



36TH INTERNATIONAL CONFERENCE ON COASTAL ENGINEERING 2018

Baltimore, Maryland | July 30 – August 3, 2018

The State of the Art and Science of Coastal Engineering

Hurricane Marie and the Port of Long Beach, California, USA



Chuck Mesa, P.E.

U.S. Army Corps of Engineers



Matthew Wesley, P.E.

U.S. Army Corps of Engineers



Los Angeles - Long Beach Harbor, CA



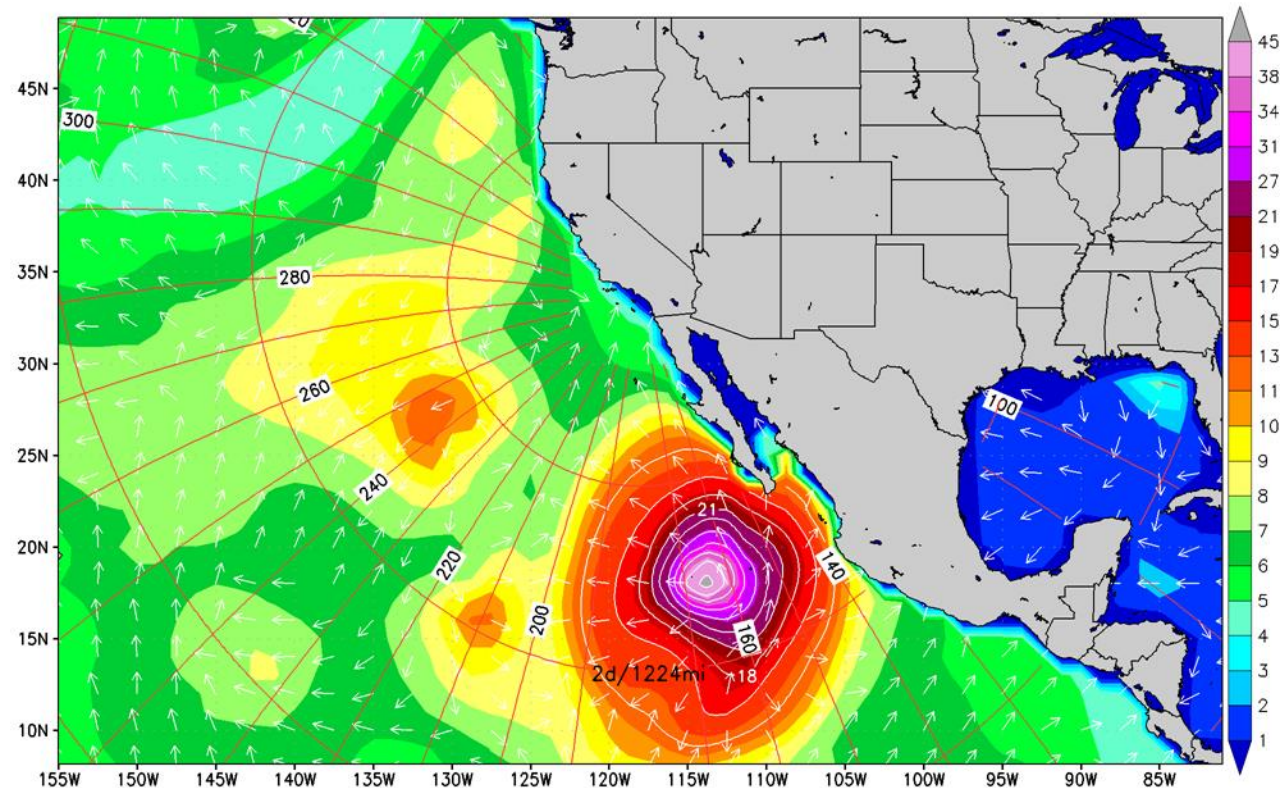
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Hurricane Marie

Cat 5, W=140 kts; P=918 mb

SURFLINE.COM Historical Archive

Significant Wave Height(ft), Primary Direction, Range(nm), Bearing 12Z25AUG2014

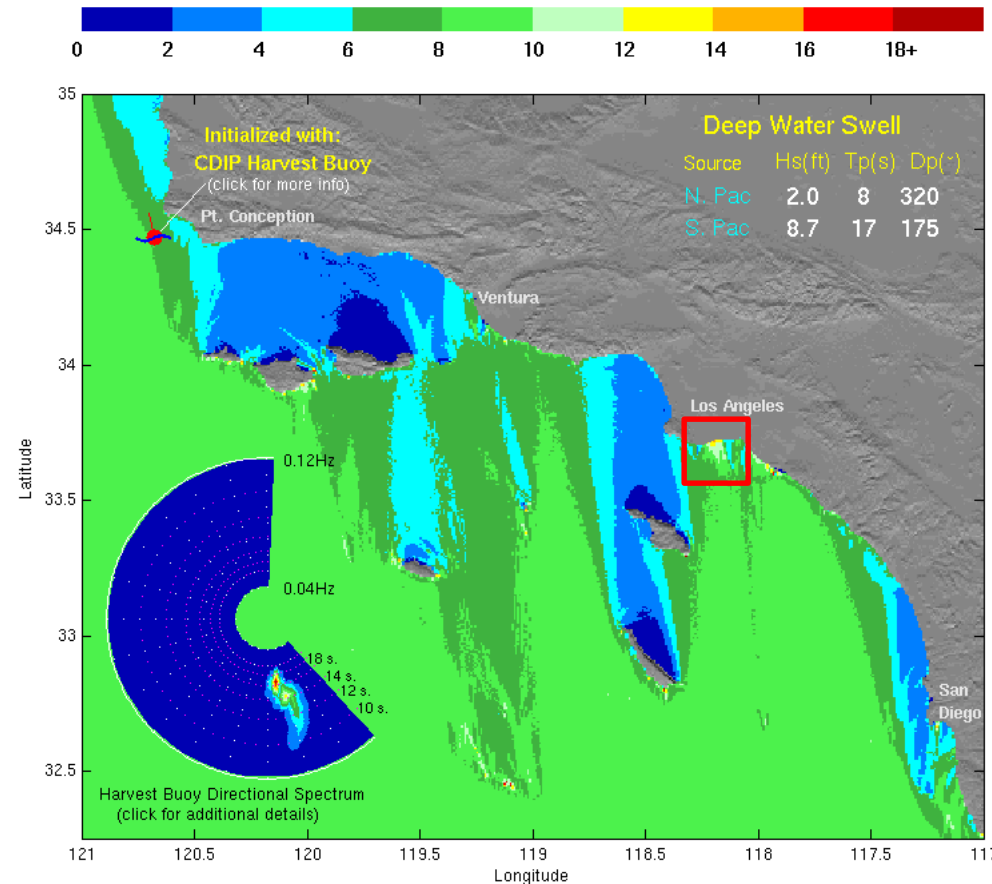


Sea State: Aug 27, 2014



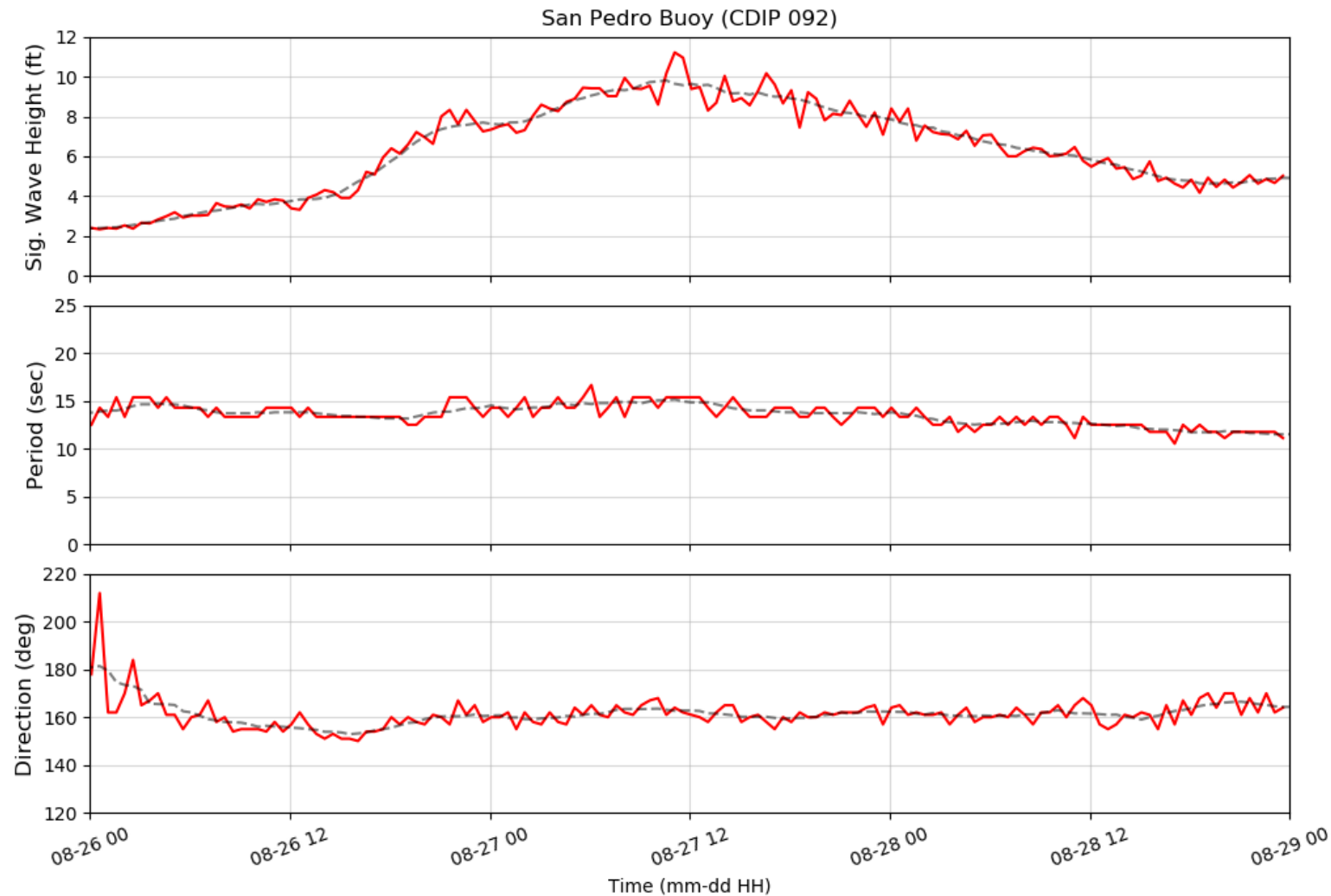
Analysis Time – 27 AUG 2014 : 1132 PST

Swell Height (ft) – Southern California Bight



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Sea State: Aug 27, 2014



$H_s = 10.0$ ft

$T_p = 15$ sec

$Dir = 160^\circ$



Uluwatu Comes to Huntington Beach



Photo Courtesy: N. Baptista



Breakwater Damages



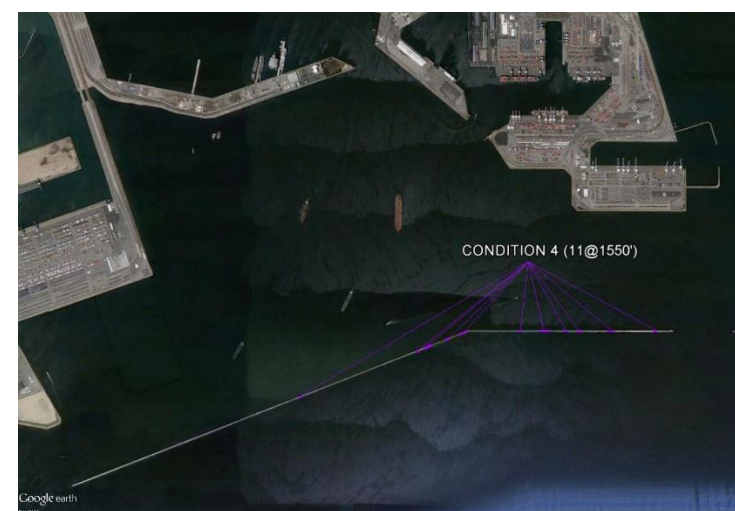
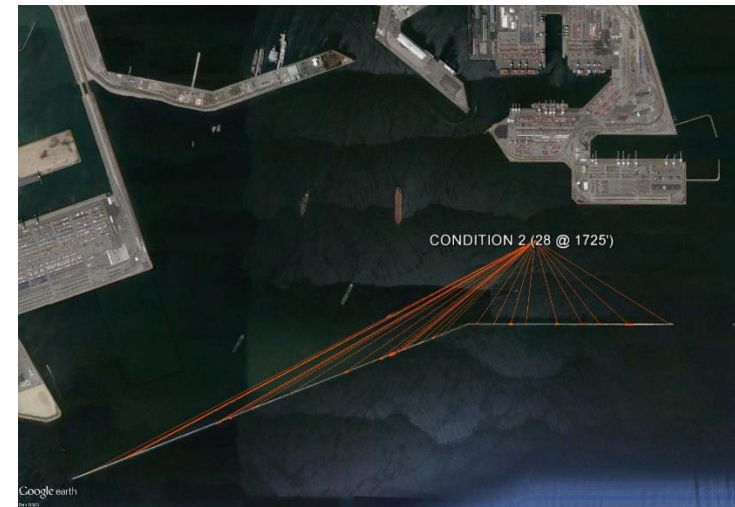
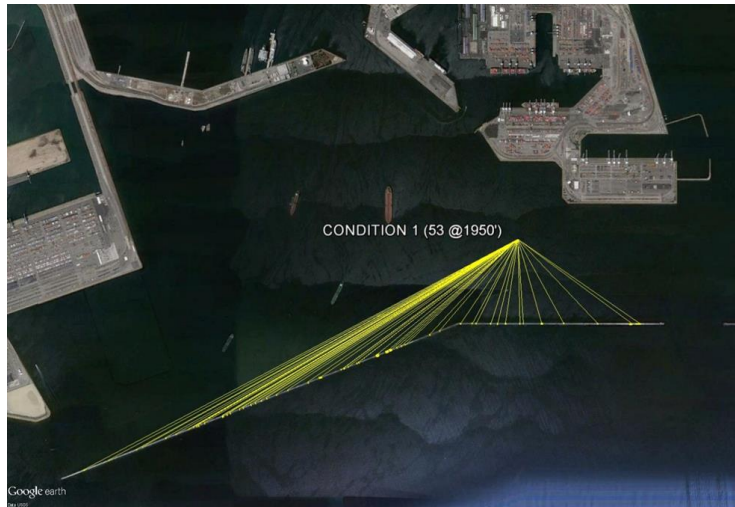
Breakwater Damages



Breakwater Damages - Breach



Breakwater Damages - All



Total:
103 Damage
Areas
6,075 LF



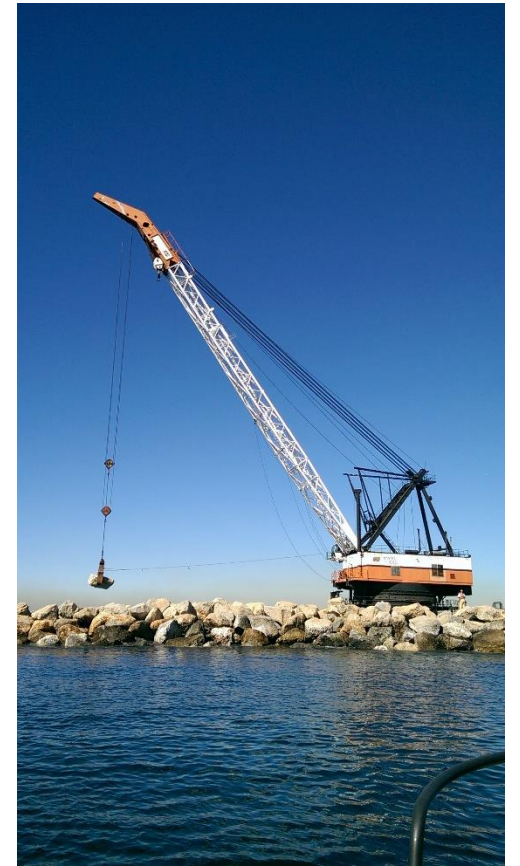
2014 Emergency Repairs

- Begin construction: Oct 8, 2014
- 12 ton armor stone
- 30,000 tons
- Complete construction: Feb 23, 2015
(138 days)
- \$4,900,000

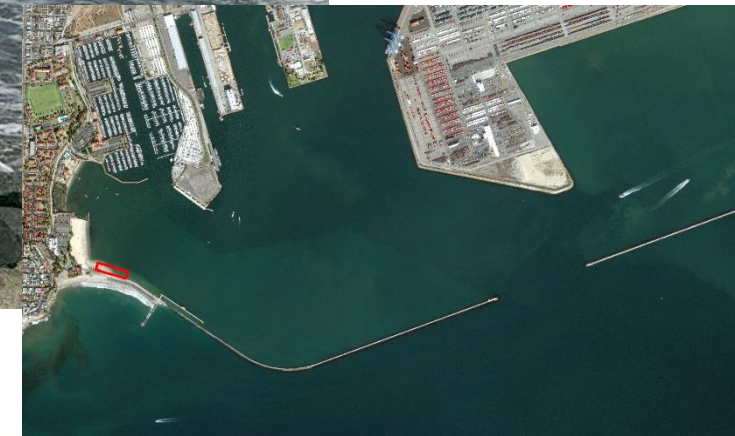


2015 Repairs

- Begin construction: Nov 2015
- 16-20 ton armor stone
- 104,000 tons
- Complete construction: On-going
- \$20,050,000



Pipeline - San Pedro Style



Extremal Analysis

Recurrence Interval (years)	Wave Height at 60' Contour Offshore Angel's Gate		
	Extratropical Swell (210°-230°)	Prefrontal Seas (170°-190°)	Tropical Sea/Swell (170°-190°)
25	9.1	13.7	13.5
50	12.3	15.5	15.6
100	15.2	17.2	17.6
200	17.9	18.9	19.6

Source: Pier 400 Design Consultants, 1993



Bathymetric Tuning



Los Angeles River

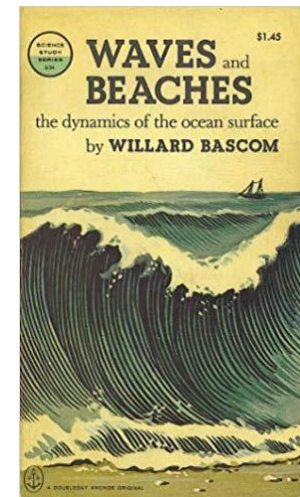
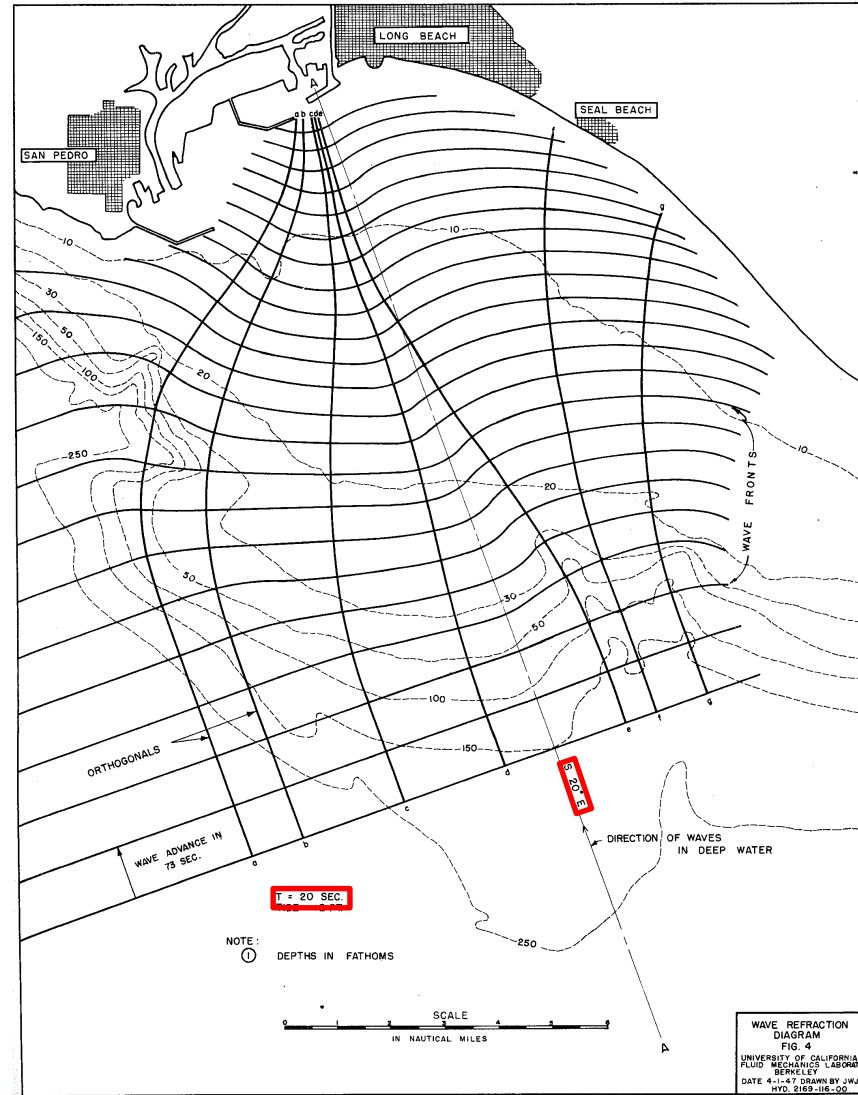
San Gabriel River

Santa Ana River



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1930 Swell Event



O'Brien, M.P. 1947. "Wave refraction at Long Beach and Santa Barbara, California". Technical Report HE-116-246. University of California, Berkley.

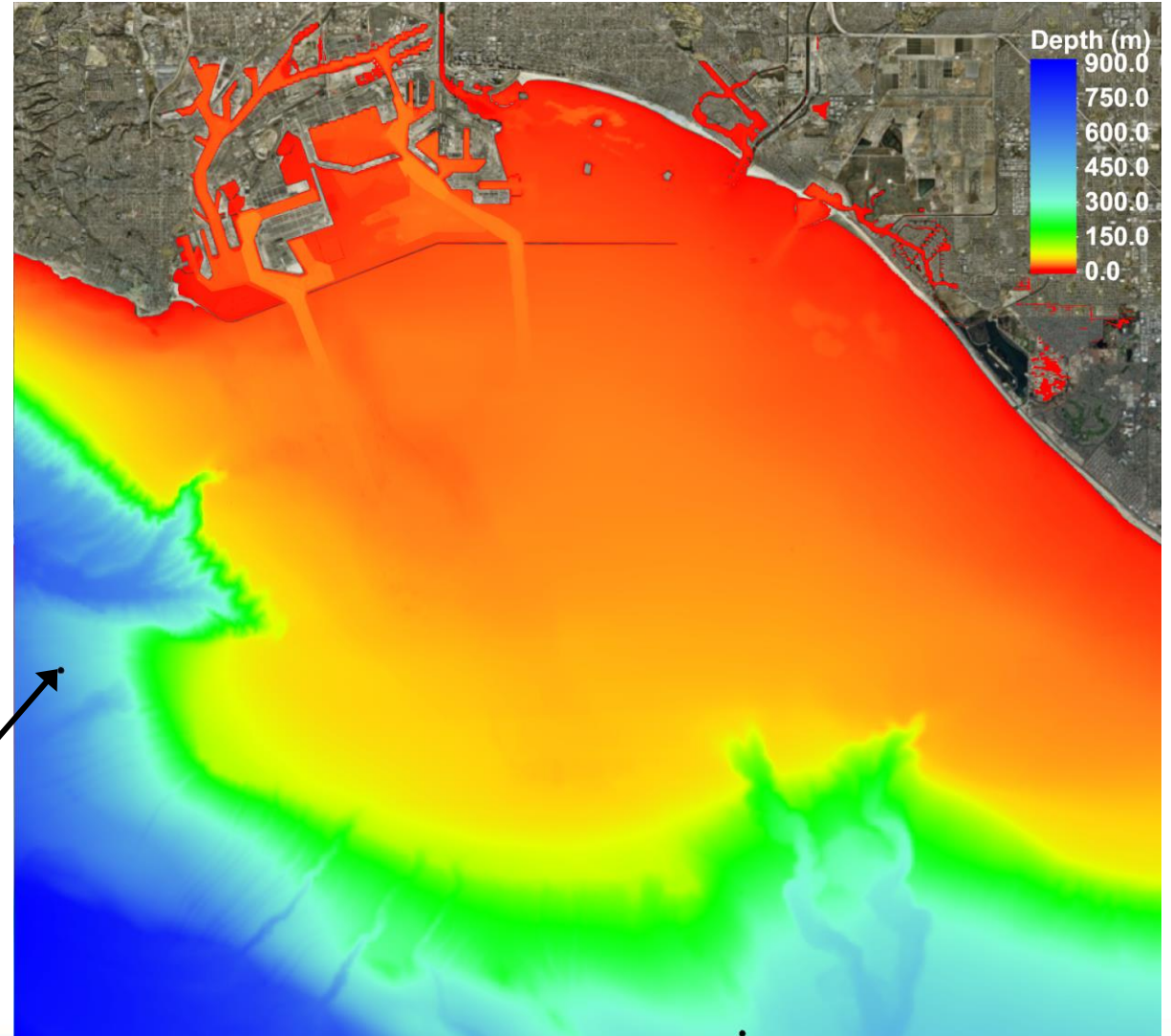


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Numerical Grid

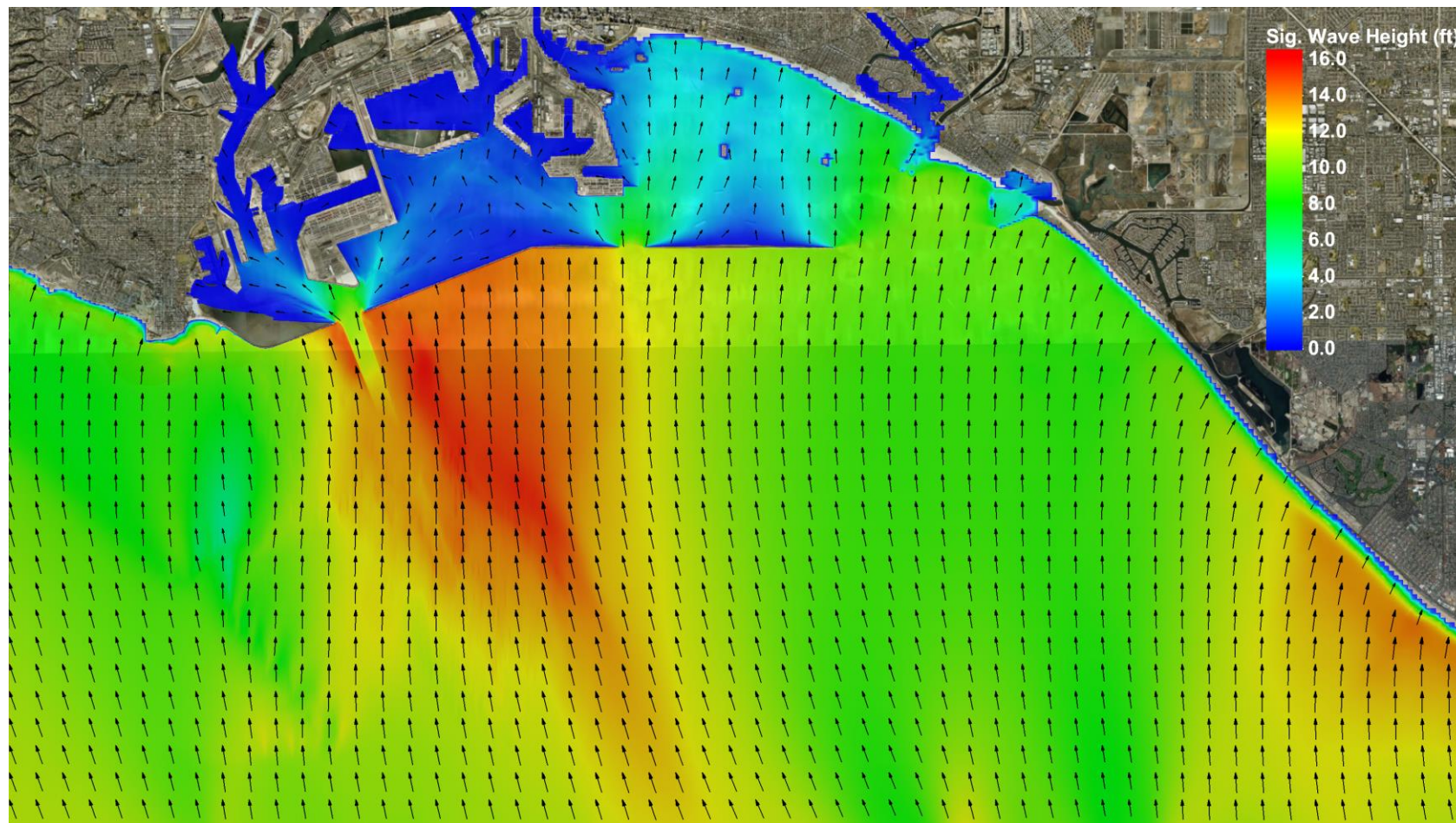
- CMS-Wave
 - Grid Properties:
 - 947 x 1698
 - Size:
 - 100 m (max)
 - 5 m (local refinement)

CDIP 092

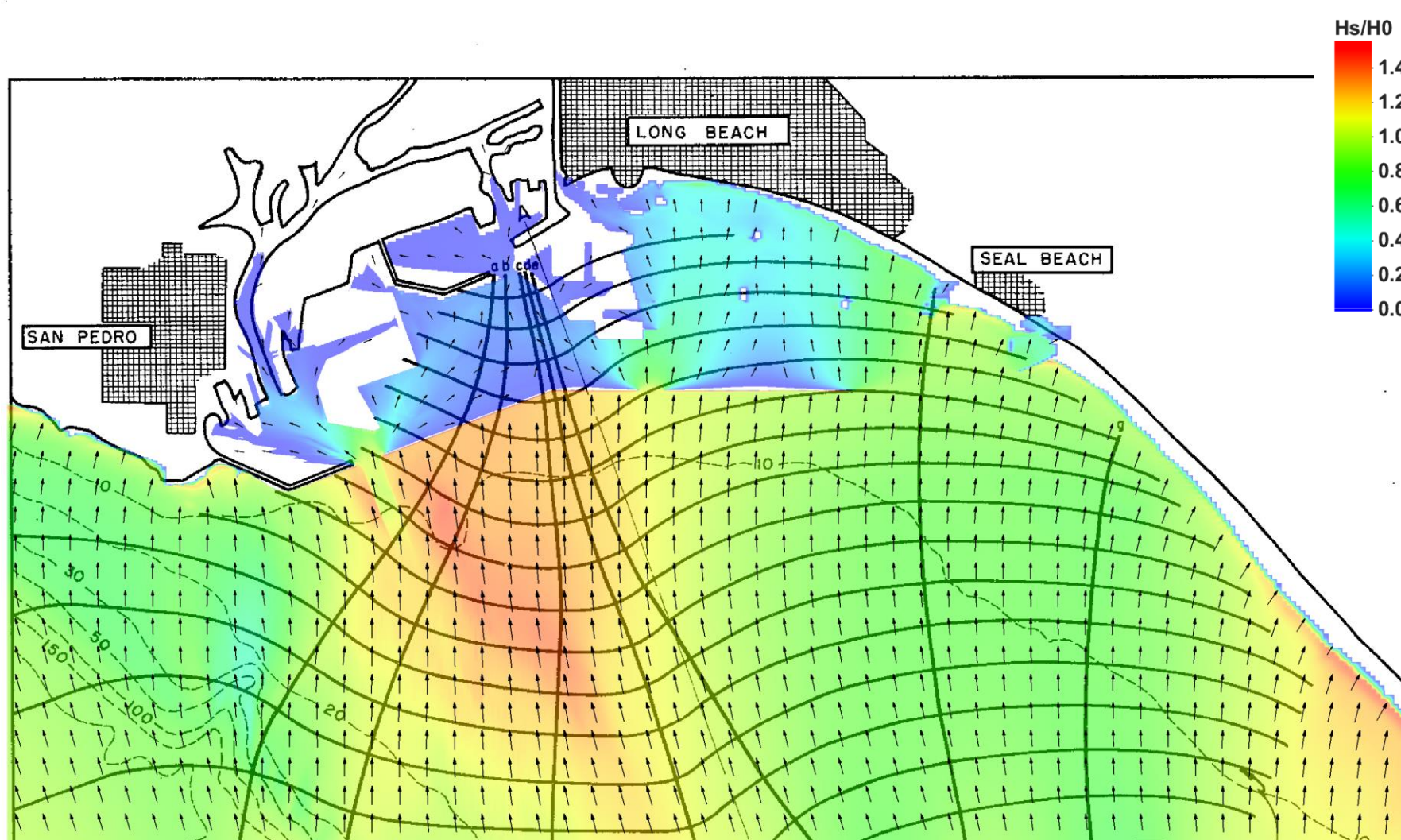


Aug 27, 2014

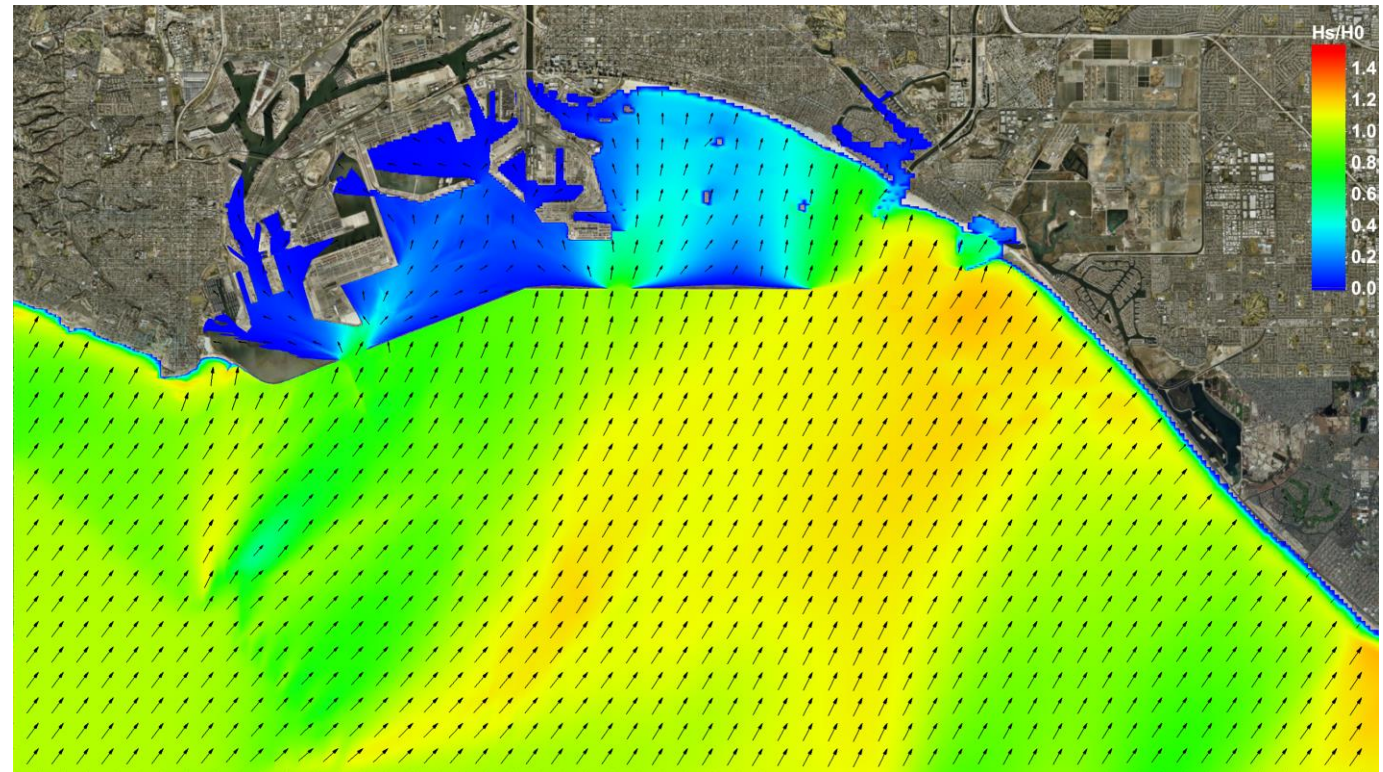
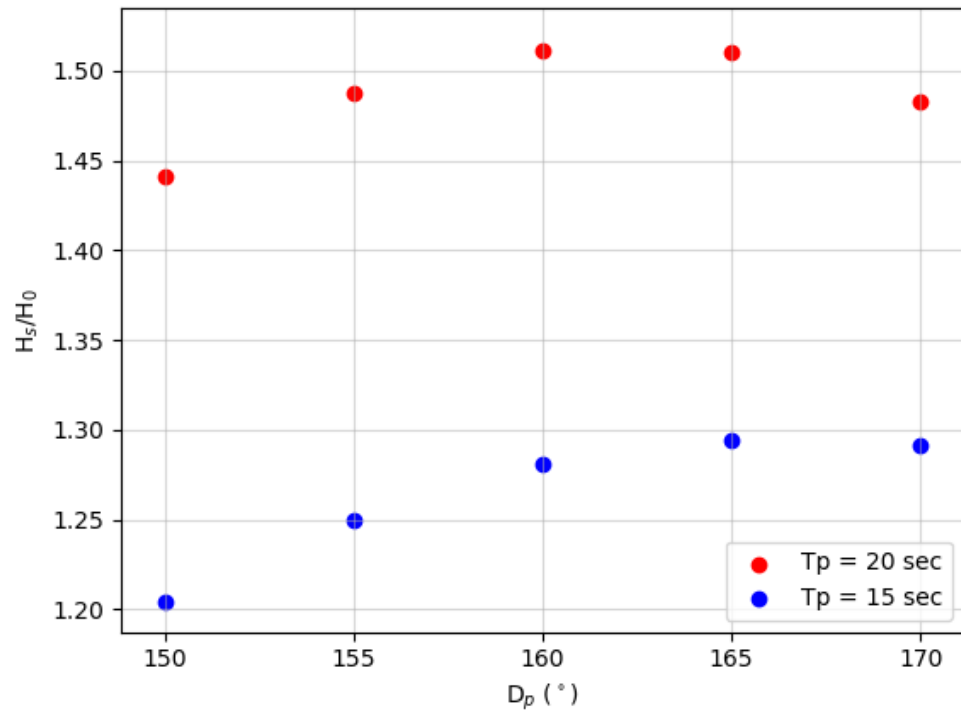
- Wave Forcing
 - $H_s = 11.25$ ft
 - $T_p = 15$ sec
 - $D_p = 160^\circ$



déjà vu All Over Again



Directional Dependence



Questions?



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