Rational for revision

The *original* 18th Air Sea Interaction conference presentation suggested that spray is produced mainly under the eyewall of the right rear quadrant and then deposited to the right of the hurricane track. This *revised* theory suggests that the spray is produced along the hurricane track and carried by the wind to the right of the hurricane track. See link to figures showing the revised and original spray production and deposition areas. The revised theory is based on the surface and subsurface sea temperature measurements in paper: Cold Wake of Hurricane Frances and its associated auxiliary material to which links are also provided.

Careful examination of the auxiliary material indicates that spray production can take place up to 400 km behind the eye and that the spray could be most intense 200 to 300 km behind the eye. The auxiliary material was not available to the presenter before the conference. The original presentation suggested that the wind direction reversal associated with the passage of the hurricane is responsible for greatly increased spray production because well established waves coming from the right are suddenly hit by wind coming left. The reason for the delayed spray production may be that it takes time for the wind coming from the left to breakup well established swell coming from the right. When hurricane Ophelia passed over buoy 41049 in 2011, the average wave period went from 10 minutes at eye to 6 minutes 100 km behind the eye; there was a corresponding increase in wave steepness from average to very steep. The short steep waves regime extended up to 400 behind the eye.

The *original* presentation suggested that the spray was centrifuged out to the right of the track. The *revised* theory does not require the intervention of centrifugal force; the spray is simply carried by the wind and settles down by gravity. At a wind velocity of 40 m/s, the air could take 25 min to travel the 60 km between the center of the spray production area and the center of the spray deposition area. Droplets falling from a height of 150 m at a velocity of 0.1 m/s could take 25 min to reach the sea surface. Updrafts can have upward velocity of over 2 m/s and could lift drops several hundred meters. The drops are produced along the hurricane track and fall 30 to 80 km to the right of the hurricane track. The air humidified by the spray spirals inward towards the eyewall where it rises.

Spray production requires both high wind and a disturbed sea surface. The long smooth waves ahead of the hurricane are not conductive to spray production. The wind on the forward side of the hurricane produces less spray than wind at the rear of the hurricane. The sea cooling is less pronounced ahead than behind the storm. Ahead of the storm, there is no preference for left or right side cooling and the cooling is limited to the to 10 to 20 m of the sea.

The cooling of the sea is almost entirely due to sea to air heat exchange in both the original and revised hypothesises. The spray production and deposition areas are larger in the revised theory than in the original theory resulting in lower sea to air heat fluxes. The main spray production area could be 300 km long by 30 km resulting in an area of 9000 km^2 versus 2500 km^2 in the original theory. The revised theory reduces the sea to air heat flux from 200,000 to 50,000 W/m^2 a heat flux which is still much higher than the maximum sea to air heat flux for interfacial heat transfer without spray.

LMM 9 September 2012