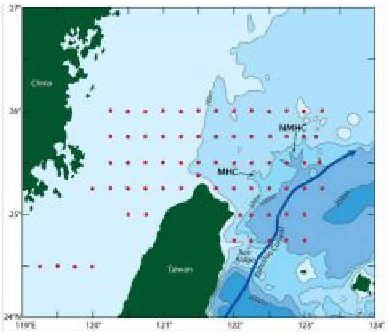
# East China Seaâ€™s Physical Oceanography Explored




Just days before a team of researchers from Woods Hole Oceanographic Institution (WHOI) and National Taiwan University set out to conduct fieldwork in the East China Sea, Typhoon Morakot â€” one of the most destructive storms ever to hit Taiwan â€” made landfall on the island, causing widespread damage and drastically altering the flow of water along the nearby continental shelf. This provided interesting â€˜liveâ€™ research topics.

In their work to understand the strong currents over the continental shelf and slope in the East China Sea, the researchers used four ships for intensive sampling of the continental shelf and slope, and deployed several moorings and conducted high-resolution hydrographic surveys. But the timing of their research also enabled them to examine the impact of freshwater run-off from Typhoon Morakot on the continental shelf northeast of Taiwan, the upwelling and cooling that occurred over the continental shelf after the Typhoon, and the effect of Typhoon Morakot on the biogeochemistry and nutrient dynamics of the continental shelf.

The research has just appeared in a special issue of the *Journal of Marine Research*.

The East China Sea is home to some of the world’s most active fisheries and shipping lanes. However the basic oceanography of the area is not yet well understood, according to WHOI coastal oceanographer Glen Gawarkiewicz, one of the primary investigators for the programme. The currents in the region are extremely powerful, and are constantly shifting and changing, which makes it tough to predict how the ocean will behave there at any given time. This makes that computer models of the area have a large degree of 'uncertainty' or margin of error.

The joint programme, called 'Quantifying, Predicting, and Exploiting Uncertainty' (QPE), is using data collected in the field to understand how uncertainty in computer models of the ocean near Taiwan changes in time and space. The QPE team aims to be able to improve the current oceanographic understanding of the East China Sea and improve methods used to model similar currents around the world. Funding for the program was provided by the U.S. Office of Naval Research.

The main goals of the QPE programme are to understand how a feature caused by upwelling of cold water, dubbed the 'Cold Dome', forms along the continental slope, and attempts to predict when and how it might appear. The QPE researchers also set out to examine when and where the Kuroshio Current (a large regional current similar to the Gulf Stream) pushes onto the continental shelf, causing complex currents to appear.

The QPE team conducted their fieldwork in the East China Sea during August and September 2009, using a satellite link to interact remotely with ocean modeler Pierre Lermusiaux at Massachusetts Institute of Technology. Each day, Lermusiaux ran computer models of the region, looking for areas of high uncertainty, then directed the team to those spots to collect samples and measure currents. The team immediately sent this new data back to Lermusiaux, who fed it back into the model. In this way, the researchers were able to improve the model’s accuracy in real time.

In addition to studying the currents of the East China Sea, the researchers also examined the formation of internal waves,long pulses of energy created either by tidal currents or by water moving past underwater physical barriers, like a ridge or canyon on the ocean floor. Although these w aves form deep underw ater, their location van be tracked by looking for surface disturbances.

Internal waves that passed beneath the ship were measured using sonar following the movement of plankton, tiny plants and animals suspended in the water.

While conducting fieldwork in the region, the QPE team were also given a rare opportunity to measure changes in ocean currents caused by Typhoon Morakot. After the powerful storm passed through the region, the researchers found a strong coastal current formed and began to pull freshwater runoff from Taiwan’s coastal region into the ocean hundreds of miles north of the island. This runoff carried pieces of wood, broken tree trunks, and even farmed freshwater fishes hundreds of miles northeast of Taiwan. The storm also drove upwelling of deep, cold water onto the continental shelf, which increased the amount of nutrients and phytoplankton after the storm.

*Image: The red dots represent profiles of water sampled during the broad scale survey. MHC denotes Mien-Hua Canyon while NMHC denotes Northe Mien-Hua Canyon. (Figure by Jack Cook, Woods Hole Oceanographic Institution).*