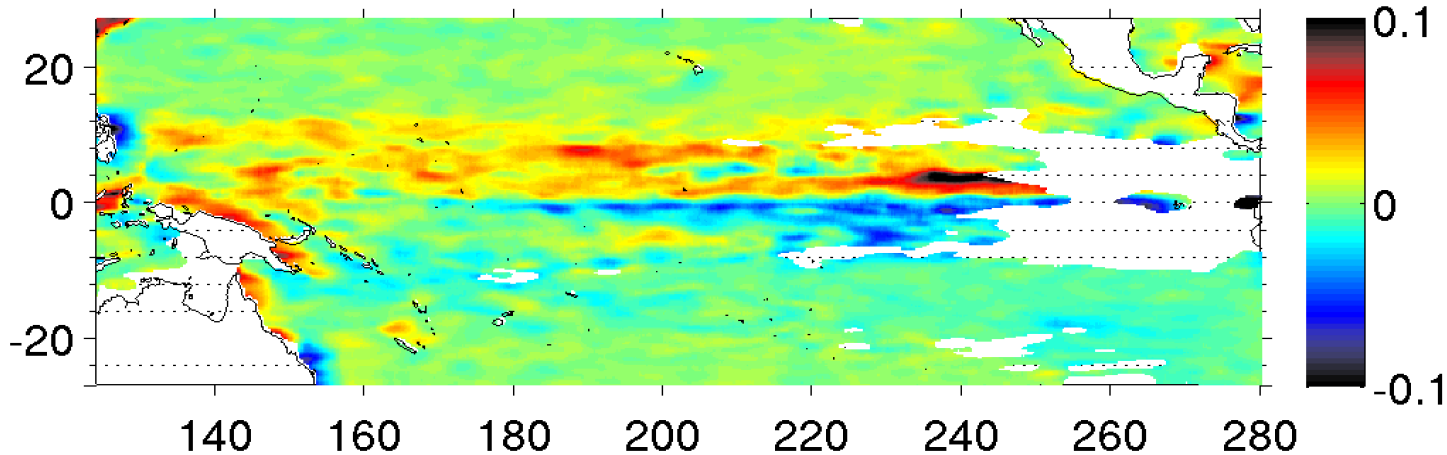
Same for anti-clockwise

- Inhomogenous repartition clockwise/anti-clockwise
- West of 250E at 5N : TIW activity
- More anticlockwise vortices around the equator

Overview in the tropical Pacific

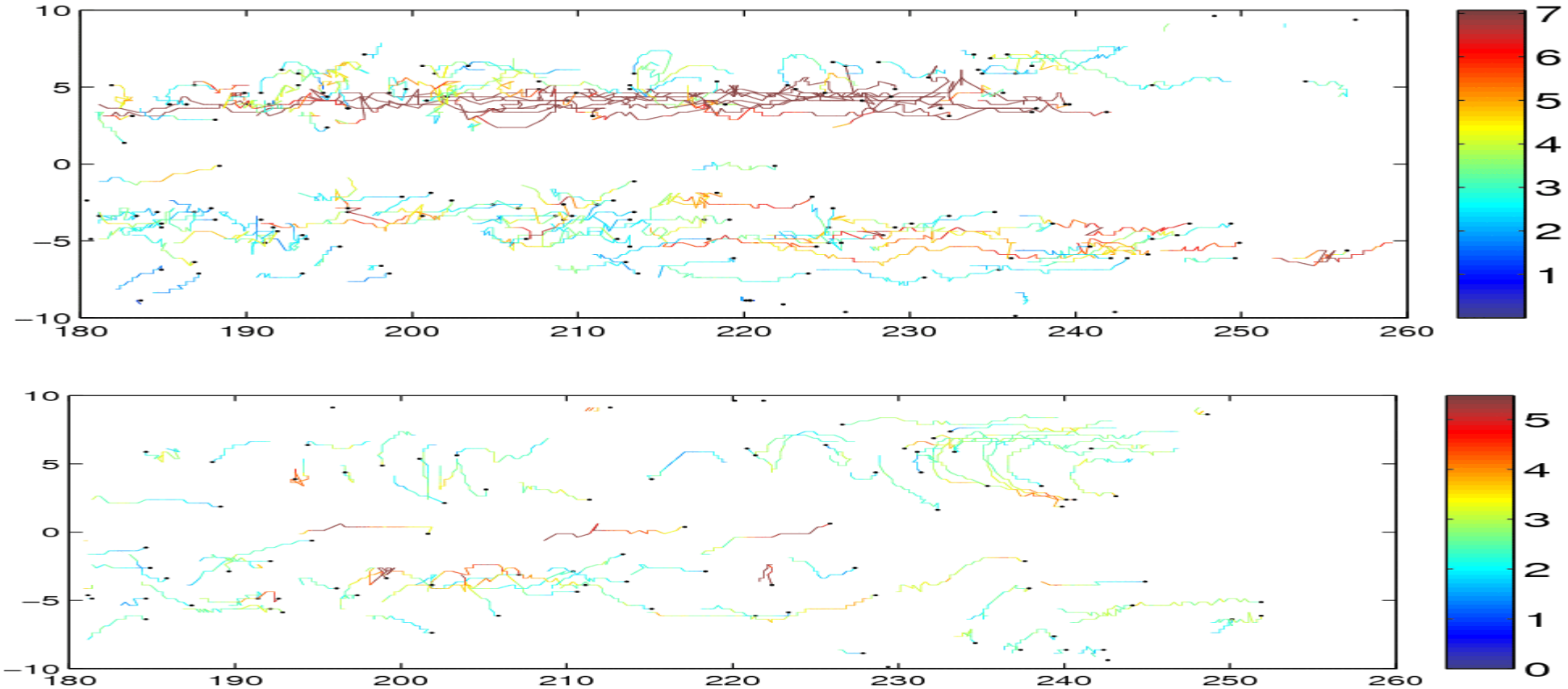


Averaged meridional velocity of anticyclonic vortices (up) and cyclonic vortices (down)

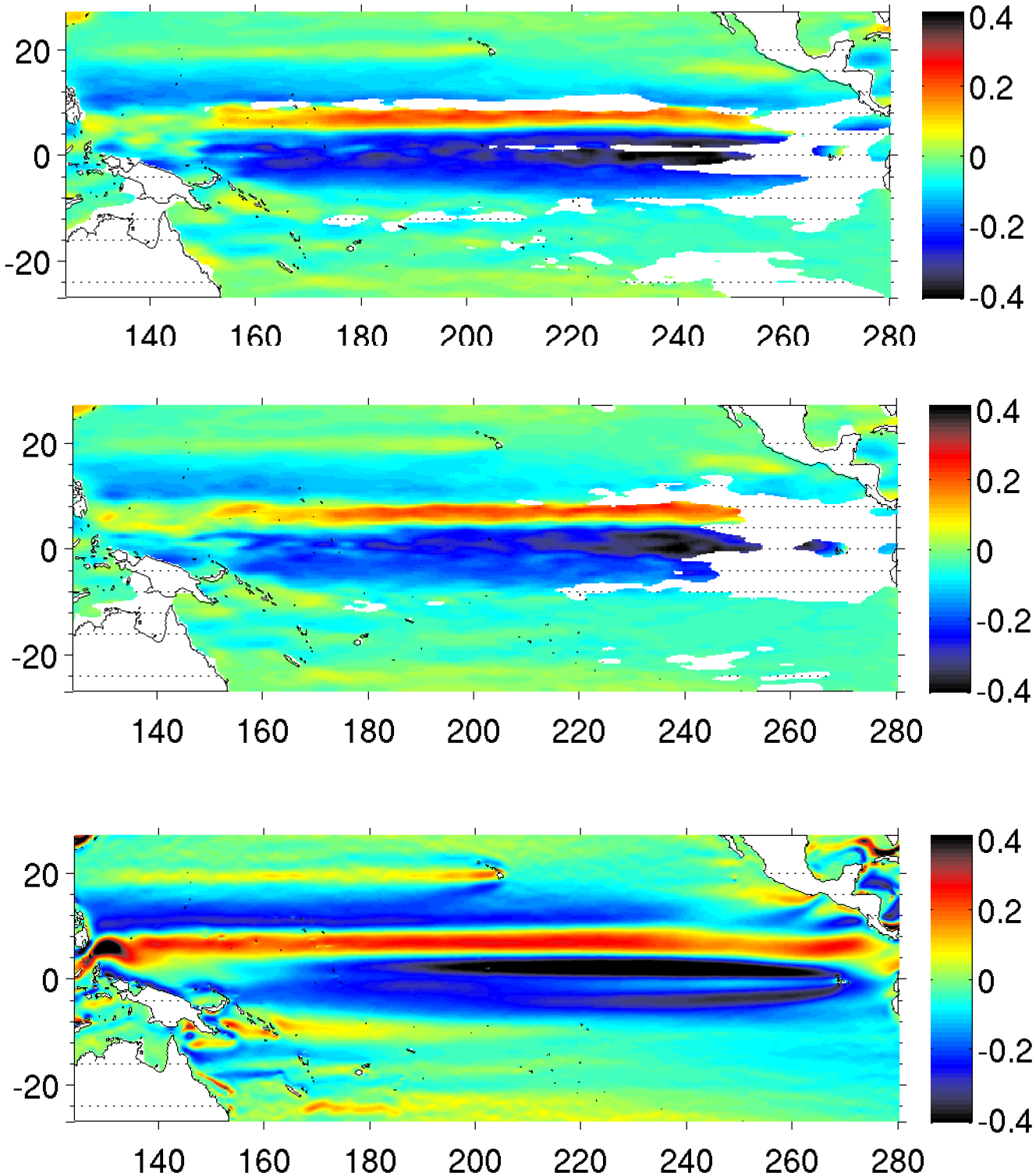


- Same divergence at Equator observed in Fu, 2009 from the propagation velocity of the variablilty that dominates the variance of SLA

Cyclonic and anticyclonic vortices tracking



Large TIV in north hemisphere only


20
0
-20
140
160
180
200
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240
260
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0.4
0.2
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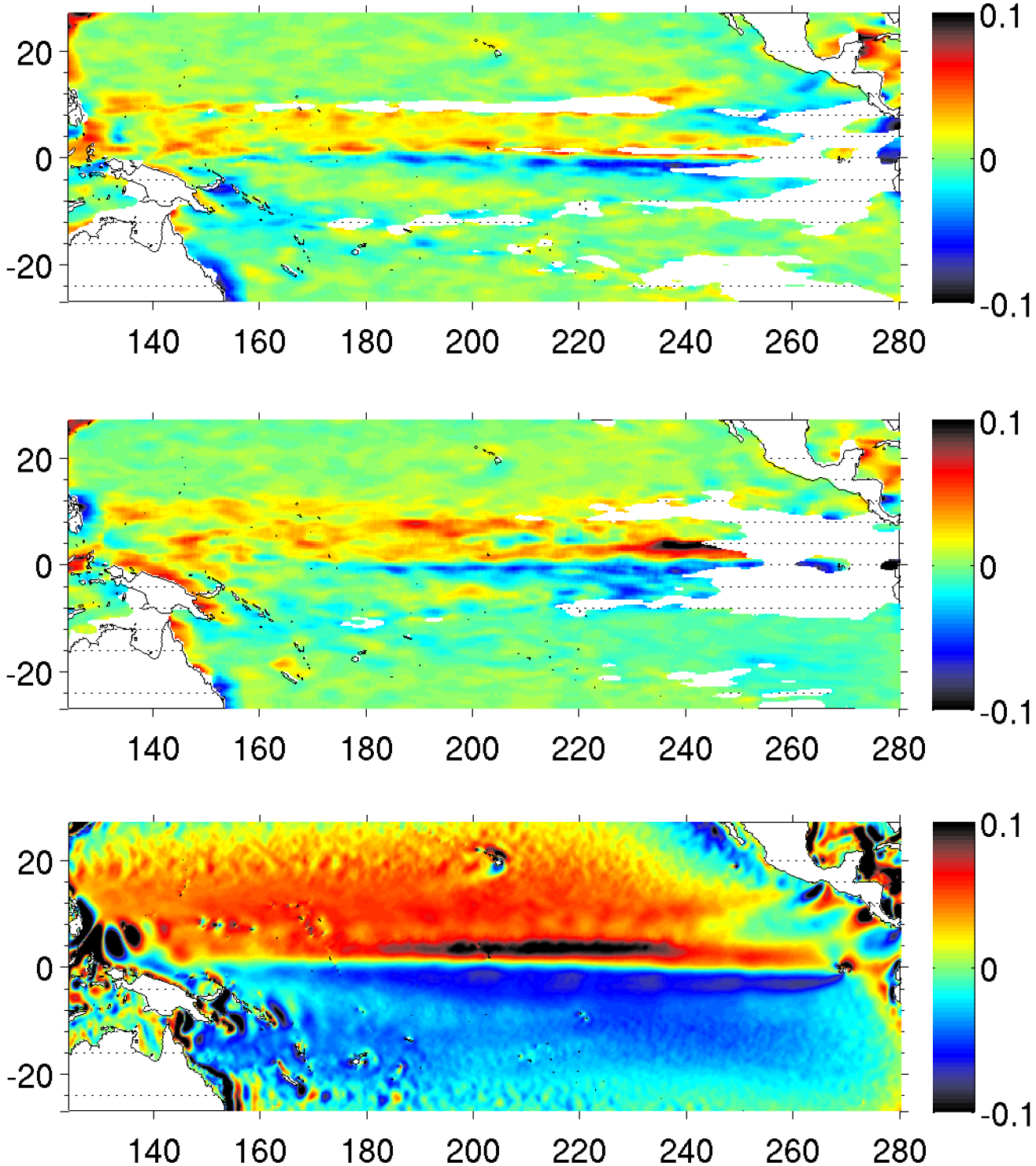
20
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