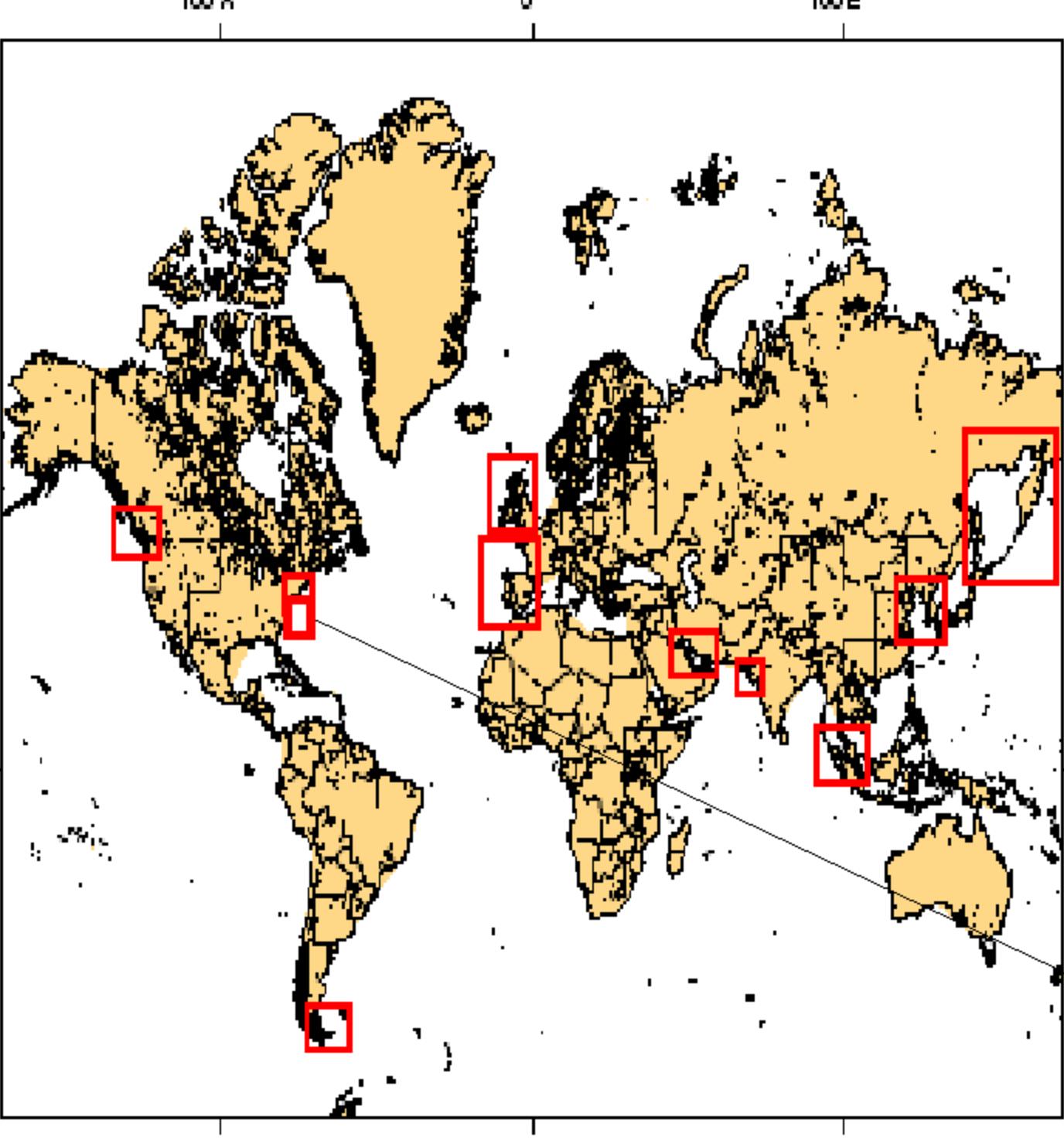


An Evaluation of the U.S. Navy's Globally Relocatable Tide Model on the East Coast of the United States.

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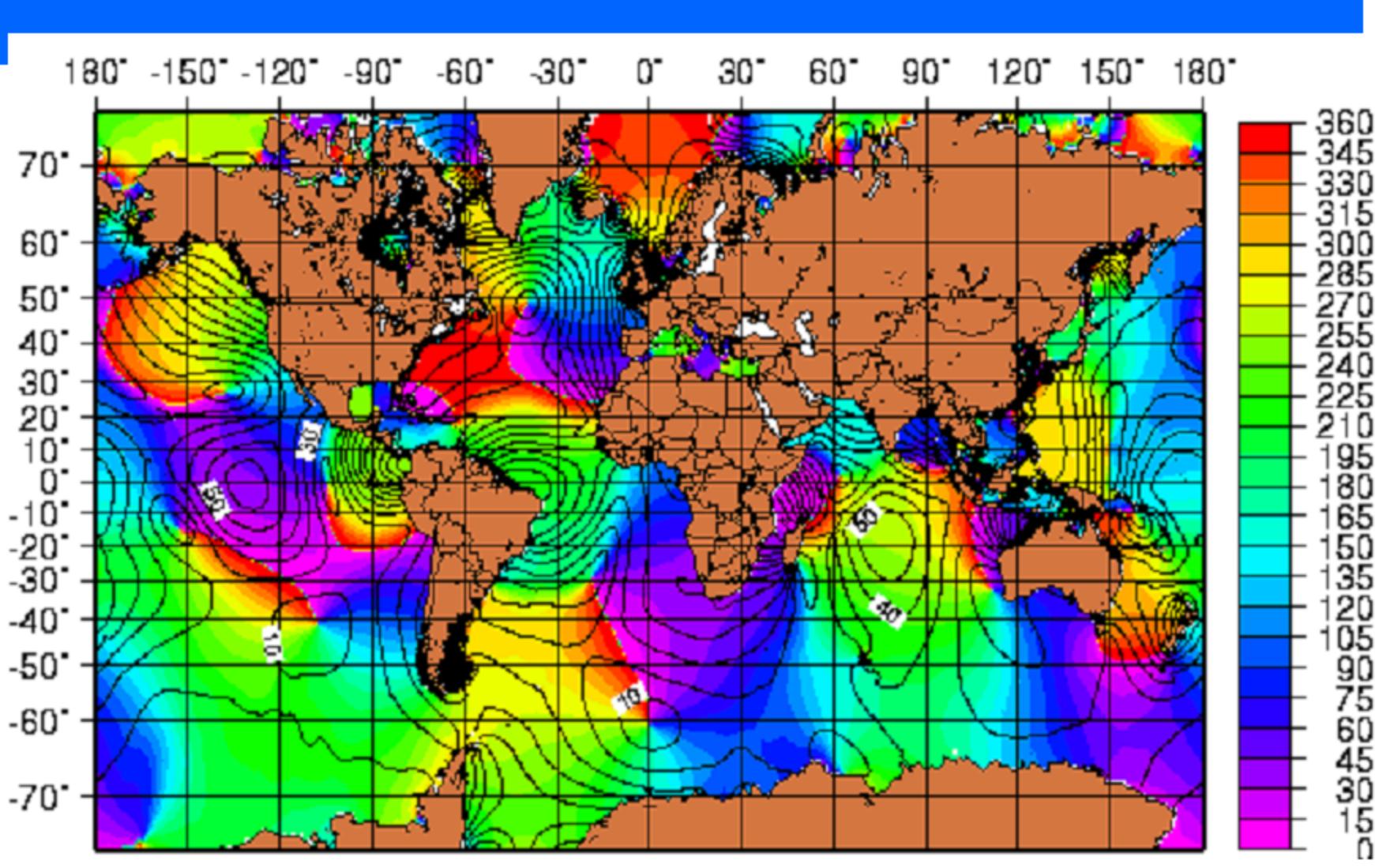
Over the past 3 years, the Naval Research Laboratory (NRL) has developed a globally relocatable tide/surge forecast system, PCTides, that can run on both a PC and UNIX based environment.

This system, consists of a barotropic ocean model that can be run in either a 2-dimensional (2-D) or a 3-dimensional (3-D) form. PCTides contains a wetting and drying algorithm for the simulation of coastal flooding due to tides and/or storm surge and is driven by surface winds and pressures and/or astronomical forcing .



Test regions for PCTides

A global tide model, the Finite Element Solutions 95.1/2.1 (FES95.1/2.1) is used to provide tidal boundary conditions.

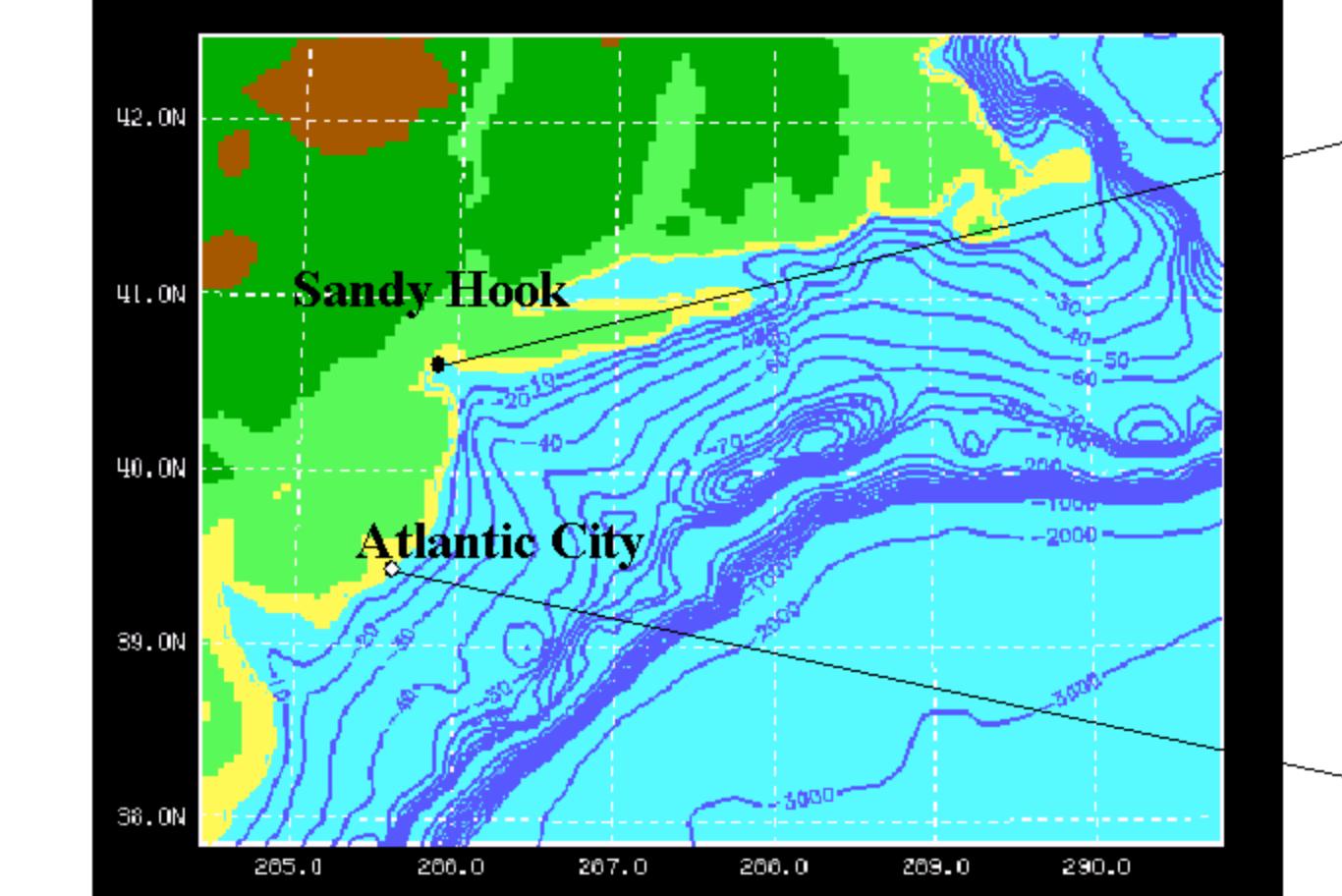


M2 Coamplitude and Phase Tidal Component

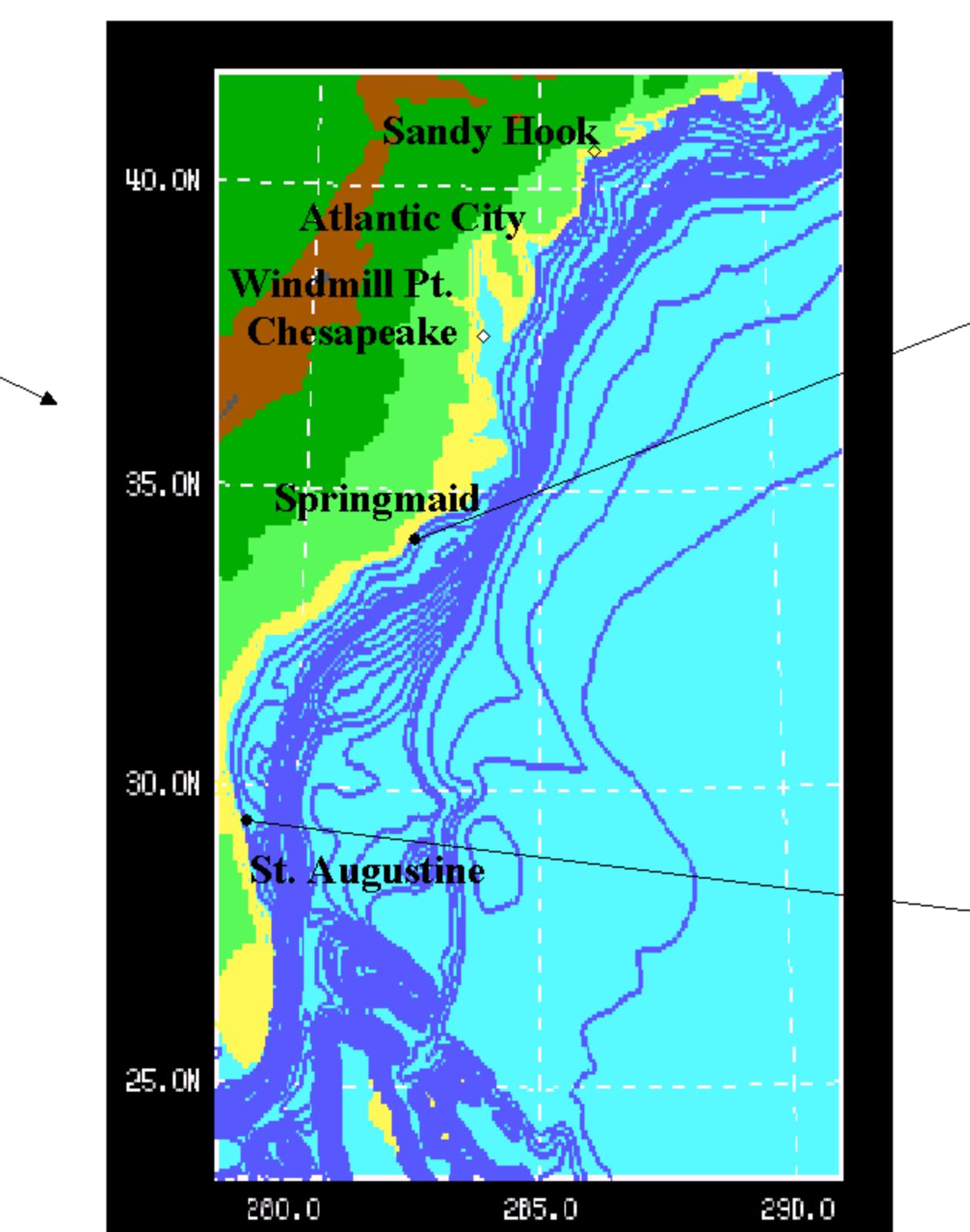
From July 19-August 17, 2000, the Naval Oceanographic Office conducted an OPTEST of its 2-dimensional barotropic finite element model called the Advanced Circulation Model (ADCIRC). NRL conducted an evaluation of the 2-dimensional, barotropic, globally-relocatable PCTides model. Both models made a 48-hour forecast each day using wind and surface pressure forcing from the Navy Operational Global Atmospheric Prediction System (NOGAPS).

During the OPTEST, the PCTides system was run daily over 3 different domains. The first covered all of the East Coast with ~10 km resolution and included the ADCIRC domain.

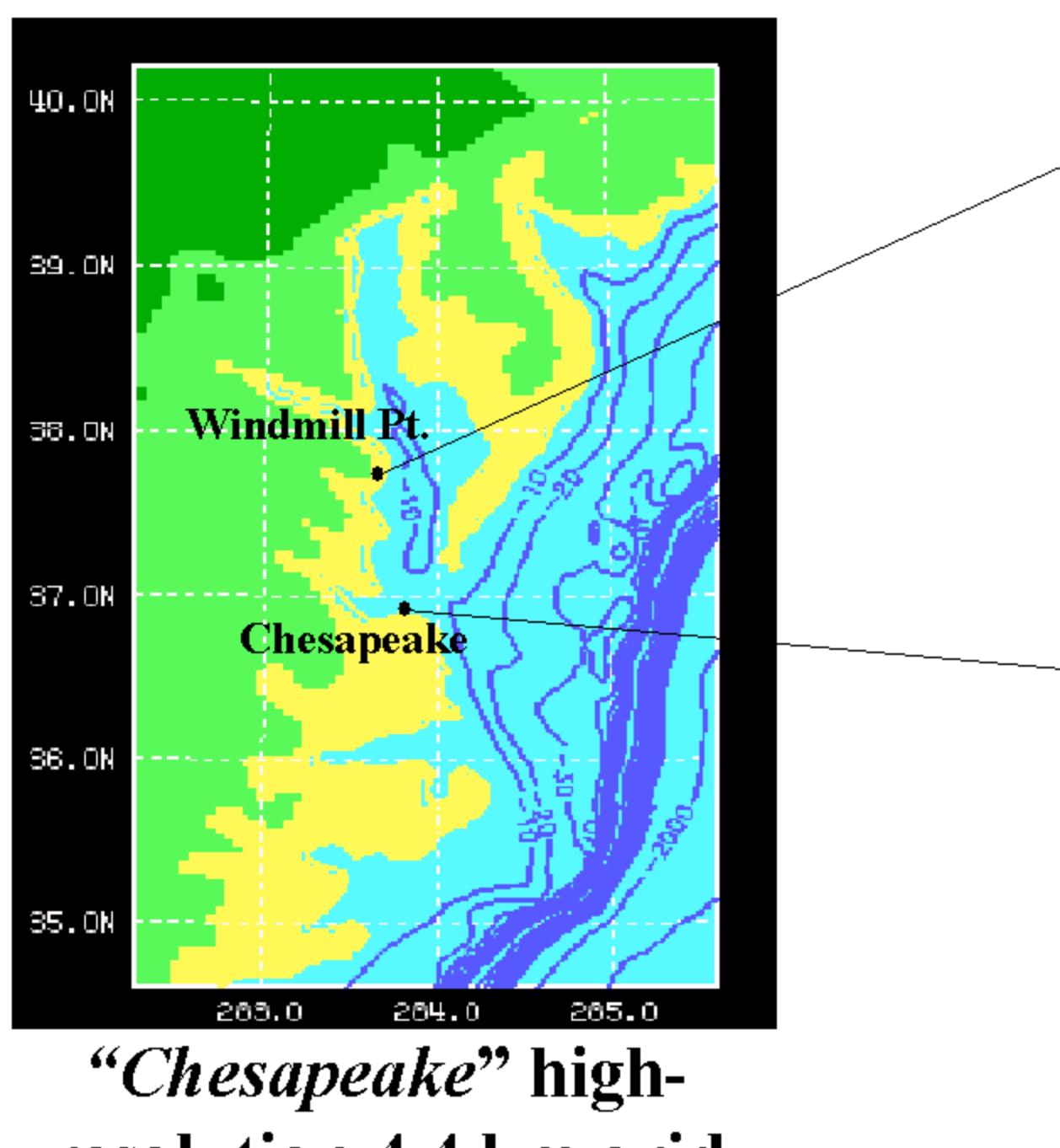
Two smaller grids with higher resolutions of ~ 5 km included 8 of the comparison areas.



"Long Island" high-resolution 4.3 km grid

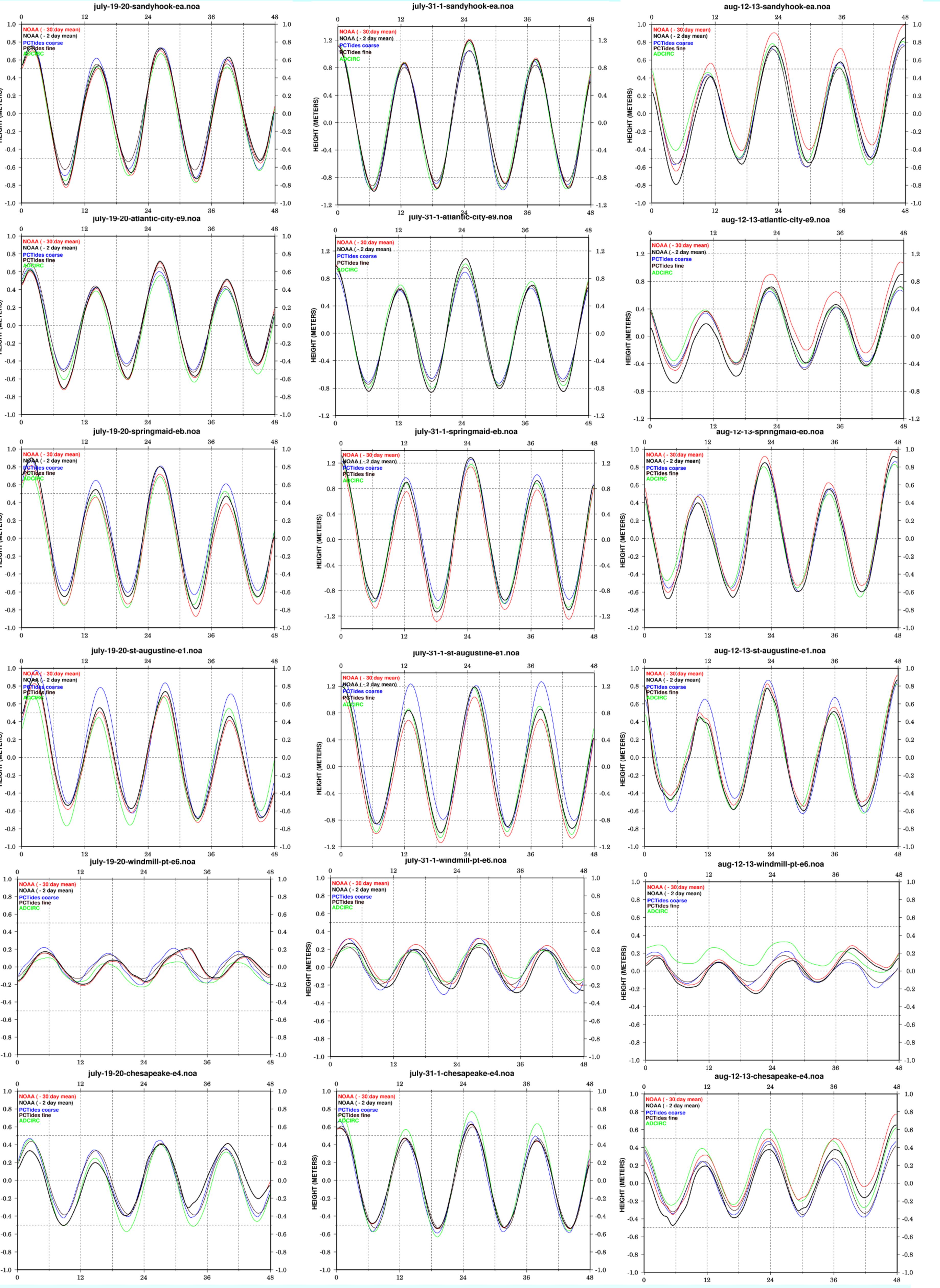


East Coast coarse 10 km grid



"Chesapeake" high-resolution 4.4 km grid

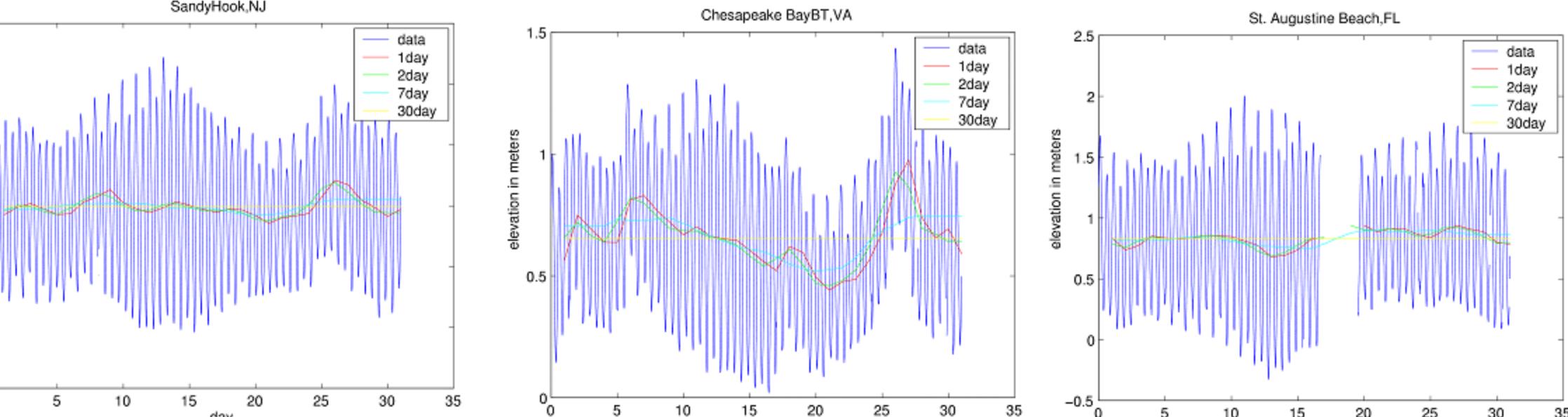
A 30-day evaluation of PCTides was conducted from July 19-August 17, 2000. During that time, the 48-hour model forecasts from three grids; one coarse resolution and two finer resolution grids, were evaluated against 12 coastal station observations obtained from the National Oceanographic and Atmospheric Administration (NOAA) Website, <http://www.co-ops.nos.noaa.gov/>.



Sample plots of the daily 48-hour tidal height forecasts from:

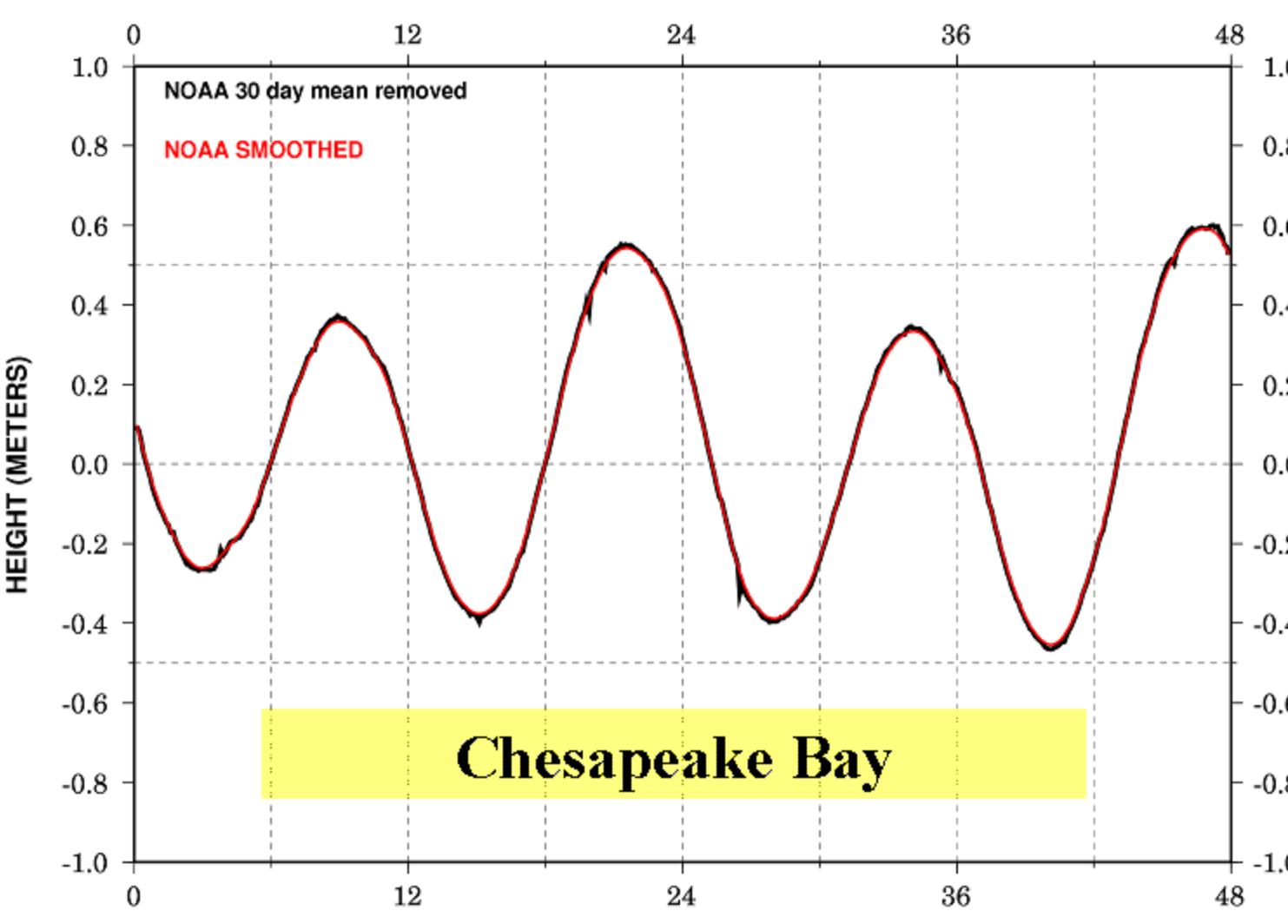
- 1: Fine resolution PCTides
- 2: Coarse resolution PCTides
- 3: ADCIRC
- 4: NOAA observations.

NOAA 30 day observations with the 1,2,7, and 30 day mean overlaid.



Both the 2 and 30 day means were removed from the NOAA observed MLLW for comparison to the PCTides tidal height deviation.

Example of NOAA observations for JULY 27-28, with the 30-day mean removed. Black line is the raw data and the red line is the raw data smoothed with a 1-2-1 Hamming smoother.



A quantitative evaluation was performed by calculating statistics calculated for each of the 12 stations over the 30-day period. This table contains the average errors over all stations for the first and second 24-hour forecast period. Although tests were performed removing both the 2 and 30 day means, the 30 day is more realistic.

Average 0-24 Hr Statistics (2 day Mean, Over 8/12 stations)			Average 24-48 Hr Statistics		
Statistics	ADCIRC	PCTIDES	Statistics	ADCIRC	PCTIDES
8/12 stations	Large	Fine	8/12	Large	Fine
Amp. AME (m)	0.08/0.08	0.07/0.09	0.06	0.08/0.08	0.07/0.08
RMS	0.10/0.10	0.09/0.10	0.08	0.11/0.11	0.09/0.10
Phase [ME] (hrs)	0.37/0.39	0.30/0.26	0.34	0.24/0.31	0.31/0.28
RMS	0.58/0.58	0.48/0.45	0.54	0.66/0.64	0.53/0.47

Average 0-24 Hr Statistics (30 day Mean, Over 8/12 stations)			Average 24-48 Hr Statistics		
Statistics	ADCIRC	PCTIDES	Statistics	ADCIRC	PCTIDES
8/12 stations	Large	Fine	8/12	Large	Fine
Amp. AME (m)	0.11/0.11	0.11/0.11	0.10	0.11/0.11	0.10/0.10
RMS	0.14/0.13	0.13/0.13	0.12	0.12/0.13	0.12
Phase [ME] (hrs)	0.27/0.33	0.31/0.27	0.35	0.27/0.33	0.30/0.28
RMS	0.65/0.63	0.47/0.43	0.47	0.60/0.60	0.50/0.45

Results from these statistics show that the absolute mean amplitude error (AME) was generally less than 11 cm for both the fine and coarse grid PCTides models. The fine resolution models usually had the lowest absolute mean error, less than or equal to 10 cm for the 8 stations. The PCTides RMS amplitude error ranges from 7-13 cm. The RMS phase error shows that PCTides' high and low water predictions are within one hour of the observations for all stations.

Summary and Conclusions

A globally relocatable tide/surge forecast system, PCTides, has been developed by the U.S. Navy for rapidly relocatable prediction of tidal amplitude and phase as well as barotropic ocean currents. The system is presently designed to run quickly on a PC or in a Unix environment. In this case, PCTides errors of 9-13 cm are minimal for a tidal range of 1-2 meters with the phase error between 17-30 minutes. These errors fall well within an acceptable criteria for operational Navy use.