Paper OS25N-14

A high-resolution glider section across the Pacific South Equatorial Current

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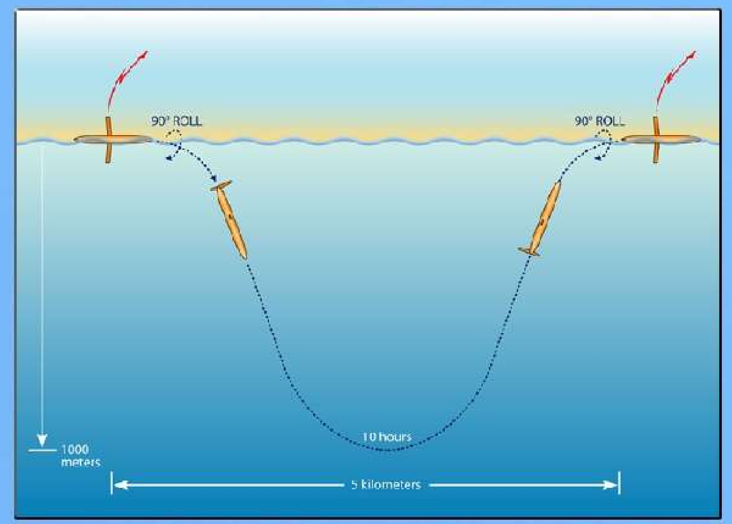
A dive of the Spray glider

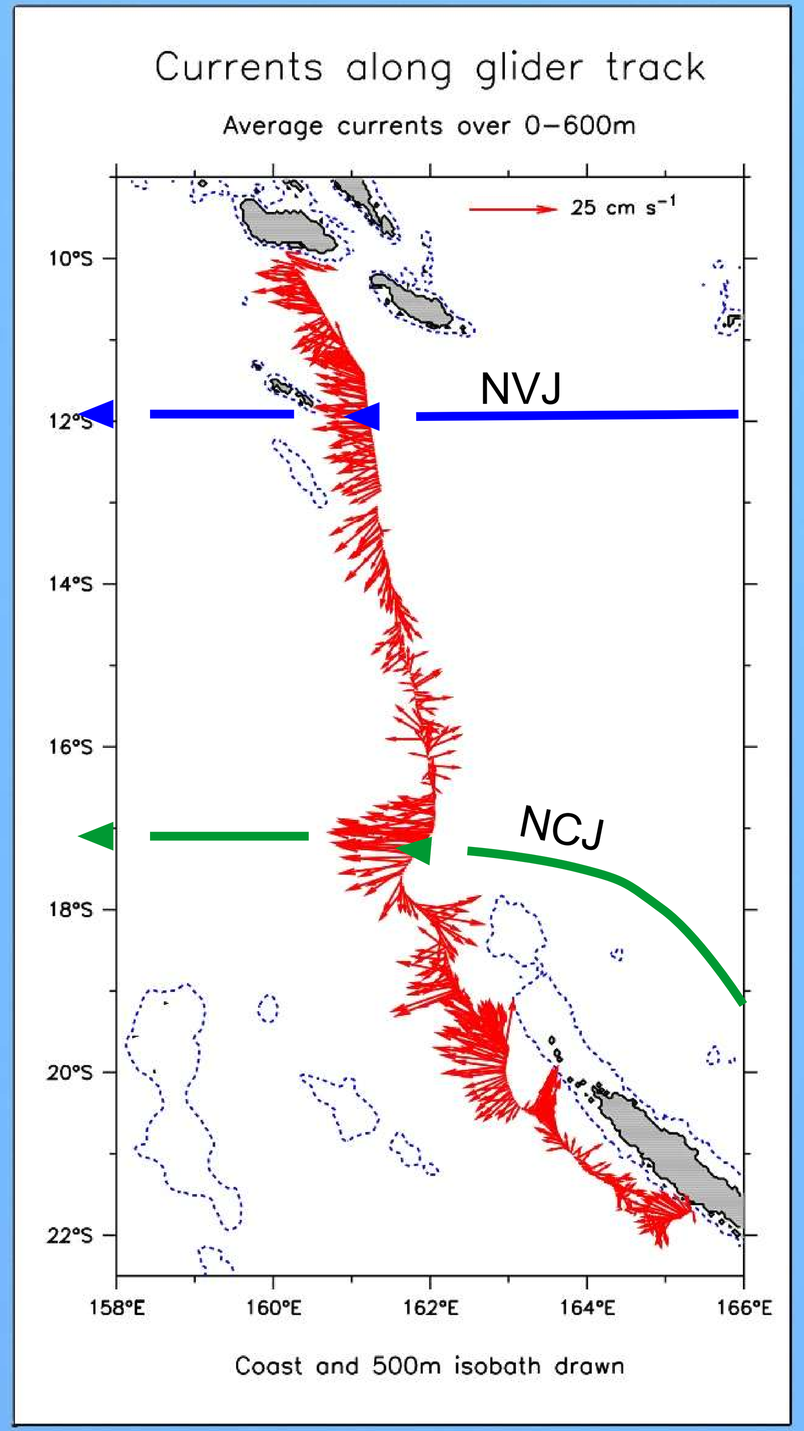


1 A glider uses a technology similar to Argo floats, but with the addition of wings and the ability to control its orientation in the water. As it rises and sinks (changing its density by pumping oil in and out of an external bladder), the battery packs inside move to control its pitch and roll, converting some of the vertical momentum to horizontal. A typical dive is at a slope of 17° from horizontal, so each of the 600m dives on this mission covered about 4km. The difference between the known path through the water and GPS fixes at the surface define the vertical-average absolute velocity. Profile information is transmitted by Iridium satellite each surfacing.

A full discussion of this technology, which describes and evaluates the three gliders in existence today, is given in:

Davis et al. (2003). Autonomous buoyancy-driven underwater gliders. In: Technology and Applications of Autonomous Underwater Vehicles. Ed. G. Griffiths, pp 37-58, Taylor and Francis.

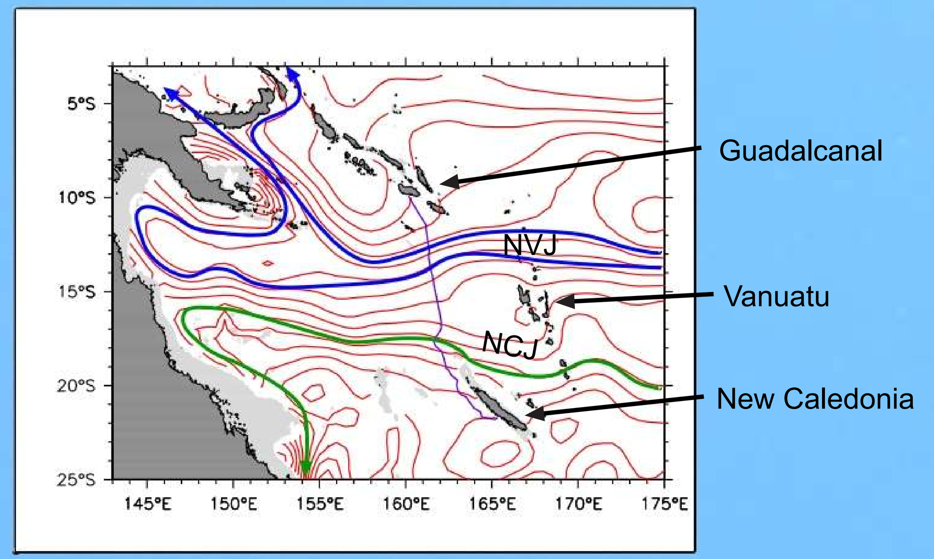
Rudnick et al. (2004). Underwater gliders for ocean research. Marine Technol. Soc. J., 38(1), 48-59.



2 Vectors of the 0 to 600m average velocity for each dive of the 4-month mission (17 July to 17 October 2005) from just offshore Guadalcanal Island to just outside the New Caledonian reef, covering 1640 km.

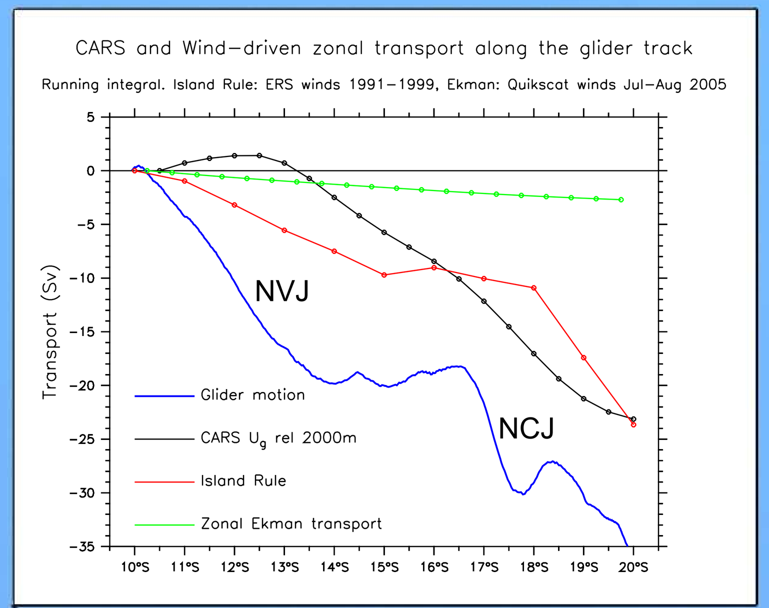
The South Equatorial Current (SEC) has two branches: the North Vanuatu Jet (NVJ), from about 14°S to 10°S, and the North Caledonian Jet (NCJ) that rounds the extensive reef system at 17°-18°S. Between them is a band of less-organized, generally eastward, flow. In the lee of New Caledonia, the glider passed through a region of eddies whose characteristics are poorly understood.

Coral Sea circulation at thermocline level

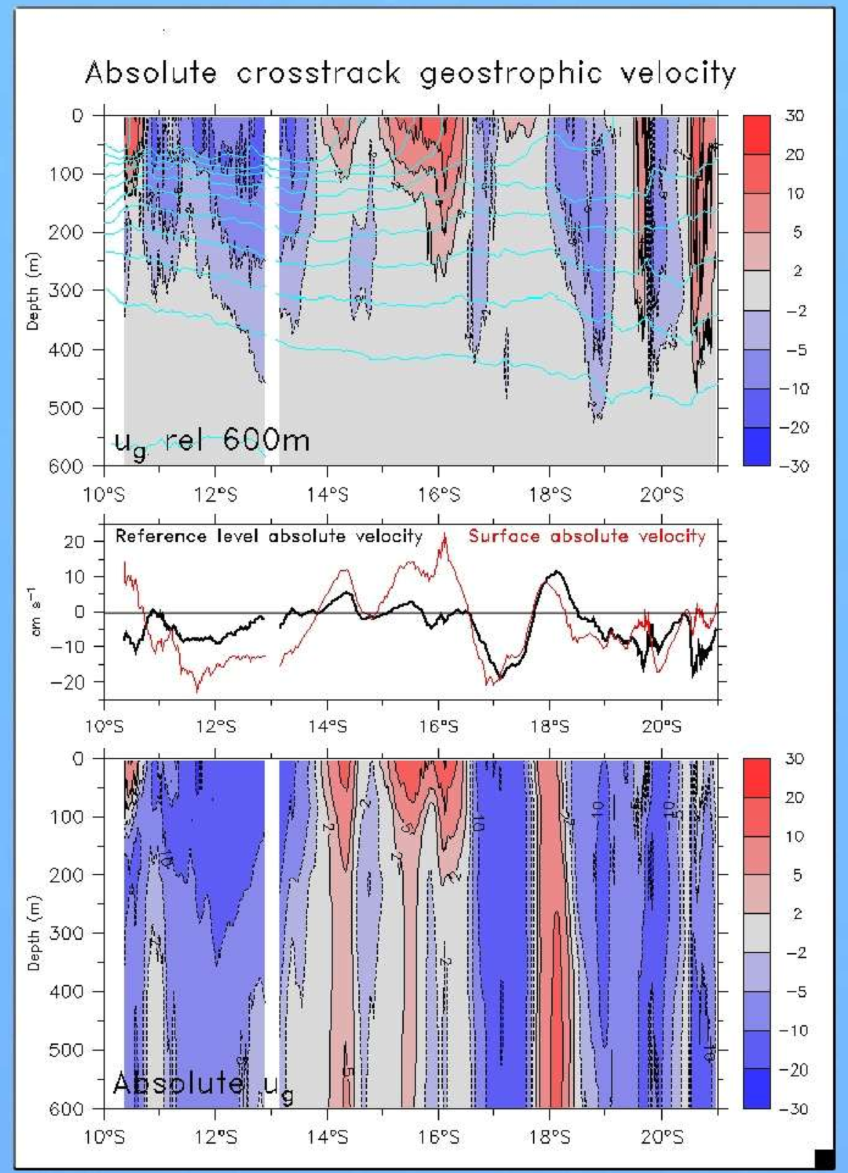


3 Geostrophic flow at 200m relative to 2000m from the CARS climatology (Ridgway and Dunn 2003). The blue and green lines show the NVJ and NCJ schematically, and the purple line is the glider track.

The South Equatorial Current enters the Coral Sea primarily through the gap crossed by the glider. After dividing around Fiji and Vanuatu, the southern jet is pushed north by New Caledonia, and flows westward to the coast of Australia. The SEC bifurcates at the coast, part flowing into the Solomon Sea and to the equator (note that the very north end appears to flow directly into the Solomon Sea), and part southward to become the East Australia Current.

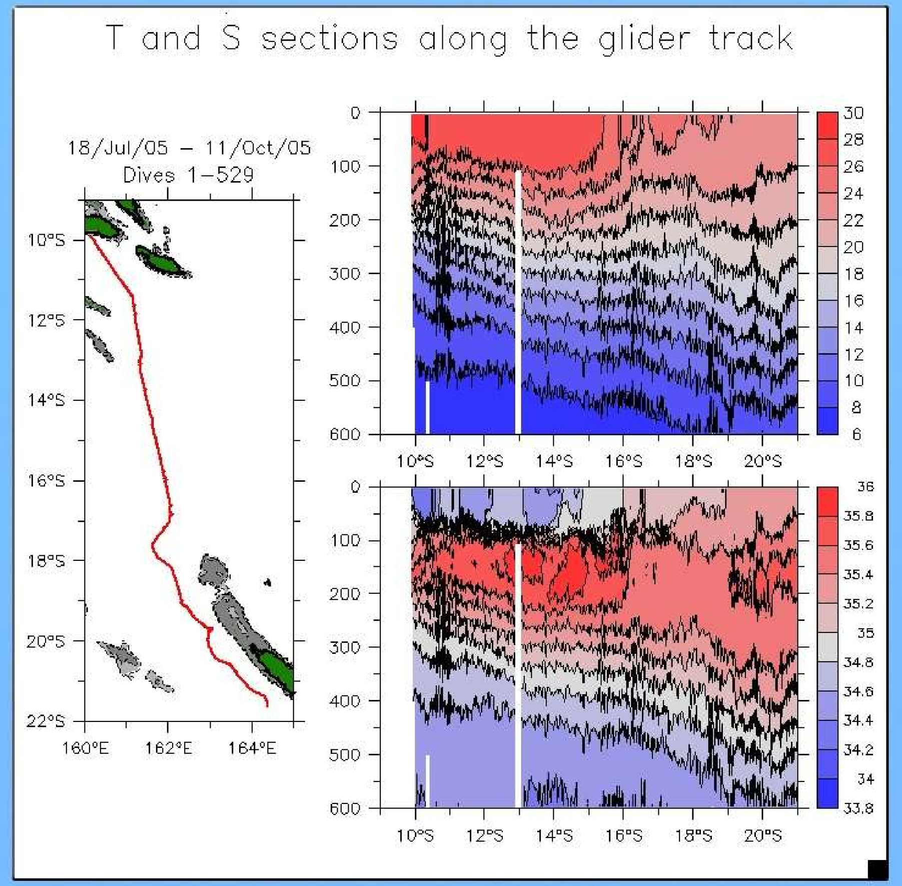


4 Zonal component of transport integrated along the glider track (integral southward from Guadalcanal).The division of the SEC into two jets is clear. In this snapshot, transport of the NVJ was about 20 Sv, and of the NCJ about 10 Sv; total transport measured was about 25% larger than either the CARS climatology or the Sverdrup "Island Rule" estimate. Since winds over the South Pacific were near seasonal normal during the months leading up to the mission, this is unlikely to have been due to interannual variations. Although the mission occurred near the seasonal transport maximum, the discrepancy is probably larger than the seasonal cycle could acount for.

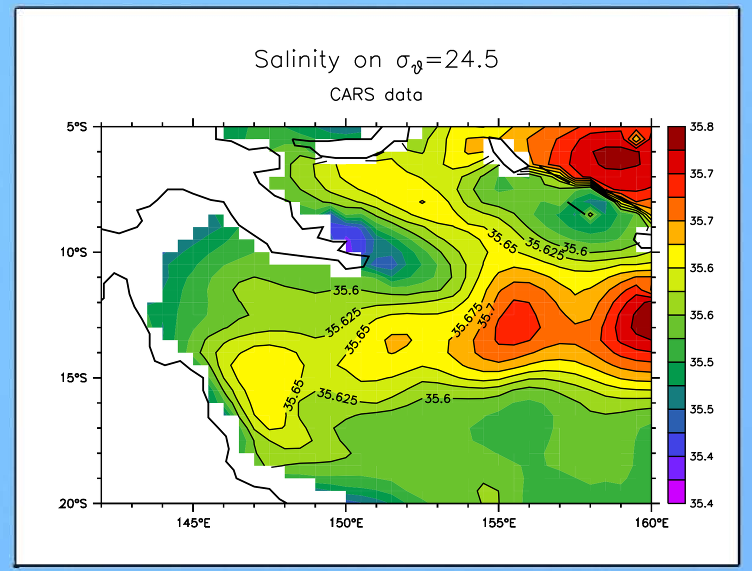


5 The glider provides both the cross-track geostrophic shear (top panel, with overlaid blue σ_θ contours) and the absolute (vertically-averaged) velocity. These yield the absolute (cross-track) geostrophic velocity (bottom); this can also be expressed as a reference level velocity (middle). Note that the cross-track Ekman velocity is small (O(0.5 cm s^{-1}) in the vertical average) compared to the geostrophic because the easterly wind is nearly across the track (see 4).

The 600m absolute velocity is almost as large as the shear flow above, and some features (e.g. the NCJ at 17°-18°S) are almost entirely due to structures below 600m.

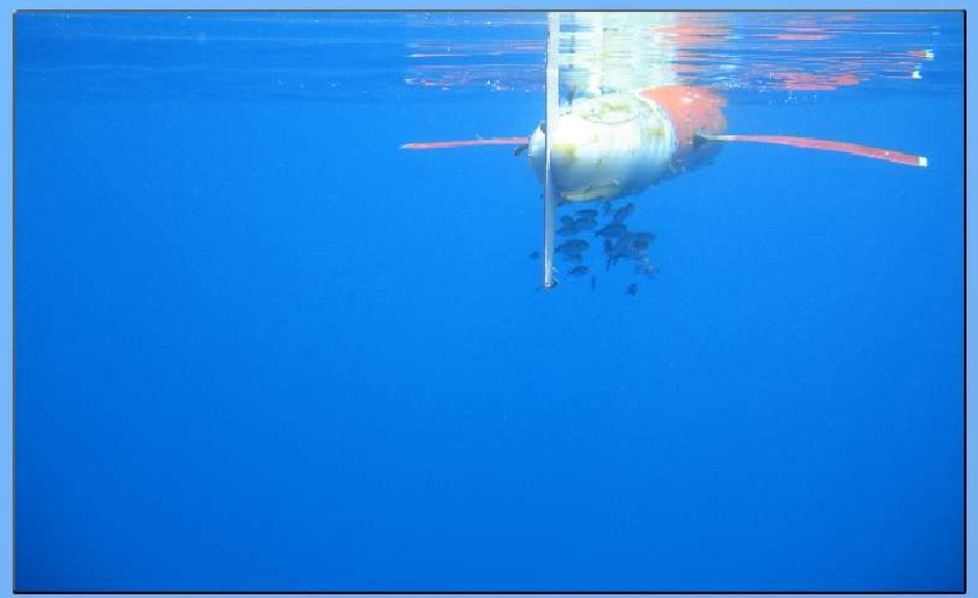


6 Temperature and salinity show the downward tilt of the thermocline on the equatorward side of the subtropical gyre (note that these sections have north on the left). The isotherms peeling off from the top of the thermocline show the tilt of the gyre bowl. A high-salinity core is seen in the upper thermocline near 13°-16°S; at 16.2°S, a high-salinity intrusion near 80m depth is associated with a temperature inversion of nearly 1°C.



7 CARS climatological salinity on σ_θ = 24.5. The high-S tongue subducted from the surface in the eastern subtropics has been advected in the thermocline around the subtropical gyre across the width of the basin. This tongue appears to be the same feature as the high-S core seen in the glider data (Fig. 6). The extension of the tongue into the Solomon Sea is consistent with the geostrophic flow pattern.

Just outside the New Caledonia reef for recovery



8 The Spray glider rests at the surface following the 4-month mission. Weighing 50kg, and able to maneuver to within a few km of the reef, it can easily be recovered by a small team in a zodiac. As shown, it blends inconspicuously into the environment.

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