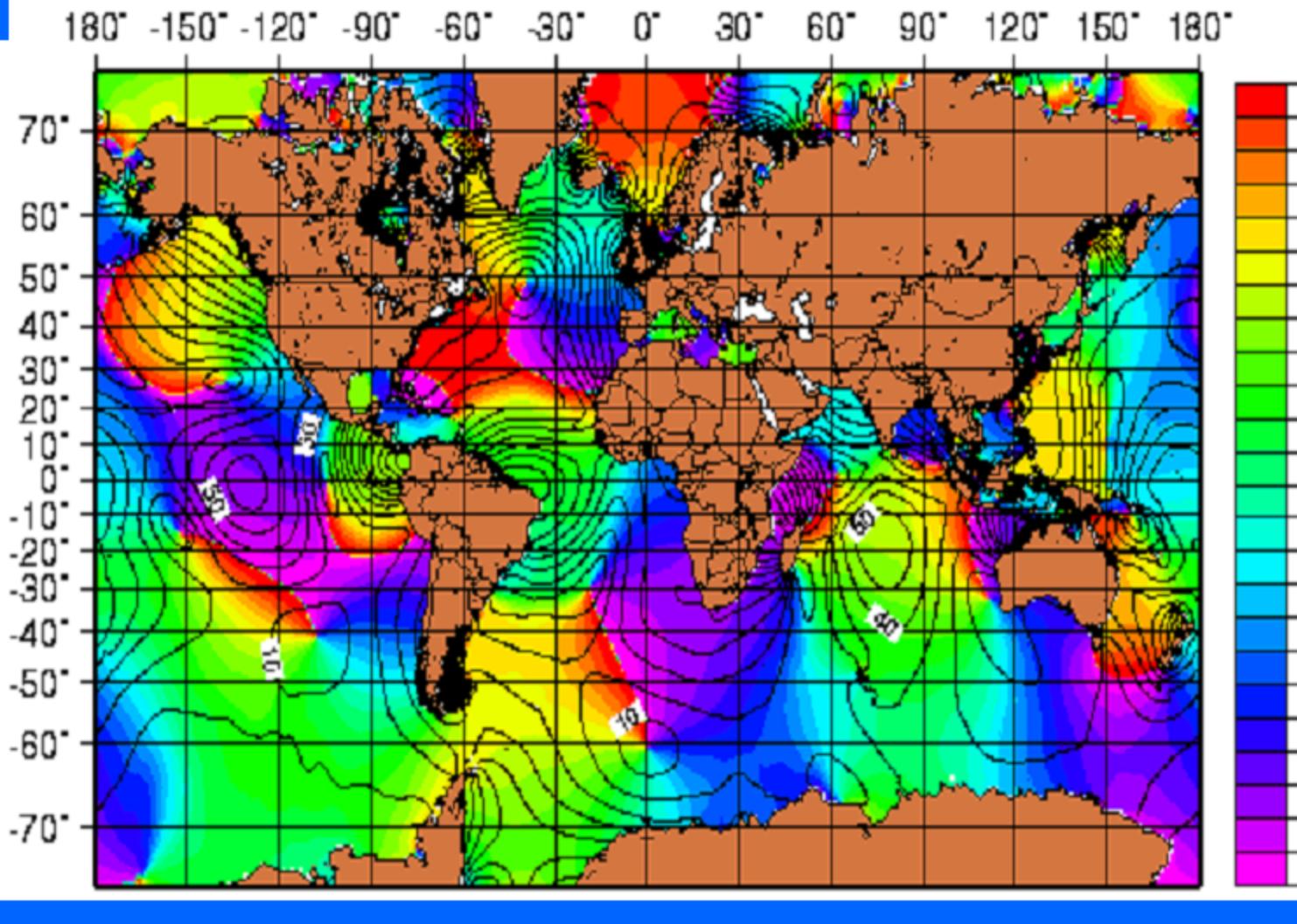




An Evaluation of the U.S. Navy's Globally Relocatable Tide Model on the Western Coast of the United States.
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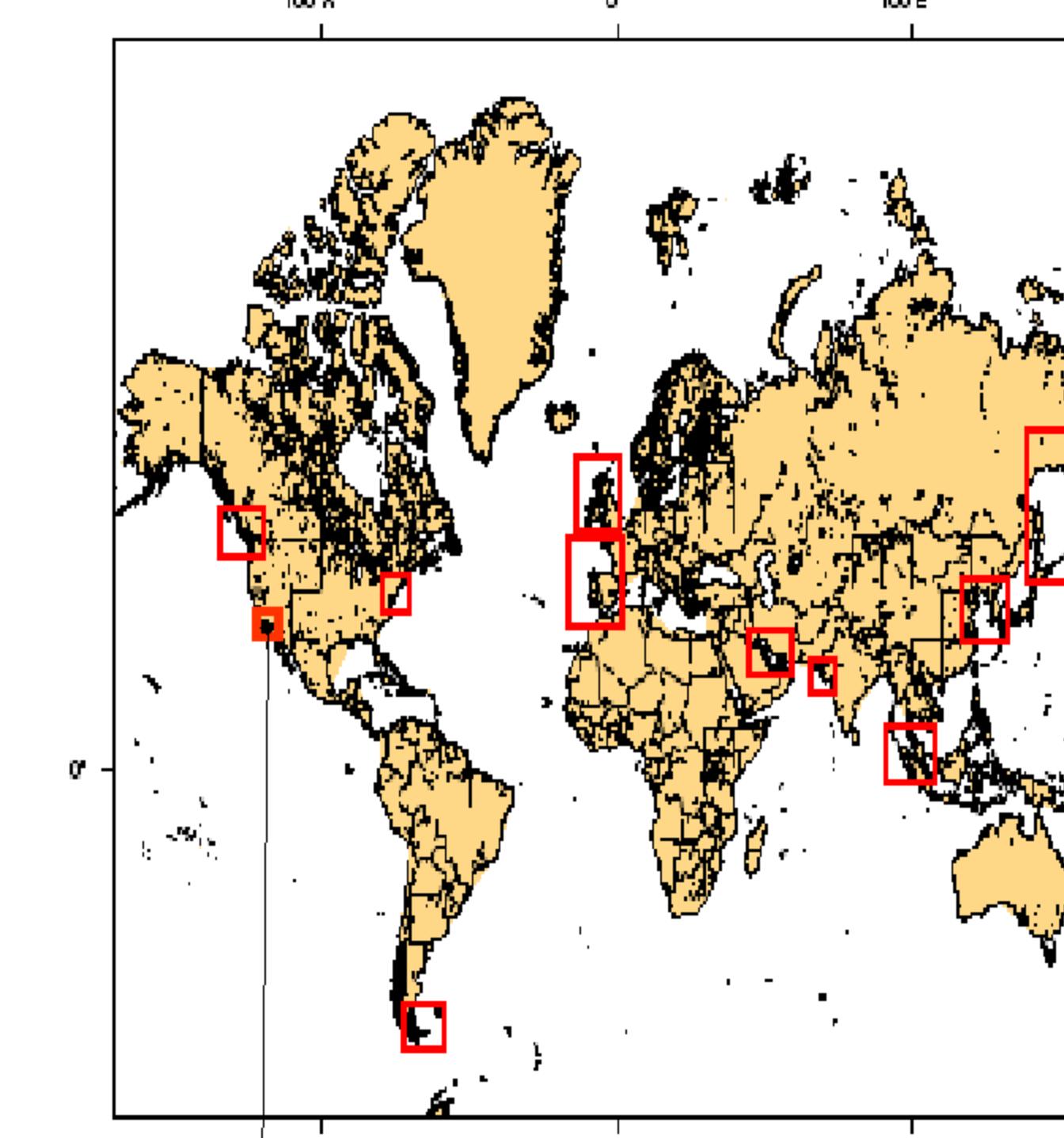
The Naval Research Laboratory (NRL) has developed a globally relocatable tide/surge forecast system, PCTides, that can run on both a PC and UNIX based environment. This system, consists of a barotropic ocean model that can be run in either a 2-dimensional (2-D) or a 3-dimensional (3-D) form. PCTides 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 .

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

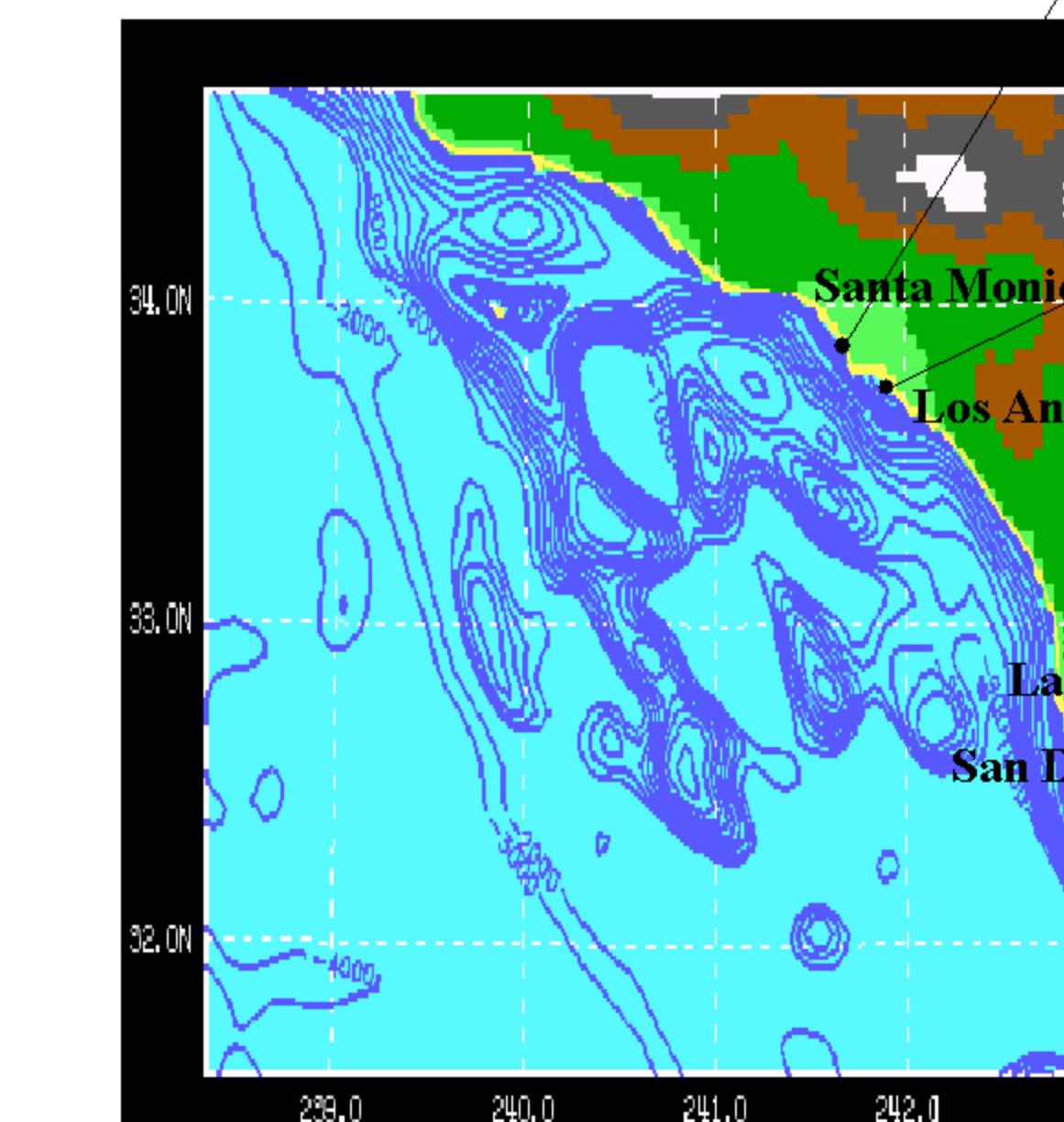


M2 Coamplitude and Phase Tidal Component

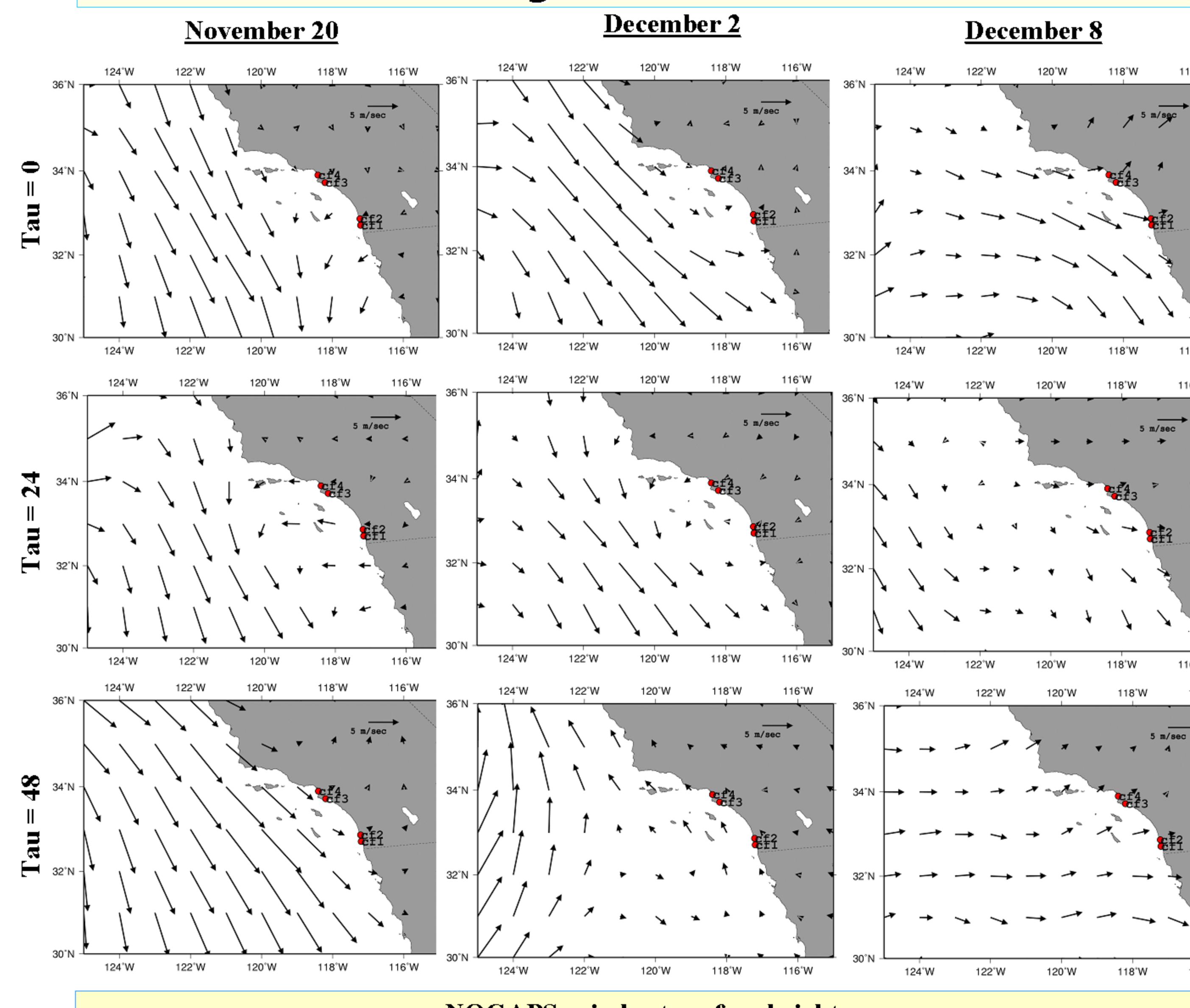
From November 14 - December 13, 2000, NRL conducted an evaluation of the 2-dimensional, barotropic, globally-relocatable PCTides model. The model made a 48-hour forecast each day both with and without winds and surface pressure forcing from the Navy Operational Global Atmospheric Prediction System (NOGAPS).



Test regions for PCTides

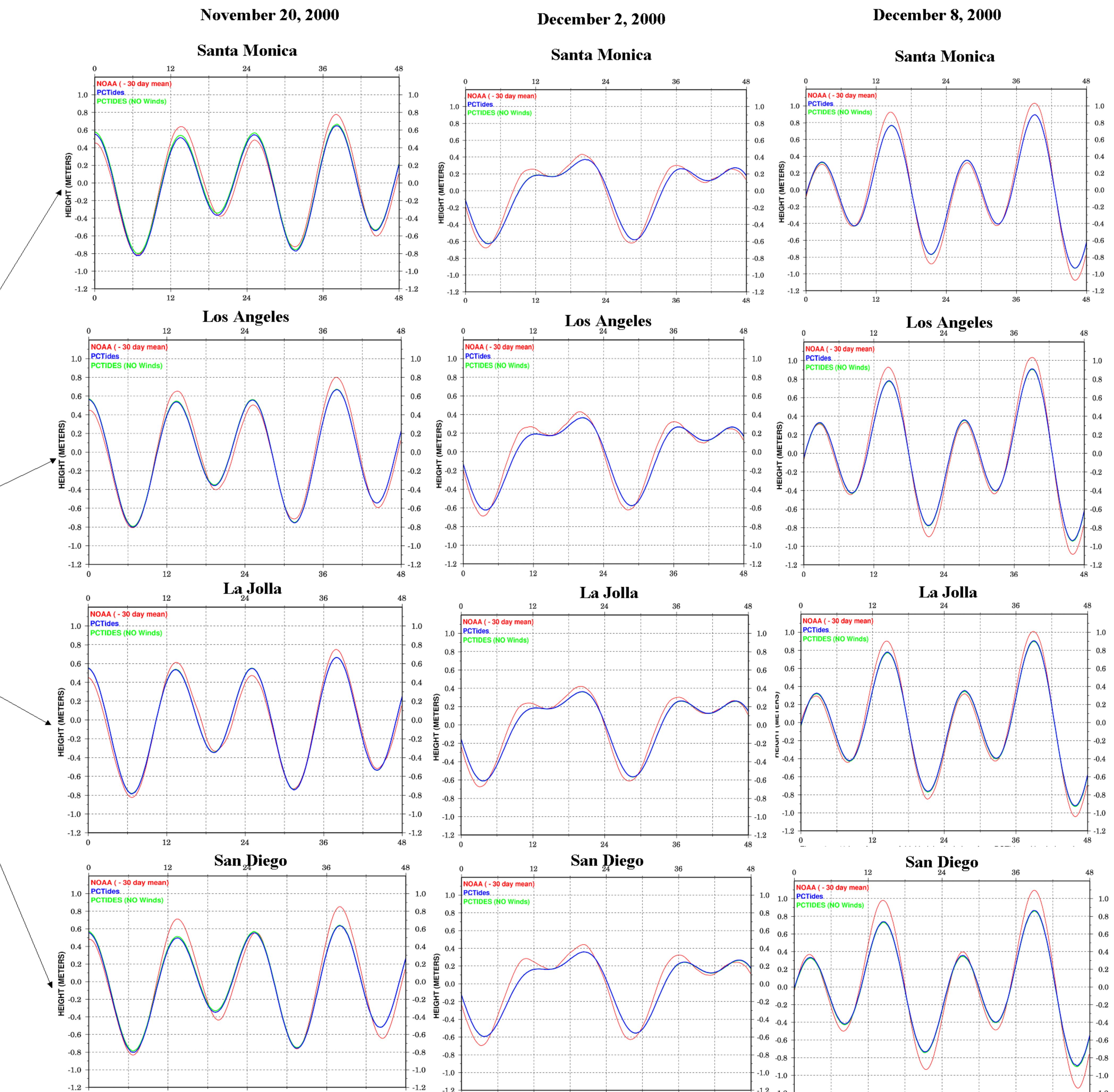


Surface winds and pressures and/or astronomical forcing drive the model.



NOGAPS winds at surface height.

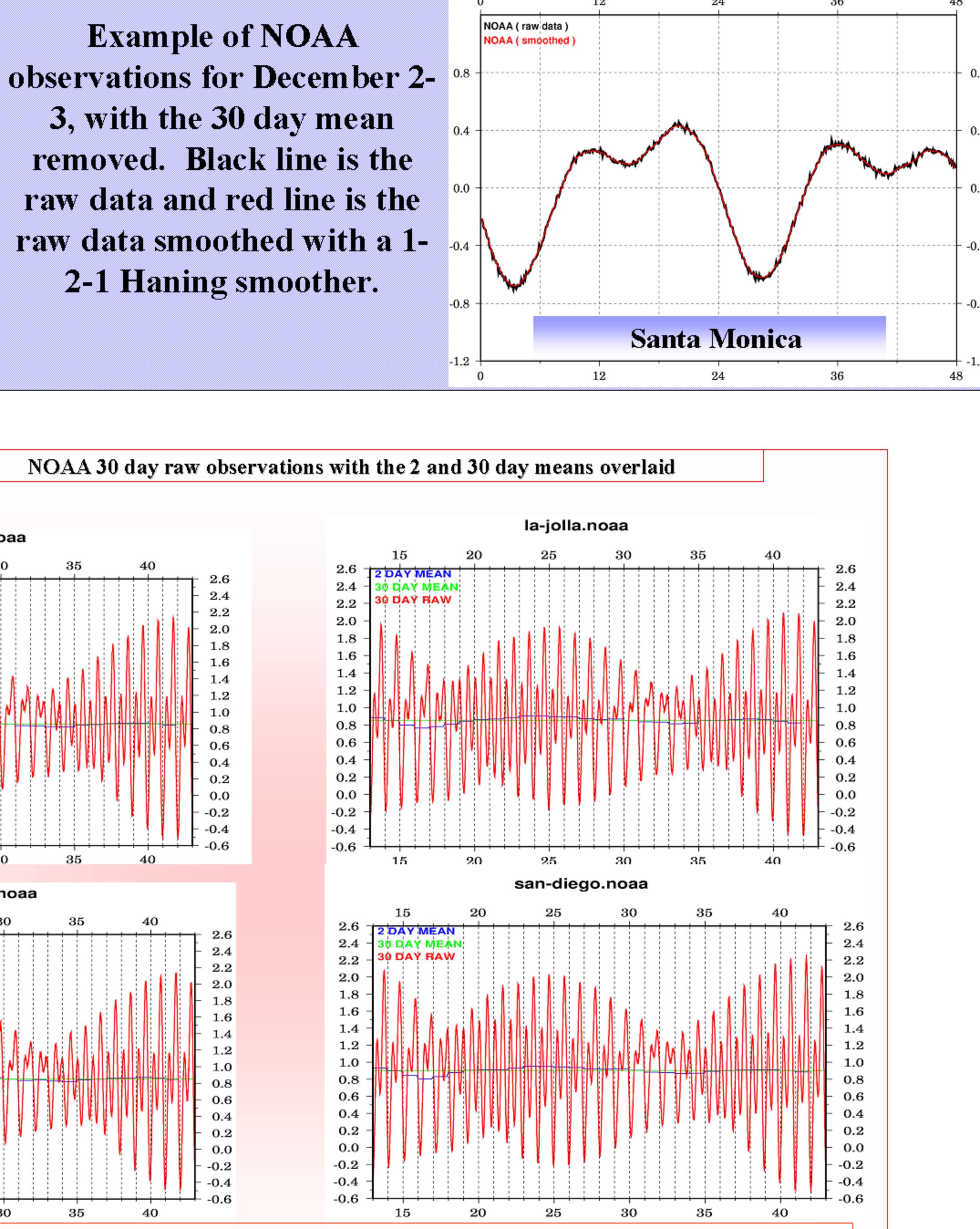
PCTides 48 hour forecast of tidal height deviation (with winds and without winds) versus NOAA observations



Summary and Conclusions

A globally relocatable tide/surge forecast system 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 the Unix environment. Shown are examples of the National Oceanographic and Atmospheric Administration (NOAA) observations (<http://www.co-ops.nos.noaa.gov/>) used to validate the PCTides model against the tidal amplitude and phase along the western coast of the U.S. The statistics show that there is not much difference between the first and second 24 hour forecast periods. Also shown by the plots, is that the winds in this area seem to have a minimal effect on the tidal conditions during this time period.

Example of NOAA observations for December 2-3, with the 30 day mean removed. Black line is the raw data and red line is the raw data smoothed with a 1-2-1 Hamming smoother.



The 30 day mean was removed from the NOAA observed MLLW for comparison to the PCTides tidal height deviation

Statistics of the model versus observations.

Tidal Amplitude RMS 024hr Forecast/24-8hr Forecast (30 Day Mean)			Phase Difference RMS 0-24hr Forecast/24-Hour Forecast (30 Day Mean)		
Stations	PCTides(with winds)	PCTides(without winds)	Stations	PCTides(with winds)	PCTides(without winds)
SantaMonica	0.09/0.09	0.08/0.08	Minutes	Minutes	Minutes
LosAngeles	0.08/0.09	0.08/0.08	SantaMonica	19.0/24.7	18.4/18.00
LaJolla	0.07/0.08	0.07/0.07	LosAngeles	17.6/19.19	17.8/17.76
SanDiego	0.14/0.14	0.14/0.14	LaJolla	19.5/20.57	19.6/19.59
			SanDiego	23.4/22.94	23.5/23.48

Tidal Amplitude AVE 0-24hour Forecast/24-8hour Forecast (30 Day Mean)			Averaged Statistics for all stations		
Stations	PCTides(with winds)	PCTides(without winds)	Statistic	PCTids (with wind)	PCTids (without wind)
SantaMonica	0.07/0.07	0.07/0.07	Avg AVE(m)	0.08/0.08	0.08/0.08
LosAngeles	0.07/0.07	0.07/0.07	RMS(m)	0.10/0.10	0.09/0.09
LaJolla	0.06/0.07	0.06/0.06	PhaseME(min)	24.8/4.78	32.3/2.98
SanDiego	0.11/0.12	0.11/0.11	AME(min)	13.6/14.51	13.7/13.67
			RMS(min)	19.9/20.79	19.8/19.71

The statistical evaluation shows that the PCTides model with and without winds compare favorably to the NOAA observations. The RMS error of the amplitude at all four stations has a maximum value of 14 centimeters. The phase RMS error is approximately 23 minutes. The small variability between the models and the data is especially seen when averaging over all four stations. The averaged absolute mean phase error is less than 14 minutes and the amplitude difference is 8 cm. The mean phase bias over the 30 day day period shows that the model peaks occur within five minutes after the NOAA observations.