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Coastal Engineering 88 (2014) 171–181

Contents lists available at ScienceDirect

Coastal Engineering

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Characterizing hurricane storm surge behavior in Galveston Bay using the SWAN + ADCIRC model

Antonia Sebastian [a,*], Jennifer Proft [b], J. Casey Dietrich [d], Wei Du [b], Philip B. Bedient [a], Clint N. Dawson [b,c]

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[b] Institute for Computational Engineering Sciences, The University of Texas, Austin, TX, United States
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ABSTRACT

The SWAN + ADCIRC shallow-water circulation model, validated for Hurricane Ike (2008), was used to develop five synthetic storm surge scenarios for the upper Texas coast in which wind speed was increased and landfall location was shifted 40 km westward. The Hurricane Ike simulation and the synthetic storms were used to study the maximum water elevations in Galveston Bay, as well as the timing and behavior of surge relative to the hurricane track. Sixteen locations indicative of surge behavior in and around Galveston Bay were chosen to for analysis in this paper. Results show that water surface elevations present in Galveston Bay are dominated by the counterclockwise hurricane winds and that increasing wind speeds by 15% results in approximately 23% (+/−3%) higher surge. Furthermore, shifting the storm westward causes higher levels of surge in the more populated areas due to more intense, higher shore-normal winds. This research helps to highlight the vulnerability of the upper Texas Gulf Coast to hurricane storm surge and lends insight to storm surge and flood mitigation studies in the Houston–Galveston region.

Nat Hazards (2015) 77:1183–1203
DOI 10.1007/s11069-015-1652-7

ORIGINAL PAPER

Vulnerability of an industrial corridor in Texas to storm surge

Daniel W. Burleson · Hanadi S. Rifai · Jennifer K. Proft · Clint N. Dawson · Philip B. Bedient

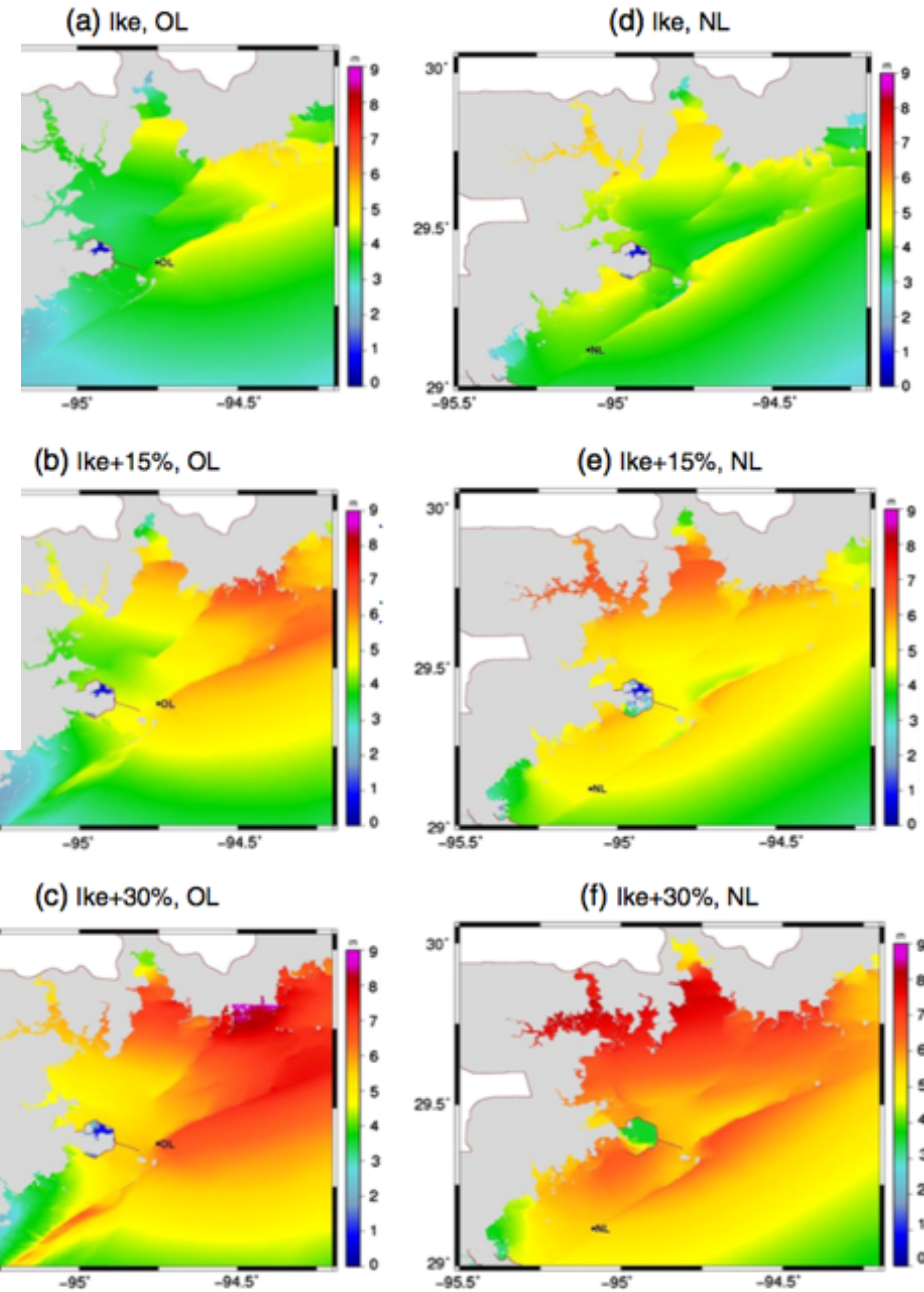

Fig. 9. Maximum water surface elevations from ADCIRC + SWAN for the Hurricane Ike original, +15%, and +30% wind scenarios at the original landfall (OL) and ne locations. a. Ike, OL. b. Ike + 15%, OL. c. Ike + 30%, OL. d. Ike, NL. e. Ike + 15% NL. f. Ike + 30%, NL.

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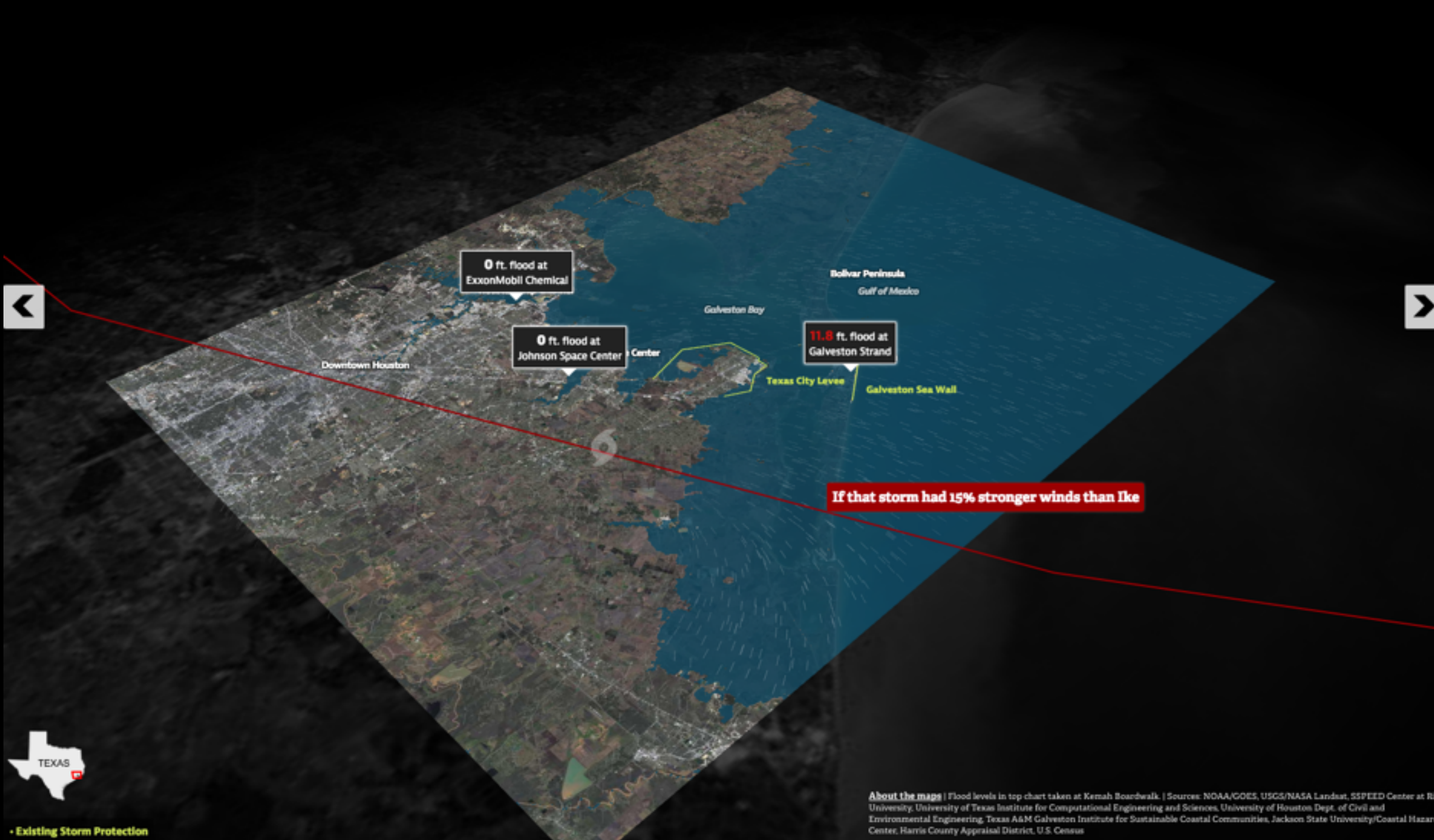
P7+15

...if that storm had been stronger, it would have devastated the Ship Channel, killed thousands, and crippled the economy.



About the maps | Flood levels in top chart taken at Kemah Boardwalk. | Sources: NOAA/GOES, USGS/NASA Landsat, SSPEED Center at Rice University, University of Texas Institute for Computational Engineering and Sciences, University of Houston Dept. of Civil and Environmental Engineering, Texas A&M Galveston Institute for Sustainable Coastal Communities, Jackson State University/Coastal Hazards Center, Harris County Appraisal District, U.S. Census

Forecasting the Effects of Coastal Protection and Restoration Projects on Wetland Morphology in Coastal Louisiana under Multiple Environmental Uncertainty Scenarios

Brady R. Couvillion[†], Gregory D. Steyer[†], Hongqing Wang[†], Holly J. Beck[†], and John M. Rybczyk[‡]

[†]U.S. Geological Survey National Wetlands Research Center
Coastal Restoration Assessment Branch
Livestock Show Office, Parker Coliseum, LSU
Baton Rouge, LA 70803, U.S.A.
couvillionb@usgs.gov

[‡]Department of Environmental Science
Western Washington University
Bellingham, WA 98225, U.S.A.

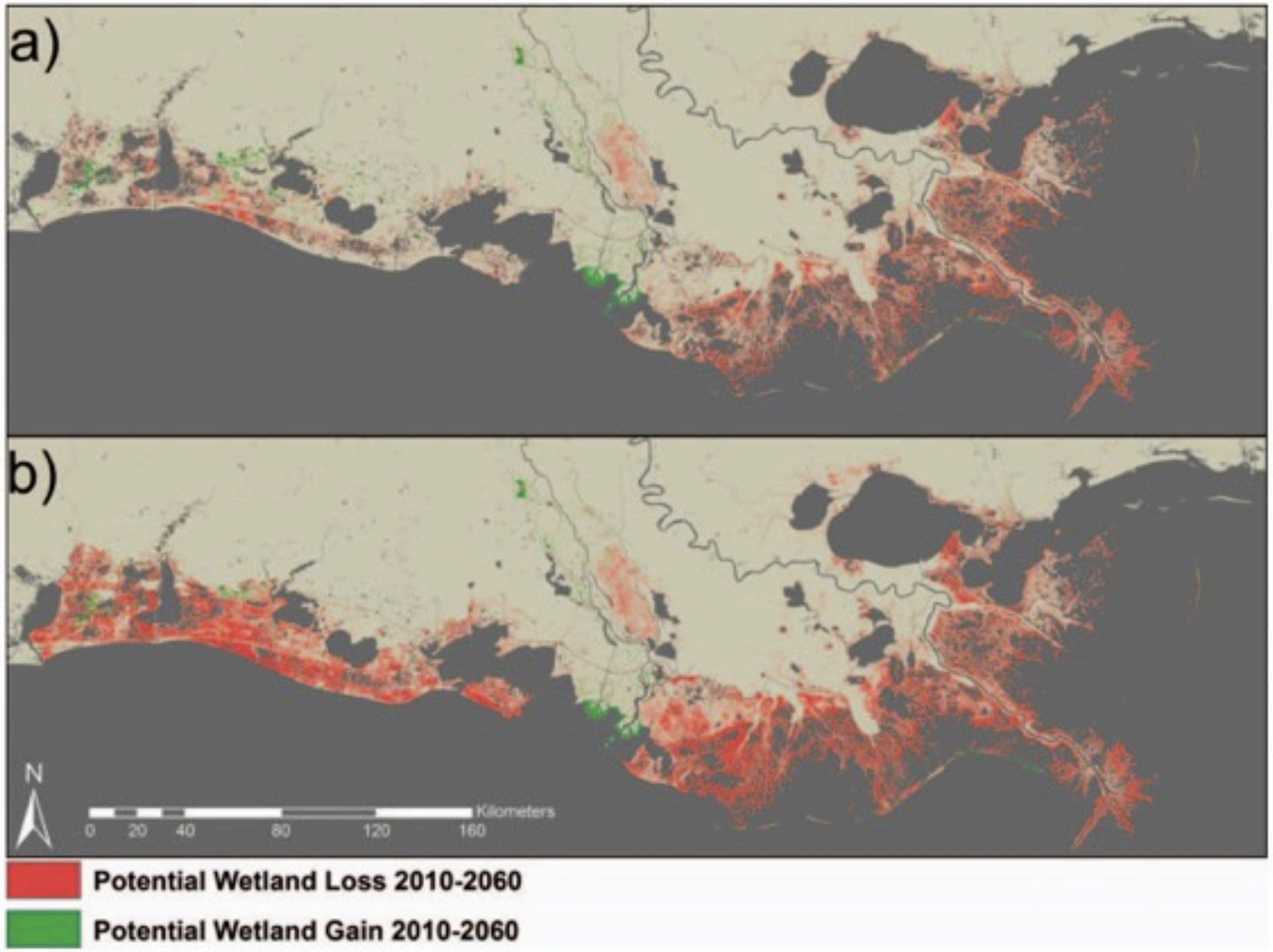


Figure 3. Map of potential wetland area changes under a "Future-without-action" condition for moderate (a) and less optimistic (b) environmental uncertainty scenarios, 2010–2060.

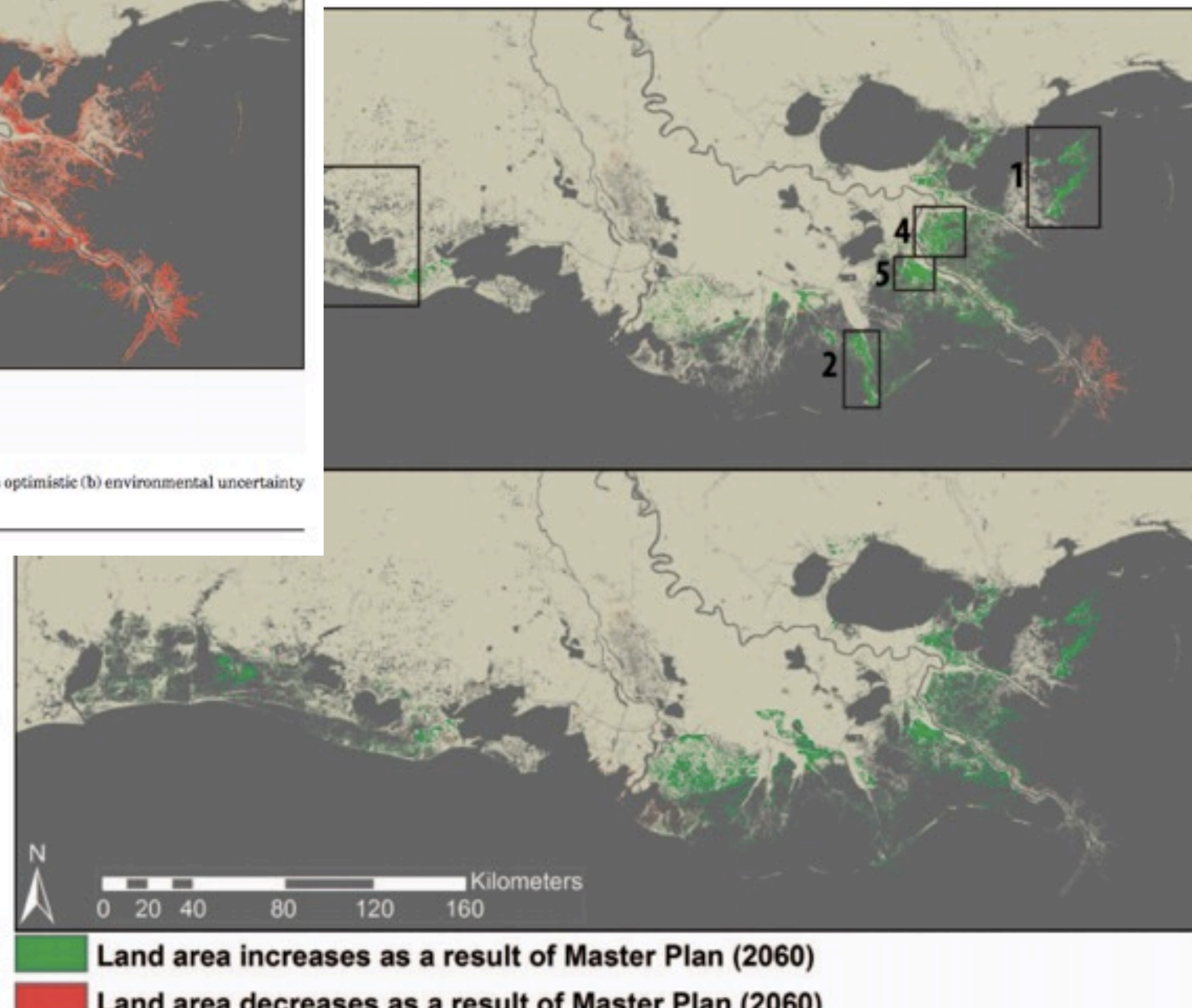


Figure 6. Projected land area increases and decreases with Master Plan implementation at the end of the simulation period (2060) under moderate (a) and less optimistic (b) environmental uncertainty scenarios. Increases and decreases are calculated by comparing FWOA model results to Master Plan model results in 2060. Locations represent the Biloxi Marshes (location 1), the western side of Bayou Lafourche (location 2), the Chenier Plain (location 3), upper Breton Sound (location 4), and the location of a proposed diversion near Myrtle Grove (location 5).

http://www.lacoast.gov/crms2/crms_public_data/publications/Couvillion%20et%20al%202013.pdf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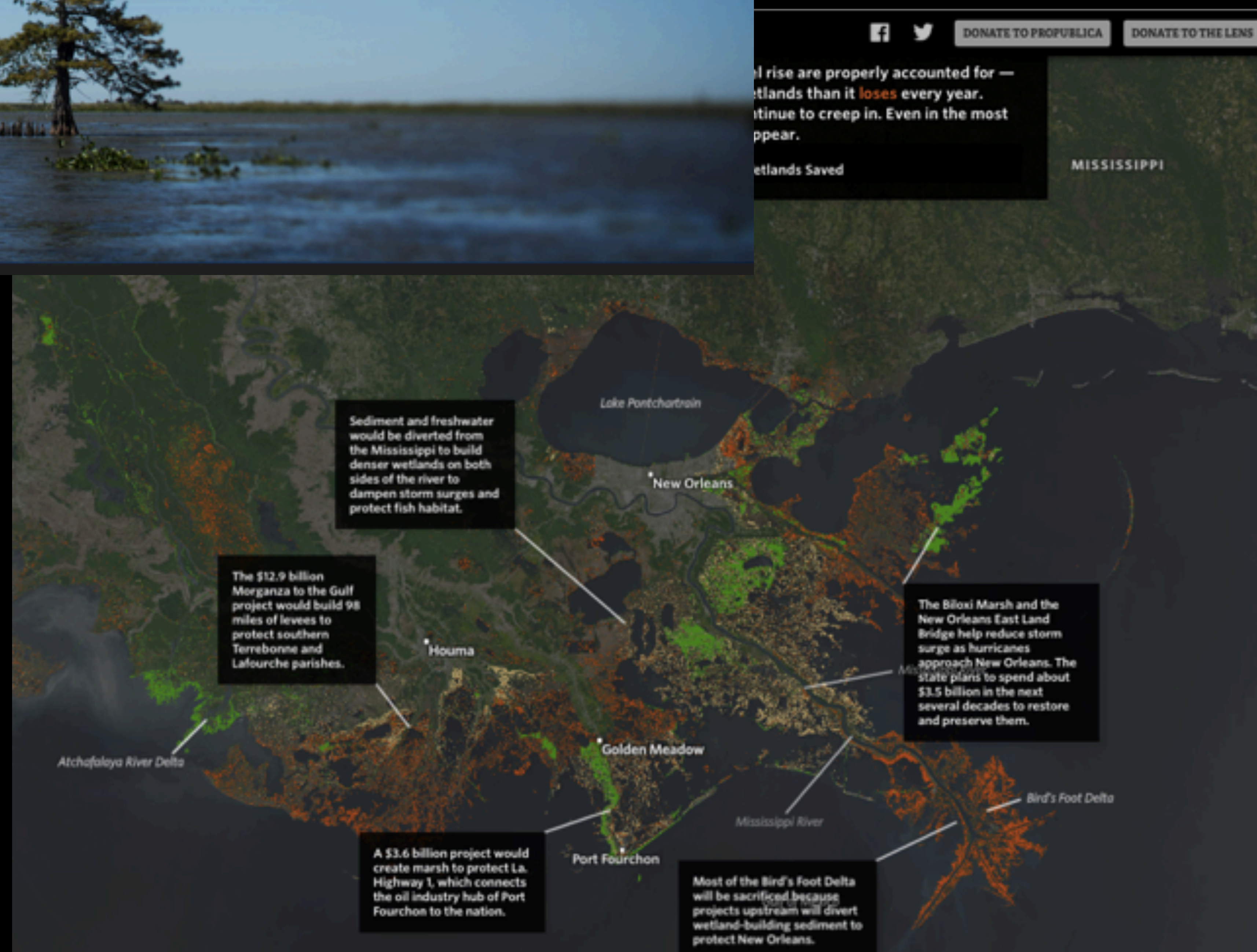
LOSING GROUND
Louisiana's Moon Shot
The state hopes to save its rapidly disappearing coastline with a 50-year, $50 billion plan based on science that's never been tested and money it doesn't have. What could go wrong?
by Bob Marshall, The Lens, Al Shaw and Brian Jacobs, ProPublica
December 8, 2014


DONATE TO PROPUBLICA
DONATE TO THE LENS
l rise are properly accounted for — tlands than it loses every year. tinue to creep in. Even in the most ppear.
etlands Saved
MISSISSIPPI
Lake Pontchartrain
New Orleans
Sediment and freshwater would be diverted from the Mississippi to build denser wetlands on both sides of the river to dampen storm surges and protect fish habitat.
The $12.9 billion Morganza to the Gulf project would build 98 miles of levees to protect southern Terrebonne and Lafourche parishes.
Houma
The Biloxi Marsh and the New Orleans East Land Bridge help reduce storm surge as hurricanes approach New Orleans. The state plans to spend about $3.5 billion in the next several decades to restore and preserve them.
Golden Meadow
Atchafalaya River Delta
Bird's Foot Delta
Mississippi River
Port Fourchon
A $3.6 billion project would create marsh to protect La. Highway 1, which connects the oil industry hub of Port Fourchon to the nation.
Most of the Bird's Foot Delta will be sacrificed because projects upstream will divert wetland-building sediment to protect New Orleans.

But you need help from the authors to both understand the research and present the results.

Step 1: Read the paper(s).

Nat Hazards (2015) 77:1183–1203
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ORIGINAL PAPER

Vulnerability of an industrial corridor in Texas to storm surge

Daniel W. Burleson · Hanadi S. Rifai · Jennifer K. Proft · Clint N. Dawson · Philip B. Bedient

Delineating the Reality of Flood Risk and Loss in Southeast Texas

Samuel D. Brody[1]; Russell Blessing[2]; Antonia Sebastian, M.ASCE[3]; and Philip Bedient, F.ASCE[4]

Urban Studies at 50

UrbanStudies
50(4) 789–806, March 2013

Examining the Impacts of Development Patterns on Flooding on the Gulf of Mexico Coast

Samuel Brody, Heeju Kim and Joshua Gunn

[Paper first received, November 2011; in final form, April 2012]

Hindcast and validation of Hurricane Ike (2008) waves, forerunner, and storm surge

M. E. Hope,[1] J. J. Westerink,[1] A. B. Kennedy,[1] P. C. Kerr,[1] J. C. Dietrich,[1,2] C. Dawson,[3] C. J. Bender,[4] J. M. Smith,[5] R. E. Jensen,[5] M. Zijlema,[6] L. H. Holthuijsen,[6] R. A. Luettich Jr.,[7] M. D. Powell,[8] V. J. Cardone,[9] A. T. Cox,[9] H. Pourtaheri,[10] H. J. Roberts,[11] J. H. Atkinson,[11] S. Tanaka,[1,12] H. J. Westerink,[1] and L. G. Westerink[1]

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Examining the impact of land use/land cover characteristics on flood losses

Samuel Brody [a] , Russell Blessing [b] , Antonia Sebastian [c] & Philip Bedient [c]

[a] Departments of Marine Sciences/Urban Planning , Texas A&M University, 200 Seawolf Pkwy , Galveston , TX , 77553 , USA
[b] Center for Texas Beaches and Shores , Texas A&M University at Galveston , Galveston , TX , 77553 , USA
[c] Department of Civil and Environmental Engineering , Rice University , Houston , TX , USA
Published online: 06 Jun 2013.

Structural Integrity of Storage Tanks

Jamie E. Padgett, Ph.D.
Assistant Professor

Risk Analysis

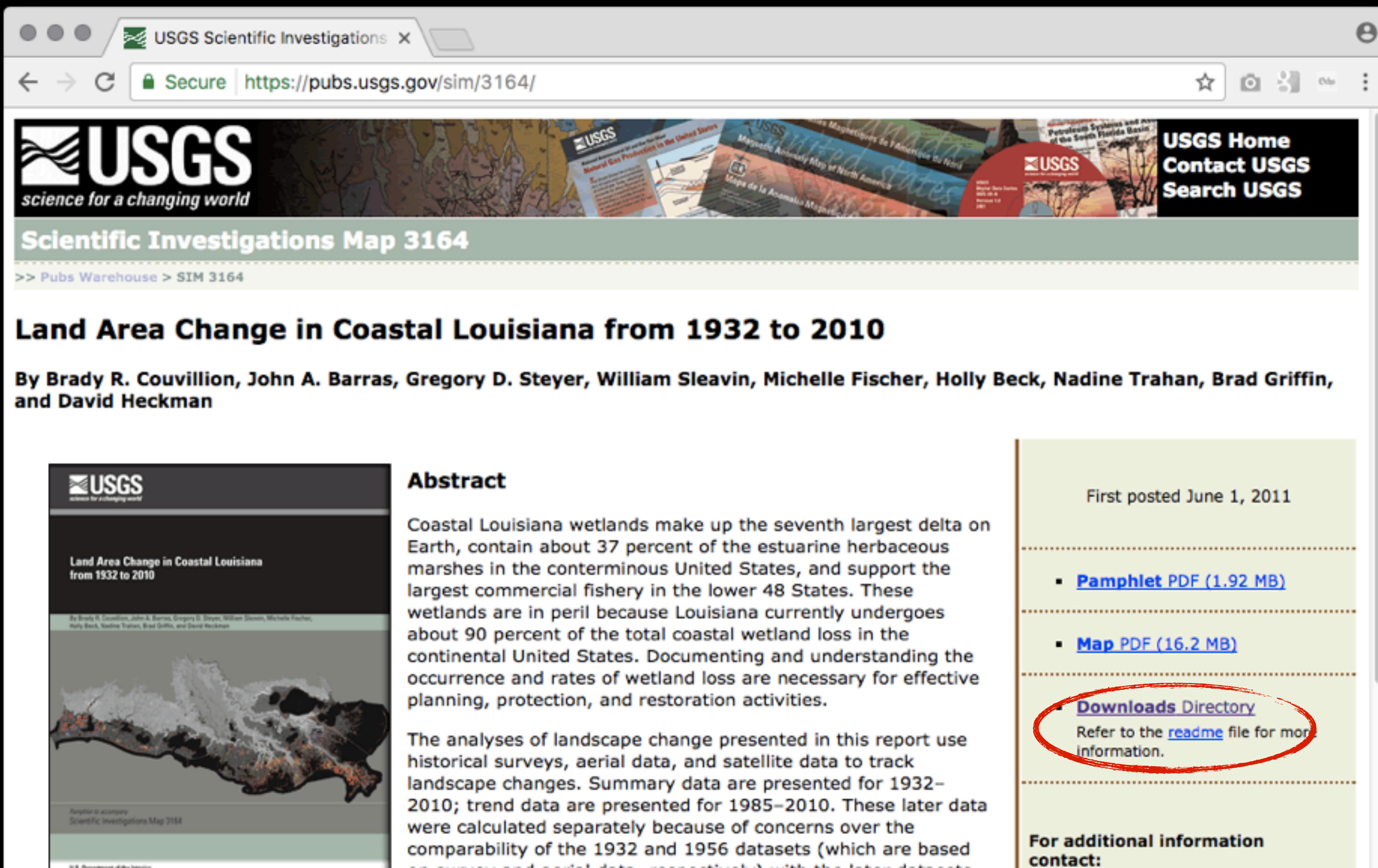
DOI: 10.1111/j.1539-6924.2012.01840.x

Perspective

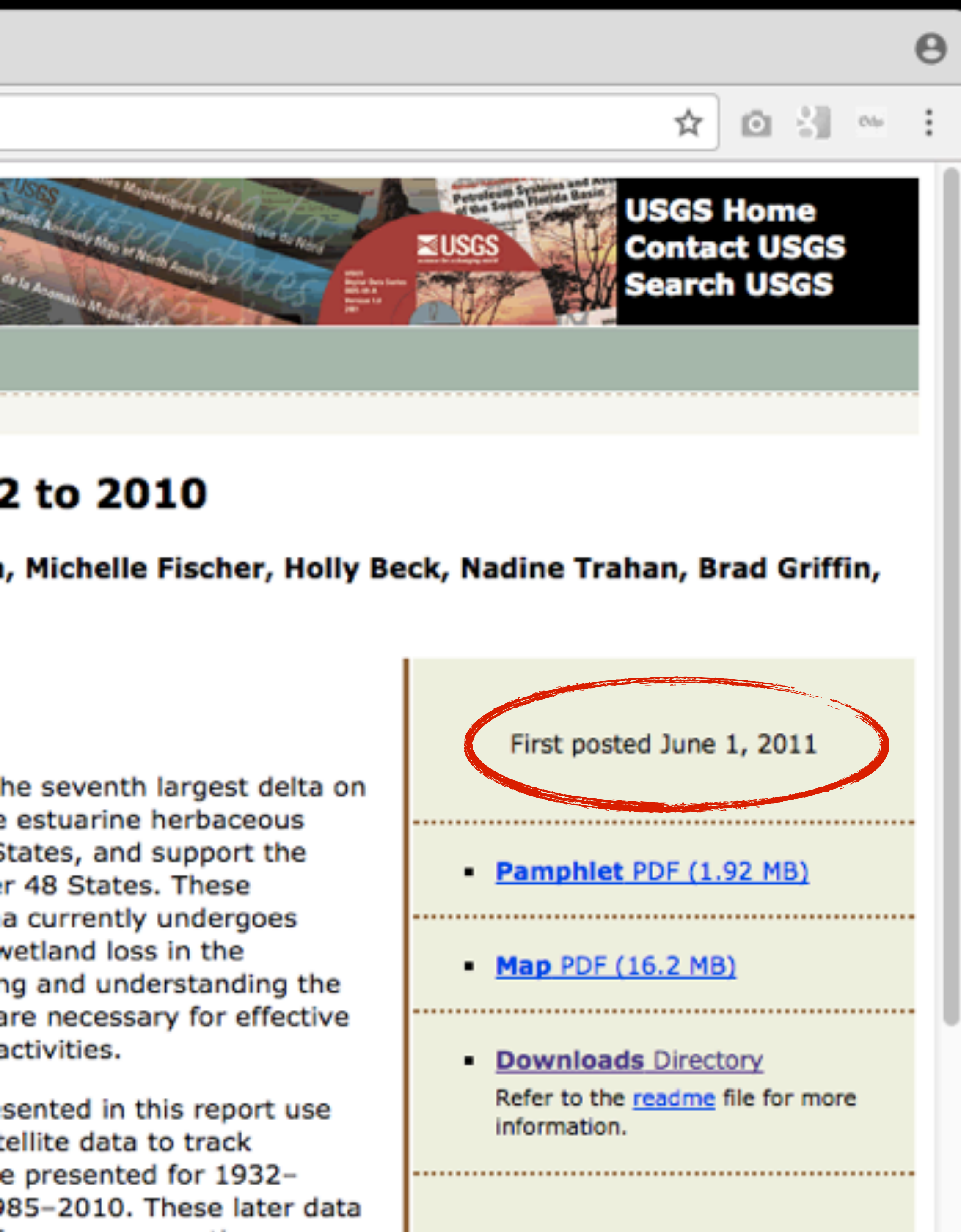
Examining the 100-Year Floodplain as a Metric of Risk, Loss, and Household Adjustment

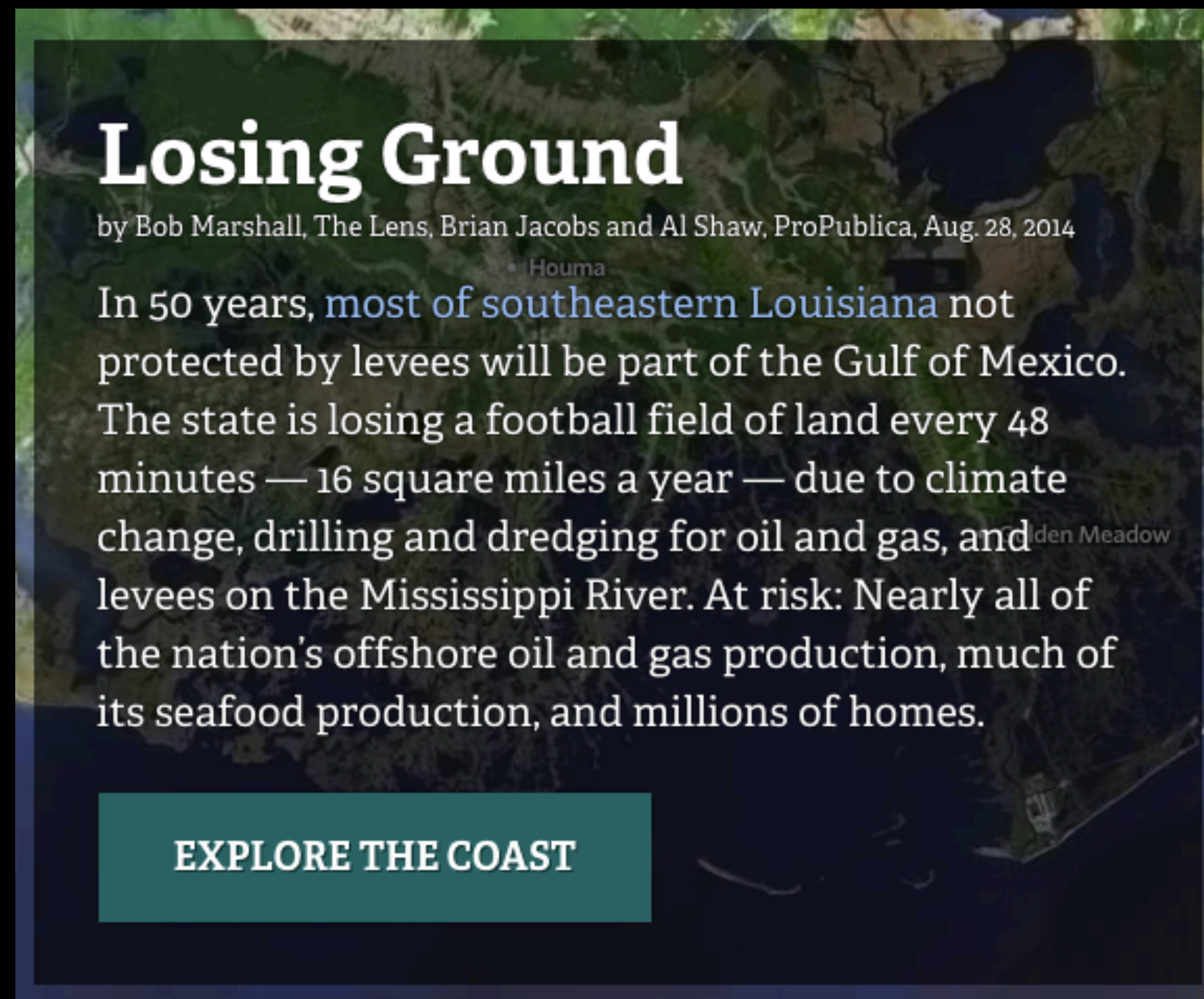
Wesley E. Highfield,* Sarah A. Norman, and Samuel D. Brody

Sometimes the data is already freely available.



Hint: Older papers can still be newsworthy!





Step 2: Learn as much as you can about the data and technologies used in the research.

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DOI 10.1007/s11069-015-1652-7

ORIGINAL PAPER

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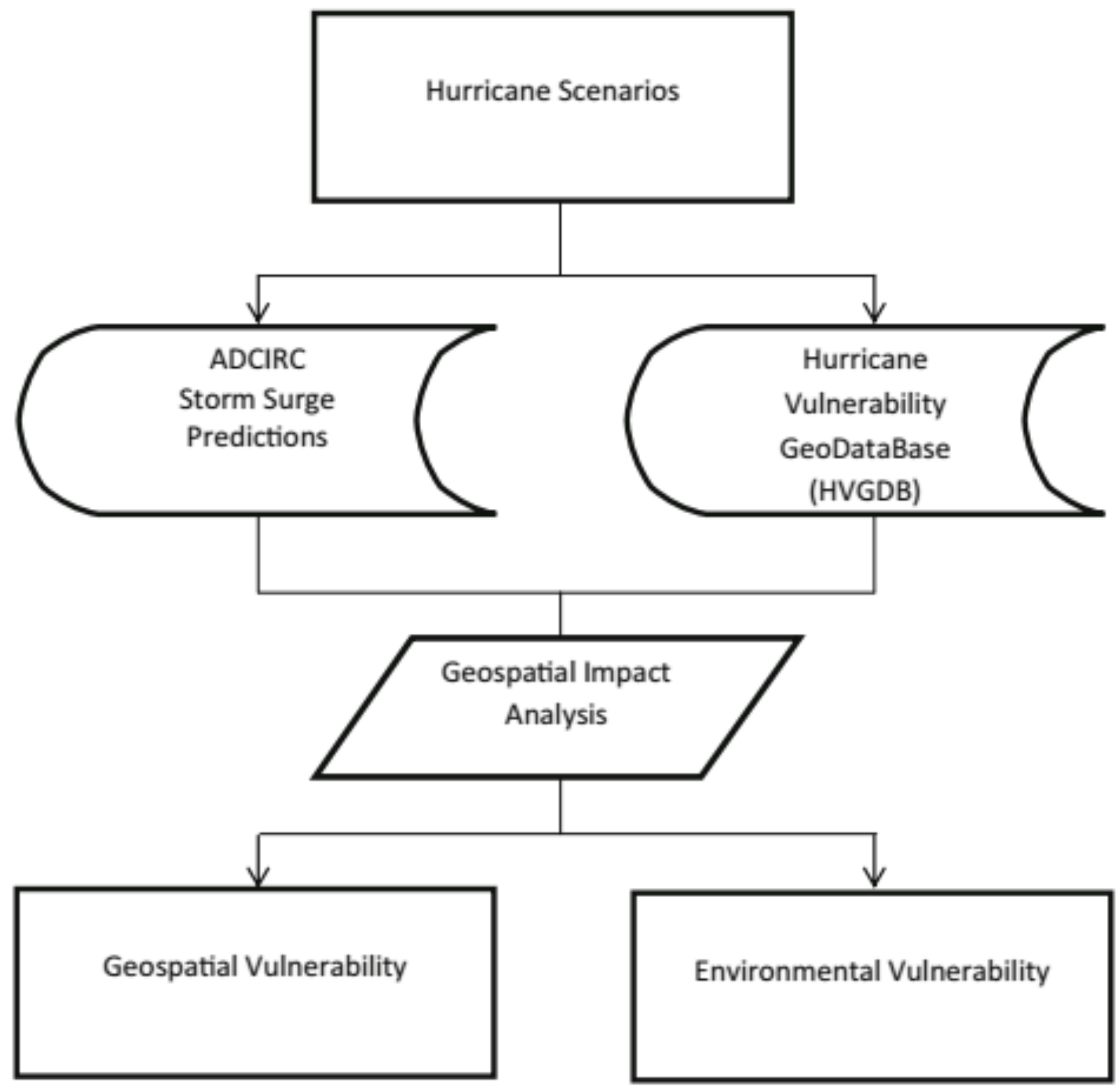

Fig. 2 A schematic of the conceptual model developed for characterizing vulnerabilities to storm surge

2.2 SWAN + ADCIRC storm surge predictions

This modeling system has been successfully validated for recent hurricanes Katrina, Rita, Gustav, and Ike (Westerink et al. 2008; Zijlema 2010; Dietrich et al. 2010; Dietrich et al. 2011a, b; Hope et al. 2013). When compared to observed high-water marks from Hurricane Ike, for instance, 94 % of modeled high-water marks were within 0.50 m of the measured values (Hope et al. 2013).

Inputs to SWAN–ADCIRC include a data assimilated Ocean Wind Field (OWF) and a high resolution computational domain encompassing the Western North Atlantic, Gulf of Mexico and Caribbean Sea. The unstructured finite element mesh incorporates a significant amount of detail around the Houston–Galveston region and consists of 3,323,388 nodes with resolution down to 30 m in the nearshore. The grid represents a subset of the grid (SL18TX33) presented in Hope et al. (2013) without the refinement that was undertaken for Louisiana. Storm surge data for calibration with 206 verified data locations that were derived from several sources including the US Geological Survey (USGS), the National Oceanic and Atmospheric Organization (NOAA), Texas Coastal Ocean Observation Network (TCOON), and the State of Louisiana Coastwide Reference Monitoring Station (CRMS).

2.3 HSC-IC Hurricane Vulnerability GeoDataBase (HVGDB)

A specialized GIS geodatabase was developed in this research that includes topography, parcel boundaries, and critical infrastructure in the HSC-IC. The main purpose of developing the HSC-IC Hurricane Vulnerability GeoDataBase (HVGDB) was to link the modeled storm surge from the scenarios described in the previous section with the geospatial land use, topography, industrial facility, and environmental data. The HVGDB can be envisioned as a tool to analyze, interpret, map, and store the resulting vulnerabilities that can also serve as a means of communication and decision-making among its users (e.g., scientists, engineers, hurricane modelers, decision makers). Therefore, while not all

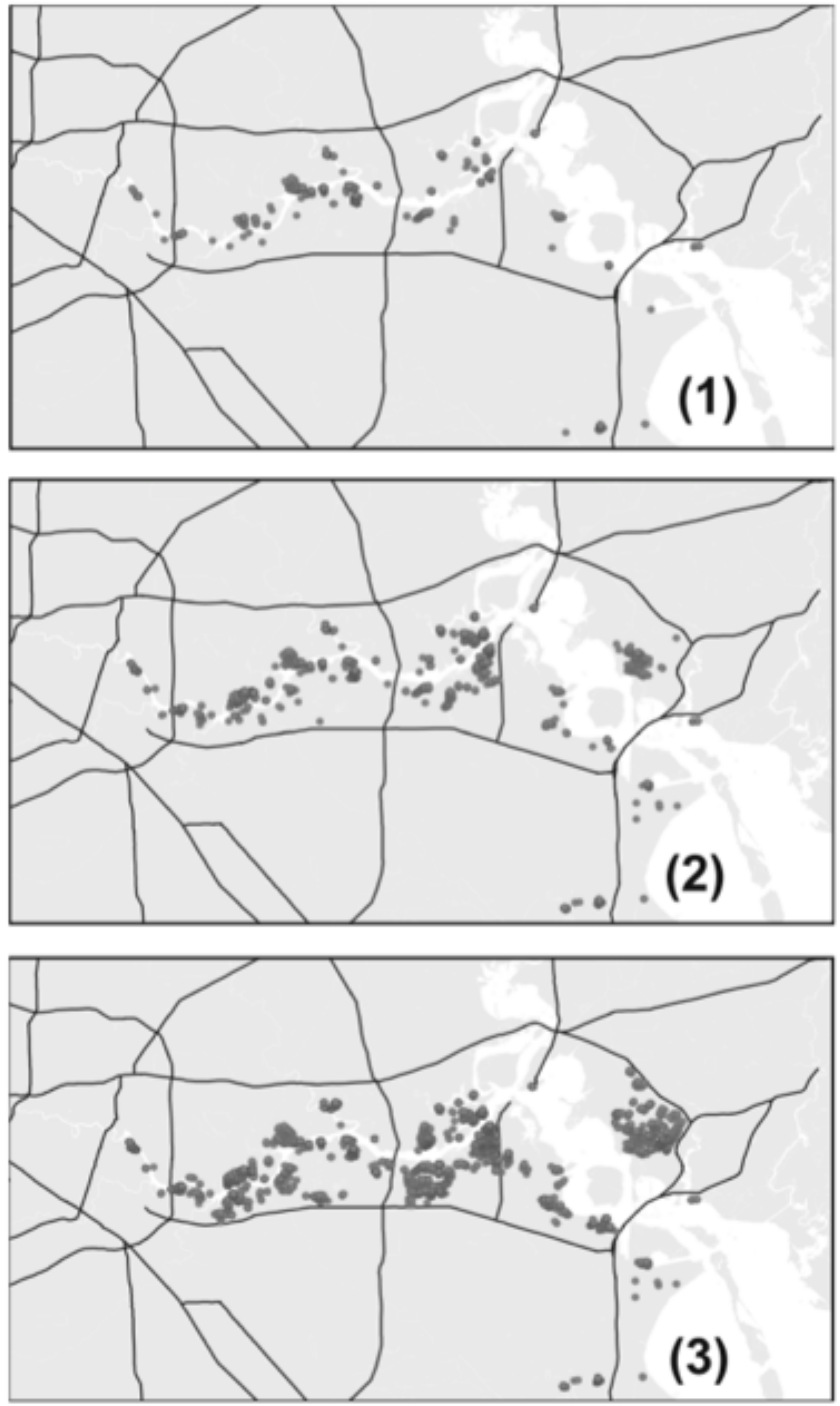

Fig. 7 Inundated tanks for the modeled scenarios. The dots represent tanks that would be inundated based on their elevation and storm surge level—Hurricane Ike (*panel 1*), Hurricane Ike at point 7 (*panel 2*), and Hurricane Ike at point 7 with 30 % increase in wind speed (*panel 3*)

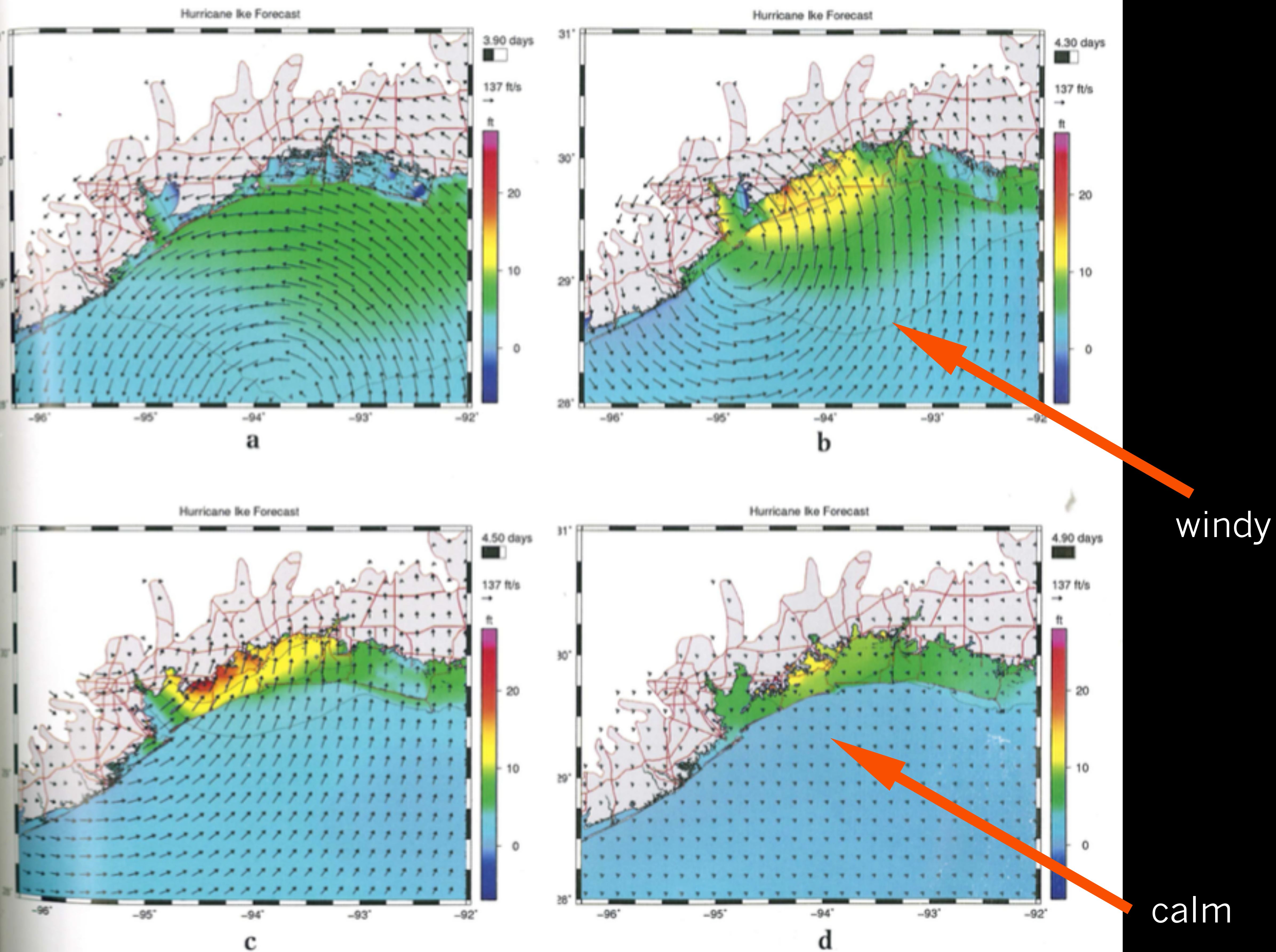

Figure 5.6a–d. The ADCIRC model maps the progression of Hurricane Ike as it makes landfall, showing wind vectors and inundation levels along the Texas coast.

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Keywords:
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Hydrograph

ABSTRACT

The SWAN + ADCIRC shallow-water circula
five synthetic storm surge scenarios for the
location was shifted 40 km westward. The
study the maximum water elevations in Gal
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for analysis in this paper. Results show that
by the counterclockwise hurricane winds a
23% (+/−3%) higher surge. Furthermore,
more populated areas due to more intense
vulnerability of the upper Texas Gulf Coast t
mitigation studies in the Houston–Galveston

Elevation Time Series at All No ×

adcirc.org/home/documentation/users-manual-v50/output-file-descriptions/elevation-time-series-at-all-nodes-in-the-model-grid-fort-63/

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Elevation Time Series at All Nodes in the Model Grid (fort.63)

Elevation time series output at all nodes in the model grid as specified in the Model Parameter and Periodic Boundary Condition File.

The basic file structure is shown below. Each line of output is represented by a line containing the output variable name(s) in bold face type. Blank lines are to enhance readability. Loops indicate multiple lines of output. Definitions of each variable are provided via hot links.

Output may be in ascii or binary format depending on how NOUTGE is set in the Model Parameter and Periodic Boundary Condition File

RUNDES, RUNID, AGRID

NDSETSE, NP, DTDP*NSPOOLGE, NSPOOLGE, IRTYPE

TIME, IT

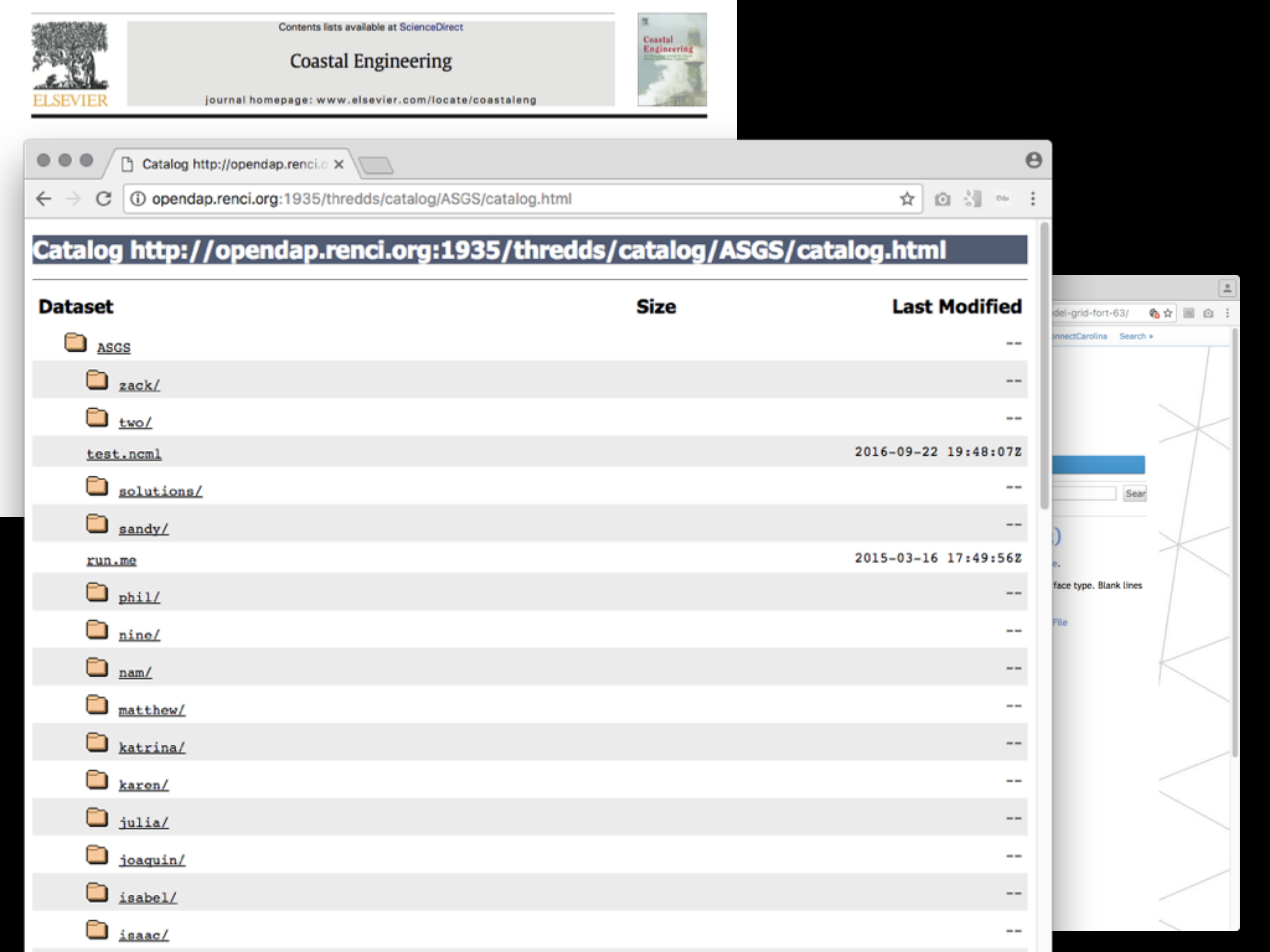
for k=1, NP

k, ETA2(k)

end k loop

Note:

If binary output is specified, the node number (k) is not included in the output.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sandy/
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phil/
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katrina/
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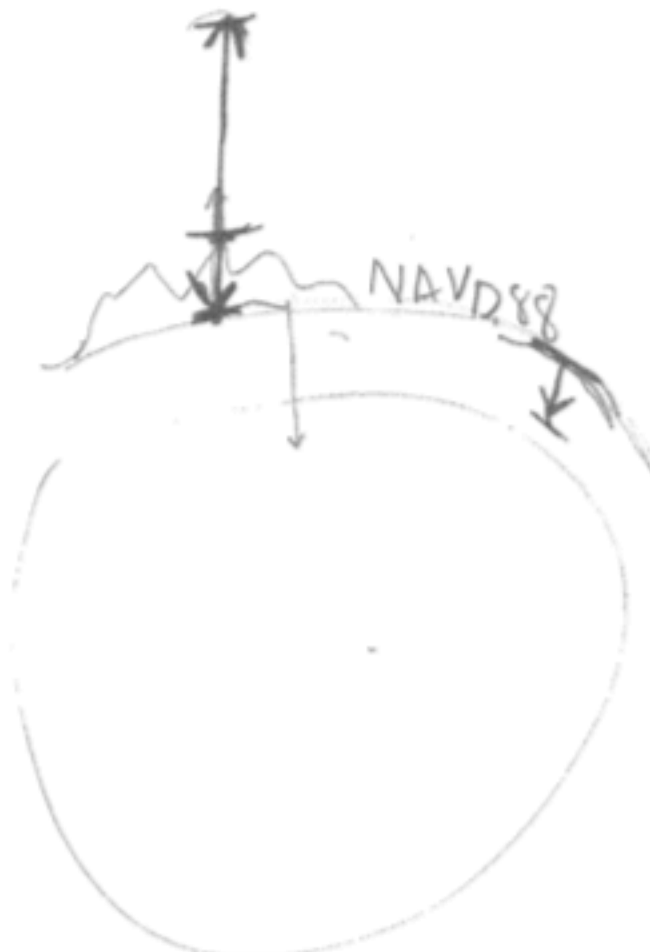
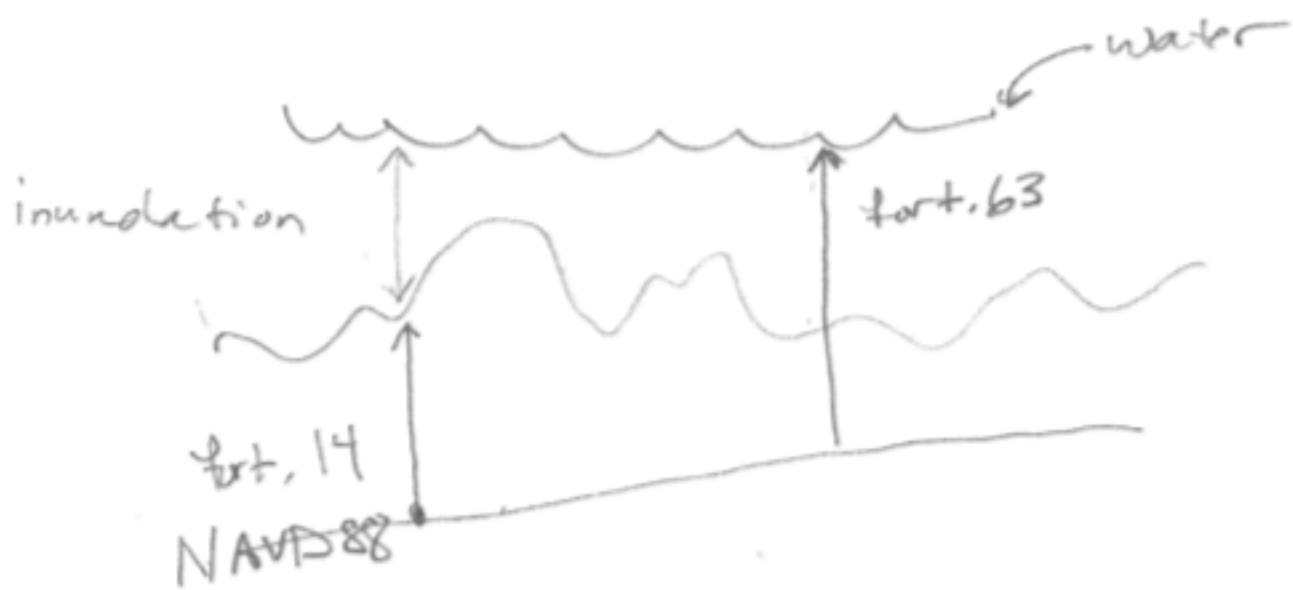
Step 3: Contact the researcher. Get on a plane if you can.

nedump





Once you get the data, make sure it matches the paper!

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ashaw@iMac-22 ike  $ head -10 fort.14.reduced2
tx2008_r35h
3666307  1846542
        1  -95.2348460000   29.8469070000  -12.6699990000
        2  -95.2344780000   29.8445710000  -12.0169990000
        3  -95.2350320000   29.8485990000  -12.8539980000
        4  -95.2354060000   29.8477430000  -12.7420000000
        5  -95.2356890000   29.8466290000  -12.6150000000
        6  -95.2349510000   29.8436950000  -11.6780000000
        7  -95.2354200000   29.8446890000  -12.0449990000
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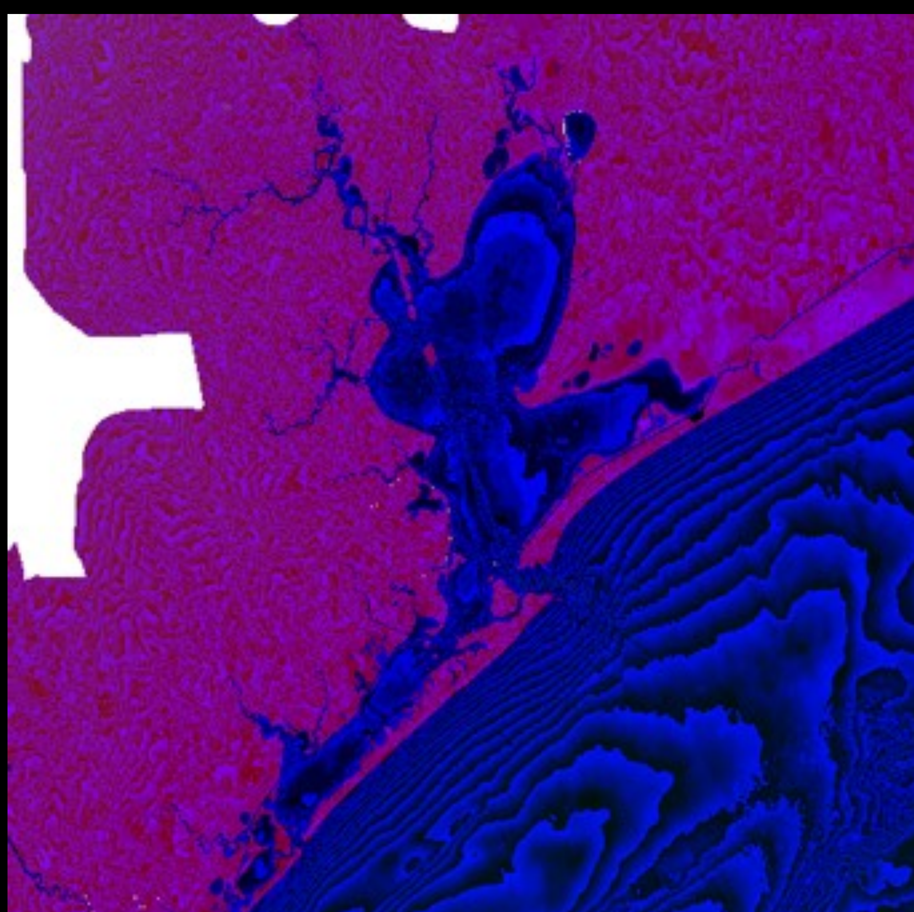
lon   lat   depth



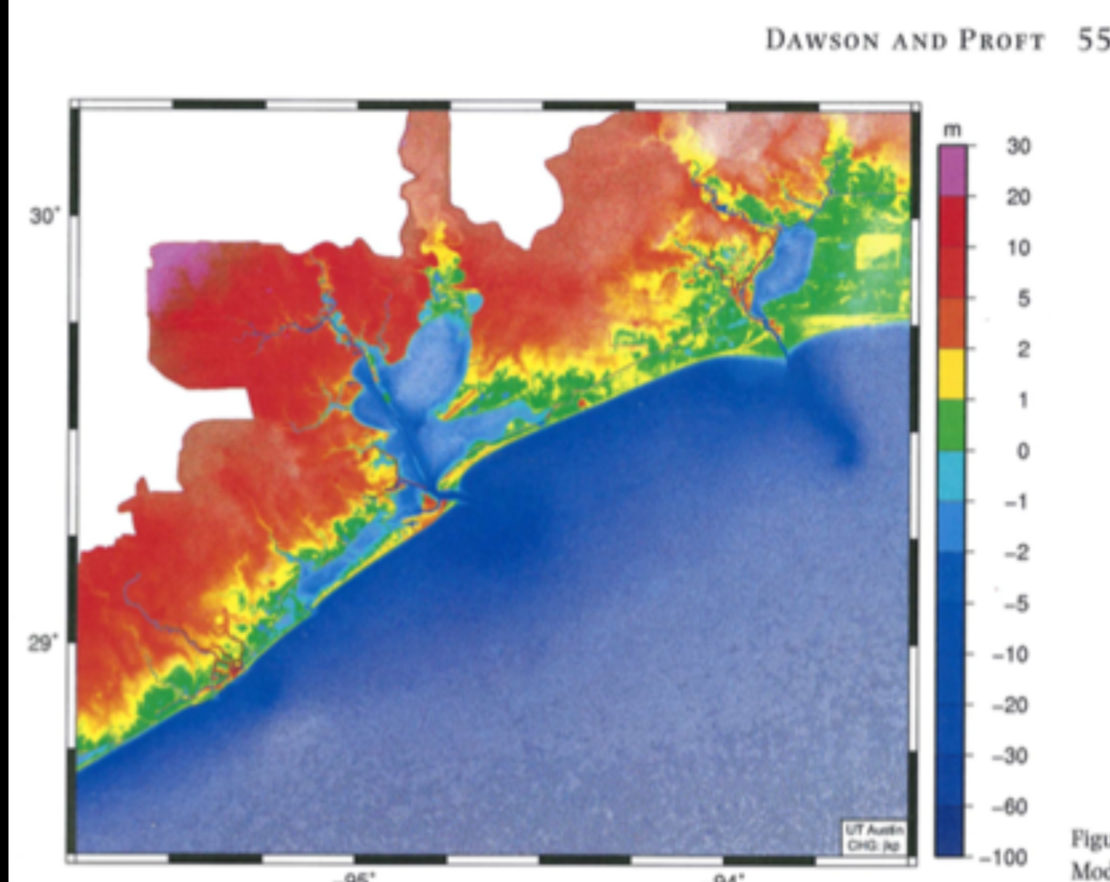


Figure 5.4. The ADCIRC Model Texas Grid.

Think about how to make the findings accessible to a wider audience.

- Color
- Labels
- Annotation
- Context

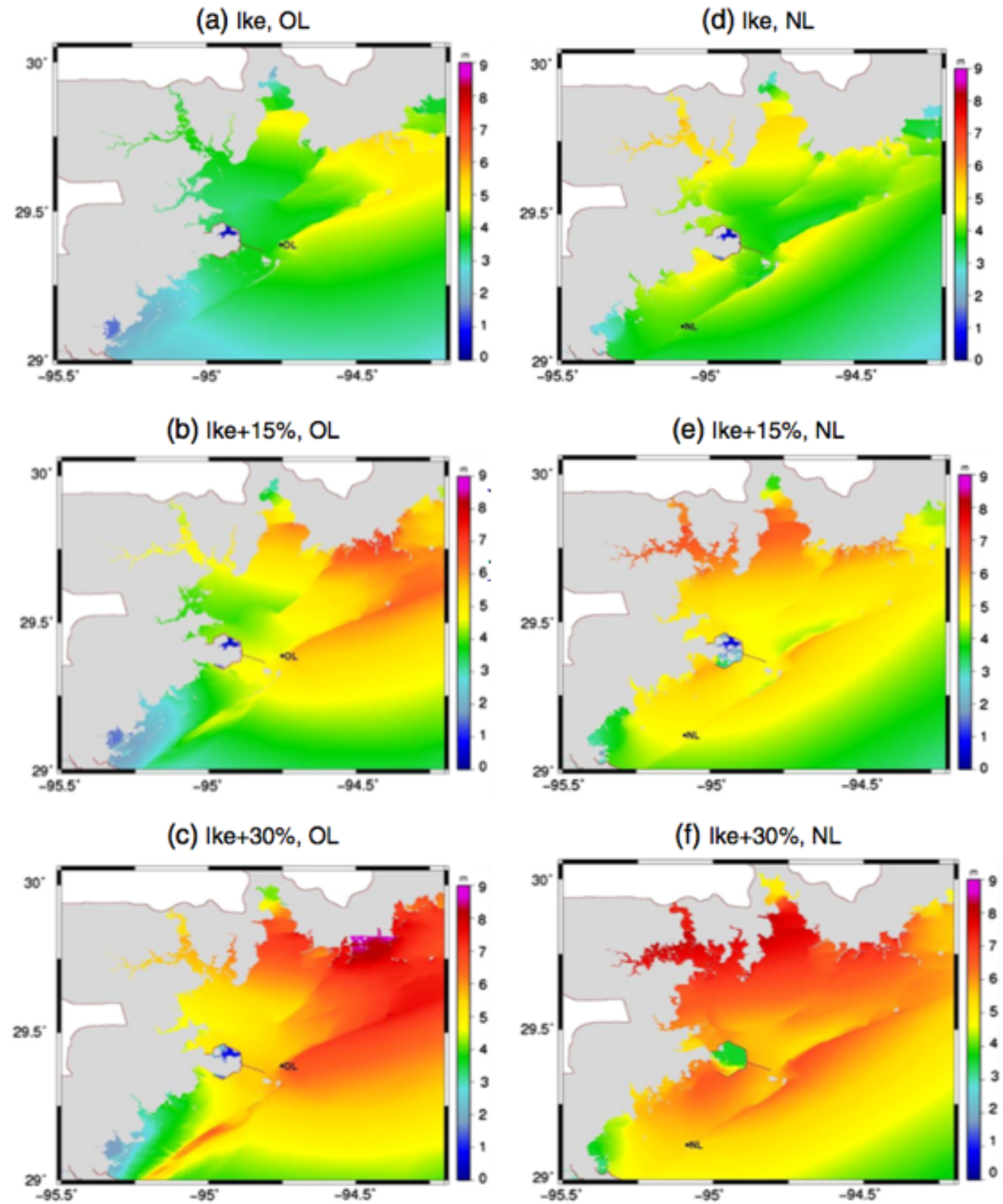
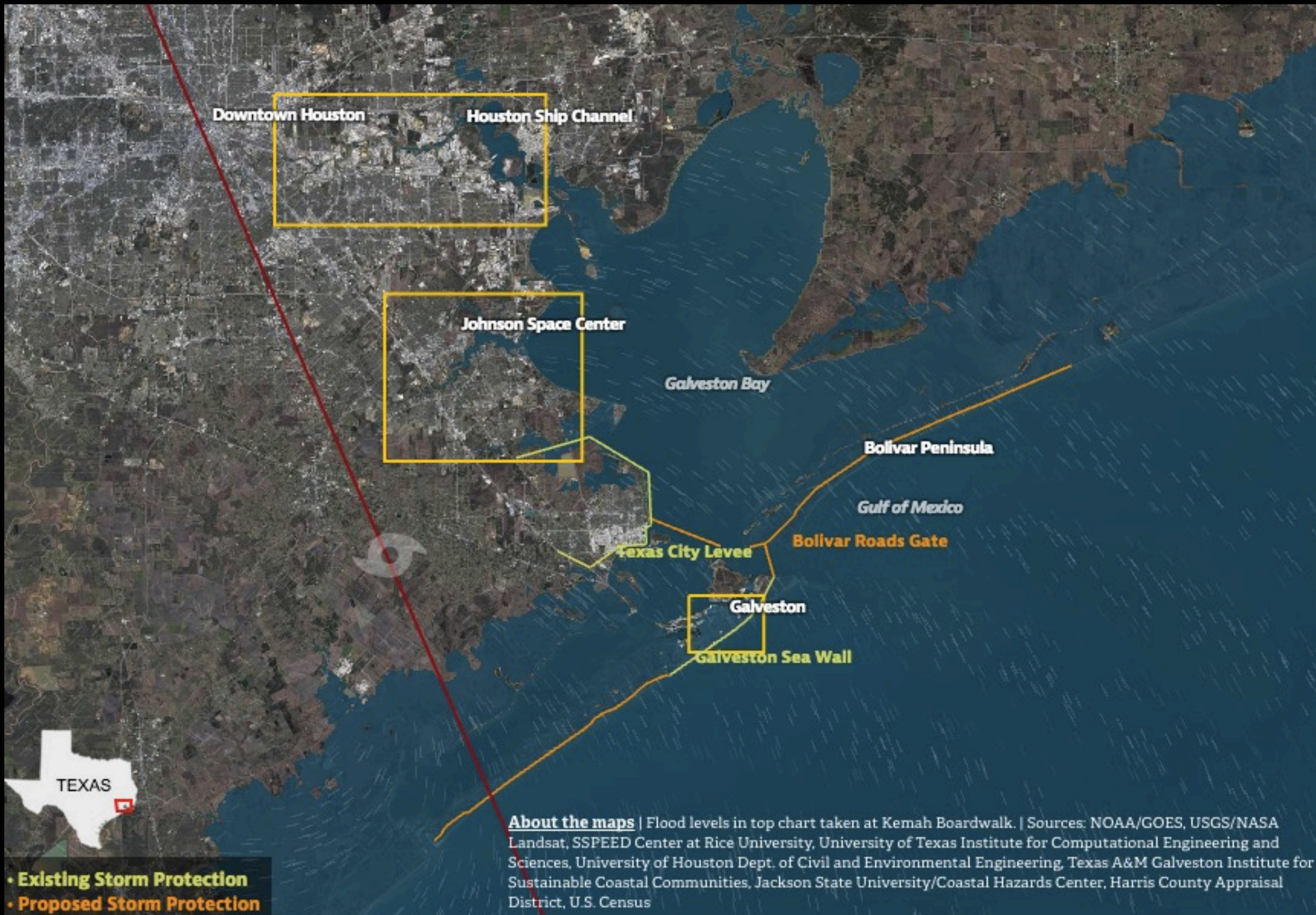
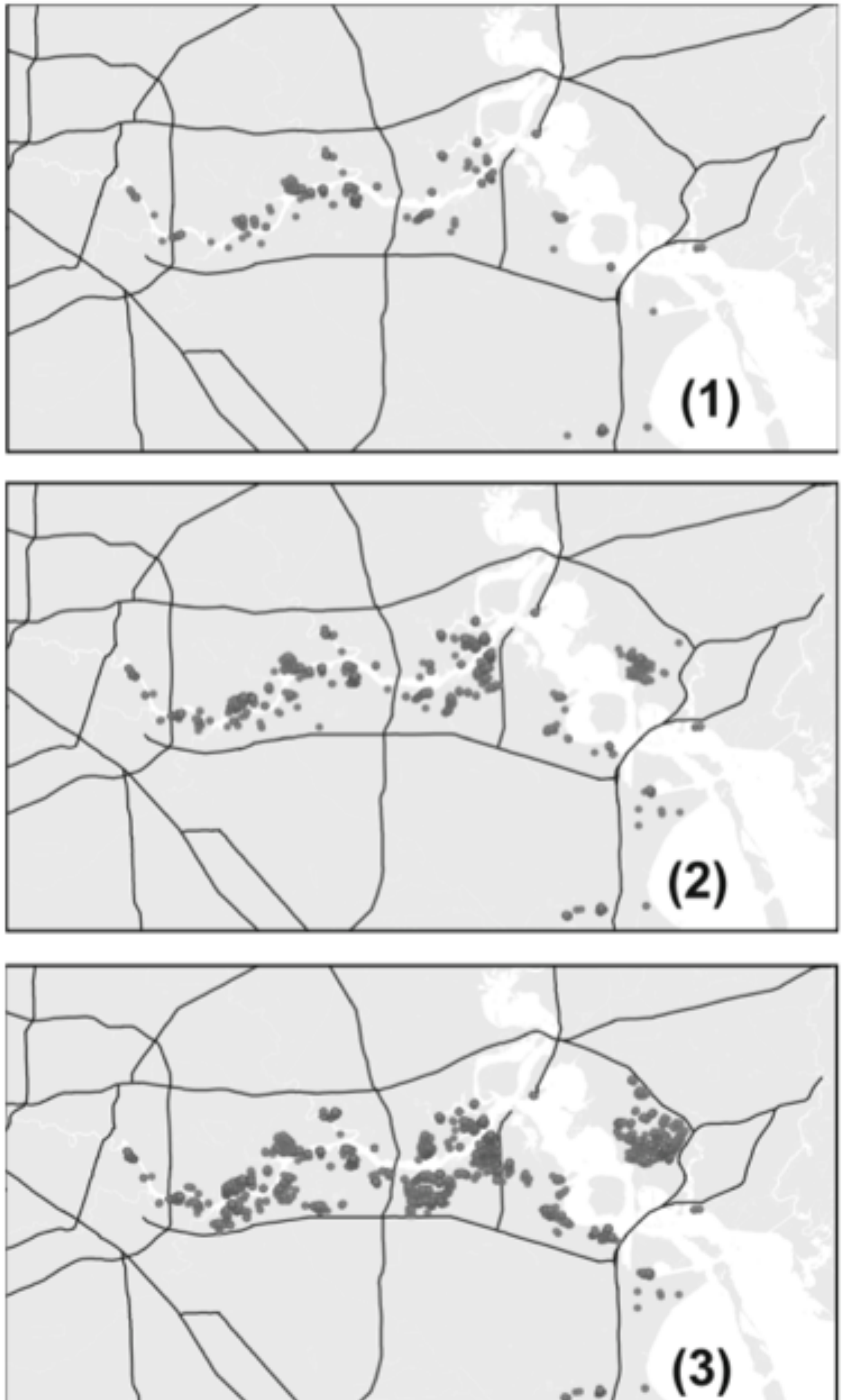


Fig. 9. Maximum water surface elevations from ADCIRC + SWAN for the Hurricane Ike original, +15%, and +30% wind scenarios at the original landfall (OL) and new landfall (N
locations. a. Ike, OL. b. Ike + 15%, OL. c. Ike + 30%, OL. d. Ike, NL. e. Ike + 15% NL. f. Ike + 30%, NL.

Where is the coastline in these maps?



About the maps | Flood levels in top chart taken at Kemah Boardwalk. | Sources: NOAA/GOES, USGS/NASA Landsat, SSPEED Center at Rice University, University of Texas Institute for Computational Engineering and Sciences, University of Houston Dept. of Civil and Environmental Engineering, Texas A&M Galveston Institute for Sustainable Coastal Communities, Jackson State University/Coastal Hazards Center, Harris County Appraisal District, U.S. Census



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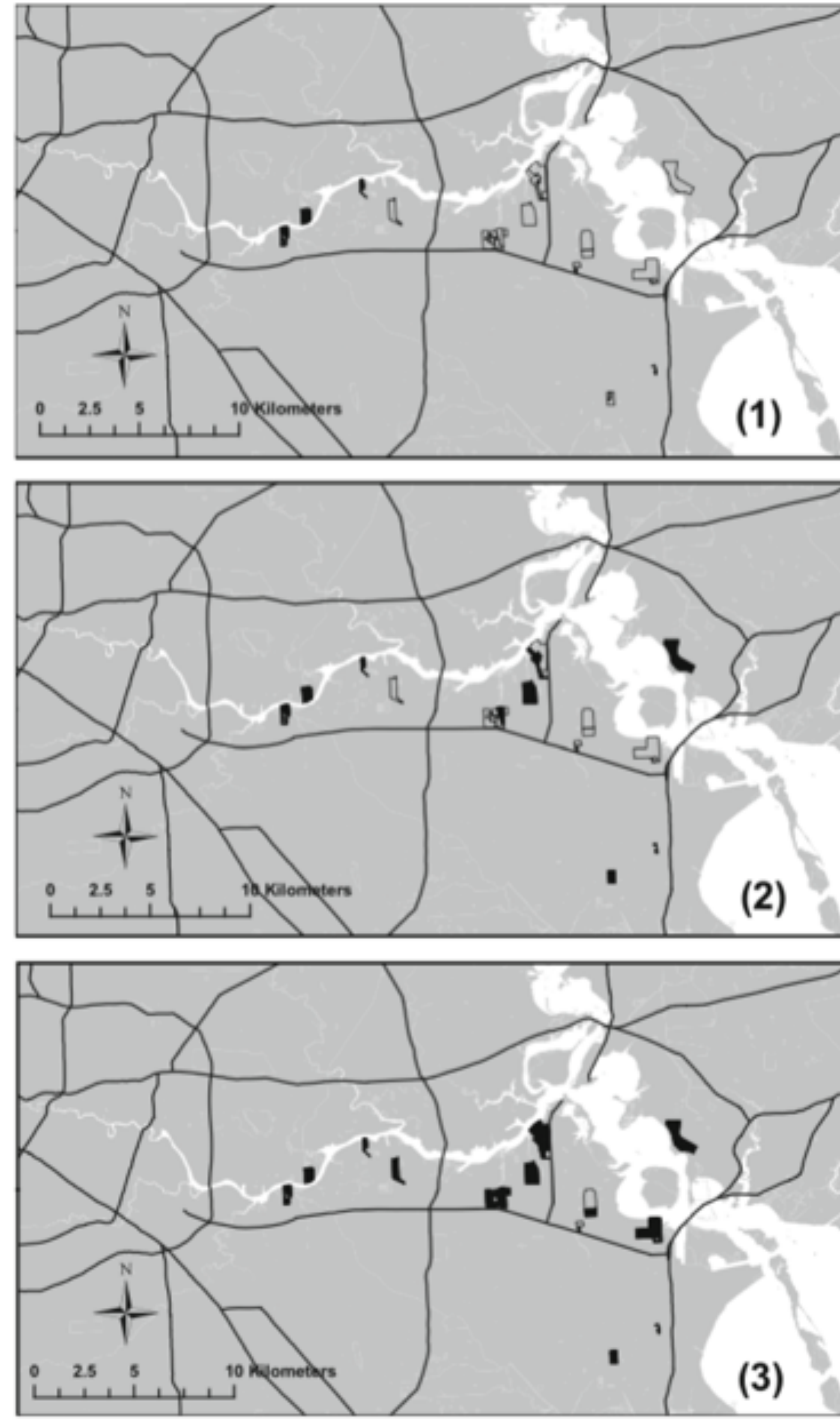
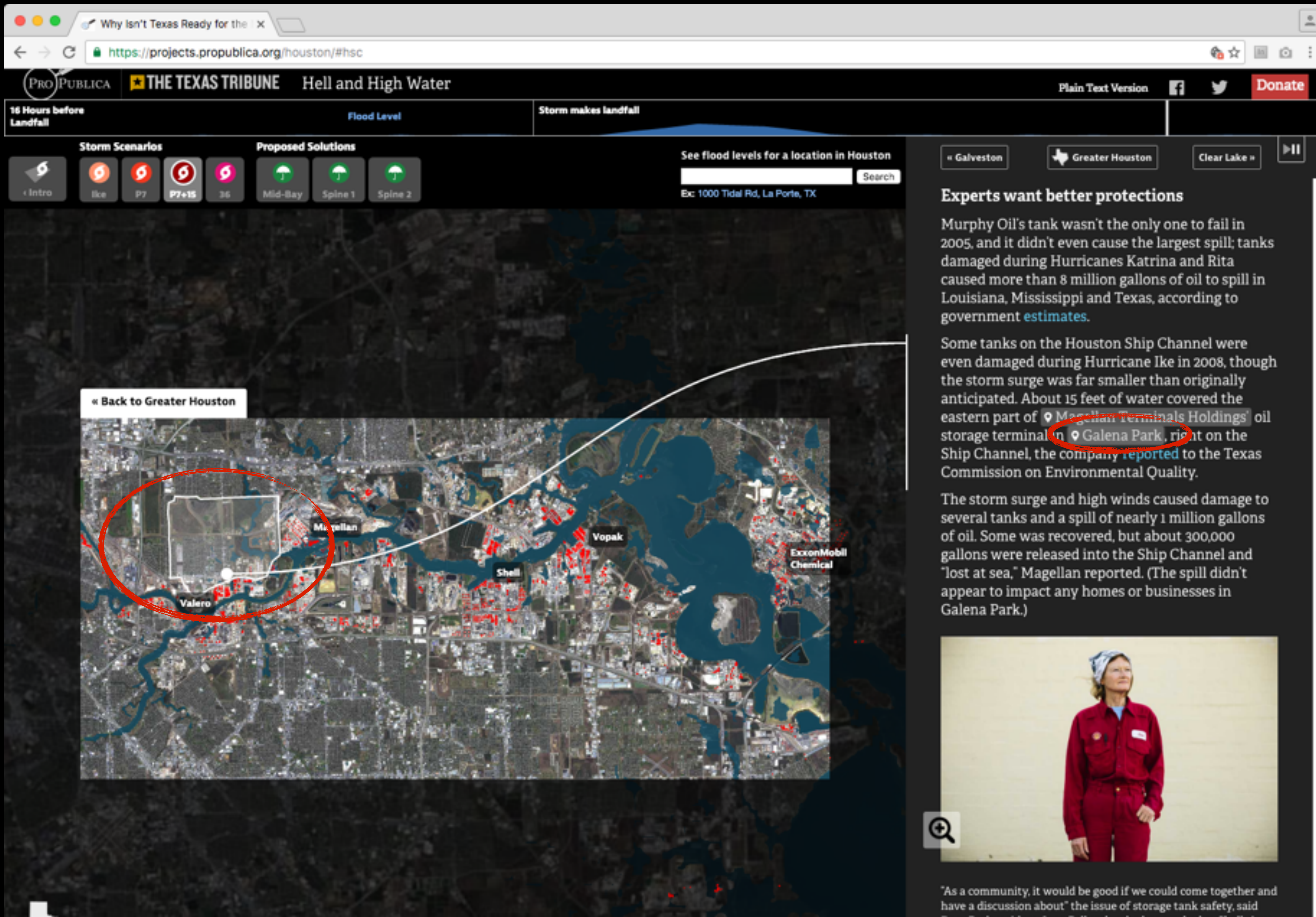


Fig. 10 RMP reporting facilities with relatively high environmental vulnerability due to stored tox volumes and high geospatial vulnerability due to inundation. Facilities in solid black represent RM reporting facilities that are the most vulnerable to releases to the environment due to storm surge f Hurricane Ike (*panel 1*), Hurricane Ike at point 7 (*panel 2*), and Hurricane Ike at point 7 with 30 % increa in wind speed (*panel 3*)

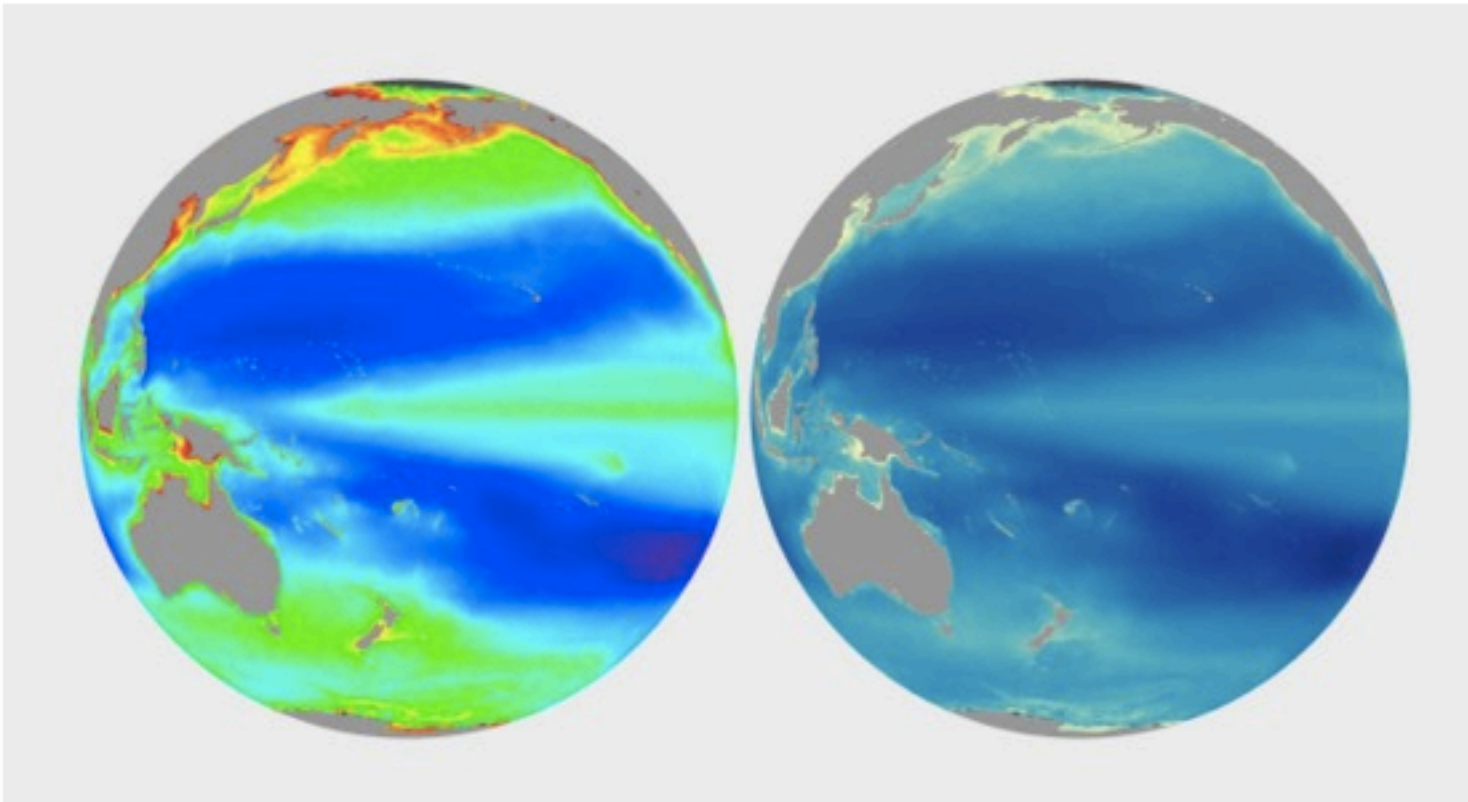
Houston Ship Channel

Adding context



Question some things that are standard practice in academia.

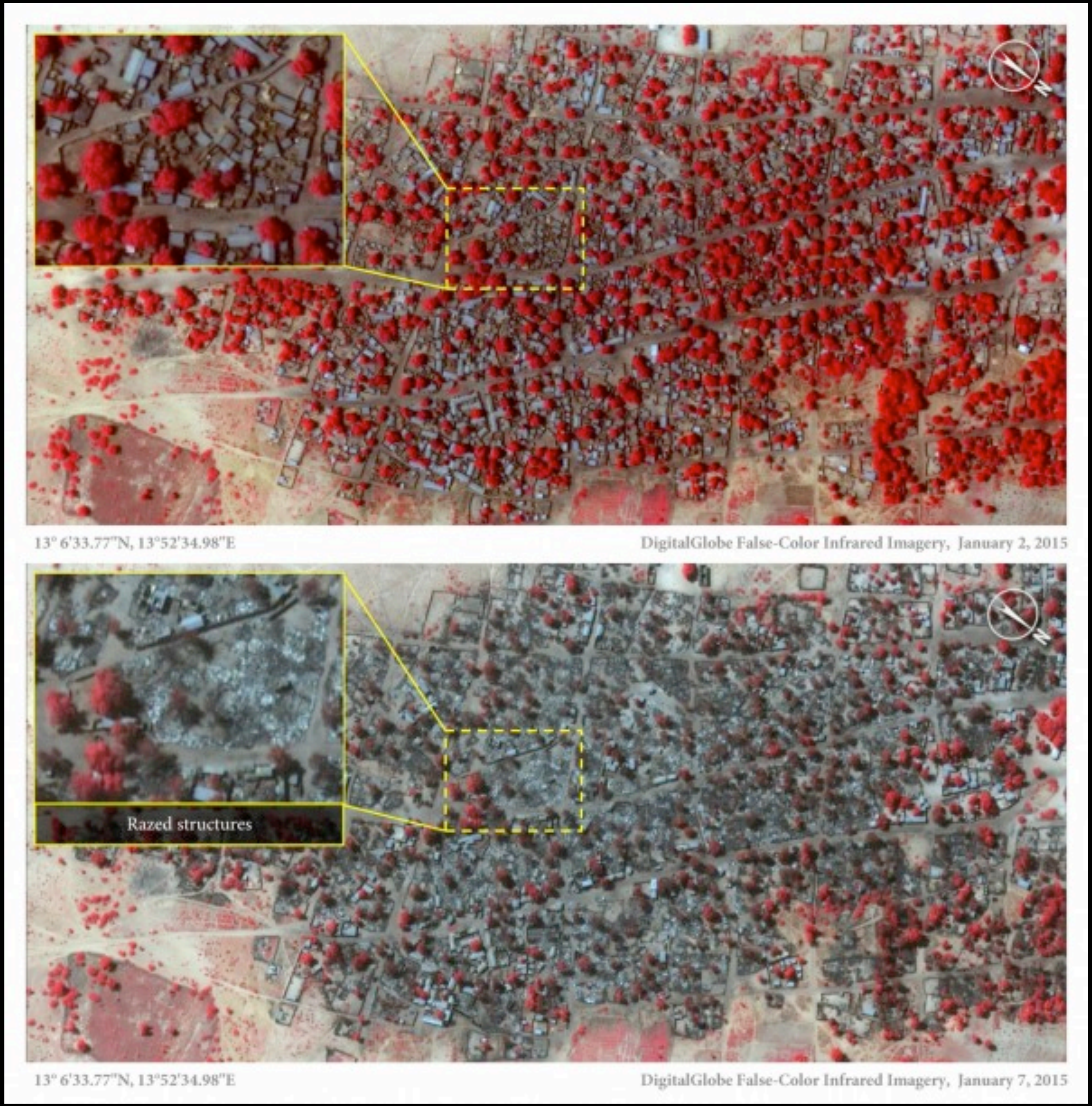
Rob Simmon/NASA



The unnatural colors of the rainbow palette (left) are often difficult for novice viewers to interpret. A more naturalistic palette for phytoplankton (more or less a type of ocean vegetation) trends from dark blue for barren ocean, through turquoise, green, and yellow for increasing concentrations of the tiny plants and algae.

http://earthobservatory.nasa.gov/blogs/elegantfigures/2013/08/19/subtleties-of-color-connecting-color-to-meaning/

Original DigitalGlobe



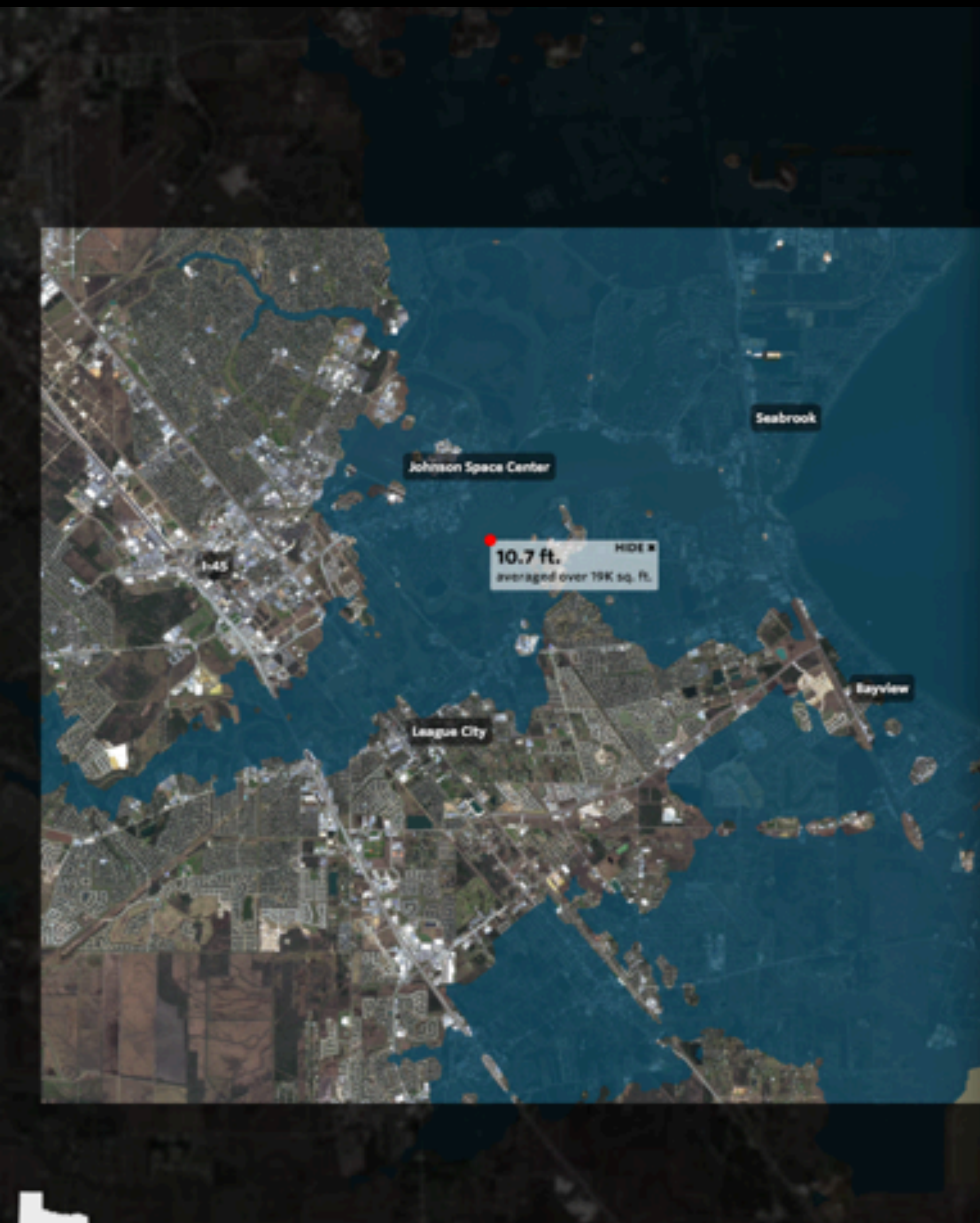
New York Times

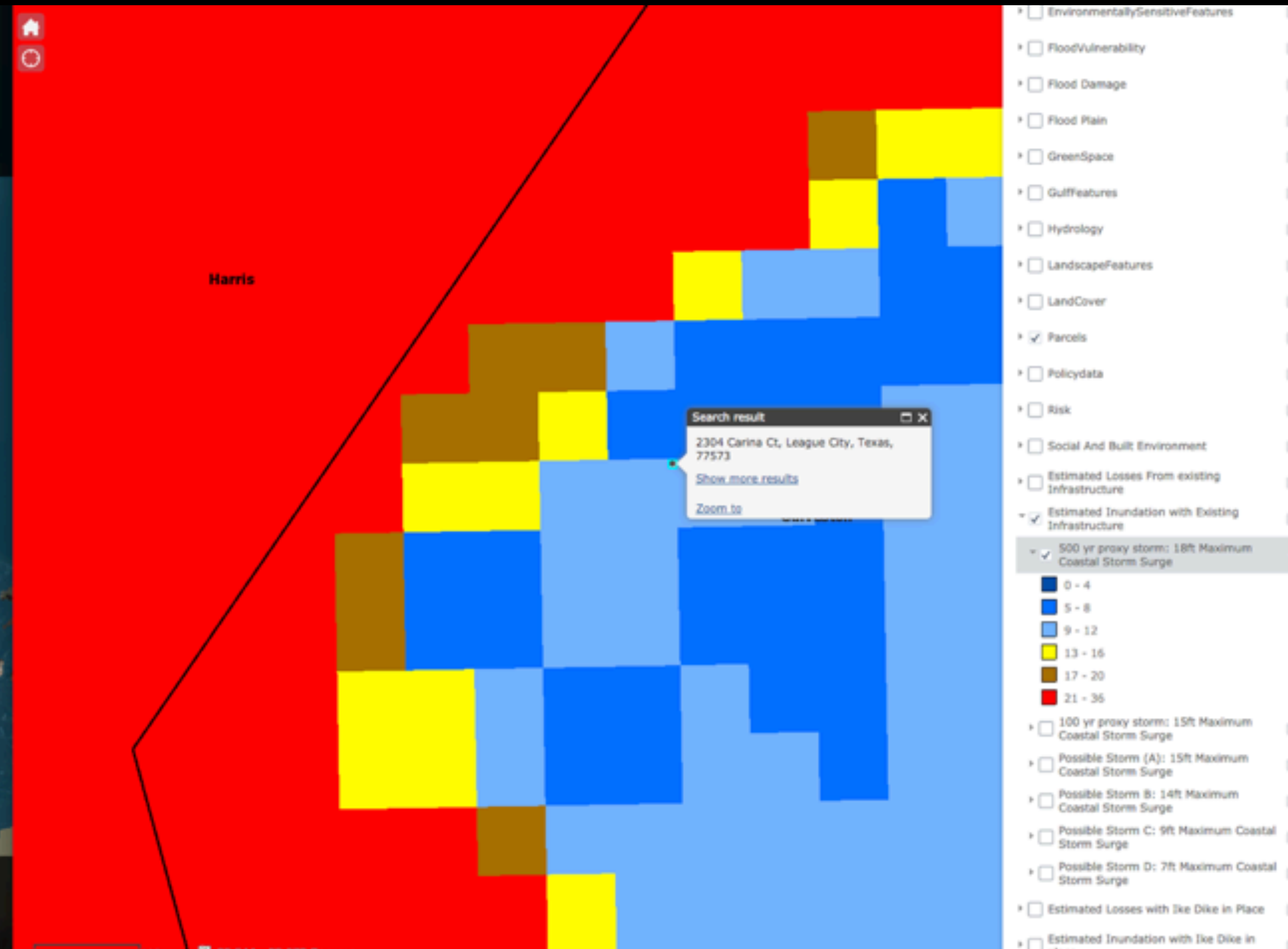
Satellite images taken five days apart show large-scale destruction in Doro Gowon, Nigeria, the home of a now-destroyed military base. Digital Globe

NOAA

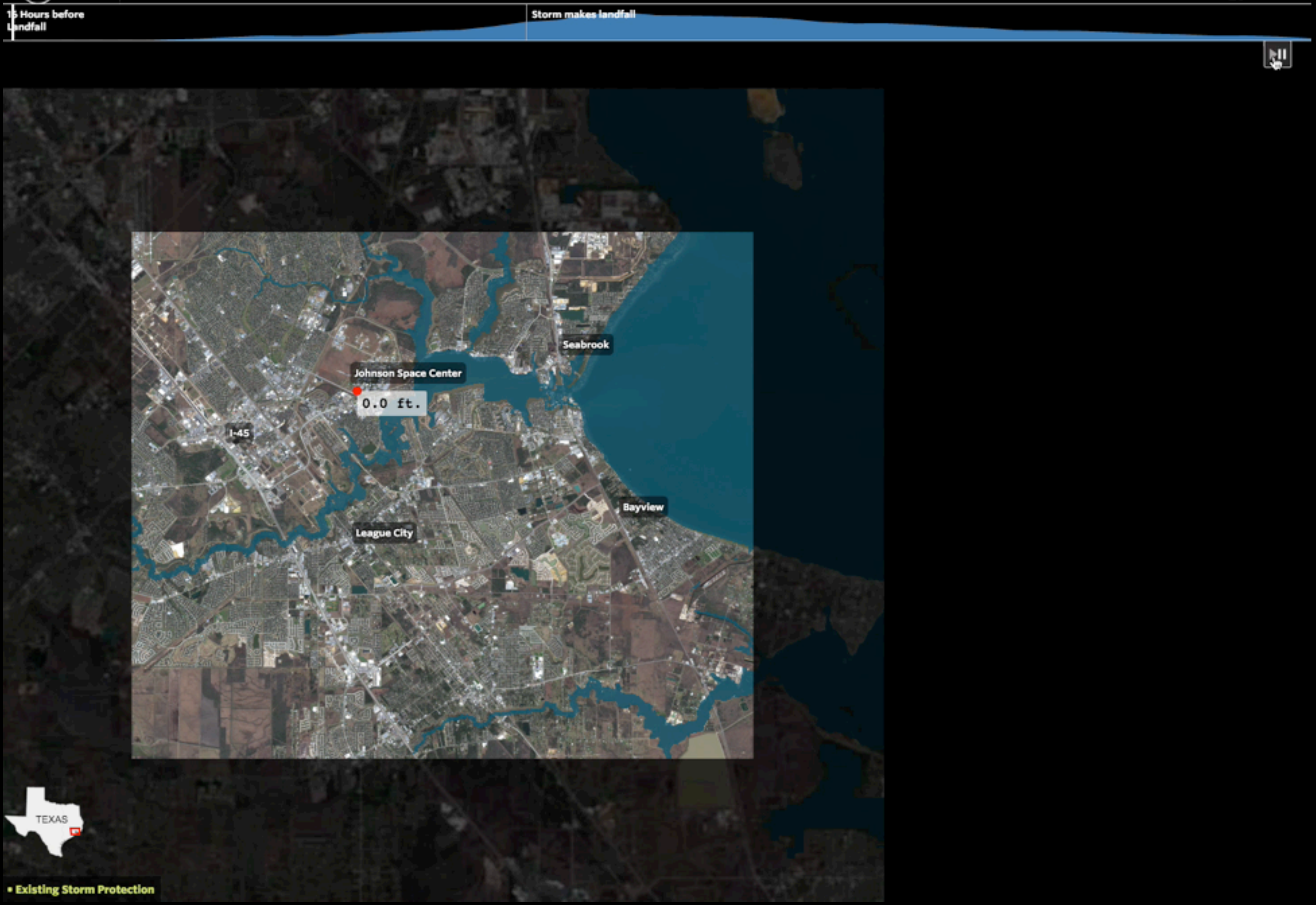
Washington Post

Keep a dialog open as you work, and share your progress (without compromising editorial integrity).





ProPublica **Texas A&M Galveston**



16 Hours before Landfall
Storm makes landfall
Seabrook
Johnson Space Center
0.0 ft.
I-45
Bayview
League City
TEXAS
Existing Storm Protection

Sometimes the point you want to make with the data is broader or different than what the paper does.

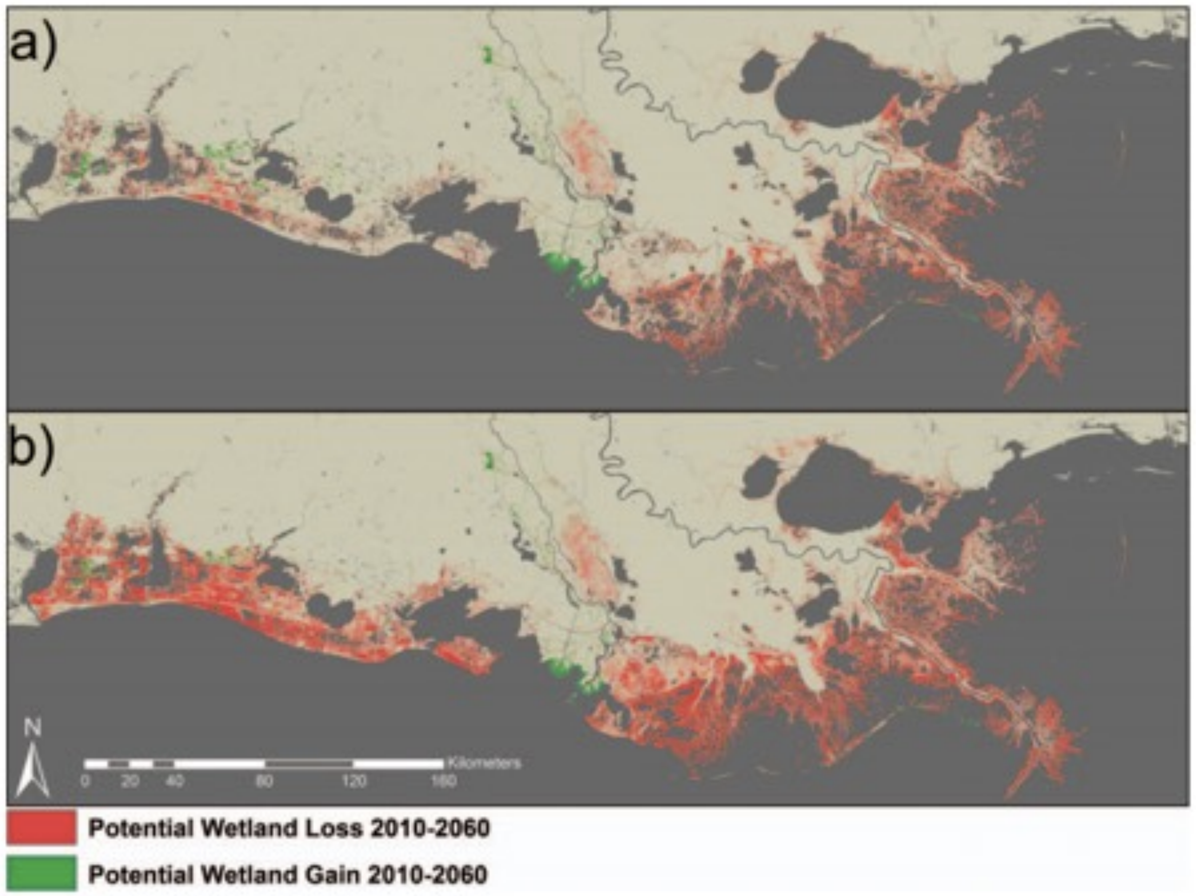


Figure 3. Map of potential wetland area changes under a "Future-without-action" condition for moderate (a) and less optimistic (b) environmental uncertainty scenarios, 2010–2060.

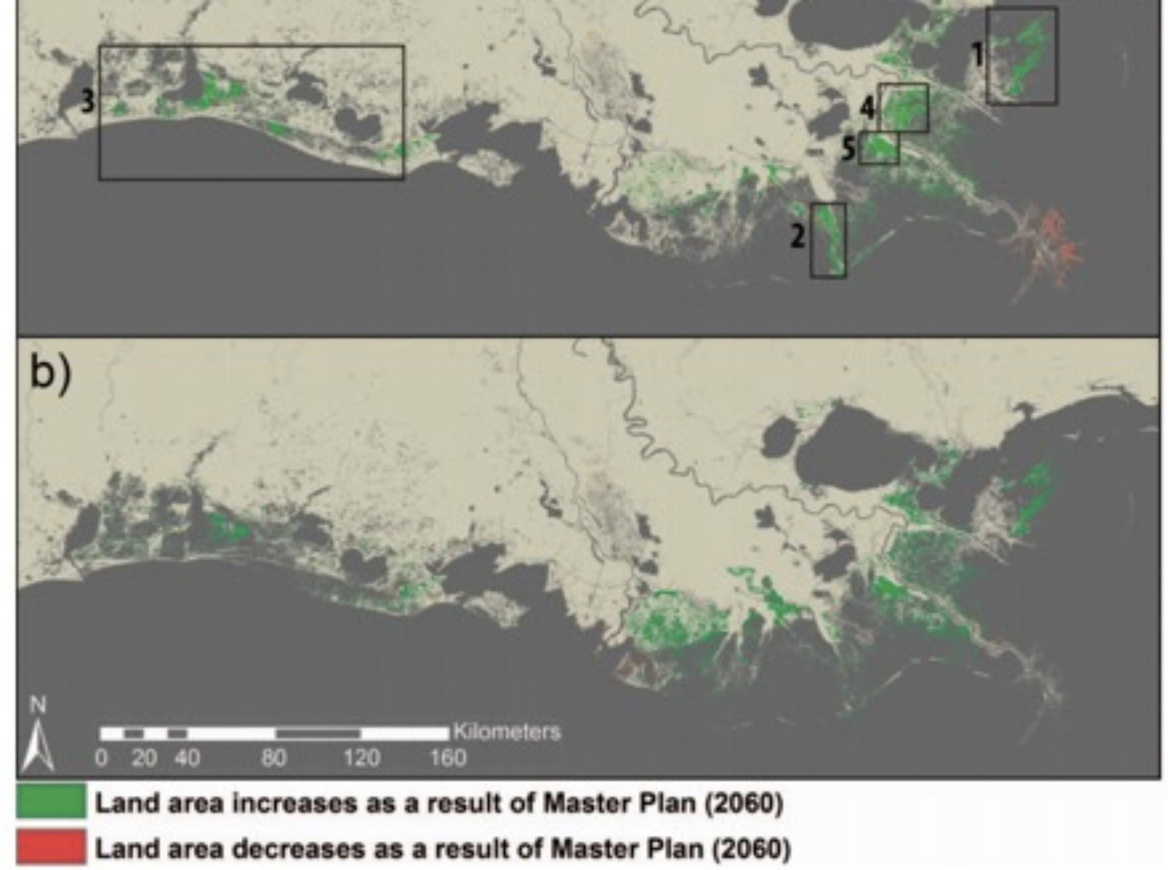
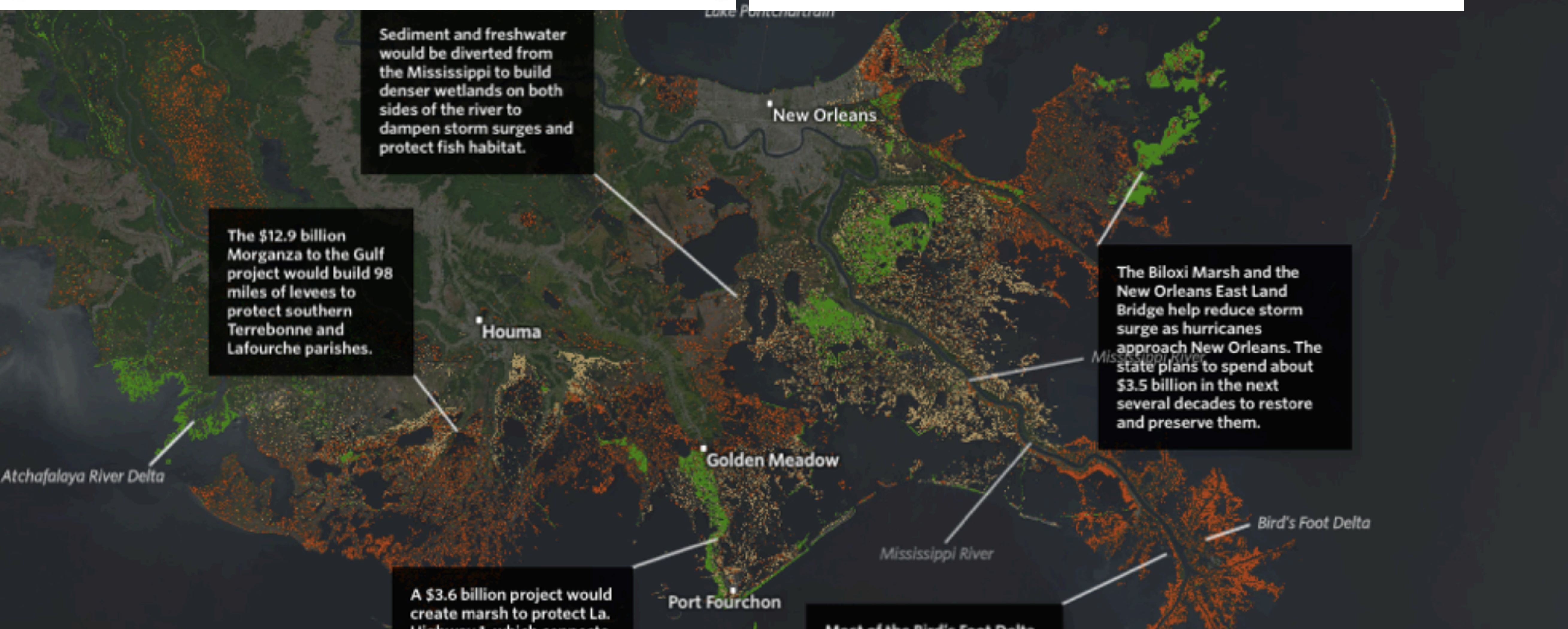
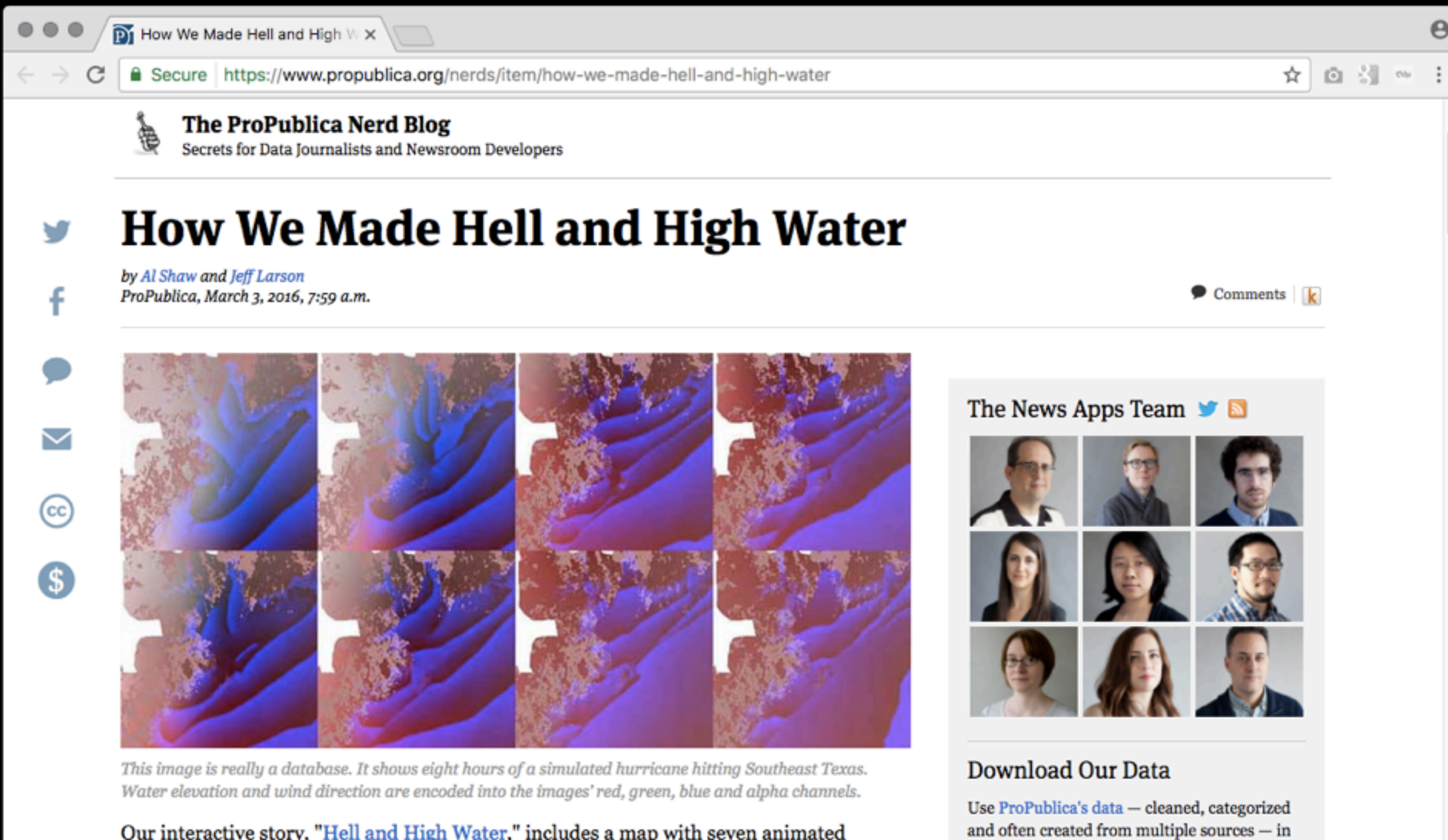


Figure 6. Projected land area increases and decreases with Master Plan implementation at the end of the simulation period (2060) under moderate (a) and less optimistic (b) environmental uncertainty scenarios. Increases and decreases are calculated by comparing FWOA model results to Master Plan model results in 2060. Locations represent the Biloxi Marshes (location 1), the western side of Bayou Lafourche (location 2), the Chenier Plain (location 3), upper Breton Sound (location 4), and the location of a proposed diversion near Myrtle Grove (location 5).



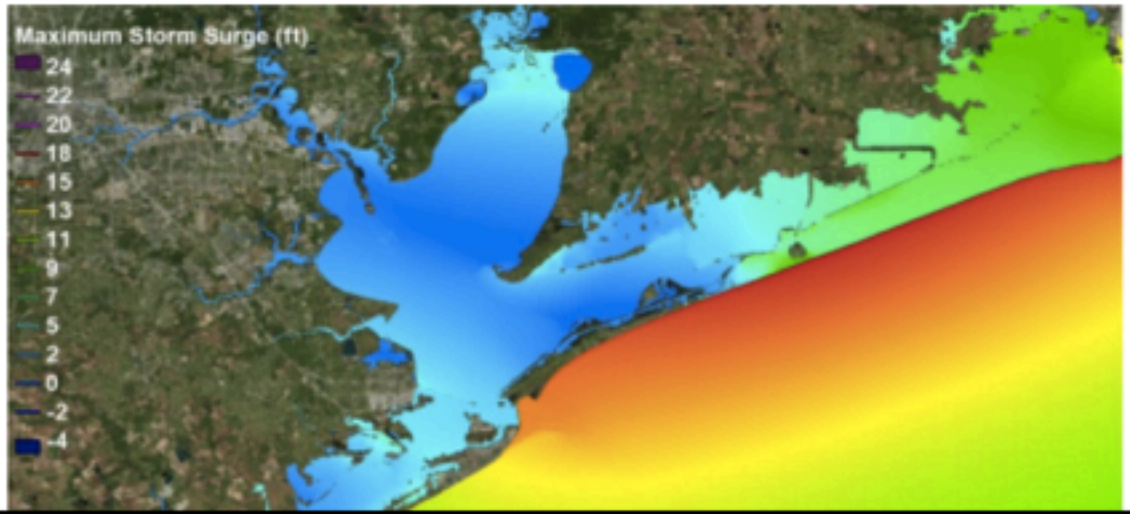
Write about what you did and share it with researchers



MARCH 16, 2016

ProPublica uses ADCIRC for investigation on Houston disaster preparedness

Researchers and engineers from the Coastal Resilience Center of Excellence (CRC) were recently involved in a major investigative multimedia report on Houston's vulnerability to major storm damage.



"**Hell and High Water**," a report by investigative journalism site ProPublica and the Texas Tribune, presents storm surge and flooding scenarios along the Texas coast using the ADCIRC computer model. ADCIRC was developed by a team co-led by CRC Principal Investigator and UNC-Chapel Hill Professor

Bruce Ebersole of Jackson State University, a co-PI on the CRC project **"The Incorporation of Rainfall Into Hazard Estimates for Improved Coastal Resiliency,"** provided data for the report.

"During my employment with the Corps of Engineers…I got a good first-hand look at how vulnerable the Houston-Galveston region is to a major hurricane storm surge," Ebersole said. "The region is steadily growing in population and infrastructure, so its potential for significant damage, and possible loss of life, during hurricanes is increasing….ADCIRC is an excellent tool for simulating hurricane storm surge [and] is central to the work which we are presently doing…. It is great to see ADCIRC get positive exposure as the valuable, reliable engineering tool that it is."

Dr. Clint Dawson, head of the Computational Hydraulics Group at the **University of Texas-Austin** and a co-PI on the **"Improving the Efficiency of Wave and Surge Models via Adaptive Mesh Resolution"** project with the CRC, said ProPublica approached his team about the story about a year ago. Dawson and colleagues contacted the Severe Storm Prediction, Education, and Evacuation from Disasters (SSPEED) Center about using data that had been generated for the Center for the ProPublica feature.

"The outcome I hope to see is better awareness among the general public and decision-makers about the risk along the Texas coast," Dawson said. "This research has received quite a bit of publicity in the Houston-Galveston area, but not so much outside of the area."

Led by UNC-Chapel Hill, the Coastal Resilience Center of Excellence is a Department of Homeland Security (DHS)-

Thank you!

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