The Global Ocean

The oceans share with the atmosphere the role of transporting heat around the Earth. Furthermore, the oceans' vastly greater heat capacity both exerts a moderating influence on seasonal and longer climate changes and provides a mechanism for sustained ocean influence on the atmosphere. This feature, sometimes referred to as the ocean's climate "memory" provides one of the main bases for our ability to predict climate. Hence CLIVAR devotes much of its energy to the study of the role of the oceans in climate. CLIVAR does this through intensive regional and process studies, through systematic sustained satellite and in-situ observations and through modelling.

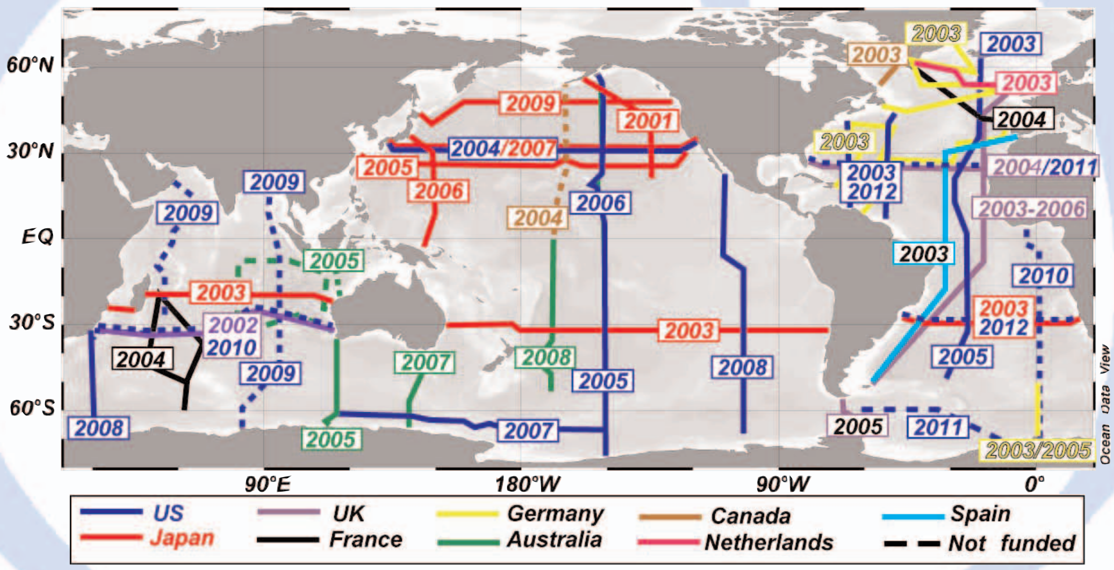
Activities

CLIVAR requires a wide range of ocean observations of adequate quality that can be combined to produce products needed for climate prediction experiments and research. Additionally, CLIVAR must develop consistent historical in-situ and satellite datasets to provide a context for current conditions as well as for exploring variability over longer time periods. CLIVAR builds on the considerable achievements of earlier World Climate Research Program initiatives: the 1990-1998 World Ocean Circulation Experiment (WOCE), that included an intensive ocean survey as well as the advent of several new remote-sensing capabilities and the 1985-1994 Tropical Ocean Global Atmosphere (TOGA) project, that established the ENSO observing system including the TAO/TRITON mooring array.

Regular maintenance trips are made to the TAO/TRITON array.

Ocean changes over decades, whether natural or human-induced, have been documented by comparing temperature/ salinity data from hydrographic sections. WOCE made a comprehensive global survey and CLIVAR, in partnership with the International Ocean Carbon Coordination Project, will repeat many of the WOCE sections so as to document change and create new ocean carbon inventories.

ENSO events cause major disruption and their early detection and forecasts of their development depend on observations from the TAO/TRITON array, from satellite observations of sea surface height, SST, and vector winds and from meteorological observations from merchant ships. Similar observing systems are now extending to the Atlantic and Indian Oceans. Additionaly satellite-derived ocean colour measurements are also known to provide early indications of ENSO events.



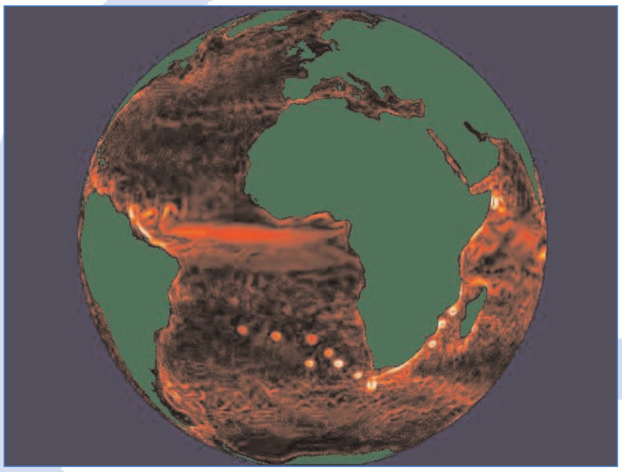
Planned and completed CLIVAR hydrography cruises with carbon measurements (www.ioc.unesco.org/ioccp).

WCRP is sponsored by WMO, ICSU and IOC

The NASA-CNES Jason-1 and the Topex Poseidon Altimeter satellites that measure the distance between the satellite and the ocean.

CLIVAR also depends on the Argo project to provide temperature and salinity profiles in the upper ocean from autonomous profiling floats. Over 1100 of the planned 3000 floats now deliver 3300 profiles per month in real time. Argo data have already been used in a wide range of climate applications and (with satellite altimetry) are a key to documenting the state of the global ocean and its storage of heat and fresh water.

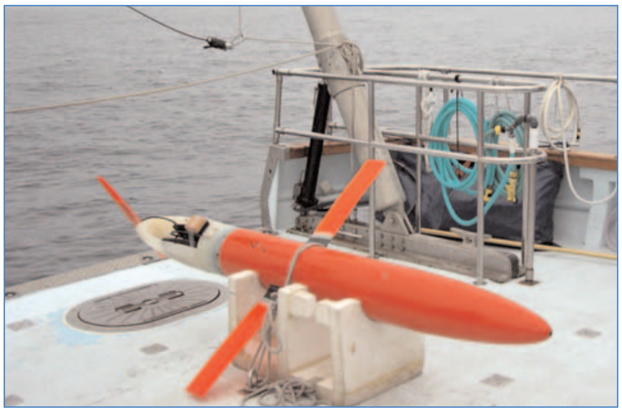
Since their introduction 30 years ago ocean observing satellites have provided global observations of ocean surface properties. In addition to robust historical records of these observations, CLIVAR particularly requires ongoing precise radar altimetry to monitor heat storage and currents, and (together with in-situ gauges) global variations in sea level. Vector winds from scatterometry and measurements of sea surface temperature are also essential. Proposed measurements of sea surface salinity from space and improved measurements of the geoid will provide new opportunities for CLIVAR.



Output from the global ECCO Consortium model.

High resolution global ocean models can now be used in coupled experiments and significant progress has been made in the the representation of physical processes in ocean climate models. CLIVAR is comparing state-of-the-art ocean models used in the IPCC class of climate models. Observations are essential for the validation of these model runs.

The ocean cannot be adequately described by observations alone. Rather, in-situ and satellite observations are assimilated into models to provide evolving estimates of the ocean state just as is done for the atmosphere by forecast centres. With the availability of sustained ocean observations, routine ocean state estimates and forecasts are now possible. Retrospectively the ocean state can now be reconstructed over the last 50 years in parallel with atmospheric reanalyses.



One of many autonomous Gliders currently under development.

Future Plans and Challenges

Our ability to observe and document the oceans' state has made enormous strides in the past 2 decades aided by satellites, autonomous instruments and a realisation of the importance of the oceans in climate. The observations identified here need to be sustained and their data managed effectively. As our ability to observe the ocean at global scales and our understanding of important climate processes improves, so the observing system can be made more effective.

Improvements in technology, new autonomous sensors, new observing platforms such as moored profilers (for time series observations), gliders (ideal for observing near ocean boundaries), the ability to measure under ice and better data communications will enhance our capabilities.

These together with improvements in models and data assimilation allow CLIVAR to play a central role in developing our understanding of the oceans' role in the coupled climate system.

More information on CLIVAR's Global Synthesis and Observation Panel activities can be found at :
http://www.clivar.org/organization/gsop/ | http://www.clivar.org/data/
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