UNDERSTANDING HOW THE BIGHT'S **OCEAN WATERS MOVE**

At a glance

Projects

Oceanography of the Great Australian Bight: the science that underpins.

Surface waves and their effects on circulation.

Theme summary

To model fine-scale ocean circulation of the Great Australian Bight and simulate the effects of waves on day to day variations.

Project investigators

SARDI and CSIRO

Program partners

CSIRO, BP, SARDI, the University of Adelaide and Flinders University are working on a $20 million research program to better understand the environmental, economic and social value of the Great Australian Bight.

Project contacts

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Overview

The broad-scale features of ocean circulation in the Great Australian Bight are relatively well known, however the finer-scale ocean circulation requires further investigation.

These projects will develop supercomputer models that detail the ocean circulation at fine spatial scales and simulate the effects of waves on day-to-day variations. The models will underpin allied research that aims to:

- determine regional connectivity for scenario studies of hydrocarbon seepage and movement; and
- understand ecosystem variability, from phytoplankton to the distribution of top predators.

The Challenge

On the continental shelf during winter, the warm waters of the Leeuwin Current extend as far east as the Eyre Peninsula. Over the deep shelf slope, strong evidence exists for the westward-flowing Flinders Current which has links to the East Australian Current.

During summer in the eastern Bight, nutrient rich water upwells from depths of about 200 metres. The nutrients fertilise microscopic plants (phytoplankton), nourishing rich ecosystems that support sardines, whales, sharks and seals. In the central Bight, however, summer downwelling rather than upwelling occurs.

This summer downwelling in the central Bight, and the Flinders Current, are of particular interest as they link the productive shelves with the nutrient rich deep ocean (where exploration for oil and gas will occur). Also of interest are the Bight's unusually large waves, well known to mariners, that can alter the ocean circulation itself.

The Research

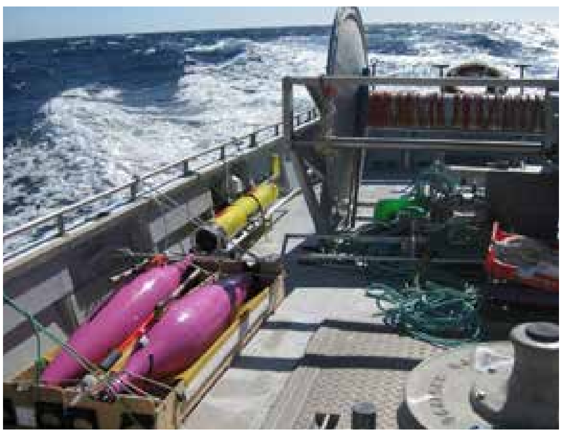
Ocean currents have a direct bearing on the marine ecosystem, but physically measuring and mapping these currents is difficult and expensive.

An alternate approach is to build computer models that simulate current variations, using previously recorded observations to 'hindcast' the day to day changes of ocean circulation over many years.

The models will be 'ground tested' using measurements collected by satellites and at sea. These data will include:

- current meter moorings deployed by BP;
- BP wave and meteorological buoys installed in the Bight;

Below: *Two purple seagliders (deep sea) and one yellow slocum glider (shallow water) ready for deployment.*



- Integrated Marine Observing System (IMOS) moorings, gliders, mammal-borne sensors and high frequency radars;
- Argo autonomous deep-profiling probes and gliders;
- Bureau of Meteorology wave buoys and coastal tide gauges;
- satellite observations of wave height, sea level, temperature and ocean colour; and
- international global model estimates of atmospheric, wave and ocean variables.

The analysis will produce a time history of ocean currents and wave properties for easy access by other scientists and the public.

The Impact

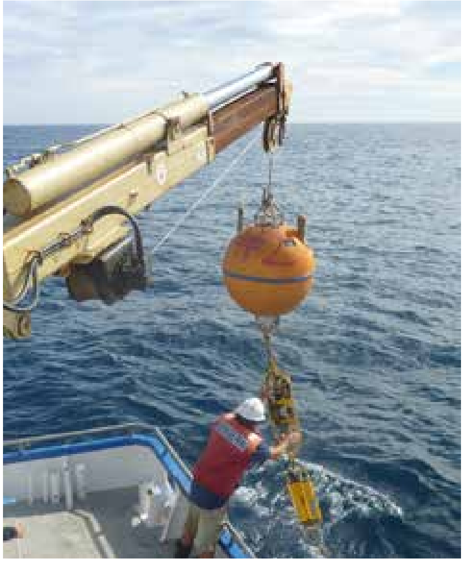
The ocean and wave model development, validation and analysis is well under way. Ocean and wave models will lead to:

- a better understanding of the shelf and slope circulation and important underlining physics, including the effects of waves;
- better and more accessible satellite products for temperature and ocean colour (chloryphyll-a);
- a greater understanding of the impact of ocean currents and waves on the benthic environment and the planktonic ecosystems that underpin the rich diversity of marine life for the region;
- the identification of hot-spots of marine life and possible bio-physical drivers; and
- connectivity of deep slope waters with the shelves and origins of naturally occurring petroleum tar balls found in the coastal regions.

The People

Associate Professor John Middleton leads the Oceanography Subprogram at the South Australian Research and Development Institute (SARDI). He has developed new theories of coastal ocean circulation and developed ocean models that have demonstrated the nature of the circulation along Australia's southern shelves. He has a strong background in mathematics and oceanography, data analysis and ocean modelling.

Dr David Griffin of CSIRO is a physical oceanographer specialising in phenomena including eddies, fronts and boundary currents. His research interests include observing, modelling and forecasting ocean conditions (including as a leader of the BLUElink ocean forecasting system),



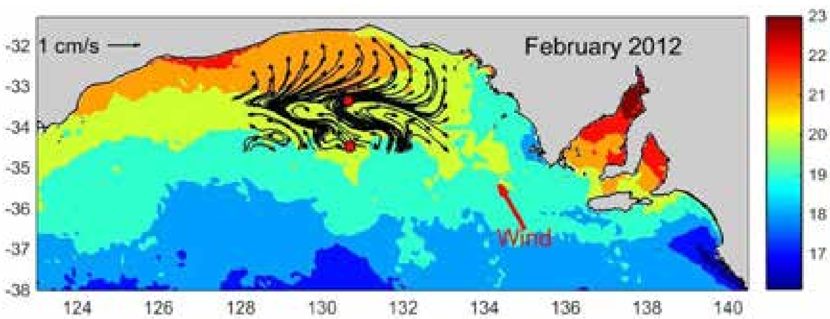
Above: *Deployment of a SAIMOS mooring by SARDI's RV Ngerin - cruical data used for model validation and analysis.*

ocean renewable energy from currents and waves, and data assimilation and satellite remote sensing.

Dr Mike Herzfeld of CSIRO is a physical oceanographer specialising in hydrodynamic modelling, particularly in coastal environments. His interest is in the improvement of numerical algorithms in regional models, with a focus on open boundary conditions. He is currently leading modelling activities in the marine modelling component of eReefs.

Dr John Luick of SARDI has over 30 years experience in ocean modelling. John is taking a lead role in the development and validation of the ocean model using the internationally adopted Regional Ocean Modelling System.

Dr Charles James of SARDI is a physical oceanographer with over 20 years of experience collecting and analysing oceanographic data and running computer simulations of physical processes. His current work includes developing coupled wave-ocean models (SWAN/ROMS) and coupling physical and biological models. His responsibilities at SARDI also include supervising the Southern Australian IMOS field program.



Above: *The monthly-averaged (February 2012) Sea Surface Temperature as predicted for the domain of SARDI's ROMS model (colour bar °C). The (red) wind vector is a monthly-average and the direction consistent with the cold Bonny coast upwelling illustrated in the far right of the figure. The summertime warming expected in the coastal and gulf regions is illustrated. The black curvilinear arrows correspond to depth-averaged currents obtained by local interpolation of the instantaneous velocity back from the arrow head and for a patch of the model: the length of a 5 cm/s vector is shown. The velocities are broadly consistent with an expected summertime anti-clockwise circulation in the Great Australian Bight. The red dots correspond to the sites of the BP current meter moorings.*

For more information

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bp CSIRO Government of South Australia Primary Industries and Regions SA

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