# Forecasting Wind-Waves at the North American Great Lakes

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The US National Weather Service (NWS) provides operational forecasts of wind-waves to the North American Great Lakes since 2004. In its initial implementation, the GLW ran on a regular spherical grid with approximately 4km spatial resolution. Recent upgrades to the GLW have increased the spatial resolution to 2.5km, also making it the first operational wave forecasting system in a major international operational center to use a curvilinear grid. The latter has allowed NCEP to generate wave forecasts on a Lambert conformal grid, addressing the needs of NWS forecasters and increasing the computational efficiency of the underlying WAVEWATCH III® model (Tolman et al., 2002). Details of the curvilinear grid implementation used in the GLW are provided in Rogers & Campbell (2009). Figure 1 illustrates the curvilinear GLW grid.

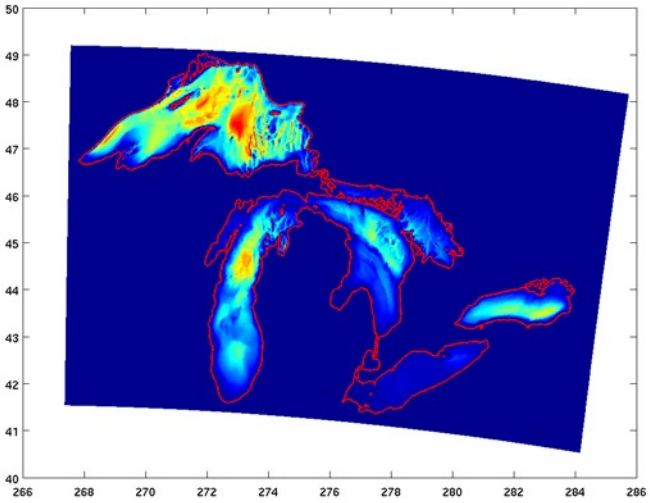


**Figure 1 Curvilinear grid used in NCEP's Great Lakes wave forecast system (GLW).**

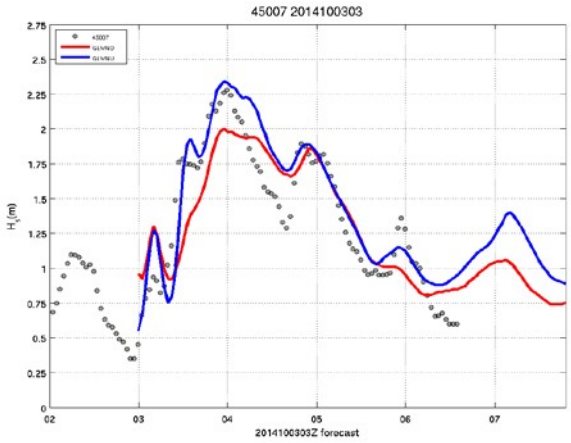


**Figure 2: Significant Wave Height (Hs) at buoy 45007 (Lake Michigan).X-axis: Days of the month in Oct 2013.**

Figure 2 shows the impact of the spatial resolution increase to GLW forecasts at a buoy maintained by the National Data Buoy Center (NDBC/NOAA), in Lake Michigan, made during a severe sea-state event on 03 Oct 2013. Circles indicate measurements of significant wave height in meters. The red line shows the performance of the model using a 4 km grid, whereas the blue line illustrates model results from the upgraded, 2.5 km curvilinear grid. In both cases, the same wind input was used, from NCEP's regional NAM model. The improvement is striking not only in terms of the skill in predicting the highest waves, but also in better defining the observed variations in wave height during the event.

In addition to changes in the spatial grid, recent upgrades to the GLW system included changing the source-term packages from the original WAVEWATCH III default configuration, consisting of wave-growth parameterizations proposed by Tolman & Chalikov (1996), to the newer source term package proposed by Ardhuin et al. (2010). The new source-term package has allowed the GLW to

dramatically improve its skill in predicting rapid wave growth in storms that develop under the more constrained Great Lakes environments. The new package also resulted in improved performance under normal sea-states and the typical wave generation conditions found in the region.

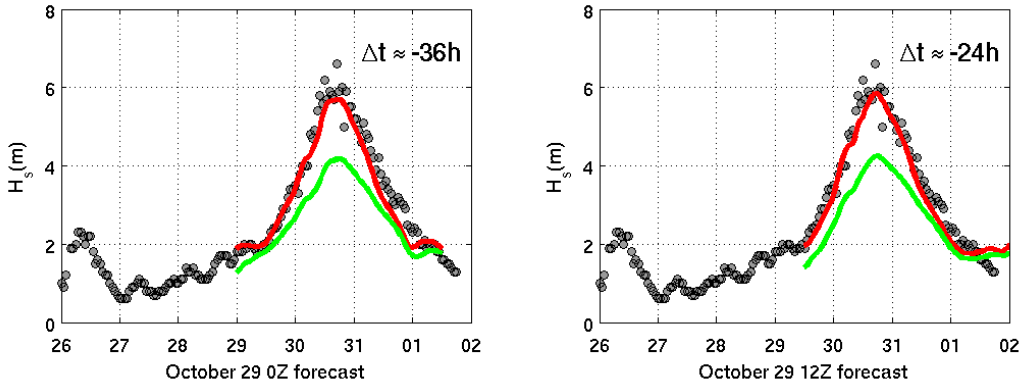


**Figure 3 GLW wave forecasting system forecasts during the passage of post-tropical storm Sandy (Oct 2012)**

Figure 3 illustrates the impact of the new source term parameterizations to wave forecasts issued by the GLW system during the passage of post-tropical storm Sandy (Oct 2012) over the Great Lakes. Circles indicate measurements of significant wave height in meters made at the NDBC buoy 45007 (Lake Michigan). The green line shows the performance of the model using the Tolman & Chalikov (1996) source-term package, whereas the red line illustrates model results from the upgraded package of Ardhuin et al. (2010). The improvements are striking for both 36 h and 24 h forecasts of maximum waves observed during Sandy. A detailed description of the GLW system and the impacts of upgrading its source-terms is provided in Alves et al. (2014).

In association with increased spatial resolution grids, source-term changes made in the GLW system have significantly improved the quality of forecasts issued by NCEP to NWS and the general public. As a consequence, the GLW system has become the major source of wave guidance used by NWS forecasters in the Great Lakes region.

**References**


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