CI-FLOW

The collaborative Coastal and Inland FLooding Observation and Warning project
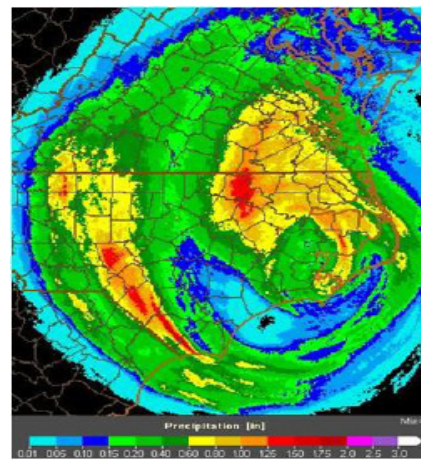
What is CI-FLOW?

Coastal and Inland FLooding Observation and Warning (CI-FLOW) is a prototype real-time system that predicts total water level in North Carolina. CI-FLOW captures the complex interaction between rainfall, river flows, waves, and tides and storm surge, and how they will impact ocean and river water levels. CI-FLOW is currently being tested in real-time when coastal storms approach North Carolina. NOAA National Weather Service (NWS) forecasters have access to CI-FLOW during these events to help them evaluate the system for application in the flood and flash flood warning process.

Addressing a need along vulnerable coasts

CI-FLOW is motivated by NOAA's critical forecast need for detailed water level predictions in coastal areas. Coastal flooding threatens more than half the nation's population and a wealth of natural and economic resources. Storms cause coastal flooding when water from the ocean is driven onto land by wind, tides, waves and storm surge. The severity of these floods can increase when intense rain falls upstream on rivers influenced by tides. CI-FLOW simulates the combined effects of coastal and inland floods.
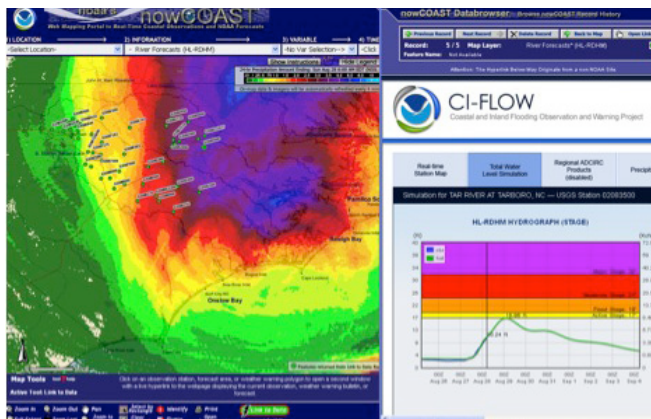
CI-FLOW data from Hurricane Irene is displayed on the NOAA nowCOAST web portal. The forecast points link back to the CI-FLOW website for more detailed data.

Connecting rainfall to rivers and oceans

To provide communities with estimates of total water level from storms, many sources of data must be included. CI-FLOW collects data from a computing system that combines radar and rain gauge information to create five-minute estimates of rainfall.
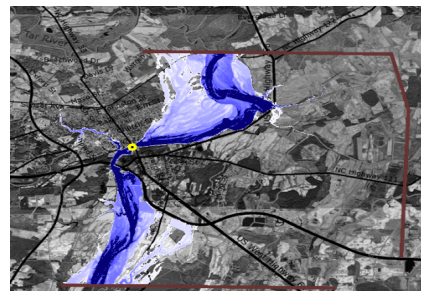
CI-FLOW uses multi-sensor precipitation estimates to track rainfall amounts within the Tar-Pamlico and Neuse river basins every 5 minutes on a 1km scale.

This information is passed on to water quantity models that simulate freshwater flows from the headwaters of the basins into the rivers; taking into account soil type, slope of the land and vegetation patterns.

The CI-FLOW stream-flow simulation for the Tar River in Tarboro, North Carolina is linked to an inundation map to show the expected extent and depth of water for a given river stage.

The CI-FLOW system then passes water flow data from river models to a coastal circulation and storm surge model that provides simulations of waves, tides and storm surge. When a storm approaches, forecasters will be able to evaluate how well the system represents the interaction between the ocean and river water and its impact on the coast.
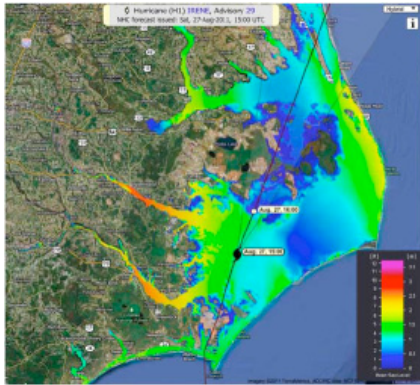
CI-FLOW predicted water levels above sea level at the time of Hurricane Irene's landfall.

Hurricane tragedies drive CI-FLOW partners

In response to the devastation in North Carolina left by Hurricanes Dennis and Floyd in 1999, a diverse group of people, including state, regional, academic and federal partners formed CI-FLOW with a united goal to improve flood predictions and warnings. Storm surge and coastal flooding killed 52 people and destroyed 7,000 homes. The area received 20-25 inches of rain over 10 days, causing rivers to crest up to 24 feet above flood stage. The storm surge was measured as high as 13 feet. Additional widespread impacts on the region included livestock and pet evacuations, water pollution from farm animal waste management sites, and backwater flooding due to inadequate bridge design. CI-FLOW focuses on the Tar-Pamlico and Neuse river basins of coastal Carolina, the areas hit hardest by the effects of the 1999 hurricanes.

Edgecombe County, NC, three days after Hurricane Floyd made landfall. Resulting severe flooding engulfed populated areas. Photo by David Saville/FEMA.

CI-FLOW partners

The NOAA National Severe Storms Laboratory with support from the NOAA National Sea Grant leads the unique interdisciplinary team including the North Carolina, South Carolina, and Texas Sea Grants, University of Oklahoma, Renaissance Computing Institute (RENCI), University of North Carolina at Chapel Hill, Seahorse Consulting, NWS Forecast Offices in Raleigh, and Newport/Morehead City, NWS Southeast River Forecast Center, NOAA's Coastal Services Center, NOAA in the Carolinas, NOAA Southeast and Caribbean Regional Team (SECART), NOAA-Integrated Ocean Observing System, Department of Homeland Security, Center of Excellence -Natural Disasters, Coastal Infrastructure and Emergency Management, Centers for Ocean Sciences Education Excellence SouthEast, Coast Survey Development Laboratory and NWS Office of Hydrologic Development.

Flooding from Hurricane Irene in August, 2011 sliced through Highway 12 on the Outer Banks of North Carolina. Photo by The Program for the Study of Developed Shorelines, http://psds.wcu.edu

Benefits of CI-FLOW

- Routine predictions of total water level and its individual components for the coastal plain
- Demonstrates the value of a linked framework to provide comprehensive water quantity information
- If implemented operationally, potential reduction in loss of life and property from weather and water hazards in the Carolinas and across our nation

Learn more:

Learn more about CI-FLOW on the Web: www.nssl.noaa.gov/ciflow. Connect with CI-FLOW on Facebook, Twitter and YouTube.