NZASE resource

Oceans around Aotearoa/NZ

Major currents act like conveyor belts; currents in blue are colder, salty and deep; those in red are warmer and shallow. National Oceanography Centre, Southampton.

The islands that make up Aotearoa New Zealand are surrounded by vast areas of ocean. A good understanding of these oceans is vital if we are to manage our resources, safely enjoy the ocean, predict our weather and deal with climate change. NZASE Science Communicator Mike Stone outlines current knowledge about currents, tides and climate change, and how scientists gather this information.

Ocean currents

Under the surface the sea looks uniform to the untrained eye, but the water actually flows in large rivers called currents (remember *Finding Nemo?*). These currents can be identified by differences in salinity, temperature and depth, which change markedly at their edges (called fronts).

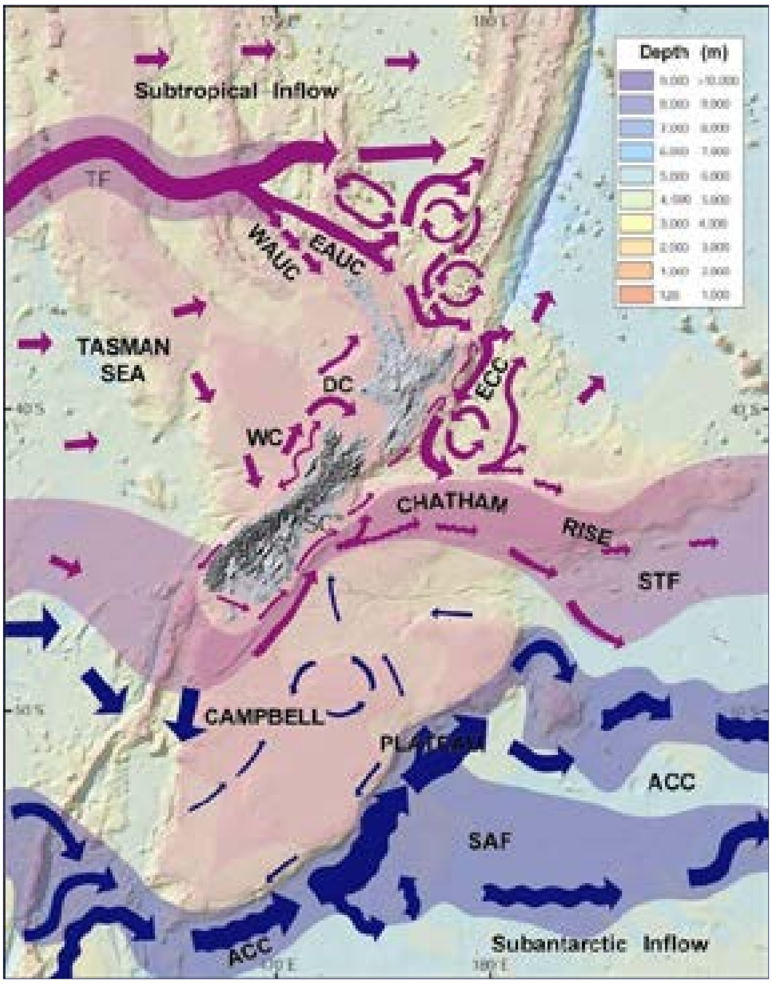
New Zealand lies in the path of several ocean currents. Those north of New Zealand are driven by winds from across the South Pacific Ocean. These winds propel warm, salty, surface water currents along the equator and down Australia's east coast before curving around and crossing the Tasman Sea. The current splits above the North Island and flows south around each coast, meeting up again north of the Chatham rise, then leaving our seas.

Further south, the cooler and less saline sub-antarctic current brings water south of Australia to the bottom of the South Island, moving up the east coast and along the south flank of the Chatham Rise before moving off, shown in the map to the right.

There are other currents around our islands at mid-ocean depths and on the bottom – these tend to be cooler, dense, and less saline than currents at the surface.

Closer to the pole, the Antarctic Circumpolar Current circulates deep, cold and very saline water. This massive ocean current is the only one that reaches from the surface to the bottom of the sea, and has the largest volume.

Ocean currents around Aotearoa/New Zealand; relatively warm currents are in red, and cooler currents in blue, with pale blocks of colour representing fronts. The Subtropical Front (STF) and Tasman Front (TF) enclose warmer surface currents; the width of arrows indicates the strength of the flow. The cooler Subantarctic Front (SAF) and the cold Antarctic Circumpolar Current (ACC) are to the south. Other currents are the East (EAUC) and West Auckland currents (WAUC), the D'Urville Current (DC), East Cape Current (ECC), and Westland Current (WC). NIWA.



Shelf seas

Our land is the visible tip of a mostly drowned continent, Zealandia. The seas of our continental shelf range from shallow, river-affected, coastal waters to essentially open-ocean – a diverse range of environments.

At the coast, offshore winds can push surface waters away out to sea, resulting in replacement by up-welling cooler, nutrient-rich waters. You can find this upwelling in places along the West Coast of the South Island and on Northland's eastern shores.

Tides

Some features of our tides are unusual. The gravitational pull of the moon, and to a lesser extent the sun, mainly drives tides. The moon's gravity attracts a water bulge (high tide) that follows its orbit of the earth, with another bulge on the opposite side of the earth giving us two high tides a day. The shape of the see floor also influences tides. Aotearoa New Zealand is unique in that the phases of these two tides, 12.4 hours apart, show a complete 360° range around the country.

In most cases, the tidal range is small - one to two metres - and tidal currents are about two km/h (one knot). An exception is

High tides (red) and low tides (blue) around Aotearoa/New Zealand; NIWA.

Raukawa Cook Strait, NIWA.

Raukawa/Cook Strait, which has very strong tidal currents. At its narrowest this water is 22km wide and 210 to 350 m deep (above). This occurs because when one side of the strait has low tide, it is almost high tide on the other. Water flows at up to eight knots (four m/s), because of the difference in water level moving through such a narrow gap. Scientists are investigating the tidal flow in this region for electricity generation.

Waves

Surfers know that sea and wind are intimately connected – waves form when the wind blows over a calm sea.

Aotearoa New Zealand lies across two zones of wind to the north and south. South-east trade winds dominate to the north, while the bulk of the country gets the roaring forties, a wide band of winds from the west. The Southern Ocean and lower Te Wai Pounamu get waves over four metres in some of the world's stormiest seas. In the north-east, waves are

Nga Kupu

Hauhā – Carbon dioxide
Hau weherua – Trade wind
Huringa āhuarangi – Climate change
Karekare – Surf, waves
Kato – Current
Kōkō – Wind
Mātai aumoana – Oceanography
Mātaitai – Salty, salinity
Moana-nui-a-Kiwa, Te – Pacific Ocean
Paenga paparahi – Continental shelf
Putunga waro – Carbon sink
Tai – Tide.

From Paekupu and Te Aka Maori Dictionary much smaller because the land blocks wind from the south-west.

The ocean and climate change

We know that our planet is warming due to the effect of increasing levels of greenhouses gases in the atmosphere. However, the ocean is also involved this process.

The ocean can store as much heat as the entire atmosphere in a few metres below the surface, and this heat moves in ocean currents. Surface water cools at the poles, becomes more dense and sinks, drawing in warm surface water from the equator. This sets up the great ocean conveyor belt that moves water, heat and nutrients around the globe (top of first page).

The sea is a carbon sink, absorbing more carbon than it releases. Carbon dioxide (CO_2) dissolves in water, and more in cooler water. Cool seawater is denser and sinks, carrying CO_2 to the depths. This keeps a significant amount of CO_2 out of the atmosphere, preventing its contribution to rising global temperatures.

El Niño is a fluctuation of the ocean–atmosphere system in the tropical Pacific Ocean that occurs every three to seven years. The resulting changes in the amount of heat moving from the sea to the atmosphere affect Pacific winds and our weather patterns. Opposite effects are caused by the La Niña weather pattern.

Marine instruments

Today's scientists use many tools to explore and measure the oceans.

Satellites such as NASA Landsat are equipped with sensors to measure the sea surface – sea temperature and height, wave height and direction, wind strength, and algal blooms.

Ship-launched instruments such as depth profilers record properties of the ocean under the surface.

Smart floats such as Argo floats record ocean properties as they drift in the upper 2km of ocean, then surface and transmit data to a land base.

An Argo smart float is readied for the ocean. When the Argo global network is complete, it will include 3,000 free-drifting floats that can measure the salinity and temperature of the ocean's top two kilometres. New Zealand research vessels released more than 100 Argo floats into the sea in 2003–4; NIWA.

Robotic ocean gliders are programmed to move underwater on a pre-determined path. They collect data from remote regions safely and relatively cheaply.

Computer modelling can also predict ocean behaviour in future climates, although this technology is in its infancy.

References

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