NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service

NOAA Operational Oceanic Heat Content Products

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In September 2012, the National Oceanic and Atmospheric Administration (NOAA) and the National Environmental Satellite Data and Information Service (NESDIS) began providing operational ocean heat content (OHC) measurements for the North Atlantic Basin. OHC is a measure of the integrated vertical temperature from the sea surface to the depth of the 26°C isotherm. It is computed from the altimeter-derived isotherm depths in the upper ocean relative to 20°C based on a hurricane season climatology and a two layer ocean model. In the present model, the OHC estimates are calculated from the sea surface temperatures (SST) obtained from NESDIS GEO-POLAR SST Analysis (Harris and Maturi, 2012) combined with altimeter-estimates of the 20°C and 26°C isotherm depths derived from a reduced gravity scheme using a daily ocean climatology of mean isotherm depths and reduced gravities. Based on a mean ratio between the 20 and 26°C isotherm depths, and the depth of the 26°C isotherm depth and the ocean mixed layer depth are inferred. By integrating the 26°C isotherm depth to the surface (where SST is the surface boundary condition) an ocean heat content is calculated (e.g., area under the curve) as shown in Figure 1. The algorithm that generates the OHC product has been running in development mode for more than 10 years at the National Hurricane Center and the University of Miami's Rosenstiel School of Marine and Atmospheric Science (RSMAS). (Figure 2) shows validation of the OHC product with Argo floats during Hurricane Earl. The algorithm uses a reduced gravity model to estimate the 20°C isotherm depth based on objectively analyzed sea surface height anomaly fields (SSHA) from available altimeter missions*, currently Jason 1 and 2, and the NESDIS GEO-POLAR SST Analysis. The software allows for additional satellite data such as another altimeter-derived SSHA field to be ingested into the calculation (Figure 3). Currently, NOAA's Office of Satellite Data Processing and Distribution (OSPO) generates operational daily fields that include input sea surface height anomaly (SSHA) and SST (Figure 4), 20° isotherm depth (D20), 26° (D26), mixed layer depth (MLD) (Figure 5), ocean heat content (OHC) (Figure 6), and mapping error from the objective mapping technique for the North Atlantic Basin (#1 in Figure 7). The North Pacific Basin (#'s 2 and 3 in Figure 7) is scheduled to go operational in the spring of 2013.

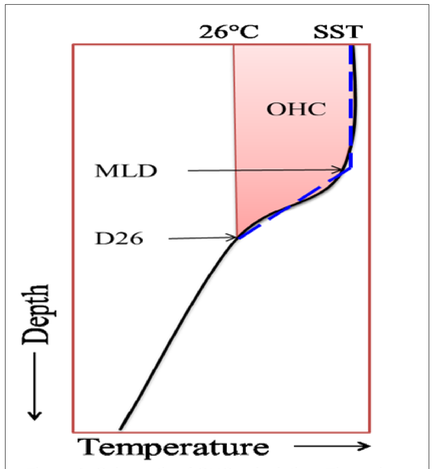

Figure 1: Schematic of OHC calculation. The red shading shows the true OHC by integrating the black temperature profile. The dashed blue line shows the approximated temperature profile of the upper ocean.

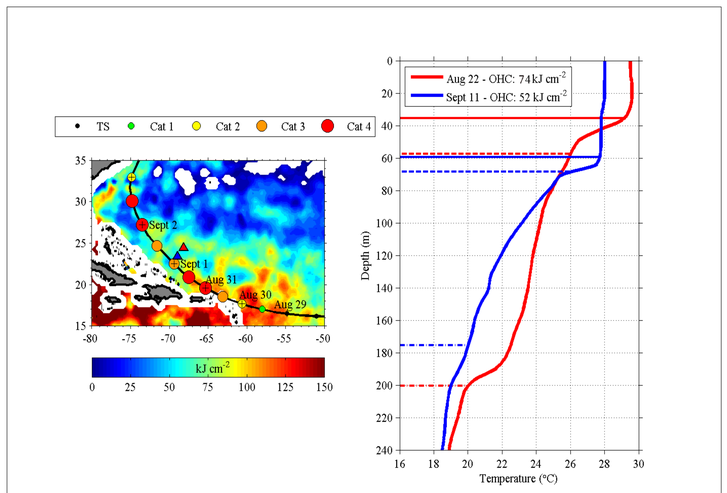

Figure 2: Illustration of the impact of Oceanic Heat Content on the rapid intensification of Hurricane Earl (2010).

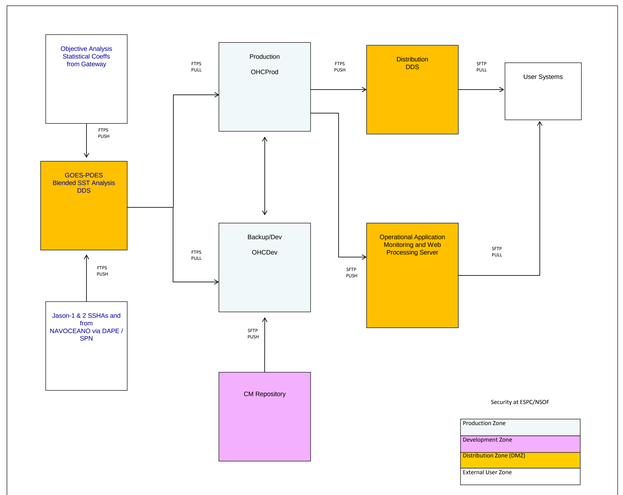

Figure 3: Oceanic Heat Content Product Data Flow Diagram

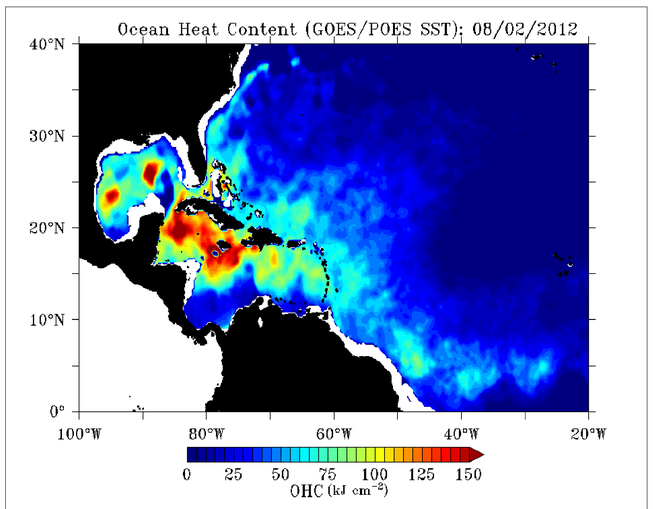

Figure 6: North Atlantic Operational Ocean Heat Content Product

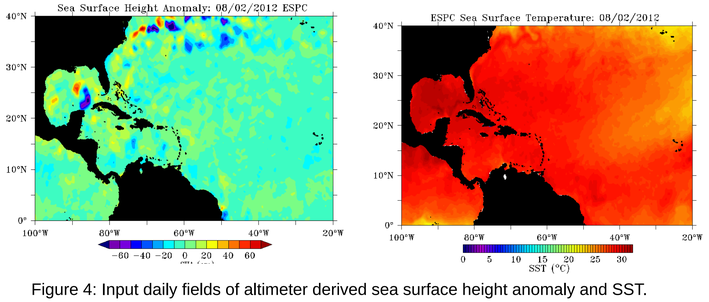

Figure 4: Input daily fields of altimeter derived sea surface height anomaly and SST.

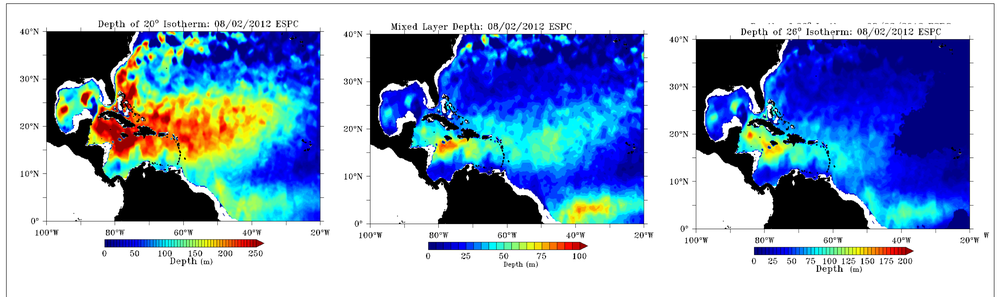

Figure 5: Output fields of 20 and 26 degree isotherm and mixed layer depths.

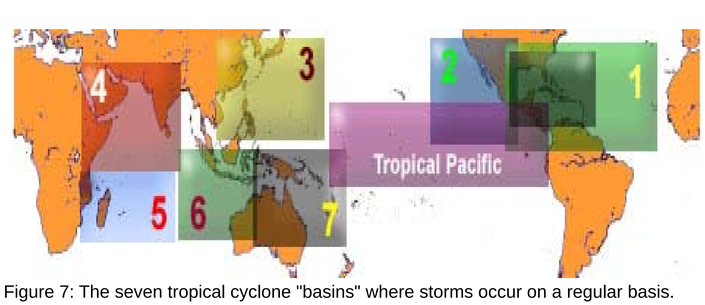

Figure 7: The seven tropical cyclone "basins" where storms occur on a regular basis.

* Note: Envisat data was originally used in the OHC product before it failed. Cryosat-2 data will be incorporated into these product. The more altimeters are used the better the product.