Gliders in the Solomon Sea

A collaboration:

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The ocean glider “Spray”:

The Spray glider is developed and built by the Instrument Development Group at the Scripps Institution of Oceanography, La Jolla, Ca, USA.

2 meters long, weighs 50kg

⇒ Work from small boats near shore, much cheaper than a ship.

Moves vertically like an Argo float; gliding controlled by moving the internal batteries.
There are several estimates of the interior subtropical-equatorial exchanges; our goal is a time series of the western boundary transport to the equator.

About half the SEC transport goes north through the Solomon Sea. Mean Solomon Sea transport is 15-20 Sv.
4 glider surveys so far (3 completed, 1 in progress)

- Red = Aug-Nov 07  (Rossel, PNG to Gizo, Solomon Islands)
- Yellow = Nov 07-Feb 08  (Honiara to Gizo via Rossel)
- Green = Feb-Jul 08  (Honiara to Gizo via Rossel)
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Vector absolute current above 500m (Tide-filtered)

An example of tide-filtering Gaussian objective mapping with a time-scale of 1.5 days. (Every other vector plotted)
Isopycnals above 25 slope down across the Solomon Sea. Upper shear is southward: WBC is an undercurrent.

Absolute crosstrack geostrophic currents from glider motion and relative geostrophy.
After 4 missions, is there a discernable “background”?

- The only consistent feature is a strong NGCC.
- Perhaps a consistent SW-ward flow in the northeast.
Pre-La Niña, “normal”

- Strong NGCC, $\sim 18$ Sv.
- Surprising that perhaps half the transport flowed through the narrow channels and reefs of PNG.
Arrival of the La Niña Rossby waves

- NGCC seemed to reverse during the course of the mission (???)
Late in the La Niña

- SEC reversed!
- Weak, disorganized NGCC.
Post-La Niña

- SEC restored
- NGCC will be too?
Strong downwelling curl at 4-12°S

\[ \text{Curl}(\tau)(10^{-7} \text{Nm}^{-3}) \]

(Quikscat winds, anomalies from the 99-08 annual cycle)
Anomalous winds and curl during Aug 07-Mar 08: La Niña

\[ \text{Curl}(\tau)(10^{-7} N m^{-3}) \]

Rossby (Island Rule) solution driven by these winds

\[ \tau (5 \times 10^{-2} N m^{-2}) \]

(Quikscat winds, anomalies from the 99-08 annual cycle)
The downwelling curl signature of the La Niña was strong. Its remote effects were fairly well simulated by a Rossby model, using the Firing et al. (1999) Time-dependent Island Rule and a Godfrey 1975 formulation for the Australia coastal signal.
Conclude

• Gliders are capable of sampling the South Pacific LLWBC. They (and their operation) are cheap enough to constitute a sustained monitoring program.

• NGCC transport is 15-20Sv, and varies interannually (?) to near zero.

• Flows in the eastern Solomon Sea need longer sampling.

• Deeper dives would be desirable (but are hard to accomplish).
Extra Figures Below
A dive of the Spray glider

A glider dives to 500-1000m, taking 3-5 hours, and moves forward about 2-4 km.

→ Very dense sampling

CTD measures, plus ....

Data reported by Iridium satellite each time it surfaces.

Estimate vertical-average absolute currents by the glider’s drift:

3 km
20 cm/s (3-5 hr)

Range about 4 months or 2000km
The glider is essentially an Argo float with wings and moveable batteries. The pump inflates and deflates the bladder to change its density. The glider’s only propulsion is a pump and external oil bladder. The battery packs move to control pitch and roll, so it glides forward as it rises and sinks. It moves very slowly (20 km/day).