SEA LEVEL RISE MONITORING AT THE LOCAL AND REGIONAL SCALE

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National Center for Sustainable Transportation

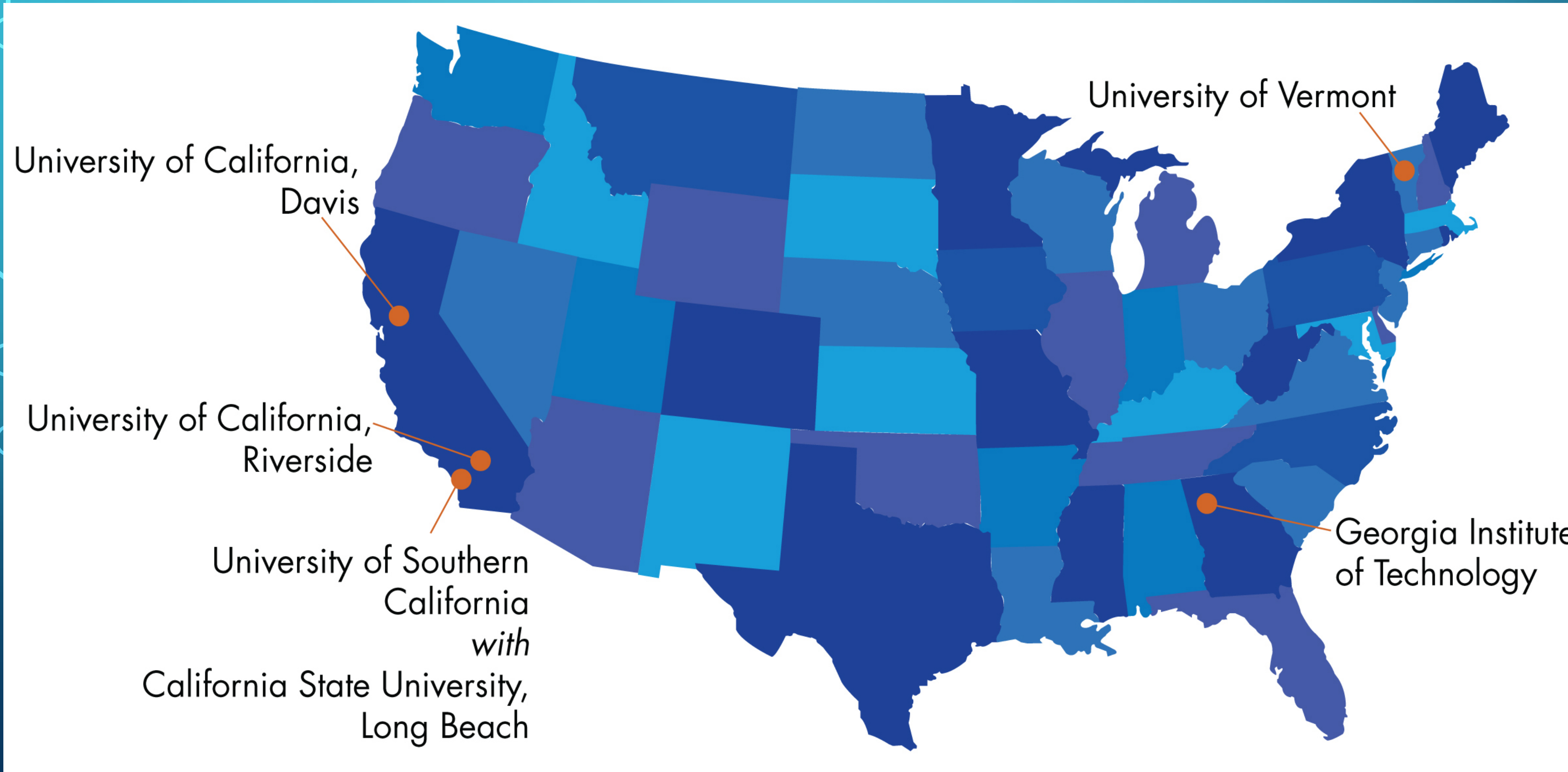
TRANSFORMING THE TRANSPORTATION SYSTEM

RESEARCH – *Producing "state of knowledge" white papers and interdisciplinary research projects*

EDUCATION – *Developing model curricula for graduate programs and advanced training programs*

ENGAGEMENT – *Informing the policy-making process at the local, state, and federal level*

NCST UNIVERSITY PARTNERS



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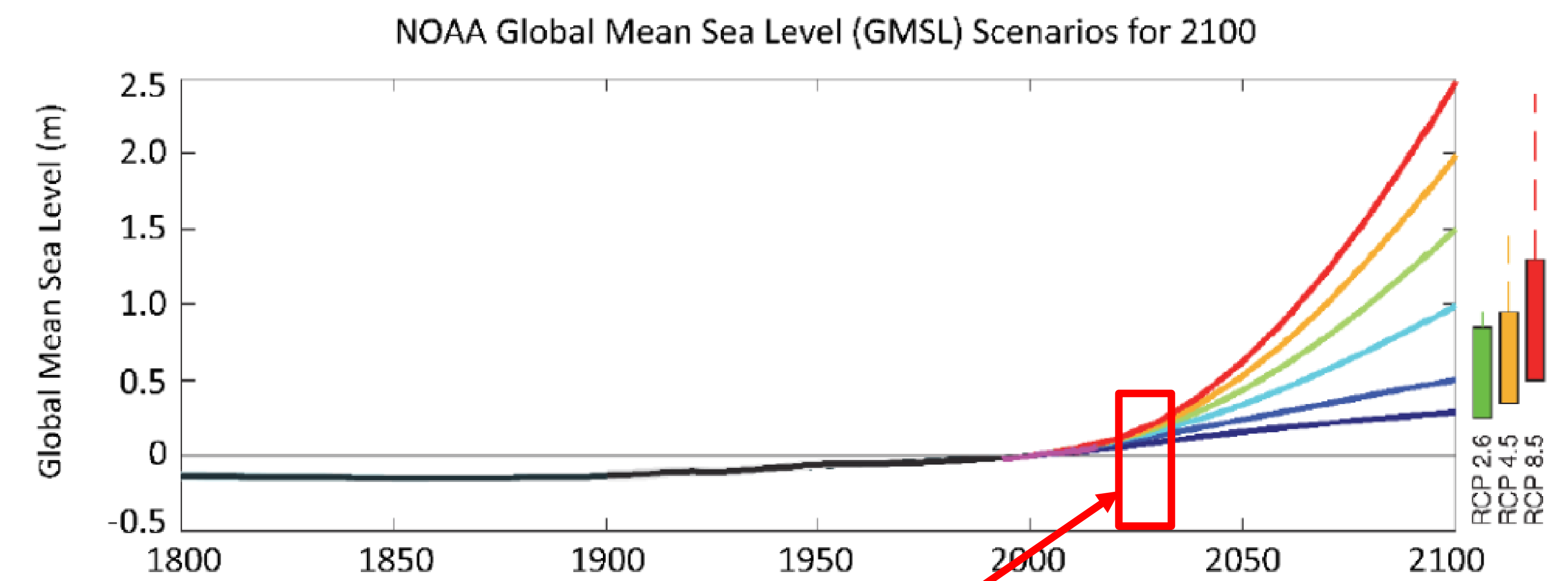
SEA LEVEL RISE



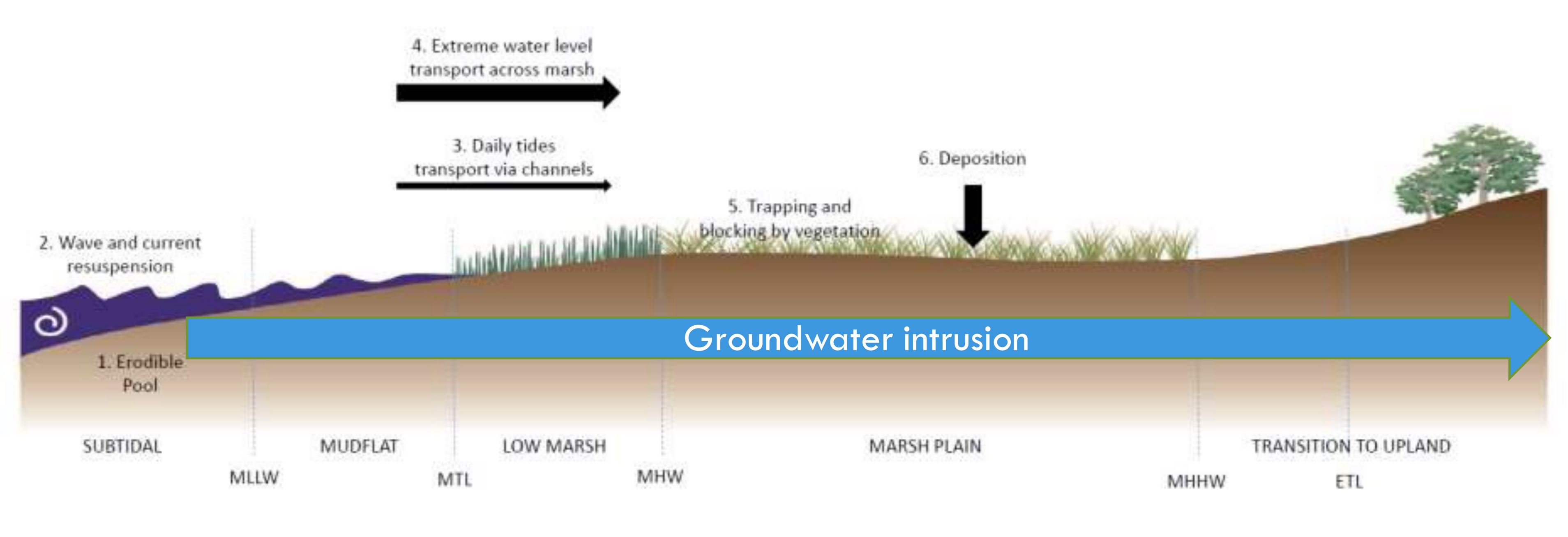
NOAA Technical Report NOS CO-OPS 083

GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES

GMSL rise scenario heights in meters for 19-year averages centered on decade through 2200 (showing only a subset)) initiating in year 2000. Only median values are shown.

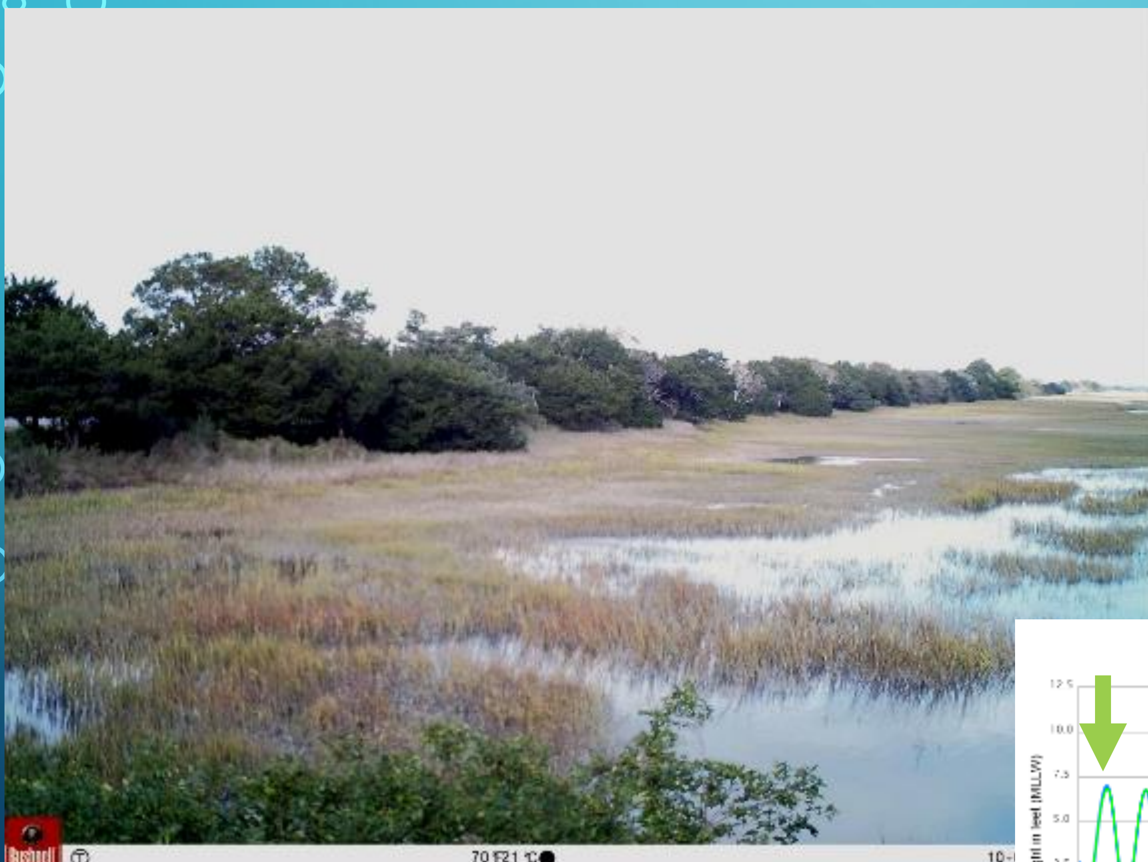
GMSL Scenario (meters)	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100	2120	2150	2200
Low	0.03	0.06	0.09	0.13	0.16	0.19	0.22	0.25	0.28	0.30	0.34	0.37	0.39
Intermediate-Low	0.04	0.08	0.13	0.18	0.24	0.29	0.35	0.4	0.45	0.50	0.60	0.73	0.95
Intermediate	0.04	0.10	0.16	0.25	0.34	0.45	0.57	0.71	0.85	1.0	1.3	1.8	2.8
Intermediate-High	0.05	0.10	0.19	0.30	0.44	0.60	0.79	1.0	1.2	1.5	2.0	3.1	5.1
High	0.05	0.11	0.21	0.36	0.54	0.77	1.0	1.3	1.7	2.0	2.8	4.3	7.5
Extreme	0.04	0.11	0.24	0.41	0.63	0.90	1.2	1.6	2.0	2.5	3.6	5.5	9.7

PHYSICAL PROCESSES INFLUENCING COASTAL ECOSYSTEMS

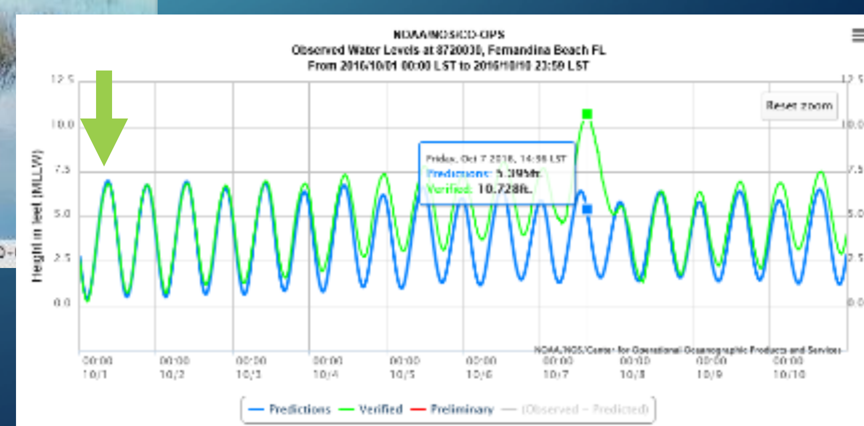


From Army Corps of Engineers 2016

HURRICANE MATTHEW (2016)

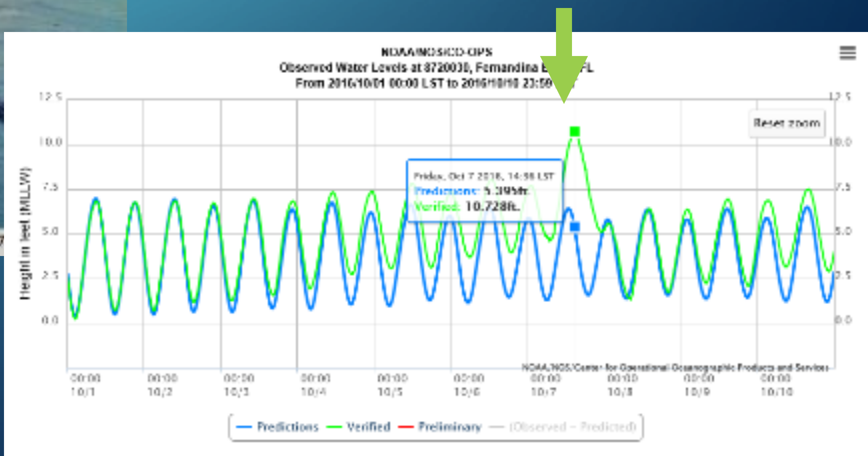


- Jekyll Island Visitors Center Viewing Deck; October 1, 2016
  - 9:50 am
- High Tide:
  - 9:51 am



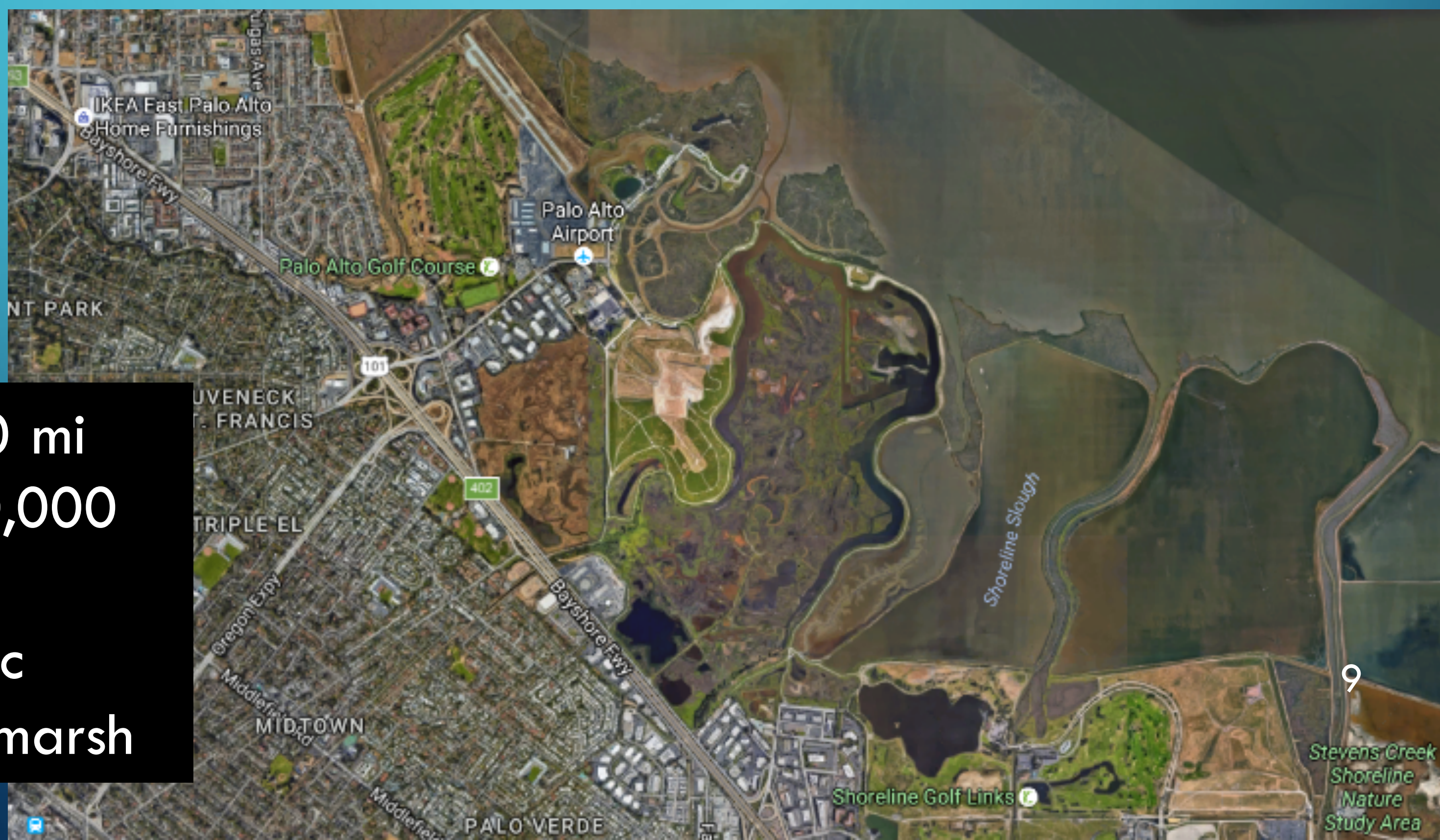
HURRICANE MATTHEW (2016)

- Jekyll Island Visitors Center Viewing Deck, October 7,2016
  - 1:45 pm
- High Tide:
  - 1:47 pm



WHAT IS THE PROBLEM?

Coastal infrastructure and shoreline ecosystems immediately adjacent and strongly interacting, no inward migration possible, loss of tidal marshes – impacts to communities/infrastructure



US – 94,000 mi coastline, 60,000 in lower 48
4.1 million ac coastal salt marsh

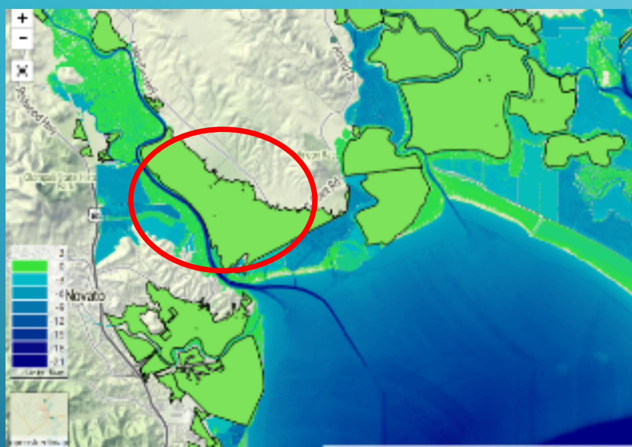
FEDERAL AND STATE (CA) GUIDANCE

Both FHWA and Caltrans urge the use of predictive models in planning for shoreline infrastructure

Both also suggest monitoring, but provide no guidance

UN-VALIDATED PREDICTIVE MODELS USED TO SUPPORT DECISIONS

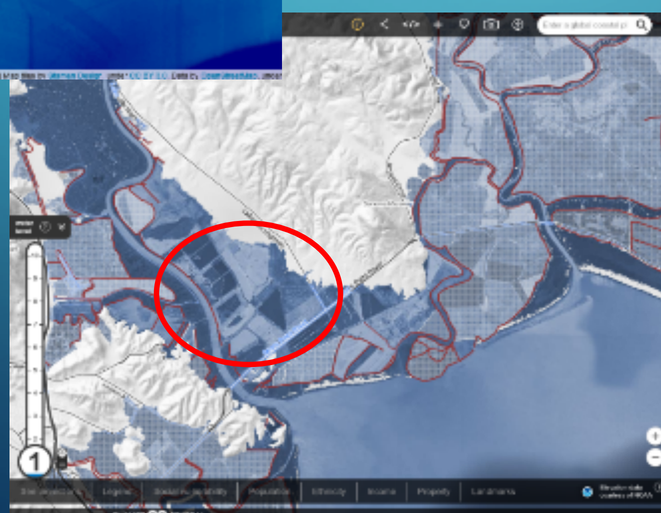
http://hwy37.ucdavis.edu/maps



LIDAR ACCURACY

24”

12”



http://ss2.climatecentral.org

WHY TRACK CHANGE?

Replacement cost of exposed infrastructure

Economic activity

Loss/change of shoreline ecosystems

Reinforcing effects between infrastructure and ecosystem

HOW WE TRACK CHANGE

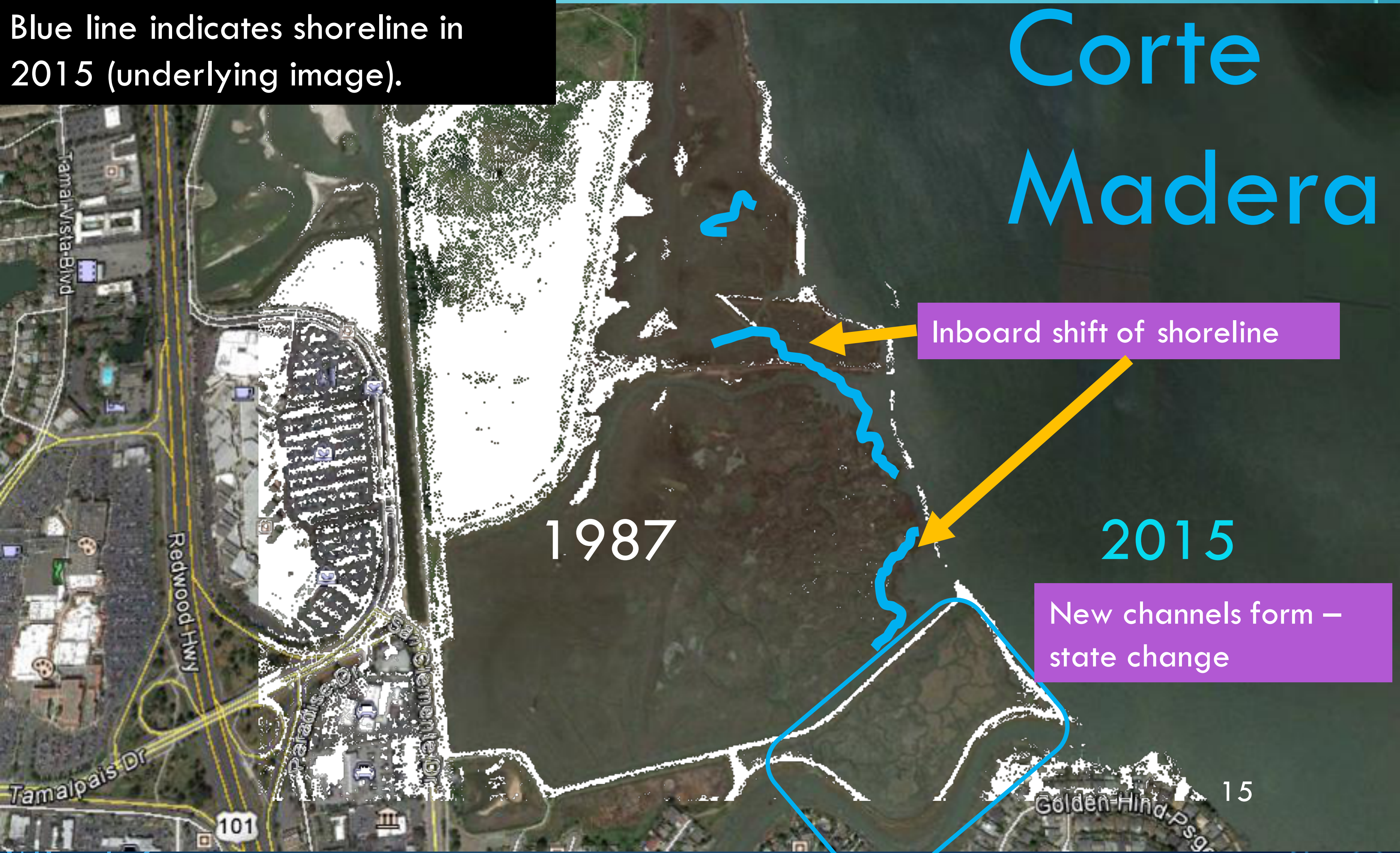
Spatio-temporal scales

- Decades/km(2) – satellite/remote sensing
- Years/m(2) – low-elevation photogrammetry/LIDAR (fixed position, airplane, UAV)
- Hours-months/cm-m(2) – very-fine photogrammetry/LIDAR (fixed position, UAV)

REMOTE-SENSING/SATELLITE IMAGERY

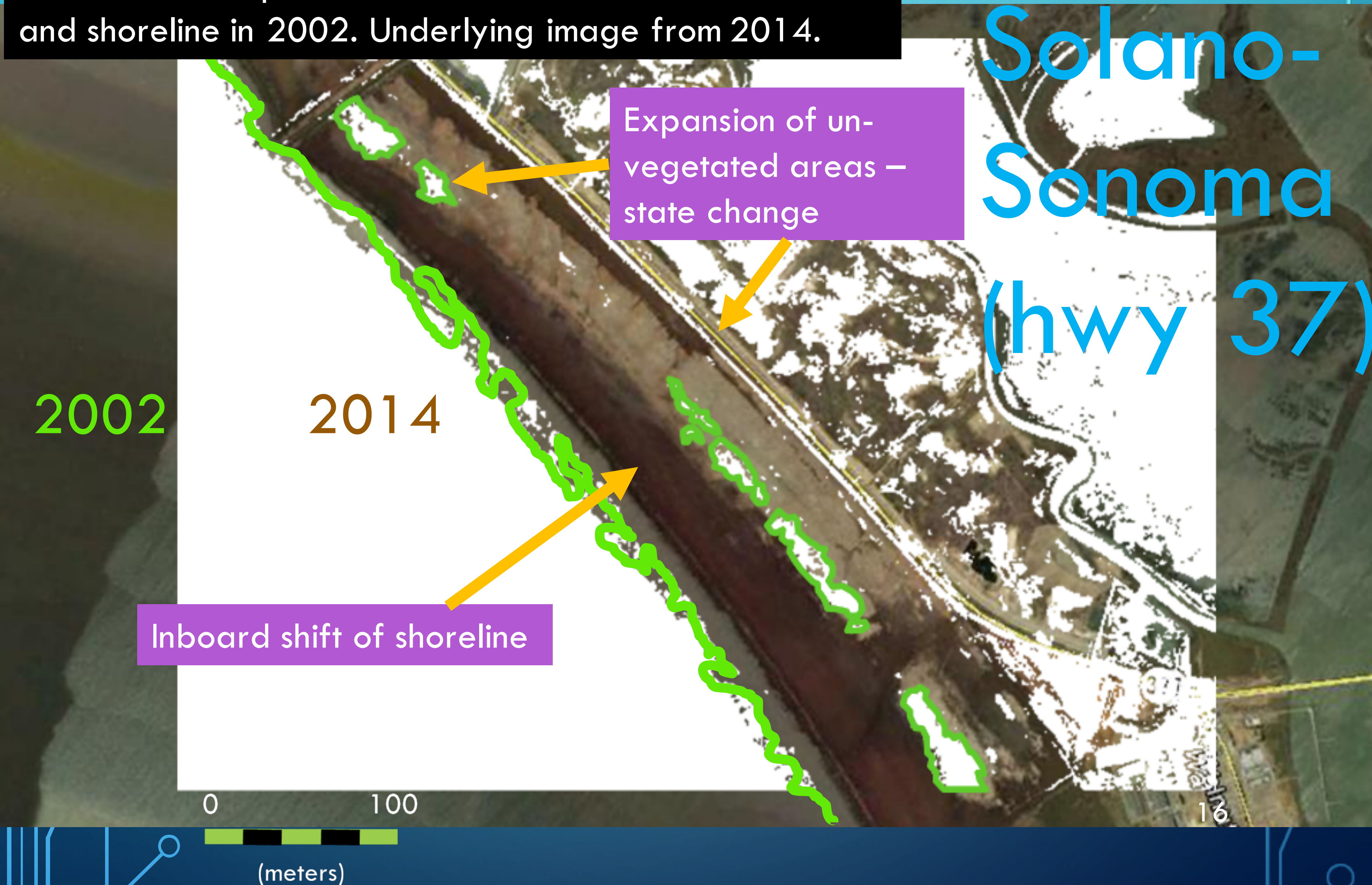
Corte Madera

White areas indicate the position of shoreline structure in 1987. Blue line indicates shoreline in 2015 (underlying image).



White areas indicate the position of shoreline structure in the earlier time period. Green lines indicate bare areas and shoreline in 2002. Underlying image from 2014.

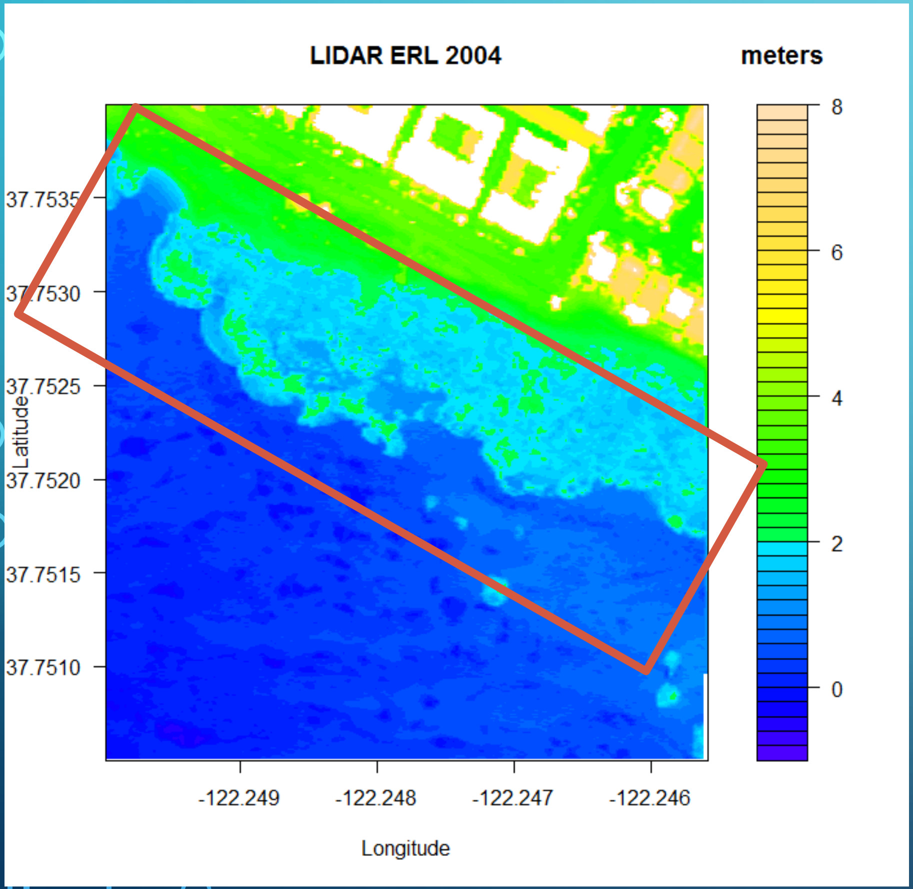
Solano-Sonoma (hwy 37)

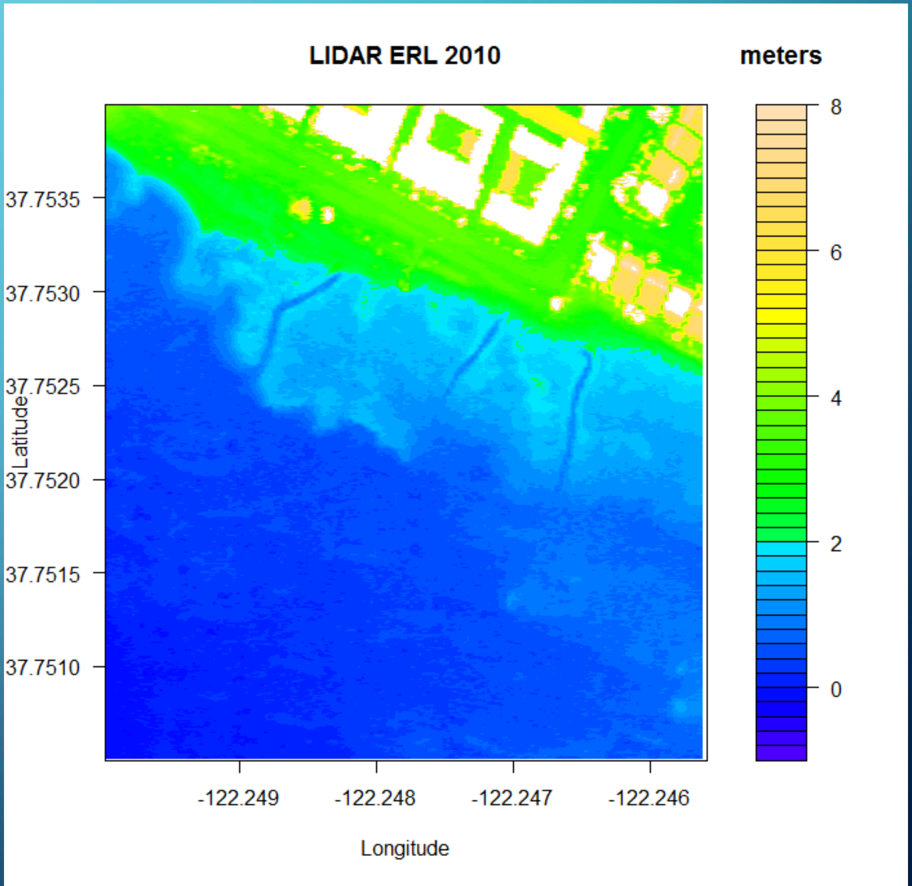


LOW-ELEVATION LIDAR

Aircraft → UAS

ELEVATION CHANGE AT 10 SITES 2004-2010

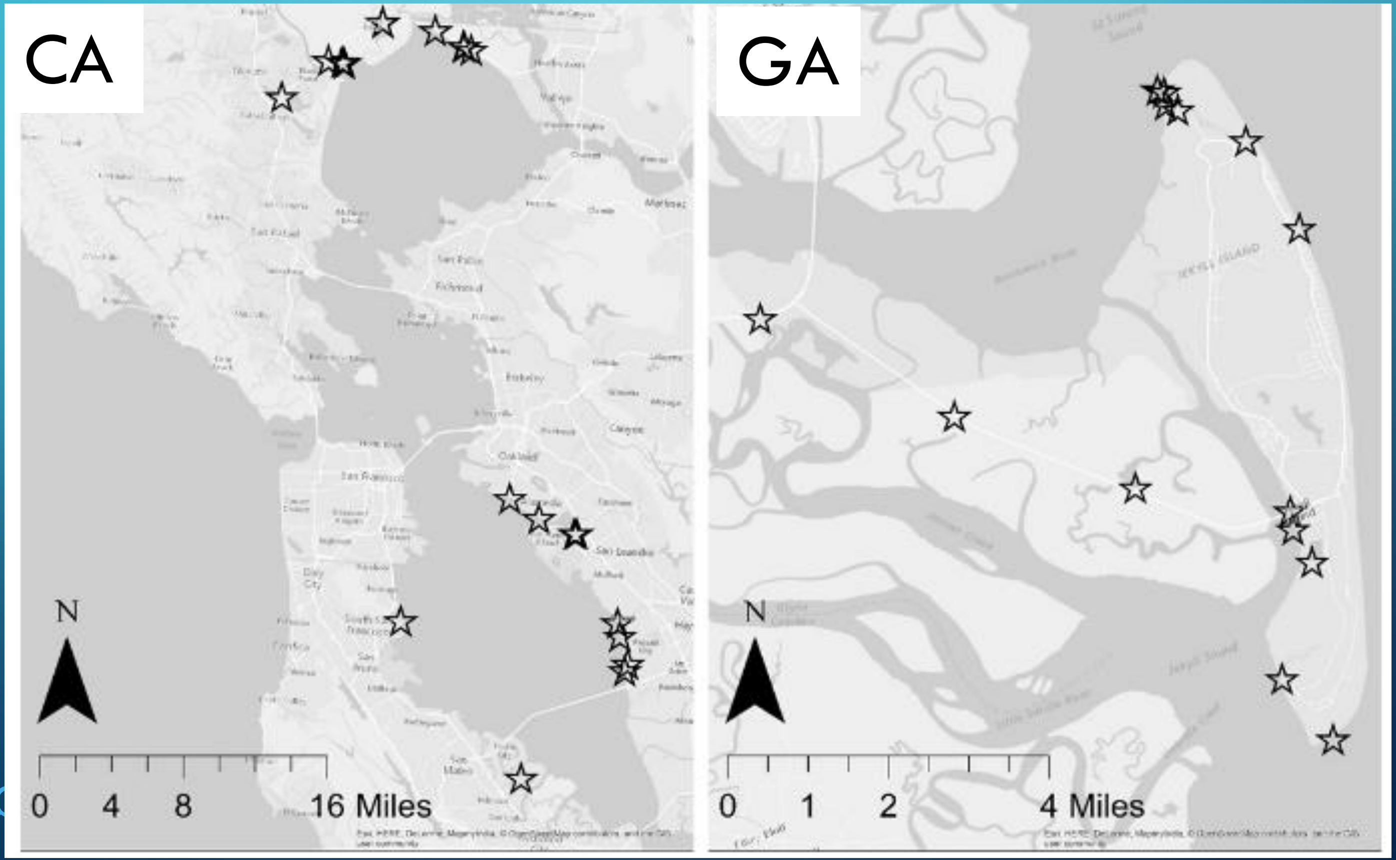




FIXED-POSITION TIME-LAPSE CAMERAS

FIXED-POSITION TIME-LAPSE CAMERAS

Sites selected to represent types (e.g., shoreline highway)



METHODS

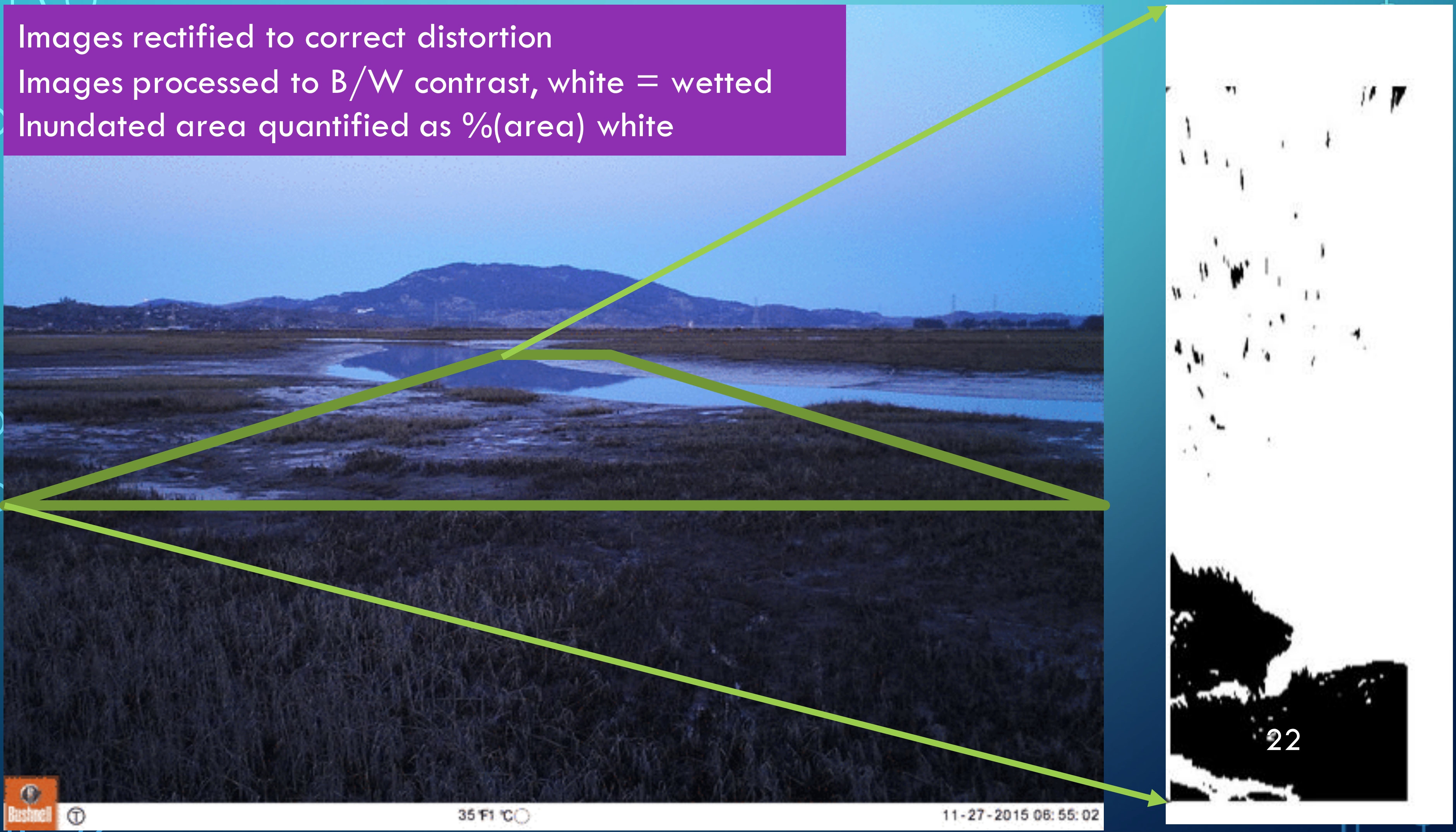
Bushnell trail cameras on posts/structures

Images at 5-15 minute interval, most at 10 minutes

Began collecting images in 2014 (funded 2015-2016)

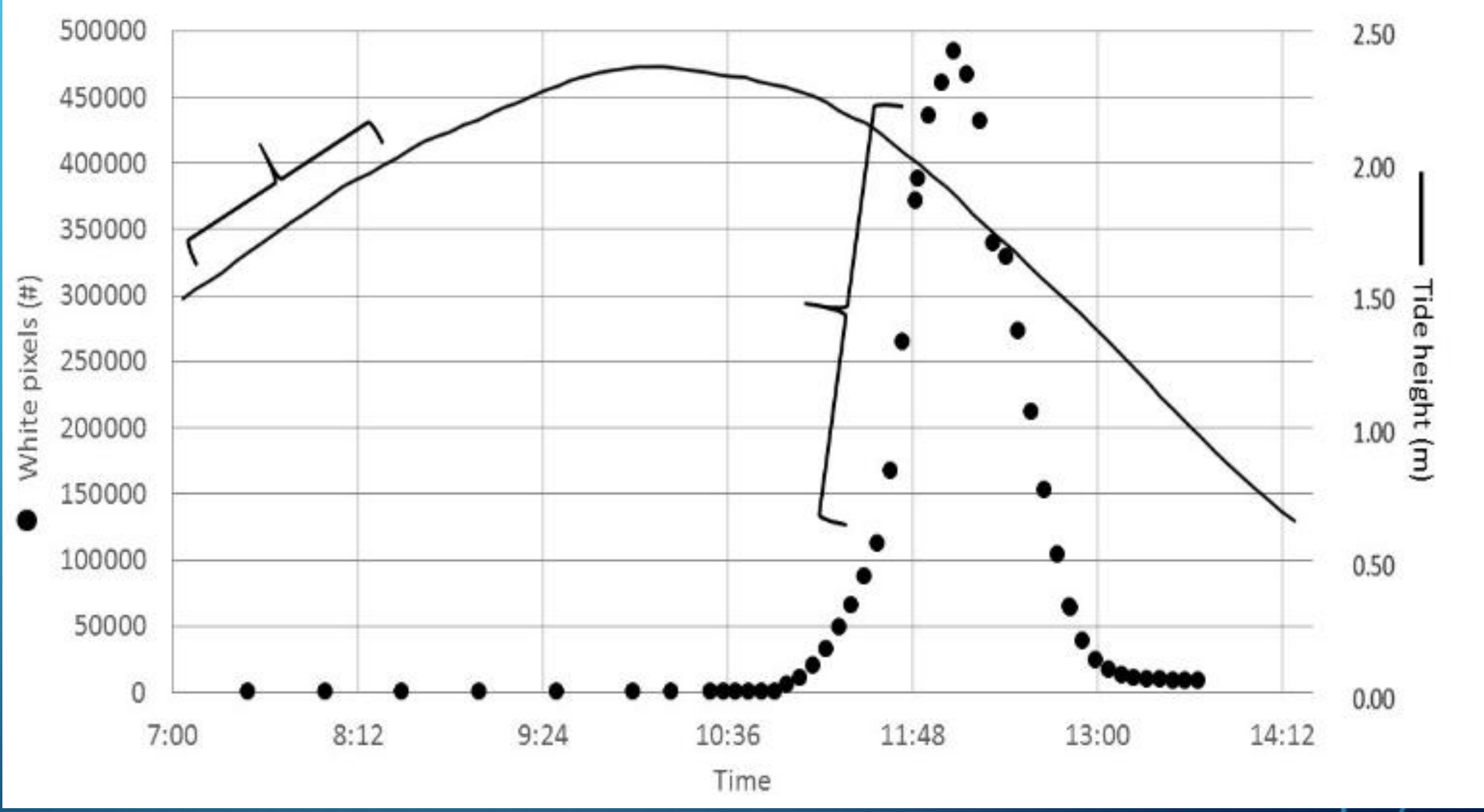
QUANTIFY INUNDATED AREA, CHANNEL POSITION

- Images rectified to correct distortion
- Images processed to B/W contrast, white = wetted
- Inundated area quantified as %(area) white



MIMIC SLR WITH TIDAL CYCLE

Measurable change in inundated area (white pixels) with <1 cm elevation change



USING STORM EVENTS TO VALIDATE MODELS

Nov 7 4.3(4.6)'
Dec 7 5.9(5.9)'
Jan 7 6.4(7.0)'
Jan 8 6.7(7.9)'
Jan 10 7.2(8.0)'
(at this point, tidally connected to Bay)
Feb 7 6.7(7.9)'

CONCLUSION

Methods like these are the only way to track sea level rise impacts in real time and to validate predictive models

NEXT STEPS

Time-lapse cameras (maintaining and expanding, funding permitting) bird counts, vegetation change

UAS-LiDAR (CA: Bay Area and open coast; GA: Barrier islands and causeways, with UGA/GA-SG) vegetation and geomorphology change

Satellite/Remote Sensing (Estimating rate and location of shoreline change – CA and GA) vegetation/soil cover change

CONTACT

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