ASLO 2017
M2C
Mountains to the Sea
Feb 26 – Mar 3, 2017
Honolulu, Hawai`i

Mediterranean Institute of Oceanography

LOPS

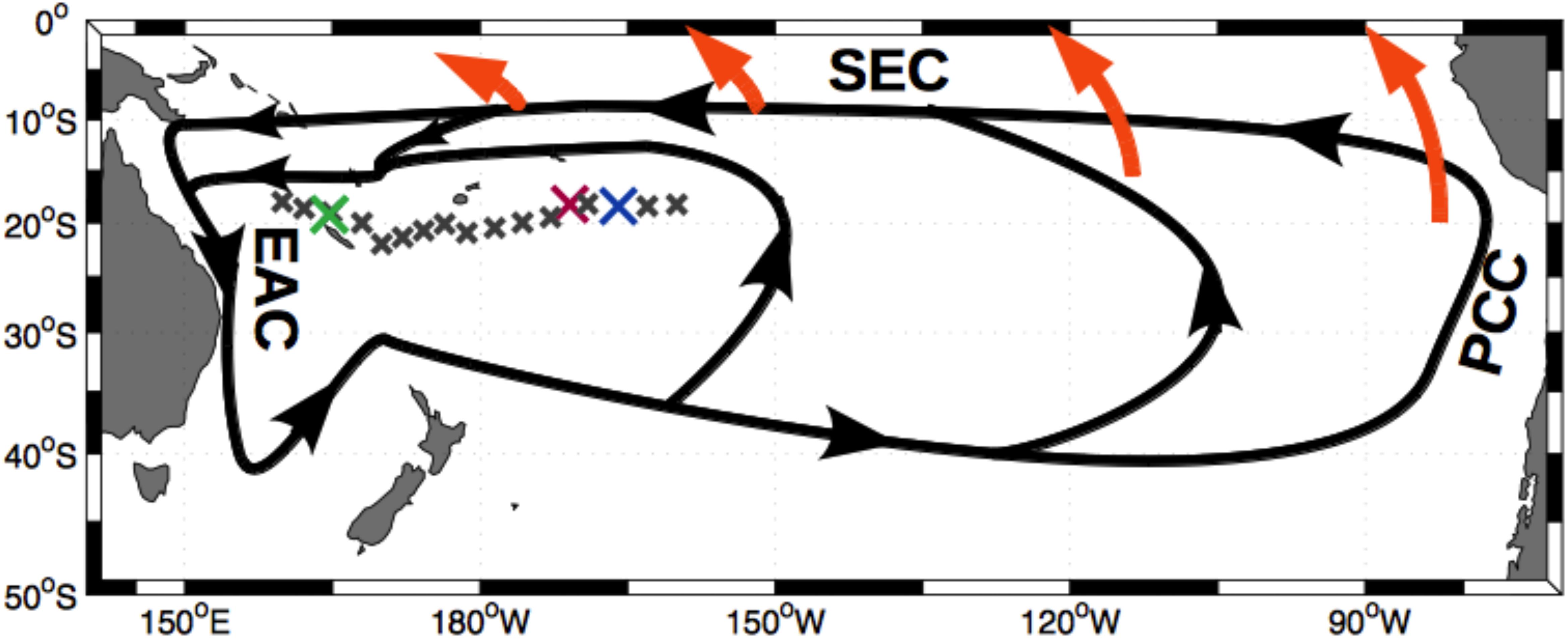
CLS
COLLECTE LOCALISATION SATELLITES

Characterization of the mesoscale circulation during the OUTPACE cruise (Southwest Pacific)

L. Rousselet[1], A. DeVerneil[1], A.M. Doglioli[1], A.A. Petrenko[1], C. Maes[2], B. Blanke[2].

[1]Aix Marseille Université, Université de Toulon, CNRS, IRD, Mediterranean Institute of Oceanography, Marseille, France
[2]Laboratoire d'Océanographie Physique et Spatiale, CNRS, Ifremer, IRD, UBO, Brest, France

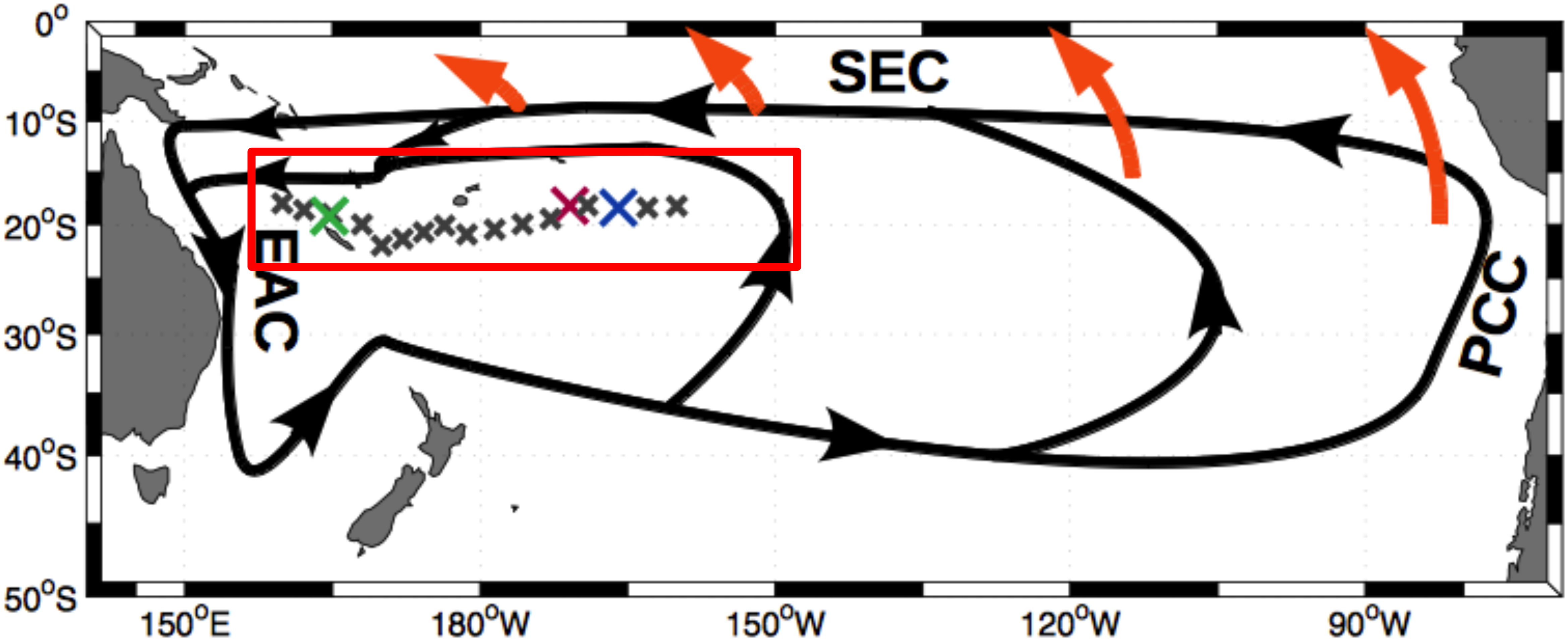
Large scale circulation in the SP Ocean



Inspired from Tomczak and Godfrey (2013)

Short Duration stations (SD)
Long Duration stations (LD)
Trade winds

Large scale circulation in the SP Ocean



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Short Duration stations (SD)
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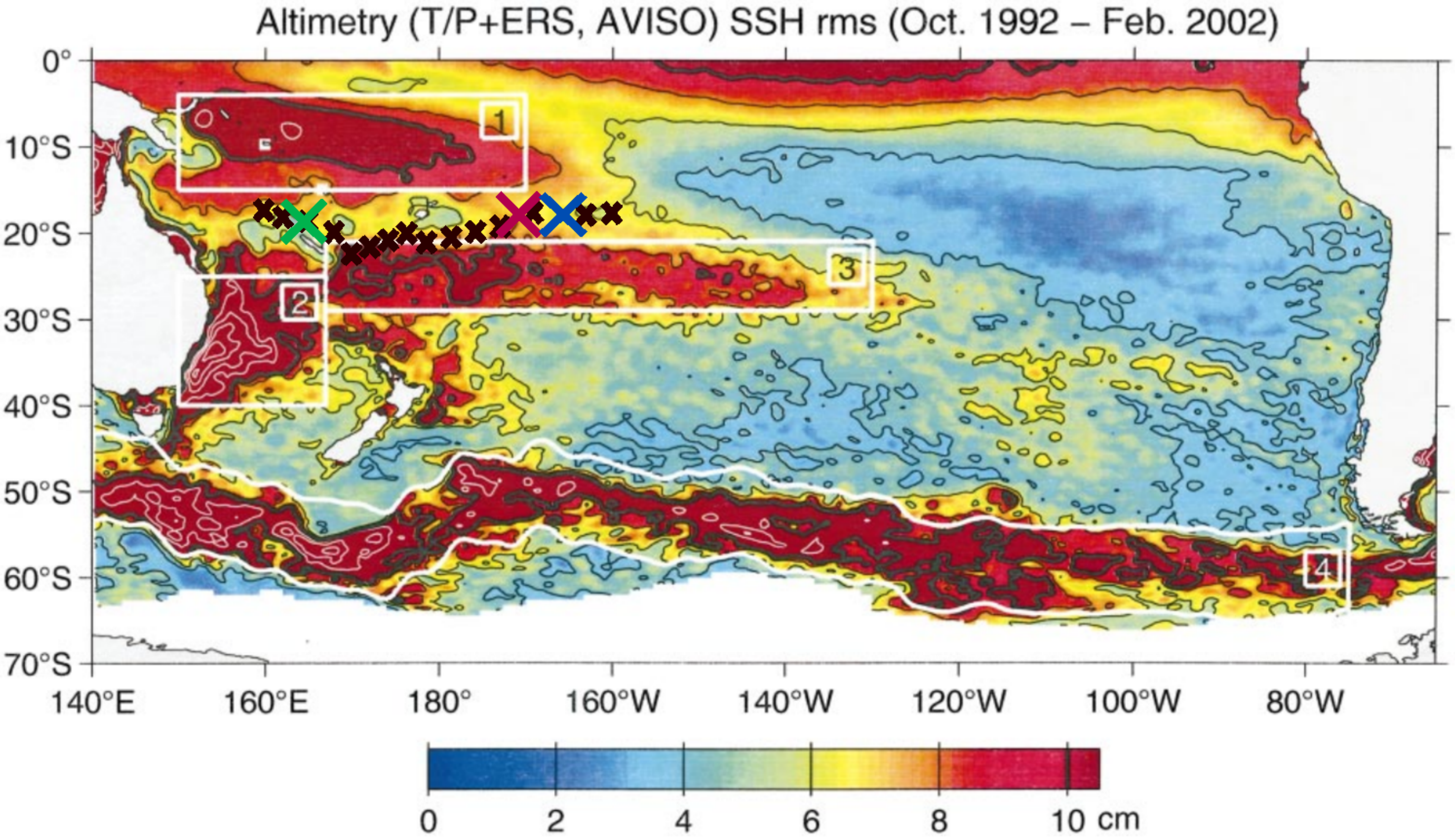
Trade winds

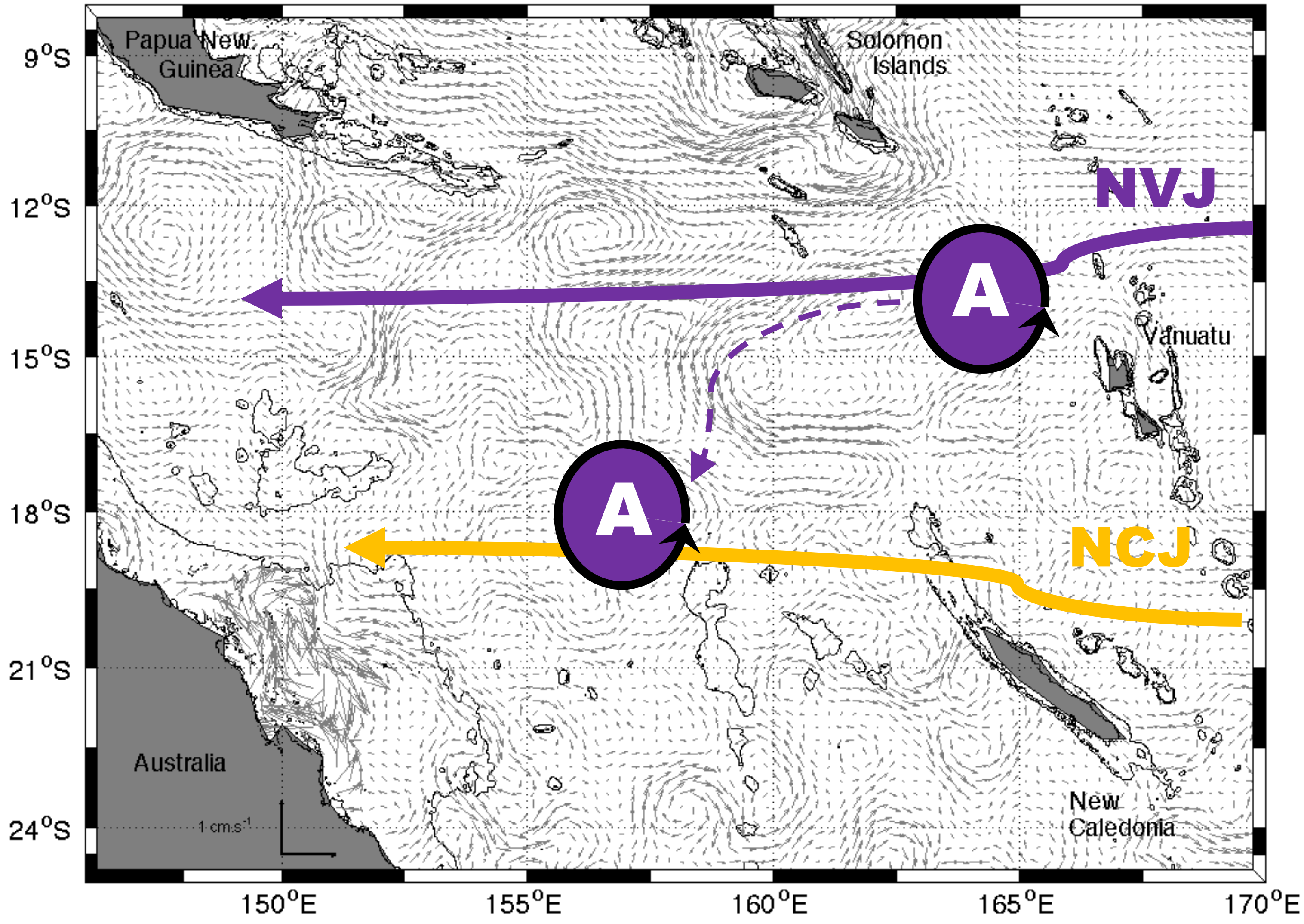
OUTPACE domain

SP Ocean : 4 regions of high variability



Modified from Qiu & Chen, JPO (2004)

Ex. of mesoscale activity impacts in the Coral Sea

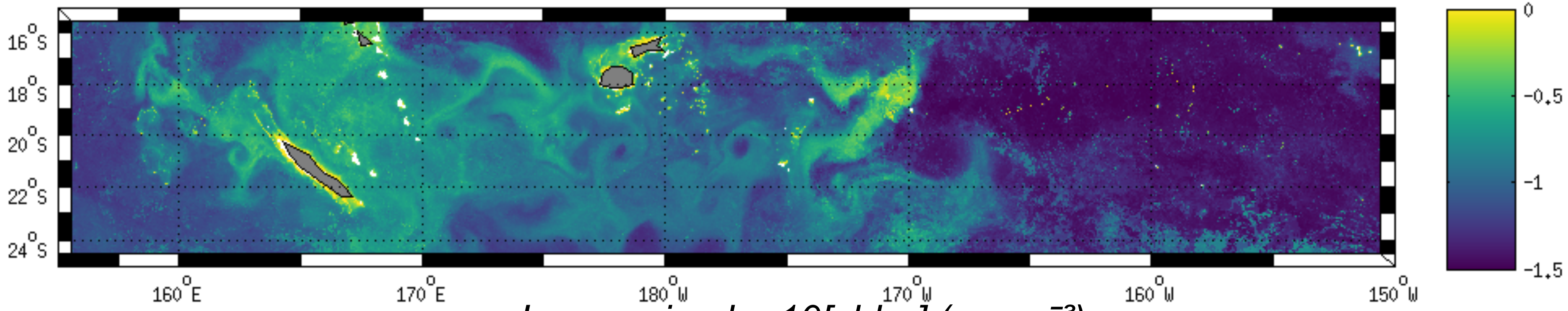


Water mass transport through mesoscale circulation [Rousselet et al., JGR, 2016]

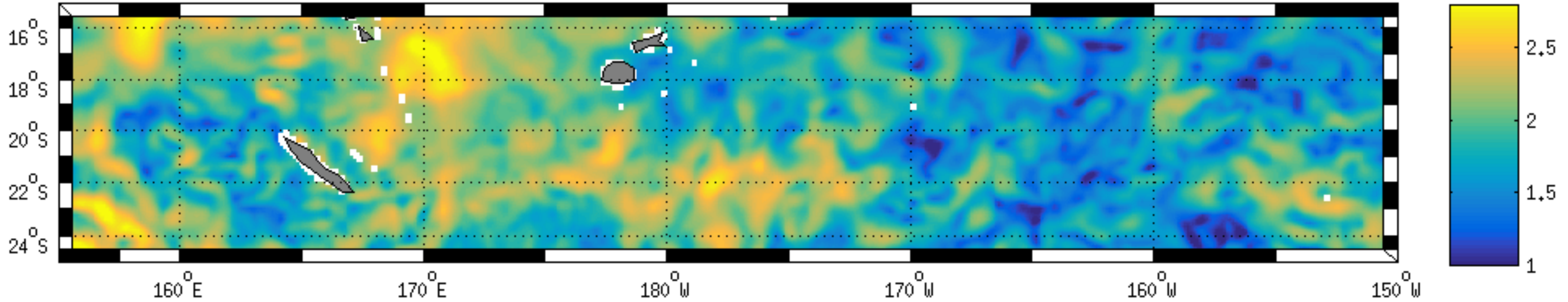
Mesoscale activity and biogeochemistry

Interest : The **biogeochemical budgets** can be strongly **affected** by **horizontal dynamics** at mesoscale (~10-100 km) and submesoscale (1-10 km).

Oligotrophic Ultra-oligotrophic



Lagrangian log10[chl-a] (mg m^{-3})



Mean Log10[EKE] (cm s^{-1})

Data & Methods

In-situ data : SADCP, MVP, SVP
Altimetry : daily 2D horizontal maps of velocity field

Geostrophy :

Coriolis effect = pressure gradient force

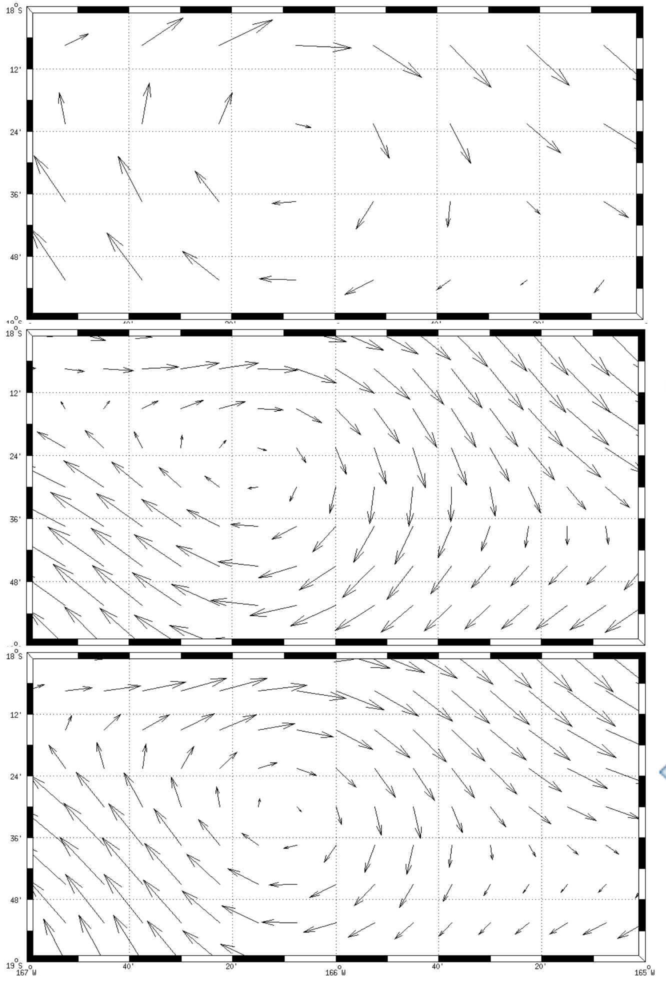
+

Ekman component

Low Resolution
(AVISO, ¼°)
LR

High Resolution
(CNES, $^1/_8$°)
HR
Provided by CLS

High resolution + Ekman
(CNES, $^1/_8$°)
HRek
Provided by CLS



+ΔResolution

+ wind effect

Which one will best represent mesoscale context during OUTPACE cruise ?

Validation of altimetric product : Case study LDC

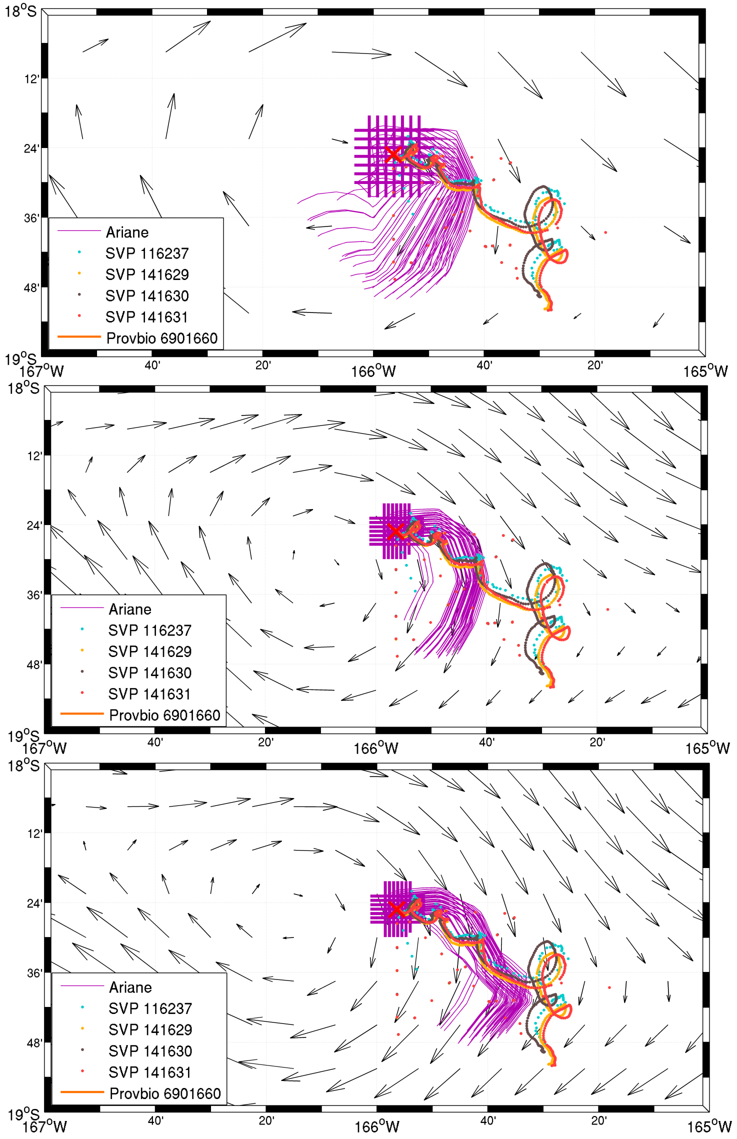
LR

HR

Provided by CLS

HRek

Provided by CLS



Numerical trajectories

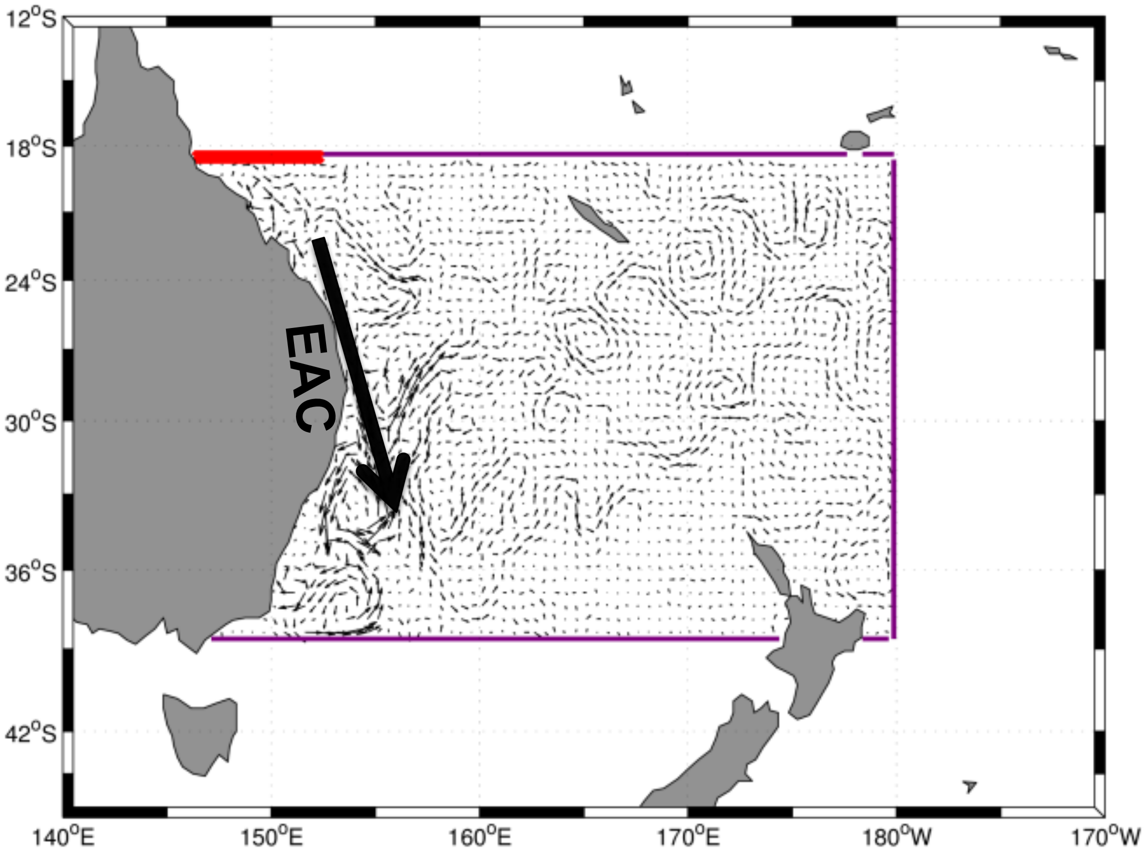
Observed trajectories (in situ)

The addition of Ekman component qualitatively change particle trajectories

Data & Methods : Lagrangian particle advection

Ariane : Lagrangian diagnostic tool → tracing water mass movements in the altimetric velocity field [Blanke and Raynaud, 1997 ; Blanke et al., 1999]

→ track origins (backward) and fate (forward) of water masses



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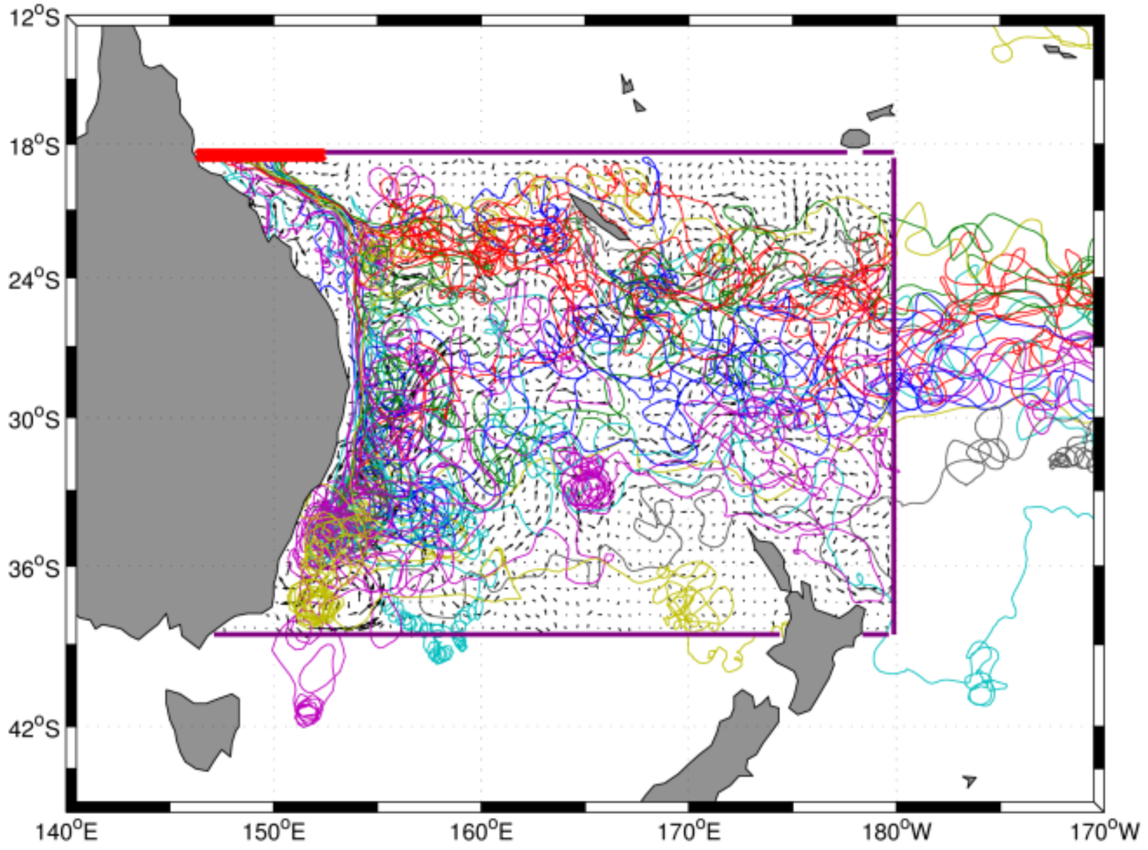
⟶ track origins (backward) and fate (forward) of water masses
⟶ **Details of particle trajectories** (qualitative)



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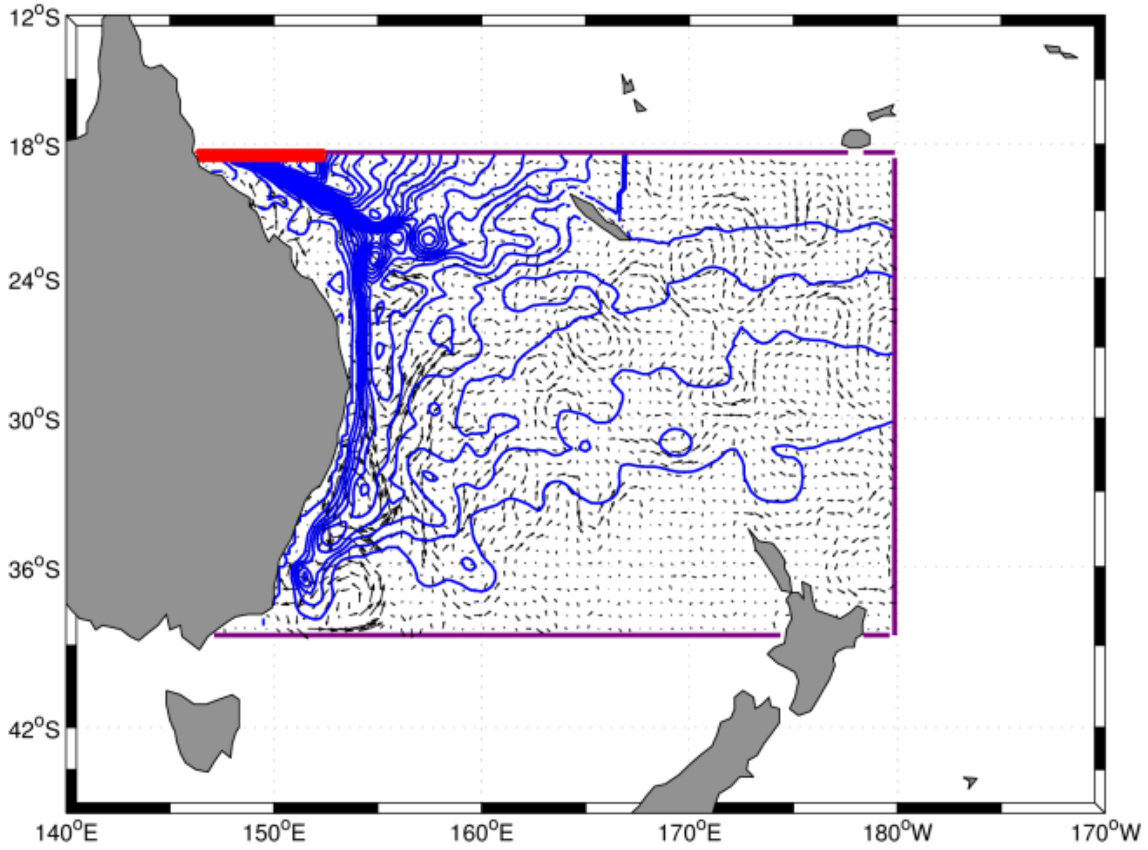
→ **2D streamlines of the flow** (quantitative)



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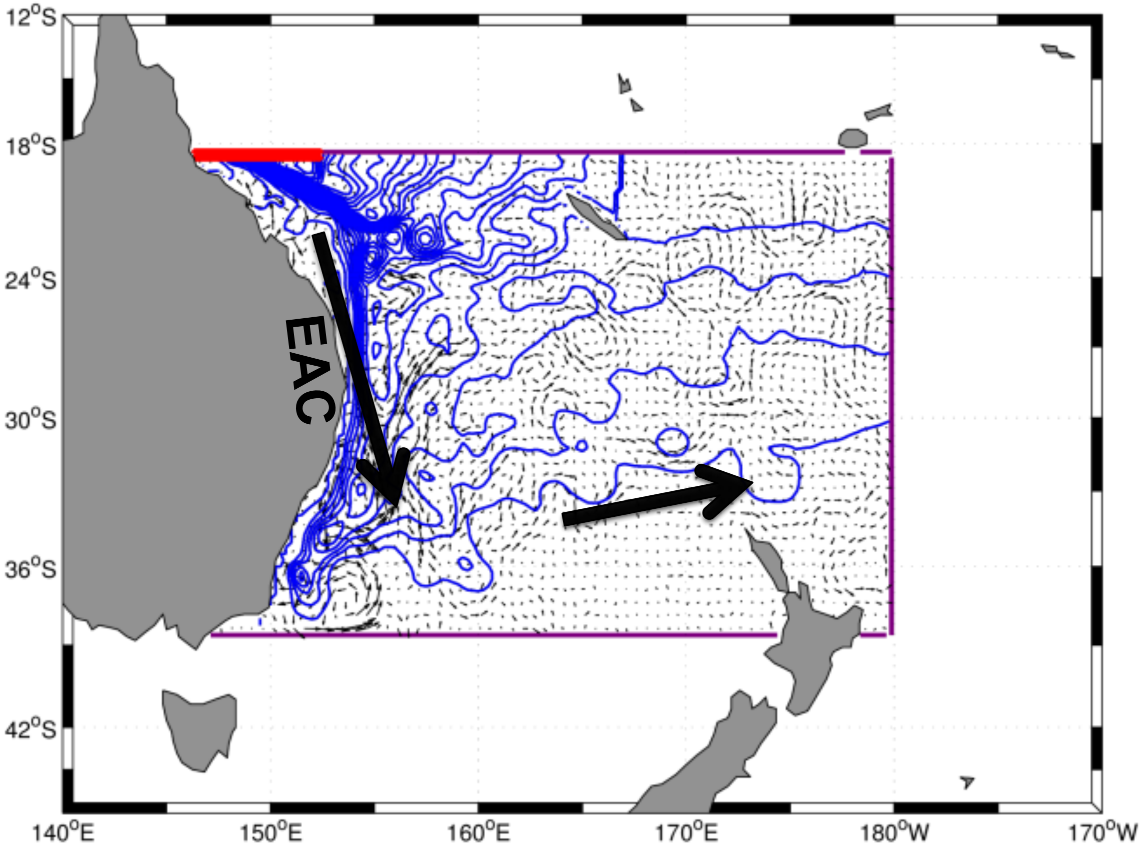


What do we learn about LDC ?

FATE:

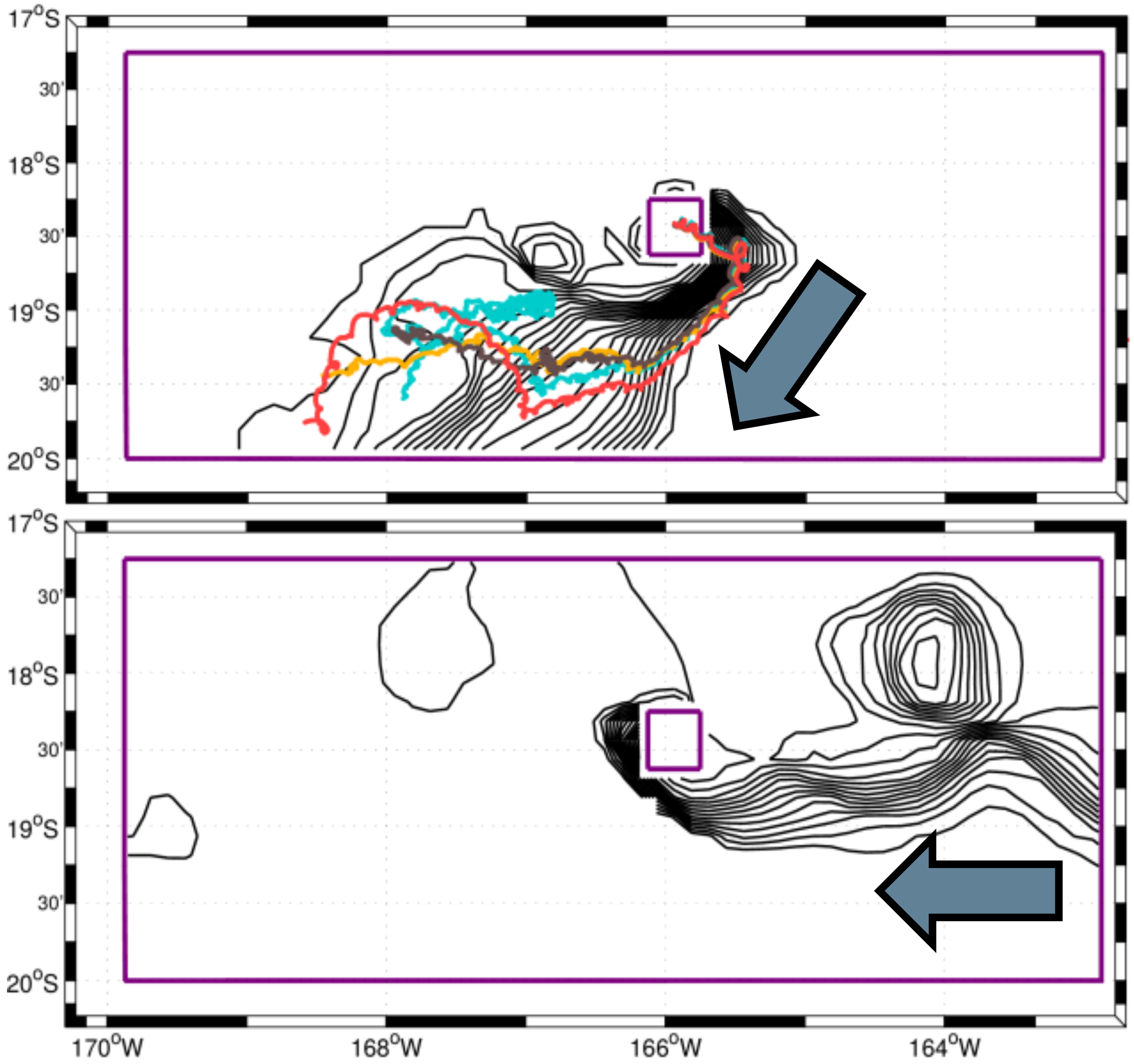
→ south-westward

→ agreement with SVP

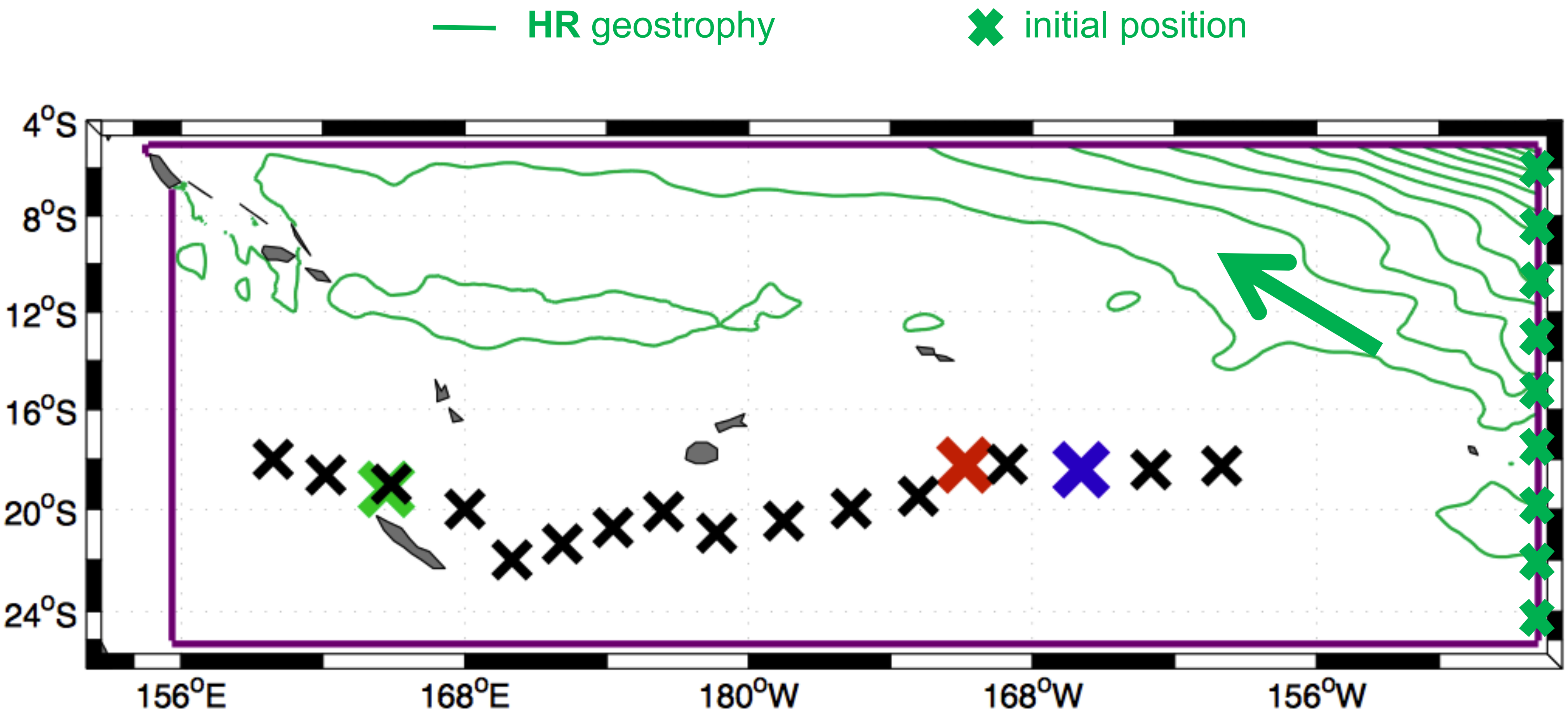
ORIGINS:

→ south and west

→ westward propagation probably within eddies



At large scale : effect of the wind ?



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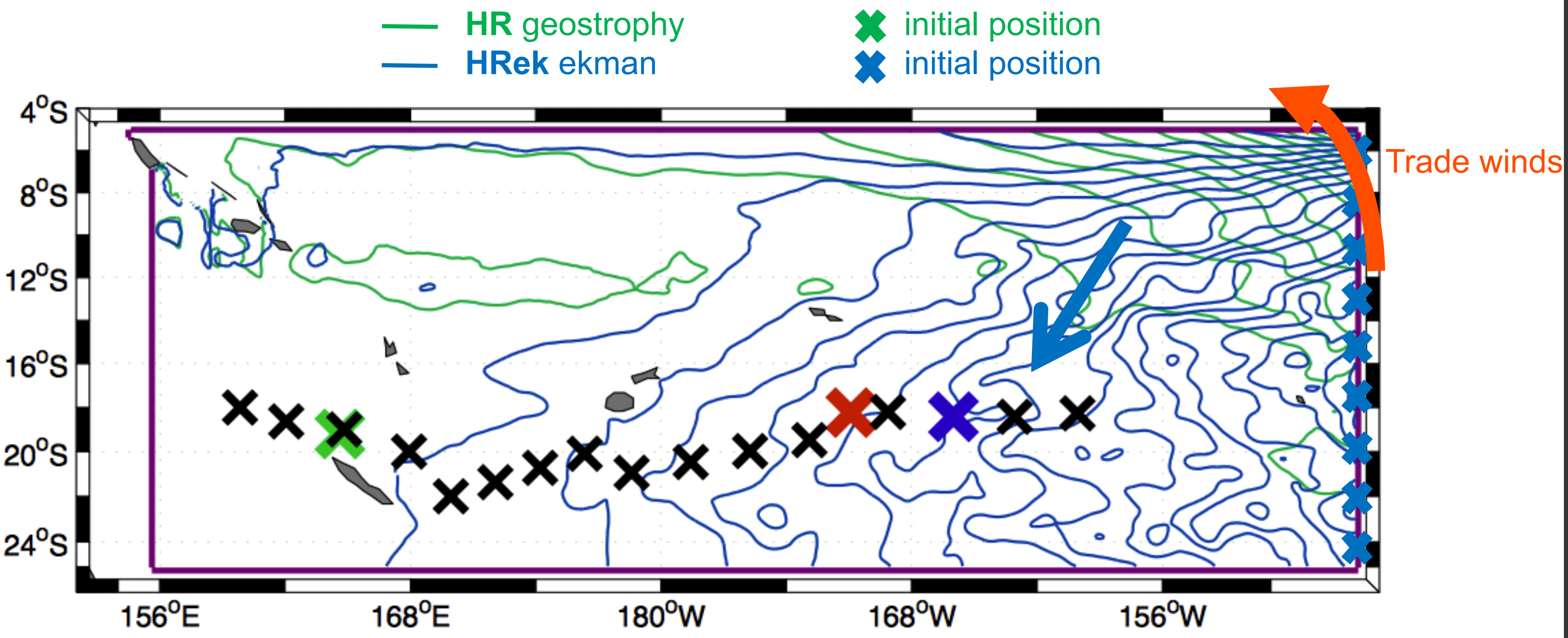
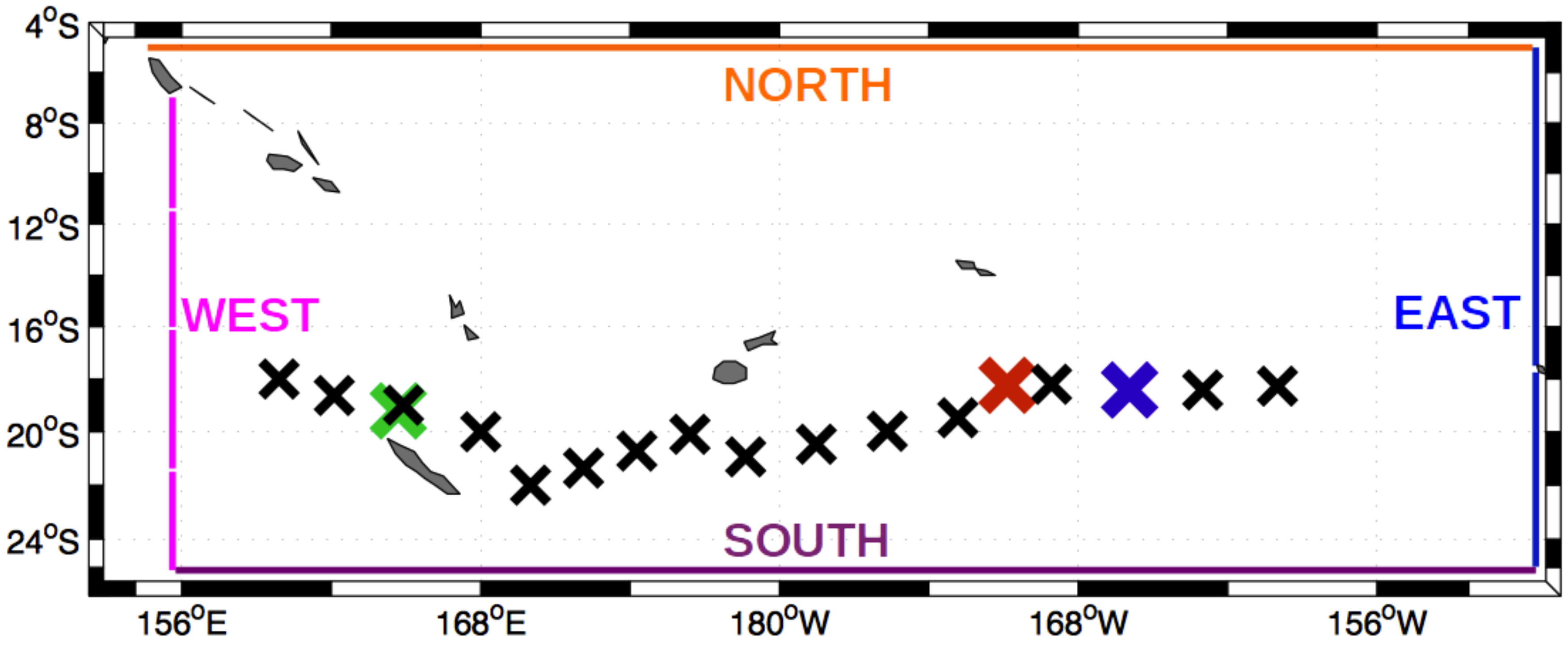


- south-westward instead of north-westward propagation
- consistent with left deviation from trade winds in HS
- **change water masses path**

Where do surface water masses come from during OUTPACE ?



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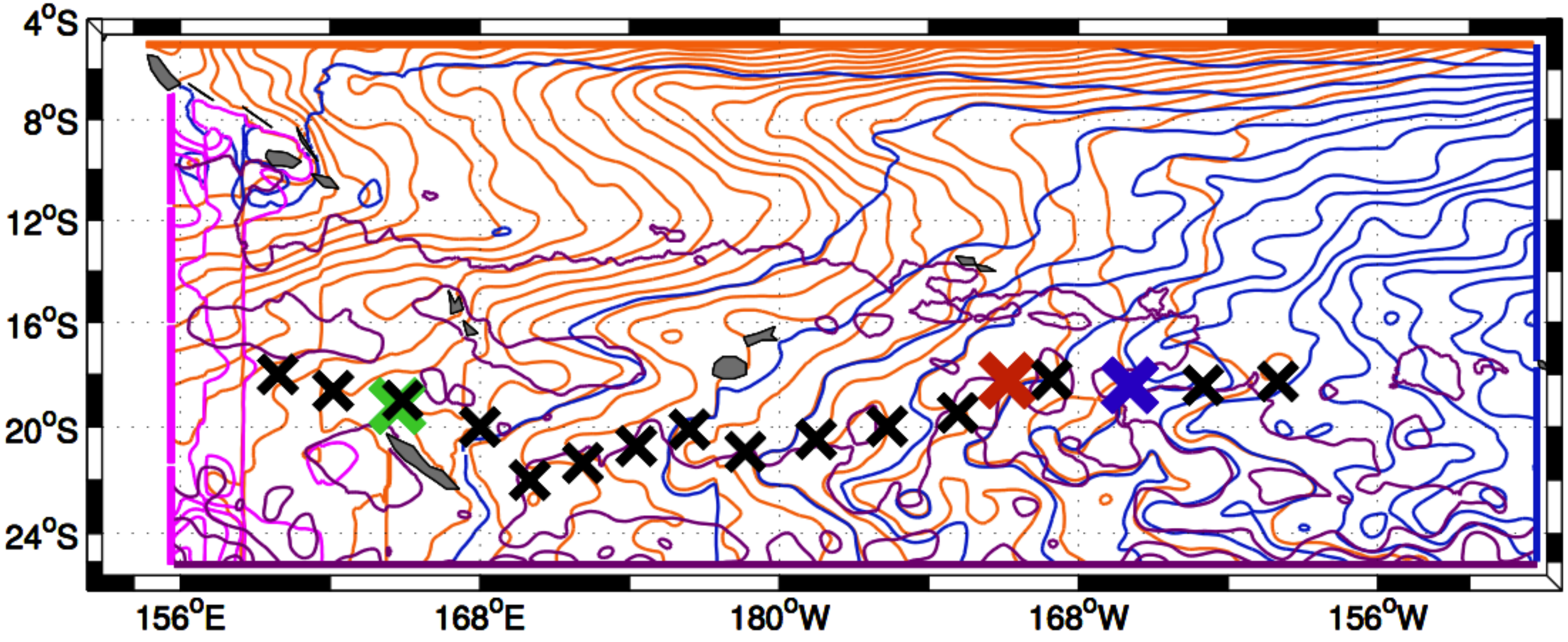

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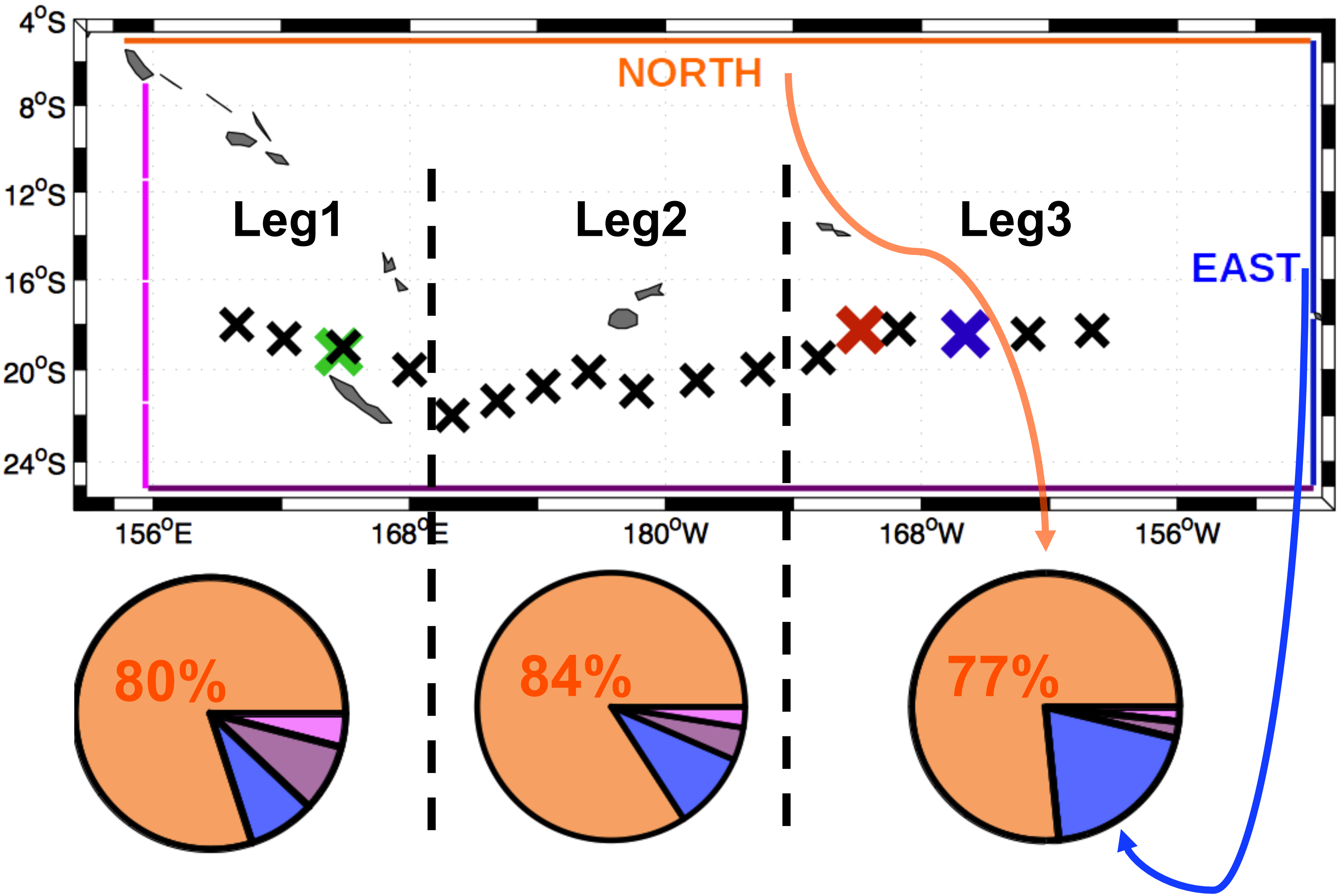

Smaller scale differences : see A. DeVerneil's talk Thursday at 12:00

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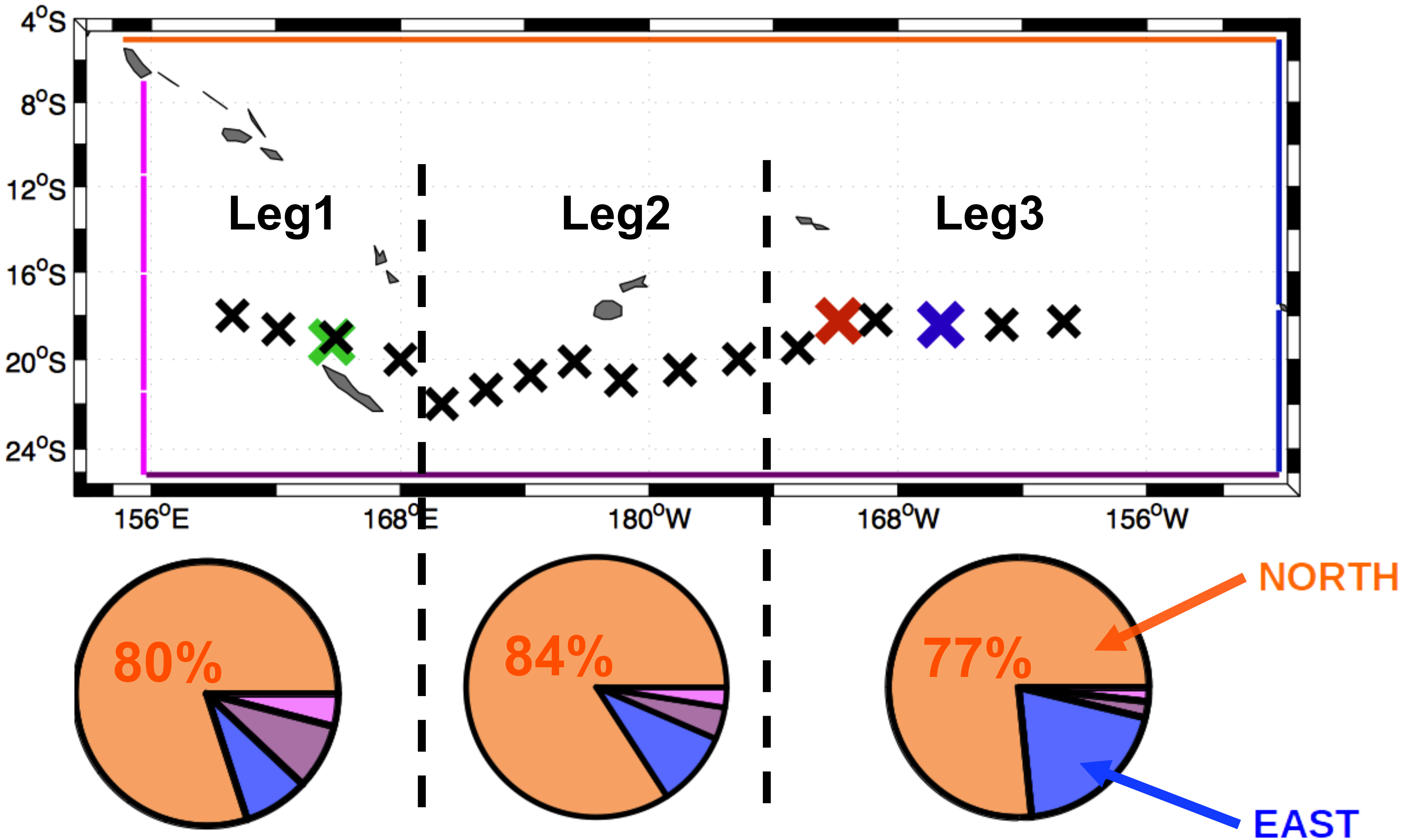

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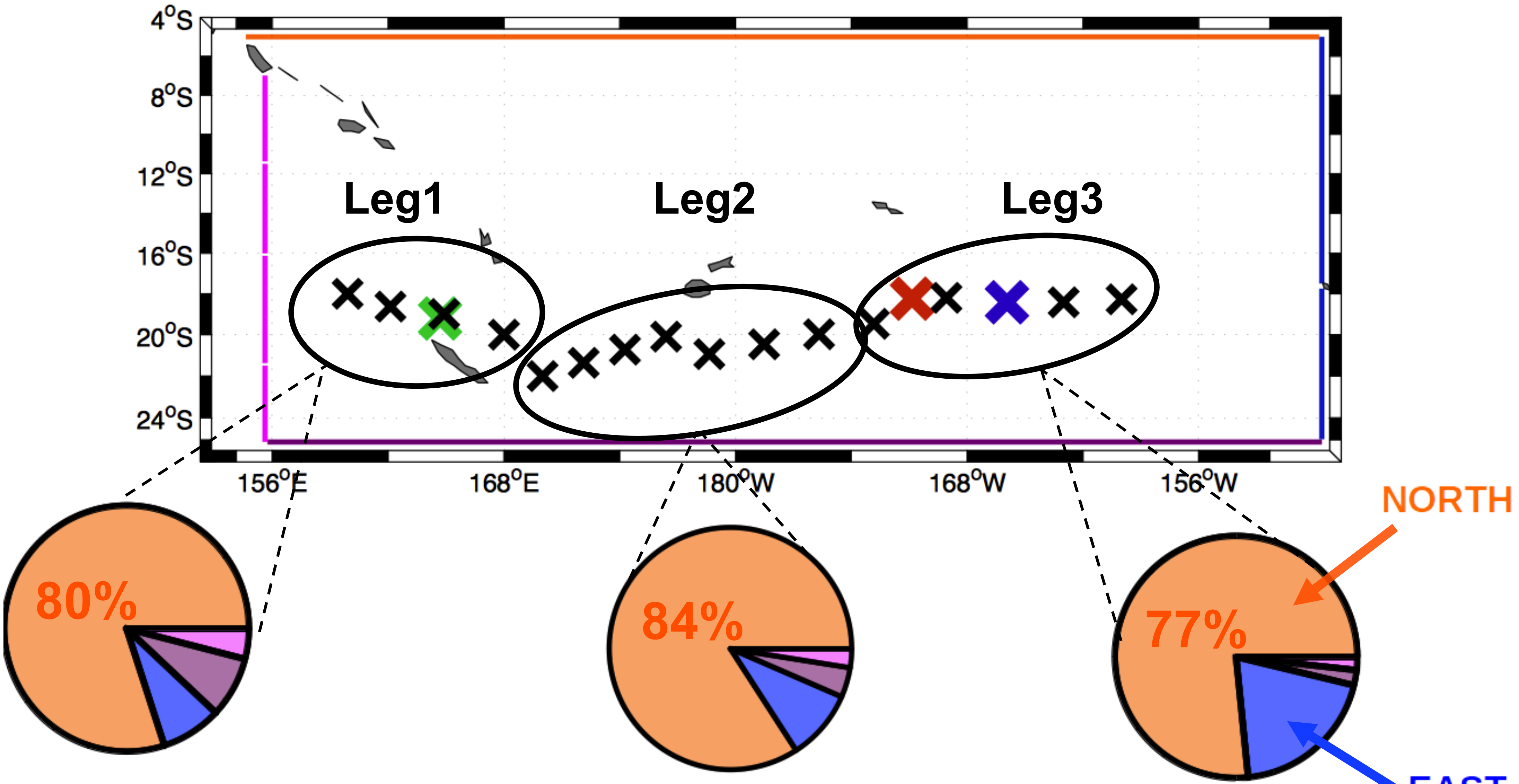

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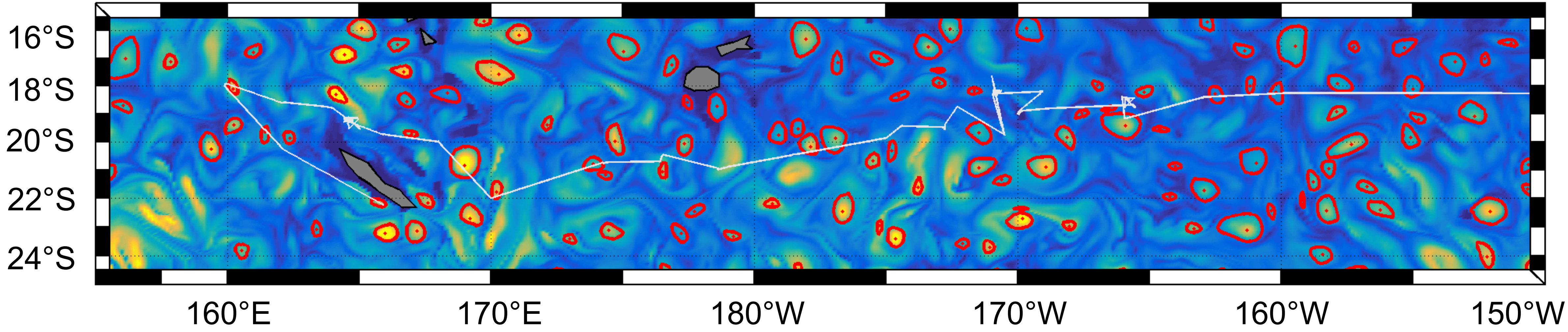
To go further ...

Lagrangian-Averaged Vorticity deviation method [Haller et al., 2015]
⟶ detect coherent structure center and contour



Vorticity on the 19th February 2015

- Lots of coherent structures that might transport water masses
- global westward propagation dominates, except in the band 180°W – 170°W

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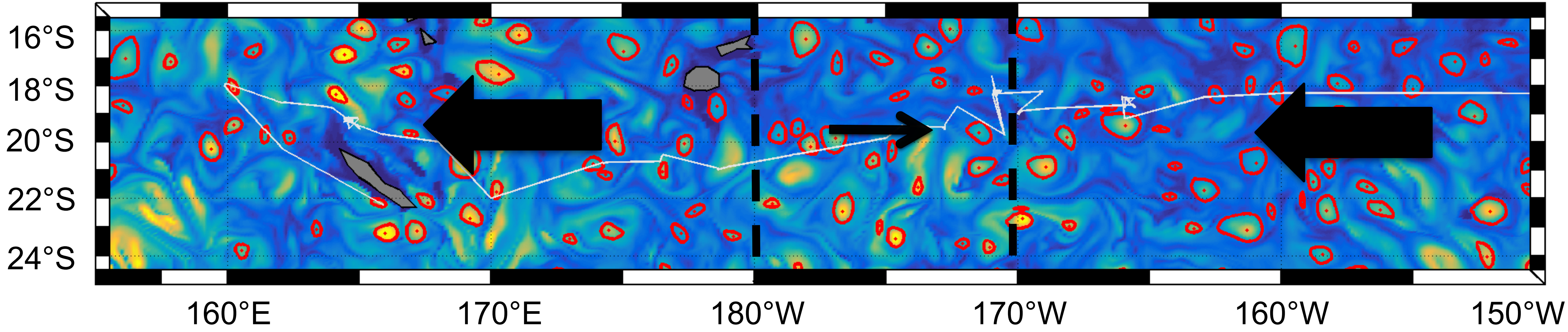


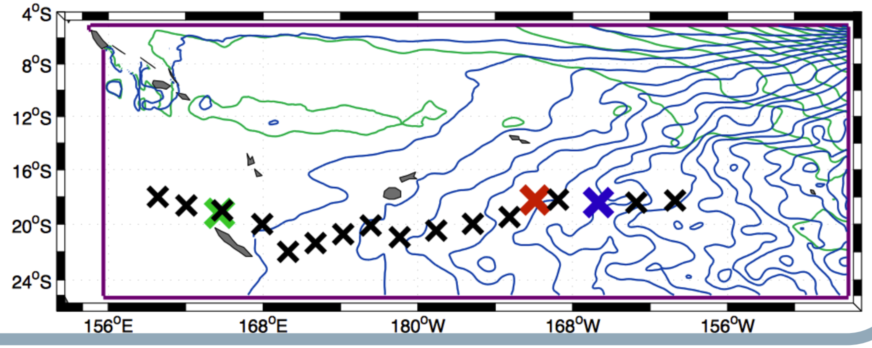
Vorticity on the 19th February 2015

- Lots of coherent structures that might transport water masses
- global westward propagation dominates, except in the band 180°W – 170°W

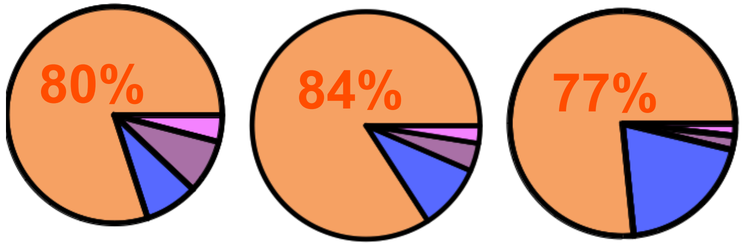
⇨ These structures may be responsible of the transport of water masses and strongly influenced the biological variability

Conclusions

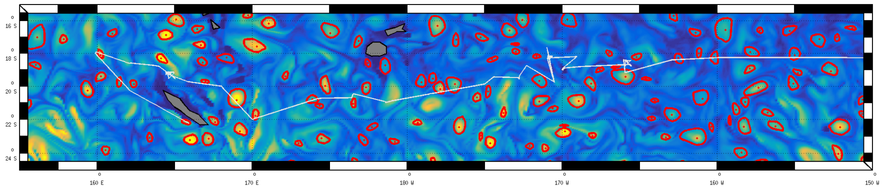
- Effect of the wind qualitatively change water masses trajectories at the surface



- Small differences in surface water mass origins with a major influence of equatorial (Northern) water masses (~80%)



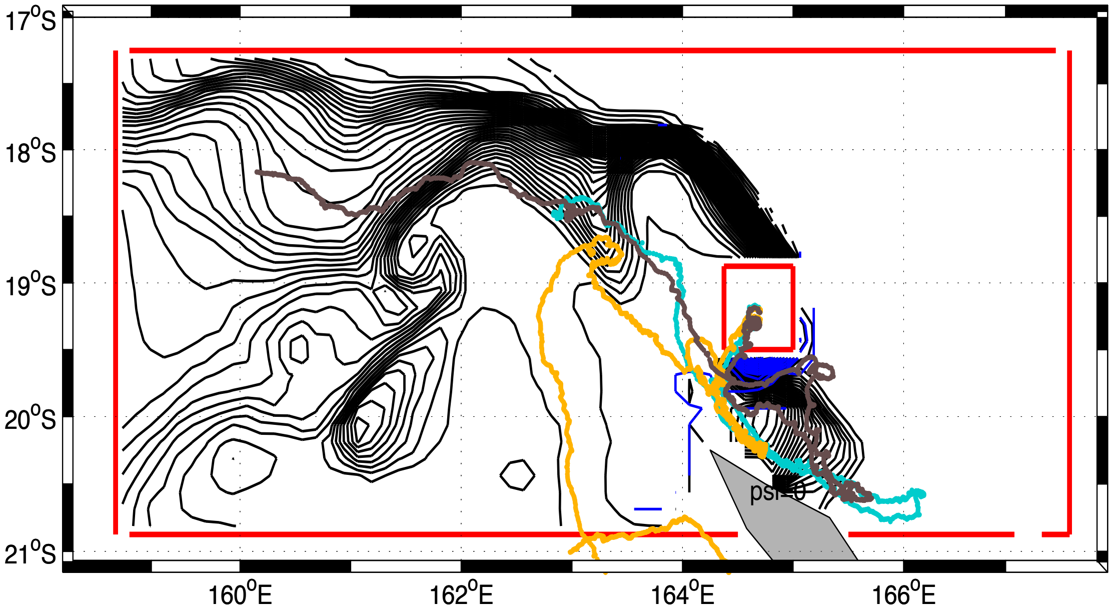
- Lots of coherent structure that can transport water masses westward but also eastward in the band 180-170°W



- **Differences of surface water masses will be mostly due to mesoscale activity and circulation**

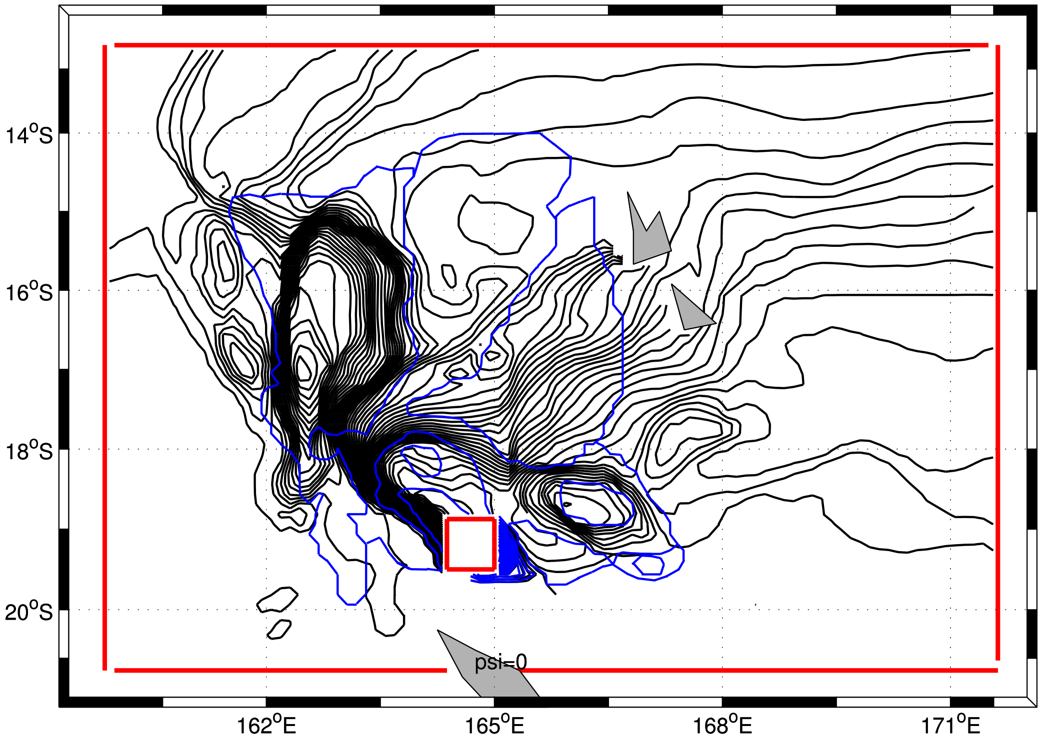
EXTRA SLIDES

Fates and Origins LDA

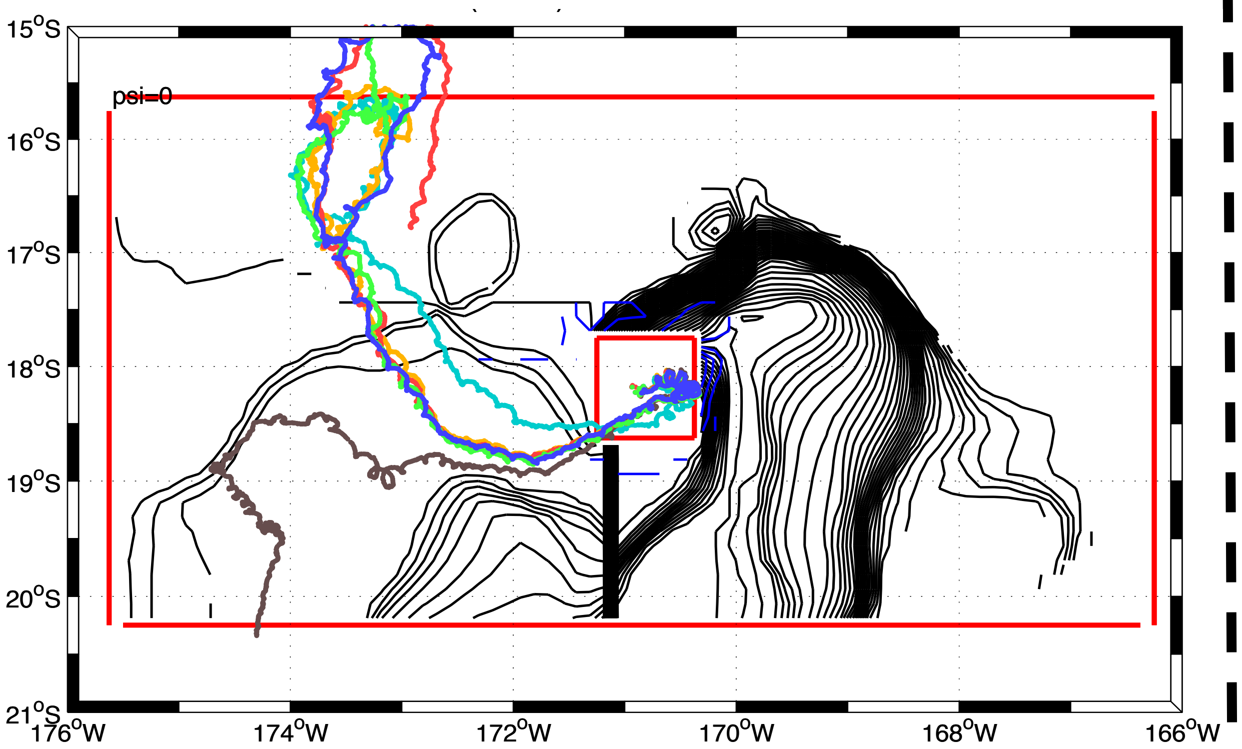


Fates

Origins



Fates and Origins LDB



Fates

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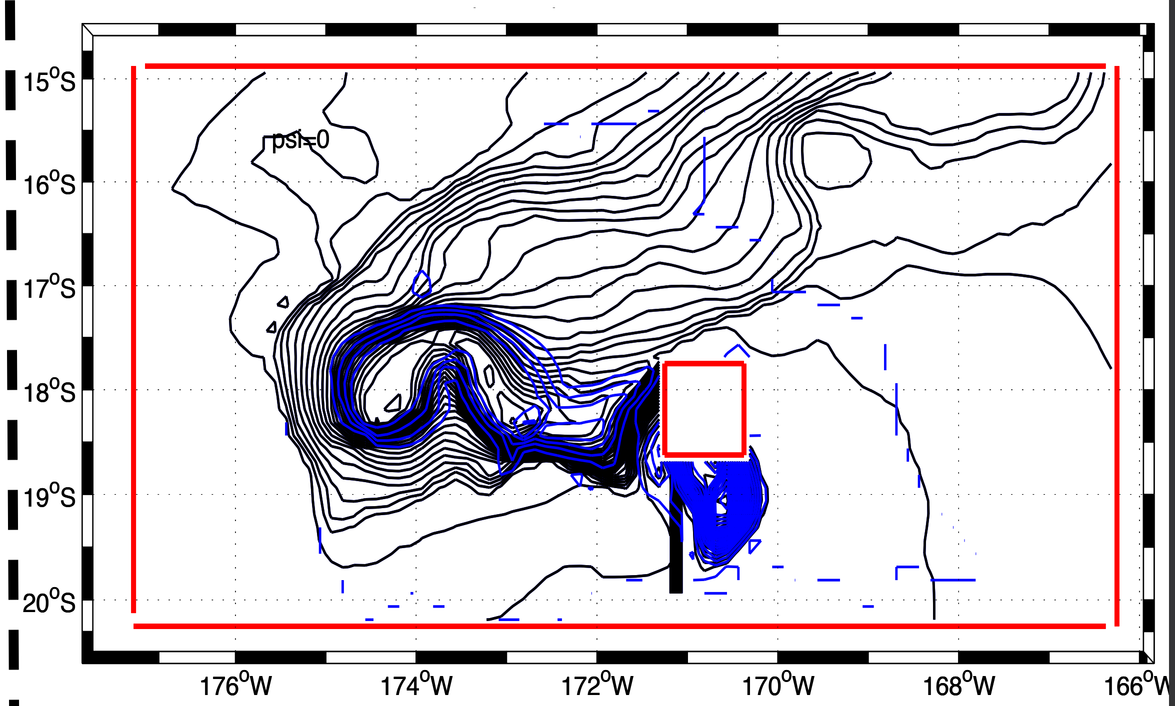
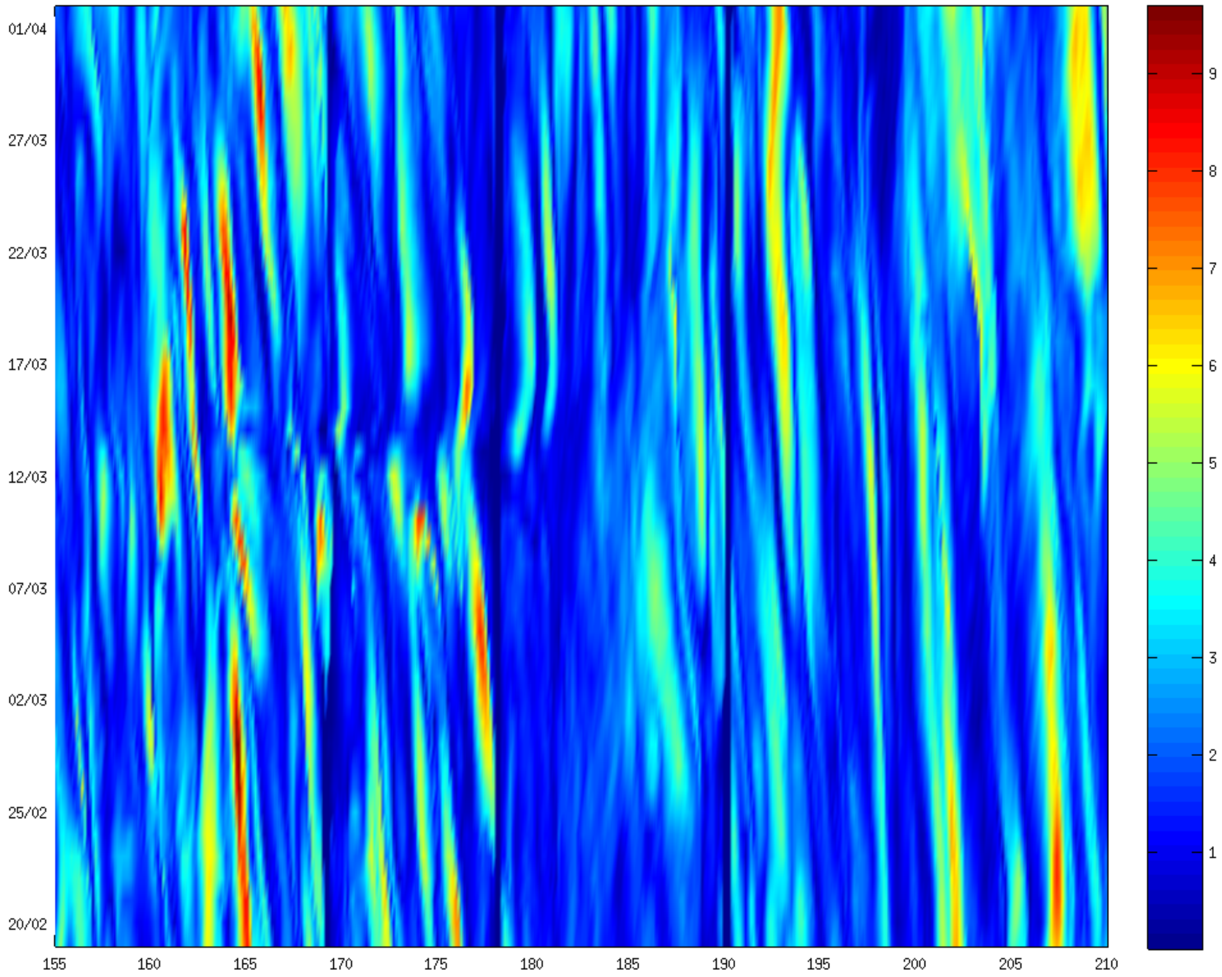


Hovmuller of vorticity



Hovmuller of the vorticity at 19°S during OUTPACE (19 Feb-02 Apr 2015)