Why did a category-two Hurricane hit Nova Scotia?

An explanation of the unusual intensity of Hurricane Juan

Prepared by Chris Fogarty
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It is not rare for hurricanes to strike Nova Scotia (once every three years lately), but usually they are barely hurricane strength when they reach our shores. Hurricane Juan made landfall on September 29th, 2003 as a marginal category two hurricane with maximum sustained wind speeds of 85 knots (157 km/h). Based on hurricane records during the past 100 years, it appears that such a strong hurricane in Nova Scotia occurs only once in 50 years.

So what made Juan so powerful when it reached Nova Scotia? The answer to that question has a lot to do with the unusually warm ocean surface water temperatures during the tail end of September 2003. Hurricanes need 26°C water temperatures to intensify. Once they move over colder waters, they begin to weaken. The rate at which they weaken depends strongly on the water temperature. The general water temperatures between the Gulf Stream and the Nova Scotia coast on September 27th were about 18-19°C, which you can see here. The normal temperatures are around 14-15°C for this date. The basic answer to the question is that the warmer-than-normal water slowed down the rate at which the hurricane would normally weaken in this region.

There is more to the story than just water temperatures. Hurricane Juan actually did not weaken much at all when it headed across the cooler shelf waters south of Nova Scotia. The hurricane accelerated, and as a result, the wind speeds increased relative to the ground and ocean. The storm on its own was still weakening, but the rapid forward motion almost counteracted the weakening as far as wind speeds were concerned. Furthermore, the hurricane spent less time over the cooler waters because it was moving so rapidly, and hence there was less time for the storm to weaken.

The warmer-than-normal water can have two effects. Firstly, it can keep the hurricane going a little longer than it would otherwise. Secondly, the atmosphere is more unstable if the water is warm, and this equates to stronger winds reaching the ground and ocean. If stronger winds reach the ocean, then these winds can help fuel the storm with more moist energy from the water. There are indications that hurricane Juan may have been 10-15 knots weaker when it hit Nova Scotia under normal ocean conditions. That would correspond to a 70-kt (130-km/h) storm. When you factor in the increased stability of the atmosphere over 15-degree (as opposed to 18-degree) water, this may account for 5-10 kts less wind at the surface. These considerations leave you with a marginal hurricane hitting the coast, with less damage.

More work will be done in order to quantify the influence of ocean surface water temperature on the intensity of hurricanes in Atlantic Canada. If the seemingly small departure of water temperature from 15°C to 18°C makes a significant impact on storm strength like we believe, then we should be very concerned about long-term trends in ocean temperatures. This *could* happen in an increasingly warmer climate or with changes in the dynamics of the warm Gulf Stream that may allow warmer waters to move toward Nova Scotia.