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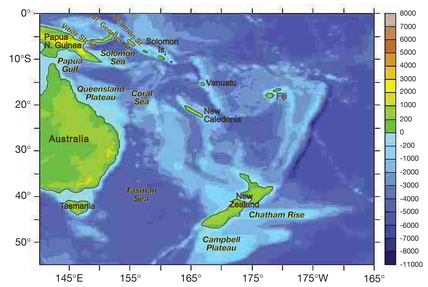

2006 AGU Fall Meeting, San Francisco, Poster OS21C-1601

JETS IN THE CORAL SEA: OBSERVATIONS BETWEEN NEW CALEDONIA AND VANUATU DURING THE SECALIS CRUISES

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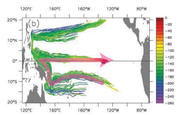
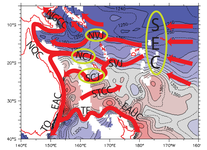
1-Context: decadal ENSO modulation

South Pacific thermocline waters are transported from the subtropical gyre center in the westward flowing South Equatorial Current (SEC), towards the southwestern Pacific Ocean-a major circulation pathway from the subtropics to the equator and to the southern ocean. The effect of the transit in the Coral Sea is potentially of great importance to tropical climate prediction because changes in either the temperature or the amount of water arriving at the equator have the capability to modulate the ENSO cycle and thereby produce basin-scale climate feedbacks.



Origins of water particles emerging in June 1998 in the Nino-3 region in an ocean general circulation model (Izumo et al, 2002)

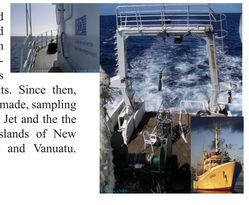
The thermocline water originates from "South Pacific Eastern Subtropical Mode Water" (Hanawa and Talley 2001) that forms in the center of the Southeast Pacific gyre where water acquires its high salinity. It is then advected to the west, forming the core of the SEC. Upon its encounter with island ridges, the SEC divides in three main jets, the South Caledonian Jet (SCJ), the North Caledonian Jet (NCJ) and the North Vanuatu Jet (NVJ). The NCJ bifurcates on the east coast of Australia, feeding both the EAC and the New Guinea Coastal Current (NGCC) system. The NGCC supplies the Equatorial Undercurrent and emerges as the east Pacific cold tongue (Tsuchiya et al. 1989).

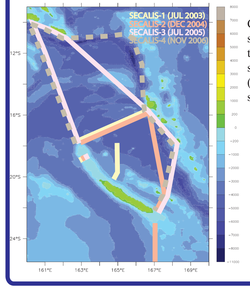


The thermocline water current system Background geostrophic streamfunction from CARS-data geostrophic currents referenced at 2000db.

2-The SECALIS cruises

A first cruise in 2003 aboard the 92-ft N/O ALIS premitted the discovery of the North Caledonian Jet, thereby verifying analytical calculations and numerical model outputs. Since then, three more cruises have been made, sampling the deeper South Caledonian Jet and the the jet structure between the islands of New Caledonia, South Solomon and Vanuatu.

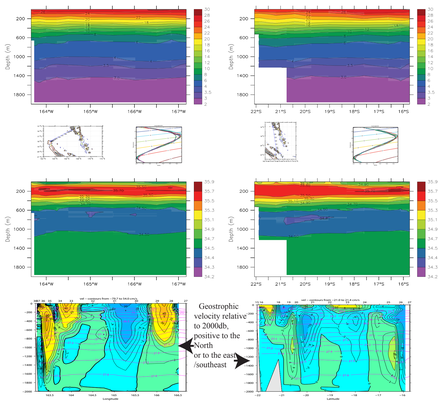




CTD, lowered - ADCP and water samples were collected during stations, along with continuous measurements of surface currents (Shipboard ADCP), temperature and salinity (thermosalinograph).

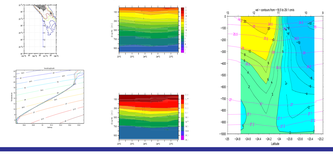
3-Secalis-2 data (Dec 2004)

The second cruise of the series is analyzed here. Salinities show the conspicuous maximum corresponding to the South Pacific Eastern Subtropical Mode Water carried by the SEC, at 200m (σ=25kg/m3) between New Caledonia and Vanuatu.
The geostrophic flow displays a series of jets that extend much deeper than the thermocline. The reason for the deep extent of those jets is not fully understood yet.



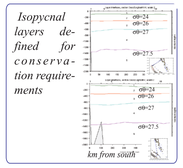
Geostrophic velocity relative to 2000db, positive to the North or to the east /southeast

To the South of New Caledonia, a westward geostrophic current is found against the coast, shallower than that found in numerical models and climatologies. The salinity structure does not show a strong maximum

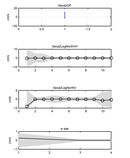


4-Transports by linear inverse model

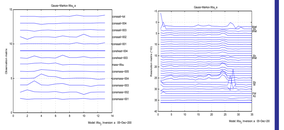
The north legs of the Secalis-2 cruise form a closed box, allowing the setup of an inverse box model. Transports between Vanuatu and New Caledonia during Secalis-2 are calculated from geostrophy and SADCP. The circulation is constrained to conserve mass, heat and salt within isopycnal layers (figure on the right). The Gauss-Markov estimator (Wunsch, 1996) is applied to ensure consistency between a priori estimates of the reference-level velocities and variance at 2000 dbars and the conservation requirements.



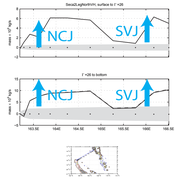
Isopycnal layers defined for conservation requirements



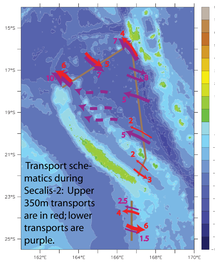
The observation and resolution matrices (right) show that equations are well-resolved. The solution is achieved with little change to the initial flow (left). Ekman transports from the dec. 1994 Quickscat winds were subject to small adjustments.



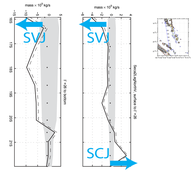
5-Secalis-2 transports



Northward transports cumulative from New Caledonia (dashed line=before inversion):
The North Caledonian Jet (NCJ) transports 6+/-0.7Sv above σ=26 (350m) near the North tip of New Caledonia. The transport below the salinity maximum reaches deep with another 10+/-2 Sv essentially above 1000 m. A northwestward jet of similar magnitude is found south of Vanuatu (SVJ).



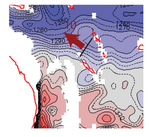
Transports south of New Caledonia are uncertain (relative to 1000db)



Eastward transports cumulative from South:
The South Vanuatu Jet (SVJ) transports 3.5+/-1 Sv above σ=26 just south of Vanuatu and 7+/-2 Sv below. A weak transport is found southward close to the coast of New Caledonia (3+/-1 Sv).

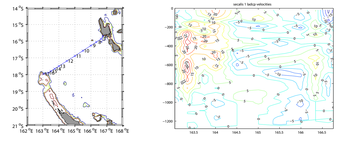
6-Variation with time

The figure below indicates transport streamfunction from geostrophic velocities relative to 2000m, from the CSIRO high resolution CARS climatology. The mean transport between New Caledonia and Vanuatu is close to 10 Sv towards the North-West.



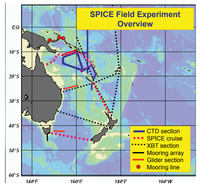
Climatologies are based on very little data in this area. Repeated hydrographic sections, Secalis-1, 3, 4 and WOCE-P21 are currently being analysed along with regional ocean models to understand the formation and behavior of the North and South Caledonian Jets.

The SECALIS program allowed consecutive measurements of the SEC inflow and the northern outflow including the North Caledonian Jet. Preliminary results from Secalis-1 below show, in 2003, a strong jet flanked by a counter-current against the coast of New Caledonia.

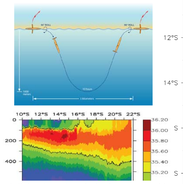


7-Towards a regional Programme: SPICE

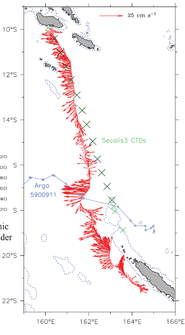
The SECALIS cruises contributed to the design of the Southwest Pacific Ocean Circulation and Climate Experiment (www.ird.nc/UR65/SPICE), aimed at understanding the role of the Southwest Pacific Ocean in the large scale decadal climate modulation of both ENSO and the Tasman Sea.
SPICE objectives are to:
1-Develop an observational program to survey the currents in the Coral, Solomon and Tasman Seas
2-Combine observations and modeling to devise an efficient monitoring program
3-Determine southwest Pacific air-sea fluxes and their effects on local climate.



SPICE will make extensive use of the Glider technology. Preliminary experiments with a SPRAY glider funded by NOAA's Consortium on the Ocean's Role in Climate have shown that gliders were able to sample recurrently the temperature, salinity and absolute geostrophic currents with a minimal infrastructure. Two SPRAY gliders have been deployed during Secalis-3 and -4. The figures on the right show the glider principle, its trajectory and the absolute geostrophic currents that it measured (Gourdeau, Kessler, Davis, Sherman, Maes and Kestenare, Zonal Jets entering the Coral Sea, to be submitted)



Salinity (upper) and absolute geostrophic velocity sampled by the SPRAY glider



8-References and contacts

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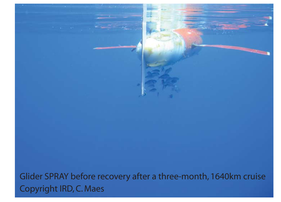

Glider SPRAY before recovery after a three-month, 1640km cruise
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