Australian Government
Bureau of Meteorology

Climate and Oceans Support Program in the Pacific

COSPPac Ocean Portal
About: Forecast Ocean Currents

In Brief

Surface Ocean Currents *forecast information is available showing a* ***short term forecast****. Currents are viewed as a* ***speed*** *with a* ***direction****. The colour represents the speed and the direction is displayed as an arrow.*

The currents provided are driven by wind and density changes due to temperature and salinity. The model represents offshore currents in the open ocean; it does not account for local effects in the coastal zone.

Introduction

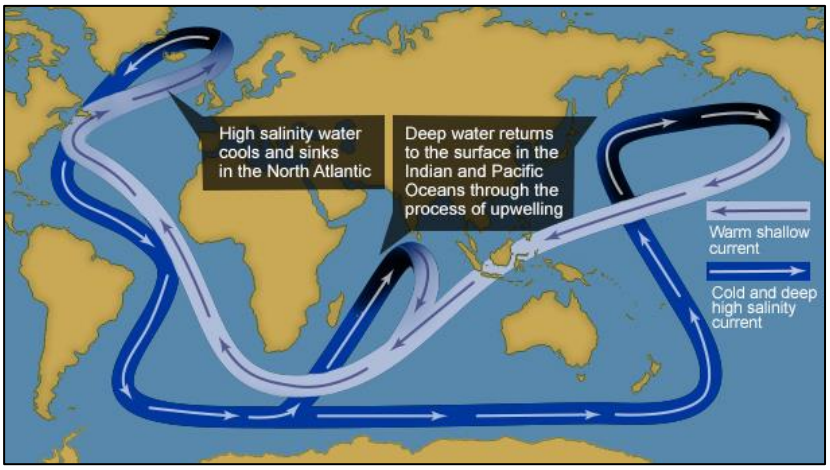
Even on a seemingly calm day, the ocean is always on the move, from the surface to the depths below. Currents move water in mainly horizontal directions (but also in vertical directions) and are driven by wind blowing across the ocean surface, differences in density related to salinity and temperature, and astronomical tides. Currents are steered by the rotation of the Earth as well as the locations of land masses and the shape of the ocean floor.

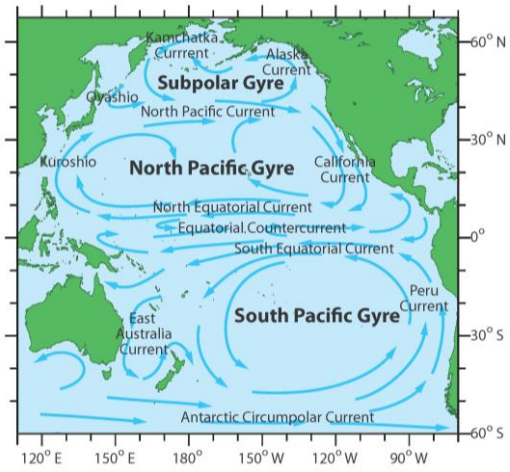
Ocean currents play a crucial role in:

- The transportation energy via heat and salt;
- Transport of nutrients and other chemicals, some of these may be pollutants and contaminants;
- Regulating the weather and climate; and,
- Sustaining marine ecosystems that are home to countless plants and animals that rely on the ocean for life.

Salinity and temperature determine the density or buoyancy of sea water. Generally at scales of 100 - 1000 km in the open ocean, warmer water with a lower salinity (less salty) is less dense and has a higher sea surface height than denser cooler water with a higher salinity. The difference in sea surface height between two areas creates a current, as water flows from the higher sea surface towards the lower sea surface.

On a global scale, changes in ocean density drive the transport of warm water poleward on the surface, to be replaced by the upwelling of cold, deep water originating from the polar regions. This transport of water drives the global thermohaline circulation (i.e. the circulation of heat and salt) within the ocean. This has been called the Global Conveyor Belt, and a particle of water can take up to 1,000 years to complete the journey.





At a basin scale, basin-wide circulations referred to as gyres are driven by large-scale atmospheric surface winds. The patterns of circulation are determined by the speed and direction of atmospheric winds, and the shapes of the ocean basins (Figure 1). It has been reported that garbage and debris accumulates within the gyres (Moore, 2003).

Figure 1. The gyres of the Pacific Ocean (picture source: Science Education Through Earth Observation for High Schools).

On a smaller scale, circulations known as 'eddies' are swirling movements that can be between 10 km to 200 km in diameter. They are relatively short-lived and are created when water spins away from a surface ocean current (Figure 2).

The water movement associated with tides induces relatively small tidal currents in the open oceans, but these currents can be substantially magnified by shallow water at coastal locations.

Currents have a major impact on human activities that take place in the marine environment, weather and climate, and the biological characteristics of the ocean.

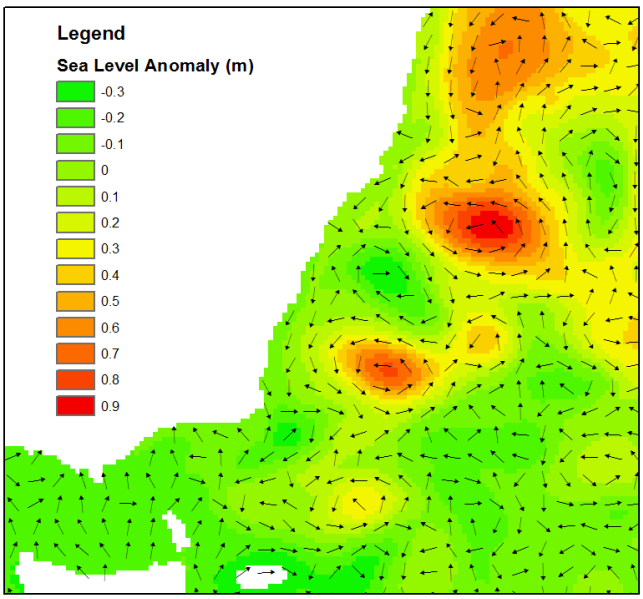
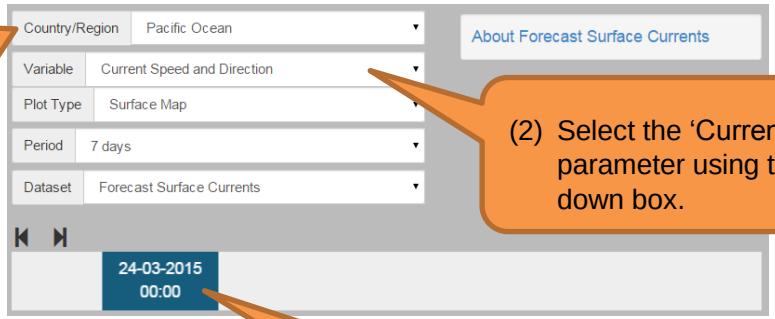


Figure 2. Anti-cyclonic (clockwise) eddies can be observed forming around higher sea level anomalies off the east coast of Australia (source: OceanMaps model)

Using the Portal

(1) For a regional view of a Pacific Nation's EEZ, select the country's name from this drop down box.



(2) Select the 'Current Speed' parameter using the 'Variable' drop down box.

(3) The slider at the bottom lets you select the date and time for the forecast information.

Description of Parameters

Current Speed with Direction:

The colours show the strength of the current speed in metres per second, while the arrows show the direction of the current. The currents shown in the Portal are indicative of the ocean surface offshore; they do not account for local effects in the coastal zone. The resolution of the dataset is 0.08°

Examples of Applications

- **Shipping:** Opposing currents can cause delays in shipping activities and increased fuel costs, which also leads to increased CO_2 emissions. Forecast ocean currents can be incorporated into route planning for offshore shipping activities in the Pacific, including inter-island ferry services.

- **Search & Rescue:** Ocean current forecasts can be used to track probable paths of people lost at sea and drifting survivor craft to improve search and rescue efforts, and to assist in estimating search areas.

- **Oil Spill Management:** Floating on the ocean surface, oil spills are spread by winds and currents. Forecast knowledge of possible oil slick movement can help inform an effective spill response, in theory leading to a reduction in potential clean-up costs and environmental impacts.

Data Source

The HYCOM Consortium provides near real-time global ocean prediction system based on the Hybrid Coordinate ocean Model (HYCOM) (Chassignet et al., 2007) and the Navy Coupled Ocean Data Assimilation (NCODA) (Lunde and Coelho, 2009). Surface forcing is from the NAVy Global Environmental Model (NAVGEM) version 1.2 The HYCOM models 3-dimensional temperature, salinity, and current structure with the ability to depict mesoscale features (fronts and eddies). Model resolution is 0.08 degrees.

Links

HYCOM + NCODA Global 1/12° Analysis

https://hycom.org/dataserver/glb-analysis

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References

Chassignet, E.P., Hurlburt, H.E., Smedstad, O.M., Halliwell, G.R., Hogan, P.J., Wallcraft, A.J., Baraille, R., Bleck, R., 2007. The HYCOM (HYbrid Coordinate Ocean Model) data assimilative system. J. Mar. Syst. 65, 60–83. doi:10.1016/j.jmarsys.2005.09.016

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Moore, C., 2003. Trashed: across the Pacific Ocean, plastics, plastics, everywhere. Nat. Hist. 112, 17–55.

Contact

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