Atmosphere–Ocean Interactions in the Exteme

ITOP: Impact of Typhoons on the Ocean in the Pacific

Narrator: Typhoons — tropical cyclones over the western Pacific Ocean. These huge, powerful storms draw their energy from the warm humid air over warm ocean waters. Typhoons pose major threats to navigation, lives, and property.

Narrator: In late 2010 scientists ventured into the path of three major typhoons.

Eric D'Asaro: I'm Eric D'Asaro and I'm at the University of Washington Applied Physics Laboratory. We're talking about ITOP, which is the impact of typhoons on the ocean in the Pacific.

Narrator: To measure that impact, the Office of Naval Research and the Taiwan National Science Council teamed up with APL-UW to deploy scores of instruments into the western Pacific Ocean.

D'Asaro: We fly out in front of the typhoons with the C130s, drop these oceanographic instruments in there, and then the typhoon runs over the instruments.

Narrator: APL-UW's Eric D'Asaro wanted data from in the water. And data you get only by flying into the storm.

D'Asaro: We do penetrations of the typhoon with the aircraft. They make more measurements. You have to actually put instruments right into the typhoon because that's where it's happening.

This is one of the floats that went into the typhoons. It was designed, built, tested, and checked out at the Applied Physics Laboratory. After the float package lands in the ocean, the float package opens up and then this drogue opens up and now we have a float as it looks in the ocean.

The typhoon comes along and the typhoon starts mixing up the ocean. What does that mean? It means it takes the water that's near the top of the ocean and mixes it down. It takes the water that's a little ways down in the ocean and mixes it up. This instrument – because it's floating like a balloon – traces those motions.

This instrument is equipped with a number of sensors. It's got a pressure sensor, which is here. Down underneath, they've got sensors that measure temperature and salinity. That tells us how much it's raining and how much heat comes in and out of the typhoon from the ocean.

Narrator: Typhoons leave visible 'scars' in the ocean. The warm ocean water that energizes typhoons is only a thin layer on top of a deep, cold ocean. The typhoon's winds and waves mix these layers, churning the cold water to the surface.

Rosalinda Mrvaljevic: My name is Rosalinda Mrvaljevic and I'm a 3rd year graduate student here at UW studying physical oceanography. Eric D'Asaro is my major professor. I just defended my Master's on this work — ITOP and the cold wake of Typhoon Fanapi.

September 17th was the date that we made the first deployment of oceanographic instruments — the EM-APEX floats and the ADOS floats approximately along this line 24 hours before the storm was supposed to get there. Here we have the 18th of September and the storm has run over the array of floats. And you can really see the sea surface temperature — this cold wake has formed and it's a pretty dramatic feature. It is about 26.5 degrees... so about 2.5 to 3 degrees cooler than the sea surface temperature was before.

The wake is much more persistent than sea surface temperature says it is because it's trapped below the surface. The sun comes out. The surface is warmed. You have a warm "cap" we're calling it that forms on the surface. But below is this thick mixed layer of 26–27-degree water that is almost like a lens or a thermostad. I found that this thick layer lasts for 20, 21, 22, 25 days.

Narrator: The cold wake that forms underneath a typhoon decreases the sea surface temperature and may reduce the storm's energy supply and intensity.

D'Asaro: We put ten of these floats into two typhoons in the Pacific. And that's one of the largest data sets for measurements of the ocean underneath typhoons that's ever been taken.

Narrator: ITOP scientists hope that ocean measurements taken before, during, and after typhoons will improve the coupled model simulations of atmospheric and oceanic processes during typhoons, and inform operational forecast and warning systems.

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