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The Physics behind the Biophysical Oceanography of the Great Barrier Reef

by

Eric WOLANSKI[1]

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SUMMARY. — Here we emphasize a fundamental difference between shelf waters of the Great Barrier Reef (GBR) and other parts of the world. The water circulation over the GBR continental shelf, like that of continental shelves worldwide, is strongly influenced by the circulation in the adjoining sea. This circulation is dominated by the South Equatorial Current, which is highly mesoscale turbulent and takes the form of jets and eddies. As these jets approach the continental shelf, they bifurcate to the north and south. Commonly shelf waters have a gentle slope, with few shoals, islands and reefs until the shelf break. In contrast, the GBR has about two thousand five hundred reefs, resulting in a flow field largely uncorrelated with the mesoscale turbulence in the adjoining Coral Sea. The currents among reefs are generally dominated by strong tidal currents, topographic eddies, jets, topographically-driven upwelling and downwelling, shear zones, stagnation zones, and topographically-steered flows. The reefs generate a "bioengineered" physical oceanography dominated by a number of processes including (1) Bernoulli tidal upwelling in reef passages; (2) inflow of oceanic water from wave breaking at the reef crests; (3) swift tidal flow through reef passages and the channelization of the tidal flow on the shelf; (4) the wind deflecting intruding oceanic water back out to sea; (5) deflection of the mean currents around a reef matrix by the "sticky water" effect; (6) convergence of opposing tidal waves in the southern GBR; (7) reduction by the reefs of the inflow into the GBR from oceanic water.

[1] RAOS Member