



Prevention 1st Symposium

Dynamic Under Keel Clearance (UKC) Project

Update Information Brief

28 September 2016

Captain Kip Louttit
Project Manager



OVERVIEW of Dynamic Under Keel Clearance Project

The Challenge:
VLCCs & ULCCs entering the POLB in a Southerly Swell

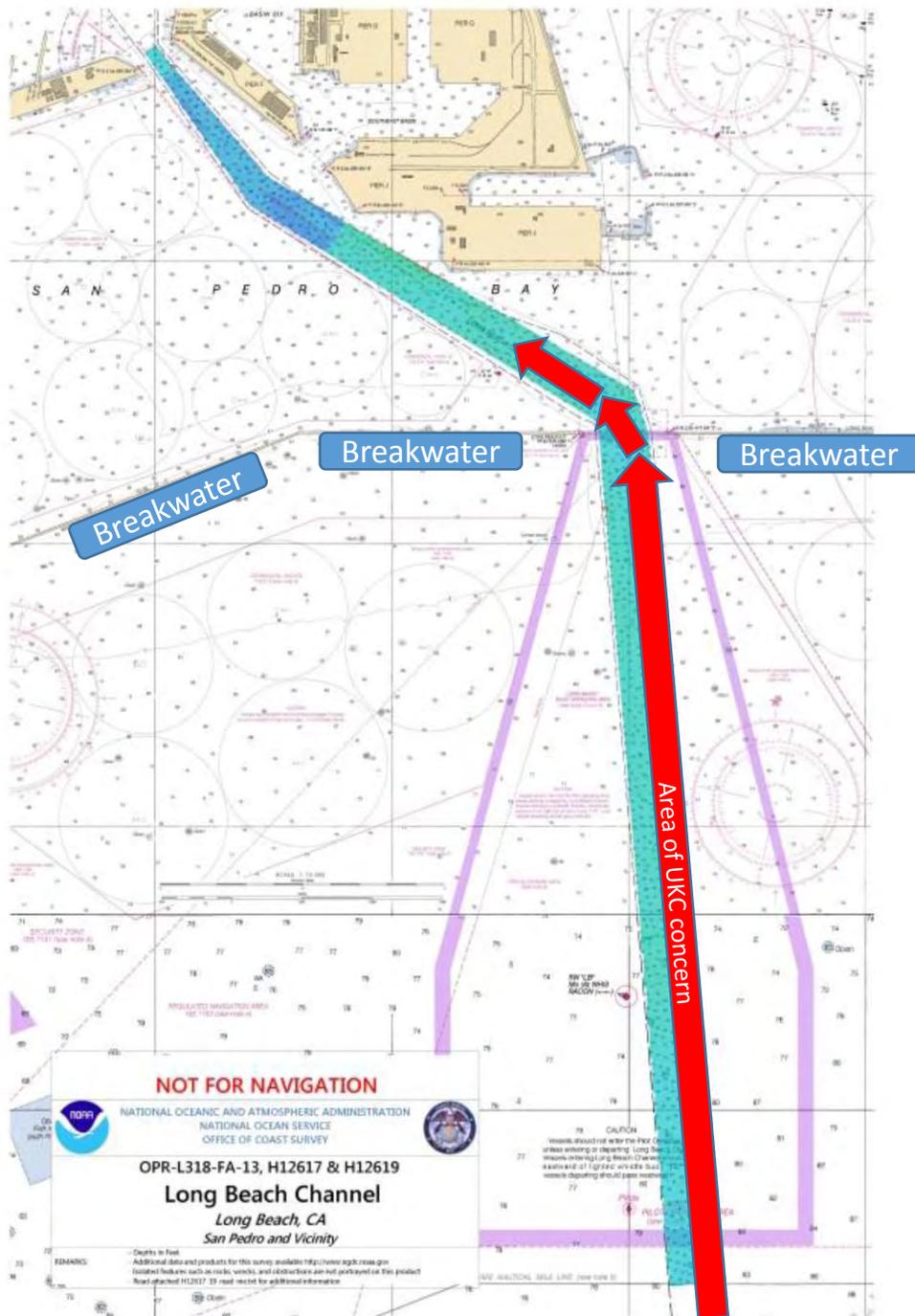


M/V *Solana* passing Jacobsen Pilot Station enroute pier 121, Tuesday 23 September 2014

Ports of Los Angeles & Long Beach

- ✓ 50 % of California's oil
- ✓ Pier T-121 is the only VLCC/ULCC berth on the West Coast





Approach to Port of Long Beach

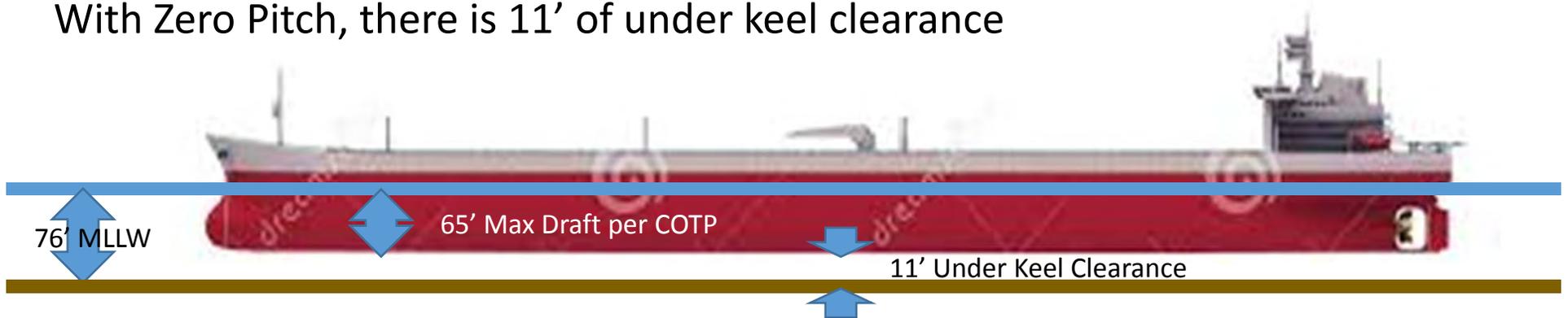
Channel dredged to 76 feet

Area of concern:

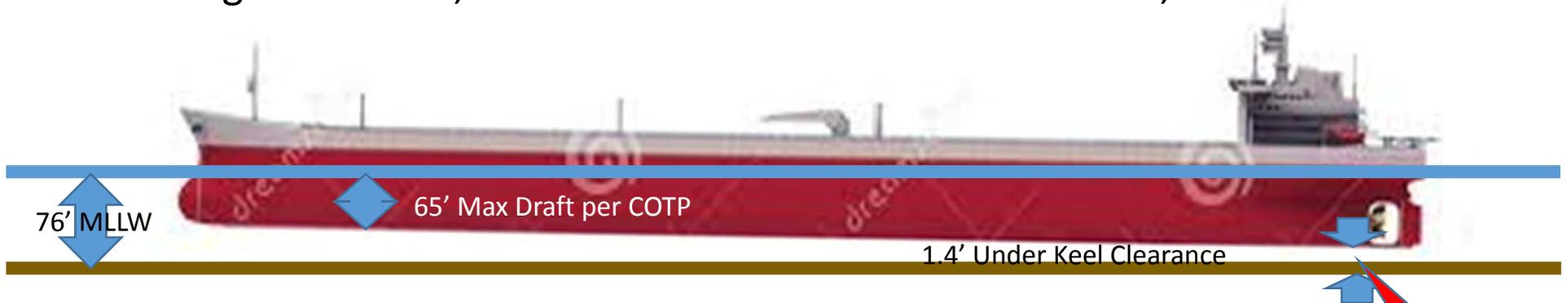
- ✓ approach channel
- ✓ turn at breakwater,
- ✓ little bit after the turn

The Pitch Problem in a Long Period Southerly Swell

With Zero Pitch, there is 11' of under keel clearance



With 1 degree of Pitch, there is a 9.6' increase in draft for a 1,100 foot tanker:



This reduces the UKC to 1.4 feet.

1.4' UKC!!

POLB dredged to 76 feet from approach channel to Pier T121 (Tesoro and Pier T121 Users)

The Present:

GO/NO GO decision made using:

- ✓ CDIP Swell Warnings
- ✓ CDIP Buoy Reports
- ✓ Experience
- ✓ Seaman's Eye
- ✓ Observed pitch & roll far enough offshore to permit "bail-out" before committing to channel



Tue 9/20/2016 9:06 AM

CDIP Processing <uproc@model.cdip.ucsd.edu>

Swell Warning - WW3 forecast

To nine_trk@cdip.ucsd.edu; Kip Louttit; Swell-alert@jacobsenpilot.com

Prediction site: SP018

Date (PST)	14+ Hs (ft)	14+ Tp (secs)	14+ Dp (deg T)	Tot Hs (ft)	Tot Tp (secs)	Tot Dp (deg T)
2016-09-20 04:00 pm	3.15	15.38	172	3.97	15.38	172
2016-09-20 07:00 pm	2.79	14.29	172	4.20	14.29	172

Link:

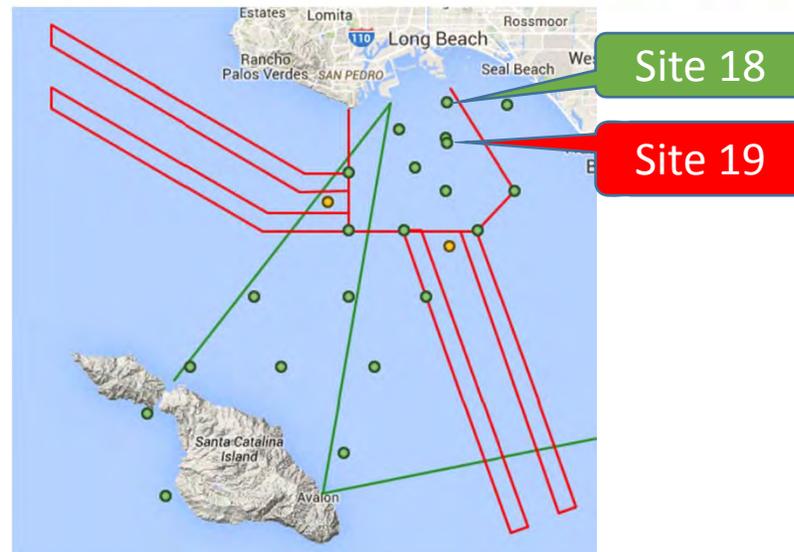
http://www.sccoos.org/data/harbors/lalb/mop_site.php?mop=SP018&page=fc_swell_plot&xperiod=14&tz=PST&units=english

Prediction site: SP019

Date (PST)	14+ Hs (ft)	14+ Tp (secs)	14+ Dp (deg T)	Tot Hs (ft)	Tot Tp (secs)	Tot Dp (deg T)
2016-09-20 04:00 pm	3.22	14.29	171	4.30	14.29	171
2016-09-20 07:00 pm	2.79	14.29	173	4.59	13.33	169

Link:

http://www.sccoos.org/data/harbors/lalb/mop_site.php?mop=SP019&page=fc_swell_plot&xperiod=14&tz=PST&units=english



Moving to the Future... UKC Program:

Feasibility Study Memorandum of Understanding Signed Nov-Dec 2014

Interested Parties and Advisors

Participants:

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

IOOS®
INTEGRATED OCEAN OBSERVING SYSTEM

SOUTHERN CALIFORNIA COASTAL OCEAN OBSERVING SYSTEM

CDIP
coastal data information program

The Port of LONG BEACH

JACOBSEN PILOT SERVICE
LONG BEACH PILOTS SINCE 1924

- ✓ Purpose, Goals, Definitions
- ✓ Study, Evaluation, Pilot, & Implementation Phases
- ✓ Desired Outcomes & Measures of Success
- ✓ Roles and Responsibilities
- ✓ \$\$ flows

Memorandum of Understanding
Feasibility Study for Dynamic Under Keel Clearance Assurance Program

I concur with the above:

By: Name/Date: Jon S. Langarup For the Port of Long Beach 12/2/14	By: Name/Date: Michael P. Cahill, 12/5/14 For the Office of Oil Spill Prevention and Response
By: Name/Date: Thomas J. Jacobsen 11-24-14 For the Jacobsen Pilot Service	By: Name/Date: Rick D. Weyen Title: Vice President, Logistics For Tesoro Refining & Marketing Company LLC

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

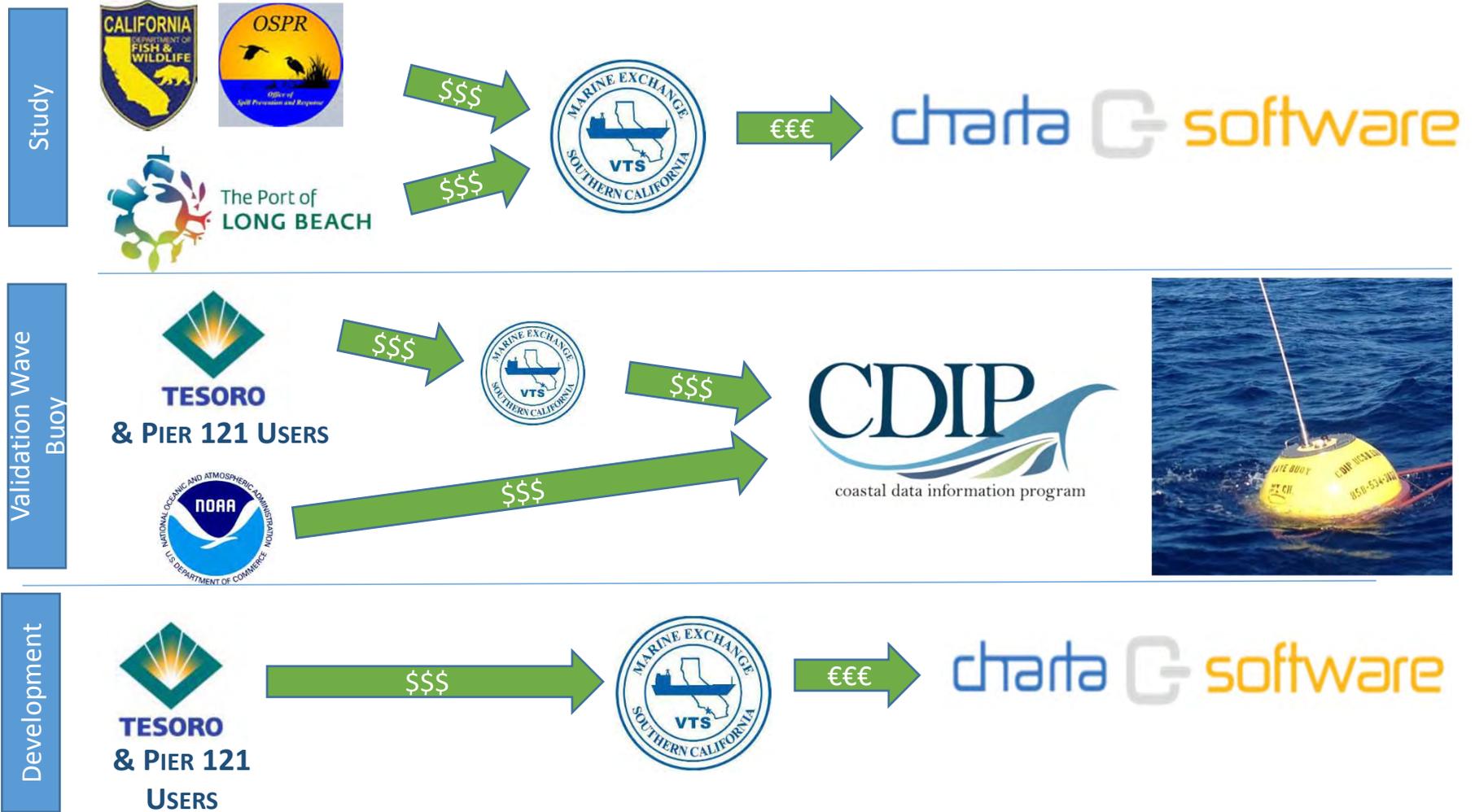
OSPR
Office of Oil Spill Prevention and Response

TESORO
& PIER 121 USERS

Project Manager:

MARINE EXCHANGE
SOUTHERN CALIFORNIA
VTS

Different phases, organizations & processes yielded different money flows:



The Potential Future:



/ > Charta Software

Charta Software

| Tailor-made high quality software combined with professional hosting, maintenance and support.

PROTIDE takes predicted:

- ✓ water levels,
- ✓ currents,
- ✓ wave conditions,
- ✓ channel depth,
- ✓ ship course and speed, and
- ✓ ship dimensions...



- Calculates vertical ship motion (Pitch, Roll, and Squat)...
- And then calculates predicted under keel clearance & bottom touch probability.

PROTIDE is now used in three harbors in the Netherlands to support the operational process:

Port of Rotterdam, Port of Amsterdam & Eemshaven

Example: A 935 foot tanker with 67 foot draft weighing 230,000 tons enters Long Beach

INPUTS to PROTIDE

1. Input Ship Info:

Request ID	11
Ship	230,000 ton VLCC (6 / T006)
Ship dimensions l / w / dwt	285 m 49 m 250000 tons
Draft f / m / a	20.46 m 20.46 m 20.46 m
Berth	Harbor entrance (23.16 m / Inbound)
Requested time of departure	2014-08-22 00:00
Water displacement	234294 tons
GM	7.78 m
GG'	0.4 m
Roll period	13.71 s
Estimation method used	Yes
Submitted by	Take Roes (2014-08-27 09:29)

2. Input Environmental Info: Water level, tide, weather, sea, and swell

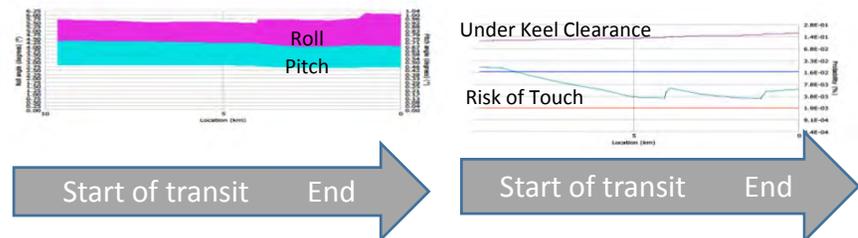
Outputs of Protide: Predicted UKC and Probability of Touch

Predicted pitch is a max of 0.75 degrees
 Predicted roll is a max of 6.15 degrees

Resulting Underkeel Clearance ranges from:
 3.9 m at the start of the transit to
 4.1 m at the end of the transit

Risk of touching bottom is:
 0.020% at start of transit,
 decreases to .0038% in the middle, and
 increases to .0050% at the end

Determination: The transit is safe

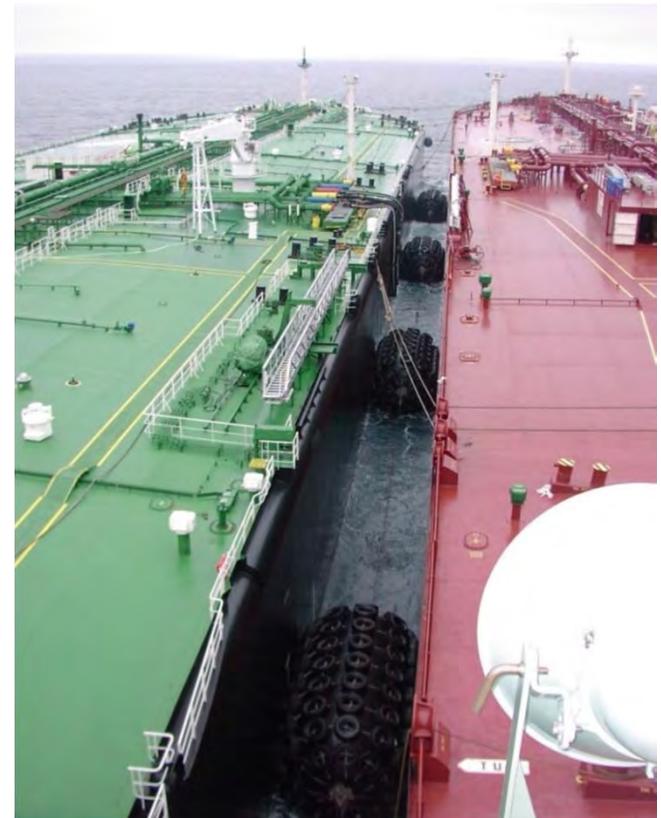


Goals of Dynamic Under Keel Clearance Project

- 1. Increase safety** by reducing the risk of an accidental grounding caused by the pitch or roll of a large vessel causing it to impact the bottom.
- 2. Increase efficiency** by enabling ship owners and masters to adjust arrival times based on the pitch and roll program being able to predict when pitch and roll will be out of limits to enter port due to unacceptable under keel draft clearance
- 3. Reduce emissions** by enabling larger ships to carry more cargo to enter the POLB, which could reduce overall stack emissions per ton of cargo arriving at the port.

Benefits

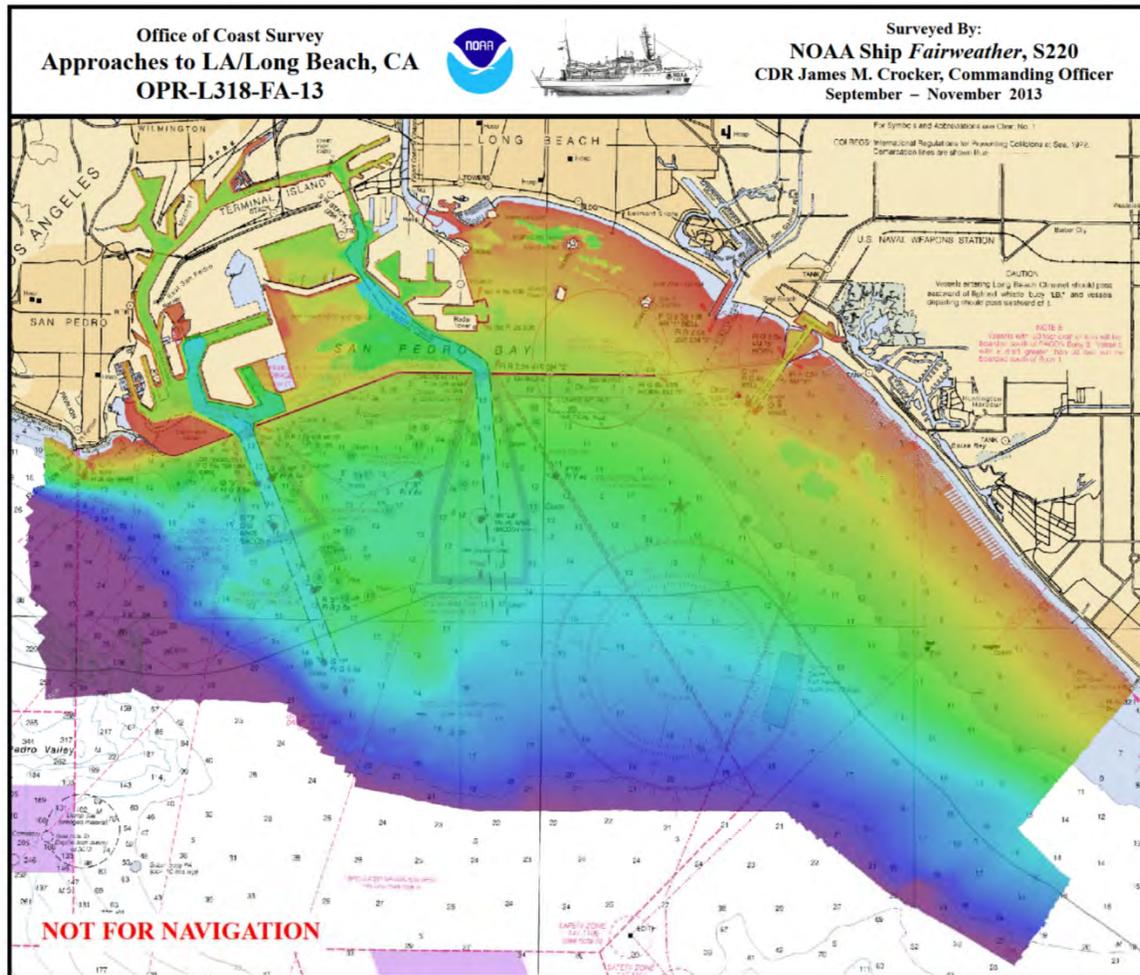
1. Reduce overall risk of transporting oil on West Coast
2. Reduce oil spill risk
 - a. Fewer oil transfers
 - b. Transfers in protected harbors rather than offshore lightering
3. More efficient use of port infrastructure, tugs & berths
4. Reduced personnel injury/exposure
 - a. Line handlers
 - b. Lessens crew man hours in demanding ops





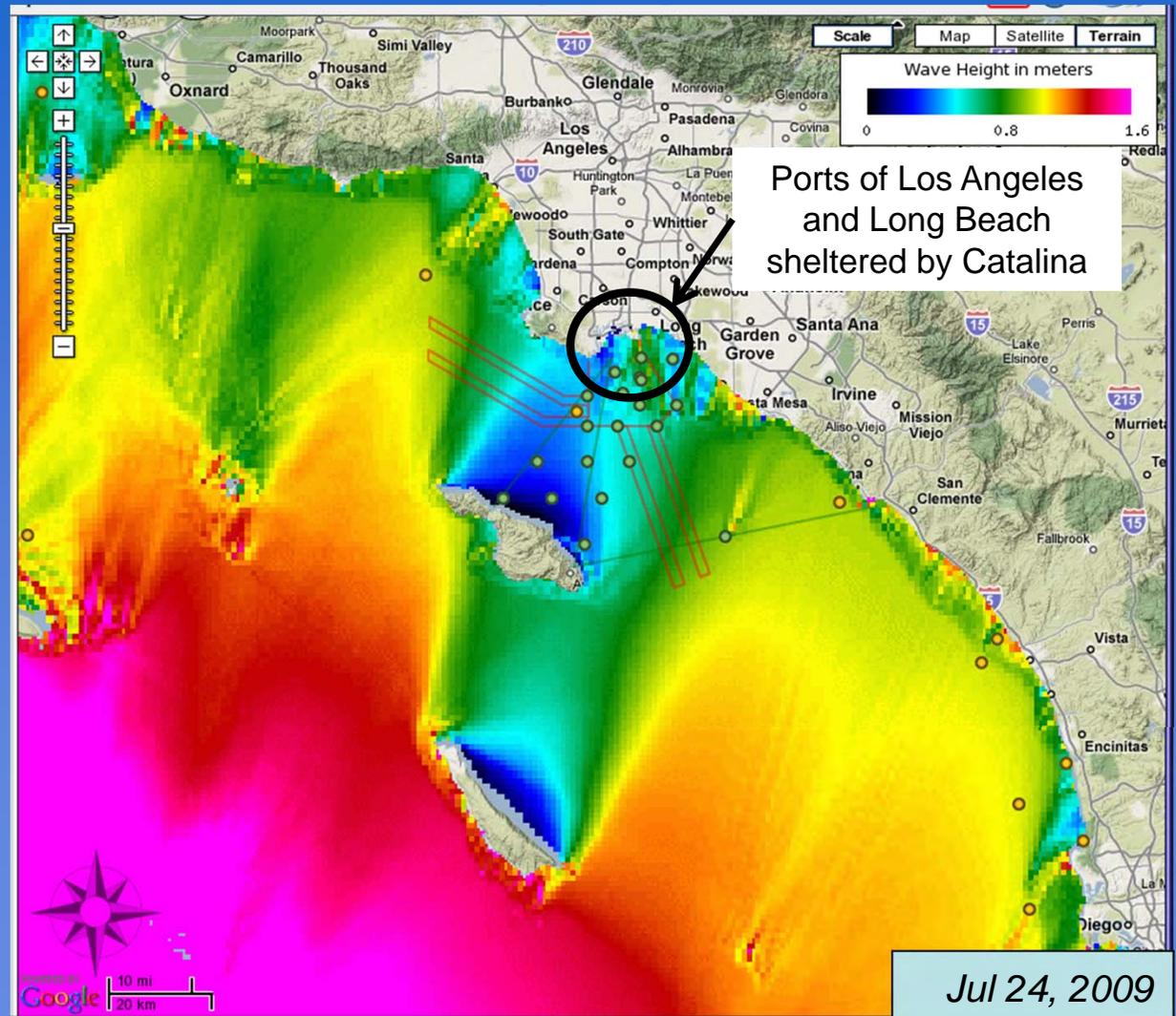
Precision navigation requires precise charts and accurate depths.

Accomplished fall of 2013 by NOAA Ship Fairweather.



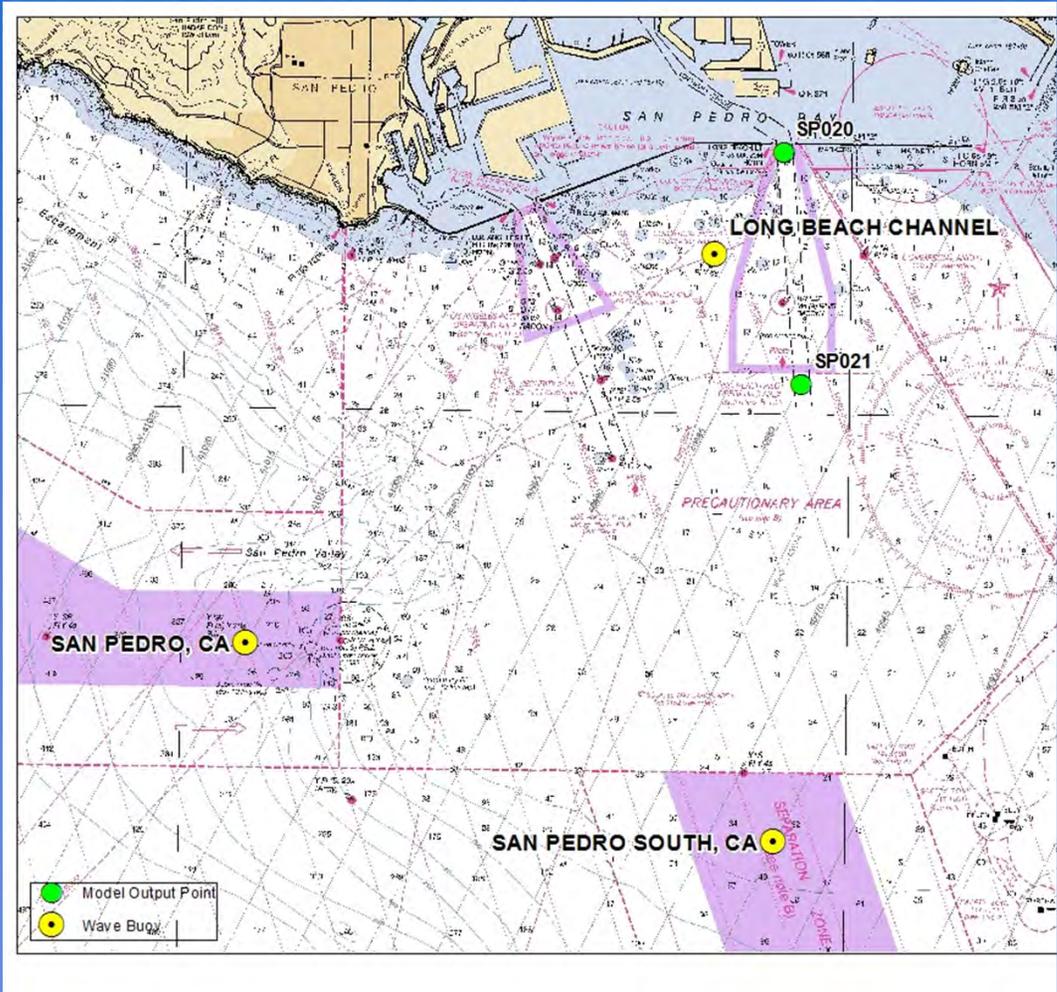
Challenges of developing a wave model for Southern California

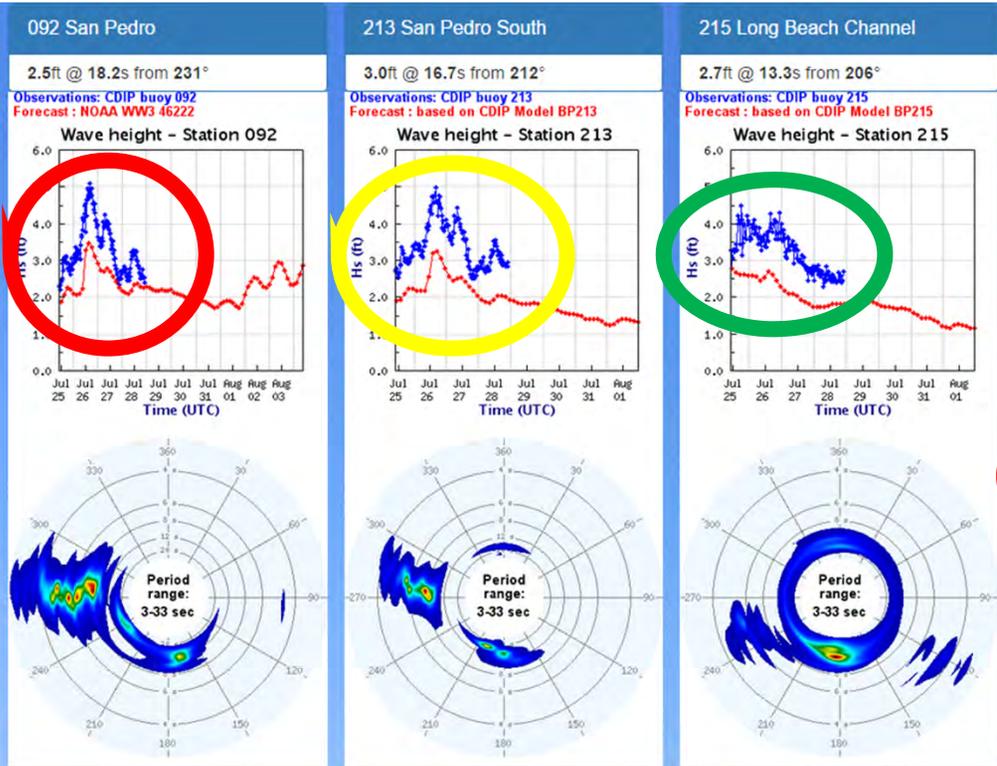
- ✓ Spatial variation due to island shadowing allows coastal variability.
- ✓ Wave heights differ according to direction of the waves.



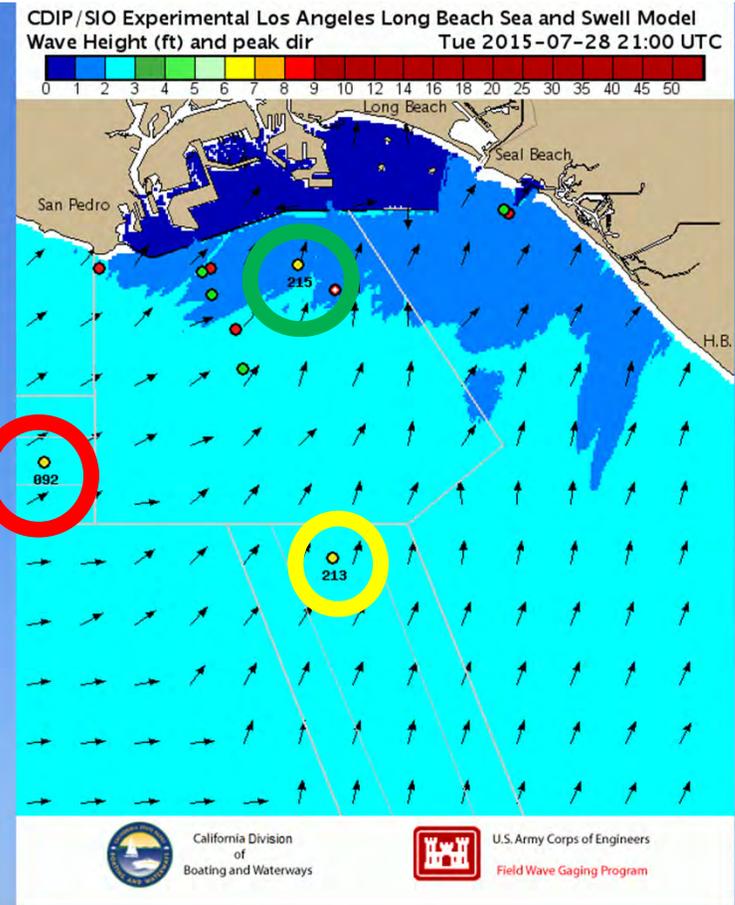
LA/LB Sheltered by San Clemente

3 wave buoys support the UKC project.
CDIP Wave model locations identified.
Hourly submission to ProTide.





Wave buoys show forecast is under-predicting. Blue actual wave line is above red forecast line.



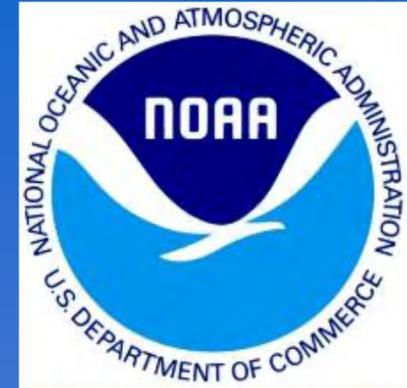
California Division of Boating and Waterways | U.S. Army Corps of Engineers Field Wave Gaging Program



Display at Marine Exchange. Buoys update every 30 minutes.

Note difference in wave direction just within this small area... validates need for 3 buoys.

✓ NOAA National Climate Prediction Centers (NCEP) is developing a *Nearshore Wave Prediction System* model for the San Pedro Bight.

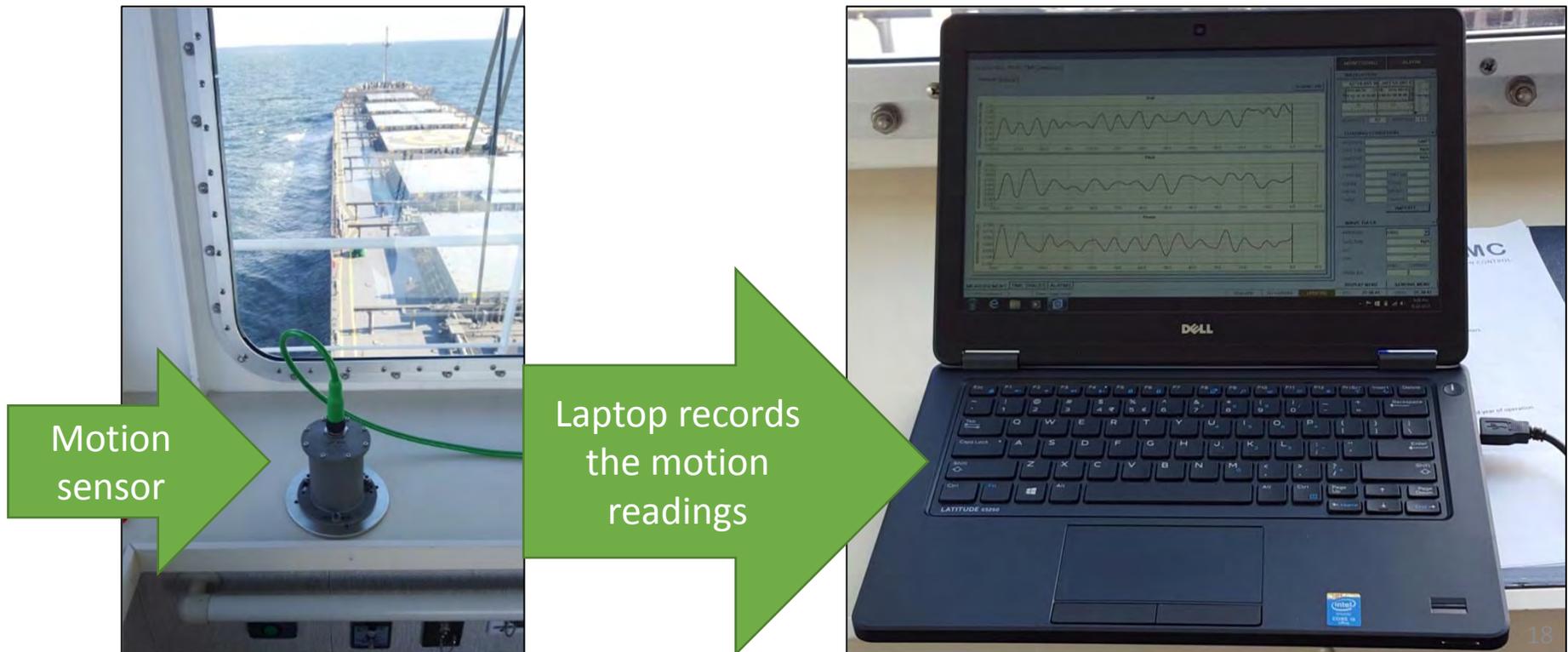


✓ While this model is being developed and validated, PROTIDE will use the CDIP wave model.



Evaluation of ship motion

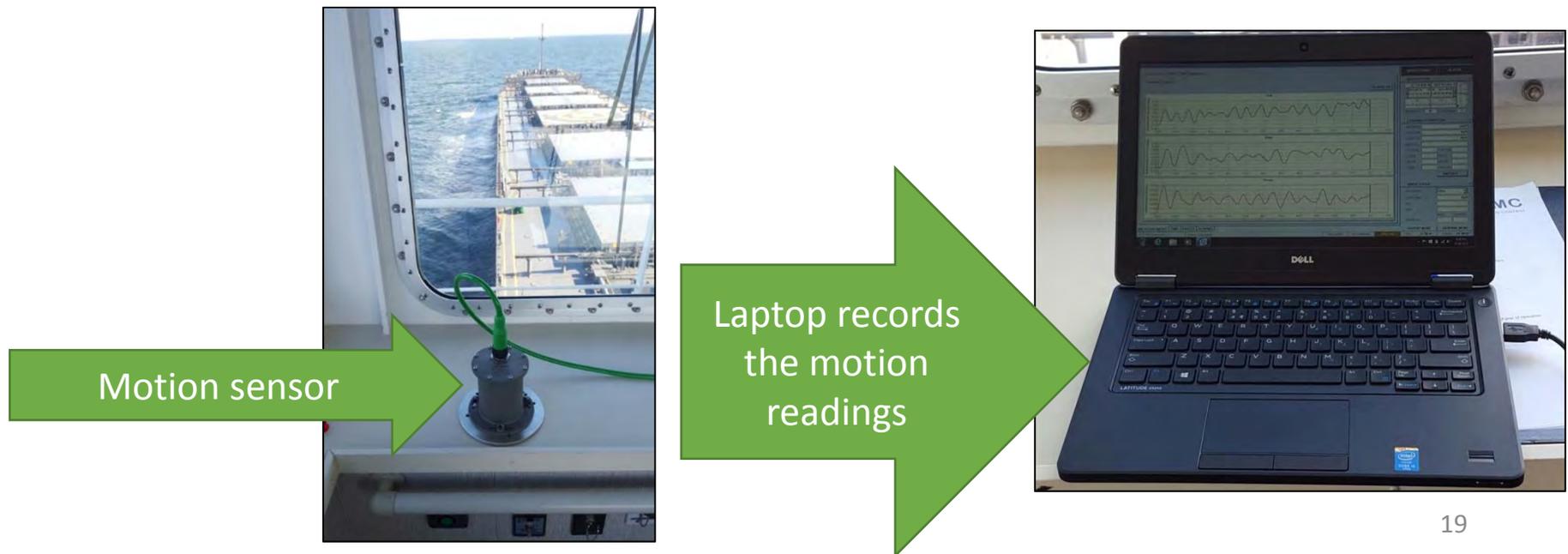
- ✓ Using Amarcon's "OCTOPUS" system
- ✓ Extremely accurate motion sensor:
 - Brought on board by the pilots
 - Placed in exactly the correct location
 - Motion measurements recorded by laptop



Evaluations thus far:

- Fall 2015: 20 large tanker transits
- Jul-Aug 2016: 10 more large tanker transits
- Results being analyzed; thus far results are favorable

- Sept 2016: Extended measurement period because previous measurement did not have desired long-period South Swell.



Example PROTIDE VALIDATION RUN
Tanker Chloe 26 Oct 2015 ... it works!



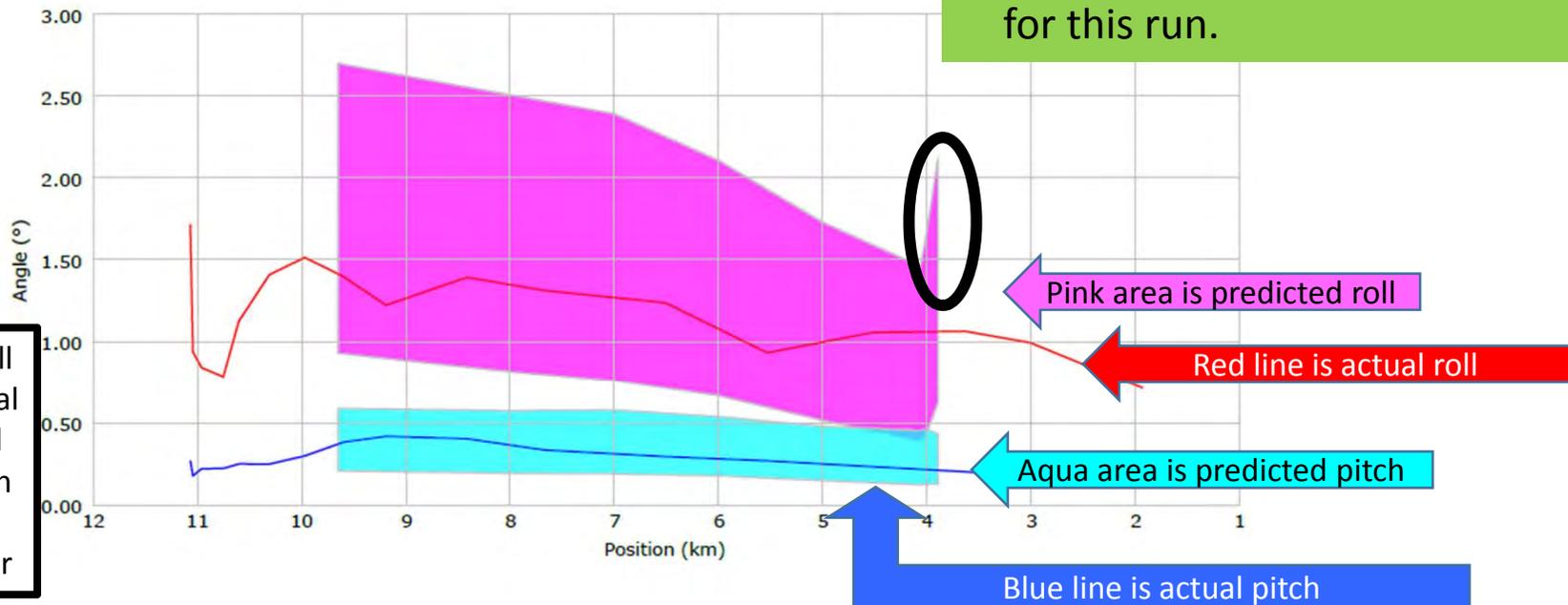
Example Validation

Tanker **CHLOE** entering Long Beach 26 Oct 2015

LOA 1092 feet Beam 196 feet
Draft 64.9 feet 320,137 DWT



Roll and pitch angles diagram



Spike in roll in black oval is ship roll due to turn at the breakwater

- Roll angle (°)
- Pitch angle (°)
- Measured roll angle
- Measured pitch angle

The actual pitch and roll are within the ProTide predicted range.
✓ Therefore, ProTide is validated for this run.



Ship entering
Long Beach with new cranes

Goals of this project:

- ✓ Tanker focus
- ✓ Increase safety & efficiency, and reduce emissions

Other potential applications:

- Unique vessels
- Bad weather
- Larger Container Ships (Pier J Long Beach)
- Larger Cruise Ships
- Other ports

Ship exiting
Long Beach in
Hurricane Marie
swells



Next Steps

1. Finish measuring transits in September 2016
2. Analyze all transits
3. Analyze the actual wave vs. forecast wave data
4. Adjust NOAA wave model based on CDIP buoy measurements.
5. Shift from CDIP model to NOAA Nearshore Wave Prediction System when it is ready
6. Determine path to operationalize the system

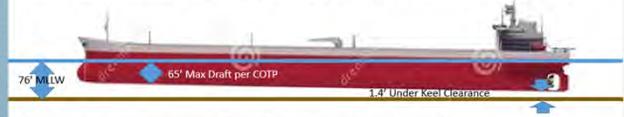


Questions? Comments?

With Zero Pitch:



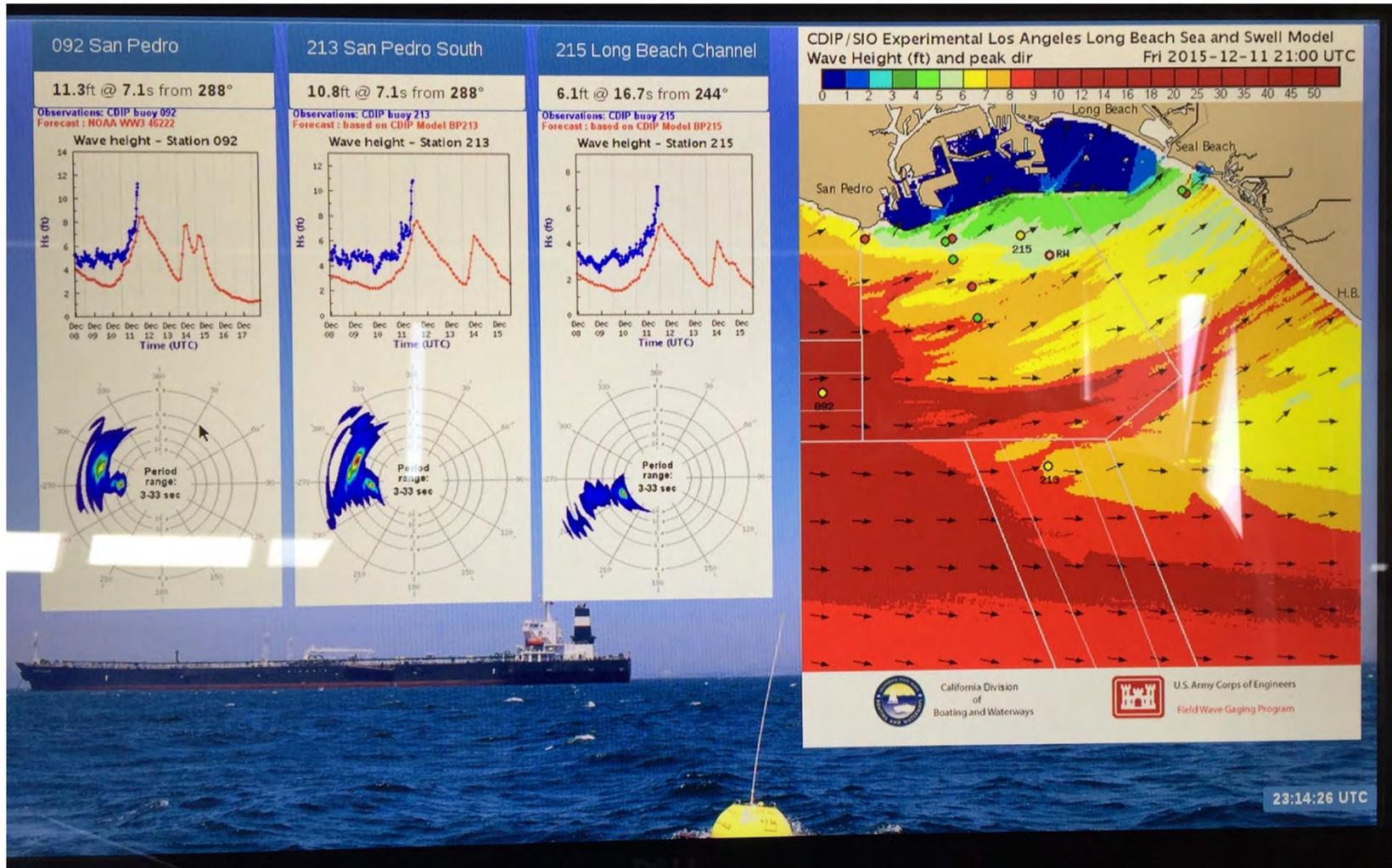
With 1 degree of Pitch, there is a 9.6' increase in draft for a 1,100 foot tanker:



POLB dredged to 76 feet from approach channel to Pier 121 (Tesoro and Pier 121 Users)



Backup



11 December 2015 storm... wave buoys recording as much as a meter more than the wave forecast.

Blue line is buoys.

Red line is forecast.

End

Point of Contact:

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