



JUNE 11 – JUNE 13

Hilton St. Petersburg Bayfront – 333 1st Street, SE

Decadal Visioning Workshop THE FUTURE OF COASTAL PROCESSES RESEARCH

Welcome

Nicole Elko, Ph.D., Executive Director, American Shore & Beach Pres. Assn. Co-Executive Director, U.S. Coastal Research Program

2024

Special Recognition

COASTAL FORUSE

The future of nearshore processes research

The Nearshore Processes Community

Ration by Nicole Ella, Fall: Feddersen, Diene Feater, Cheryl Hapke, Jesse McNuck, Ryan Malligan, H. Table Ogkan-Hallor, Nathanis/ Plant, and Britt Raubenhoimer

ecember 2014



2024 Decadal Visioning Workshop Steering Committee

- Jon Miller, Stevens Institute for Technology
- Tiffany Roberts Briggs, Florida Atlantic University
- Peter Ruggiero, Oregon State University
- Mara Orescanin, Naval Postgraduate School
- Ethan Theuerkauf, Michigan State University
- Meg Palmsten, U.S. Geological Survey
- Daniel Sharar-Salgado, U.S. Department of Transportation
- Adam Gold, Environmental Defense Fund
- Greg Dusek, National Oceanic and Atmospheric Administration
- Jack Puleo, University of Delaware
- Nicole Elko, American Shore and Beach Preservation Association
- Julie Rosati, U.S. Army Corps of Engineers
- Bret Webb, University of South Alabama
- Diane Foster, University of New Hampshire
- Jessie Straub, U.S. Army Corps of Engineers
- Jenna Brown, U.S. Geological Survey
- Mary Cialone, U.S. Army Corps of Engineers
- Annie Mercer, American Shore and Beach Preservation Association

Shore & Beach # Vol. 83, No. 1 # Winter 2016

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Who is in the room: 148 attendees







USCRP 2014-2024 Research Themes

Complex issues that require integrated approaches AND provide opportunities for unique partnerships



Extreme Events:

Storm-induced flooding, coastal erosion, community impacts, natural recovery



Long-term Processes and Coastal Response:

Sea level change, future storms, sediment supply, land use changes, human interventions

Biological, Chemical, and physical processes

impacting human and ecosystem health

USCRP Vision Through the Years

USCRP Visioning Sessions

• Future of Nearshore

Processes (2014)

Interagency Collaboration (2016)

Federal and Academic
 Collaboration (2016)

Year	Research Theme	Needs Identified Via	# Funded Projects	Total Funding
2016	Dunes on Developed Coasts	Thematic Workshop	5	\$220K
2018	Storm Processes and Impacts	Thematic Workshop	7	\$775K
2019	Research in Support of Federal Stakeholder Priorities (Including DUNEX)	Interagency Collaboration	24	\$5.4M
2020	Federal Science Priorities in Long- term Processes and Estuarine Ecosystems	Interagency Collaboration	15	\$5.0M
2021	Human and Ecosystem Health in the Coastal Zone	Thematic Workshop	11	\$3.3M
2022	Translating Coastal Research into Application	Interagency Collaboration	11	\$4.4M
2023	SEDiment transport COllaborative LABoratory Experiment (SEDCOLAB)	Interagency Collaboration, Expert Steering Committee	5	\$5.0M



How the Agenda is Built

Working through challenges and solutions to actionable research



Why is Community Visioning Important?





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Agenda Review, Logistics, Expectations Linda Manning, President, The Council Oak LLC (Facilitator)



The Agenda



Co-developed

Challenges Discuss what the community me What challenges will we face in the next 10 years?

Tools and

Approaches

Identify and prioritize key management challenges and high priority science gaps to guide the next decade of coastal research

- 4 Breakout Groups builds on the previous step
- O Mixed groupings stay in the same groups
- Synthesis between each step = common starting point
- Informed by presentations

Research Questions



- Fast paced
- O Workshop is a starting point



Collecting Information In Variety Of Ways



- Discussion in breakout groups and plenaries
- Breakout worksheets \bigcirc









Tools and Approaches

- O Flip charts with provocative questions
- Polls \bigcirc
- Post workshop survey
- O Index card questions every morning

Research **Ouestions**

What basic research questions and data gaps need to be addressed in order for the tools and approaches to be



USCRP Toolbox: Website & Resource Table



- O Presenter and moderator bios
- O Local coastal points of interest
- O 1989, 1998, 2014 Reports
- O Nearshore National Plan
- O USCRP by the numbers the first decade
- O St. Petersburg suggestions

Logistics and Announcements



- O Restrooms in main hallway
- Lunches on your own
- O Breaks coffee in the hallway
- O Local coastal points of interest handout
- Happy Hour (and the hotel) are "cashless"
- O Glass doors lock upon exit

Workshop Mindset



- O Be concise and clear
- O Consider multiple disciplines
- O Share relevant information
- Ask meaningful questions
- O Test assumptions / consider bias
- O Explain the "why"
- Try not to jump ahead

Conference Wifi



To access conference wifi:

Connect to "Hilton Meetings"

When the browser window opens, enter the password:





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Decadal Visioning Workshop THE FUTURE OF COASTAL PROCESSES RESEARCH

10-Year Review and State of Nearshore Research Dr. Diane Foster, USCRP Co-Executive Director Dr. Bret Webb, Co-Executive Director, USCRP

2024



Outline

"The Nearshore **Report** is a catalyst for the nearshore research community to leverage its strong existing *relationships* to enrich a heretofore distributed approach to U.S. nearshore research."

State of Nearshore Research: A Decade of Progress

Major Recommendations from 2014 Meeting

O Extreme Events

O Human and Ecosystem Health

Cong Term Coastal Behavior

Workforce Development



USCRP Overview

"Build a U. S. Nearshore Research Program - a sustained, coordinated program funded by multiple agencies."

US Coastal Research Program (2016 – 2023)

PROJECTS ADDRESSING

NEARSHORE PRIORITIES

Human &

ecosystem health 27.6%

Long-term

coastal processes 40.2%

Extreme events

32.2%

516 Proposals Received

○ 77 Proposals Funded

○ \$150M Requested

○ \$23.5M Awarded

 USCRP BY the number s

 The first decade

 Image: state state



Overview

"Coastal research needs in terms of data, knowledge and tools span multiple agencies, and exceed the capacity of individual agencies."



Extreme Events



Key Advances

- Community activities
 - O Dunes & Storms workshop, Dunex, NEER
- New Technologies
 - Pre-post surveys (Drones, UAVs), Drifters, DAS, Inline holography
- 🔾 Science
 - Nearshore exchanges with other bodies (e.g. marshes, aquifers, atmosphere, infrastructure, people)

DUNEX - DUring Nearshore Event eXperiment

Investigate interactions among water, atmosphere, & land processes during major storms



Overviews: Cialone et al. 2019, 2023; Straub et al. 2023. Thank you Britt Raubenheimer

DUNEX - Nearshore Exchanges with.....



Ocean-atmosphere-transport processes

Waves affect wind-drag which affects waves and water levels, waves & bathymetry affect flow vorticity & undertow Potter et al. 2022, Rey & Mulligan 2021, Elgar et al. 2023, Dooley et al. 2024, Chen et al. 2023

Swash-land-vegetation interactions

Aeolian transport of wet sediment, water content affects sediment strength Swann et al. 2021, Mansur et al. 2022, Itzkin et al. 2023, Brilli et al. 2024



Swash-rain-aquifer interactions

IG waves move thru aquifer, salt water enhances groundwater denitrificationDelisle et al. 2024, Roy et al. 2024

Ocean-shore-sound interactions

Breaching from sound-side inundation, wetlands attenuate waves but not high water levels Sherwood et al. 2023, Over et al. 2021, Cassalho et al. 2021, Jaber et al. 2021, Wargula et al. 2021, Tomiczek et al. 2022



Overviews: Cialone et al. 2019, 2023; Straub et al. 2023. Thank you Britt Raubenheimer







Facilitate and coordinate rapid responses for coastal storms
 SUPPORT: Facilitate deployment of surge and waves topography, landcover, and vegetation observations

 DATA DISTRIBUTION: Observations, metadata, & data shared with community via DesignSafe-CI. Used as baseline data for recovery studies

Participate on NHERI Leadership Corps

O https://converge.colorado.edu

 Collaboration rapidly-deployable Sentinel to system for atmospheric, ocean, morphology water quality data: Phillips et al. 2023

neerassociation.org. Thank you Britt Raubenheimer



NEER:Nearshore Extreme Events Reconnaissance Association





Hurricane Laura 2020 (Max Gust 127 mph)

- EVENT COORDINATION: shared deployment plans via DesignSafe-CI Slack channel and daily https://converge.colorado.edu
- USGS Storm Team coordinate with NSF EERs,
 RAPID Facility, other teams/agencies
- RESULT: Floodwaters drained more slowly and marshes submerged longer onshore of breakwater, potentially resulting in increased damage to vegetation. Cadigan PhD dissertation
 Cadigan et al. 2021, Chen et al. 2023 NSF project to examine recovery

neerassociation.org. Thank you Britt Raubenheimer



Human and Ecosystem Health

- O Community activities
 - January 2021 USCRP HEH Workshop
 - Elko et al., 2022 "Human and ecosystem health in coastal systems "
 - Natural and Nature Assessment (White house)
- Agency Developments
 - USACE Engineering with Nature, N-EWN
 - O NOAA Climate Resilience Program

Courtesy, Elizabeth Halliday, WHOI

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Brander Lab (Anna Bolm) OSU

Coastal Pollutants

- Mitigate nearshore fecal pollution, nutrients, and harmful algal blooms, and microplastics
- Standardize HEH terminology taking into consideration the regional and local perspectives.
- Standardize observational techniques and approaches Brander et al. 2020; Cowger et al. 2020
- Establish early warning and event response thresholds based on sound science

) Improve data access.

The Nature Conservancy

Nature & Nature-Based Solution Recommendations

- Quantify the risk and potential of NNBF.
- Collect environmental data to calibrate and validate coupled nearshore-ecosystem models
- Support long-term sampling and statistical analysis of routine necessary for .evaluating ecosystem performance
- Develop lower cost and rapid response tools to help coastal managers better respond to pollutant and ecosystem threats.

Engineering with Nature

- O USACE established ~2013
 - O Strategic plan 2018-2023
 - O Engineeringwithnature.org
 - O Strong partnerships and engagement
- Network for Engineering with Nature (N-EWN)

Determining The Scales For Natural Infrastructure To Mitigate Coastal And Riverine Flood Hazards, Bilskie & Tritinger

Engineeringwithnature.org

Retrospective

"Identify and coordinate 'experiments of opportunity,' long-term coastal change projects concerning large-scale processes, sediment budgets, and ecosystem services, as future interagency field experiments."

312 NATIONAL NATURAL SCIENCE FOUNDATION OF CHINA NSFC	111 UK RESEARCH INNOVATION UKRI	72 FUNDACAO PARA A CIENCIA E A TECNOLOGIA FCT	66 NSF DIRECTORATE FOR GEOSCIENCES GEO	53 GERMAN RESEARCH FOUNDATION DFG	47 AGENCE NATIONALE DE LA RECHERCHE ANR
	109 EUROPEAN UNION EU	45 CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTIFICO E TECNOLOGICO CNPQ 45	36 35 FUNDAMENT RESEARCH FUNDS FOR THE CENTRAL UNIVERSITIES	BALLIAN ARCH CIL DE PESSOAL DE NIVEL SUPERIOR	32 MINISTRY OF EDUCATION CULTURE SPORTS SCIENCE AND TECHNOLO
240 NATIONAL SCIENCE FOUNDATION NSF	93 SPANISH GOVERNMENT	ARTIONAL OCEANIC ATMOSPHERIC ADMIN NOAA USA 39 NATURAL SCIENCES AND	SI JAPAN SOCIETY FOR THE PROMOTION OF	S0 EUROPEAN RESEARCH COUNCIL ERC	29 CHINESE ACADEMY OF SCIENCES
	81 NATURAL ENVIRONMENT RESEARCH COUNCIL NERC	angineering Research council of Canada NSERC 37 NATIONAL KEY RESEARCH AND	30 SO SO SO SO SO SO SO SO SO SO	27 CHINA SCHOLARSHI COUNCIL	25 GRANTS IN AID FOR SCIENTIFIC RESEARCH

USCRP has funded 77 projects surrounding **Extreme** Events, Long-Term Coastal **Evolution**, and Human & Ecosystem Health

Long-term coastal processes 40.2%

Human & ecosystem health 27.6%

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH

Extreme events

32.2%

USCRP-funded research...

Project keywords related to Long-Term Coastal Evolution

-

a

50

2014-01

2014-05

Montaño et al, 2020

2014-09

2015-01

Community Advancements

- Sea-Level Rise
- Coastal Flooding
- Long-Term Shoreline Change
- Long-Term Habitat Transformation \bigcirc

6	Observations	Modeling	Tools
2017-01	UAVsLiDARSatellitesCommunity	 Decadal+ Shoreline Change Testbeds 	 New Models Web Tools Analysis Pkgs ML Al

2015-05

2015-09

Time

2016-01

2016-05

 $R_2 = 0.80$

RMSE = 7.2 m

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2016-09

June 2016

Other Notables

- O Citizen/Community Science
- O Low-Cost Instrumentation

Policinador 27

- O Beneficial Use (& the 70/30 Goal)
- O Beach Profile Evolution
- O Interdisciplinary Research
 - NSF Coastlines & People Hubs (CoPe)
- O Translational Science

○ NOAA NCCOS Effects of Sea Level Rise

Sediment

Budgets

Workforce Development & Training

"Utilize a new and/or existing collaborative funding mechanism for graduate student fellowships to foster the next generation of nearshore scientists and engineers."

What Did We Say... in 2012?

- US programs in decline due to lack of funding
- Educational opportunities decreasing
- USACE R&D funding declining

The state of U.S. coastal engineering & science

Science and Technology Committee American Shore & Beach Proscrution Association February 2012

Pathy The state of U.S. constal engineering and asiance is in flux. ASBPA is concerned that academic coastid engineering and acimer programs in the U.S. may serioudly docline in the next flux is in post, in grant due to molecule fluxerin fluxing, aSSPA sectors to restrice confidences in our national coastid expertise. ASBPA seeds to partner with agencies, academia, and the private sector to work toward improving the state of U.S. coastid engineering and acidota. ASBPA sequence state and local effects to proveed U.S. engineering and acidota. ASBPA sequence is assume in the implementation of the slightly revised versions of the following recommendations from the 1999 National Research Concerl share). "Montage the Research and Educational Network in constant

 The coastal engineering its science scademic semimanity sheald enablisk a consertion to improve research and education through cooperative arrangements for leveraging major research facilities and educationic capabilities.

The National Science Foundation should ostablish a program to fund fundamental rosearch on coastal orginaeting and science (in its Engineering Division and/or elsewhere).

 The USACE and infor federal agencies should establish a submatial program to fund applied meanth is academic council angineering and science programs and promote partnerships between scalema, fideral agencies, & grivate interests.

Engineering"

In record years, function countil expertises has been called upon in respont of complex problems inverting the physical dynamics, acousts and emitoremental impacts sing the U.S. count. Consentances of European universities and origineering institutes, for example, have invested millions of European universities and origineering institutes, for example, have invested millions of European universities and origineering institutes, for example, have invested millions of European universities and origine a similar coordinated afforts to mainstain exactlence in causaid angineering and science has not occurred in the U.S. There is a promising need to previse partnering area group U.S. count investments. Academic research has been fragmented and functing levels have detantished. Without a widely fashing base, oriversity programs that were no construe in this field strategies to array class.

ASBPA is constanted about the diminishing level and depth of supertise in U.S. countil mightering it science and seeks to restare excellence in this field. ASBPA has investigated this concern by summining the three "larg" of U.S. cound engineering and science faderal agreedes andersis, and the primes sector. Assidentias do not have a condition to support finding the countil meansch. Large-scale research programs and find experiments with federal and academic pathering (e.g., SANDYDUCK or the National Schemar Transport Study) have not been

Page 1 of 2

Workforce Development & Training

"Utilize a new and/or existing collaborative funding mechanism for graduate student fellowships to foster the next generation of nearshore scientists and engineers."

What Did You Say... in 2018?

- > Funding decreasing, difficult to obtain
- Generally small number of faculty, post-docs
- Substantial staffing needs in fed agencies

A COLUMN AND A COLUMN	
Trair U.S. co	ning the next generation of astal scientists and engineers
5	CIDECELARID TREPERSOLOGY COMMITTEE Original 2018
	by .
Nicole Elko, Reza i	Marsoodi, Alex Renaud, and Tiffary Roberts Briggs
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What Did You Say... in 2024? -> <u>Come to the Thursday Plenary!!!</u>

Workforce Development & Training

USCRP Impact

- Engineering 36%
- Physical Sciences 33%
- Biology & Life Sciences 21%
- O Environmental Studies 6%
- Policy/Planning/Social 4%
The Coastal Resiliency Space



Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH



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Historical Perspectives on Nearshore Research Dr. Rob Holman, Oregon State University

2024



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Panel Discussion: Stakeholder Perspective of Local Societal Challenges

2024

Historical Perspectives – Before 2014 Rob Holman Oregon State University

Prior to 1989
St. Pete I, 1989
St. Pete II, 1998
Duck, 2002

• Where haven't we studied?

Abby Sallenger, Fort Ord, ~1980

Prior to early 1980's

- Small community
- ICCE was the only conference
- No AGU session
- ONR had Coastal Geography program
- Sea Grant- had coastal interests (NSTS experiment)
- USACE / CERC active in lab

Evolution Through the 1980's

• Series of Duck experiments, 1981, 82, 85, 86

- Development of AGU nearshore sessions
- Expansion of USGS interest in nearshore processes
 - Reduction in ONR interest to 4 nearshore
 PI's

St. Pete I, April, 1989



- ONR needed to define intentional program or get out of nearshore
- Jointly sponsor first community meeting with Sea Grant, USACE, USGS and NSF
- Goals were:
 - to assess current state of the science
 - Identify priority directions for future.
- Attendees were all scientists!!
- Designed to be unassociated with specific funding thrusts.
- Successful report that helped guide next 15 years of research



1989 St Petersburg Nearshore Meeting

Kneeling Row (left to right): Tony Bowen, Dick Sternberg, Bob Dean, Bill Birkemeier, Abby Sallenger, Rob Holman (front), Joan Oltman-Shay, Ron Guenther, Nobu Kobayashi, Steve Elgar.

Middle Row (left to right): Yogi Agrawal, Phil Liu, Mike Freilich, Dave Aubrey, Keith Bedford (behind), Doug Inman,

Peter Howd (behind), Brian Greenwood, Ib Svendsen, Gary Zarillo, ?, Ed Thornton, Geisler Gust, Liu?, Tony

Dalrymple, Reg Beach, David Huntley, Harry Yeh

Back Row (left to right): Tim Stanton, John Trowbridge, Steve McLean, Bill Dally, Dan Hanes, Jim Kirby, Jurgen Battjes, Jeff List, John Dingler

<u>Resulting</u> <u>Org Charts</u>

Structure of the Nearshore Problem



<u>Resulting</u> <u>Org Charts</u>

Structure of the Fluids Problem



- 1. Wave breaking
- 2. Infragravity wave dynamics
- 3. Swash dynamics
- 4. Bottom boundary layer
- Small-scale
 Sediment transport



- 1. Wave breaking
- 2. Infragravity wave dynamics
- 3. Swash dynamics
- 4. Bottom boundary layer
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 Sediment transport



- 1. Wave breaking
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 Sediment transport



- 1. Wave breaking
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- 3. Swash dynamics
- 4. Bottom boundary layer
- Small-scale Sediment transport



- 1. Wave breaking
- 2. Infragravity wave dynamics
- 3. Swash dynamics
- 4. Bottom boundary layer
- 5. Small-scale Sediment transport



St. Pete II, 26-28 October 1998

- Decadal update
- Supported by NOAA-Sea Grant, NSF, ONR, USGS, USACE
- Reflects
 - end of cold war and changing DOD interest.
 - Increasing threats from sea level rise and climate change.
 - Progress due to suite of large field experiments, improved models and much improved instrumentation with GPS, sonars, turbulence sensors and remote sensing methods.
 - An agency desire to study other than Duck.
 - Birth of LSCB
 - Birth of USGS National Assessment program
- What are important science questions?
- What are the impediments to answering them?
- What are best research strategies?
- What infrastructure is needed?

Priority Science Issues:

- 1. Fluid and sediment processes in the **swash zone**
- 2. Breaking waves, bottom boundary layers and associated turbulence.
- 3. Wave-driven **currents**
- 4. Nearshore **sediment transport**
- **5. Morphology** (small and LSCB)

Research Strategies:

- 1. Develop and test community models (led to NOPP)
- 2. Expand observations on varied beaches over range of scales (next was NCEX, 2003)
- 3. Suggested list of infrastructure improvements

Rob Holman, Bill Birkemeier, Tony Dalrymple, Bob Guza, Abby Sallenger

- Reflects
 - Concern over lack of community vision beyond NCEX
 - Evolving and increasing federal priorities (away from ONR)
 - Self-supported
 - Ten year forward look
- Keyed to societal needs
 - What can't we do
 - What are key science limitations

Societal Problems with Science Roots:

- Coastal Erosion and Flooding
 - Storm (hazard) scale
 - Tsunami
 - Long-term (CZM scale of decades)
- Defense Needs:
 - Battlespace characterization
 - Mine burial
 - Trafficability
 - Environmental impact
- Sediment Management
- Recreation and Safety
- Navigation
- Water Quality
- Structures and Engineering



Outcomes of Discussions:

- 1. We do not have sufficient information to determine what elements of physics are most limiting to our current abilities (although we might speculate).
- 2. We do not know whether predictions are more limited by physics or boundary conditions (esp bathy).
- 3. Answers to the above appear best found through extensive comparison of models to data (numerical model test bed).
- 4. We know little of the dynamics on reflective or highly dissipative beaches.

Recommendations:

- 1. Need studies of sensitivities (and insensitivities) of models, compared to typical available input errors
- 2. We need to exercise models against any and all available data.
- 3. We propose this take the form of **observatories** in sites of combined science and political interest.





Session Objective: Establish a common understanding of coastal communities' problems and challenges.

MODERATOR

- Amanda Stoltz, Social Scientist, U.S. Geological Survey
 PANELISTS
- **Dr. John Bishop**, Coastal Manager, Pinellas County, Florida
- **Dr. Barnali Dixon**, Professor and Executive Director of the Initiative on Coastal Adaption and Resilience (iCAR) and Director of Geospatial Analytics Lab.
- O Dr. Jonathan Simm, Technical Director of Resilience, HR Wallingford
- Beau Suthard, Program Director, National Coastal, Ports & Marine consulting, APTIM



Stakeholder Perspective of Local Societal Challenges

Dr. John Bishop Coastal Manager, Pinellas County, Florida

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Example of Coastal Community of Societal Challenge.

- *a.* An example of a coastal community or societal challenge that you think we are making progress in addressing in the last 10 years?
- Real-estate, but I'm undecided on whether we are making progress.
- Much of the studies and design work are in support of projects that require private lands to build.
- What private lands might be required should be kept in mind at the onset and minimized.

Easement Example

A project that minimized is private footprint has a better chance

Restrictive easement requirement can sink a project.



What will U.S. Coasts Look Like in 10 Years?

- a. Based on your knowledge base and frame of reference, what do you think the U.S. coasts will look like in 10 years? Remember, this can be physically, socially, public health, transportation, any aspect of how coast may look different.
- Aside from some minor localized changes, the same. A few more projects will be completed and a few more structures will have succumbed to mother nature but by in large it will be the same.



Dr. Barnali Dixon, Professor and Executive Director of the Initiative on Coastal Adaption and Resilience (iCAR) and Director of Geospatial Analytics Lab.

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An integrated approach to coastal research using coupled natural-human systems frameworks, place-based approaches and crowdsourcing

Barnali Dixon, PhD

Professor, School of Geosciences, University of South Florida Saint Petersburg and Executive Director of Initiative on Coastal Adaptation and Resilience (iCAR)



Email: bdixon@usf.edu

USCRP June 11, 2024



Core Challenges and iCAR's mission

- This is an integrated platform to promote community-engaged data-driven advocacy and informed decision-making
 - Connecting marginalized communities to Govt agencies & NGOs
 - Better <u>understanding of information flow</u> so this can be improved
- Change <u>one-size-fits-all policy</u> solution paradigms to custom policy solutions
- Opportunity to change from 'slow reactive problem solving that lags behind the problem' to 'pro-active approach' - this is where the smart city framework comes in handy



Why Customize? Example of South Pinellas County



Coastal Communities and Challenges are Diverse



Sources: <u>http://www.airportairparkhomes.com/homedetail.asp?id=504(right)</u> <u>https://www.zillow.com/naples-fl/florida-private-fly-in-gated-community_att/</u> (lower middle)

<u>Overall Goals</u>: Improve Prediction, Know Uncertainties, and Involve Communities



<u>Ultimate Benefits</u>: Enhance Data Collection, Improve Model Calibration & Validation and Develop Custom Policy Solutions



How does future look like? Real estate holding changes and racial ownership



What do we need to think about?

10:48 45

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GIVE THE TIMES

Their Florida 'Paradise' Keeps Flooding, but Some Can't Afford a Solution

In the Shore Acres neighborhood of St. Petersburg, rising water has become a constant threat. Many residents cannot afford to elevate their homes or move.

🛱 Share full article 🔗 🗍 🗔 557 Read in app



nytimes.com







"For sale" signs dot almost every block in Shore Acres. Zack Winnan for The New York Times

After Hurricane Idalia, residents pressed the city to do more. St. Petersburg has since started to install nearly \$4 million worth of new equipment to prevent

invtimes.com





"There's that guilt factor," she said. "Just seeing them go through it, repeatedly, in the time that I've lived here — it's hard."



AA Invite not several hundred AA Invite not several hundred AA Invite not several hundred C I

Apart from the Differential ability to adapt and be resilient, these two structures will have differential impacts on water flow.

Storm surge Extreme rainfall events Or combined effects

Our models, policies, and planning efforts need to adjust!

Isolation?!

liddle: **Sedwick Doran**

Thank You! Question?

• Thank you, Co-PIs and their Team

<u>USF</u>

Mike Hancock Alec Collarusso Yi Qiang, Md Zakaria Salim Ga Tech Subhro Guhathakurta, **Dylan Whitlow** Patty (Mengje) Zhu Peng Chen Phillip Si ANL **Eugene Yan** Sahagun (Sofi) Covarrubias

Thank you, Partners :

Pinellas County Emergency Management City of Saint Petersburg Community Collaborative



CRIS*: a multi-modular crowd-sourced Community Resiliency Information System (CRIS*) to overcome traditional smart cities' focus on infrastructure and grid vulnerabilities/resiliency while overlooking socio-economic vulnerabilities.

Our proposed vision of a smart city integrated with CRIS[™] allows scalable and customizable solutions for policymakers using information generated 'by the people', thus ensuring participation of diverse communities in smart city technology, thus creating a Holistic Smart City (HSC).



Thank you, Sponsors :

NSF Award Number – SS&C 2325631 AT&T Climate Resiliency Community Challenge

My Email: bdixon@usf.edu






Dr. Jonathan Simm, Technical Director of Resilience, HR Wallingford

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH

Jonathan Simm, PhD, FREng

HR Wallingford, United Kingdom

Technical Director

Coastal engineering and flood risk management

Guidance document author/editor

- Rock manual (CIRIA)
- Beach management manual (CIRIA)
- Groynes guide (CIRIA)
- International Levee Handbook
- NNBF international guidelines

Plus assistance with US National Levee Safety Guidelines.





A coastal societal need or challenge addressed (in UK)

Adaptation and resilience

- Shoreline management approach which accepts and works with change in the cross-shore position of the shoreline
 - Before jumping to selection of measures (conventional, NNBF, etc).
- Idea of "coastal change management areas" which recognise reality of "coastal squeeze" with sea level rise.
 - coastal bluffs, wetlands, sand dunes
 - Introduction of Coastal Transitions Accelerator
 Programme
- Land use changes which allow communities as well as the physical coast to roll back.



Coastal squeeze arises when the coastal system is maintained in a particular location, leading to compression of the zone seaward of the defense line, rather than allowing natural rollback of the system.

What coasts might look like in 10 years (in UK)

Much the same (urban), retreated (rural)

- Implications of shoreline management plans for coastal units:
 - Hold the line (urban coasts): increased use of beach nourishment (but reduced source material availability); more tidal barriers (c.f. Texas, New Jersey)
 - No active intervention: degraded defences; (lack of maintenance plus undermining due to beach change); eroded coastal bluffs
 - Retreat: new wetlands in front of retreated defences
- National coastal monitoring programme
 - <u>https://coastalmonitoring.org/</u>
- More focus on social impact and deliberative community engagement
 - Move from DAD (Decide, Announce, Defend) to EDD (Engage, Deliberate, Decide)



hrwallingford



Beau Suthard,

Program Director, National Coastal, Ports & Marine consulting, APTIM

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH

Beau Suthard, PG

Program Director Coastal, Ports, & Marine





COASTAL COMMUNITY OR SOCIETAL CHALLENGE ADDRESSED

- Project implementation and performance monitoring
 - Continuing need for regionalization of coastal restoration/protection projects
- Workforce Development
 - Limited pool of Undergraduate/Graduate student engineers and scientists with practical/applied experience
- Development and use of nature-based solutions for coastal restoration/protection
 - Continuing need to learn from and adapt smaller-scale projects to larger-scale projects
- Research on the identification of infragravity motions in the nearshore
 - Need to convert existing knowledge base into practical design guidelines



WHAT WILL U.S. COASTS LOOK LIKE IN 10 YEARS?

From a coastal restoration/protection standpoint, there will be fewer large-scale projects resulting in more small-scale projects and possibly more armoring

- Regulatory and legal approval impacts (making projects unbuildable)
- Cost to benefit analysis restrictions
- Lack of funding, or inability to build projects within timelines associated with funding due to extended regulatory reviews
- Lack of sand resources for larger projects
- More frequent emergency needs due to climate impacts
- Increasing design, permitting, and construction costs





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Challenges Discuss what the community no What challenges will we face

in the next 10 years?

Co-developed Solutions

Discuss how we move forward:



Tools and Approaches

Discuss implementation strategies What ways will we achieve the solutions?

Research Questions

?



BREAKOUT #1

Prioritizing Coastal Community Challenges



How the Agenda is Built

Working through challenges and solutions to actionable research



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Breakout Session Instructions

WHAT'S MY BREAKOUT ROOM?

Your badge has a star on it that corresponds to one of the following

breakout rooms:





JUNE 11 – JUNE 13

Hilton St. Petersburg Bayfront - 333 1st Street, SE

Decadal Visioning Workshop THE FUTURE OF COASTAL PROCESSES RESEARCH



2024

Break



Decadal Visioning Workshop 2024 THE FUTURE OF COASTAL PROCESSES RESEARCH



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Decadal Visioning Workshop THE FUTURE OF COASTAL PROCESSES RESEARCH

Panel Discussion: Summary of Research Priorities from Federal Agencies



Session **Objective: Provide an** overview of research foci for federal agencies, including major challenges.

MODERATOR

- Stephanie Patch , Associate Professor, University of South Alabama
 PANELISTS
- Mark Osler, Senior Advisor for Coastal Inundation and Resilience Science and Services, National Oceanographic and Atmospheric Administration
- Dr. Hilary Stockdon, Program Coordinator for Coastal-Marine Hazards and Resource Program, U.S. Geological Survey
- Dr. Benjamin Hamlington, Research Scientist in Climate Change, Jet
 Propulsion Laboratory, National Aeronautics and Space Administration
- Dr. Julie Rosati, Technical Director Civil Works Research and Development,
 U.S. Army Corps of Engineers and Co- Co-Executive Director, USCRP



Mark Osler,

Senior Advisor for Coastal Inundation and Resilience Science and Services, National Oceanographic and Atmospheric Administration

Summary of Research Priorities from Federal Agencies

Mark Osler

Senior Advisor for Coastal Inundation and Resilience

National Oceanic and Atmospheric Administration U.S. Department of Commerce

USCRP Decadal Visioning Workshop June 11, 2024



Outline

- A note about research
- Past 10 years
- Current needs



A Note About Research

Deliver climate services: Generate climate science & information: Evaluate climate services: Mapping and visualization Observations Peer review ٠ ٠ . Products and tools Modeling and simulation User surveys ٠ ٠ Indigenous and traditional knowledge Extension services Benefit/cost analysis ٠ ٠ Lived experience Training and capacity building Randomized control trials ٠ Develop Generate Deliver Use **Evaluate** Develop climate services: climate services: Science translation Risk assessment Hazard mitigation User engagement Design co-production Project design and planning Application development Investing and asset management .

A Federal Framework and Action Plan for Climate Services March 2023

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A Note About Research



RL1: Basic research, experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

RL4: Successful evaluation of system, subsystem, process, product, service, or tool in a laboratory or other experimental environment

RL8: Finalized system, process, product, service or tool tested, and shown to operate or function as expected within user's environment; user training and documentation completed; operator or user approval given.

https://orta.research.noaa.gov/support/readiness-levels/⁹⁶

What research advances have been made in the last 10 years? What is the implication or applicability of that research?

- I have no idea!
- Sea level change / High tide flooding
- Natural and nature based solutions
- Broadening of resilience concepts
- Economic analysis

What are the thorniest research questions you are confronting and why are they challenging?

- Compound flooding
- Probabilistic treatment of hazard / risk
- Natural and nature based solutions
- From understanding to prediction
- Science of decision making



Dr. Hilary Stockdon,

Program Coordinator for Coastal-Marine Hazards and Resource Program, U.S. Geological Survey

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Science for Resilient Coastlines

Hilary Stockdon, Program Coordinator USGS Coastal & Marine Hazards and Resources

US Coastal Research Program Decadal Visioning Workshop – June 2024

USGS Coastal Hazards and Resources

The demand for actionable information is increasing. USGS science can guide consequential decisions.

Understanding, modeling, and forecasting natural coastal processes and responses across diverse landscapes and communities in order to **inform emergency response**, **long-term planning**, and resource management.

- **Coastal Change Hazards**: Physical processes and impacts to diverse coastal landscapes, across all time scales
- Integrated Coastal Science: Impacts of coastal processes on ecosystems, resources, communities
- **Coastal Risk and Resilience**: Ecosystem restoration, hazard preparation and risk reduction, climate adaptation





Advances over Past Decade

People

- Scientific research and products are centered on people and what they need.
- The diversity of science experiences, skills, roles is valued and powerful.
- Intentional (and sometimes unlikely) collaborations are addressing complex problems along coastlines.



This group This meeting

Sealevel ...

Welcome to the U.S. Coastal Research Program

A National coastal effort to coordinate Federal activities, strengthen academic programs, & address coastal community needs

JOIN

Interagency Task Force on Sea Level Change

See Level 101 National Sea Level Egitting Recording Name & Contra Stand Vision

NOAA's Coastal Coupling

Community of Practice

For Official Use Only SOST COASTAL RESILIENCE WORKSHOP: FINDINGS AND RECOMMENDATIONS

A Report by the SURCOMMITTEE ON OCEAN SCIENCE AND TECHNOLOG

COMMITTEE ON ENVIRONMENT

NATIONAL SCIENCE & TECHNOLOGY COUNCIL

Jamiary 2022

Changing? The Earth's seasure rising at a higher rate than they have in the part This change is a direct result of a changing climate. Here is how we

Why is Sea Level

Causes Global vs. Registral Change Hoor We Measure Understanding Future Sea Local Jeparts Solutions

new and who

Challenges Currently Facing

- Understanding, modeling, and forecasting coastal landscape change[^] in response to climate change, natural processes, and management actions across diverse landscapes (national scale*) and communities (local resolution[#]) remains elusive.
- Demand for information is exploding, so too are services/tools/products offering solutions. We have a responsibility to not overwhelm and/or confuse people.

• People.

[^] Coastal change is complicated! A mix of scales, sediment types, natural processes, human intervention, feedbacks ...

* National is complicated! A mix of sandy barriers, rocky cliffs, cobble beaches, coralfronted islands, wetlands, permafrost, bluffs, ice...

> [#] Local is complicated! A mix of people, resources, environments, needs, land use/type, priorities ...



St Petersburg, 2023 Idalia passes offshore





Dr. Benjamin Hamlington

Research Scientist in Climate Change, Jet Propulsion Laboratory, National Aeronautics and Space Administration

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH



National Aeronautics and Space Administration

Jet Propulsion Laboratory California Institute of Technology Pasadena, California

Summary of Research Priorities from Federal Agencies*

Ben Hamlington

Research Scientist NASA Jet Propulsion Laboratory Team Lead NASA Sea Level Change Team

USCRP Decadal Visioning Workshop June 11, 2024

NASA Sea Level Change Team (N-SLCT)

First N-SLCT started in 2014, with fourth iteration of N-SLCT beginning in 2024

 90+ U.S.-based scientists across federal agencies and academia

Objectives:

- Deepen our knowledge of the Earth system interactions that influence relative sea level change, with emphasis on the physical processes that are poorly known or not included in the consensus climate knowledge;
- Deliver improved estimates of future sea level effects that integrate across the Earth system processes and span relevant temporal and spatial scales
- Contribute to the National and global basicscience foundations that support sea level and coastal resilience decision-making.

An interdisciplinary team to tackle an interdisciplinary problem



Leadership Structure of N-SLCT



Knowledge Value Chain For Climate Services (FTAC, 2023)

N-SLCT #1: 2014-2017

N-SLCT #2: 2017-2020

N-SLCT #3: 2020-2024

N-SLCT #4: 2024-2028



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JPL/Caltech BUSINESS DISCRETE – Not for public distribution

What research advances have been made in the last 10 years? What is the implication or applicability of that research?



- Satellite observations in the coastal zone have increased dramatically over the past decade.
- Includes both continuity of existing missions and launch of satellites with new technology.

Global partnership on Earth observing, satellite and climate science



What are the thorniest research questions you are confronting and why are they challenging?

- Integration across physical processes, timescales, and spatial scales to assess and predict impacts.
- Leveraging observations to improving modeling of physical processes important in the coastal zone.
- "Balancing" fundamental research with the push to be responsive to needs of stakeholders.
- Shortening time from formulation to launch to be responsive to needs in the coastal zone.
- What observations are the highest priority in the coastal zone? Why? → 2027 Decadal Survey is on the horizon.



Dr. Julie Rosati

Technical Director Civil Works Research and Development, U.S. Army Corps of Engineers and Co- Co-Executive Director, USCRP

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH

USACE Summary of Coastal Research Priorities

Future of Coastal Processes Research Workshop U.S. Coastal Research Program June 11-13, 2024

Julie Dean Rosati, PhD, PE

Lead Technical Director Flood Risk Management TD Civil Works Research & Development Area Coastal & Hydraulics Laboratory Engineer Research and Development Center U.S. Army Corps of Engineers













USACE R&D STRATEGY Scan the QR Code to download a copy of the USACE R&D Strategy and other USACE R&D communication products



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USACE Coastal ActivitiesKey MissionsNavigationFirst Civil Works Mission

Reduce loss of life & property to flood and storm hazards Provide knowledge, technology, and resilient solutions with quantified, equitable benefits

National security, commerce,

recreation

Credit: T. Burroughs. USACEHO

70%

Beneficial

Use by

2030

عاليه کار

631 NAV 400 CSRM 57 ENV

Coastal Systems Portfolio Initiative https://cspi.usace.army.mil/

Environmental

Ecosystem Restoration Sustainability Natural Resource Management Regulation & Regulatory

Nature-Based Solutions

Quantify Engineering Functions

Measure Impact The Corps Environment 2024

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Coastal R&D Advancements in Past Decade Selected Examples

Data

Availability & Integration of National Coastal Data

Detailed Pre-Storm h revisit rate satellite magery for national scale coastal project monitoring

On-site Rapid

Numerical Models for Decision Support

Advanced numerical models, AI/ML data and methods for decision-support

(MORPHOS PBL)

WAM Model

Wind & Pressure + Waves + Surge

+ Morphology



Morphodynamic Model Development Wind Transformatic Wave Transformation Example Capabilities and retreat Long-term wind-driver time arouth Subaqueous Transpor influence of cost



Nature-Based Solutions

Demonstrating and documenting viability of NBS



SMS

Interface

'ESMF Compliant

SHOR

ADCIRC'

TWAN

CSTORM Couple

EWN[®] Toolkit for **CSTORM**

NBS

US ARMY CORPS OF ENGINEERS • ENGINEER RESEARCH AND DEVELOPMENT CENTER • // UNCLASSIFIED // • Jun 2024 • 114 Compound Flooding

Storm Surge + Waves + Riverine + Groundwater + Precipitation + Stormwater Drainage





Coastal R&D Gaps

Selected Examples

Dredging Innovations, Placement & Sediment Transport

Cohesive + non-cohesive sediment transport morphology change: storm, seasonal, yearly, decadal scales



Adaptive Strategies

Define / Monitor Tipping points Plan for Adaptation a priori



Credit: J. Wozencraft, USACE JABLTCX

Nature-Based Solutions

Quantifying life-cycle engineering performance, value and impact



Coastal USACE Commander's Decadal Challenges (BCER)

		1114	CLASSINED						
Coastal Commanders' Decadal Challenges	URD	MVD	NAD	NWD	POD	SPD	SAD	5WD	Total
Assessment of Value/Impact of NNBF	4	7	8	7	1	n		n	16
All Things Sediment	2	0	5	- 3	T.	2	а	0	14
More Holistic Assessment of Study Areas and Surround (Watershed/region)	а	a	4	÷i	2	Ť	а	0	14
Strategies for Addressing Decreasing Sustainability of Coastal Infrastructure	2	1	4	4	1	1	2	1	13
Compound Flooding Modeling and Assessment Capabilities	2	1	1	:1	(1)	1	5	0	12
Incorporating Adaptive Strategies in Project Planning (methods & policy)	0	1	2	2	1	2	1	1	10
Workforce: Supporting a large & talented enough workforce to meet CSRM demand	Ŧ	0	2	0	2	2	3	0	10
Partnering with Non-Federal Sponsors (increased authority)	0	0	2	2	1	1	т	1	8
Benefits: Methods to Assess Other Social Effects and Environment	Ó	n	3	0	Ť	n	٥	n	2
Districts on popular and division	7	1		2	2	2	E	1	1.1

Board on Coastal Engineering Research March 2024, Image Credit: B. Charbonneau

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Keys to USACE Coastal Successes



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Decadal Visioning Workshop THE FUTURE OF COASTAL PROCESSES RESEARCH

Panel Discussion: Summary of Research Priorities from Academia



Summary of Research Priorities from Academia

MODERATOR

- Session **Objective: Provide an** overview of the immediate and long-term research foci for academia, including major challenges
- Jack Puleo, Professor and Chair of the Department of Civil and Environmental Engineering, University of Delaware

PANELISTS

- Dr. Peter Ruggiero, Professor, College of Earth, Oceanic, and Atmospheric Sciences, Director of the Cascadia Coastlines and Peoples Hazards Research Hub, Oregon State University
- O Dr. Christine Angelini, Director of Coastal Solutions, University of Florida
- Dr. Ryan Mieras, Assistant Professor of Coastal Engineering, University of North Carolina Wilmington
- Dr. Mara Orescanin, Associate Professor, Director for the Consortium for Robotics and Unmanned Systems Education and Research, Naval Postgraduate School



Dr. Peter Ruggiero,

Professor, College of Earth, Oceanic, and Atmospheric Sciences, Director of the Cascadia Coastlines and Peoples Hazards Research Hub, Oregon State University

Is there a bulldozer in your model??



JGR Earth Surface

COMMENTARY 10.1029/2018JF004957 Is There a Bulldozer in your Model? Eli D. Lazarus¹ and Evan B. Goldstein² "We suggest that active, responsive human processes that affect sediment transport during major storm events be included in evolving efforts to model geomorphic change."

Envisioning Resilient Coastal Futures via Exploring Alternative Coupled Natural Human Scenarios and Adaptation Pathways



Peter Ruggiero Oregon State University



Coastal Societal Need or Challenge that we are Making Progress on:

Long-term coastal evolution due to natural and anthropogenic processes - Elko et al., 2015



'What drives human interventions, how do mitigation strategies coupled with natural processes, impact system dynamics and long-term sustainability, and how might these factors evolve as physical, economic, and policy forcings change?'

Envisioning Resilient Coastal Futures via Exploring Alternative Coupled Natural Human Scenarios and Adaptation Pathways

JOURNAL OF GEOPHYSICAL RESEARCH, VOL.

Coupled barrier island–resort model: 1. Emergent instabilities induced by strong human-landscape interactions D. E. McNamara^{1,2} and B. T. Werner¹

Received 28 May 2007; revised 1 September 2007; accepted 12 December 2007



- Resorts and barrier islands are dynamically coupled through storm damage and beach erosion, and measures taken to prevent or mitigate them (e.g., beach nourishment).
- Results suggest that coastal areas that have recently instituted protection measures eventually will experience a widespread upsurge in damage if these practices are sustained, even in the absence of climate-change induced increased storminess.

Envisioning Resilient Coastal Futures via Exploring Alternative Coupled Natural Human Scenarios and Adaptation Pathways

Trajectories of Change and Alternative Futures



Exploring the impacts of climate and policy changes on coastal community resilience: Simulating alternative future scenarios

Alexis K. Mills", John P. Bolte", Peter Ruggiero", Katherine A. Serafin", Eva Lipiec", Patrick Corcoran", John Stevenson", Chad Zanocco", Denise Lach"

Envisioning Resilient Coastal Futures via Exploring Alternative Coupled Natural Human Scenarios and Adaptation Pathways





Mills et al., 2019, 2021 Leung, 2024



Human drivers cause greater variation in landscape metrics than natural drivers





Envisioning Resilient Coastal Futures via Exploring Alternative Coupled Natural Human Scenarios and Adaptation Pathways

Limited Beach Access

Unlimited Beach Access

100

90

80

70

60

50

40

30

20

10

2010

2025

2040

Percent of Shoreline Hardened

Shoreline Armoring vs. Beach Accessibility Adaptation Tradeoffs Percent Armored (Rockaway Beach)

---- Status Quo

---- ReAlign

---- Hybrid

2070

2085

2055

Time

---- Hold The Line

---- Laissez-Faire

Beach Accessibility (Rockaway Beach)



water

Quantifying Uncertainty in Exposure to Coastal Hazards Associated with both Climate Change and Adaptation Strategies: A U.S. Pacific Northwest Alternative Coastal **Futures Analysis**

Alexia K. Milla 9, Peter Russiero 9, John P. Bolle 3, Katherine A. Seralio 9 and Eva Lipier

Mills et al., 2019, 2021

Earth's Future

RESEARCH ARTICLE 10.1029/2023EF003672

The Future of Developed Barrier Systems: 1. Pathways **Toward Uninhabitability, Drowning, and Rebound**

K. A. Anarde^{1,2} , L. J. Moore¹ , A. B. Murray³ , and I. R. B. Reeves^{1,4}

- Landscape changes threaten development, and in response, humans employ defensive measures that physically modify barrier geometry to reduce relatively short-term risk.
- These measures include the • construction of large dunes, emplacement of beach nourishment, and removal of washover.

1.4



Earth's Future

RESEARCH ARTICLE 10.1029/2023EF003672 The Future of Developed Barrier Systems: 1. Pathways Toward Uninhabitability, Drowning, and Rebound

Special Section:

K. A. Anarde^{1,2} , L. J. Moore¹, A. B. Murray³, and I. R. B. Reeves^{1,4}

- Simulations show that, over decades to centuries, measures to protect roadways and communities alter the physical characteristics of barrier systems in ways that ultimately limit their habitability.
- The pathway toward uninhabitability (via roadway drowning or community narrowing) depends largely on dune management—because building dunes blocks overwash delivery to the barrier interior—and on initial conditions.



Environmental Research Communications

LETTER

Generic adaptation pathways for coastal archetypes under uncertain sea-level rise

Marjolijn Haasnoot^{1,1}, Sally Brown^{3,4}, Paolo Scussolini³, Jose A Jimenez⁶, Athanasios T Vafeidis⁷, and Robert J Nicholls³



What's the problem?

- Uncertainty about the future complicates and paralyzes decision making
- Present approach to adapting to sea-level rise (SLR) is often 'wait and see' due to uncertainty in rate and magnitude

What's the solution?

Adaption pathways

- sequences of linked actions that can be implemented as conditions change
- switch to another action when no longer performs acceptably (adaptation tipping point)
- support decision making under uncertainty in three ways:
 - overcome policy paralysis by creating manageable steps
 - 2. explicit visualization of alternative pathways
 - 3. what decisions and when decisions are needed by identifying policy objectives

Final Thoughts on Coupled Natural Human Coastal Change:



 How we manage our coast can potentially have as great of an impact as climate change (at least over time scales of decades).

<u>convergent Research and deep engagement</u> with decision makers and coastal community members can inform emergency management (bulldozers) and land use planning (adaptation pathways) to increase resilience.

- Crosses disciplinary and sectoral boundaries
- Supports common goal setting
- Develops integrated knowledge for science and society
- Creates new knowledge paradigms
- ♦ Makes research more relevant, usable, credible
- Enables network building, trust building
- ♦ Increases adaptation literacy, willingness to adapt





Summary of Research Priorities from Academia

Dr. Christine Angelini,

Director of Coastal Solutions, University of Florida

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH

AN ACADEMIC, COMMUNITY ECOLOGIST'S PERSPECTIVE ON PROGRESS & OPPORTUNITIES IN COASTAL RESEARCH





CHRISTINE ANGELINI C.ANGELINI@UFL.EDU

UF Herbert Wertheim College of Engineering UNIVERSITY of FLORIDA

Major Advance in the last 10 Years:

Plants + Animals Can Modify Geomorphic Evolution of our Coasts





Reijers et al. 2019 A Levy expansion strategy optimizes early dune building by beach grasses. Nature Communications 10: 2656.





Dally et al. Shell Hash: a nature-based solution for beachfront coastal resilience?

Consolvo et al. 2022. Effects of shell hash on friction angels of surficial seafloor sediments. J. Waterways,Port, Coastal and Ocean Engineering 148 (5).



Major Advance in the last 10 Years:

Plants + Animals Can Modify Geomorphic Evolution of our Coasts







Major Advances Needed the next 10 Years:

Science to Support More Holistic, Ambitious and Smart Management



2. Science (+ policy) for **Bigger**, **Faster**, **Stronger** Managed Coastal Systems

3. Making the robust case for when, where and how to engage in coastal realignment





USCRP





c.angelini@ufl.edu



Summary of Research Priorities from Academia

Dr. Ryan Mieras,

Assistant Professor of Coastal Engineering, University of North Carolina Wilmington

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH

USCRP DECADAL VISIONING WORKSHOP ST. PETERSBURG, FL

11 JUNE 2024

RYAN S. MIERAS

MIERASR@UNCW.EDU





COASTAL ENGINEERING

Coastal societal need/challenge we are making progress in addressing in the last 10 years?

Implementation/integration of consumer electronics (e.g., Raspberry Pi, Arduino) into <u>low-cost</u> coastal instrumentation and sensing platforms, particularly for extreme events (e.g., storms, high tide flooding) and/or rapid-response deployments

Examples of Recent Low-cost Instrumentation / Remote Sensing Platforms

- Line-scanning, Low-Cost (LLC) Lidar (O'Connor et al., 2022; van Weichen et al., 2024)
- Blickfeld Cube1 Lidar (Mieras et al., 2023)
- Sunny day flooding sensors (Gold et al., 2023)
- OpenOBS (Eidam et al., 2022)

- Low-cost wave gauges (Temple et al., 2020)
- microSWIFT wave buoys (Thomson et al., 2023)
- Instagrain Grain size Camera (Goldstein et al., 2022)

Line-scanning, Low-Cost (LLC) LiDAR System – Improved understanding of dune collision and erosion dynamics under active storm forcing

O'Connor et al. (2022); van Weichen et al. (2024)



Continuous beach morphology observations under active storm forcing using compact 3D LiDAR scanners **Mieras et al. (2023)**





Major advance needed in the next 10 years?

Operationalization & integration of real-time, low(<u>er</u>)cost sensing platforms into coastal/ nearshore forecasting



Image Source: https://www.merchantsfleet.com/wp-content/uploads/2020/06/what-is-last-mile-delivery.jpg

Major advance needed in the next 10 years?

Operationalization & integration of real-time, low(<u>er</u>)cost sensing platforms into coastal/ nearshore forecasting







FIG. 1. (a) The Spoondrift Spotter wave measuring device, and (b) the Spotter web-based data dashboard.

Raghukumar et al. (2019)

www.hohonu.io



Dr. Mara Orescanin,

Associate Professor, Director for the Consortium for Robotics and Unmanned Systems Education and Research, Naval Postgraduate School

Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH

US COASTAL RESEARCH PROGRAM

Observing and Modeling Morphological Change

We have come a long way in understanding sediment, but there are still so many unanswered questions!



Observing and Modeling Morphological Change

Why do we care about sediment?

- Coastal erosion/retreat from sea level rise
- Economic benefits of beach tourism
- Natural protection from extreme events = a buffer zone

Some Key Topics (Approximately!)

- Extreme Events
 - Hurricanes/storm surge
 - Coastal flooding
 - Beach-dune interactions
- Infrastructure/Beach interactions
 - Engineering structures
 - Engineering with Nature
 - Beach/nearshore Nourishment
- Climate Change
 - Sea level rise
 - Increased frequency of extreme events
 - Long term morphological trends









Observing and Modeling Morphological Change

(SOME) Achievements from 2014-2024

- Observations:
 - Increased resolution
 - Novel platforms/instrumentation
 - Increased coordination
- Numerical modeling advancements:
 - Coupling hydrodynamics to morphodynamics
 - Novel modeling to incorporate wave processes
 - Including vegetation
 - Wave overtopping/breaching
- Data Assimilation
 - Model improvement through integration of observation:
- Machine Learning
 - Object detection, classification, physics informed neural networks





Observing and Modeling USCRP Morphological Change

Challenges for the Next Decade:

- The Data Decade! Better coordination of data products, model outputs, etc
 - More funding/recognition/investment for sustained ٠ observations to observe climate trends
 - Better abilities to share data between locations/disciplines/entities
- Continue quantifying **biological/chemical influences on** sediment transport
 - Are there universal generalizations that can be made globally?
 - Integration into numerical modeling •
- Integration of **fast/small scales** into morphological modeling
 - Models have difficulty with scarps/breaches/rapid • channel erosion
 - Requires test cases, which requires data





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Wrap up of Day 1

Linda Manning, President, The Council Oak LLC (Facilitator)




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