SOLWARA

Alimentation des eaux équatoriales par la Mer des Salomon: impacts climatiques et bio-géochimiques

Alexandre Ganachaud, Institut de Recherche pour le Dévelopement, LEGOS, Nouméa

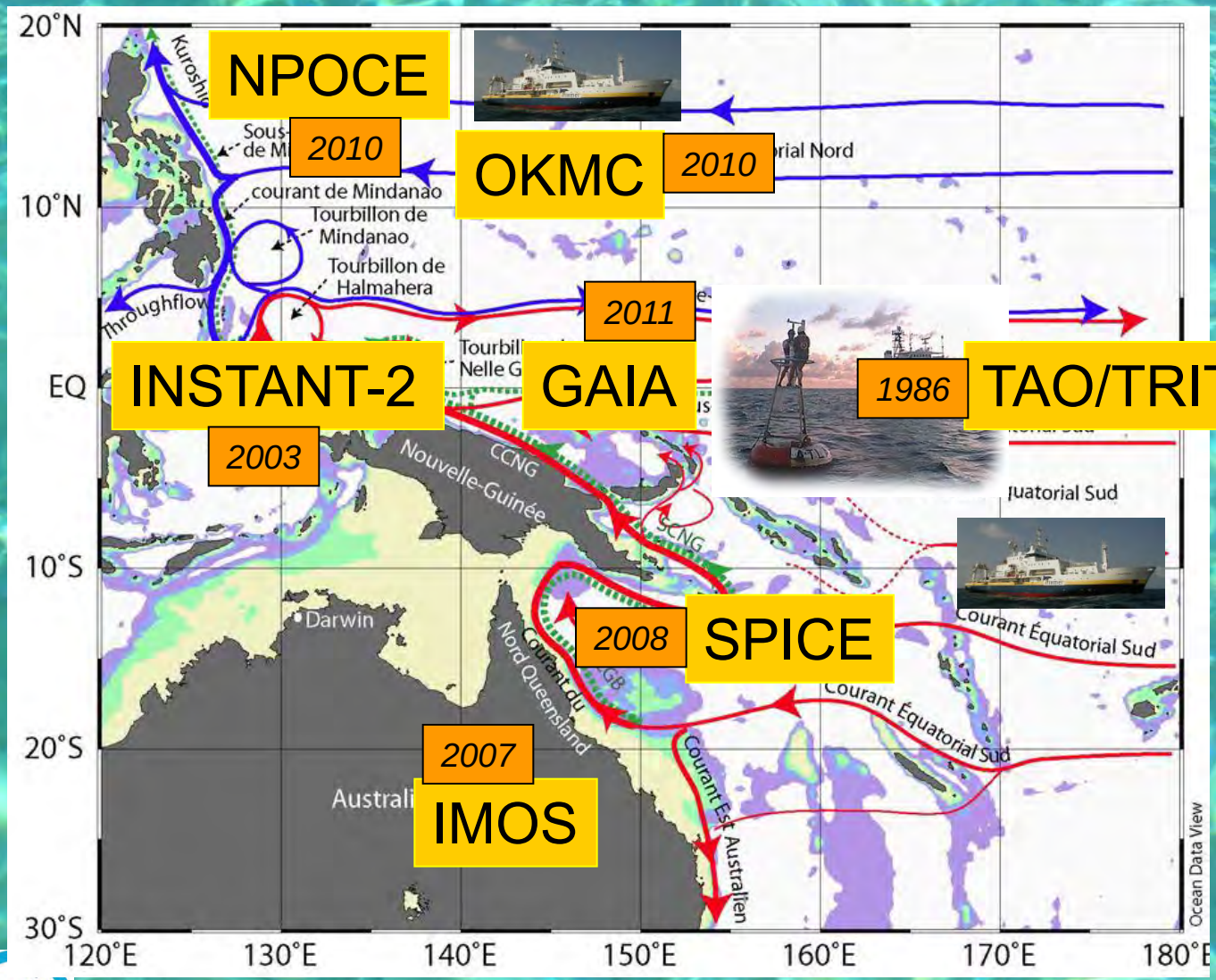
SOLWARA PIs and costs

Alexandre Ganachaud, IRD/LEGOS
Sophie Cravatte, IRD/LEGOS
Catherine Jeandel, CNRS/LEGOS
Jacques Verron, CNRS/LEGI

International collaboration:
J. Sprintall, SIO, USA
W. Kessler, PMEL, USA
E. Butler, CSIRO, AUS
A. Bowie, UTAS, AUS

ANR: 500ke, 465 jETP (4PhD).
LEFE/INSU: 300ke
Consolidated costs:
- ANR: 4.5Me
- Shiptime 0.5 Me
- Total ~5.3Me

A West Pacific coordination



GEOTRACES Boundary exchanges

CLIVAR Newsletter, 2010
Map: Fieux, 2010

Context:

Southwest PacIfic Ocean Circulation and Climate Experiment (SPICE / CLIVAR)

P.I. A. Ganachaud

17 laboratories

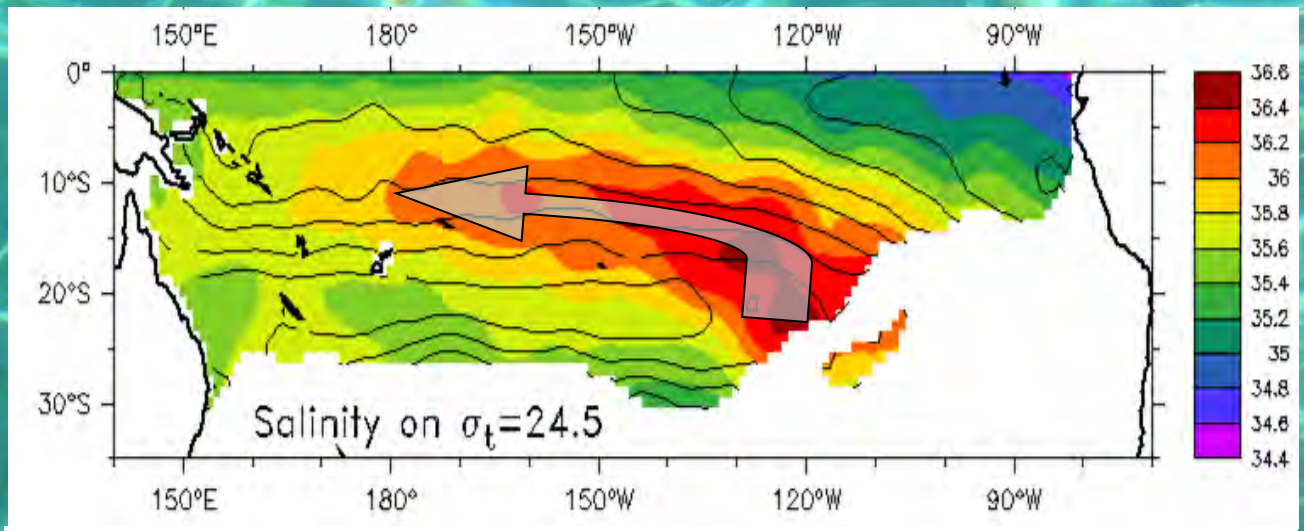
13 institutes

5 countries

www.clivar.org

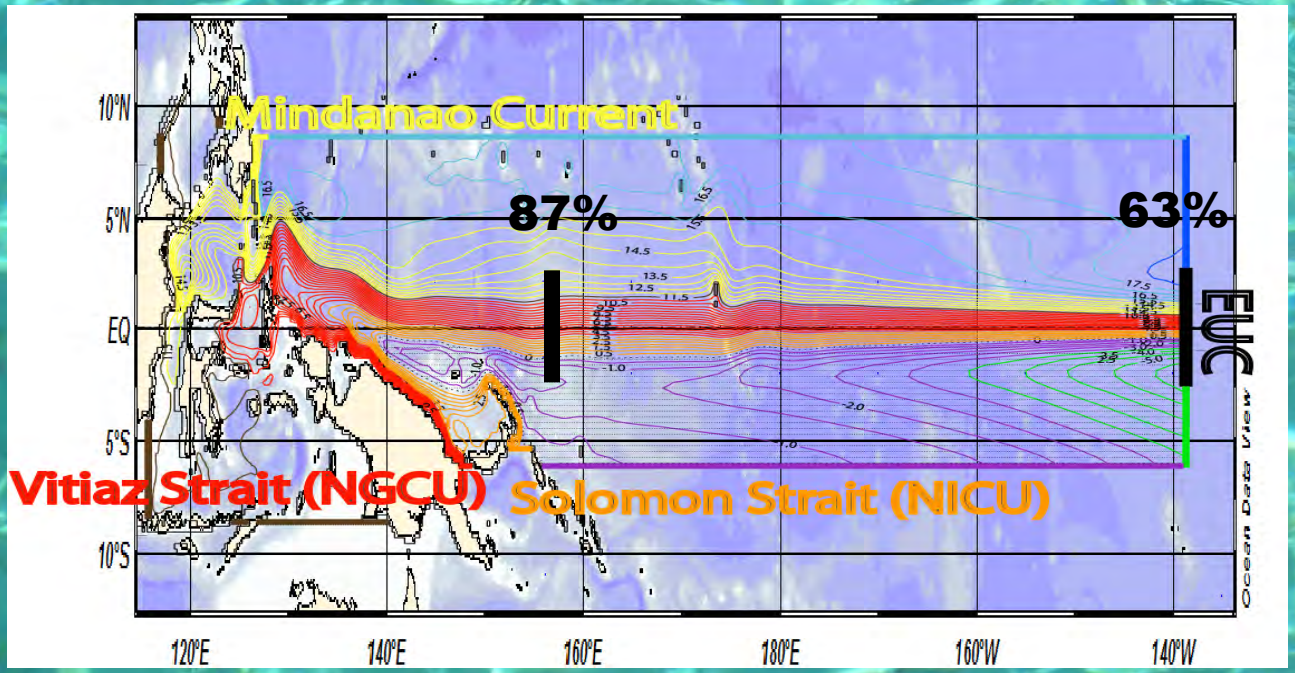
Why SPICE ?

Decadal climate variability
Connection subtropics to equator
and Tasman Sea **through WBCs**



Salinity and geostrophic streamlines on 24.5 (courtesy B. Kessler)

EUC sources

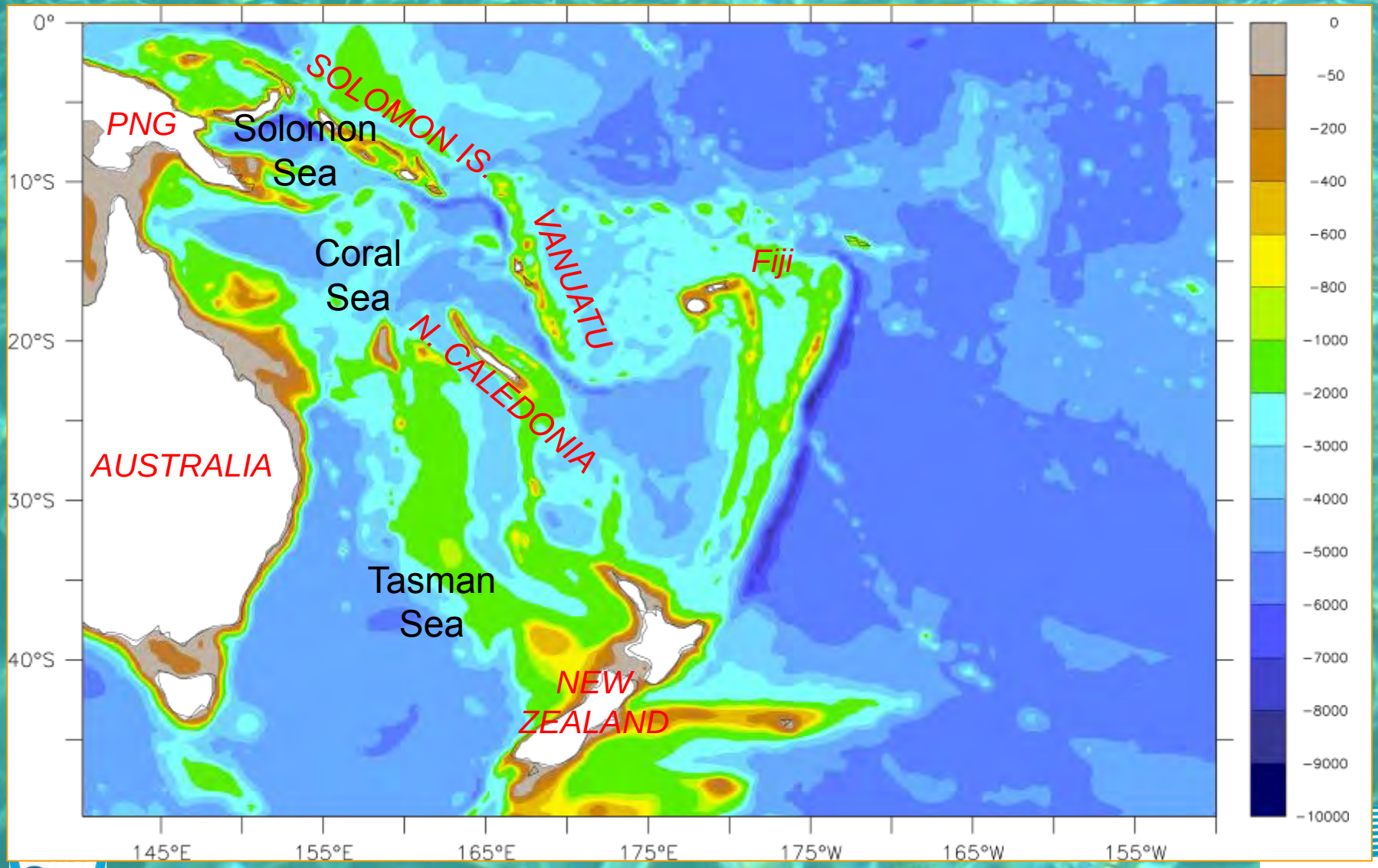


Lagrangian study from a numerical simulation:

- 87% of the EUC water comes from the western boundary currents
- 60% from the Solomon Sea

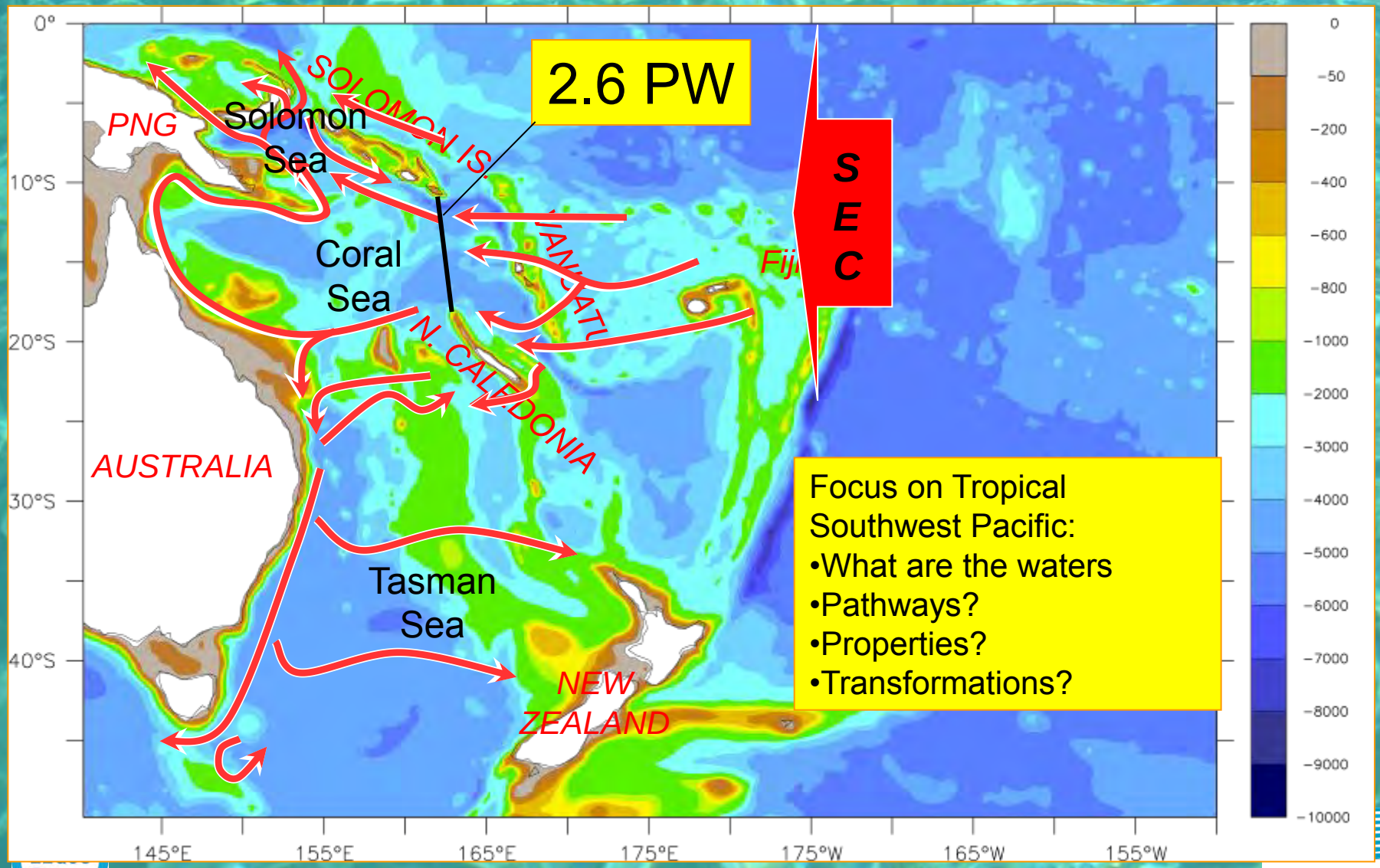
Grenier et al., 2011

Southwest Pacific topography



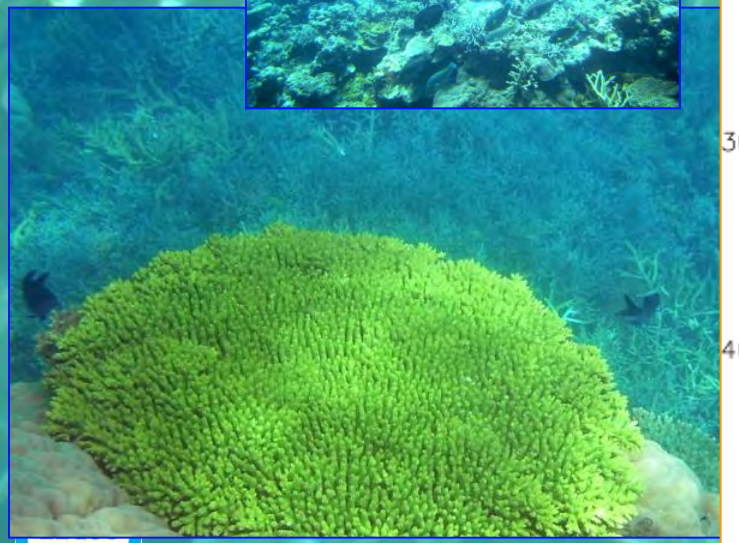
Institut de recherche pour le développement

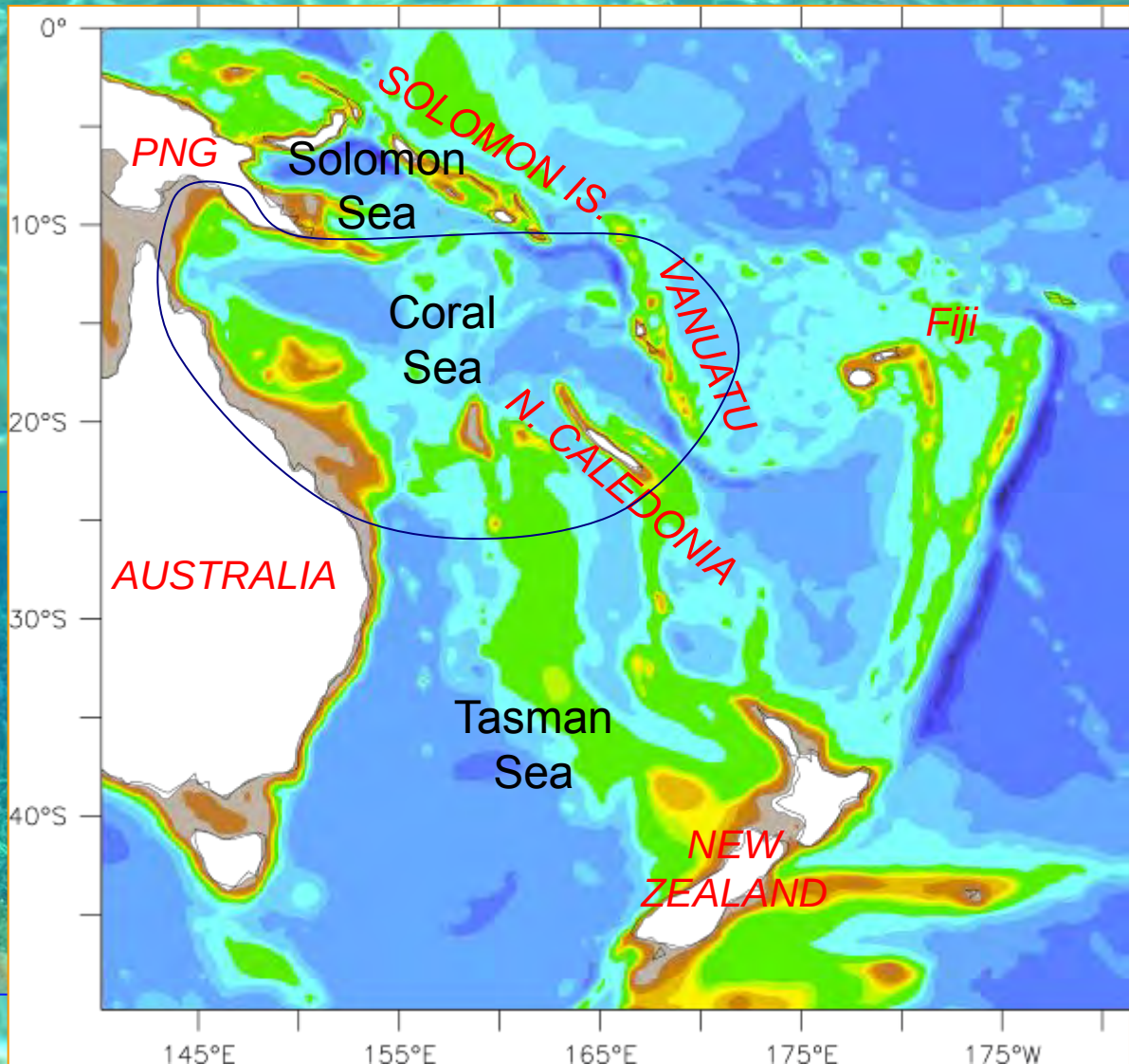
Fate of the incoming warm water



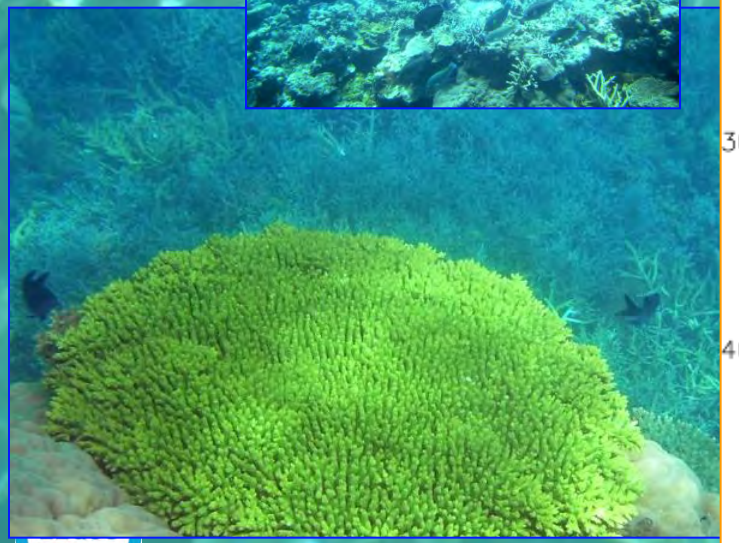
Institut de recherche pour le développement

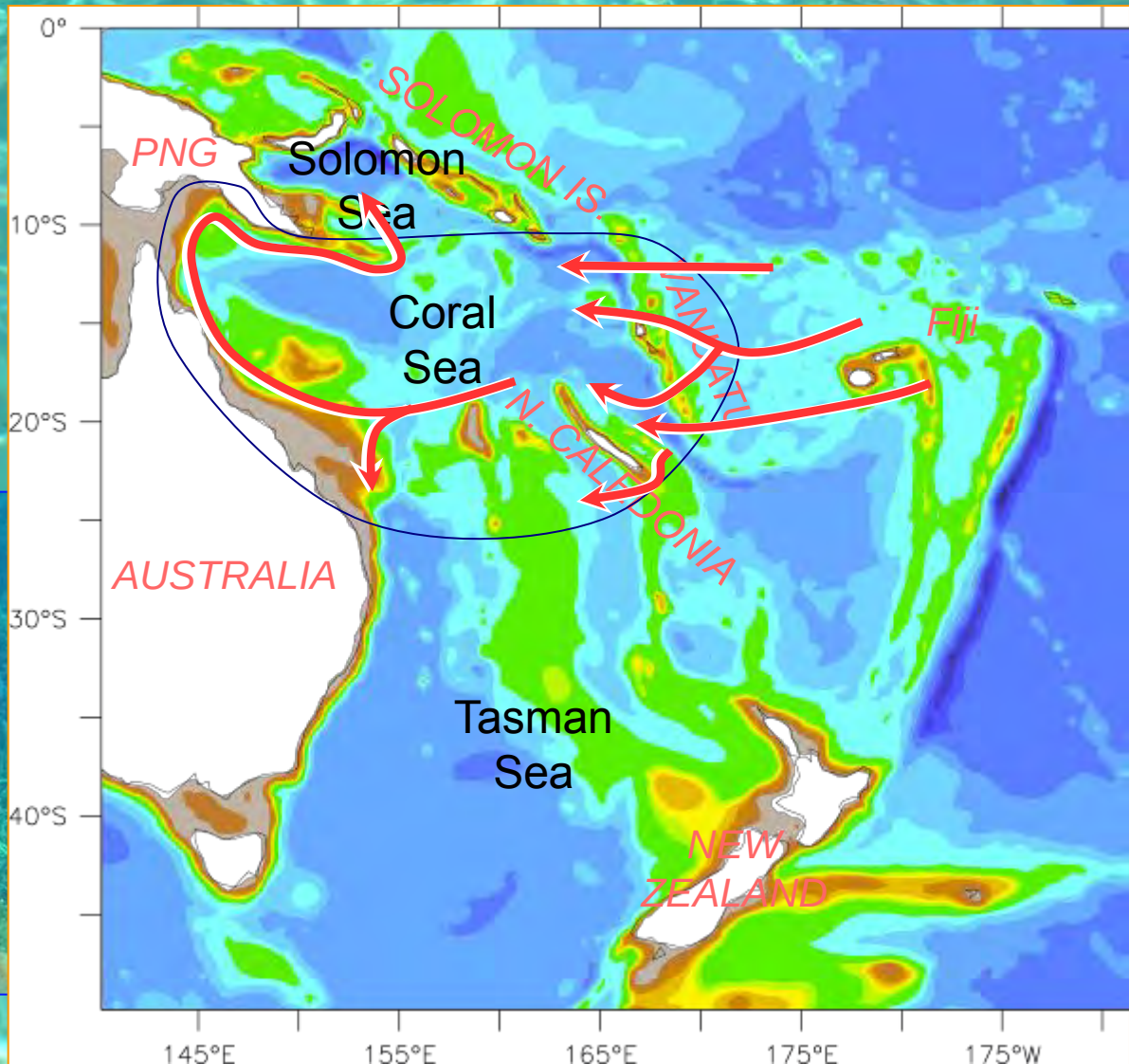
Part I: Coral Sea



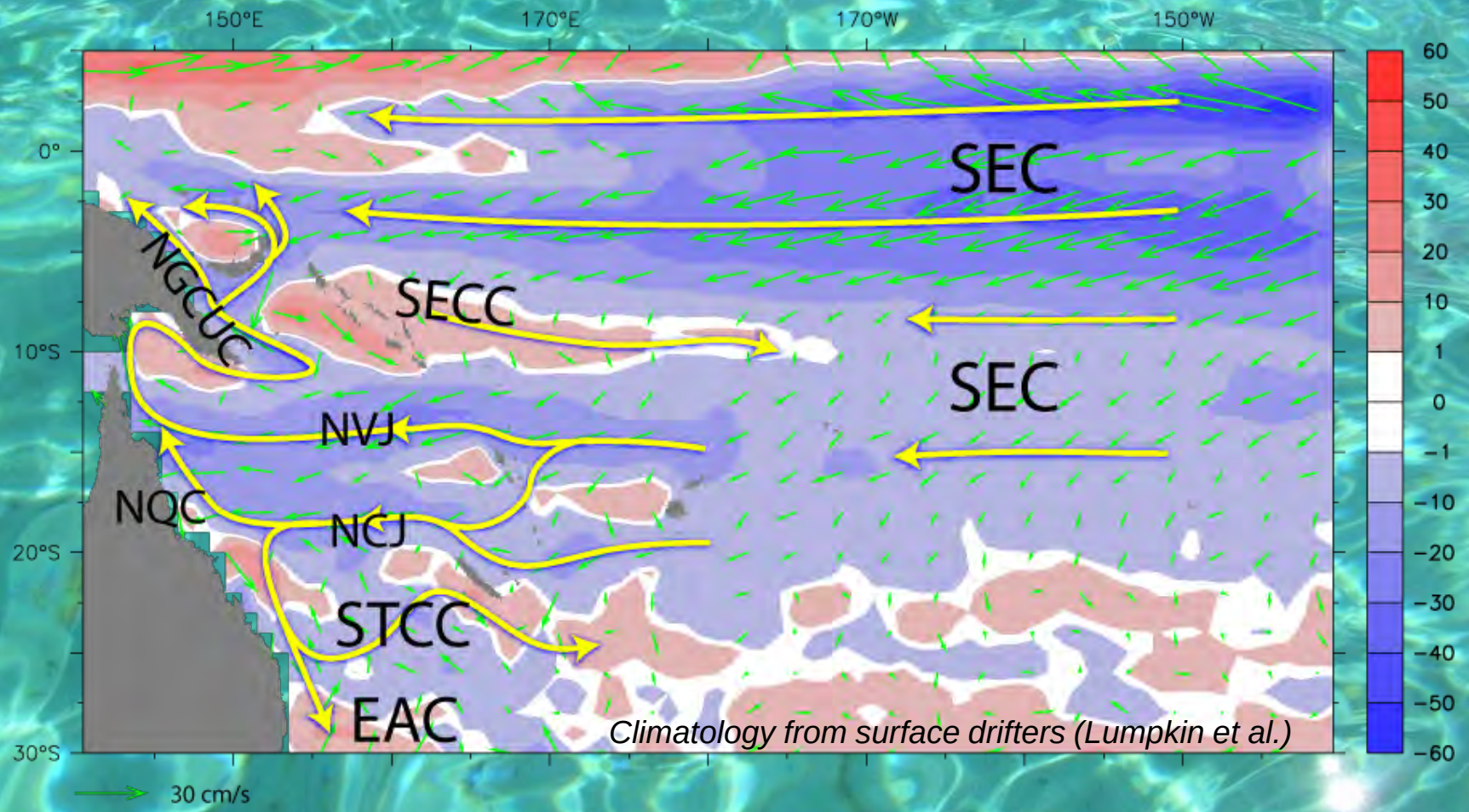


Part I: Coral Sea





Currents of the Coral Sea

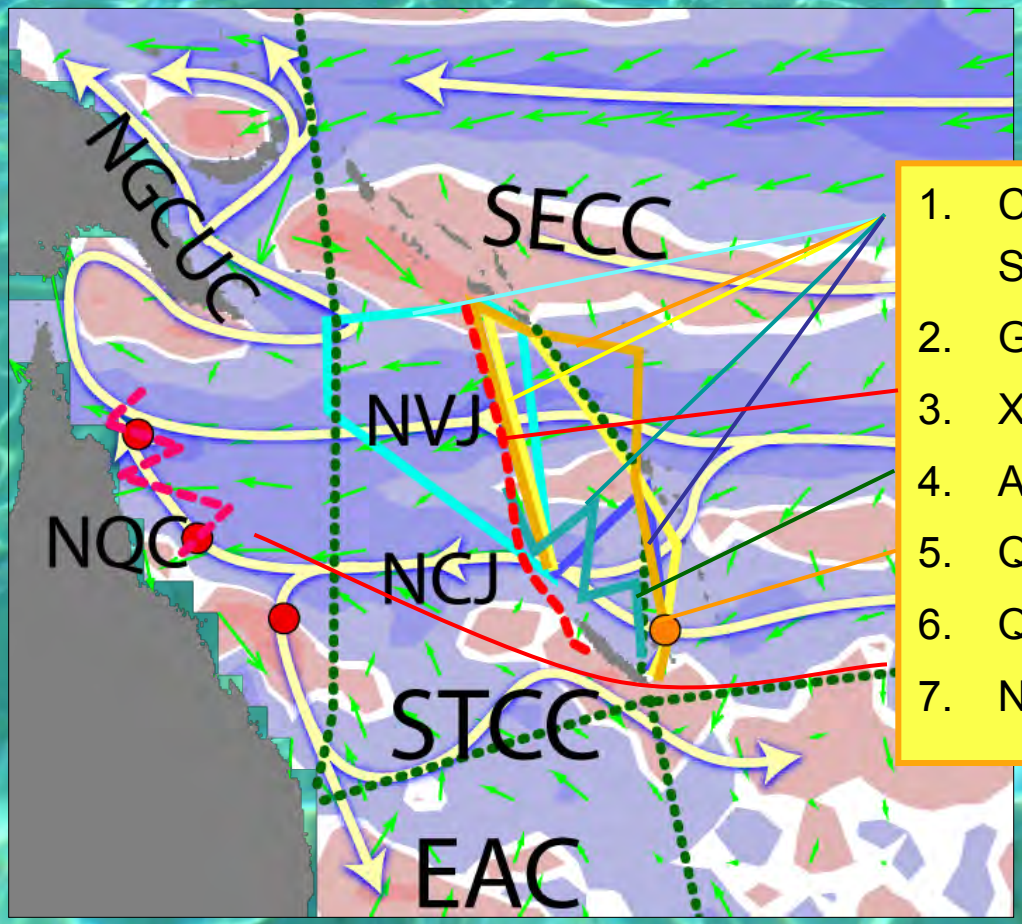


Climatology from surface drifters (Lumpkin et al.)

See Choukroun et al. 2010

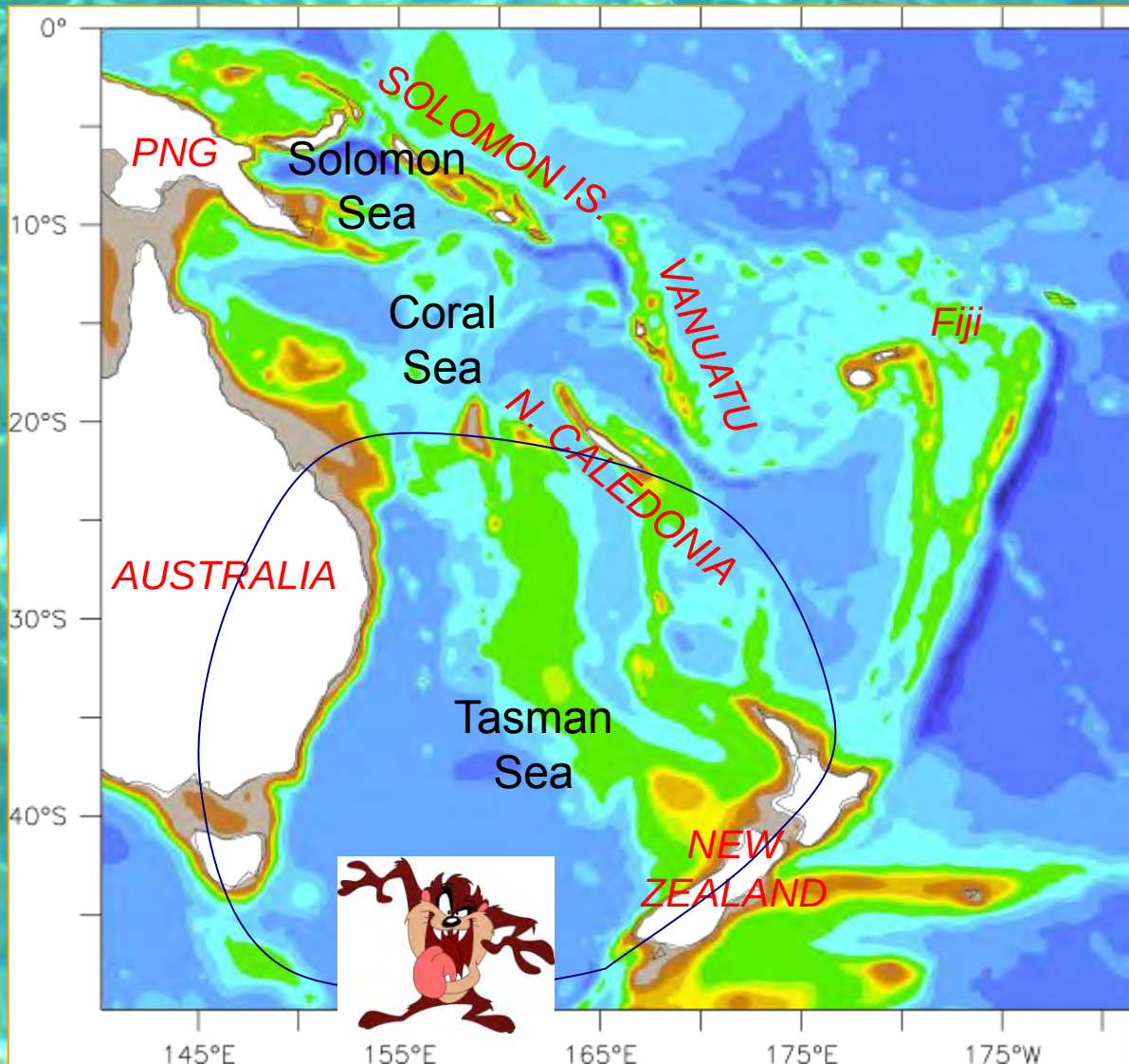
Institut de recherche pour le développement

Ongoing experiments, Coral Sea

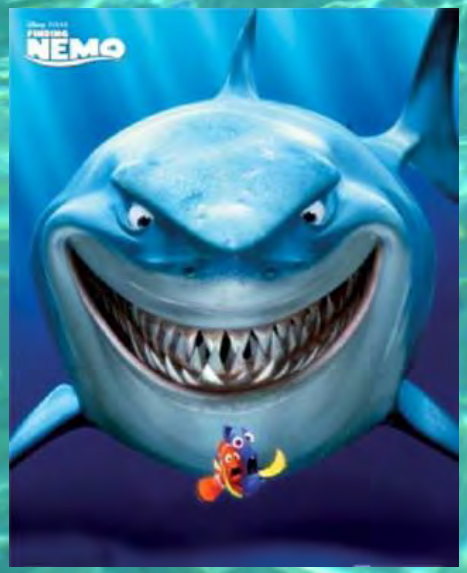


1. Cruises 2003-2010: SECALIS/FLUSEC/SECARGO
2. Gliders: SIO / PMEL / IRD
3. XBT/Argo on Voluntary OS
4. Altiglidex Mooring/Satellite
5. Q-IMOS Moorings NQC
6. Q-IMOS Gliders NQC
7. Numerical simulations

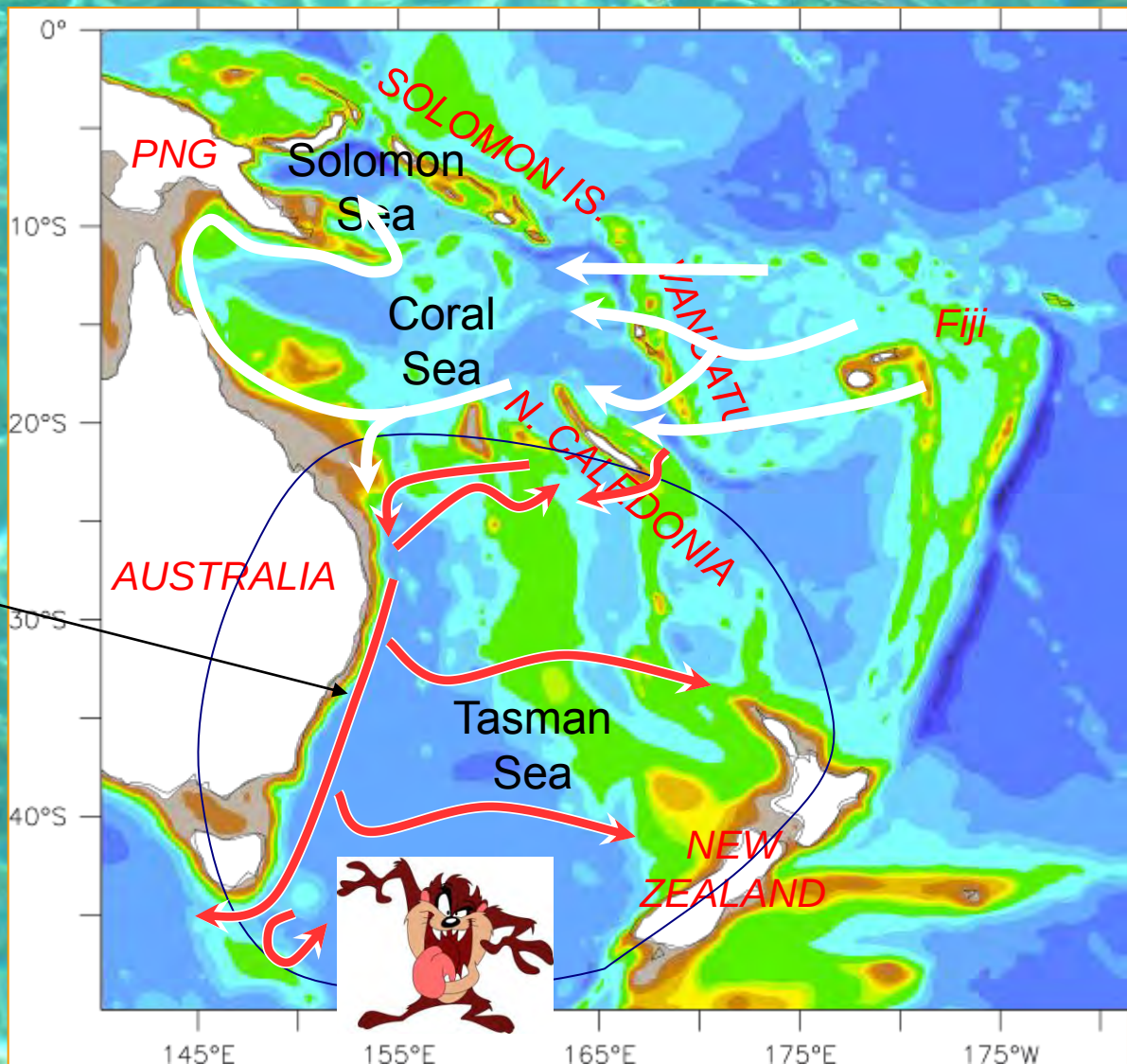
Part II: Tasman Sea



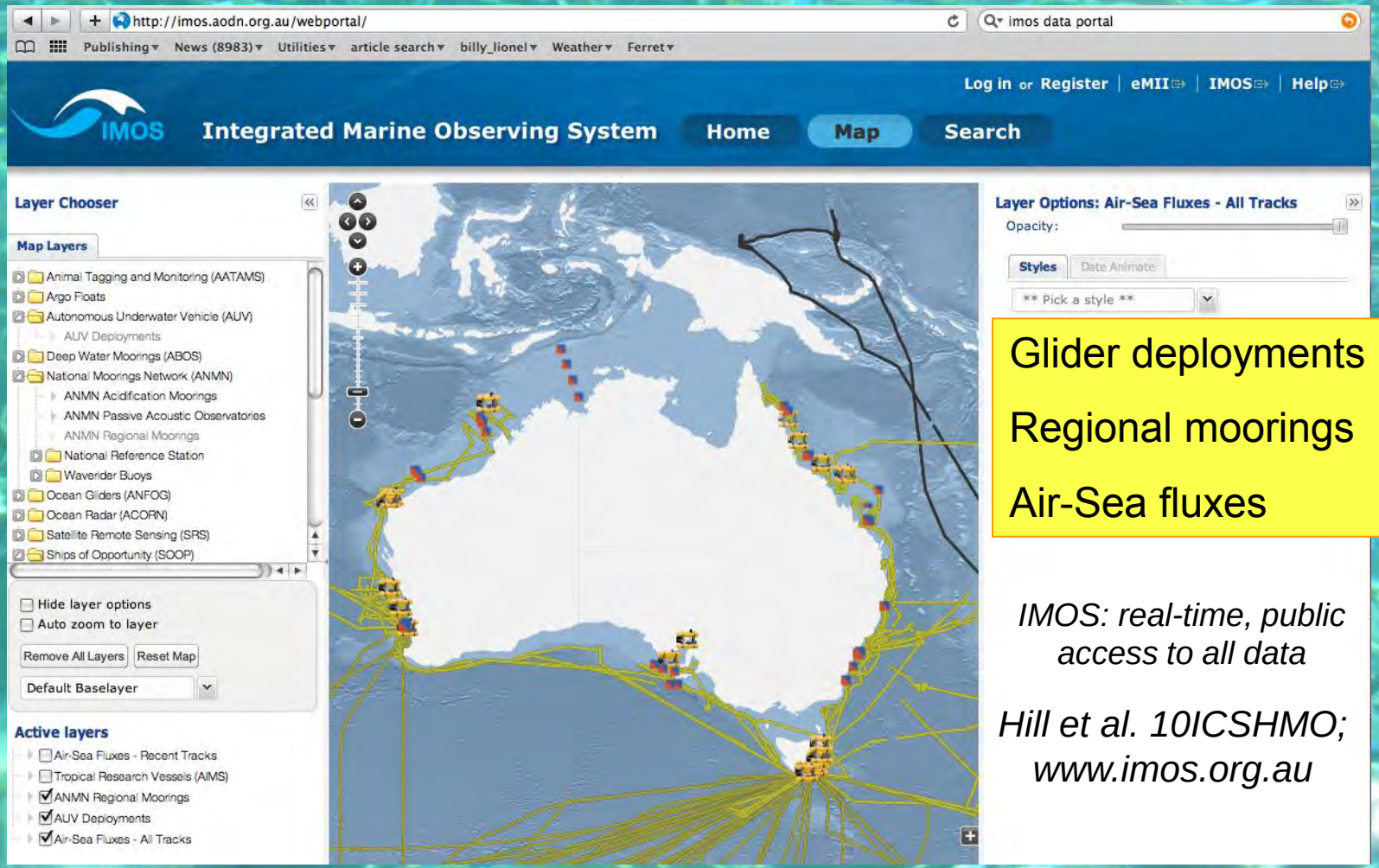
Part II: Tasman Sea



East Australian Current



Australian Ocean observations: IMOS



Glider deployments

Regional moorings

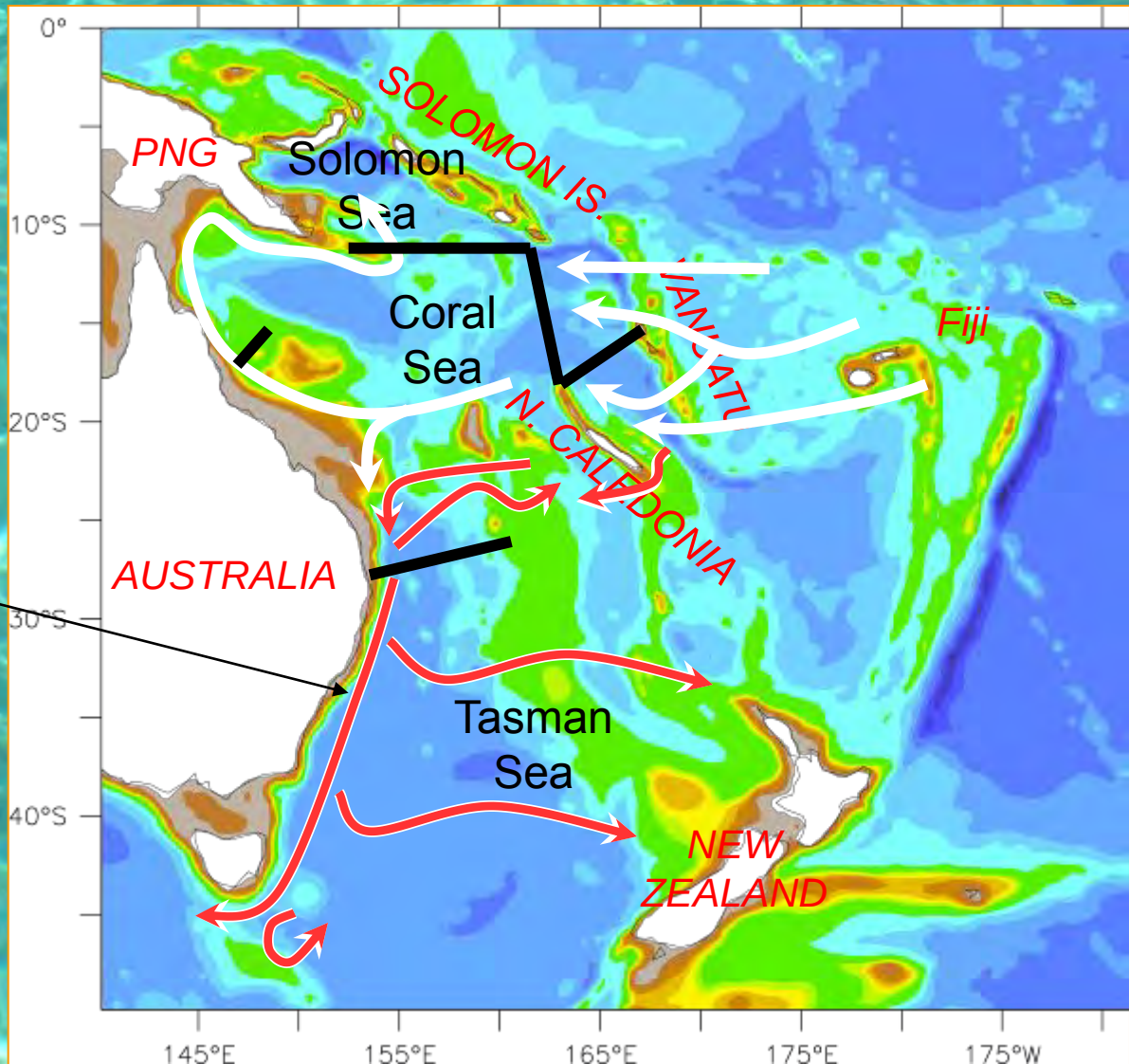
Air-Sea fluxes

IMOS: real-time, public access to all data

Hill et al. 10ICSHMO; www.imos.org.au

Measuring all inflows and boundary currents

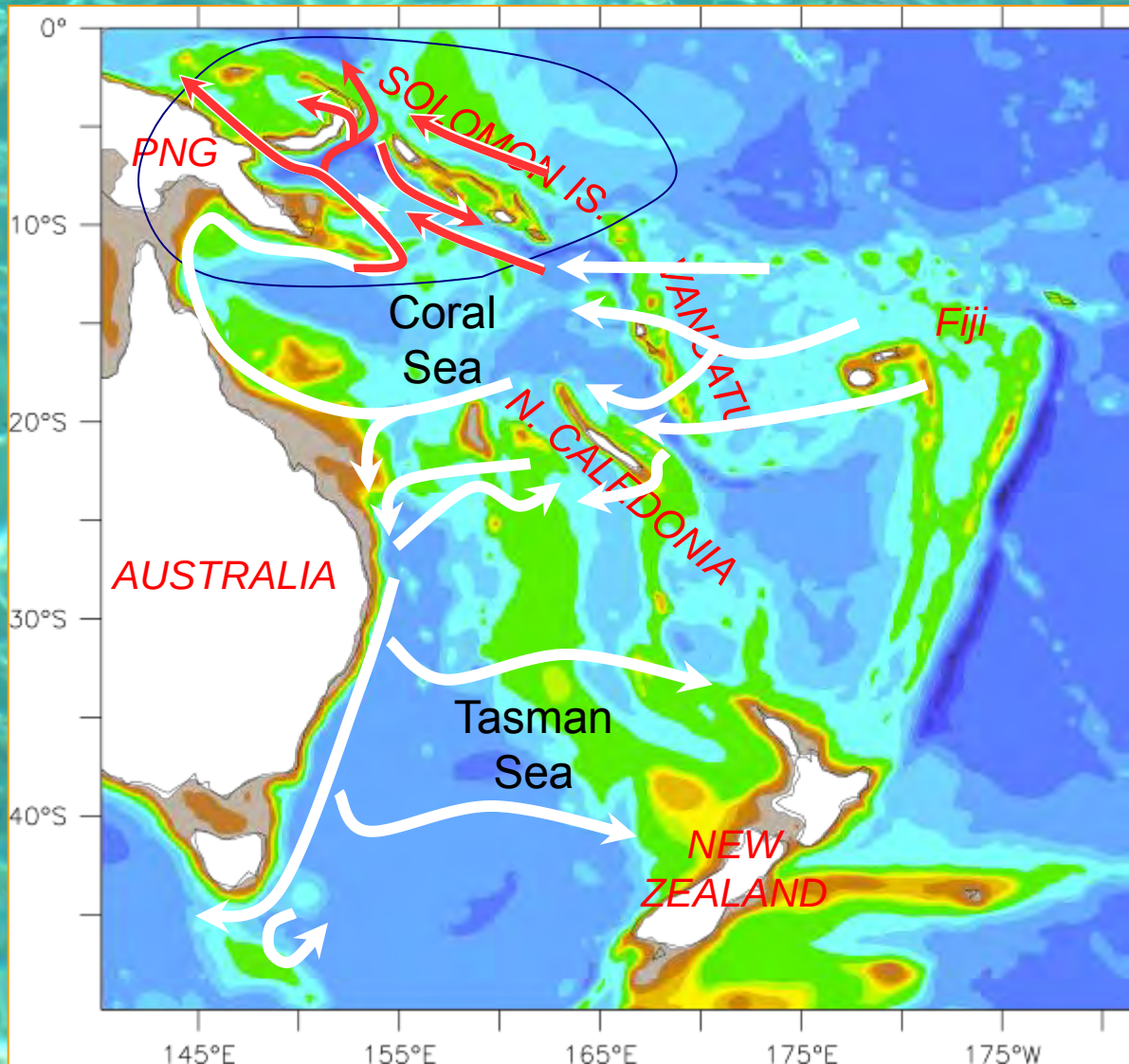
East Australian Current



Part III: Solomon Sea
ANR Solwara project

www.solomonseaoceanography.org

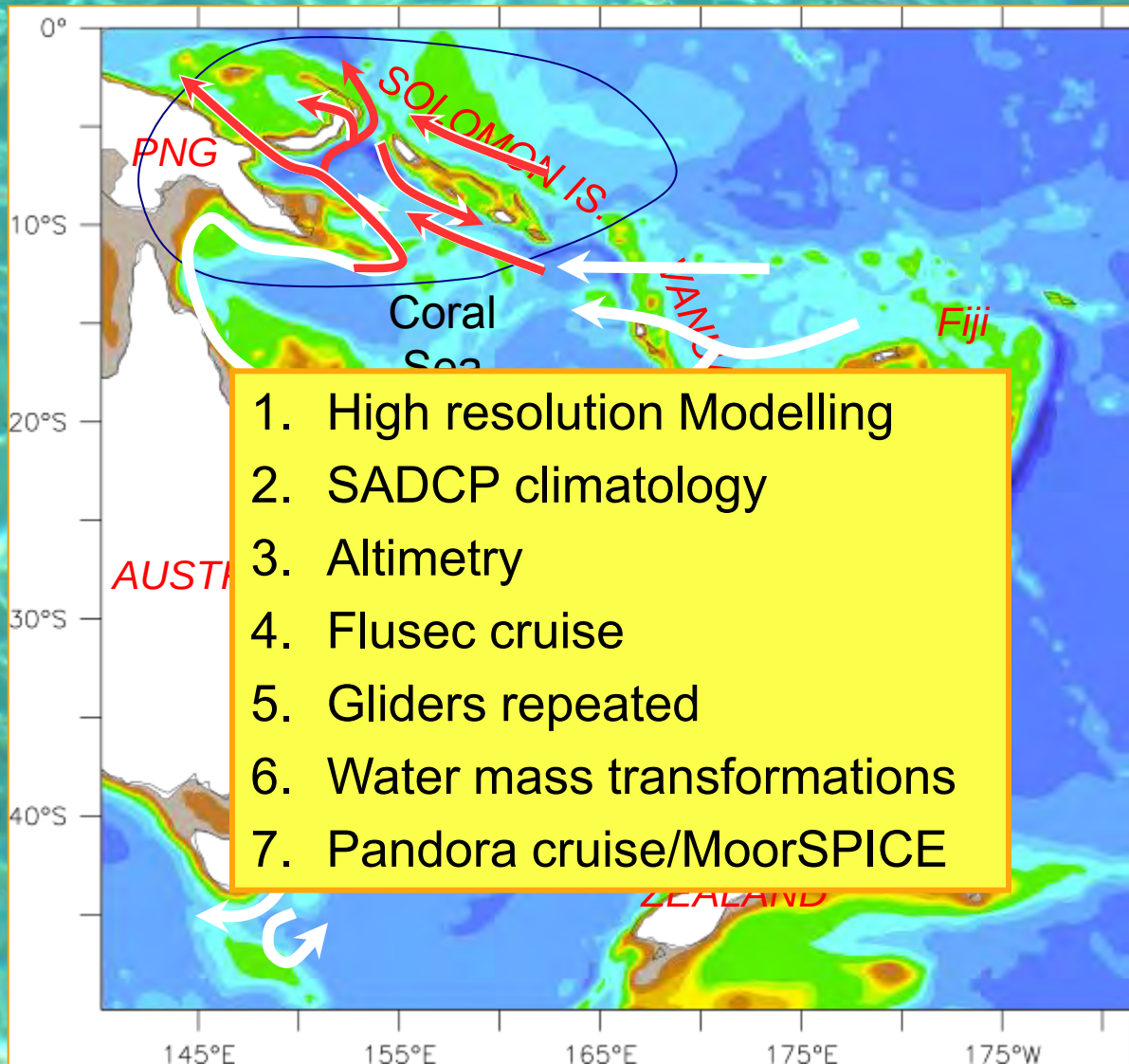
Kavat mask
Gazelle Peninsula
New Britain



Part III: Solomon Sea
ANR Solwara Project

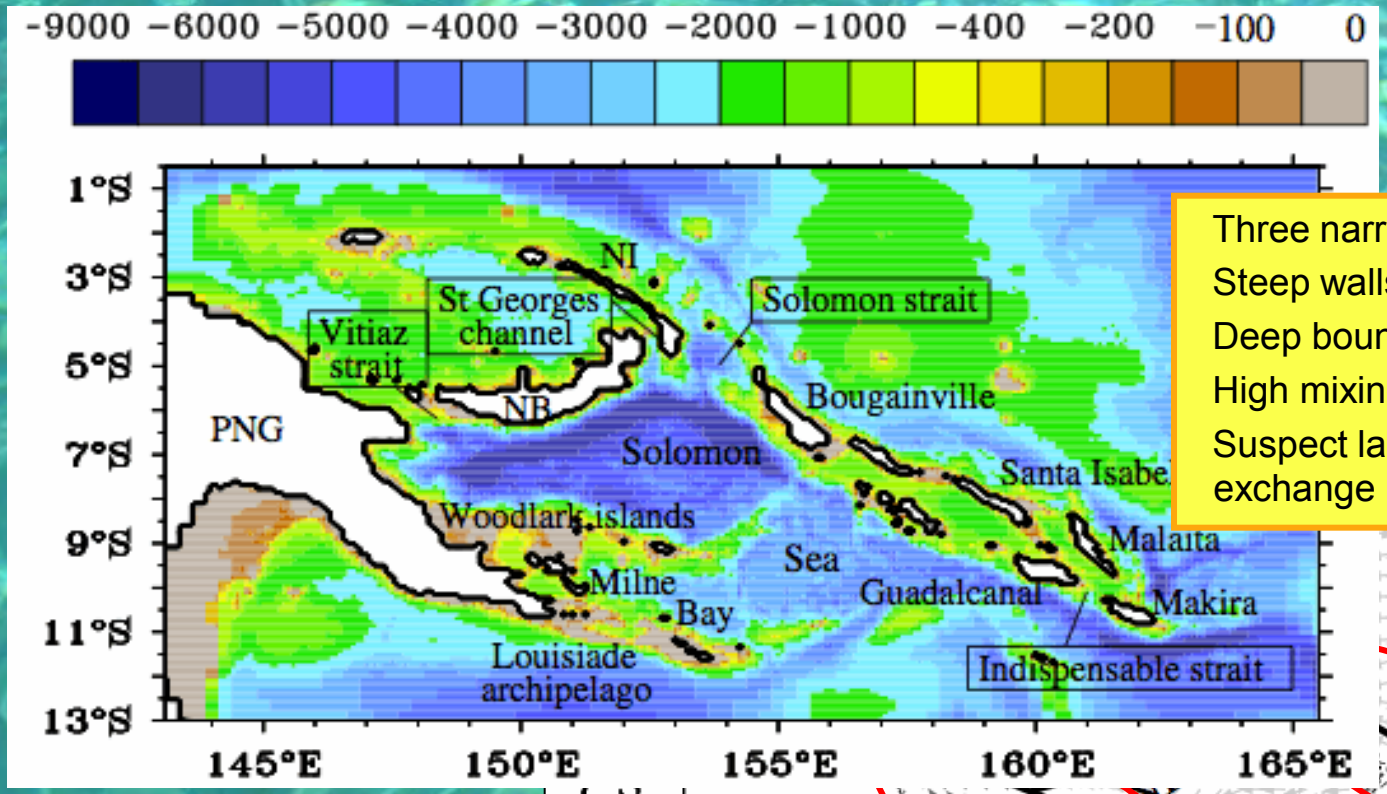
www.solomonseaoceanography.org

Kavat mask
Gazelle Peninsula
New Britain

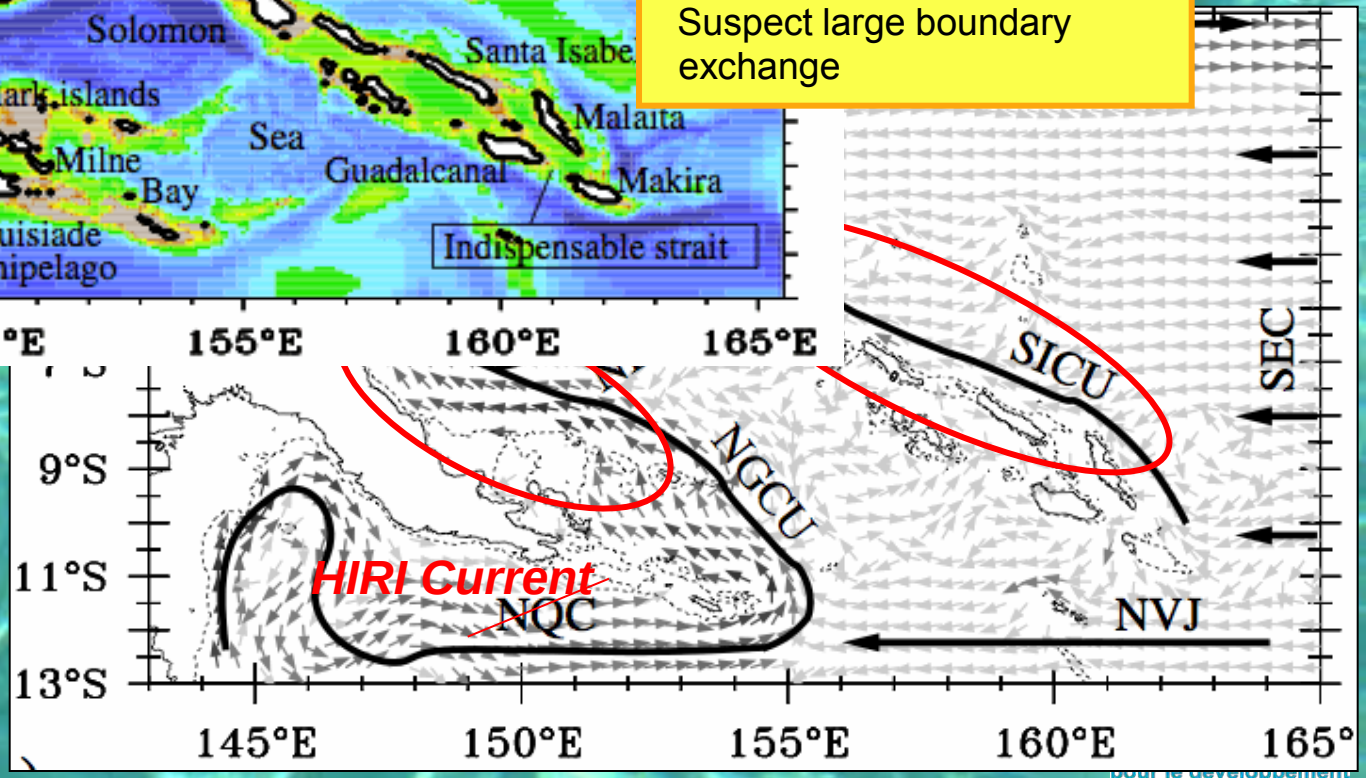


1. High resolution Modelling
2. SADCP climatology
3. Altimetry
4. Flusec cruise
5. Gliders repeated
6. Water mass transformations
7. Pandora cruise/MoorSPICE

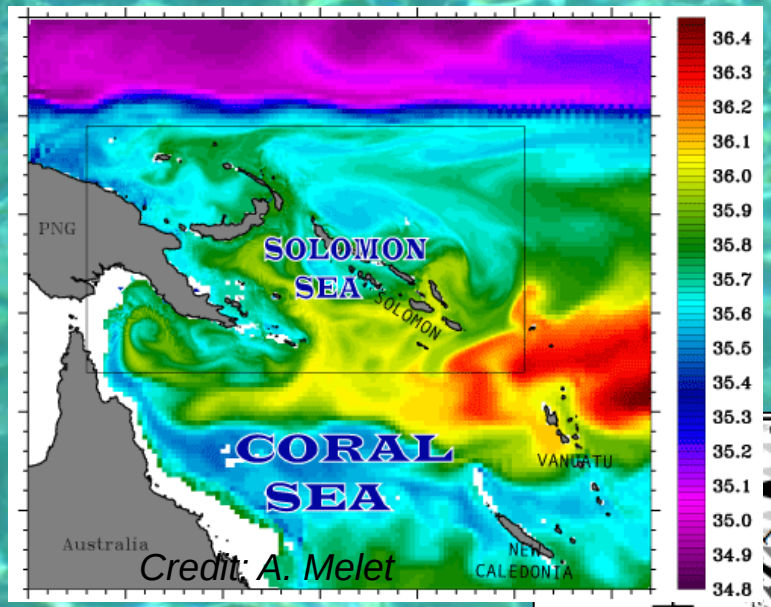
Modelling: regional, high resolution



- Three narrow straits
- Steep walls
- Deep boundary currents
- High mixing
- Suspect large boundary exchange



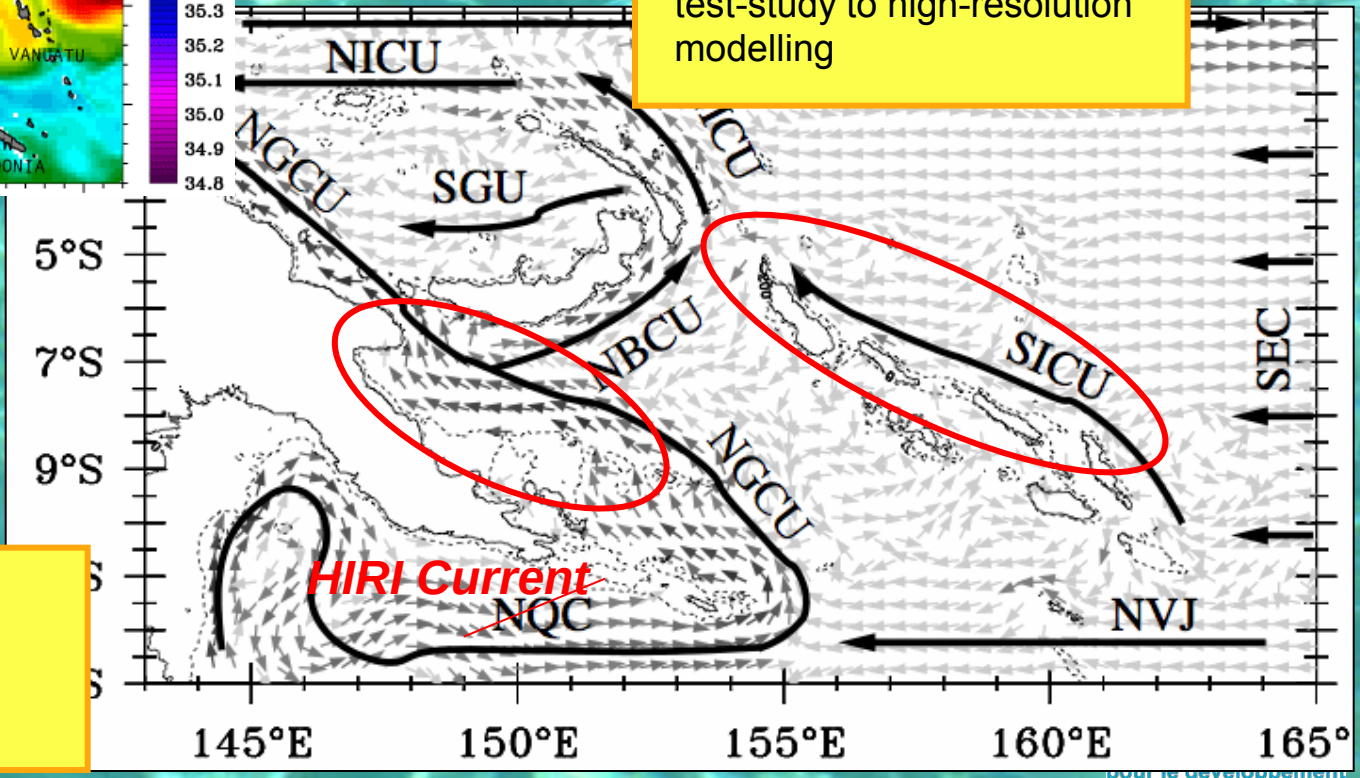
Modelling: regional, high resolution



Credit: A. Melet

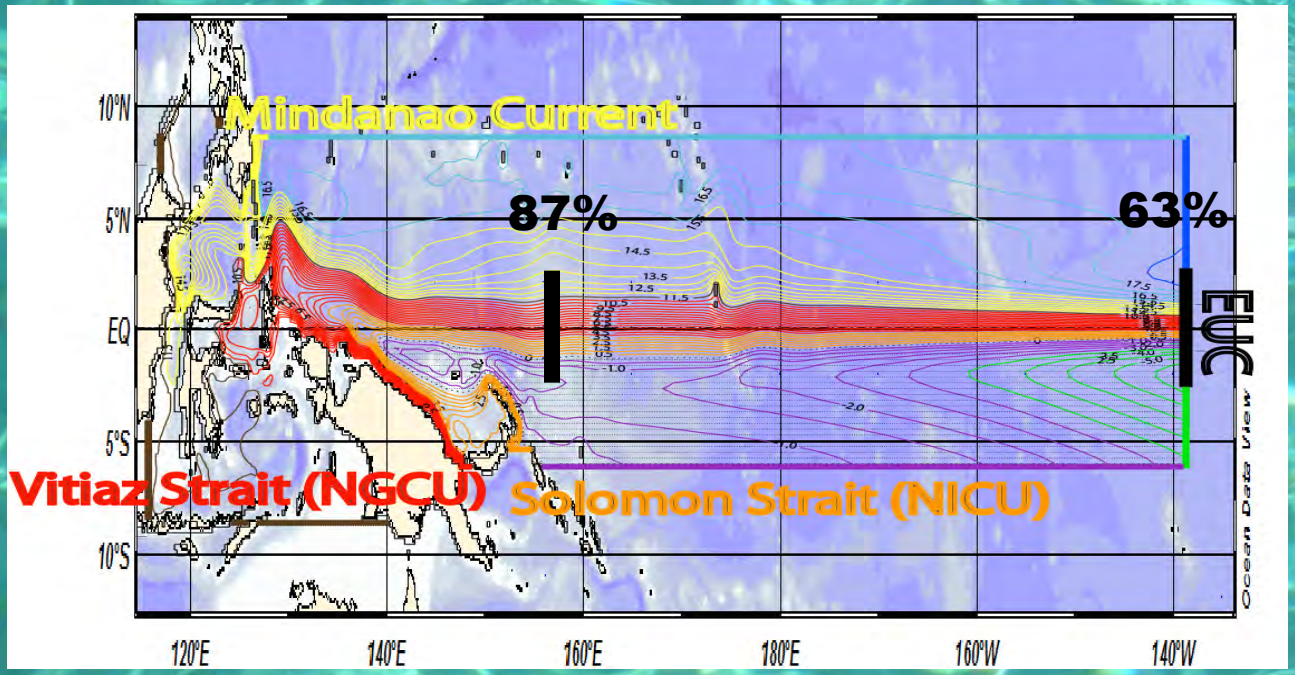
- 1/12° completed (NEMO)
- 1/32° ongoing (post-Solwara PhD)
- The Solomon Sea became a test-study to high-resolution modelling

1. French NEMO
2. French ROMS
3. BRAN (AUS)
4. OFES (JP)



Verron et al., 10ICSHMO
Grenier et al. 10ICSHMO
Melet et al. 2010, 2011a
Grenier et al. 2011

EUC sources

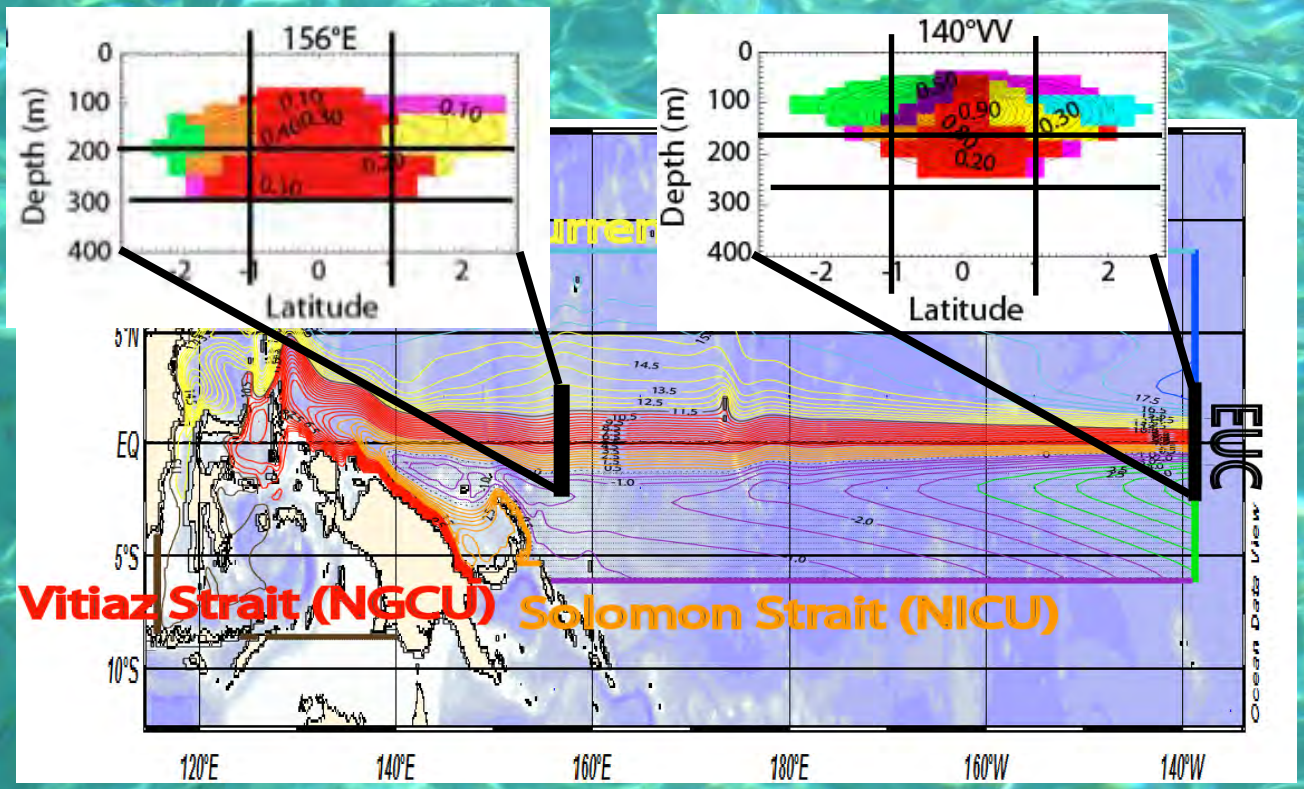


Lagrangian study from a numerical simulation:

- 87% of the EUC water comes from the western boundary currents
- 60% from the Solomon Sea

Grenier et al., 2011

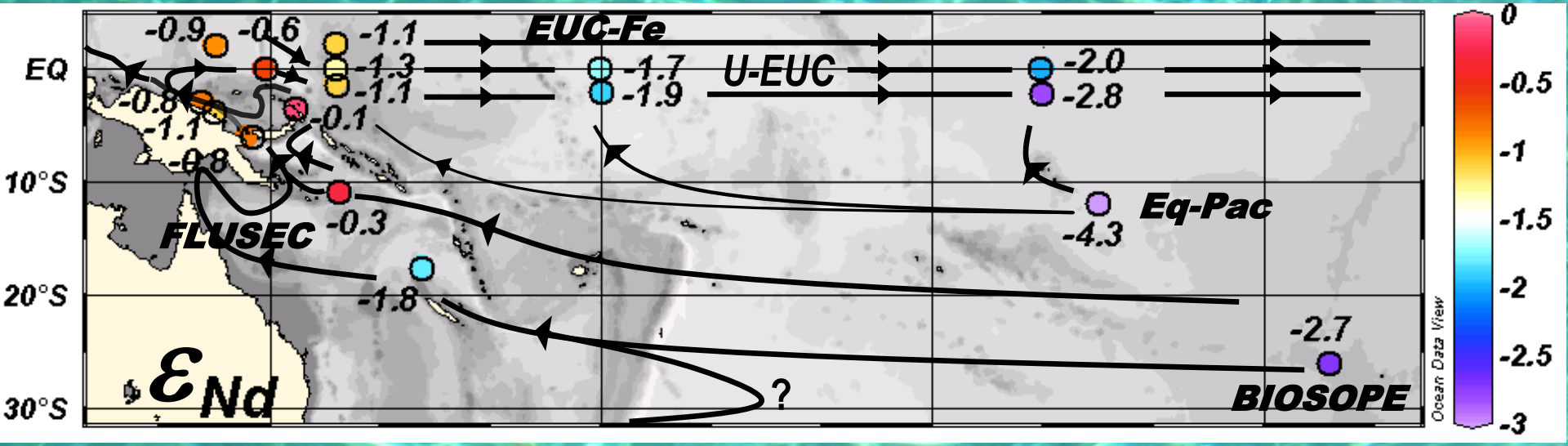
EUC sources



The lower layer of the EUC is mainly composed of Vitiaz Strait waters

Grenier et al., 2011

Implications for geochemical enrichment

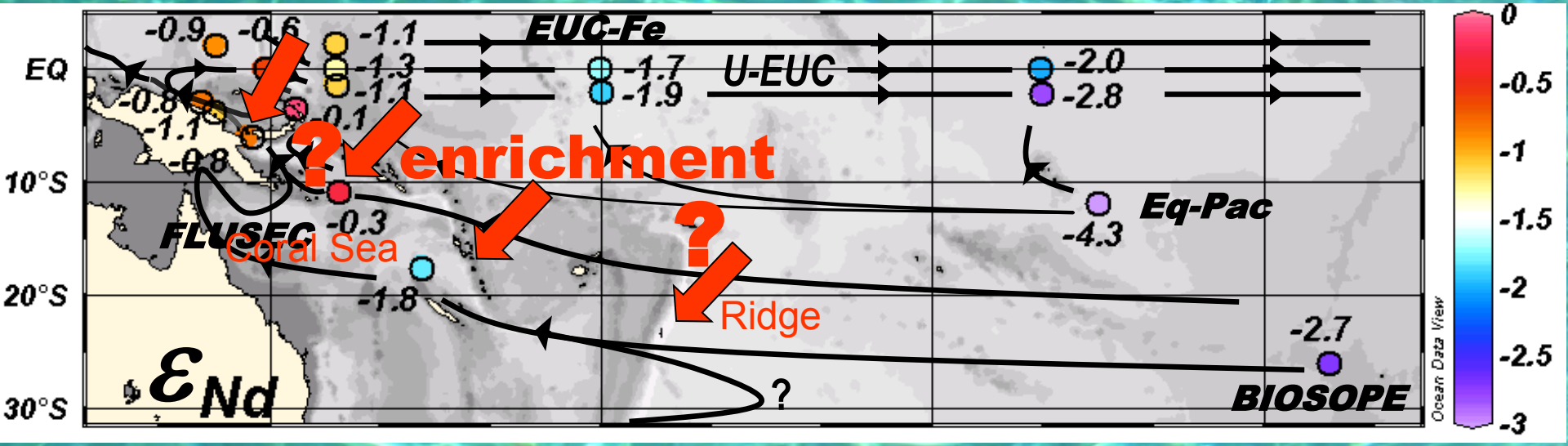


Neodymium isotopic composition ε_{Nd} of thermocline waters

Grenier et al., TBS

Neodymium is a tracer of continental supplies; water mass pathways; mixing

Implications for geochemical enrichment

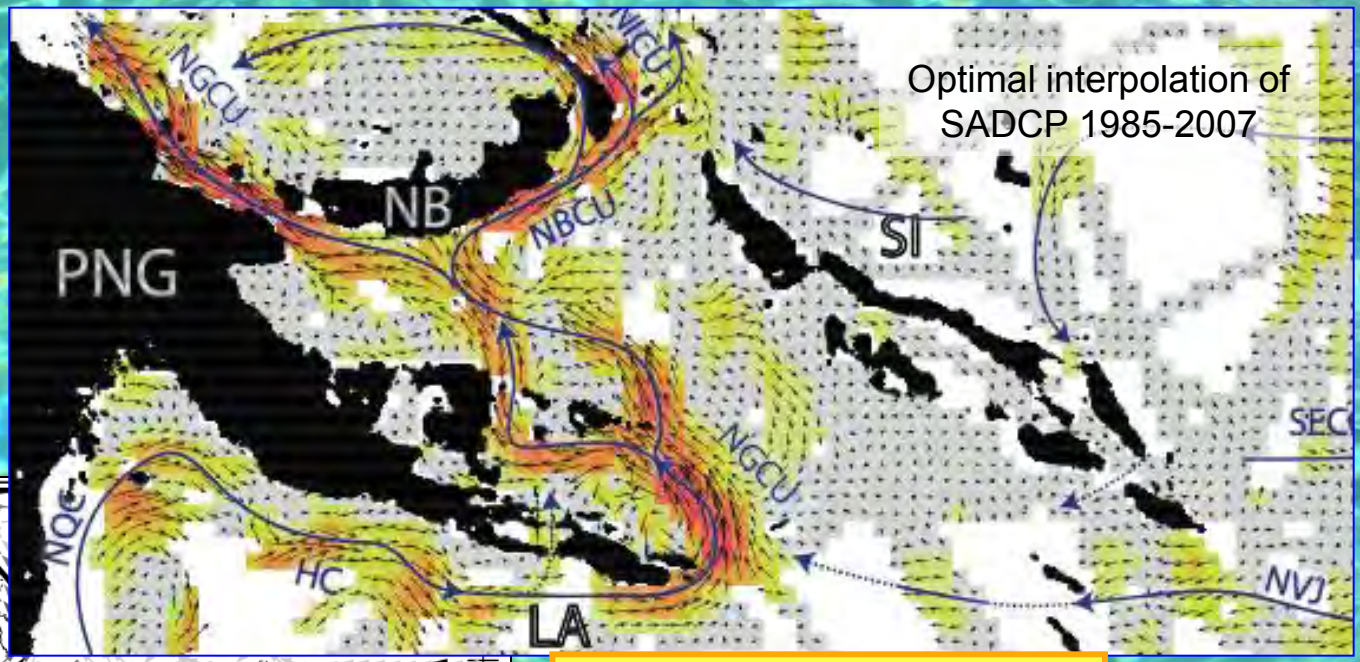


- Fiji/Tonga Ridge: potential source of chemical enrichment of the water masses between the gyre and the Solomon Sea
- Coral Sea enrichment: more samples are needed to locate precisely WHERE:
  -Gulf of Papua? Fly River?
- Solomon Sea enrichment: PANDORA cruise (July 2012)

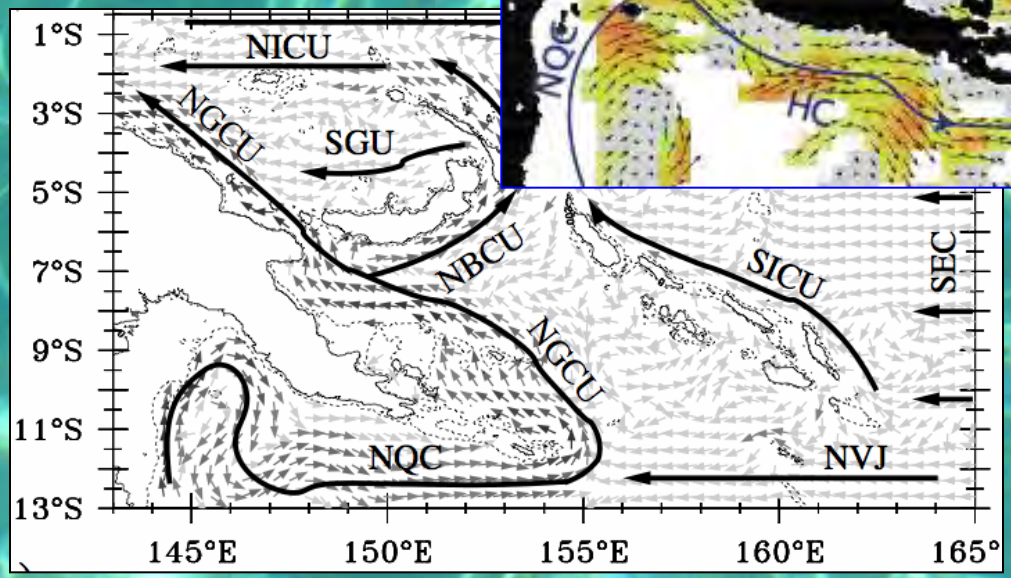
Grenier et al., TBS

Institut de recherche pour le développement

Current climatology of the Solomon Sea



Optimal interpolation of SADCP 1985-2007



Little oceanographic data

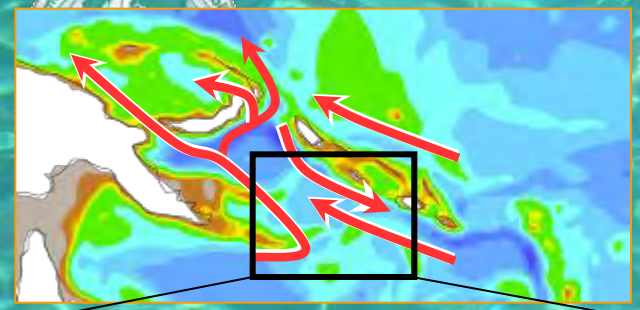
Opportunistic SADCP surveys (Ship Acoustic Doppler Current Profilers) with currents 0-300m (or more)

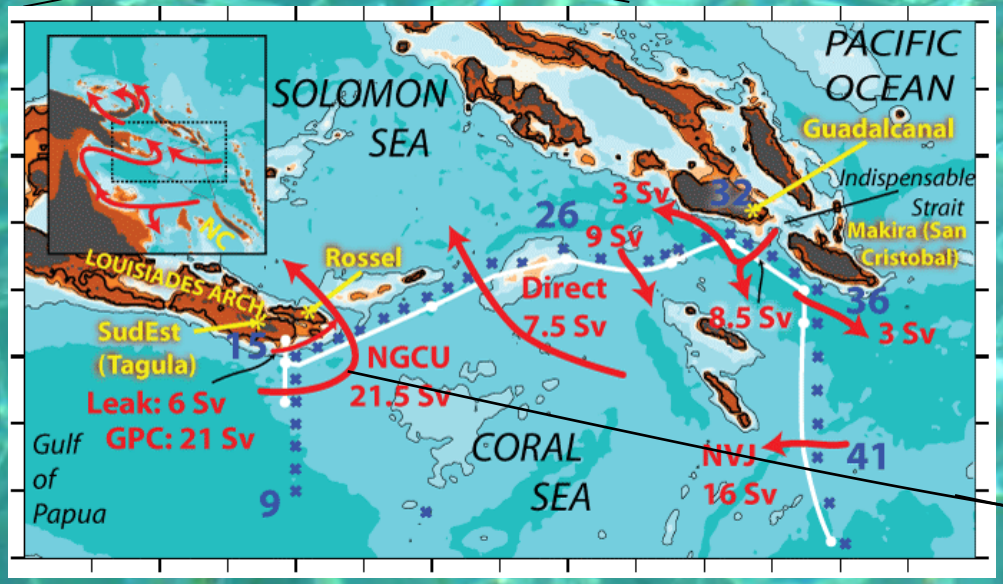
Cravatte et al. 10ICSHMO

Cravatte et al. 2011

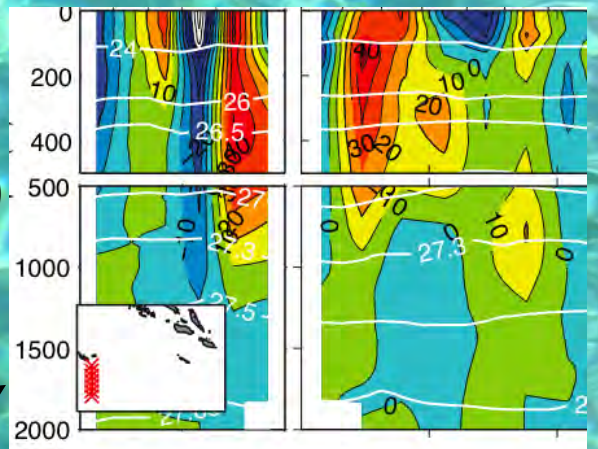
Institut de recherche pour le développement

Transports Into the Solomon Sea

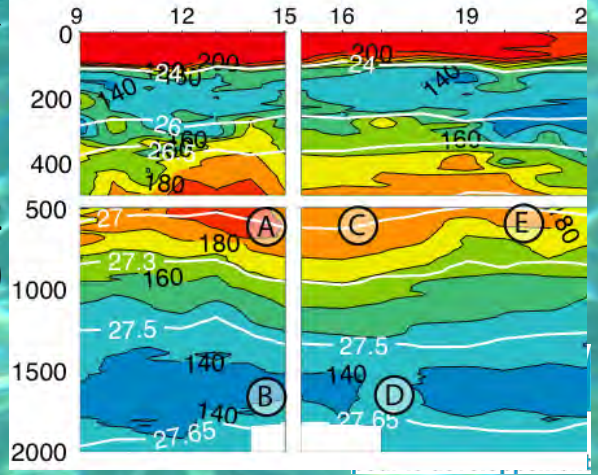




V (cm/s)



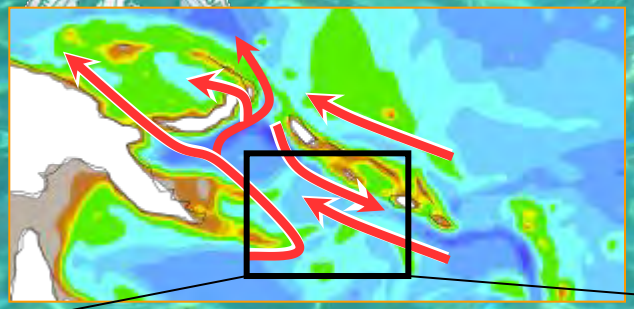
O2 (umol/kg)

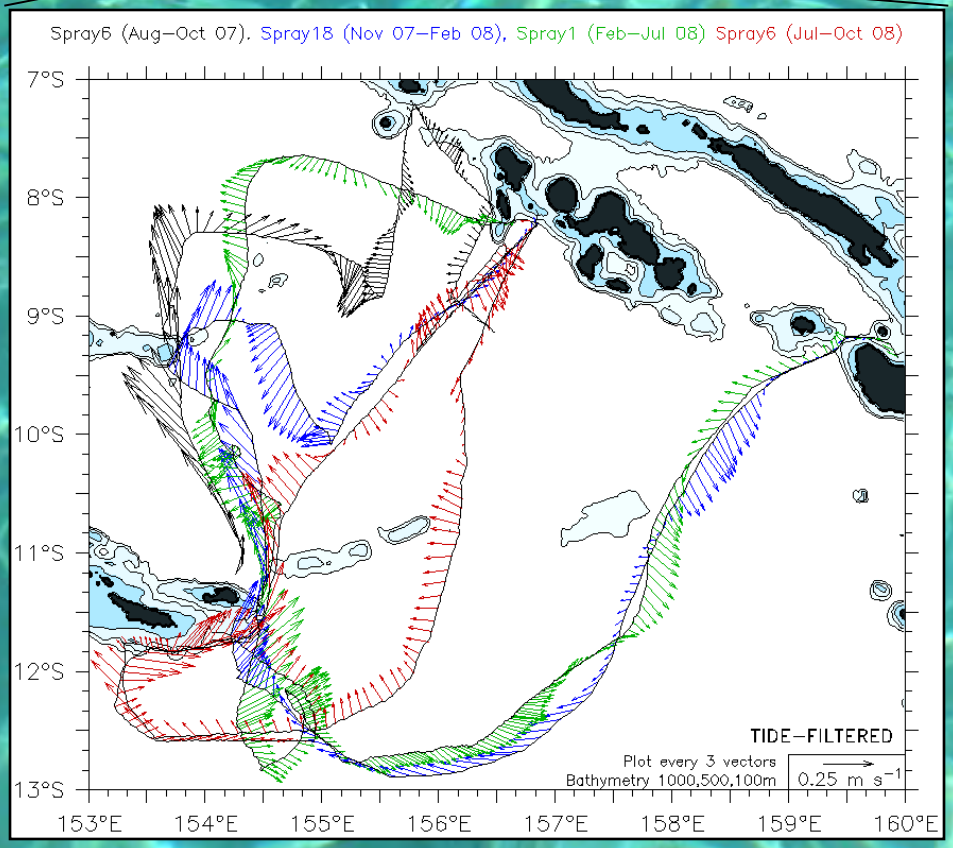


Hydrographic survey across the Solomon Sea: cruise Flusec 2007 (PI C. Maes)

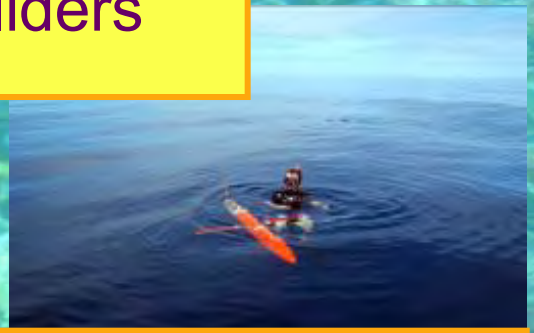
Gasparin et al., 10ICSHMO
Gasparin et al. submitted

Transports Into the Solomon Sea: gliders





0-700m average velocity *(Kessler, PMEL; Davis, SIO)*



18 deployments since 2007

The northward inflow (0-700m layer):

1. Averages 20 to 25 Sv
2. Is highly variable: 0 to 30 Sv
3. Decreases with La Niña
4. Has little seasonal variability

Davis et al. submitted

LEGOS

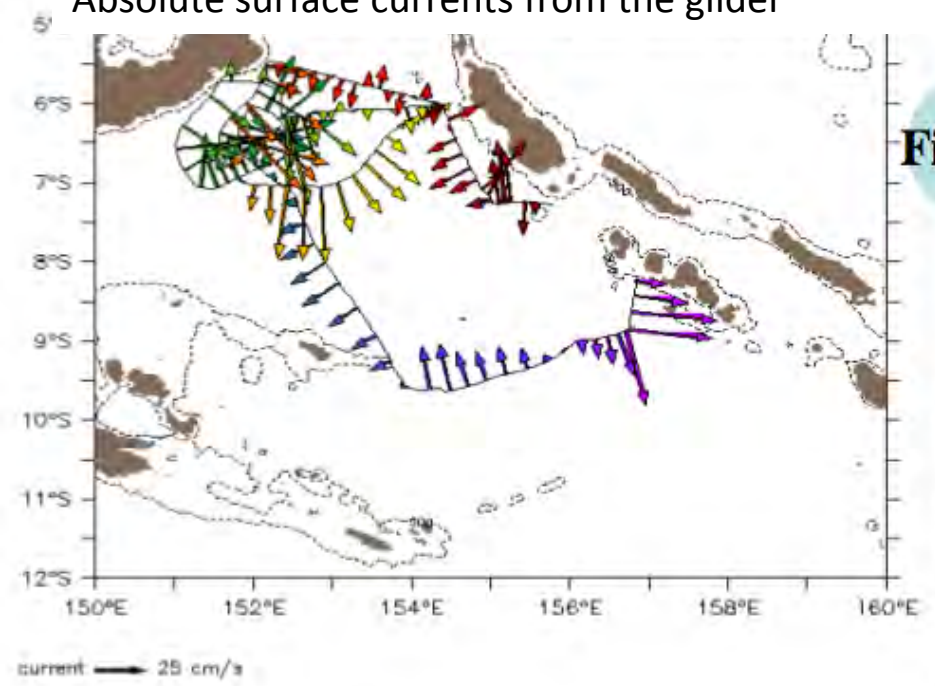
IRD
Institut de recherche pour le développement

Mesoscale from gliders and altimetry

- Gliders provide high resolution sampling (5km) over the water column
- Altimetry helps understanding what the slow-moving glider samples

Gourdeau et al., OSTST 2011

Absolute surface currents from the glider



Absolute surface currents from co-located altimetry

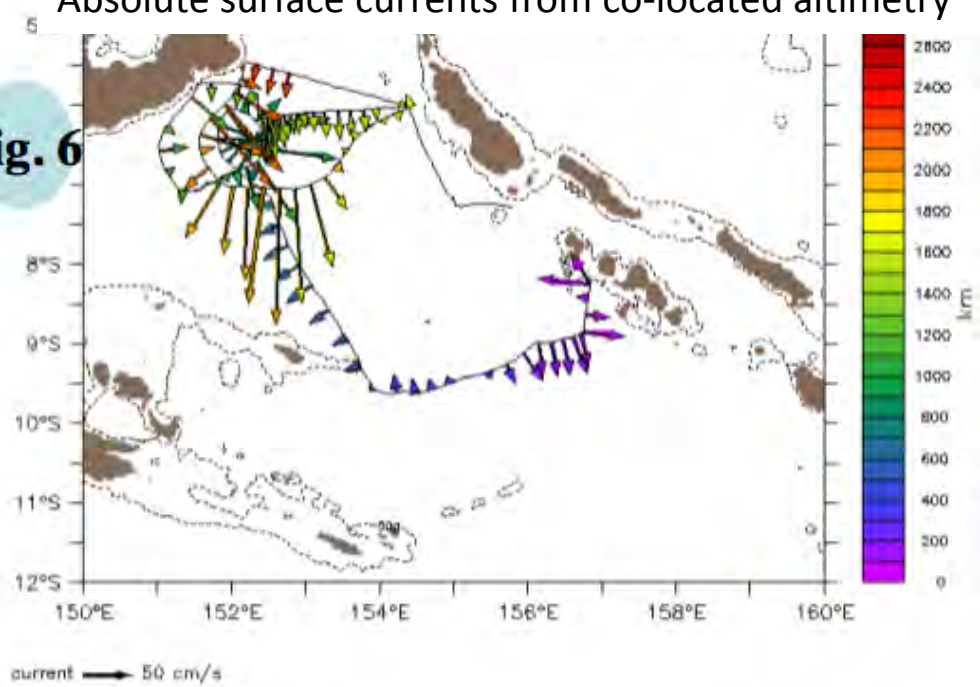
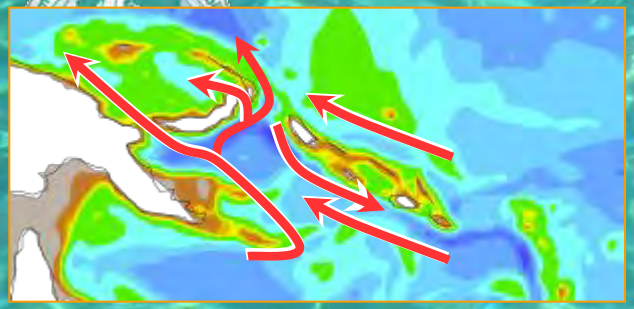
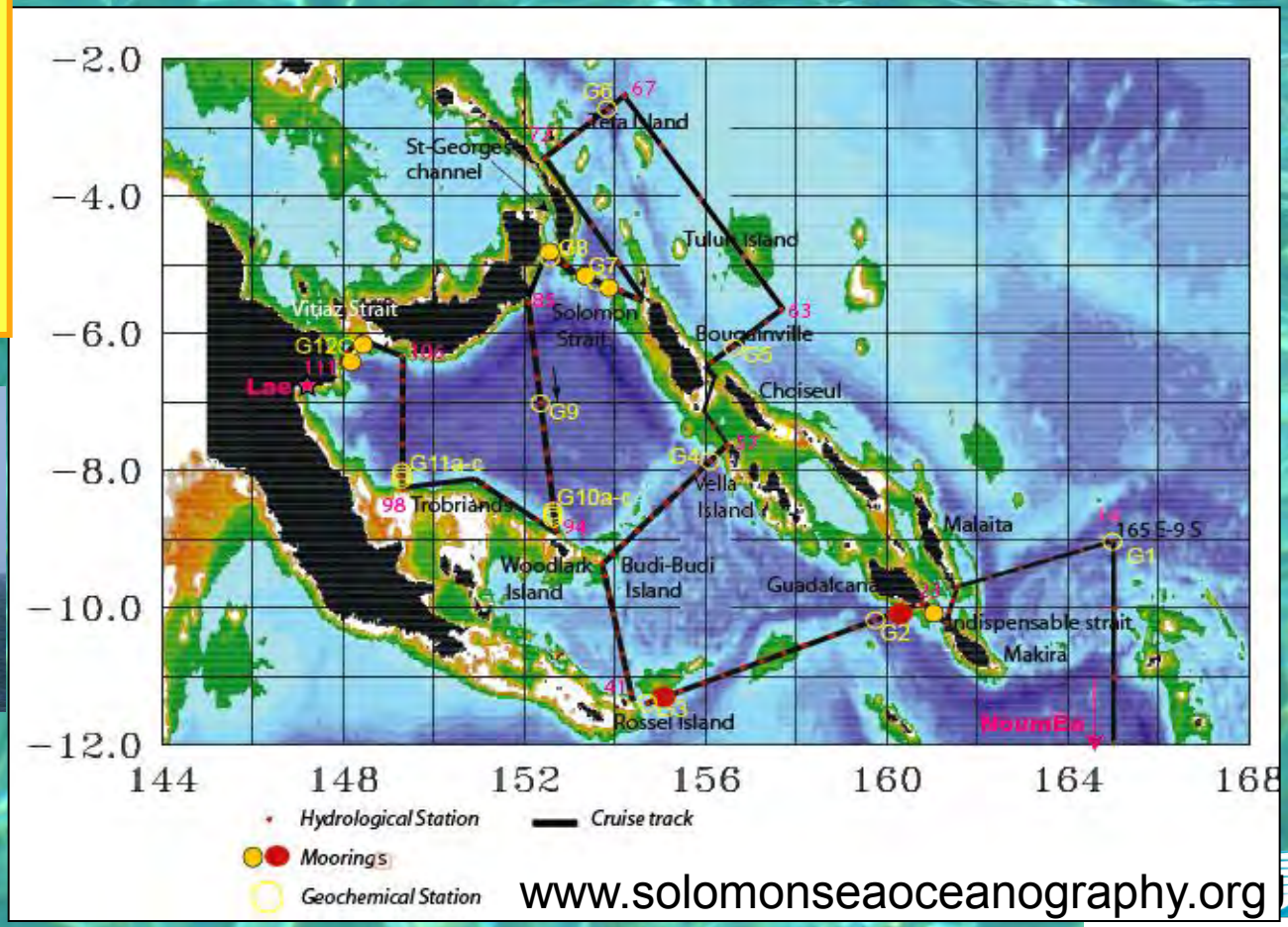


Fig. 6

Pandora Cruise 2012
(LEGOS/SIO/CSIRO)



Observations:
- Solomon Sea moorings
- Multidisciplinary cruises
- PIES



www.solomonseaoceanography.org

Conclusions

Solwara is on the way:

Intensive efforts in observations and modelling underway in the Solomon Sea

What did we learn so far?

- **Currents can be very deep**:
  WHY?? Implications for the equatorial connection?
- **Double boundary current system** in the Solomon Sea and some disagreements among the models
- **Huge variability** of currents and transports (seasonal, intraseasonal, interannual).
- Important **mixing** in the Solomon Sea (model)

Institut de recherche pour le développement

Perpectives

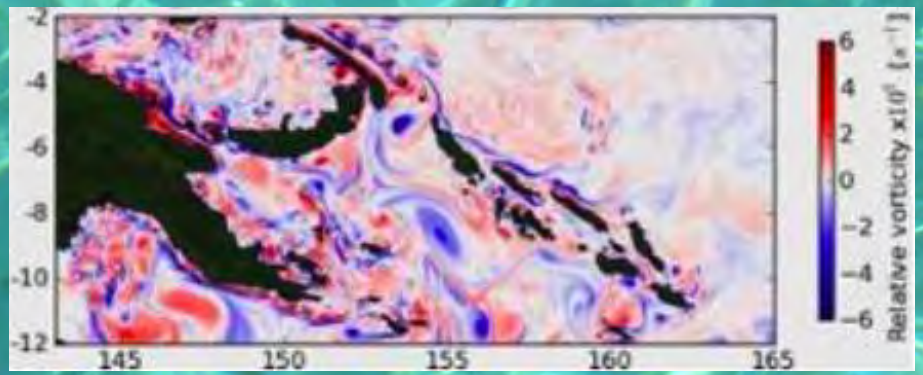
Solwara is on the way:

Intensive efforts in observations and modelling underway in the Solomon Sea

What did we learn so far?

Where do we go from here?

- **Modelling at higher resolution / SWOT**
- **Tides**
- **Repeat cruises**
- **Monitoring**
- **Detailed geochemical analysis**
- **Evaluating improvement to climate prediction**



1/36° simulation (Courtesy J. Verron)

Institut de recherche pour le développement