

Estimating the Circulation and Climate of the Ocean

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The purpose of the effort supported by the Ocean and Climate Change Institute (OCCI) was to foster a collaboration between scientists at WHOI and the Estimating the Circulation and Climate of the Ocean (ECCO) project. The ECCO project is a large multi-institutional effort involving oceanographers and computer scientists at the Massachusetts Institute of Technology (MIT), NASA's Jet Propulsion Lab, and the Scripps Institution of Oceanography. The main task of the project is to combine a numerical simulation of the global ocean circulation with existing observational data streams — including data from ship-based surveys, satellite observation, and measurements from the Argo float program — to obtain the best estimates of the ever changing ocean circulation. The purpose of the ECCO project is ultimately to provide a tool for studying large-scale ocean dynamics, designing observational programs, and examining the ocean's role in climate variability. However, in order to achieve this, much work needs to be done to bring ECCO from its current experimental status to that of a practical and operational tool for oceanography.

While much of the ECCO project is devoted to the technical development of mathematical and computational details of combining observational data with an ocean circulation model, less effort has so far been spent on evaluating whether the estimates are realistic. These numerical ocean models require vast amounts of time on the world's largest supercomputers to accomplish. In many cases, numerical ocean models provide detailed simulations that are beautiful to look at and yet are wrong when compared to the real observations. It is the role of WHOI scientists involved in this project to evaluate the truthfulness of the ECCO output. One of WHOI's greatest strengths lies in its seagoing and observational work. WHOI has many observational oceanographers with datasets in hand that can be used to evaluate the skill of the ECCO ocean state estimates. This work will ultimately lead to improvements in the ECCO project.

An ad hoc group of members of the WHOI Physical Oceanography department began a collaboration with the ECCO project to evaluate and utilize these ocean state estimates. Our scientific interests are very broad including: property fluxes around the globe, dynamics of boundary currents and jets, tropical oceans, the southern ocean, and the circulation and sea-ice distributions in the Arctic and Antarctic. There are many observational programs already underway at WHOI that would benefit from interactions with the ECCO project. These include the CLIVAR Mode Water Dynamic Experiment (CLIMODE) in the Atlantic Ocean, the Kuroshio Extension System Study (KESS) in the Pacific Ocean, the Diapycnal and Isopycnal Mixing Experiment in the Southern Ocean (DIMES), Argo float data synthesis, air-sea flux estimate improvement, and Arctic observations. The ECCO output can help provide a broader context in which to place these observations and fill in missing data gaps.

Using the funding provided by provided the OCCI to the ECCO collaboration, we:

- Provided a computer for a Postdoctoral Investigator, Alan Condron, whose salary was supported by MIT via the ECCO, but was supervised by Peter Winsor (WHOI, PO).
- Set up and maintained a webserver to provide the ECCO output to the WHOI community.
- Hosted and attended meetings between the MIT and WHOI groups involved in the ECCO collaboration.

A limited part of the ECCO collaboration that was initially supported by OCCI is still continuing via other fund mechanisms. This is principally being done by Elizabeth Douglass, a WHOI Postdoctoral Scholar, who is working with the KESS and CLIMODE datasets in conjunction with the ECCO analysis.