98th

Board on Coastal Engineering

Research Meeting

September 13-15, 2022

Coastal Community Resilience Research Needs in Cold Regions under a Changing Climate

98th Board on Coastal Engineering Research
Anchorage, AK

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Meeting Concept: *Identify coastal research needs associated with coastal communities in cold regions including issues of climate change, social equity, and environmental justice.*

MEMBERSHIP
U.S. ARMY BOARD ON COASTAL ENGINEERING RESEARCH

MILITARY MEMBERS

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DESIGNATED FEDERAL OFFICER

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MG William (Butch) H. Graham

MG Graham assumed responsibility as the Deputy Commanding General for Civil and Emergency Operations, U.S. Army Corps of Engineers on July 20, 2020.

He received his commission from the Reserve Officer Training Corps in 1989 from the University of Pittsburgh. He is an Engineer Officer who has commanded Soldiers at all levels up to division. His commands include: A Company, 1st Engineer Battalion, 1st Brigade, 1st Infantry Division (Mechanized), Fort Riley, Kansas; 40th Engineer Battalion, 2d Brigade, 1st Armored Division, United States Army Europe and Seventh Army, Germany, and OPERATION IRAQI FREEDOM, Iraq; United States Army Corps of Engineers Pittsburgh District, Pittsburgh, Pennsylvania; and North Atlantic Division, United States Army Corps of Engineers, Brooklyn, New York.

Previous assignments also include: Platoon Leader, B Company and later Executive Officer, A Company, 23d Engineer Battalion, 1st Brigade, 3d Armored Division, United States Army Europe and Seventh Army, Germany, and in support of OPERATION DESERT SHIELD/DESERT STORM, Saudi Arabia; Assistant Operations Officer and later Assistant Division Engineer, Engineer Brigade, 1st Infantry Division (Mechanized), Fort Riley, Kansas; Battalion Operations Officer, 1st Engineer Battalion, 1st Brigade, 1st Infantry Division (Mechanized), Fort Riley, Kansas; Operations Officer and later Deputy Commander, United States Army Corps of Engineers Pittsburgh District, Pittsburgh, Pennsylvania; Plans and Operations Officer, Division Engineer Section, G-3, 4th Infantry Division, Fort Hood, Texas; Executive Officer, 588th Engineer Battalion, 4th Infantry Division (Mechanized), Fort Hood, Texas, and in support of OPERATION IRAQI FREEDOM, Iraq; Executive Officer, Engineer Brigade, 1st Armored Division, United States Army Europe and Seventh Army, Germany; Division Engineer, 1st Armored Division, United States Army Europe and Seventh Army, Germany, and in support of OPERATION IRAQI FREEDOM, Iraq; Director, Coalition-Joint Engineering Directorate, Combined Security Transition Command-Afghanistan, and in support of OPERATION ENDURING FREEDOM, Afghanistan; Chief of Staff, United States Army Corps of Engineers, Washington, DC; and Director, Task Force Enhanced Security Zone, OPERATION RESOLUTE SUPPORT, Afghanistan.

Graham is a graduate of the Senior Service College Fellowship at Massachusetts Institute of Technology, the Joint and Combined Warfighting School, and United States Army Command and General Staff College. He holds a Bachelor of Science in Mechanical Engineering from the University of Pittsburgh and a Master of Science in Environmental

Engineering from the University of Kansas. His awards and decorations include the Distinguished Service Medal, Legion of Merit (with one bronze oak leaf cluster), Bronze Star Medal (with four bronze oak leaf clusters), Meritorious Service Medal (with three bronze oak leaf clusters), Army Commendation Medal (with one bronze oak leaf cluster), Army Achievement Medal (with one bronze oak leaf cluster), and the Combat Action Badge.

engineering from the University of Pittsburgh and a Master of Science in environmental engineering from the University of Kansas.

His awards and decorations include the Distinguished Service Medal, Legion of Merit (with 1 Bronze Oak Leaf Cluster), Bronze Star Medal (with 4 Bronze Oak Leaf Cluster), Meritorious Service Medal (with 3 Bronze Oak Leaf Clusters), Army Commendation Medal (with 1 Bronze Oak Leaf Cluster), Army Achievement Medal (with 1 Bronze Oak Leaf Cluster), and the Combat Action Badge.

BG Daniel H. Hibner

Brigadier General Daniel H. Hibner commissioned in 1993 from Kemper Military College. During his 29 years as a commissioned officer, he served in numerous command and staff positions in the United States and the Middle East and currently serves as the commander of the U.S. Army Corps of Engineers, South Atlantic Division. Brigadier General Hibner joined the South Atlantic Division from Fort Leonard Wood, where he served as the Commandant of the U.S. Army Engineer School. Prior to his assignment as Commandant, Brigadier General Hibner commanded the U.S. Army Corps of Engineers Savanah District from 2018 to 2021. He has held various leadership positions from platoon to brigade; and has deployed once in support of Operation Joint Guardian in Kosovo, four combat tours to Iraq during Operation Iraqi Freedom, and one deployment to Afghanistan in support of Operation Enduring Freedom.

Other previous assignments include Levant Branch Chief for the Plans and Policy Directorate, U.S. Central Command; participation in the Joint Advanced Warfighting School (JAWS) Senior Service College, Norfolk, Virginia; Chief of Plans for the 4th Infantry Division; Commander of the 4th Engineer Battalion during Operation Enduring Freedom; Deputy Chief of Staff for the 4th Infantry Division; Operations Officer for the 3rd Brigade Combat Team, 4th Infantry Division; Operations Officer for 1-8 Infantry Combined Arms Battalion, 3rd Brigade Combat Team; Plans Officer for the 4th Infantry Division in Iraq; completion of Command and General Staff College and the Advanced Military Studies Program (SAMS), Emergency Operations Center Chief, District Executive Officer, Project Engineer, Construction Manager, and the Fallujah Resident Office Officer in Charge of Reconstruction for the New Orleans District; Assistant Brigade Engineer and Battalion Adjutant during Operation Joint Guardian in Kosovo; Company Commander of Alpha Company, in 11th Engineer Battalion, 3rd Infantry Division which included a deployment to Iraq for the invasion in January 2003; and Platoon Leader and Battalion Maintenance Officer in the 65th Engineer Battalion.

Brigadier General Hibner served in the U.S. Army Reserves as an infantry officer for three years before transitioning to active duty as an engineer officer. He holds a Bachelor of Science in Construction Management from Purdue University, a Master of Science in Engineering Management from the Missouri University of Science and Technology, a Master of Military Arts and Science from the School of Advanced Military Studies, a Master of Science in Campaign Planning and Strategy from the National Defense University and is a Project Management Professional. His awards and decorations include the Silver Star, Defense Superior Service Medal, Legion of Merit, Bronze Star Medal (with three oak leaf clusters),

Purple Heart, Meritorious Service Medal (with three oak leaf clusters), Joint Service Commendation Medal, Army Commendation Medal (with three oak leaf clusters), Army Achievement Medal, Combat Action Badge, Ranger Tab, Expert Infantryman Badge, Basic Parachutist Badge, Air Assault Badge, and is also the recipient of the Army Engineer Association’s Bronze and Silver Order of the de Fleury Medal.

COL (P) Antoinette R. Gant

Col. (Promotable) Antoinette R. Gant assumed duties as the Commander and Division Engineer of South Pacific Division (SPD), U.S. Army Corps of Engineers on July 9, 2021. Established in 1888 and headquartered in San Francisco, SPD is one of nine USACE regional commands. The region encompasses all or part of ten states with four operating districts headquartered in Albuquerque, Los Angeles, Sacramento, and San Francisco. As the SPD Commander and Division Engineer, she is responsible for leading a workforce of more than 2500 military and civilians, overseeing hundreds of water resource development, military, and interagency design and construction projects valued at more than $16 billion in support of our communities, our Nation, and our warfighters.

A native of Port Gibson, Mississippi, Gant graduated from Prairie View A&M University in Texas as a Distinguished Military Graduate with a Bachelor of Science in Civil Engineering and a commission in the Engineer Regiment. She holds a Master of Science in Engineer Management from Missouri University of Science and Technology, Rolla, Missouri, and a Master of Science in national resource strategy from the Dwight D. Eisenhower School, National Defense University, Washington, DC. She is a certified Project Management Professional.

Gant has served in a variety of command and staff positions for engineering units stateside and abroad. Prior to South Pacific Division, Gant was commander of the US. Army Corps of Engineers South Pacific Border District from July 2020 to June 2021. Gant previously served as the combined joint engineer for the Resolute Support and OFS headquarters, Kabul, Afghanistan, military assistant to the Assistant Secretary of the Army-Civil Works, Washington, DC, chief of operations for the engineer directorate, US Army South, Fort Sam Houston, San Antonio, Texas, and the director for the Directorates of Public Works and Installation Support, ASG-Kuwait. She also served as the Executive Officer for Special Troops Battalion and Brigade Engineer, 4BCT, 4th Infantry Division, Fort Carson, Colorado. Other USACE assignments include Commander for both the Albuquerque and Louisville Districts. She has deployed in support of Operation Iraqi Freedom, Operation Enduring Freedom, and Operation Freedom Sentinel.

A strong advocate for STEM, Gant has worked to develop partnerships with agencies and organizations to promote science, technology, engineering, and math initiatives. She has received several national and community awards, to include 2021 Black Engineer of the Year Conference Awards (BEYA) Army Stars and Stripes Award recipient, the 2020 Women of Color Career Achievement in Government Award, the YWCA Women on the Move Award, Women of

Influence in Government by Albuquerque Business First, BEYA Special Recognition Award, and Alpha Kappa Alpha Sorority, Inc., South Central Region Visionary Leader, and Global Leader Awards. Gant's military awards and decorations include the Legion of Merit (2), Defense Meritorious Service Medal, Bronze Star Medal, and Meritorious Service Medal (7). She is also a recipient of the Army Staff Identification Badge, Recruiter Badge, and the Army Engineer Association Silver de Fleury Medal.

Col. Gant is married to Leonard Gant of Kansas City, MO, who is a Middle School Math Educator. They have two children, Lauryn, 24, a third-year doctoral veterinary medicine student at Tuskegee University and Leonard II, 18 and a sophomore at Florida A&M University studying Business Administration with a concentration in Supply Chain Management.

COL John P. Lloyd

Col. John P. Lloyd joined the North Atlantic Division as its Commander and Division Engineer June 24, 2022. Previously he was assigned to Headquarters, U.S. Army Corps of Engineers, where he served as the Chief of Staff since July 20, 2020. As USACE Chief of Staff, Lloyd managed the headquarters staff of a three-star direct reporting unit comprised of more than 36,000 Soldiers and civilians with an annual portfolio of nearly $84 billion. He led the organization through many events decisive to command success, most notably, synchronizing the USACE response to COVID-19 efforts across the enterprise including resource management, personnel resources, logistical support, and subject matter expertise resulting in a coordinated USACE plan and timely response to the needs of state and local governments. He guided the staff through the development, publication, and modification of budgetary guidance to address challenges in a fiscally constrained environment and coordinated Army reporting requirements with the Office of the Chief of Engineers. Lloyd led the development of the Authorization Realignment Policy to effect strategic planning for the future workforce, served as a member of the U.S. Army's People First Task Force, and as a Cohesion Assessment Team Leader.

Prior to his assignment as USACE Chief of Staff, he served as Command Engineer, U.S. Forces Korea, and United Nations Command. As Command Engineer, he oversaw a multi-billion-dollar host nation construction program and managed the environmental program for the USFK commander. He also coordinated and synchronized mine clearing operations within the Demilitarized Zone. From July 2016 to July 2018, Lloyd served as the Commander of the USACE Pittsburgh District, and during this time, acted as Task Force Commander in the U.S. Virgin Islands and Puerto Rico. In this role, he was responsible for overseeing the USACE response to hurricanes Irma and Maria and a subsequent power grid restoration involving more than 200 enterprise employees and 5,000 utility workers. Lloyd has served in a variety of military assignments spanning his career of more than 27 years. Some of his additional assignments include Strategic Planner, 18th Airborne Corps, Fort Bragg, N.C., an assignment that included a deployment to Iraq; Combat Engineer Trainer, Fort Irwin, Calif.; Aide-de-Camp to the Deputy Commanding General, 18th Airborne Corps; Battalion Commander, 19th Engineer Battalion, Fort Knox, Ky.; and Army Fellow assigned to the Asia Pacific Center for Security Studies in Honolulu, Hawaii.

A native of Lockport, N.Y., Lloyd earned his commission May 1995 through the Reserve Officer Training Corps at Cameron University, Lawton, Okla. Along with his bachelor's degree, he has earned a master's degree in Joint Campaign and Strategic Planning from the National Defense University and graduated from the Canadian Forces College where he studied National Security Policy. Lloyd holds a certification in Construction Project Management from Columbia University in New York, a certificate in Advanced Security Cooperation from the Asia Pacific Center, and is a graduate of the Joint Advanced Warfighting School, Norfolk, Va. Lloyd's military awards and decorations include the Legion of Merit, Bronze Star Medal, Defense Meritorious Service Medal, Army Meritorious Service Medal, Army Commendation Medal, the Joint Service Achievement Medal, the Army Achievement Medal, the National Defense Service Medal, and the Bronze Order of the de Fleury Medal. Lloyd is a graduate of the U.S. Army Sapper School, Air Assault School, Pathfinder School, and is a senior rated jumpmaster.

Nicole Elko, Ph.D.

Dr. Elko is the Science Director for the American Shore and Beach Preservation Association (ASBPA), Executive Director of the South Carolina Beach Advocates, an Executive Director of the U.S. Coastal Research Program (USCRP), and President of Elko Coastal Consulting based in Folly Beach, SC. She received her Bachelor of Science degree in environmental resource management with a minor in marine science from Pennsylvania State University in 1996 and her Master of Science degree from the University of South Florida in geology in 1999. She received her Ph.D. degree in geology from the University of South Florida in 2006 after working with the United States Geological Survey (USGS) Coastal Marine Geology Program, St. Petersburg, and while serving as the coastal coordinator for Pinellas County, FL.

Dr. Elko has 20 years of experience in the coastal management field and has managed or assisted with more than 20 beach preservation projects along the U.S. Southeast and Gulf coasts. She has experience working with local communities and various state and Federal agencies to communicate societally-relevant coastal management challenges. Through her advocacy work, she aims to help translate these coastal management challenges into research needs and science questions for the nearshore research community to address. She has co-authored a one book on coastal management and 16 journal publications, including The Future of Nearshore Processes Research, which is a seminal report that provides a research vision developed by the nearshore community.

At ASBPA, Dr. Elko helps provide science-based guidance to Congress, federal and state agencies, and local communities on national coastal resilience challenges. She is also a founder of the grass-roots USCRP, which was a CERB initiative. USCRP is a collaboration of researchers from Federal agencies, academia, & NGOs that aims to better coordinate coastal research, enhance funding sources, & strengthen academic programs to build a skilled coastal workforce.

At the state level, Dr. Elko serves on Governor McMaster’s Floodwater Commission. She also teaches a Beaches 101 training course to regulators and elected officials in the Carolinas. In her role as Executive Director of the South Carolina Beach advocates, she serves a board of directors made up of the mayors and administrators of the state’s beach communities. Her knowledge of science and policy supports the group’s mission to educate the public, governmental authorities, and elected officials as to the environmental, economic, and societal impact of South Carolina's beaches and inlets. At the local level, her business provides

coastal research and advocacy services, including hydrographic surveying and beach monitoring, sea level rise adaptation, and beach/dune and marshfront management planning.

In her free time, she enjoys surfing with her family and has recently taken on the role of Director of the Folly Beach Wahine Classic, which is one of the southeast's premier surfing events and South Carolina's only the only all-female surf contest.

H. Tuba Ozkan-Haller, Ph.D.

Dr. Tuba Özkan-Haller is the Interim Dean of Oregon State University ‘s College of Earth, Ocean, and Atmospheric Sciences. and Professor in the Colleges of Earth, Ocean, and Atmospheric Sciences and Engineering. CEOAS is the center of Earth sciences research and academic programs at Oregon State. Its oceanography program is ranked no. 3 in the world. Özkan-Haller previously served as Associate Vice President for Research Administration and Development in Oregon State University’s Research Office. She previously also served as Associate Dean for Research and Faculty Advancement in the College of Earth, Ocean, and Atmospheric Sciences. As a faculty member, she focuses on the use of numerical, field, laboratory, and analytical approaches to arrive at a predictive understanding of waves, circulation, and beach change in the nearshore ocean, including the continental shelf, the surf zone, inlets, and estuaries. The results of this work are being applied to navigational planning, for the development and design of wave energy conversion devices, and for forecasting of beach-goer hazards.

She has also extensively engaged in work to increase diversity and inclusivity in academia and was a co-Principal Investigator for OSU’s ADVANCE grant from the National Science Foundation aimed at increasing the participation of women and other under-represented groups within faculty in STEM disciplines. She has given various invited talks on this subject, including a plenary talk at the 2018 Goldschmidt Conference of the Geochemical Society and the European Association of Geochemistry. Özkan-Haller is passionate about communicating science to the public and has appeared in numerous documentaries produced by the History Channel, the National Geographic Channel, and Oregon Public Broadcasting, and was quoted in various news segments and newspaper articles, most recently about sneaker wave fatalities along the Pacific Northwest Coastline of the US. She has also authored various opinion pieces. Özkan-Haller is the recipient of the Office of Naval Research Young Investigator Award, the Outstanding Faculty Member Award at the University of Michigan as well as the Pattullo Award for Excellence in Teaching Award and Woman of Excellence Award at OSU. She holds a B.S. in Civil Engineering from Boğaziçi University in Istanbul, Turkey, and a M.C.E. and Ph.D. in Civil Engineering from the University of Delaware.

Lewis Ed Link, Ph.D.

Dr. Lewis E Link is currently a Senior Research Engineer, Department of Civil and Environmental Engineering, University of Maryland. His emphasis in teaching and research has been on natural hazard risk and resilience assessment and mitigation. He currently serves as an advisor to the Governor of Maryland as a member of the Maryland Coast Smart Council and to the Chief of Engineers, U S Army Corps of Engineers through the Corps Coastal Engineering Research Board. He led the post-Katrina analysis of New Orleans and Vicinity as Director of the Interagency Performance Evaluation Task Force and participated as a member of the International Advisory Commission, Netherlands, to develop a long-term strategy for adaptation to sea level rise and climate change.

Dr. Link is a contributing Editor for The Military Engineer and has assisted in the development of an enterprise-wide strategy for accelerating innovation and a new strategy for Civil Works Research and Development for the Corps of Engineers. He previously served as a Senior Executive in the Department of Army as Director of Research and Development and Chief Scientific Advisor, U. S. Army Corps of Engineers. He is a member of the National Academy of Construction and has received the Army Engineer Associations Silver and Gold DeFleury Medals as well as the Engineering News Records Award of Excellence.

Julie Dean Rosati, Ph.D., PE

Dr. Rosati is the Lead Technical Director for Civil Works R&D at the U.S. Army Corps of Engineers, Engineer Research Development Center in the Coastal & Hydraulics Laboratory. In this role, she oversees basic and applied research involving coastal, watershed, navigation, and environmental assessments over short-term storm hazards and long-term evolution. She also serves as Technical Director for the Flood & Coastal Risk Management R&D mission area.

Dr. Rosati has published more than 20 peer-reviewed journal articles, two book chapters, and mentored junior researchers in their professional growth by guiding development of their publications. Her recent research applications have focused on interagency collaborations for coastal system resilience, marine transportation resilience, and integrated engineering, environmental, and community resilience. Additional research interests include long-term coastal morphologic change and regional sediment management. Dr. Rosati is a Professional Engineer in Mississippi and serves as Technical Director for the American Shore and Beach Preservation Association, an Associate Editor of ASCE's "Waterways" journal, and represents the Corps as a founding agency of the multi-organizational US Coastal Research Program.

Charter
Board on Coastal Engineering Research

1. Committee's Official Designation: The committee shall be known as the Board on Coastal Engineering Research (BCER).

2. Authority: The Secretary of Defense, pursuant to 33 U.S.C. § 426-2 and in accordance with the Federal Advisory Committee Act (FACA) (5 U.S.C., Appendix) and 41 C.F.R. § 102-3.50(a), established this non-discretionary advisory committee.

3. Objectives and Scope of Activities: Pursuant to 33 U.S.C. § 426-2, the BCER shall provide independent advice and recommendations on the functions of the Coastal Engineering Research Center, as set out in paragraph four below.

4. Description of Duties: The BCER provides independent advice and recommendations on the work of the Coastal and Hydraulics Laboratory, which includes the Coastal Engineering Research Center, on coastal engineering research priorities and additional functions as assigned by the Commanding General, U.S. Army Corps of Engineers ("the Chief of Engineers").

5. Agency or Official to Whom the Committee Reports: The BCER reports to the Secretary of Defense or the Deputy Secretary of Defense ("the DoD Appointing Authority"), through the Secretary of the Army and the Chief of Engineers, who may act upon the BCER's advice and recommendations in accordance with Department of Defense (DoD) policy and procedures.

6. Support: The DoD, through the Office of the Secretary of the Army, provides support for the BCER's functions and ensures compliance with the requirements of the FACA, the Government in the Sunshine Act (5 U.S.C. § 552b), governing Federal statutes and regulations, and DoD policy and procedures.

7. Estimated Annual Operating Costs and Staff Years: The estimated annual operating cost, to include travel, meeting, and contract support, is approximately $327,000. The estimated annual personnel cost to the DoD is 2.0 full-time equivalents.

8. Designated Federal Officer: The BCER's Designated Federal Officer (DFO) shall be a full-time or permanent part-time DoD civilian officer or employee, or active duty member of the Armed Forces, designated in accordance with DoD policy and procedures.

   The BCER's DFO is required to attend all BCER meetings for the entire duration of each and every meeting. However, in the absence of the BCER's DFO, a properly approved Alternate DFO, duly designated to the BCER in accordance with DoD policy and procedures, shall attend the entire duration of all BCER meetings. The DFO, or the Alternate DFO, approves and calls all BCER meetings; prepares and approves all meeting agendas; and adjourns any meeting when the DFO, or the Alternate DFO, determines adjournment to be in the public interest or required by governing regulations or DoD policy and procedures.

9. Estimated Number and Frequency of Meetings: The BCER shall meet at the call of the BCER's DFO, in consultation with the BCER's Chair. The estimated number of BCER meetings is two per year.

10. Duration: The need for this advisory committee is on a continuing basis; however, the charter is subject to renewal every two years.

11. Termination: The BCER will terminate upon rescission of 33 U.S.C. § 426-2.

12. Membership and Designation: The BCER, pursuant to 33 U.S.C. §§ 426 and 426-2, shall be composed of seven members. Four members shall be officers of the U.S. Army Corps of Engineers, appointed as follows –

    a. one of whom shall be the Deputy Commanding General for Civil and Emergency Operations, U.S. Army Corps of Engineers ("the Deputy Commanding General"), who shall serve as the Chair of the BCER for no fixed term of service; and
    b. the other three shall be chosen from among the eight coastal division commanders, based on tenure as a division commander and expertise in the matters before the BCER.

    The remaining three BCER members shall be civilian engineers selected with regard to their special fitness, such as expertise and advanced education in the fields of beach erosion, shore protection, nearshore coastal processes and infrastructure, and related fields. Comprehensive expertise of the three civilian members will be able to advise on coastal processes and nearshore beach, dune and bluff response for the Atlantic, Gulf of Mexico, Pacific, and Great Lakes coastal regions of the Nation.

    The appointment of the civilian BCER members and the three coastal division commanders shall be approved by the DoD Appointing Authority, for a term of service of one-to-four years in accordance with DoD policy and procedures. Pursuant to 5 U.S.C. § 3109 and DoD policy and procedures, appointments for civilian members of the BCER are subject to annual renewals. No member, unless approved by the DoD Appointing Authority, may serve more than two consecutive terms of service on the BCER or serve on more than two DoD Federal advisory committees at one time.

    BCER members who are not full-time or permanent part-time Federal officers or employees, or active duty members of the Uniformed Services, shall be appointed as experts or consultants, pursuant to 5 U.S.C. § 3109, to serve as special government employee (SGE) members. BCER members who are full-time or permanent part-time Federal officers or employees, or active duty members of the Uniformed Services, shall be appointed pursuant to 41 C.F.R. § 102-3.130(a) to serve as ex officio RGE members.

    All BCER members are appointed to exercise their own best judgment on behalf of the DoD, without representing any particular point of view, and to discuss and deliberate in a manner that is free from conflict of interest.

    Pursuant to section 105 of the Flood Control Act of 1970 (Public Law 91-611), SGE members may be paid at a rate not to exceed the daily equivalent of the rate for a GS-15, step 10, for each day of attendance at BCER meetings, not to exceed 30 days per year, in addition to travel and other necessary expenses connected with their official duties on the BCER, in accordance with the provisions of 5 U.S.C. §§ 5703(b), (d), and 5707. RGE members shall be reimbursed for official BCER-related travel and per diem.

13. Subcommittees: The DoD has determined that subcommittees will not be authorized for this advisory committee.

14. Recordkeeping: The records of the BCER shall be managed in accordance with General Records Schedule 6.2, Federal Advisory Committee Records, or other approved agency records disposition schedule, and the appropriate DoD policy and procedures. These records shall be available for public inspection and copy, subject to the Freedom of Information Act (5 U.S.C. § 552).

15. Filing Date: April 21, 2022

98th BOARD ON COASTAL ENGINEERING RESEARCH MEETING

13-15 September 2022
Fireweed Conference Center
725 E. Fireweed Lane, Anchorage, AK 99503

WebEx
https://usace1.webex.com/meet/jason.a.channell
Meeting Number and Access Code: 1992 90 7006

By Phone
US Toll Free: 1-844-800-2712
US Toll: 1-669-234-1177

AGENDA

THEME: Coastal Community Resilience Research Needs in Cold Regions under a Changing Climate

***Meeting Concept*:** *Identify coastal research needs associated with coastal communities in cold regions including issues of climate change, social equity, and environmental justice.*

(All in Alaska Daylight Saving Time Zone)

Tuesday September 13, 2022 – Board Members Site Visit, Bethel, AK

0730	Depart Hotel individual transportation
0800	Meet at Security Aviation, 6121 S Airpark Pl, Anchorage, AK 99502
	Charter Flight Site Visit for BCER Board Only
	In case of prohibitive weather for flying, BCER will visit Point Woronof, AK.
	Plan to meet at Security Aviation for go/no go, unless advised otherwise.
0830	Flight Departure
1000	Arrival and transition to City of Bethel Council Chambers in City Hall,
	300 Chief Eddie Hoffman Highway, Bethel, AK
1030	"Community Coastal Resilience & Social Challenges" – Anna Hoffman
1100	Site Visit- (Bring water and snacks)

- Meet City Manager Pete Williams at Small Boat Harbor
- Discuss float maintenance, removal for ice
- Discuss harbor dredging through ice
- Move to entrance channel revetment, discuss ice plucking issues with stone armor
- Move to east pile bulkhead, discuss retaining wall issues, moorage, USACE tieback project

- Move to City Dock, discuss hub transhipment of goods to the region, view docks and landing craft mooring
- Move to First Avenue Bulkhead, discuss thermosyphon issues
- End discussions or move to Mission Road pile and stone revetments to see further ice effects as desired

1600 Return to Anchorage, AK, adjourn

1630 Anchorage, AK - JABLTCX Lidar Aircraft Tour (30 min tour)

- Joint Airborne Lidar Bathymetric Center of Expertise- Security Aviation

1900 BCER Board Dinner at Crow's Nest (in hotel)

Wednesday 14 September 2022 -- Fireweed Conference Center

Meeting Attire: Military- Cammies/OCP; Civilian-Business Casual

0700 0830 Registration Fireweed Conference Center
0730 0830 Breakfast
0830 **Call to Order**
Dr. Julie Rosati, Designated Federal Officer (DFO)

0830 0900 Welcome and Introductions
MG William H. "Butch" Graham, Jr., Deputy Commanding General for Civil and Emergency Operations, Headquarters (HQ), U.S. Army Corps of Engineers (USACE)

LTC Virginia Brickner, Deputy Commander, Alaska District (POA)

0900 0930 Observations from Site Visits
MG William H. "Butch" Graham, Jr. and Board Members

0930 1000 Purpose and History of the BCER
Dr. Ty V. Wamsley, SES, Director Coastal & Hydraulics Laboratory (CHL)

1000 1015 Break

Panel Session #1: Alaska's Coastal Setting and Challenges
Moderator: Mr. Nathan Epps, POA

1015 1045 Alaska District's Coastal Shoreline Erosion Projects and Challenges
Mr. Bruce Sexauer, POA

1045 1115 Impacts of Changing Sea Ice on Wave Climate and Shoreline Erosion
Dr. Alec Bennett and Dr. Valdimir Alexeev
International Arctic Research Center, University of Alaska Fairbanks

1115 1145 Community Coastal Resilience & Social Challenges

		Ms. Malinda Chase, Tribal Liaison, International Arctic Research Center
1145	**1245**	**Lunch (Onsite)**
		Panel Session #2: Ongoing Research, Needs and Gaps Moderator: Dr. Jane Smith, Emeritus ST, CHL
1245	1315	Armor Units for Coastal Protection in the Arctic Mr. Nathan Epps, POA
1315	1345	Storm Selection for Design Event Scenarios – Case Study at Utquigvik Ms. Rebecca Kloster, POA
1345	1415	Coastal Hazards System for Pacific Basin Dr. Norberto Nadal-Caraballo, CHL
1415	1445	Mapping Alaska's Coastline: Research, Development, and Collaborations Ms. Jennifer Wozencraft, CHL, and Dr. Erin Trochim, Alaska Center for Energy and Power (ACEP), University of Alaska Fairbanks
1445	**1500**	**Break**
1500	1530	Summary of Outcomes and Recommendations Aligned with BCER Initiatives Dr. Jane Smith, Emeritus ST, CHL
1530	1600	Public Comment
1600	1630	Summary of Action Items Dr. Julie Rosati, CHL
1630	1700	Board Closing Remarks Open Discussion Board Members
1700		Adjourn
1745		Dinner Social Haute Quarter Grill

Thursday, 15 September 2022 – Executive Session – Fireweed Conference Center

Meeting Attire: Military- Cammies/OCP; Civilian-Business Casual

0700	0800	Registration Fireweed Conference Center
0730	0830	Breakfast
0830	0900	Comments on Meeting Outcomes MG William H. “Butch” Graham, Jr.
0900 - -	0930	Near-term Needs: Coastal Model R&D Next-Gen Coastal Storm Risk Management Toolbox Strategic Coastal Model R&D Mr. John Winkelman, Coastal Working Group Lead, CHL Dr. Jane Smith, Emeritus ST / Dr. Matthew Farthing, ST, CHL
0930	1000	Overview of FY24 Civil Works RD&T Program Dr. Ty V. Wamsley, CHL
1000	1030	Discussion of 99th BCER: Location and Theme MG William H. “Butch” Graham, Jr.
1030	1045	Review Action Items Dr. Julie Rosati, CHL
1045	1100	Closing Remarks.
1100		Adjourn

98th BCER FAQ GUIDE

1. September 13th Site Visit (BCER Board Members only)

- Plane departure will be at 0830 at 6121 S. Airpark Place, Anchorage, AK 99502
- Direction from Hotel Captain Hook to Terminal are provided in eBook and hand out.
- No shuttle service available please plan to drive or carpool, there is ample parking available at terminal.
- Flight Conditions
  - The aircraft does not have in-flight lavatories and all participants should expect a 1.5-hour flight with no bathroom breaks, so it would be advisable to not drink a lot of coffee or water before the flight and use the facilities in Anchorage before departing
  - As a back-up plan, in case weather prohibits flying, the BCER will visit Point Wozonof, AK.
- Weather
  - It is forecasted to have a 50% chance of rain on the 13th so please bring raingear for trip
  - Temperatures will range from 44 to 52 degrees Fahrenheit. Please dress comfortable for an outdoor cooler walking tour. Jackets/ raingear recommended.
- Food
  - Grab breakfast before departing avoid drinks
  - Lunch will be given on the plane in between tours.
  - Please bring water, snacks, backpack any other items needed to be comfortable for the duration of the tour.
- The JABLTCX Tour will follow directly after the Bethel tour at Security Aviation, 6121 S Airpark Pl, Anchorage, AK 99502
- Board Dinner will be held at the Crows Next located inside the Captain Cook Hotel on top of tower 3

2. Meeting September 14-15th

- Meeting will be held in Alaska Daylight Saving Time Zone
- Average weather for meeting days has a high of 56 and a low of 44 degrees F. Rain is forecasted as well.
- Registration fees can be paid at anytime once you have submitted your registration form. Virtual options are:
  - CASHAPP- $TanitaEnglish
  - VENMO- @CERB-USACE (Tanita Warren)
  - PAYPAL- tanitaenglish@yahoo.com
  - Cash will always be accepted, no checks.
- No Shuttle service from hotel to conference center (directions provided in eBook)
- Breakfast/lunch/breaks will be served at conference center
- Electronic Books will be emailed out 1 day before meeting date
- WebEX/dial in information located on agenda.

3. Social events

- September 14th Dinner social- Haute Quarter Grill @1745 open to all attendees

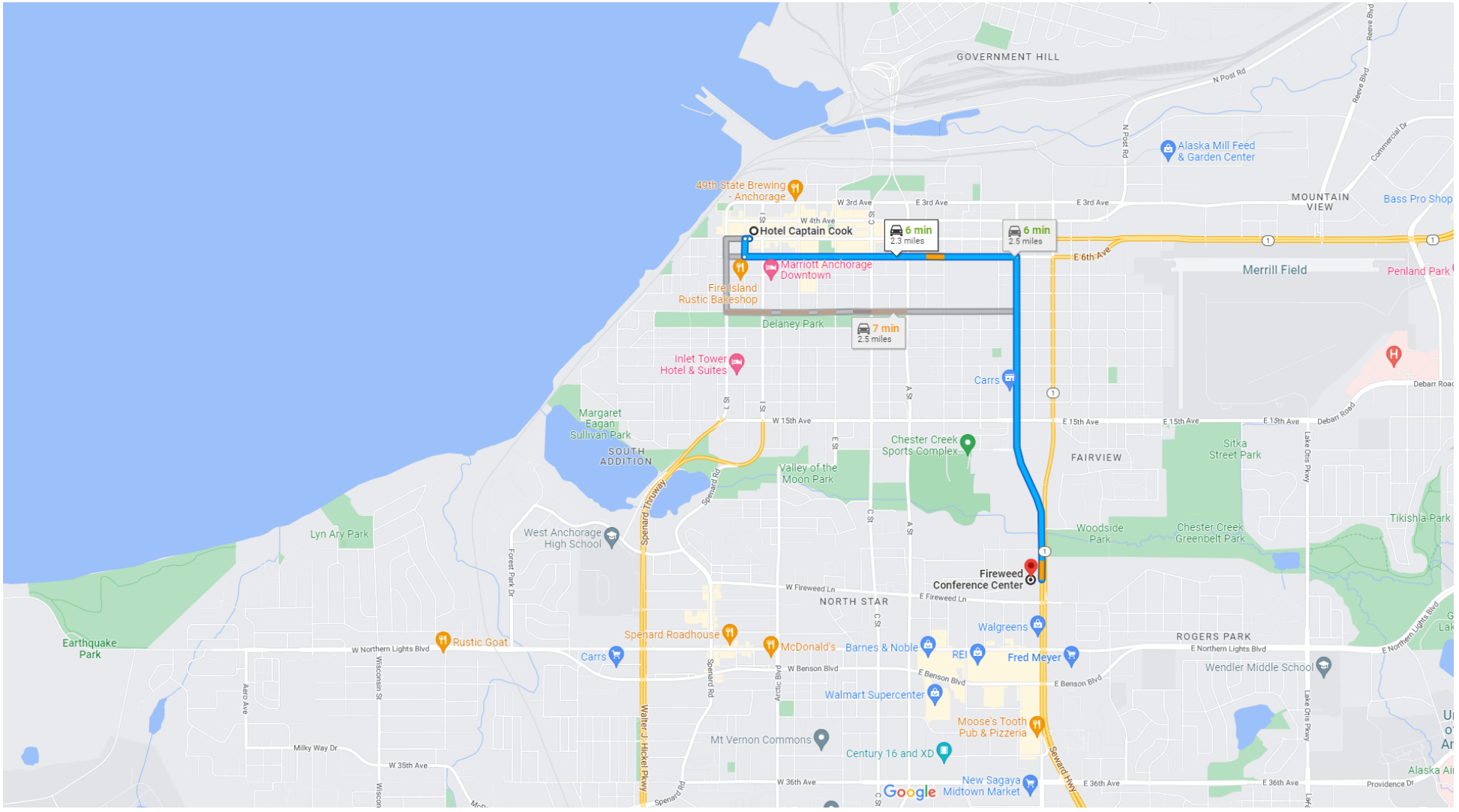
4. General info.

- Hotel Captain Cook- 939 W 5th Ave, Anchorage, AK 99501- (907) 276-6000
- Security Aviation, 6121 S Airpark Pl, Anchorage, AK 99502
- Fireweed Conference Center- 725 E Fireweed Ln, Anchorage, AK 99503
- Haute Quarter Grill- 525 W 4th Ave, Anchorage, AK 99501

Google Maps Hotel Captain Cook, 939 W 5th Ave, Anchorage, AK 99501 to Fireweed Conference Center, 725 E Fireweed Ln, Anchorage, AK 99503

Drive 2.3 miles, 6 min

Directions to BCER meeting from Hotel



Hotel Captain Cook
939 W 5th Ave, Anchorage, AK 99501

1. Head west on W 5th Ave toward K St — 89 ft
2. Turn left at the 1st cross street onto K St — 358 ft
3. Turn left at the 1st cross street onto W 6th Ave — 1.0 mi

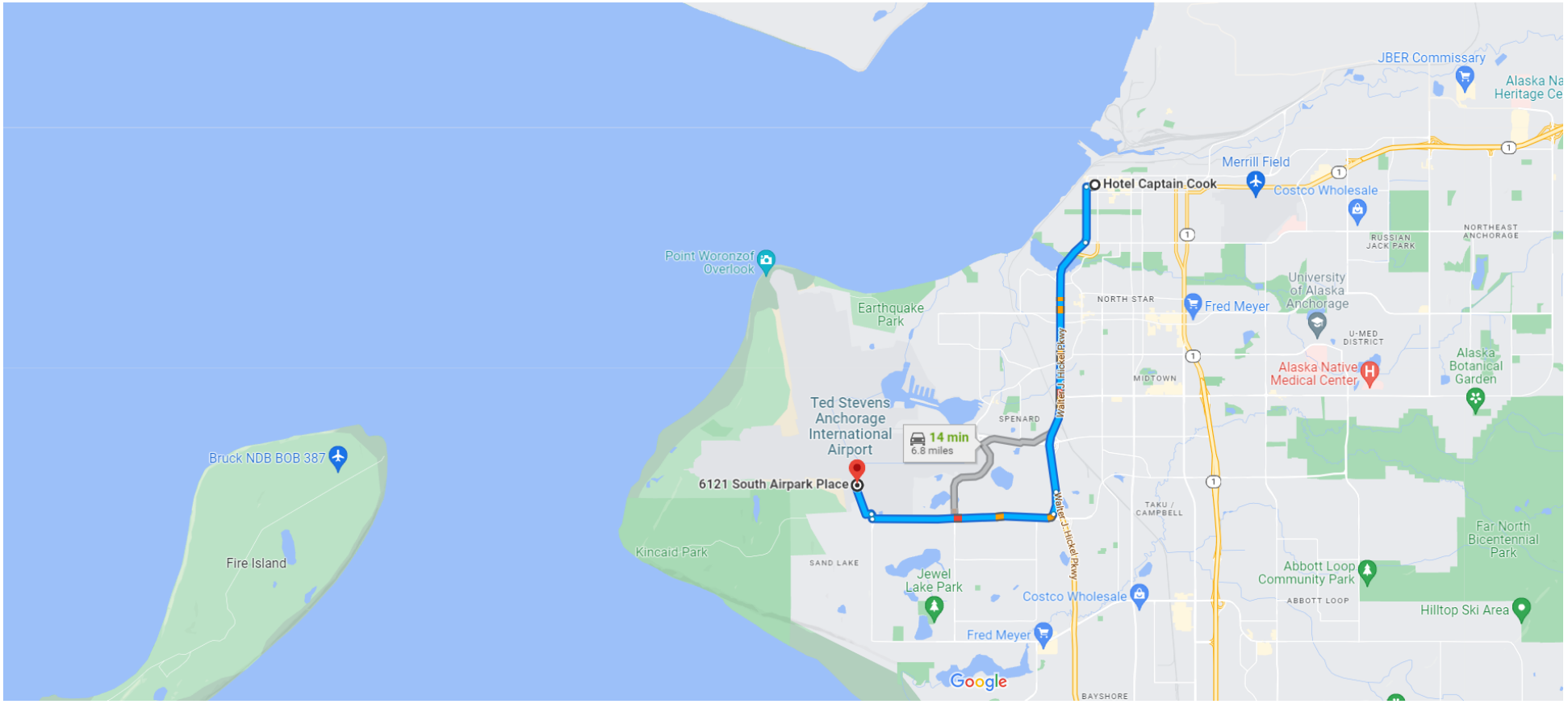
4. Turn right onto AK-1 S/Gambell St
Continue to follow AK-1 S
Destination will be on the right

1.2 mi

Fireweed Conference Center
725 E Fireweed Ln, Anchorage, AK 99503

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Google Maps Hotel Captain Cook, 939 W 5th Ave, Anchorage, AK 99501 to 6121 S Airpark Pl, Anchorage, AK 99502 Drive 7.0 miles, 14 min



Hotel Captain Cook
939 W 5th Ave, Anchorage, AK 99501

Take Minnesota Dr/Walter J. Hickel Pkwy and Raspberry Rd to S Airpark Pl

12 min (6.5 mi)

1. Head west on W 5th Ave toward K St

466 ft

2. Use the left 2 lanes to turn left at the 2nd cross street onto L St

0.7 mi

3. Continue onto Minnesota Dr/Walter J. Hickel Pkwy

3.2 mi

4. Take the exit toward Raspberry Rd

0.3 mi

5. Keep right at the fork and merge onto Raspberry Rd

2.2 mi

Drive to S Airpark Pl

1 min (0.5 mi)

6. Turn right onto S Airpark Pl

371 ft

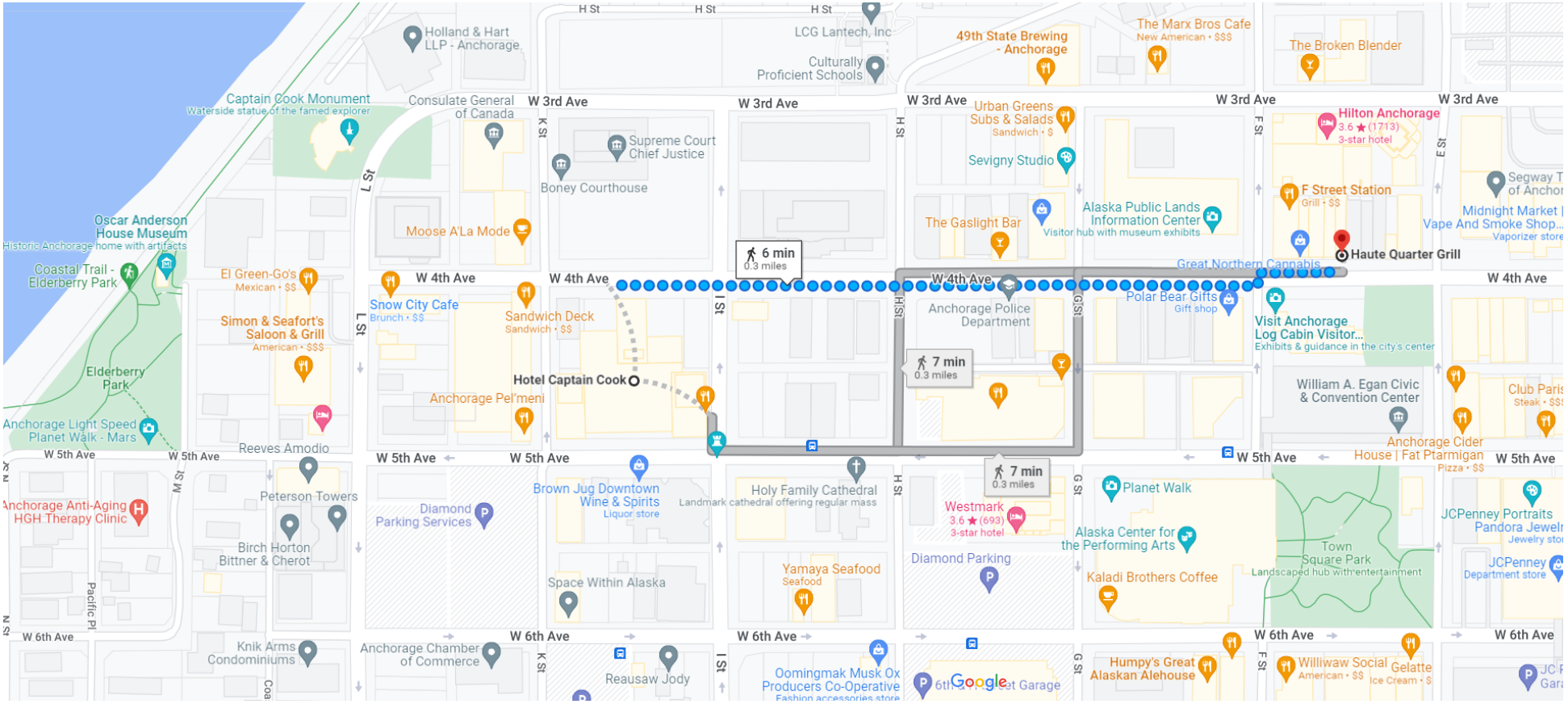
7. Turn left to stay on S Airpark Pl

Destination will be on the right

0.4 mi

6121 S Airpark Pl
Anchorage, AK 99502

Google Maps Hotel Captain Cook, 939 W 5th Ave, Anchorage, AK 99501 to Haute Quarter Grill, 525 W 4th Ave, Anchorage, AK 99501 Walk 0.3 mile, 6 min



⚠ Use caution—walking directions may not always reflect real-world conditions

Hotel Captain Cook
939 W 5th Ave, Anchorage, AK 99501

↑ 1. Head east on W 4th Ave toward I St
0.3 mi

Haute Quarter Grill
525 W 4th Ave, Anchorage, AK 99501

Site Visit

Bethel, AK

BETHEL SITE VISIT

Lewis Nathan Epps, PE
Chief, Hydraulics and Hydrology
Alaska District
Date: 13 SEP 2022

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

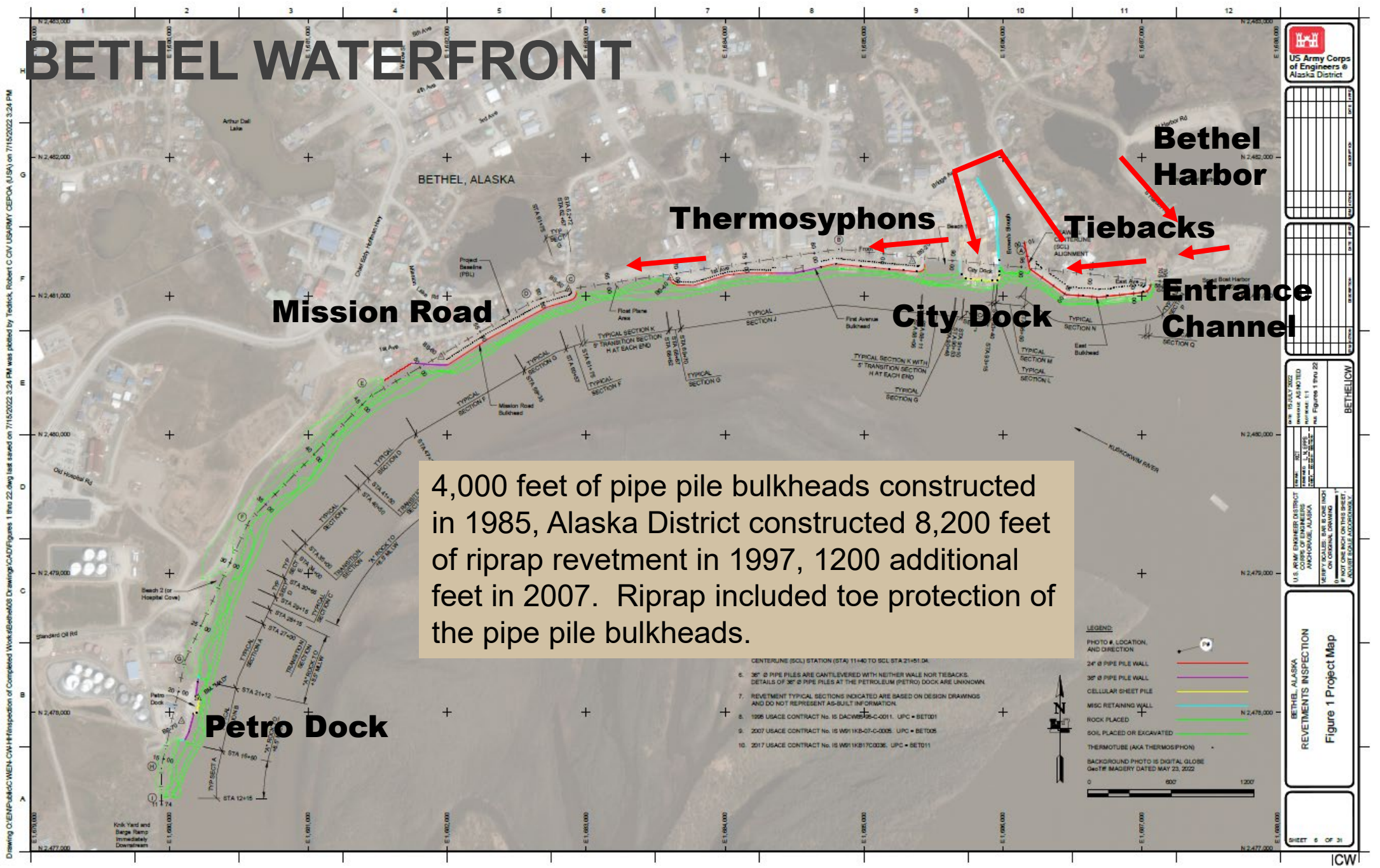
US Army Corps of Engineers®

LOCATION

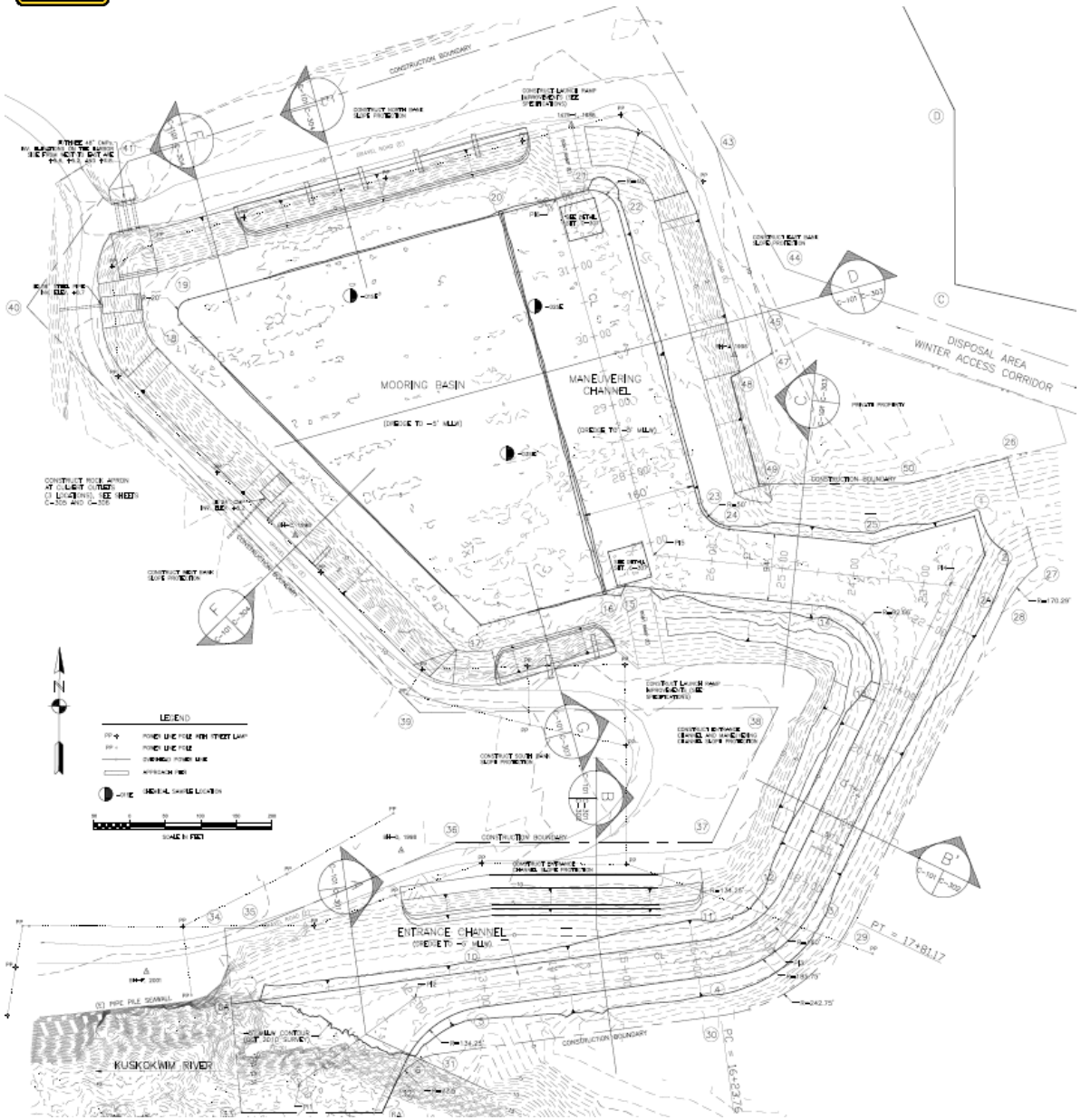

Arctic Ocean
Chukchi Sea
Nome
Fairbanks
Bering Sea
Anchorage
Bethel
Juneau
Bristol Bay
Gulf of Alaska
Unalaska

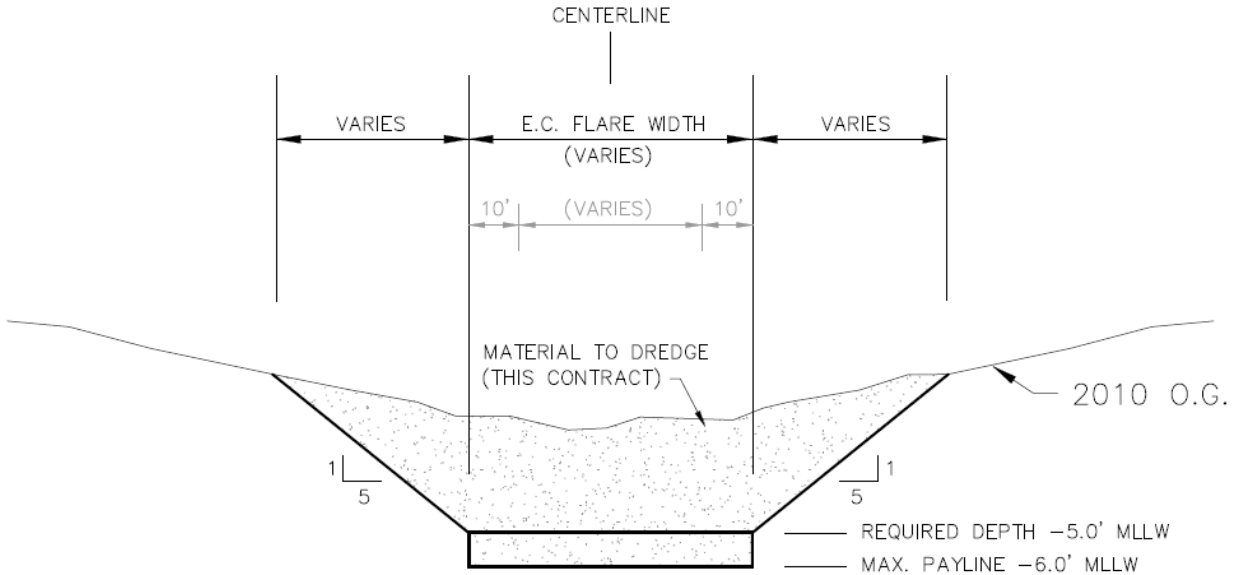
BETHEL

BETHEL WATERFRONT



BETHEL HARBOR – O&M DREDGING





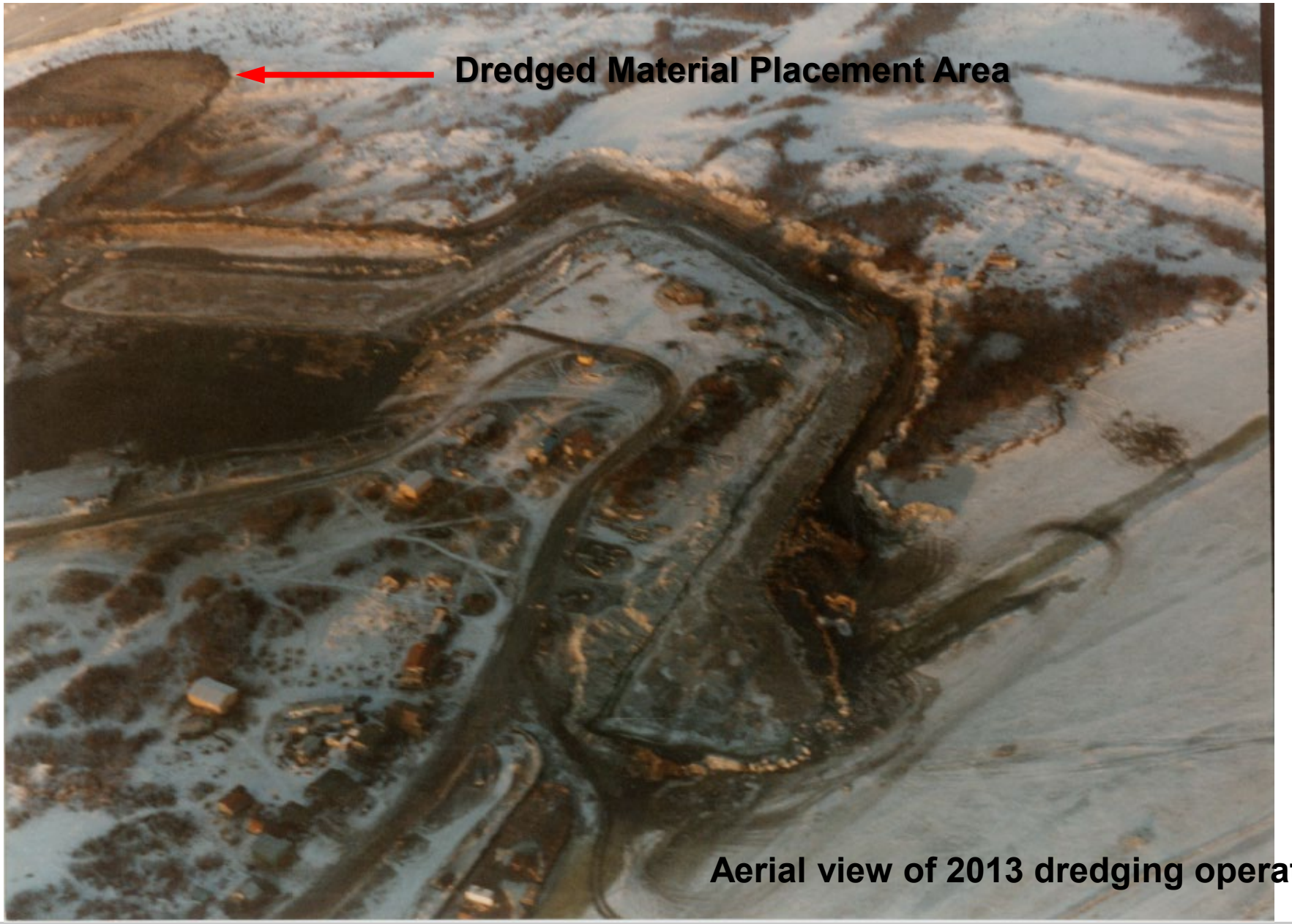
A C–101 C–301 TYPICAL SECTION: DREDGING – ENTRANCE CHANNEL FLARE

NOT TO SCALE

STA. 10+00 TO 12+89.20

Bethel Harbor was constructed in 1983 and is dredged on an approximately 10-year interval. Maintenance dredging was performed in 1992, 1997 and 2013 with dredge quantities between 15,000 and 30,000 cubic yards.

BETHEL HARBOR – O&M DREDGING



Aerial view of 2013 dredging operations

BETHEL HARBOR - ICE RIPPING

Ripping ice prior to clearing and dredging

BETHEL HARBOR - EXCAVATION

Dredging from the ice. Hauling material to the disposal site is far easier over frozen ground in the winter.

BETHEL HARBOR – ENTRANCE CHANNEL ARMOR

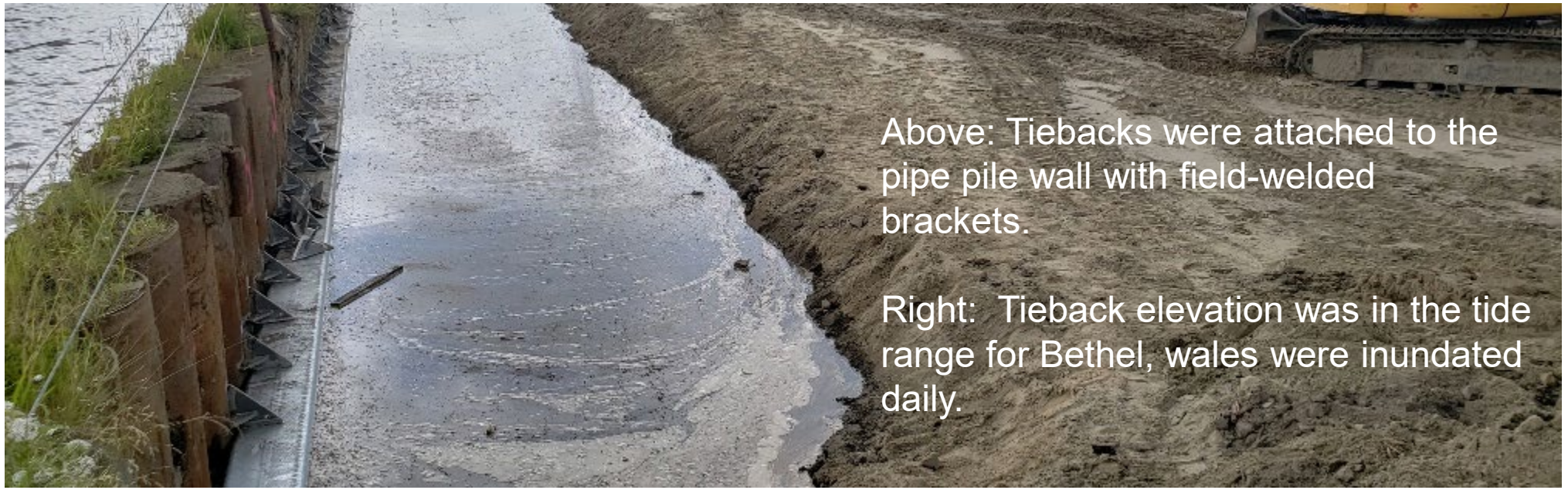
Above: Bethel Harbor entrance channel revetment.

Right: Kipnuk revetment, 2008 photo. Armor plucked by ice.

PIPE PILE BULKHEAD TIEBACKS

Alaska District installed tiebacks onto the pipe pile wall in 2018.

PIPE PILE BULKHEAD TIEBACKS

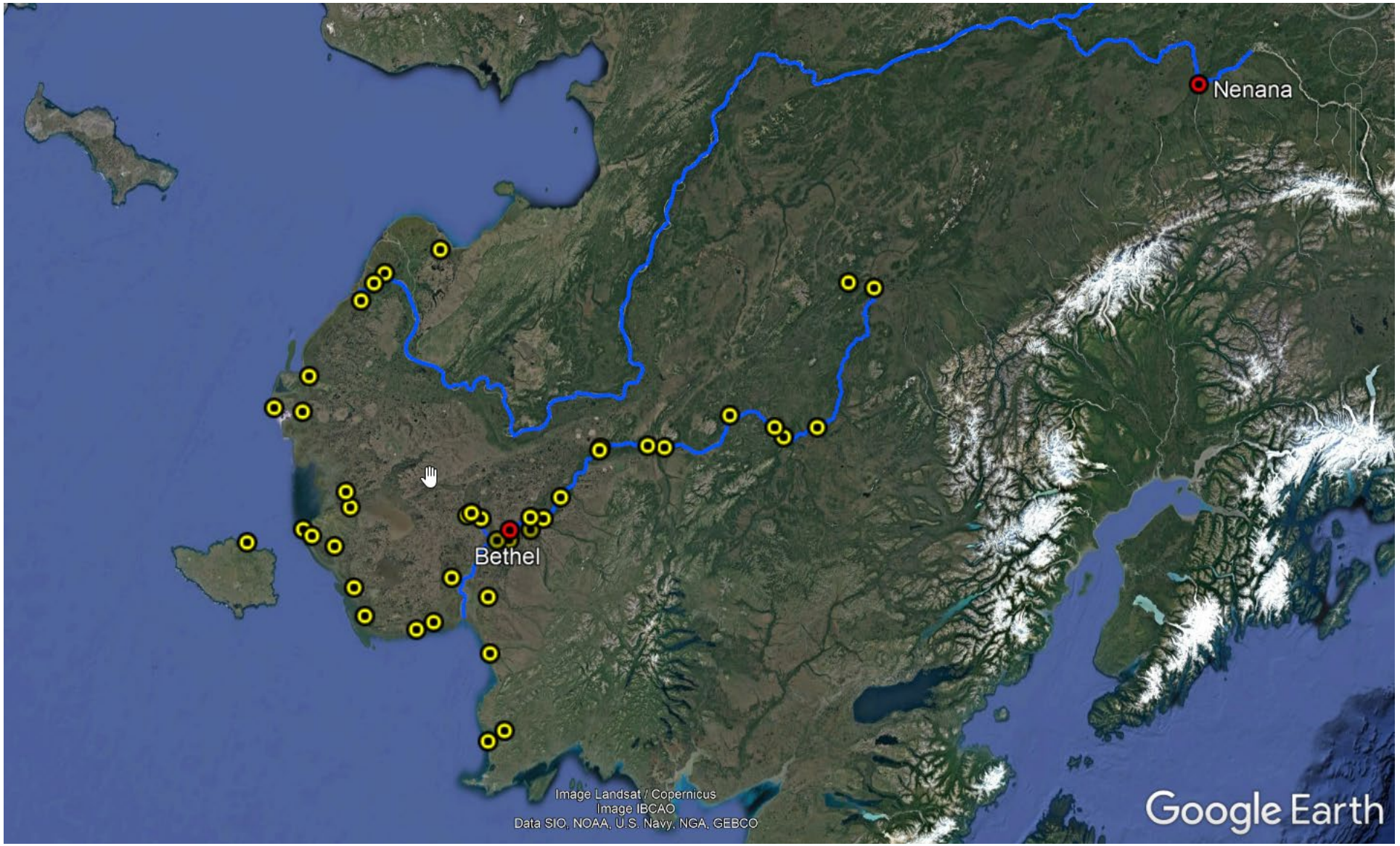


Above: Tiebacks were attached to the pipe pile wall with field-welded brackets.

Right: Tieback elevation was in the tide range for Bethel, wales were inundated daily.

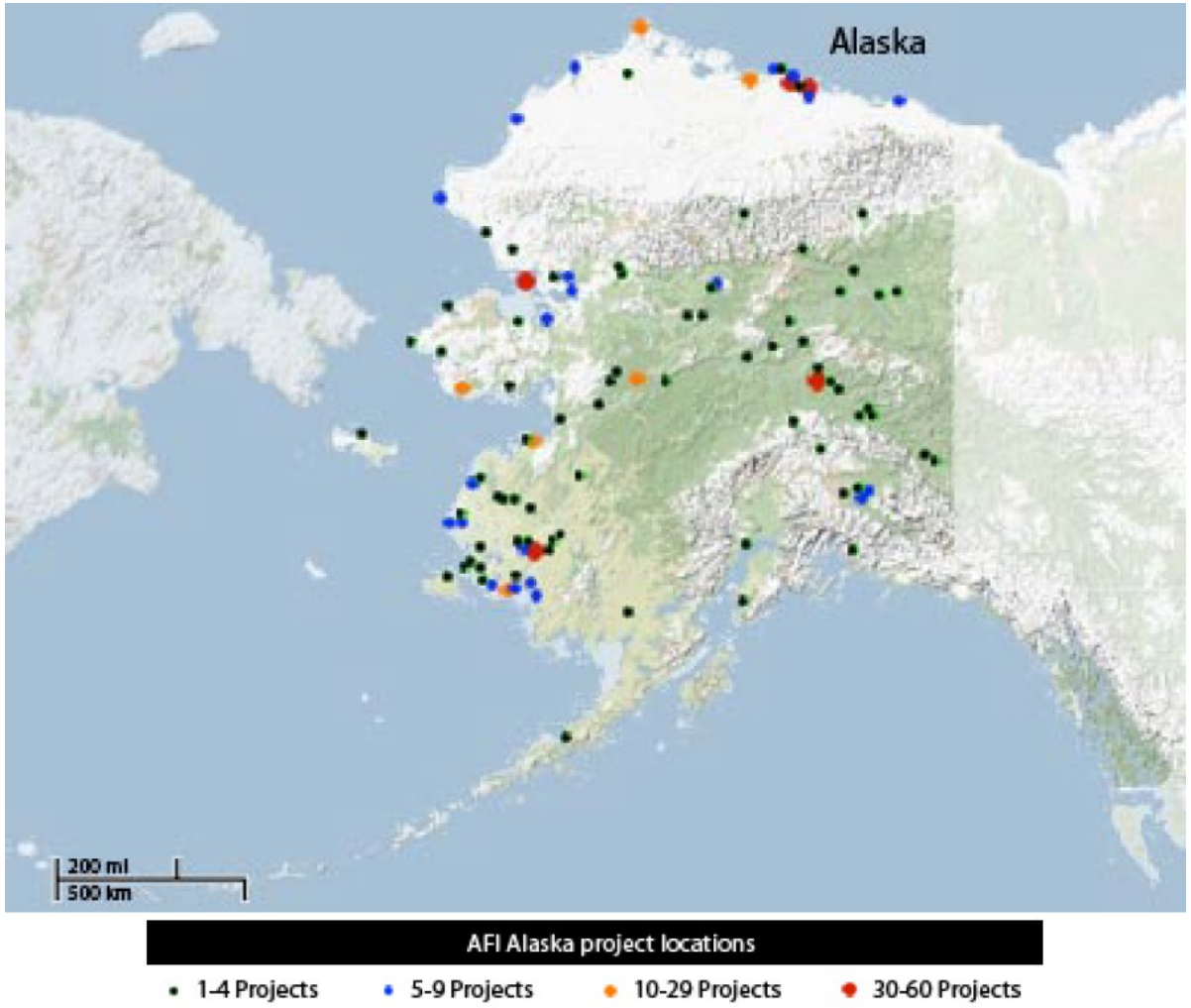
REGIONAL HUB

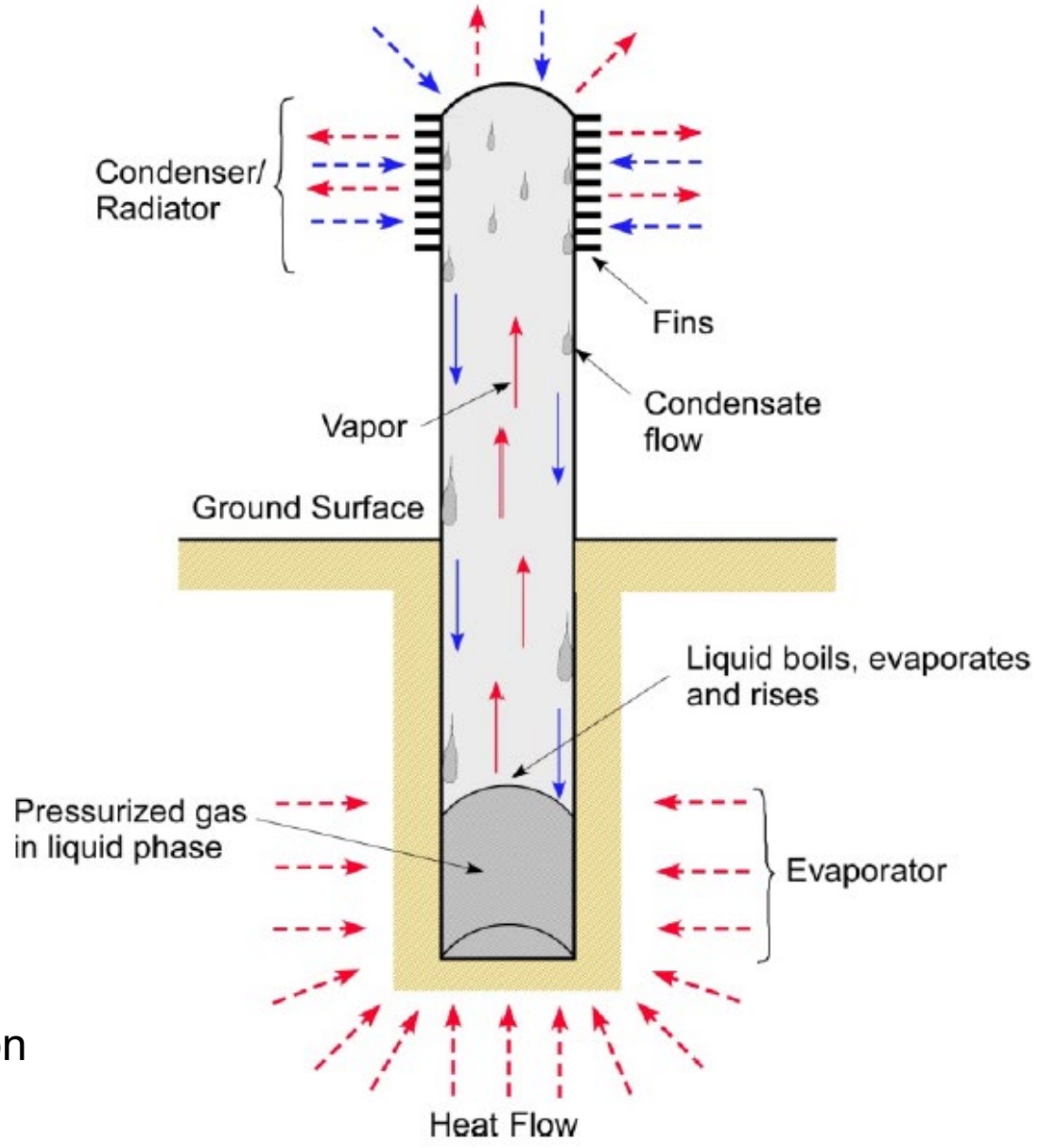
Bethel serves as the transportation hub for a majority of the Yukon-Kuskokwim Delta region. Communities served by waterborne commerce include most coastal communities and communities on the Kuskokwim River. Air transportation for many lower Yukon communities also flies through Bethel.



REGIONAL HUB

THERMOSYPHONS





From ERDC/CRREL TR-14-1, Review of Thermosyphon Applications by Dr. Anna Wagner

THERMOSYPHONS

Presentations

Ty V. Wamsley, Ph.D., SES

Dr. Wamsley was appointed to the Senior Executive Service in October 2018, he serves as Director of the Coastal and Hydraulics Laboratory (CHL) at the U.S. Army Engineer Research and Development Center (ERDC). Headquartered in Vicksburg, Mississippi, CHL performs ocean, estuarine, riverine and watershed regional scale systems analyses work in support of the U.S. Army Corps of Engineers (USACE), the Department of Defense, and other federal agencies, as well as state and municipal governments and private industry. Areas of expertise include hydrologic analysis, hydraulic structures, coastal engineering, flood risk reduction, dredging, navigation, and military logistics. As director, Dr. Wamsley leads a team of more than 270 researchers, support staff and contractors. He is responsible for planning, directing and coordinating a multi-million dollar research program, and developing new and strategic research program areas in coastal and hydraulics technical disciplines. He manages and maintains physical facilities with a total area of one million square feet. Ongoing projects execute field data collection, laboratory analysis, physical modeling, and numerical modeling to produce design guidance and cutting-edge products to support successful coastal and inland water resources management. He also serves as the senior executive lead for the ERDC Civil Works Research and Development Area. Dr. Wamsley holds a bachelor's degree in civil engineering from North Carolina University, a bachelor's degree in accounting from the University of Houston, a master's degree in ocean engineering from Texas A&M University and a PhD in water resources engineering from Lund University. Dr. Wamsley has published several publications and received numerous army awards.

//CUI//

Purpose and History of the Board on Coastal Engineering Research

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

COASTAL & HYDRAULICS LABORATORY

Board on Coastal Engineering Research

TY V. WAMSLEY, PhD, SES
Director, Coastal & Hydraulics Laboratory
Engineer Research and Development Center

98th Meeting Board on Coastal Engineering Research
September 13-15, 2022

Board on Coastal Engineering Research (CERB)

- Established via Public Law 88-172 of the 88th Congress, November 1963 to *provide guidance and advice to the Chief of Engineers and the Coastal Engineering Research Center (CERC)*, which was established by the same law.
- In 1996 CERC merged with the WES Hydraulics Laboratory to become CHL and *the CERB continues to provide that same guidance to CHL, the other ERDC labs, and Corps leadership on Corps coastal research*.

CHL Strategic Goals

CERB "Fingerprints" in Today's R&D Program

- Field Research Facility was established by the CERB and operated through funds from the Coastal Field Data Collection Program
- The Dredging Research Program was initiated by the CERB and is now replaced by the Dredging Operations and Environmental Program (DOER)
- The Coastal Inlets Research Program grew from CERB efforts that started with the 53rd CERB meeting in June 1990
- Regional Sediment Management (RSM) was the theme of the 67th CERB meeting in May 1998 and has grown to a continuing national program

USACE R&D Strategy

TOP 10 USACE RESEARCH AND DEVELOPMENT PRIORITIES

1. Mitigate and Adapt to **Climate Change**
2. Win **Future Wars**
3. Modernize our Nation's **Infrastructure**
4. Support Resilient **Communities**
5. Enable Smart and Resilient **Installations**
6. Ensure **Environmental** Sustainability and Resilience
7. Secure Reliable Installation **Energy**
8. Revolutionize and Accelerate **Decision Making**
9. Improve Cyber and Physical **Security**
10. Protect and Defend the **Arctic**

Priorities are not ranked; numbers are for identification purposes only

USACE R&D STRATEGY

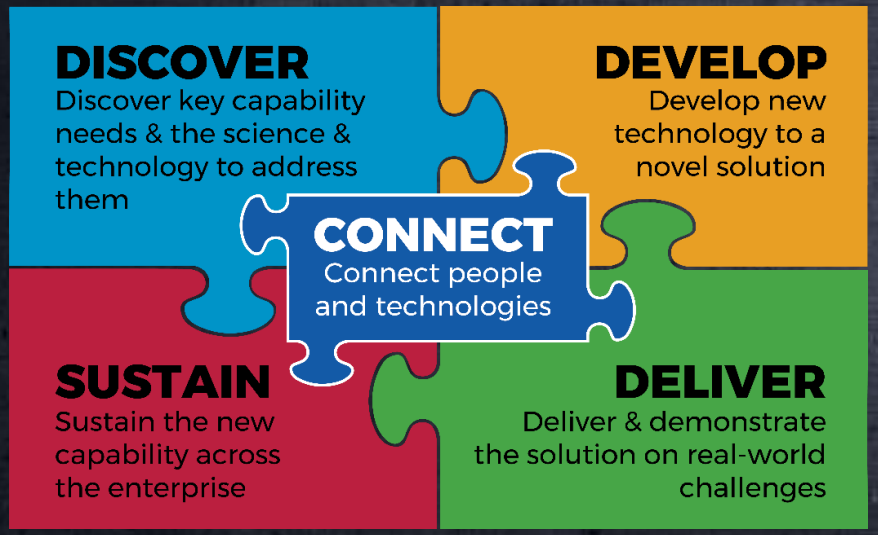
Scan the QR Code at right to download a copy of the **USACE R&D Strategy** and other USACE R&D communication products

★ SUPPORTING SCIENCE, RESEARCH, AND DEVELOPMENT TO DELIVER ENDURING WATER RESOURCE SOLUTIONS

USACE CW R&D Strategy

THREE COMPONENTS – STRATEGIC, OPERATIONAL, AND TACTICAL

Mission: Provide **value** to our Nation by delivering **solutions** that fully address today's and tomorrow's most challenging Civil Works problems through research, development, and application of **innovative science and engineering technologies**.



CW R&D Strategy Aligns with the USACE Technology Innovation Strategy

Strategic R&D Program

Focused on addressing mid- to far-term enterprise priorities **(Strategic Focus Areas)** identified by USACE leadership

***Target*: 80-85% of USACE CW R&D Program Investment**

Proposed New Civil Works R&D Account

Tactical R&D Program

Focused on addressing operational needs identified through field-generated **Statements of Need (SON)** to meet near-term (~1-2 years) Tactical Focus Area requirements

***Target*: 15-20% of USACE CW R&D Program Investment**

Operational R&D Support

Focused on addressing mid- to far-term (2-5 years) regional innovation needs identified by MSC leadership

*Resourced by **MSC Program/project funds** through PPBE process*

USACE Civil Works Strategic R&D

STRATEGIC FOCUS AREAS

Sustainable Species Management

Measuring, predicting, and managing harmful, nuisance, threatened and endangered species through ecosystem restoration

NextGen Water Resources Infrastructure

Building smarter, longer-lasting infrastructure

Innovations in Sediment Management

Maximizing beneficial use of sediments

Comprehensive Water Risk Management

Effectively and efficiently managing water before, during, and after it hits the ground

I-4A: Innovative Applications of Big Data Analytics, AI, & Autonomy

Leveraging robotics, AI and data as a force multiplier

Crisis Mitigation, Response, & Recovery

Proactively saving lives and communities

Purpose of the CERB

- Champion and guide strategic coastal R&D to solve the problems the Nation will face over the next 10-20 years.
- Recommend research priorities to the USACE Commander
- Advocate for the investment to make it happen.

ERDC

ENGINEER RESEARCH & DEVELOPMENT CENTER

COASTAL & HYDRAULICS LABORATORY

Ty V. Wamsley, PhD, SES
Director, Coastal & Hydraulics Laboratory
Ty.V.Wamsley@usace.army.mil
(601) 634-2001

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DISCOVER • DEVELOP • DELIVER

new ways to make the world safer and better

Panel Session #1: Alaska's Coastal Setting and Challenges

Moderator:

Mr. Nathan Epps, POA

Bruce Sexauer

Mr. Sexauer has been with the Corps since 1993 where he started his career in the Seattle District. He began in Water Management performing reservoir operations and updating the water control systems. Bruce moved to Planning in 1995 and continued in that field as he transferred to the Alaska District in 2003. In 2014, Bruce was selected into his current position of Chief of Civil Works Project Management Branch. Bruce has extensive experience in the planning and project management of Civil Works projects with specialized focus on flood damage reduction and navigation projects. Many projects he has helped deliver have required unique justifications, legislative assistance, or policy waiver in response to the extreme remote nature and austere conditions of rural Alaska. Bruce and his wife live in Anchorage, Alaska and have four children living in various places around the country. They enjoy camping, fishing (Bruce), reading (Linda), and participating in community theatre

Alaska District's Coastal Shoreline Erosion Projects and Challenges

Bruce Sexauer
Alaska District
Anchorage, AK.

Erosion along the coastline of Alaska has been an ever-present phenomenon. According to the U.S. Geological Survey (USGS), Geographic Names Information System, Alaska has about 10,000 officially named and thousands of unnamed rivers, creeks, and streams. There are nearly 44,000 miles of tidal shoreline and more than 3 million lakes (USGS, 2009). With this immense amount of water-land connection, the issue of erosion in Alaska is significant.

The potential for erosion exists wherever land and water connect. Erosion, as part of a natural process, does not become a problem until it starts to affect something of intrinsic or quantifiable value. In the past, communities simply moved away from erosion sites as necessary. As communities became tied to the land through infrastructure development, it became more difficult to move away from erosion sites, and residents have tried to combat erosion on their own until the problem grew so severe that external assistance was needed.

The Corps has responded through studies and constructed projects often finding new and unique ways to justify and implement projects in rural Alaska. This presentation will examine the Corps response to erosion issues in Alaska including the evolution of erosion control programs, special legislation, and a look at recently funded erosion control projects in Utqiagvik and Kenai, Alaska. Though not geared to a research request, this presentation is intended to give more context to the various needs for data collection and funding of model development in Alaska.

ALASKA DISTRICT'S COASTAL SHORELINE EROSION PROJECTS AND CHALLENGES

Bruce Sexauer, Chief Civil Works Project Management Branch
Programs and Project Management Division

15 September 2022

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

US Army Corps of Engineers®

OVERVIEW

Setting the Stage

Accomplishments under Section 117

Repeal of Section 117 and Advent of Section 116

Section 116 Activities

WRDA 2022 Provision

The Future

SETTING THE STAGE

Issues – Climate and Conditions

- Sea Ice Retreat / More Storm Threat
- Degrading Permafrost
- Little Room to Move
- Very Little Sponsor Cash
- Coordination Challenging

SETTING THE STAGE

GAO Report 04-142, December 2003

- ALASKA NATIVE VILLAGES - Most Are Affected by Flooding and Erosion, but Few Qualify for Federal Assistance
  - Flooding and erosion affects 184 out of 213, or 86 percent, of Alaska Native villages to some extent.
  - Alaska Native villages often fail to qualify for assistance under these programs due to high costs and lack of benefits

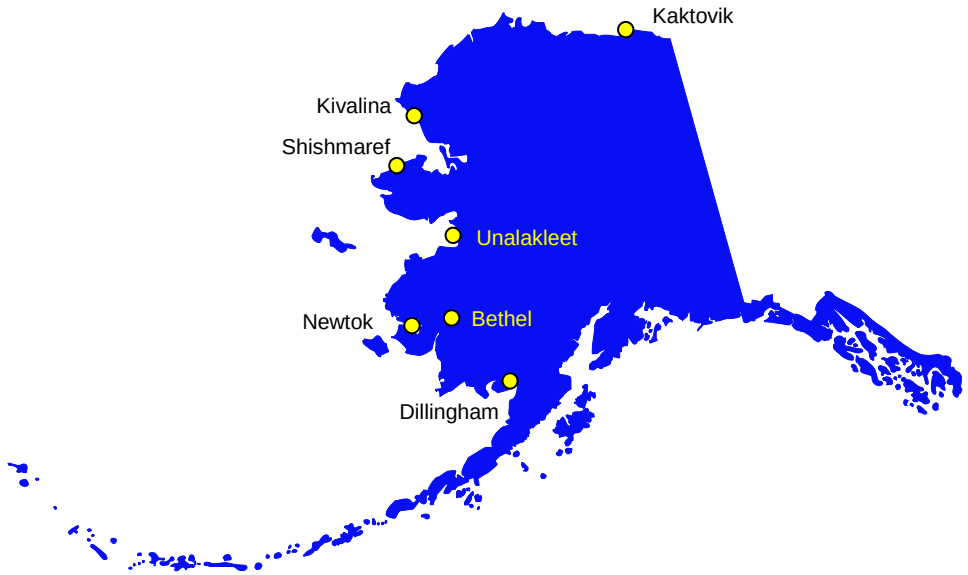
GAO Report 09-551, June 2009

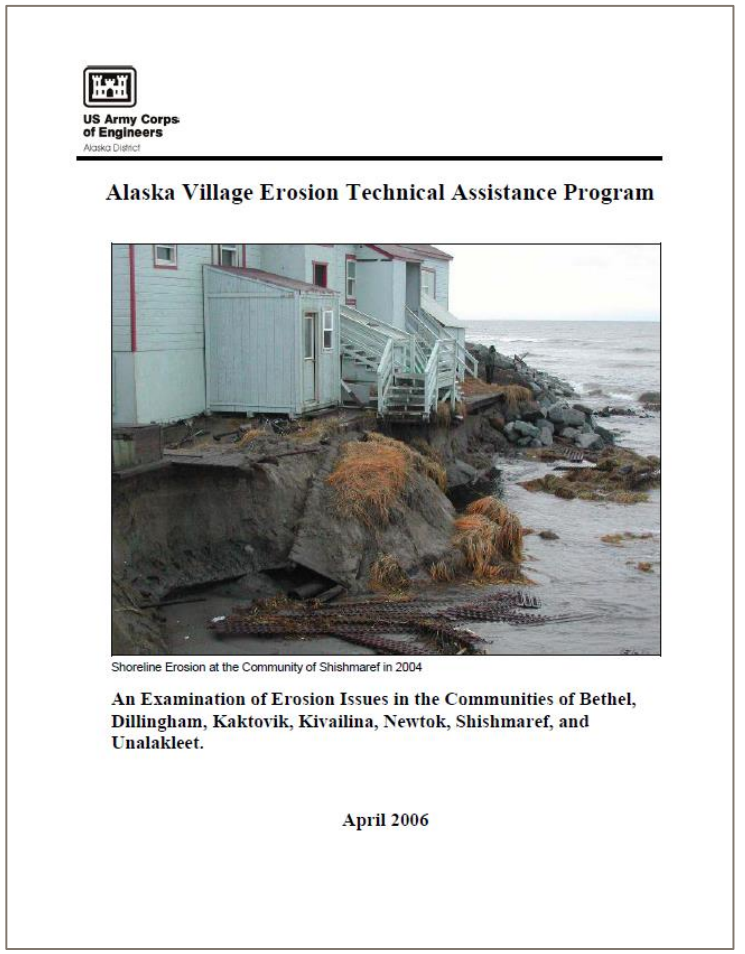
- ALASKA NATIVE VILLAGES – Limited Progress Has Been Made on Relocating Villages Threatened by Flooding and Erosion
  - States no relocation authority exists
  - Identified Need for “Baseline Flood Assessment”
  - A lead Federal agency is needed

TRIBAL PARTNERSHIP PROGRAM

House Report 108-10 for the 2003 Omnibus Appropriations Act, February 2003 Directed Corps to assess erosion at seven communities asking three questions

- What are the costs associated with continued erosion of these communities?
- What are potential costs associated with moving the affected communities to new locations or an existing community?
- What is the expected timeline for complete failure of the usable land associated with each community?





US Army Corps of Engineers
Alaska District

Alaska Village Erosion Technical Assistance Program

Shoreline Erosion at the Community of Shishmaref in 2004

An Examination of Erosion Issues in the Communities of Bethel, Dillingham, Kaktovik, Kivailina, Newtok, Shishmaref, and Unalakleet.

April 2006

BASELINE EROSION ASSESSMENT

Conference Report to Accompany the Fiscal Year 2005 Consolidated Appropriations Act, PL 108-447, Division C

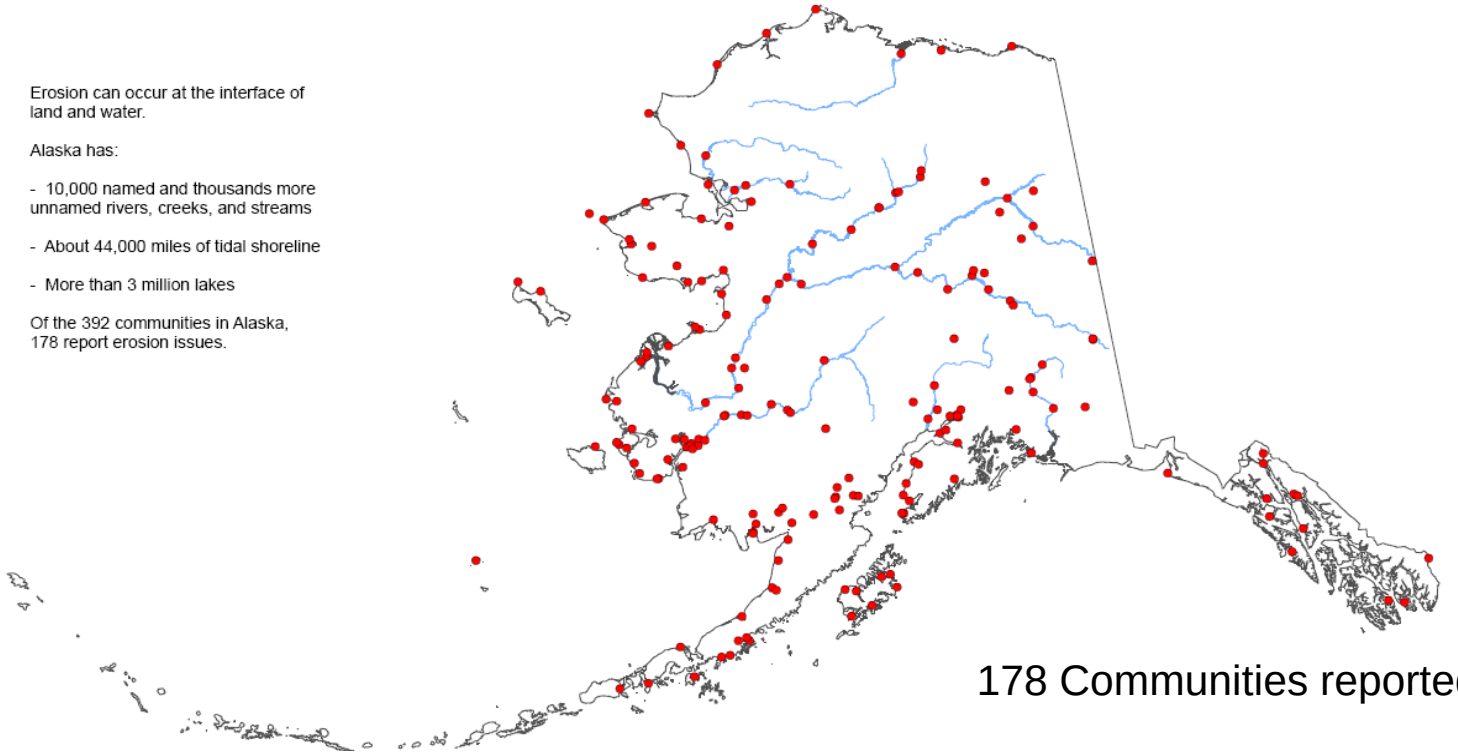
"The conference finds there is a need for an Alaska erosion baseline study to coordinate and plan the appropriate responses and assistance for Alaska villages in the most need and to provide an overall assessment on the priority of which villages should receive assistance. Therefore, the conference has provided the $2 million for this study."

Erosion can occur at the interface of land and water.

Alaska has:

- 10,000 named and thousands more unnamed rivers, creeks, and streams
- About 44,000 miles of tidal shoreline
- More than 3 million lakes

Of the 392 communities in Alaska, 178 report erosion issues.



178 Communities reported being affected by erosion

SECTION 117 & THE ALASKA COASTAL EROSION PROGRAM

Consolidated Appropriations Act of 2005,PL 108-447, Division C - Energy and Water Development Appropriations Act, 2005, which states as follows:

- *“SEC. 117. Notwithstanding any other provision of law, the Secretary of the Army is authorized to carry out, at full Federal expense, structural and non-structural projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska, including relocation of affected communities and construction of replacement facilities.”*

Energy and Water Appropriations Bill, 2006, Senate Report 109-84, Page 41 states:

- *“The Committee has provided $2,400,000 for Alaska Coastal Erosion. The following communities are eligible recipients of these funds: Kivalina, Newtok, Shishmaref, Koyukuk, Barrow, Kaktovik, Point Hope, Unalakleet, and Bethel. Section 117 of Public Law 108-447 will apply to this project.”*

ACCOMPLISHMENTS UNDER SECTION 117

Significant erosion protection installed

- Kivalina – 2,000 feet of revetment at a cost of $13,466,000
- Shishmaref – 1,375 feet of revetment at a cost of $19,447,000
- Unalakleet – 671 feet of revetment at a cost of $18,863,000
- Investigations were underway at Point Hope and Koyukuk

Funded mostly in Emergency Appropriations Bills

Repealed by Section 117 as contained in Division C of the Omnibus Appropriations Act of 2009 (P.L. 111-8)

SECTION 116 – SECTION 117 WITH COST SHARING

Section 116 of the Energy and Water Development and Related Agencies Appropriations Act PL 11-85

Section 116 of the Energy and Water Development and Related Agencies Appropriations Act, 2010, Public Law 111-85, Title I states: *"The Secretary of the Army is authorized to carry out structural and non-structural projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska, including relocation of affected communities and construction of replacement facilities: Provided, That the non-Federal share of any project carried out pursuant to this section shall be no more than 35 percent of the total cost of the project and shall be subject to the ability of the non-Federal interest to pay, as determined in accordance with 33 USC 2213(m).“*

Key Points
-Studies 50%-50%
-Implementation 65%-35%
-Justification can include other social effects
-Ability to pay

SECTION 116 ACCOMPLISHMENTS

Barrow

Construct five miles of shoreline protection along the coast of Utqiagvik and Browerville.

- Funded $364,000,000 in DRSAA to design and construct project
- Total Project Cost: $494,012,000 (newly certified)
- Study and Design funded through remaining Alaska Coastal Erosion program funds

Kenai Bluffs

The project will provide a berm that stretches about 5,000 feet along the base of the eroding City of Kenai bluff.

- Funded $28m in BIL for design and construction
- Total Project Cost: $44,409,000
- Study funded under GI
- Design now funded under BIL but City performing

WRDA 2022 PROVISIONS

Sec. 402. Storm damage prevention and reduction, coastal erosion, and ice and glacial damage, Alaska.

-Repeals and replaces Section 116

-Allows all previously approved Section 116 projects to continue under this authority

-Ability to Pay gets linked to Economically Disadvantaged Communities

What this means

-Economically Disadvantage Communities defined

(1) Low per capita income - The area has a per capita income of 80 percent or less of the national average.

(2) Unemployment rate above national average - The area has an unemployment rate that is, for the most recent 24-month period for which data are available, at least 1 percent greater than the national average unemployment rate.

-Both Barrow and Kenai qualify under unemployment rate

-Both want to see WRDA pass/fail as this greatly affects cost sharing

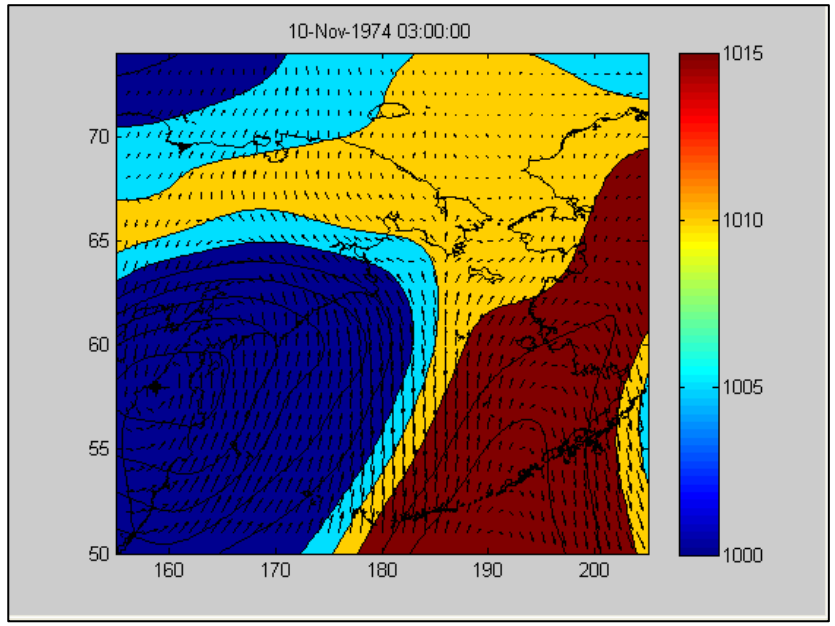
THE FUTURE

Section 117 and 116 have been successful and more communities want assistance.

State identified 31 environmentally challenge communities, many due to erosion

Data driven systems like Western Alaska Wave Model need updating

Cost effective arctic shoreline erosion techniques



Alec Bennett, Ph.D.

Dr. Bennett is a faculty member at the University of Alaska, an expert in computational modeling of climate driven hazards and extreme events, and has a background in security related analysis, from local to national levels. His work focuses on links between climate related drivers and security related concerns for proactive planning and decision making under uncertainty. He leads the Climate Security graduate program within the Homeland Security and Emergency Management program at UAF and is an active member of the Center for Arctic Security and Resilience.

Vladimir Alexeev, Ph.D.

Dr. Alexeev is an expert in large-scale climate modeling with global and regional coupled circulation models, including modeling of coastal processes. He uses a hierarchy of models and observational data to study large-scale dynamics of climate. He graduated from the Moscow Institute for Physics and Technology in 1984, defended his PhD in 1987, worked at the Institute of Numerical Mathematics of the Russian Academy of Sciences until 1994, Institut fuer Atmosphaeren Physik an der Universitaet Rostock in Germany (1995-96) and from 1996 at the Niels Bohr Institute of the University of Copenhagen before moving to Alaska in 2002.

Impacts of Changing Sea Ice on Wave Climate and Shoreline Erosion

Alec Bennett, Ph.D., and Vladimir Alexeev Ph.D.
International Arctic Research Center, University of Alaska Fairbanks
Fairbanks, AK.

Background

A wanning Arctic presents a range of foreseeable changes, but also brings significant uncertainty for planning purposes. One of the most frequently identified direct impacts for the Arctic has been the reduction of Arctic Sea ice from historical levels. The effects on the nearshore environment generated by this loss are widespread. Reductions of Arctic Sea ice directly alt□r the wave environment in profound ways, as larger areas of open water result in greater fetch length for wave development. Significant wave height in the region had historically been minimal, even during summer lows. Under recent and projected changes, however, nearshore wave activity is expected to grow substantially, poising significant planning challenges. One of the most identifiable of these has been recognized as a rapid advancing of coastal erosion rates.

Erosion

Traditionally the North Slope of Alaska has. been protected from significant erosion impacts due to a combination of low fetch distances, protective landfast ice, and permafrost strengthened ground that was more resistant to rapid erosion events. In the past few decades, however, the combination of warming air temperatures thawing land and exposed coastlines has led to dramatic rates of erosion, reaching as high as 22m/yr. in high bluff environments with exposed coasts. The rates of observed erosion vary significantly along the coastline however as. surficial geology nearshore bathymetry, shore slope, and barrier island presence or absence present complicating factors for predicting specific rates of erosion into the future. Attempting to pan around these issues requires taking into account a large number of variables. Some of these factors are particularly unique to the Arctic environment and knowledge gained in other areas. may not transfer as readily. Among those unique factors are the effects of landfast and nearshore ice as part of these coastal systems.

Landfast Ice & Erosion

Landfast ice is. ice that forms. and attaches to the nearshore environment, and often forms. separately from sea. Ice (although the two often connect in the region during the coldest parts. of the year). However, even under reductions of sea ice landfast ice continues and is likely

to continue to present a number of challenges for erosion and coastal management. Some of the most significant factors include those, of 'ivu' events (ice push), and ice gouging or scouring which occurs in the subsurface environment, often in nearshore locations. Both of these situations are expected to increase in likelihood and severity with higher wave activity and erosion of barrier islands is. expected to complicate the challenges.

"Ivu"/ Ice Push Events

Ivu, or ice push events, occur when landfast ice is pushed on shore from high wind and wave activity which occurs more frequently in open water scenarios. These events produce significant shoreline disruption, with past events in Alaska exceeding 6m in height, extending 3.5km along shore and shifting debris as much as 130m inland. Other locations have seen as high as 12m walls of ice on shore. High erosion may occur as ice remains into later seasons and debris is transported via meltoff. Mechanisms of ice transport result in scarring of the landscape, generation of berms, and in some cases sediment buildup remains once ice has cleared. These have, the potential to alter local hydrology, disrupt permafrost in the nearshore environment, and the force generated by these events presents a threat to constructed infrastructure in the region. Under warming, it is expected these events will increase in frequency and intensity, as higher levels of wave activity led to early season breakup or disruption in the formation of landfast ice.

Ice Gouging/ Scouring Events

Similar to ivu v, events, ice gouging or scouring occurs when large pieces of nearshore ice are pushed into shallow areas by increased wind activity combined with higher wave heights, leaving deep gouges in subsurface structures. The shallow environment along the North Slope of Alaska, in many cases no more than 3-5m depths for the first 10-20km offshore combined with an increase of wind and wave activity is expected to increase the frequency and severity of events, presenting challenges for near shore navigation, potential damage to subsurface infrastructure like pipelines and transmission lines, and displacement of marine sediments

Barrier Islands

The presence or absence of barrier islands acts as protective modifiers for coastline wave activity, but under open water conditions, barrier island systems on the North Slope are seeing increasing movement, as storm events generate accelerated accretion in some areas and rapid erosion behavior in others. The increase in frequency of storm systems combined with open water is expected to have a strong influence on their persistence into the future, as many of these

islands have previously resisted erosion due to landfast shore ice during major storm seasons combined with subsurface permafrost acting as a limiting factor during erosion events. The absence of islands is expected to present more opportunities for ivu and ice gouging events to occur, as greater mobility of ice affects surface and subsurface environments.

UAF & Collaborators

With expertise on permafrost, sea ice dynamics landfast ice, and a range of coastal processes, UAF is exploring these issues alongside collaborators at the Department of Energy, USGS and other agencies. However, sparse observational networks, data resolution challenges, poor representation of key physical processes (e.g., erosion of permafrost-laden coasts, coastline evolution, etc.), and lack of a unified approach integrating the complex issues makes it difficult to develop new modeling tools for both short term warning systems and long-term planning.

Impacts of Changing Sea Ice on Wave Climate and Shoreline Erosion

Alec Bennett[1,2] • Hazard Modeler / Climate Security Faculty

Vladimir Alexeev[1] • Computational Modeler / Research Faculty

1. International Arctic Research Center, 2. College of Business & Security Management on the UAF Troth Yeddha' Campus

UNIVERSITY OF ALASKA FAIRBANKS

International Arctic Research Center

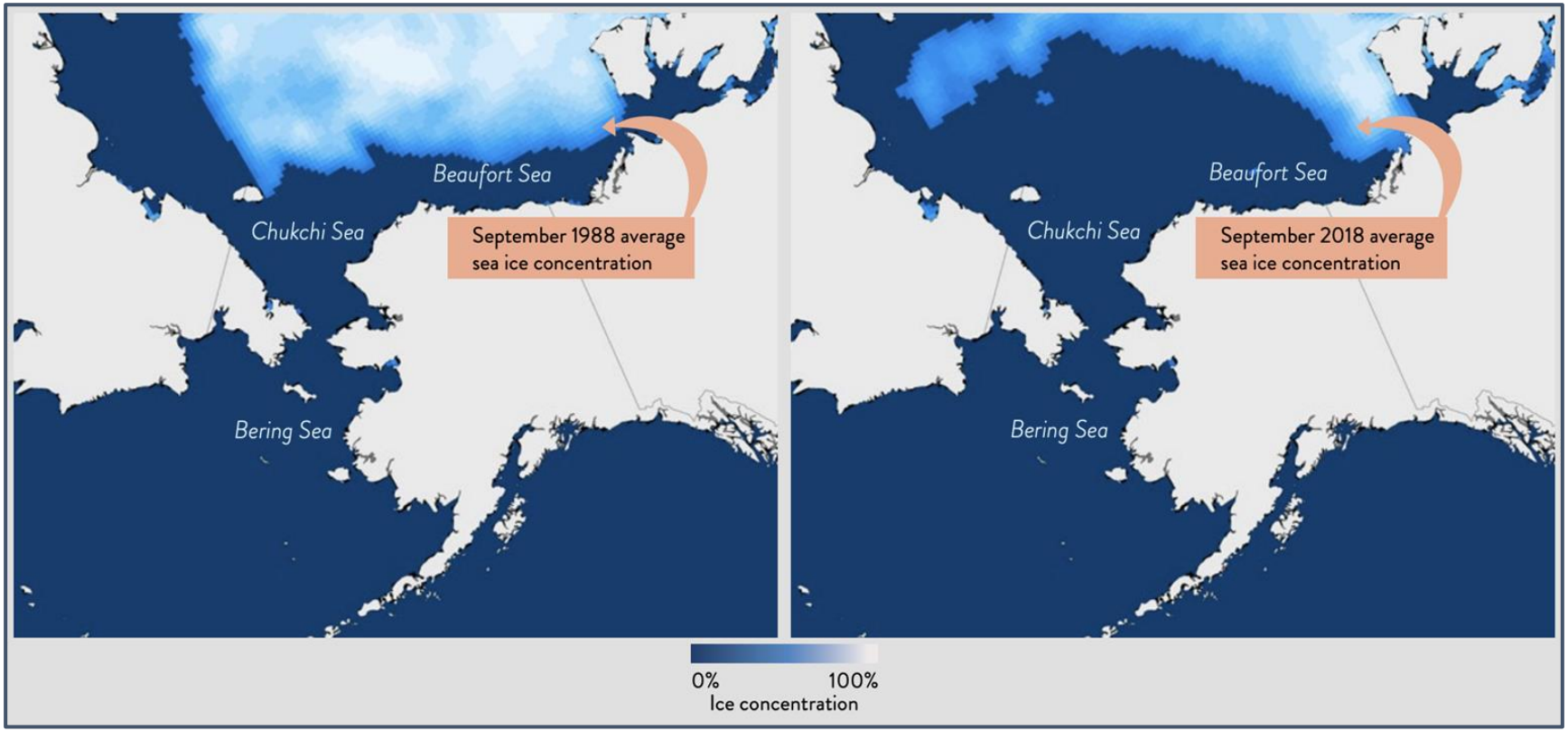
Background Image: Benjamin M. Jones

Sea Ice Extent

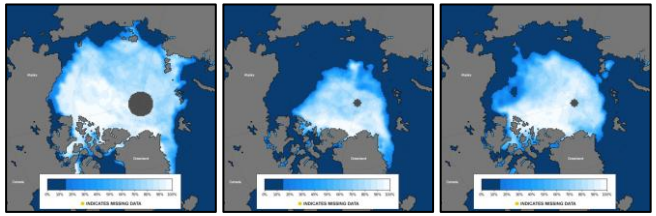
Long term trends have shown an overall reduction in sea ice extent and concentration, despite interannual variability.

Once protected coasts are now being exposed for longer periods, generating greater fetch length, resulting in higher wave activity.

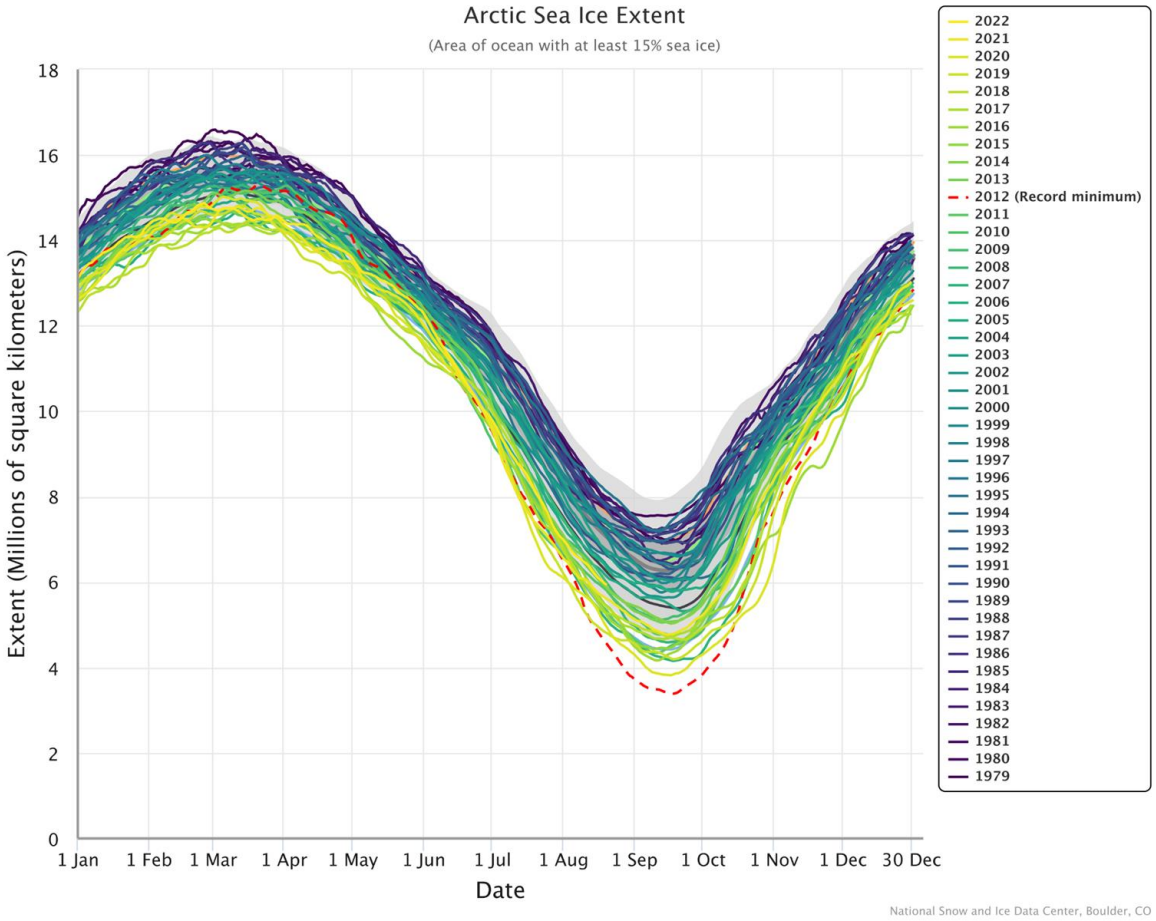
Sea Ice Concentration & Variability



Thoman, R. & J. E. Walsh. (2019). Alaska's changing environment: documenting Alaska's physical and biological changes through observations. H. R. McFarland, Ed. International Arctic Research Center, University of Alaska Fairbanks.

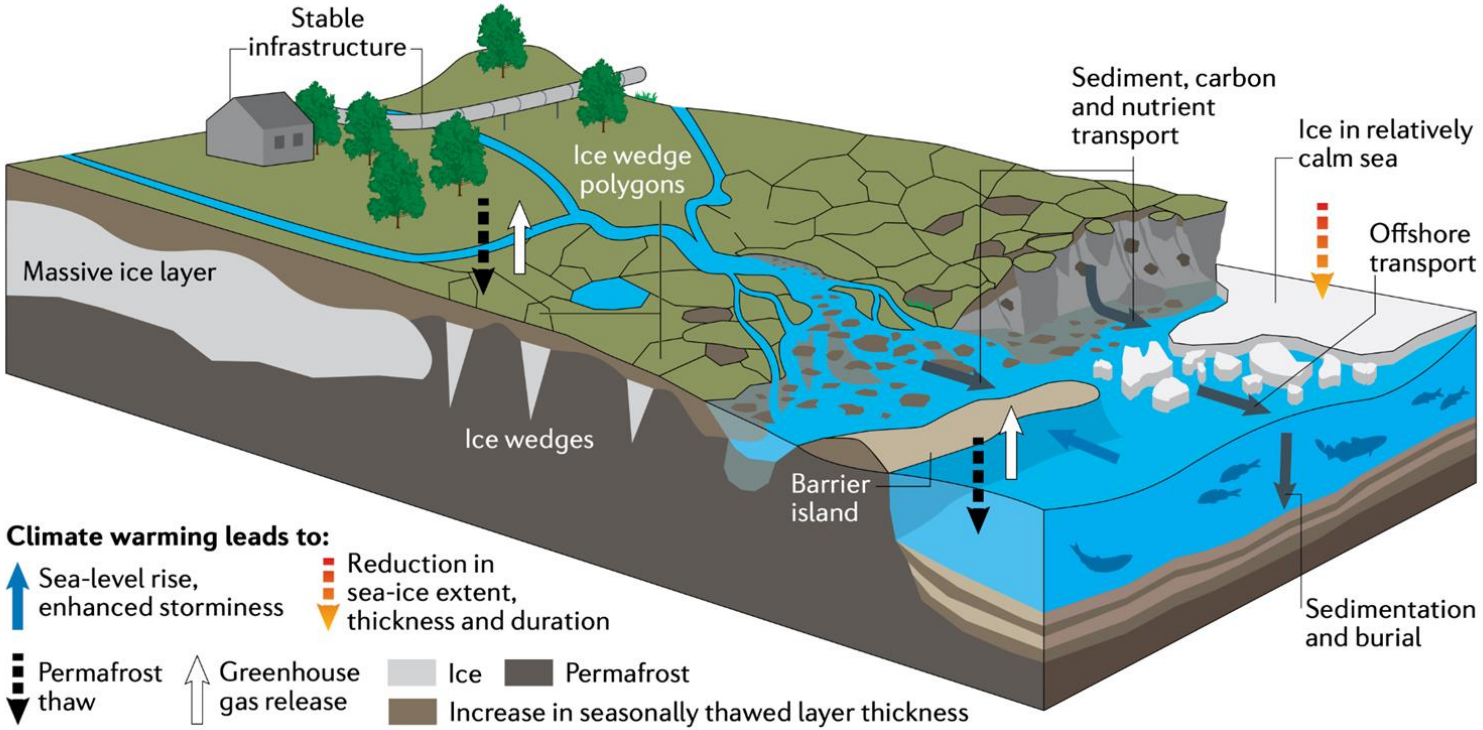


Interannual variability is a significant factor in planning, but long term trends indicate clear movement toward less sea ice over time.



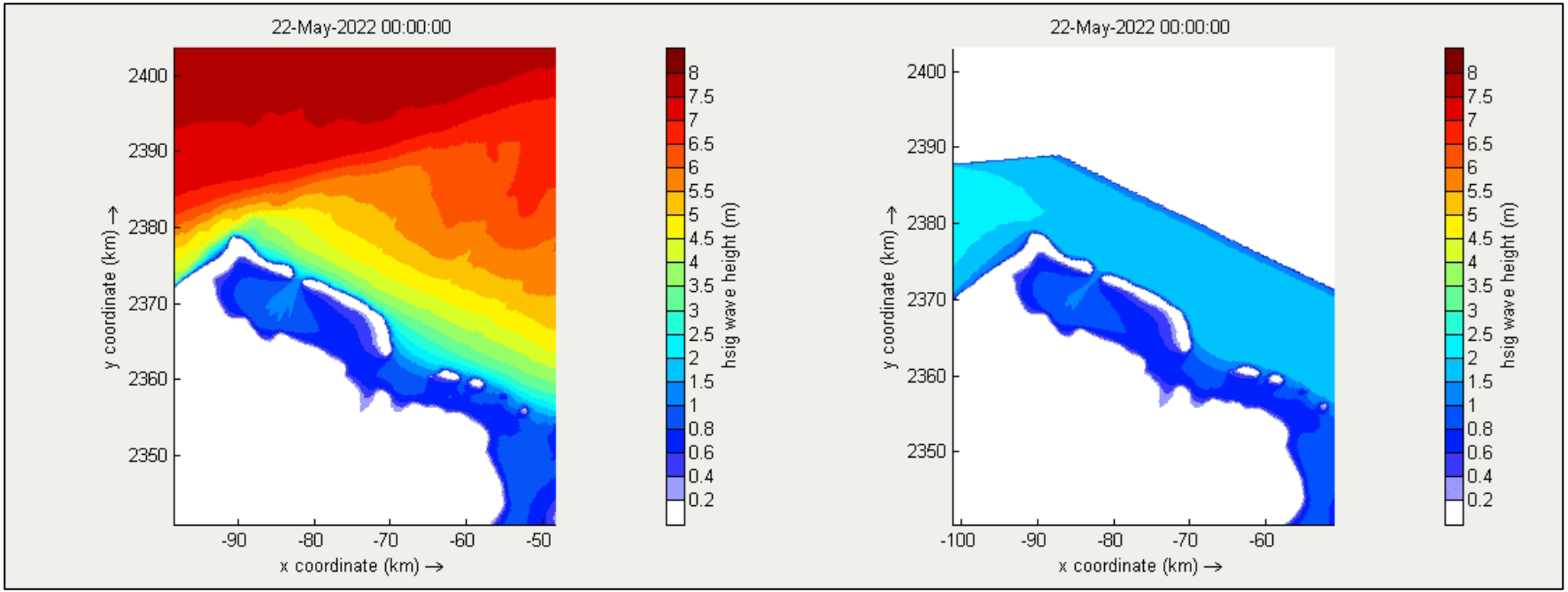
National Snow and Ice Data Center, Boulder, CO

Declining Sea Ice Drives Coastal Changes



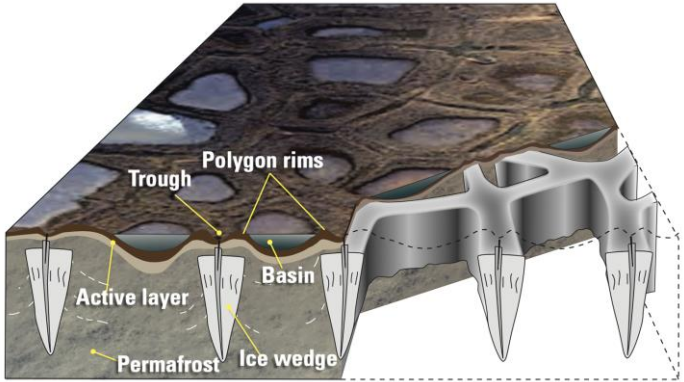
Irrgang, A.M., Bendixen, M., Farquharson, L.M. et al. Drivers, dynamics and impacts of changing Arctic coasts. Nat Rev Earth Environ 3, 39–54 (2022). https://doi.org/10.1038/s43017-021-00232-1

Utqiaġvik Significant Wave Height

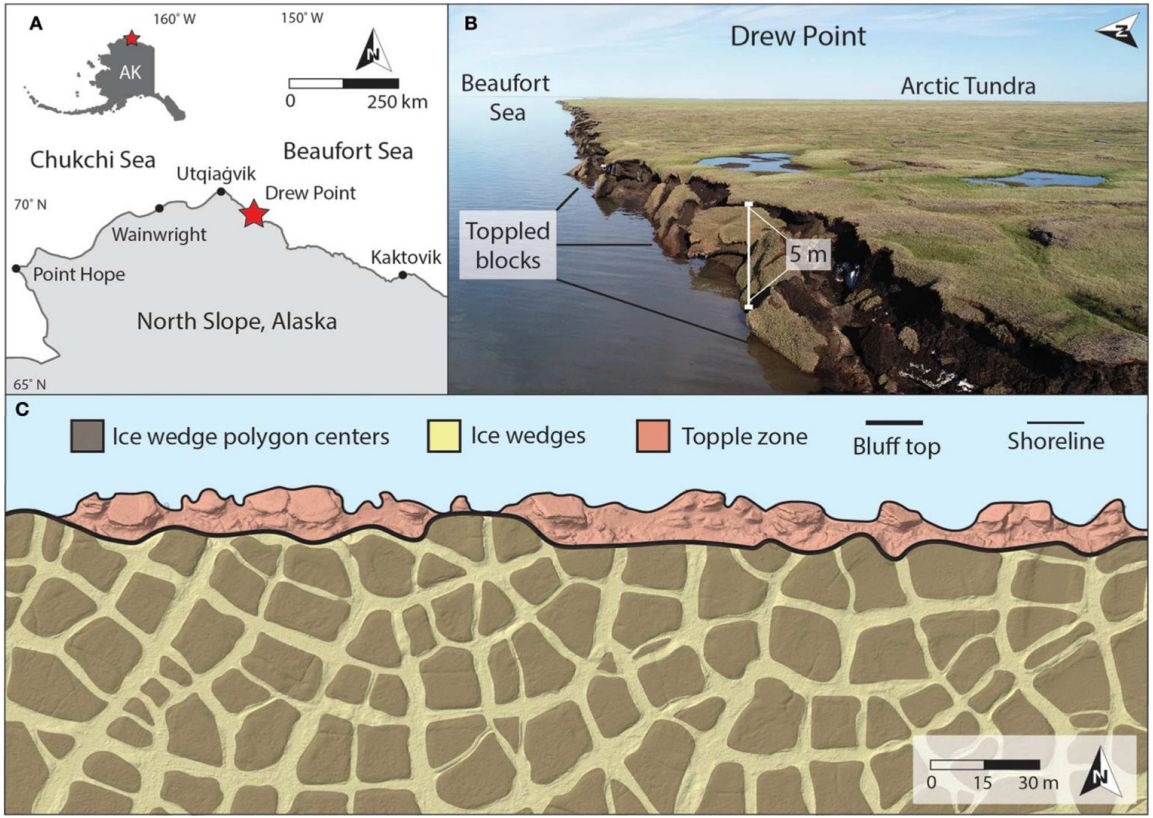


Wind forcing of 15m/s from 70 degrees. Comparison of open water (left) with offshore sea ice (right).
Modeling performed by V. Alexeev (IARC) using the Delft3D model.

Coastal Erosion

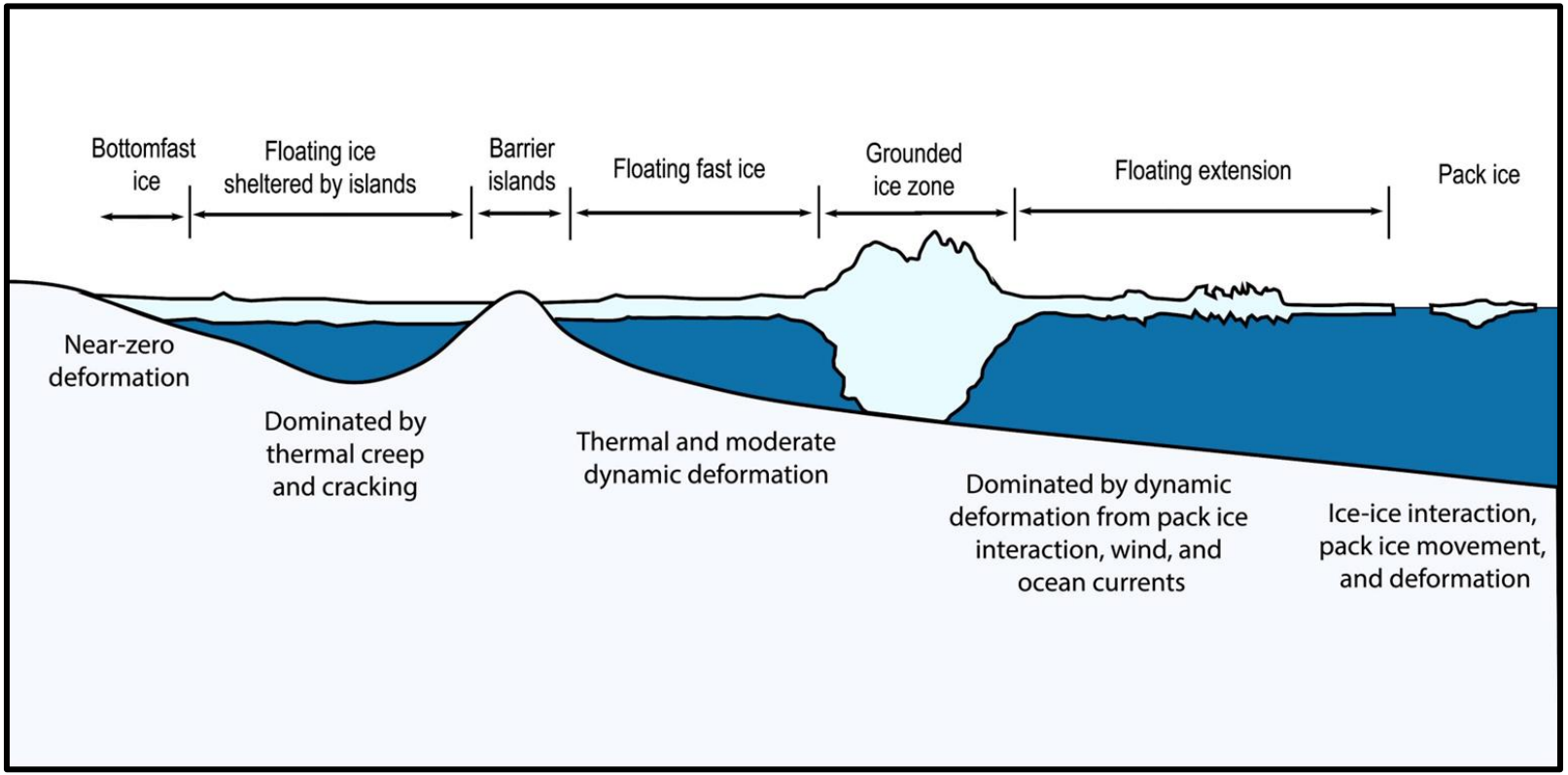


Martin, et al.. 2009. “Wildlife Response to Environmental Arctic Change: Predicting Future Habitats of Arctic Alaska.



Thomas, Matthew A., Alejandro Mota, Benjamin M. Jones, R. Charles Choens, Jennifer M. Frederick, and Diana L. Bull. 2020. “Geometric and Material Variability Influences Stress States Relevant to Coastal Permafrost Bluff Failure.” *Frontiers in Earth Science* 8 (May): 1–13. https://doi.org/10.3389/feart.2020.00143.

Landfast Ice Characteristics



Dammann, D. O., Eriksson, L. E. B., Mahoney, A. R., Eicken, H., and Meyer, F. J.: Mapping pan-Arctic landfast sea ice stability using Sentinel-1 interferometry, The Cryosphere, 13, 557–577, https://doi.org/10.5194/tc-13-557-2019, 2019.

Ice Push/Shove, or “Ivu”

Ivu events (also known as ice shove events) occur when wind and wave activity forces ice on shore.

These have the potential to alter coastal systems, leading to accretion, erosion, and secondary impacts.

Purcell, J. (2020, December 3). Northwest Alaska: Be prepared for an ice build up, Ivu possible. https://www.alaskasnewssource.com/2020/12/04/an-uncommon-forecast-in-northwest-alaska-prepare-for-an-ivu/ (Image originates from: Harvey and Arlene Sookiayak. Weatherpix Archives-2009)

Associated Press. (2006). Arctic ice crashes on Alaskan shores. https://www.nbcnews.com/id/wbna11064216

Ice Push/Shove, or “Ivu”

The result of these may include long term changes to nearshore hydrology, generation of new ridges, and amplified erosion following events.

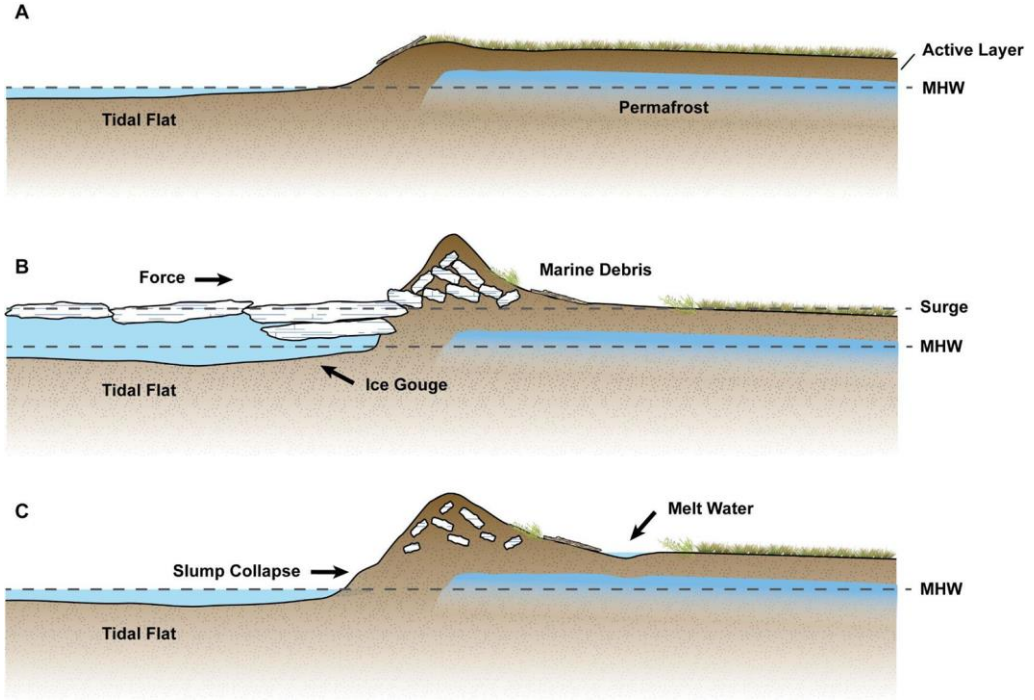


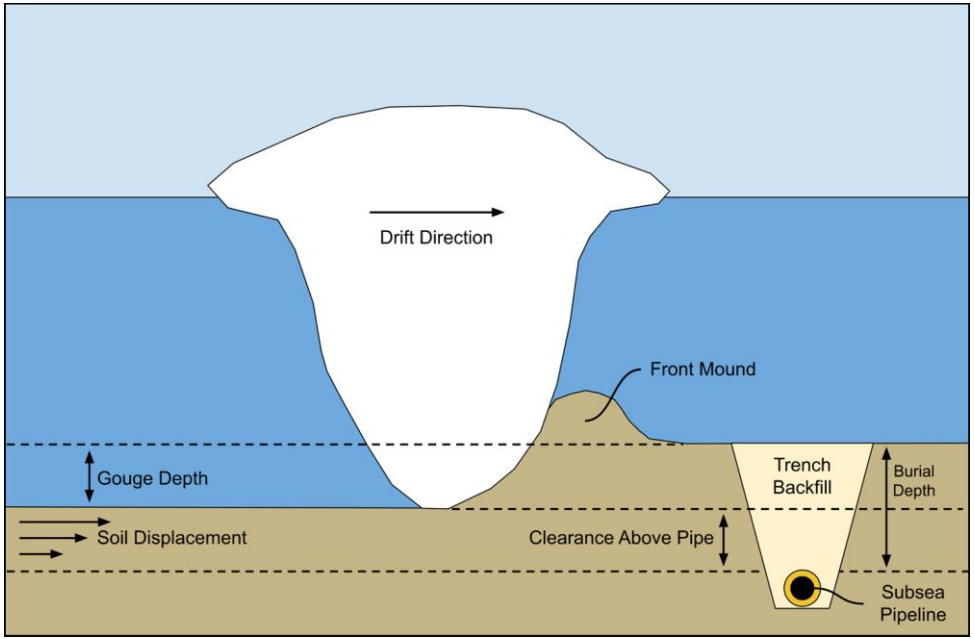
FIGURE 8. Conceptual diagram showing the before **(A)**, during **(B)**, and after **(C)** cross-sections of the Eastern portion of the coastline (Figure 3). Key features are annotated with the arrows. **(A)** Undisturbed coastline prior to the ivu depicting bluff consisting primarily of unconsolidated wind-blown sand. **(B)** During the event, ice, sediments, and other marine debris were piled on top of the bluff. **(C)** Ivu debris pile as it was surveyed and documented 5 months after the ice push. MHW, mean high water. https://www.frontiersin.org/articles/10.3389/feart.2020.00344/full

Ice Gouging Events

Ice gouging / scour events represent a similar concept to shove / ivu events.

Sea floor displacement occurs due to ice shove behavior, threatening infrastructure.

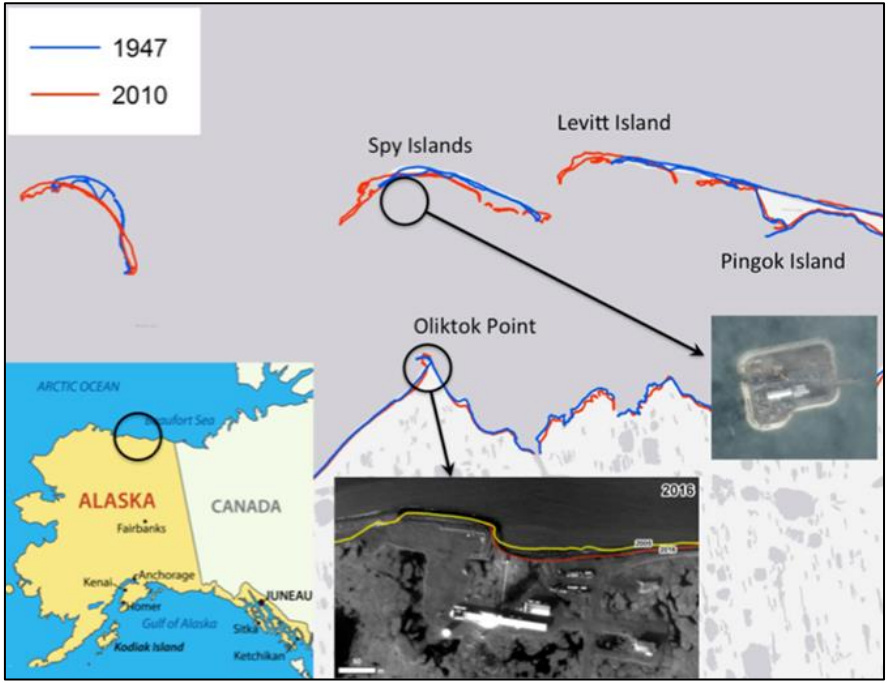
Added challenges exist in that the detection of these events is more difficult due to their subsurface nature.



Adapted by author from: Barrette, Paul D. , and Denise Sudom. "Ice-Soil-Pipeline Interaction during Seabed Gouging in Physical Tests: Database Analysis and Outstanding Issues." Paper presented at the OTC Arctic Technology Conference, Houston, Texas, February 2014. doi: https://doi.org/10.4043/24604-MS

Barrier Islands

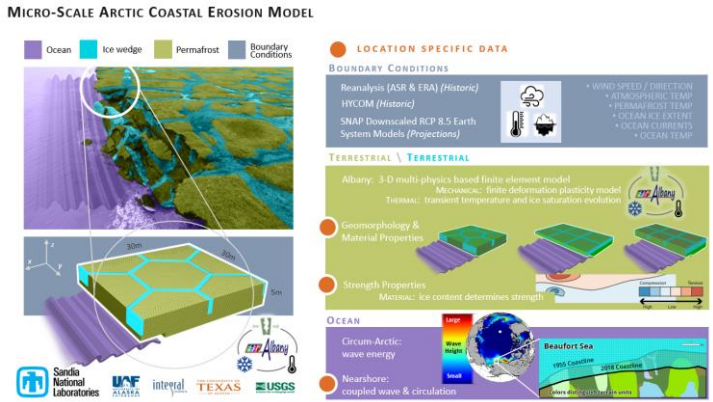
Barrier island systems and other forms of shelter currently comprise a significant portion of the Arctic coastline. These systems are prone to rapid erosion, not only impacting built environments on the islands, but exposing previously protected areas to significant wave activity.



InteRFACE & Collaborations

UAF is currently collaborating with the Department of Energy to improve the understanding of near shore coastal dynamics in the Arctic in order to better inform the Energy Exascale Earth System Model (E3SM). Ongoing work relies on a wide variety of models, in partnership with Sandia National Laboratories and Los Alamos National Laboratory.

This project is also informed by work with partners at USGS, and works to better understand physical changes and human system impacts through multi-sector dynamic approaches.

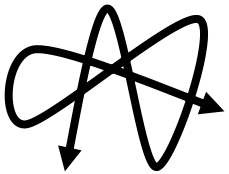


https://energy.sandia.gov/programs/arctic/software/arctic-coastal-erosion-ace-model/

Research & Development Recommendations

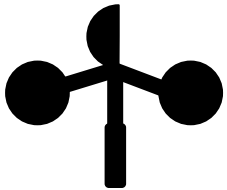
Key Processes

Key processes still not well resolved/modeled (permafrost-laden erosion, coastline migration, landfast ice formation and movement, barrier island dynamics, etc.) and feedbacks



Understanding Complex Extremes

Extreme events generate significant impacts, but often fall outside of trend based assessment



Monitoring & Observation

Limited number of monitoring stations, moorings, and infrequency of data gathering (including repeat gathering)

Logistics

More work is needed to integrate the understanding of these processes into planning efforts and developing decision-support tools

Contact details

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Vladimir Alexeev - valexeev@alaska.edu

WEBSITE

iarc.uaf.edu

Panel Session #2: Ongoing Research, Needs and Gaps

Moderator:

Dr. Jane Smith, Emeritus ST, CHL

Nathan Epps

Mr. Epps is a life-long Alaskan and is the Chief of the Hydraulics and Hydrology Section of the U.S. Army Corps of Engineers (USACE) Alaska District. His work covers a wide range of duties covering Civil Works, Military and Inter-Agency and International Support services business lines with a primary focus on the planning and design of navigation projects, storm risk management projects, and riverine hydrology. Nathan graduated from the University of Alaska Anchorage with a civil engineering degree in 2005 with emphasis in structural and coastal engineering and has worked for the Alaska District since that time. In his 17 years with the Corps of Engineers Nathan has been involved with coastal planning and design projects, including the Baseline Erosion Assessment for the State of Alaska, coastal flood risk management at Golovin, Sub-arctic deep draft ports at Nome and Port Clarence, and small boat harbors at Port Lions and St. George. Throughout Nathan's career with the Alaska District, he has provided guidance and review of coastal projects for rural and remote communities throughout Alaska, along with Military projects and Federal aid to Southeast Asia partners. Nathan was also the principal hydrologist for the Chena River Lakes flood control project for 5 years, providing forecast and operational decisions for Moose Creek Dam. During his career, Nathan has deployed to Afghanistan for a total of 18 months where he led development of national transportation infrastructure and focused on hydrologic issues. In all his work, Nathan particularly enjoys working on solving problems for communities with talented and dedicated teammates and any opportunity to share and develop his technical capabilities.

Armor Units for Coastal Protection in the Arctic

Nathan Epps
Alaska District
Anchorage, AK.

The Alaska District has a long history of experience in designing coastal protection and navigation structures using quarry stone armor units. The availability of rock in the state and the quality of the material has provided affordable projects for many locations through the state in climates affected by extreme cold temperatures, energetic wave conditions and sea ice loading. Successful project implementation dates back to the 1950s with construction of the Nome seawall which protects the northern town. More recent projects in Kivalina and Shishmaref have also protected communities north of the Arctic Circle.

The Alaska District is currently designing coastal protection works for Utqiagvik, the northern most community in the United States. The current design incorporates quarried armor stone with successively smaller underlayers dissipate wave and ice energy and to protect the fine soils of the shoreline from eroding. In locations where rock production and placement are not feasible, concrete armor units can be used instead. In most cases, these sites will be located far away from a viable rock source or in close proximity to a supporting concrete industry to cast armor units nearby, or the wave loading conditions at the site are so extreme that it becomes cost prohibitive to produce stones large enough to remain stable. One such site is located on Shemya Island, home to Eareckson Air Force Station where the fuel pier needed to support continued operations is protected by 12 ton Dolos units. These units were manufactured in Tacoma and shipped to the site for placement.

Typical failure modes for shore protection and navigation structures include erosion at the toe of the structure leading to launching of armor units, run up and over wash of waves leading to erosion behind the crest or damage to facilities to be protected and breakage of armor units under wave and ice loading. The use of rock as an armoring material has proven to be successful under these conditions; weighted toe details with extra rock allows armor units to shift and adapt to lower toe elevations as erosion occurs. The porosity of rock structures reduces wave run up and dissipates energy through the voids of the structure. Armor rock has also been shown to manage extreme temperature swings and repeated freeze-thaw cycles without breakage and resist ice shove events without damage.

Concrete armor units are untested under these conditions and their performance to these conditions is not known. Concrete armor units are usually cast of greater than 5,000 psi concrete

and are capable of handling great compressive loads, but the concrete is unreinforced and unit movement and impacts cause cracking and tension loads which lead to breakage under high loads or a large number of loading cycles. Unit breakage produces heavy pieces which are lighter than design wave conditions and have the potential to cause secondary impact damage during subsequent loading events.

To utilize this technology in the arctic environment, it is recommended to perform scale model testing of concrete units subject to ice loading and perform a full-scale demonstration project of a coastal structure in the Arctic to monitor performance of these units to the ice and temperature conditions of this region. Successful test results would provide the Corps of Engineers an alternative material to recommend for construction of facilities in the arctic region.

ARMOR UNITS FOR COASTAL PROTECTION IN THE ARCTIC

Lewis Nathan Epps, PE
Chief, Hydraulics and Hydrology
Alaska District
Date: 14 SEP 2022

US Army Corps of Engineers®

THE ALASKAN ROCK EXPERIENCE

KIVALINA – CONSTRUCTED 2008 - 2010

2019 PHOTO

SHISHMAREF – CONSTRUCTED 2004 - 2009

NOME SEAWALL – CONSTRUCTED 1947 - 1951

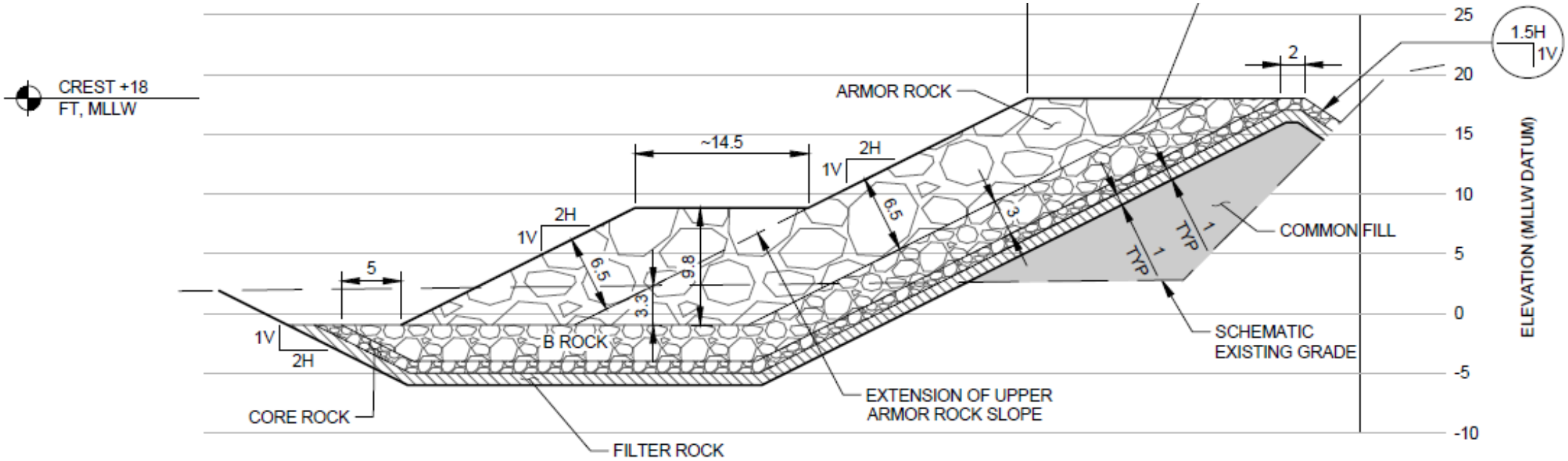
BAR008 ARMOR DESIGN

Why does the revetment design use rock?

Armor Rock:	5,400 lbs.
B Rock:	540 lbs.
Core Rock:	20 lbs.
Filter Rock:	gravel

Rock quality test requirements:

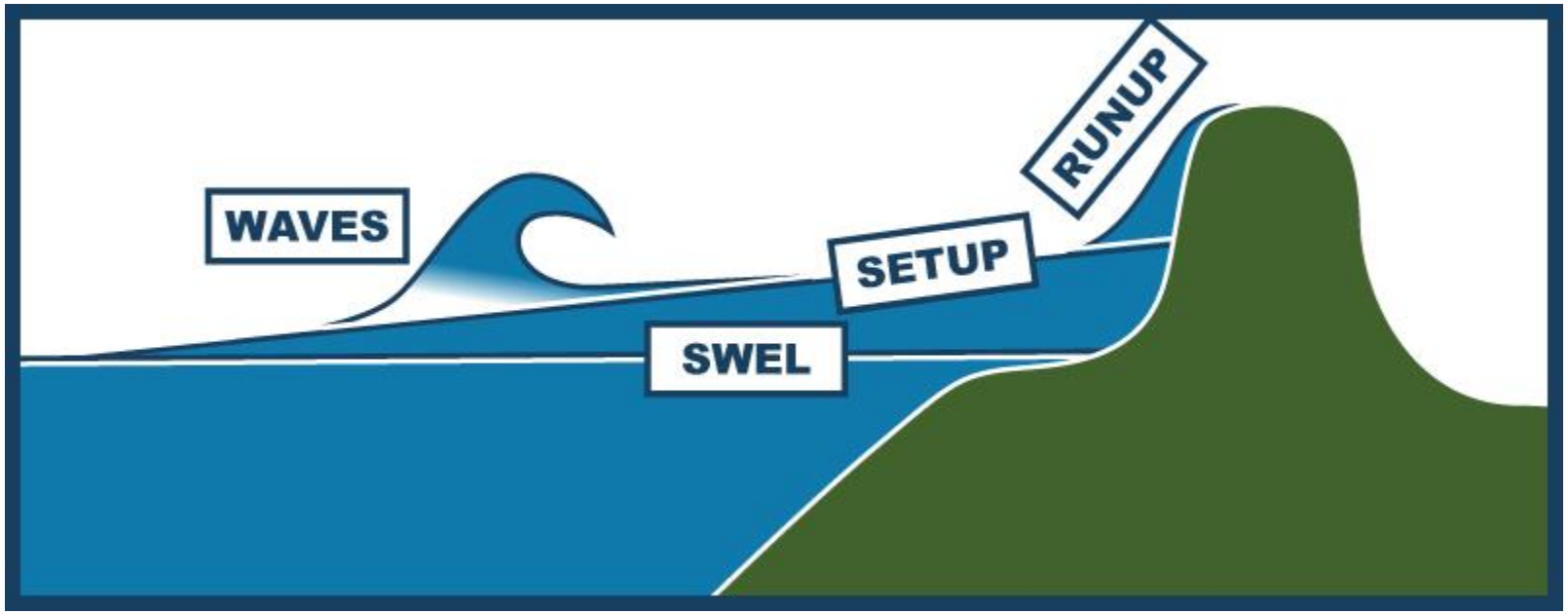
Resistance to Freezing and Thawing
Resistance to Wetting and Drying
Resistance to Sodium Sulfate
Abrasion
Accelerated Expansion (Ethylene Glycol)



DOLOS – EARECKSON FUEL PIER

CRITERIA FOR REVETMENT ARMOR UNITS

- Adjustability to Toe Erosion - armor units will shift in response to beach dynamics
- Porosity – voids between armor units absorb wave energy and reduce run up
- Resistance to Waves and Ice – armor units must be stable under design wave conditions and ice loading events to prevent armor unit movement and breakage



CORE-LOC UNITS

DOLOS – EARECKSON FUEL PIER

XBLOCPLUS ADVERTISED CONSTRUCTION

ICE SURVIVABILITY – SCALE MODEL TEST

63 seconds

ICE SURVIVABILITY – NOME CAUSEWAY

25 seconds

RESEARCH AND DEVELOPMENT RECOMMENDATIONS

Key Uncertainties with Concrete Armor unit Survivability

- Resistance to movement under ice loading conditions
- Structure porosity impacts on run up
- Structure sensitivity to toe scour conditions

Demonstration Program

- Scale Model test of CORE-LOC demonstration section
- Full scale demonstration revetment project at an ice-affected site and monitoring using CORE-LOC units

Rebecca Kloster

Rebecca Kloster is a civil engineer within the Hydraulics and Hydrology Section at the Alaska District of the U.S. Army Corps of Engineers (USACE). Her work centers on planning and design of small boat harbors and coastal storm damage reduction projects. Prior to joining the Alaska District, Rebecca graduated from OSU with a Master of Science focused on coastal engineering. In her 7 years with the Alaska District, she has had the opportunity to work on several interesting and challenging projects that required collaboration with USACE ERDC-CHL and experts in other coastal districts. Rebecca has designed two small boat harbors, one to support commercial fishing in Craig, AK and another to support subsistence activities in Elim, AK. She also designed a 5-mile coastal revetment for Utqiagvik, AK, the northernmost community in the United States. She also supports Alaska District O&M work by performing the engineering for maintenance dredging at Dillingham and Nome Harbors, including working with the US Naval Academy to study sediment movement at Nome Harbor, and evaluating proposed modifications to USACE harbors through the Section 408 program. She provided guidance for the addition of a wave barrier tied into Haines Harbor and the ferry dock replacement on Sand Point Harbor. Rebecca is passionate about working with rural communities to develop engineering solutions for coastal subsistence and economic accessibility and vulnerability issues.

Storm Selection for Design Event Scenario–Case Study at Utquigvik

Rebecca Kloster
Alaska District
Anchorage, AK.

Utqiagvik (formerly known as Barrow) is the northernmost community in the United States, approximately 750 miles north of Anchorage, Alaska. In 2003 the Barrow Storm Damage Reduction Project feasibility study was initiated but no National Economic Development plan was identified. In 2017 the Alaska District was able to re-evaluate a project to reduce the risk of erosion along the Utqiagvik coast. To determine the design conditions for the 5-mile coastal rock revetment, the Alaska District worked closely with ERDC-CHL to develop the method for storm selection and determined the validity of the model results based on historic community observation. The modeling utilized the Arctic coast Wave Information Study (WIS) hindcast data, which was originally developed during 2003 Barrow Storm Damage Reduction Project and covered 1982 through 2003 and 27 pre-1982 selected storms. The WIS data was updated through 2017 for the Barrow Alaska Coastal Erosion Project. NOAA offshore mean weekly ice fields were used to limit wave growth in the third-generation wave model (WAM) on a month-to-month basis. Offshore ice fields with 70% ice coverage were treated at 'land' within the WAM model. To determine storm surge and wave height at the project site, the Coastal Storm Modeling System (CSTORM-MS) coupled Advanced Circulation (ADCIRC) and Steady State Spectral Wave (STWAVE) was utilized. The ADCRIC-STWAVE model did not account for shorefast ice and therefore did not capture the potential protective nature of shorefast ice against spring storms.

The 2003 modeling effort showed that defining a storm that impacts Utqiagvik was not a simple measure of change in wind speed, wave height, or barometric pressure. Due to the presence of ever-changing offshore sea ice, there is not a linear relationship of wind speed and locally generated wave heights. The fetch over which wind blows is not a constant controlled by land and the duration may not be long enough for fully developed seas. Similarly, the previous study showed that most waves are local waves and long period waves seldom reach this site. Low pressure systems that impact Utqiagvik, Polar Lows, form quickly (12-24 hours) and dissipate quickly (often within 2 days). Since these pressure systems are short lived there is limited time for them to change the total water level in the way that tropical cyclones and hurricanes do.

To define "what is a storm" for Utqiagvik, a peaks-over-threshold method for storm selection was used on the continuous data from 1985-2017 for wind speed, offshore wave height, and barometric pressure. The wind speed was filtered for ice free months and then for winds that

were directed towards shore. The first 34 storms were selected based on wind speed and then the top nine storms that were classified by offshore wave height, but not already listed based on wind speed, were added to the list. A search through historic documents, including state disaster declarations and news articles, was conducted to find storms that had news-worthy impacts, but were not already captured, added three more storms. The top ten events based on pressure, not already captured, were added along with the top ten wind events during iced conditions. The wind events during ice conditions were included to account for potential changes in storm size due to changing sea ice conditions. Overall, 66 storms were selected. With the limit of 33 years of continuous hindcast data, the largest offshore wind speed and wave height that could be reasonably estimated was the 66-year storm event.

The largely destructive October 1963 storm, available from the hindcasted large storms prior to the continuous data, was also modeled to compare inundation results to photo-evidence and observations of inundation at northeast end of Utqiagvik, the Naval Arctic Research Lab (NARL). Surprisingly, the ADCIRC-STWAVE model was not able to demonstrate any inundation within the community with the October 1963 modeled storm. By looking at the at the inundation extents the team was able to determine if the model was producing results that were inconsistent with historic observations within the community. The Alaska District and ERDC-CHL team determined the best path forward was to use the wave-resolving version Xbeach to develop annual exceedance probabilities for run-up elevation and overtopping. During model validation, ERDC-CHL was able to produce a 2D wave-resolving video showing similar wave run-up overland flow patterns as observed during a 2018 storm near the center of town. The run-up and overtopping AEP curves were used to determine the crest elevation of rock revetment.

Defining the physical processes required for storm development in the Arctic is a complex, non-linear process that dependent on ice extents. There are limited water-level and wave field measurements along the Arctic coast to calibrate a model to. Observations of design event scenarios are dependent on historic community observation, which coupled with limited field data, makes it challenging to define the physical processes required to develop damaging storms. To determine the accuracy of the models developed for Utqiagvik, historic photo-evidence and newer long-term coastal cameras were required. To model the impacts that Arctic storms have on the Utqiagvik coastline, a phase-resolving transect wave model was required. Though XBeach is a geomorphological model, the complex nature of coastal erosion in permafrost-rich area makes modeling changes in beach profiles challenging.

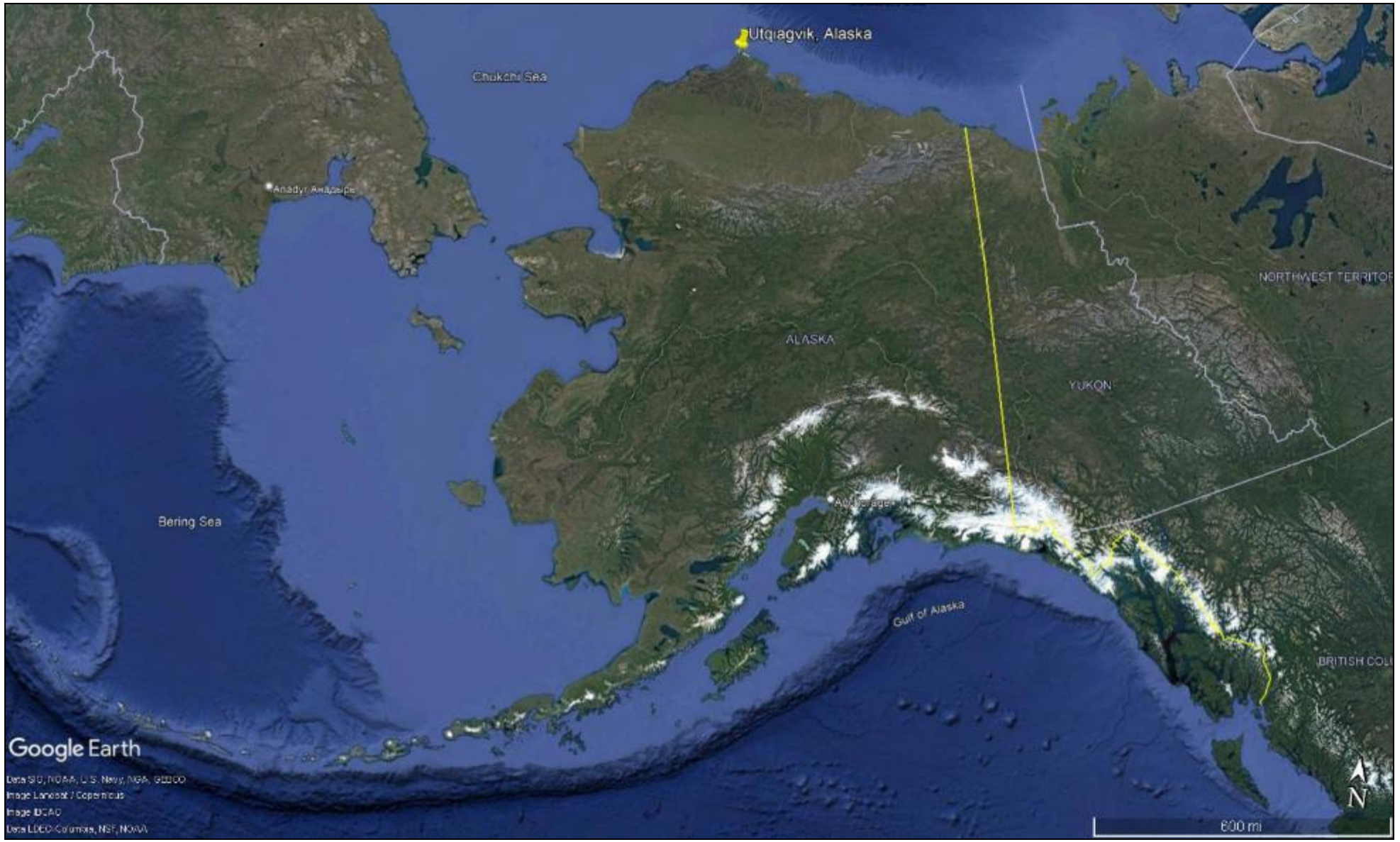
STORM SELECTION FOR DESIGN EVENT SCENARIOS – CASE STUDY AT UTQUIGVIK

Rebecca Kloster, PE
Hydraulics and Hydrology
Alaska District
U.S. Army Corps of Engineers
14 September 2022

US Army Corps of Engineers®

Utqiagvik, Alaska: Emergency Storm Risk Reduction Measure
August 2022

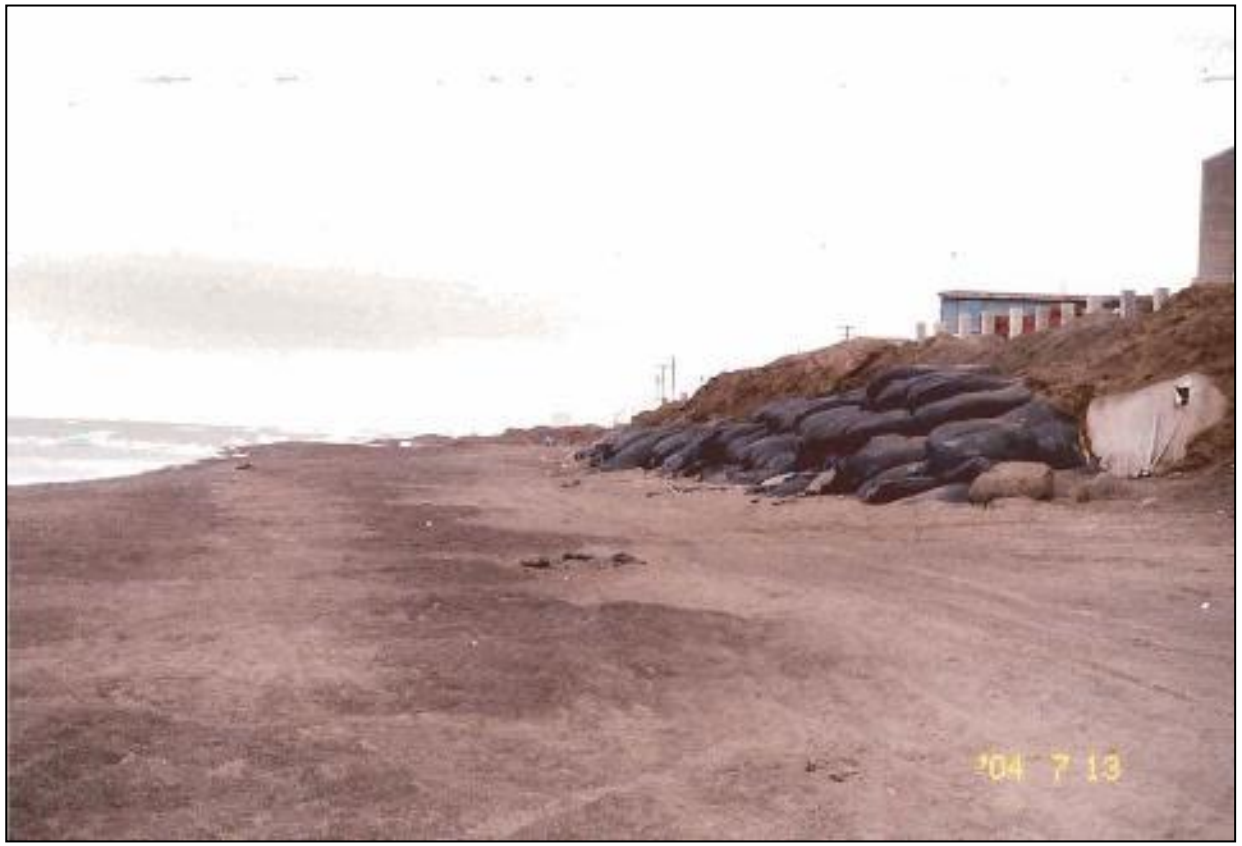
BARROW ALASKA COASTAL EROSION PROJECT



BARROW ALASKA COASTAL EROSION PROJECT

BARROW ALASKA COASTAL EROSION PROJECT

Impact of shorefast ice on coastal vulnerability:

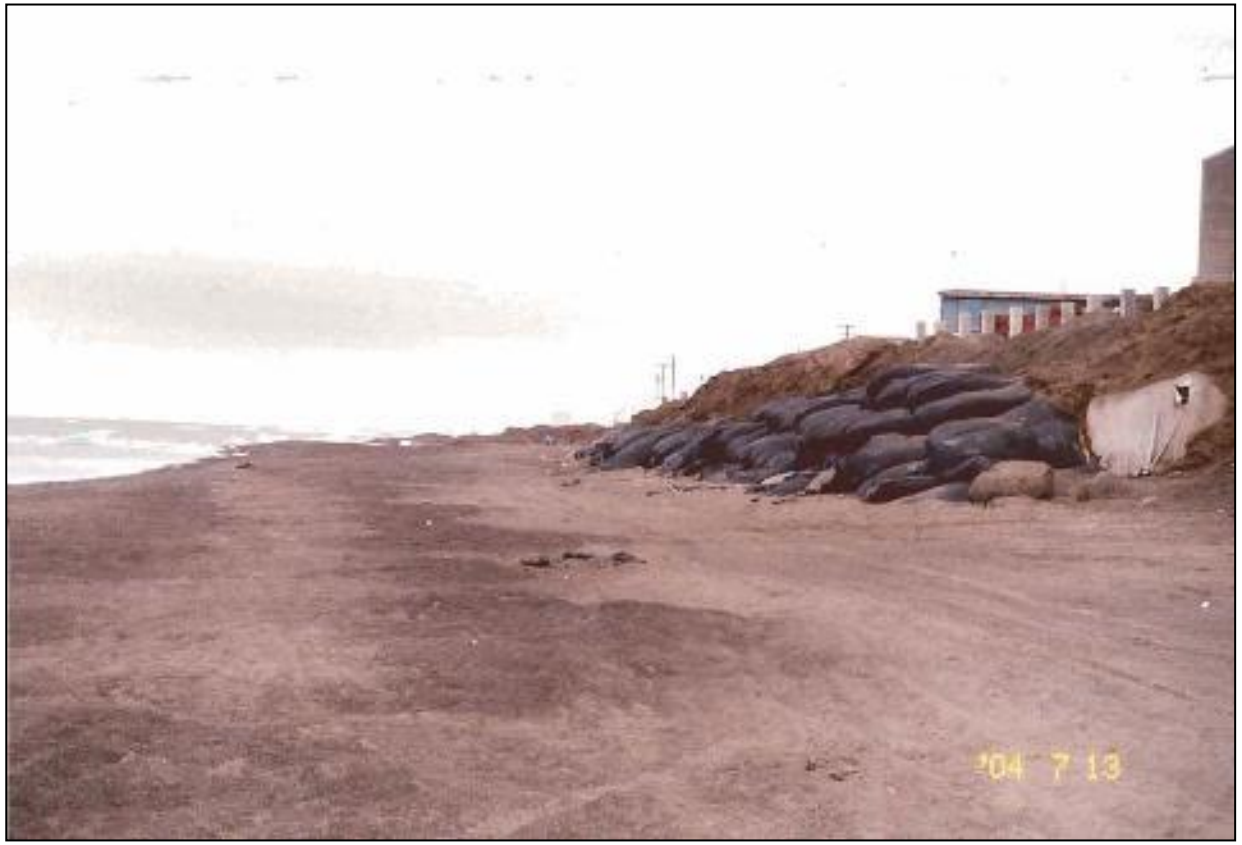


Utqiagvik, Alaska: Ice free summer beach
July 2004

Utqiagvik, Alaska: Ice impacted spring beach
June 2000

BARROW ALASKA COASTAL EROSION PROJECT

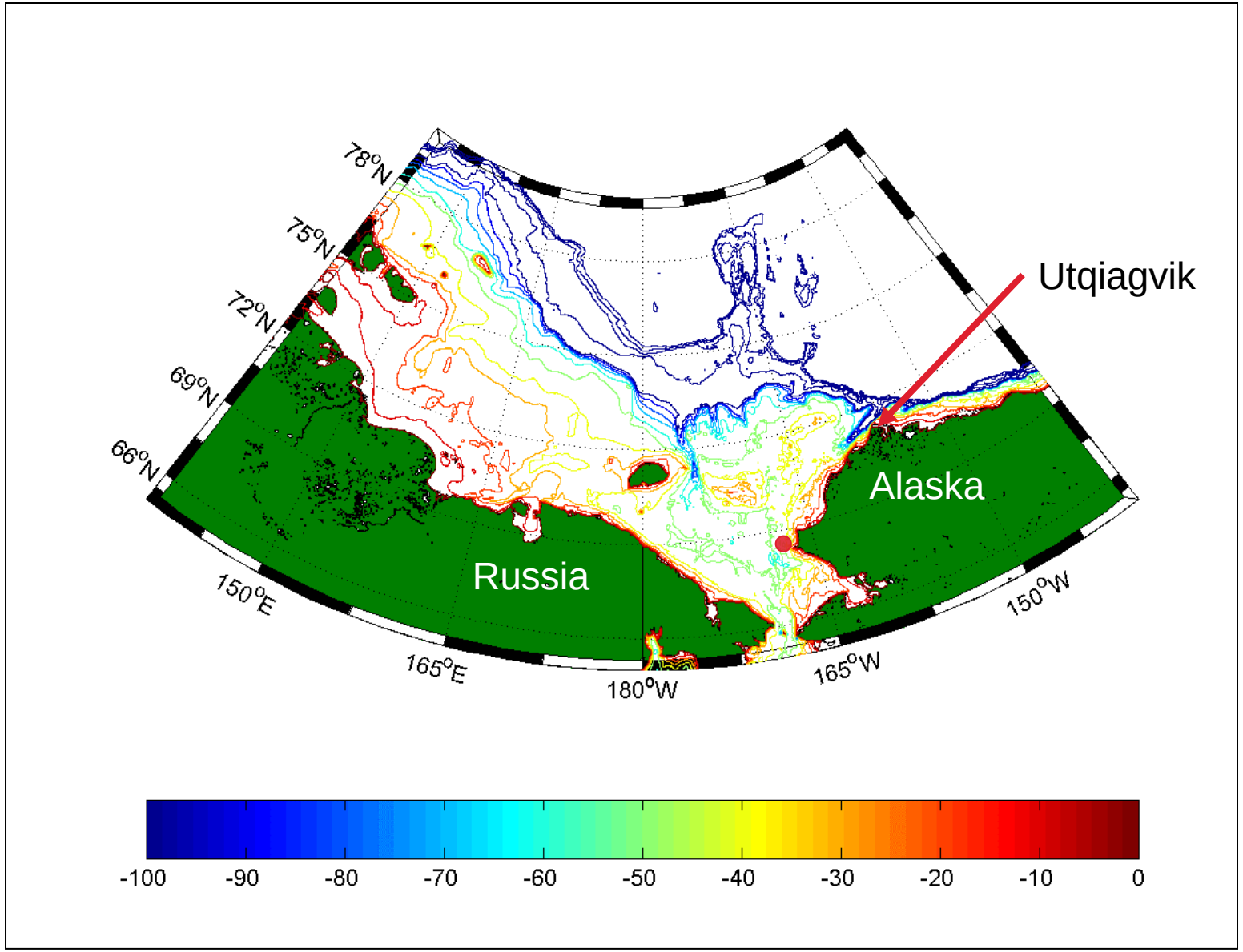
Impact of beach width on coastal vulnerability:



Utqiagvik, Alaska: Emergency Storm Risk Reduction Measure
July 2004

Utqiagvik, Alaska: Emergency Storm Risk Reduction Measure
August 2022

BARROW ALASKA COASTAL EROSION PROJECT

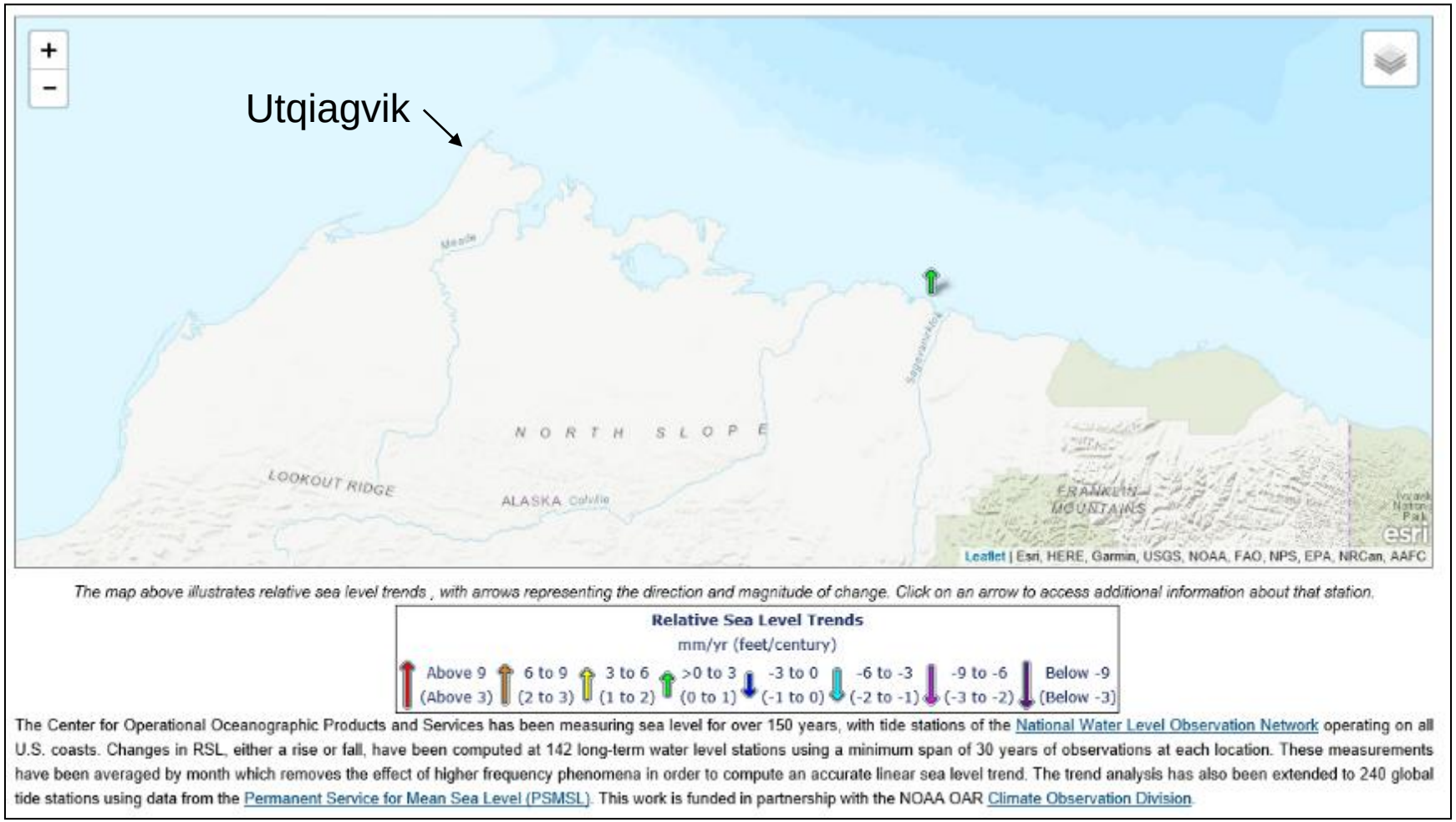


BARROW ALASKA COASTAL EROSION PROJECT

North Slope Borough's emergency response to coastal erosion:

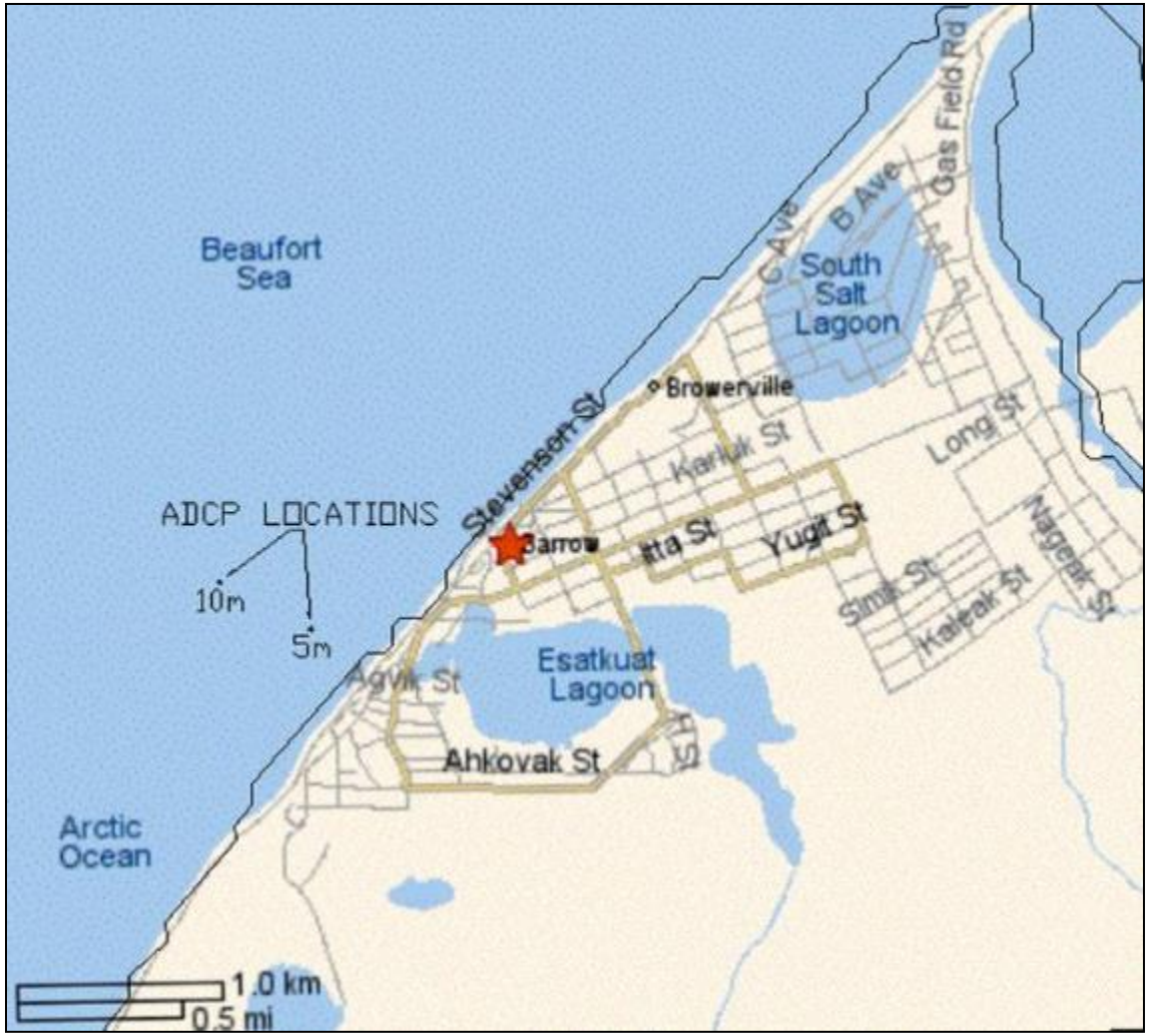
BARROW ALASKA COASTAL EROSION PROJECT

Availability of water level and sea-level rise data:



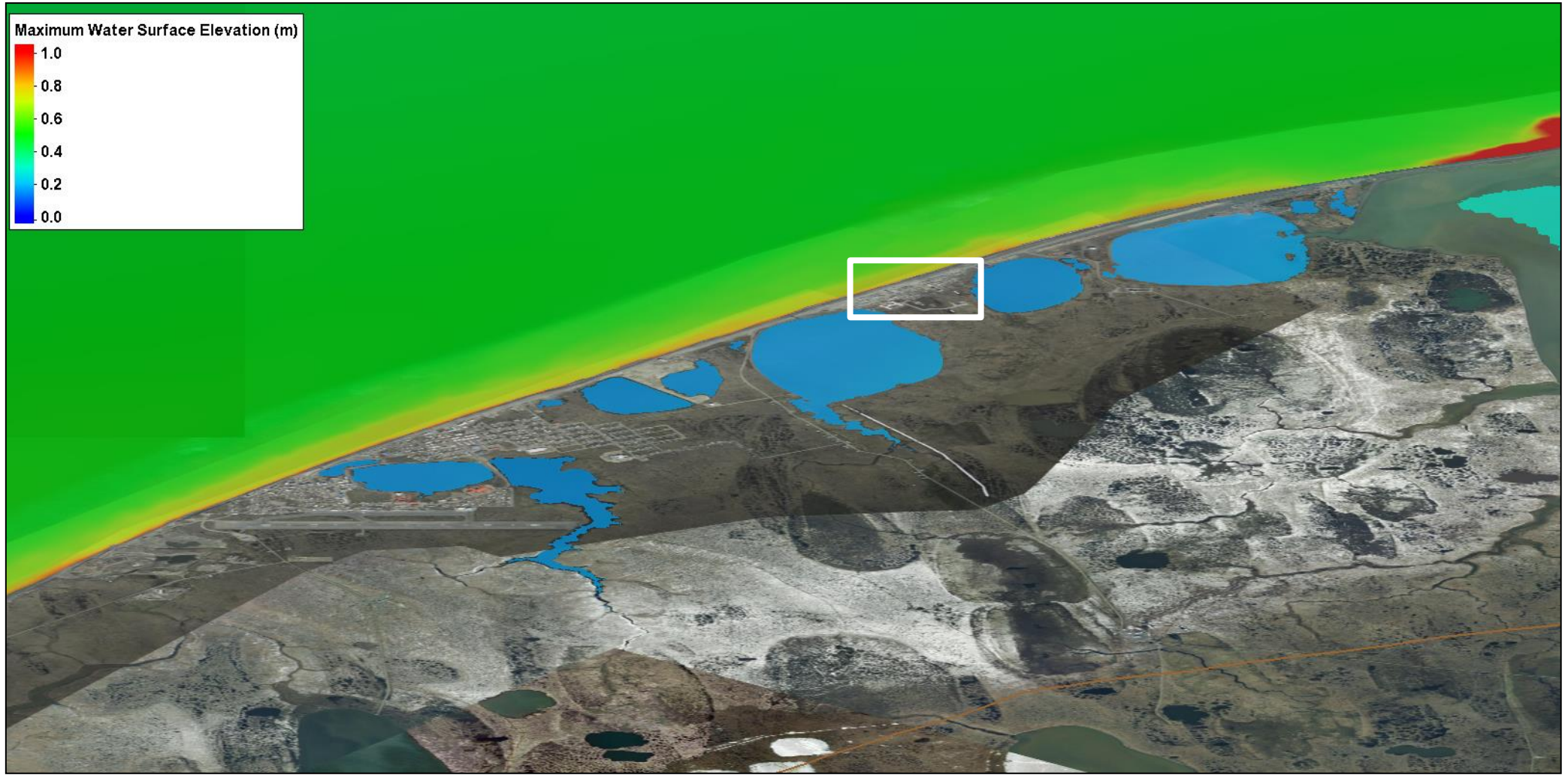
BARROW ALASKA COASTAL EROSION PROJECT

2003 ADCP data for model calibration:



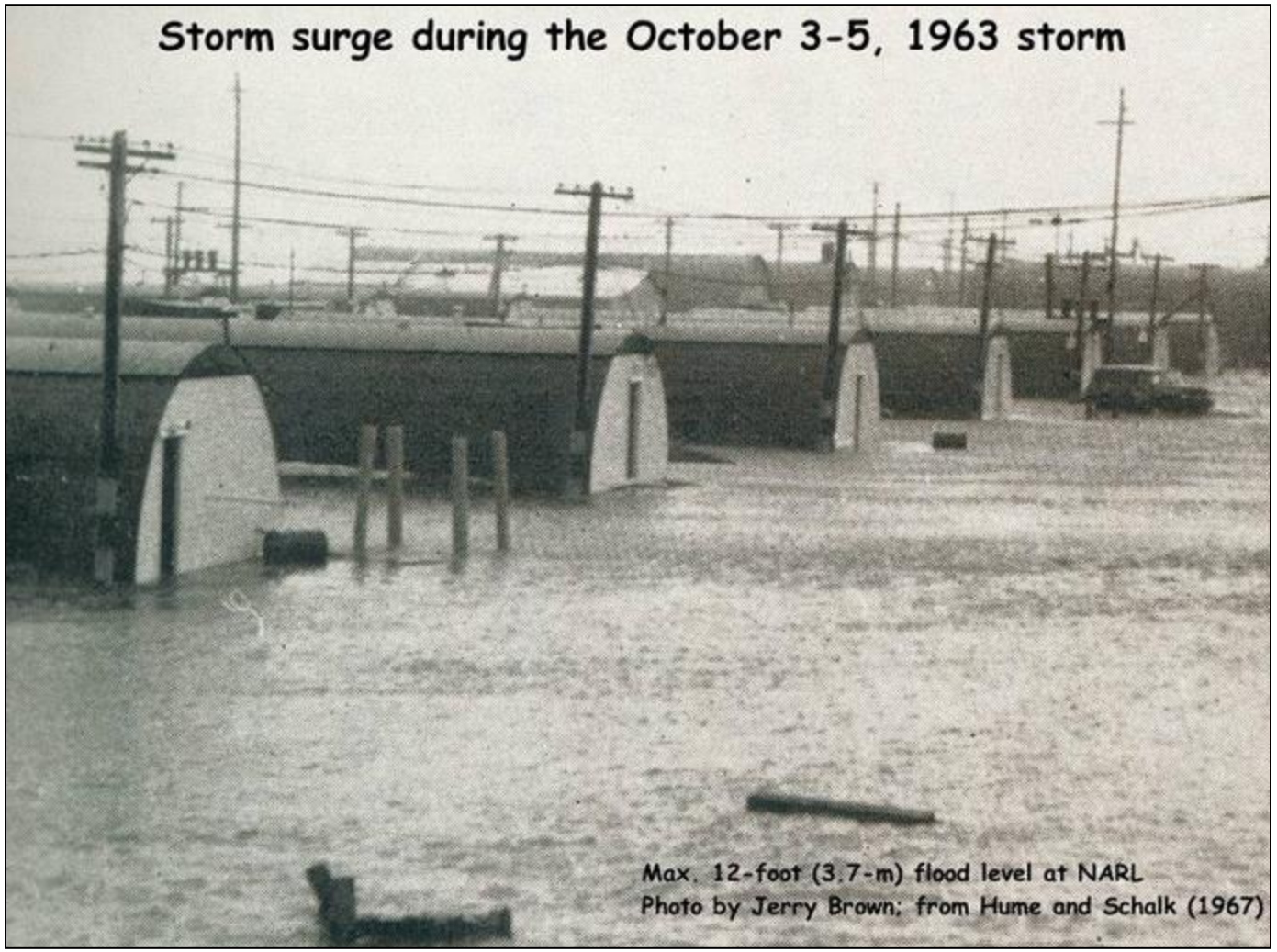
BARROW ALASKA COASTAL EROSION PROJECT

Challenges with modeling known inundation:



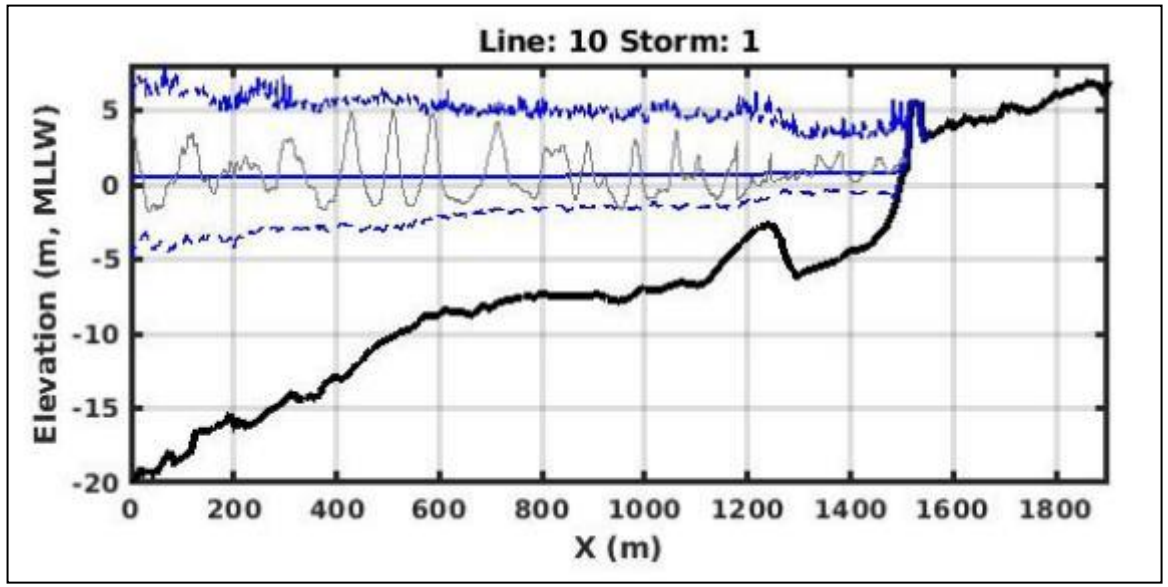
BARROW ALASKA COASTAL EROSION PROJECT

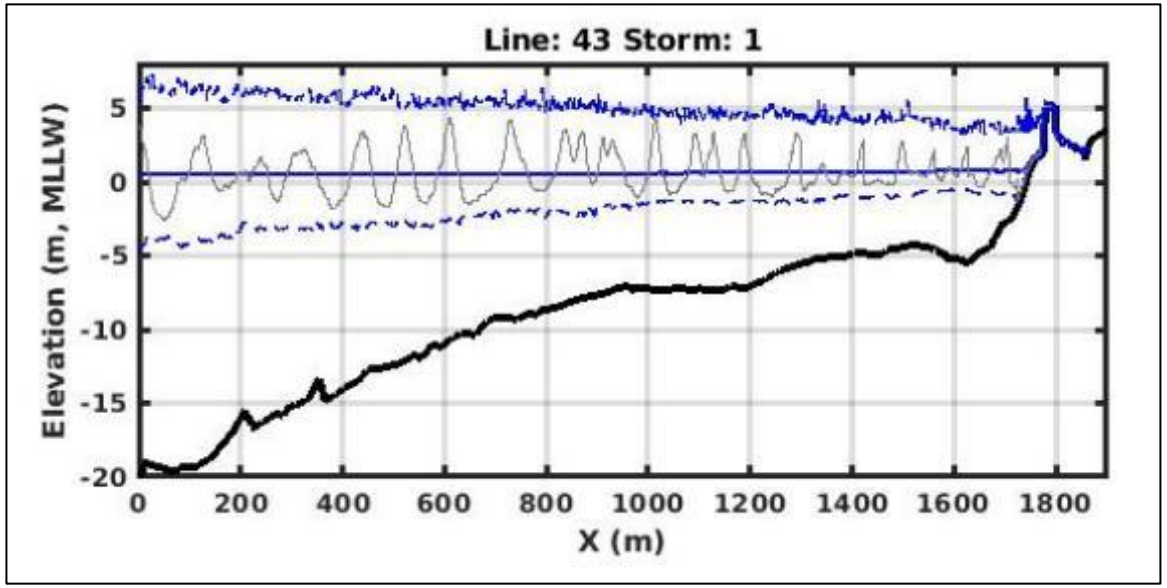
October 1963 flooding at NARL:



BARROW ALASKA COASTAL EROSION PROJECT

Xbeach transect model results:





BARROW ALASKA COASTAL EROSION PROJECT

Autumn storms in Barrow in 1985 caused a chunk of the permafrost bluff to fall away.

BARROW ALASKA COASTAL EROSION PROJECT

Conclusions:

- Defining the physical processes required for the development of a storm in the Arctic is a complex, non-linear process.
- Development of Arctic storms is dependent on ice extents
- Phase-resolving wave models are required to determine run-up extent
- There is no existing numerical model that can model the interaction of air temperature, water temperature, wave run-up, and permafrost degradation to determine an erosion rate.

Research and Development Questions:

- How do daily changes in icepack impact short lived Polar Lows?
- Could coupling ADCIRC and a phase-resolving wave model produce more detailed results?
- As permafrost degradation and erosion continues to be an issue in the Arctic and sub-Arctic, can geomorphological models be adjusted to model erosion of permafrost-rich coastlines?
- Can long-period waves transmission under ice impact the Arctic coastline?

QUESTIONS?

Alaska District
U.S. Army Corps of Engineers

"Building and Preserving Alaska's Future"

Norberto Nadal-Caraballo, Ph.D.

Dr. Norberto Nadal-Caraballo is a Senior Research Engineer and lead of the Coastal Hazards Group (CHG) at USACE-ERDC-CHL. His areas of expertise include coastal storm hazards, probabilistic hazard analysis, extreme value analysis, flood damage and risk assessment, compound coastal-inland flooding, and extreme storm climatology. The Coastal Hazards System (CHS) initiative led by Dr. Nadal-Caraballo is a national-scale, multi-agency effort for quantifying storm hazards along all U.S. coastlines. He has undertaken leading roles in multiple national coastal hazard studies, including the 2012 Great Lakes Inter-Agency Coastal Flood Study, the USACE North Atlantic Coast Comprehensive Study (NACCS), the Coastal Texas Study, the South Atlantic Coastal Study (SACS), and the 2021 Louisiana Coastal Study.

Coastal Hazards System (CHS) for the Pacific Basin

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Vicksburg, MS

Collaborator
Madison C. Yawn
Coastal and Hydraulics Laboratory
Vicksburg, MS

The Pacific Basin geographical area is exposed to extreme coastal storm hazards that threaten mission-critical DOD installations and USACE operations throughout the region. Climate change is expected to significantly exacerbate these coastal hazards in the future, creating new challenges for U.S. interests and further increasing vulnerabilities with implications for national security, defense, flood risk management, and coastal storm resiliency. To safeguard critical assets, increase infrastructure resilience, and ensure mission readiness, an immediate need exists for more accurate quantification of coastal storm hazards to support planning, adaption, and resiliency efforts. The proposed work will use a combination of observed historical data and atmospheric/hydrodynamic numerical simulation of tropical and extratropical storm events to quantify the frequency and severity of storm and climate-induced events impacting USACE's Areas of Responsibility (AORs) and DOD installations. This will be achieved through an expansion of the Coastal Hazards System (CHS) to the Pacific Basin. The CHS-Pacific will consider all USACE Pacific Divisions including the Pacific Ocean Division (POD), South Pacific Division (SPD), and Northwestern Division (NWD).

The CHS is a national-scale, multi-agency initiative for the quantification of coastal hazards due to extreme storm events in current and future climates for U.S. coastlines and other strategic locations critical to national security. The CHS (https://chs.erdc.dren.mil) currently provides accurate storm hazard information covering the entirety of the U.S. Atlantic Ocean basin, including the Gulf of Mexico coastlines and U.S. assets in the Caribbean. The CHS currently includes a coastal storm data repository and a web-based data mining and visualization interface that provides an environment for development, long-term storage, and rapid use of Probabilistic Coastal Hazards Analysis (PCHA) framework products. The CHS ingests information from past storm observations and synthetic data generated from high-fidelity simulations of atmospheric and hydrodynamic events.

The CHS-PCHA framework quantifies hazards by utilizing robust and efficient probabilistic and machine-learning models along with synthetic-storm suites to maximize coverage of various

storm climate scenarios with different probabilities and parameter spaces in conjunction with coastal hydrodynamic models. Key to this storm-climate hazard quantification framework is the Coastal Storm Modeling System (CSTORM-MS), which includes a suite of high-fidelity models, including the Advanced Circulation (ADCIRC), for coastal storm surge, currents, and wave simulation of extreme coastal events such as hurricanes and other coastal storms, including the effects of near-term and future sea-level rise. The viability of expanding the CHS to the Pacific Basin has already been demonstrated at select DoD installations. The CHS-Pacific will provide (1) a coastal hazards database, including frequency and magnitude of storm water levels, currents, and waves for present and future-climate conditions, and high-fidelity model simulation data, (2) a webtool for data and information deployment, and (3) tools for rapid forecasting of storm water levels and waves. These capabilities reduce the costs of design and construction of coastal storm risk reduction features (nature-based and/or gray infrastructure) and have produced savings in the hundreds of millions of dollars (e.g., Coastal Texas and North Atlantic regions). CHS' pre-computed high-fidelity hazards expedite USACE project execution in response to future climate change conditions to protect and reduce the risk to lives and property, especially in economically disadvantaged communities.

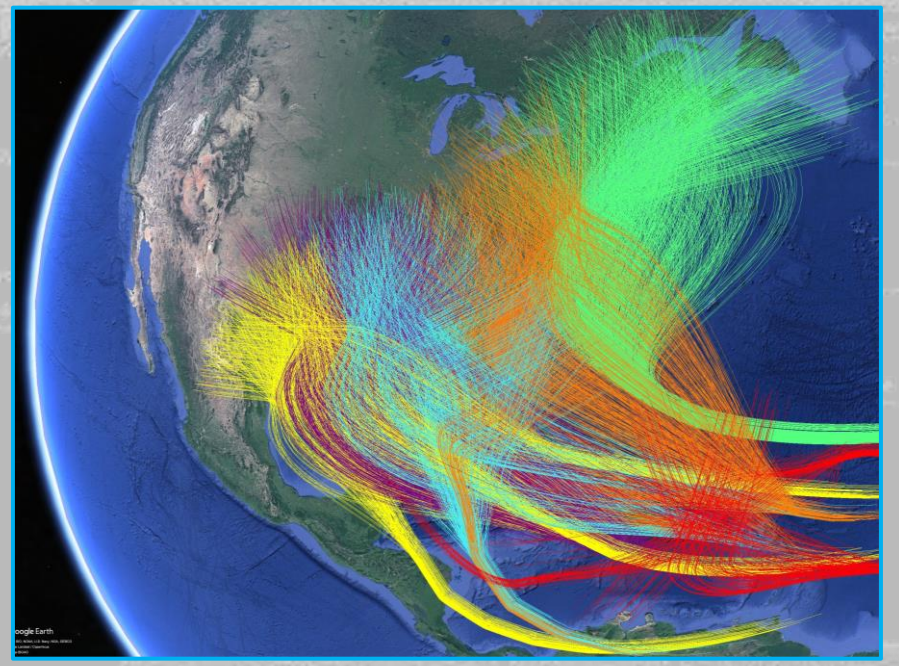
CHS comprehensive coastal data have already produced several significant improvements in the USACE practices including facilitating a greater understanding of risk and resiliency across a wide range of coastal studies and providing surrogate models using machine learning that provide very rapid high-fidelity computation of coastal processes for approaching storms and for risk assessment. The result is a shift in coastal engineering from modeling-centric to decision-centric, which is a primary goal of SMART planning. In the Atlantic region, the CHS includes a pre-computed set of more than 4,500 tropical cyclones and extratropical storms; a larger storm suite is envisioned for the CHS-Pacific to encompass tropical and extra-tropical storms, as well as ice coverage scenarios. The CHS' proven track record for quantifying extreme coastal storm hazards in the Atlantic coastlines will serve as the blueprint for quantifying extreme storm and climate-induced hazards impacting USACE AORs in the Pacific Ocean basin. The development of Pacific storm parameters and model capabilities for this region will provide robust and accurate quantification of the frequency and magnitude of expected coastal storm hazards. The CHS-Pacific will include present and future waves, ice coverage, water levels and currents at coastlines of interest in the Pacific region, addressing climate and community resilience needs. Developing this coastal hazard and climate change information will lead to a reduction in project-specific schedules and costs over the region and will allow for mission continuity without climate-change related disruptions.

COASTAL HAZARDS SYSTEM (CHS) FOR THE PACIFIC BASIN

Norberto C. Nadal-Caraballo, PhD
Senior Research Engineer / Coastal Hazards Group (CHG) Lead

Madison C. Yawn
Research Physical Scientist / CHG Co-Lead

U.S. Army Engineer Research and Development Center
Coastal and Hydraulics Laboratory



98th Meeting of the Board on Coastal Engineering Research (BCER)

13-15 September 2022 – Anchorage, Alaska

U.S.ARMY

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ERDC ENGINEER RESEARCH & DEVELOPMENT CENTER

CHL COASTAL & HYDRAULICS LABORATORY

CHS

Coastal Hazards System (CHS)

What is the CHS?

A national-scale, multi-agency initiative for accurate, efficient, and consistent quantification of coastal storm hazards along U.S. coastlines and other strategic locations critical to our national security.

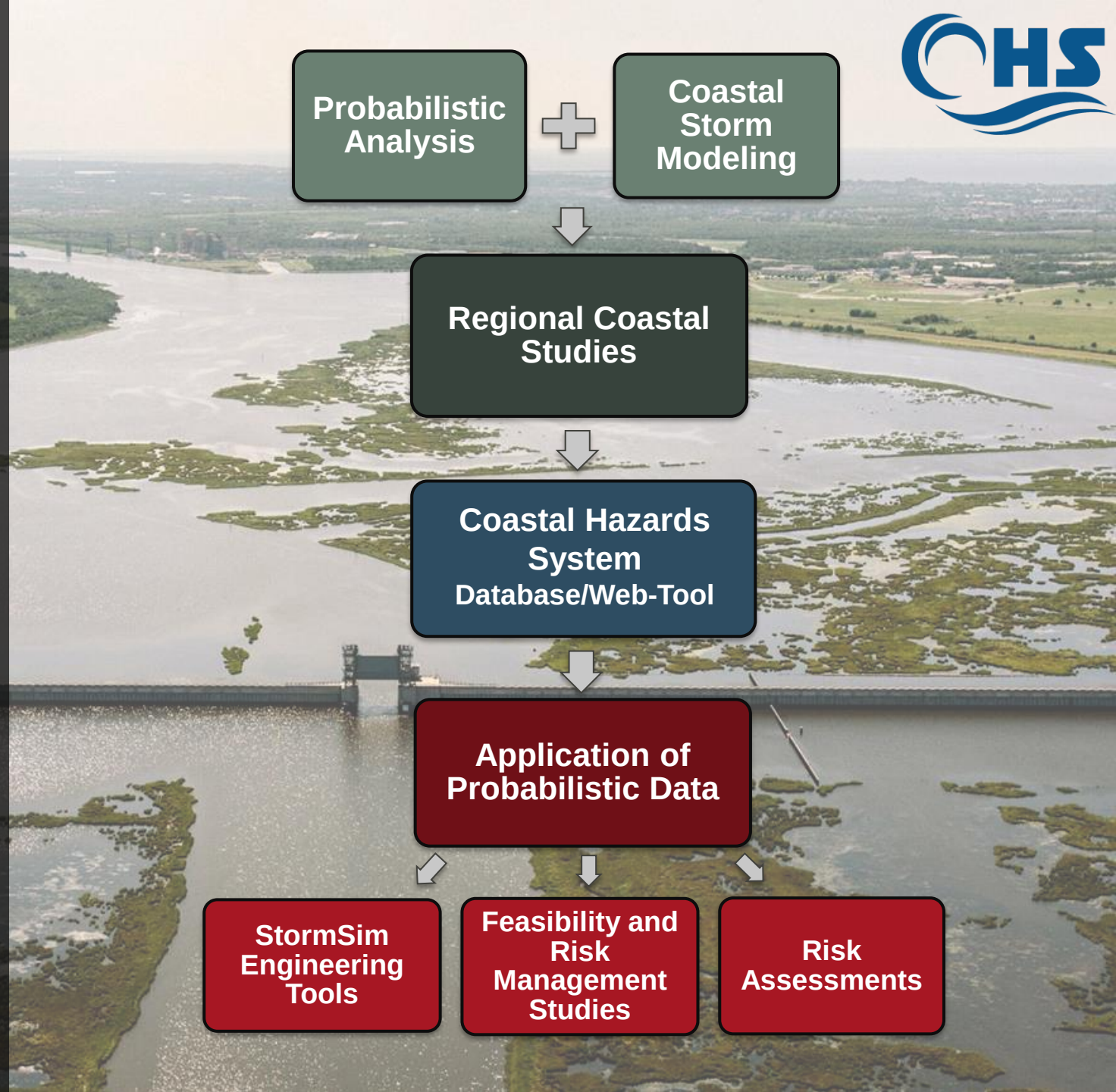
Goal:

Provide high-fidelity, high-resolution state-of-the-art hydrodynamic and probabilistic modeling and companion tools in a multivariate statistical context for coastal planning, engineering, and operations and maintenance.

Impact to the Nation:

Methods, data, and tools within the CHS serve as the basis for coastal engineering by providing high-fidelity, probabilistic coastal hazards on a national scale.

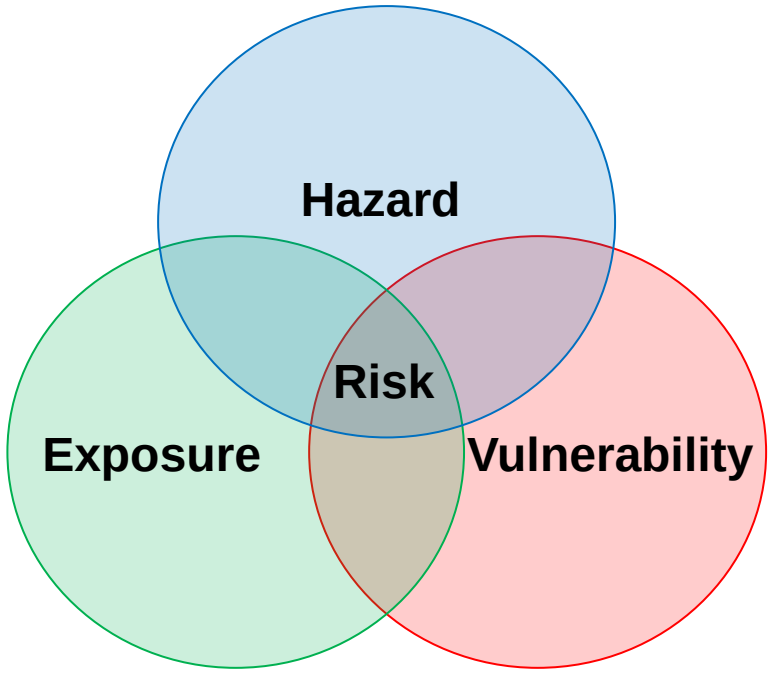
https://chs.erdc.dren.mil



REGIONAL COASTAL HAZARDS

Risk = Hazard × Exposure × Vulnerability

Hazard = Magnitude × Frequency



Primary Hazards

- Storm surge
- Still water level (SWL = surge + tide)
- Sea-level rise (future SWL)
- Wave height, period, direction
- Swell and infragravity (IG) waves
- Currents (water velocity)
- Maximum wind speed

Secondary Hazards

Derived from primary or compound hazards

- Wave runup and overtopping
- Storm surge overflow
- Forces/loading on structures
- Shear stress (levees)
- Sediment transport
- Beach erosion

Compound Hazards

- Rainfall
- Riverine discharge

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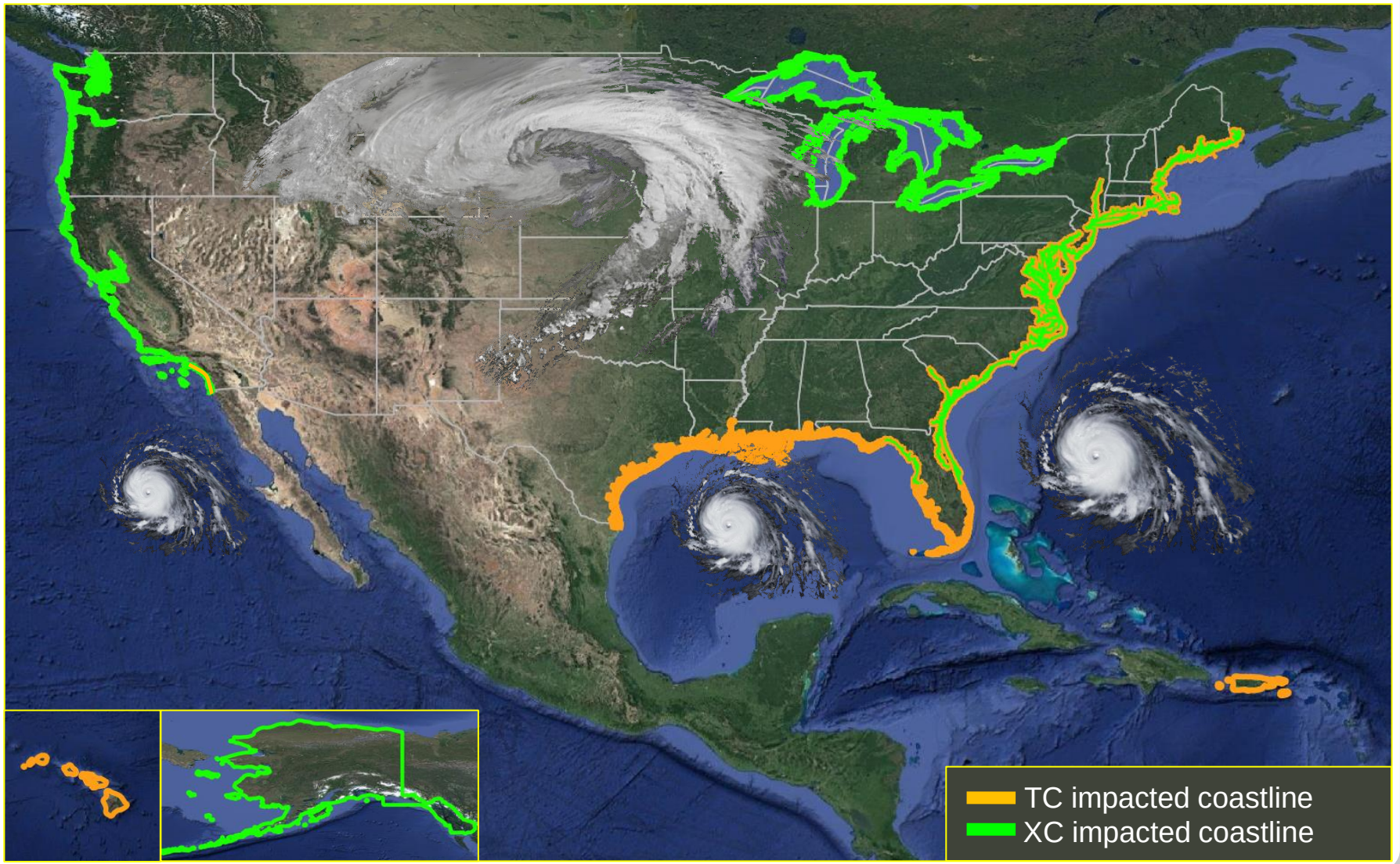
REGIONAL COASTAL HAZARDS

Hazard Magnitude & Frequency ⇒ Dominant Coastal Storm Forcing

- Great Lakes
  - Extratropical cyclones
- Atlantic Coast
  - Tropical cyclones (TC)
  - Extratropical cyclones (XC)
- Gulf of Mexico
  - Tropical cyclones
  - Non-tropical storms (NTS)
- Puerto Rico & USVI
  - Tropical cyclones
  - Extratropical cyclones
- **West Coast**
  - **Extratropical Cyclones**
  - **Tropical cyclones (S. CA)**
- **Alaska**
  - **Extratropical cyclones**
- **Hawaii & Pacific Islands**
  - **Tropical cyclones**
  - **Extratropical cyclones**



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REGIONAL COASTAL HAZARDS

1980s

Monochromatic waves

Limited modeling

Linear superposition of SWL components

Extreme statistics based on measurements

Scenario based design (Probable Maximum Storm/Hurricane, Return period event)

Undefined uncertainty

1990s

Irregular waves

Historical Databases (WIS, HURDAT, NOAA)

Limited modeling

Linear superposition of SWL components

Reliability

Extreme statistics based on measurements

Scenario based design (Probable Maximum Storm, Return period event)

Undefined uncertainty

2000s

Improved manuals

Online data

Improved modeling

Linear superposition of SWL components

Risk

Extreme statistics based on JPM, meteorology

Event-based simulation, Life-cycle simulation

Performance-based design

2010s

High-Fidelity (HF) models

JPM with epistemic uncertainty

HF databases that encompass probability space [Coastal Hazards System (CHS)]

Response-based simulation with HF models

Metamodeling

Combination of above

SWL = still water level
JPM = joint probability method
HF = high fidelity

REGIONAL COASTAL HAZARDS – CHS

USACE Regional Studies

- **North Atlantic Coast Comprehensive Study (NACCS)**
- **Coastal Texas Study (CTXS)**
- **South Atlantic Coastal Study (SACS): 3 Phases**
- **Louisiana Study (2021)**
  - Hurricane and Storm Damage Risk Reduction System (HSDRRS) Re-Certification

USACE Supplemental Studies

- **NACCS**
  - NY-NJ Harbors and Tributaries CSRM
  - New Jersey Back Bays CSRM
  - Nassau County Back Bays CSRM
- **CTXS**
  - Sabine 2 Galveston – Feasibility and PED
  - Galveston, TX – Coastal Spine
- **SAD: Miami/Dade County, FL Keys, Collier County studies**
  - FEMA Region IV data

FEMA Coastal Flood Hazard Studies

- **Region V**
  - Great Lakes
- **Region VI**
  - Texas – Appeal support
  - St. Tammany Parish, Louisiana *(Parish led)*
- **Region IV**
  - Mississippi – Mapping update *(State led)*
- **Region II**
  - Nantucket Island – Pilot

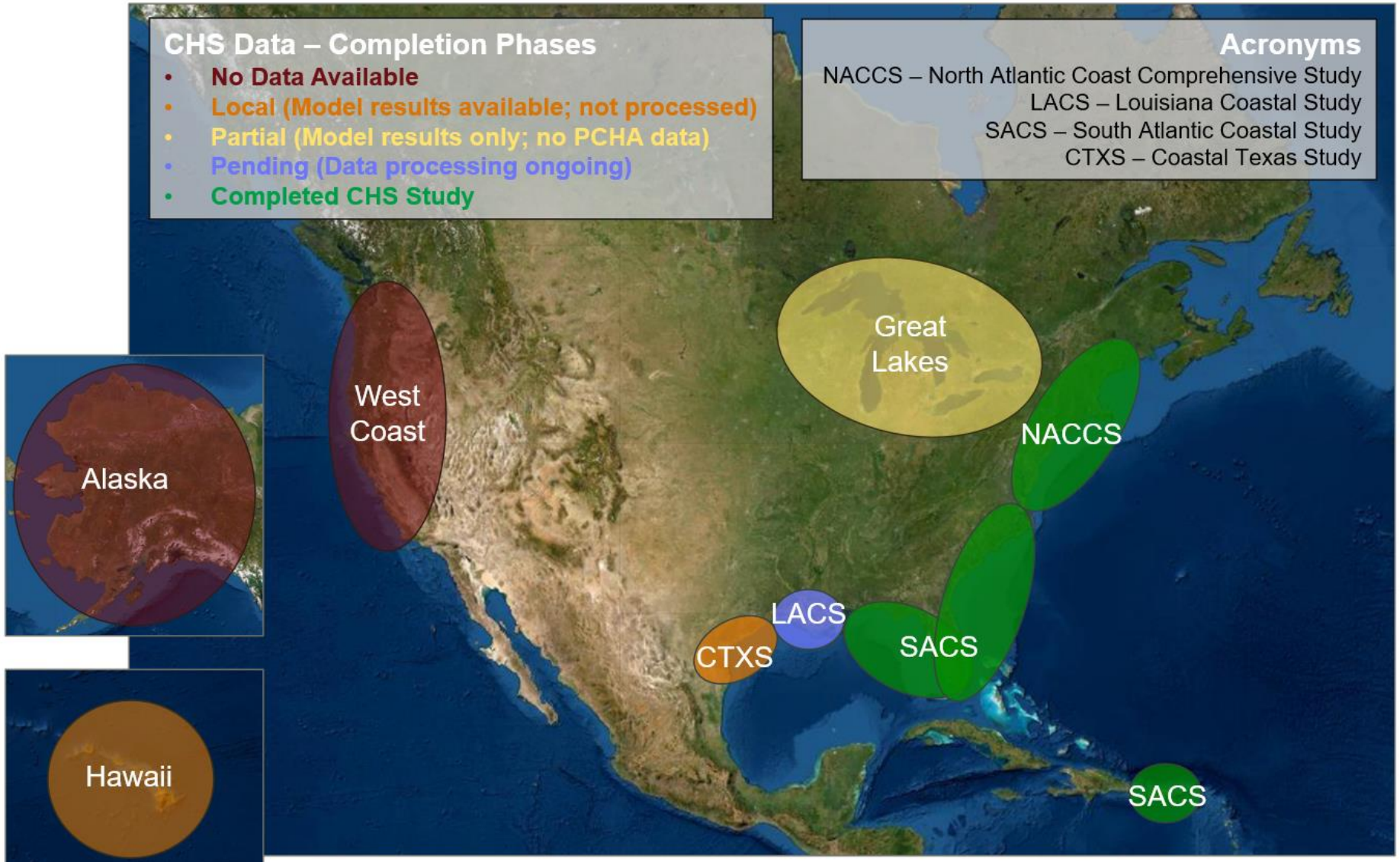
U.S. Nuclear Regulatory Commission (NRC)

- **Quantification of Uncertainty in Probabilistic Storm Surge Models (NACCS)**
- **Pilot Study on Compound Flooding Hazards (CTXS)**

DoD Missile Defense Agency

- **Homeland Defense Radar – Pacific Missile Range**

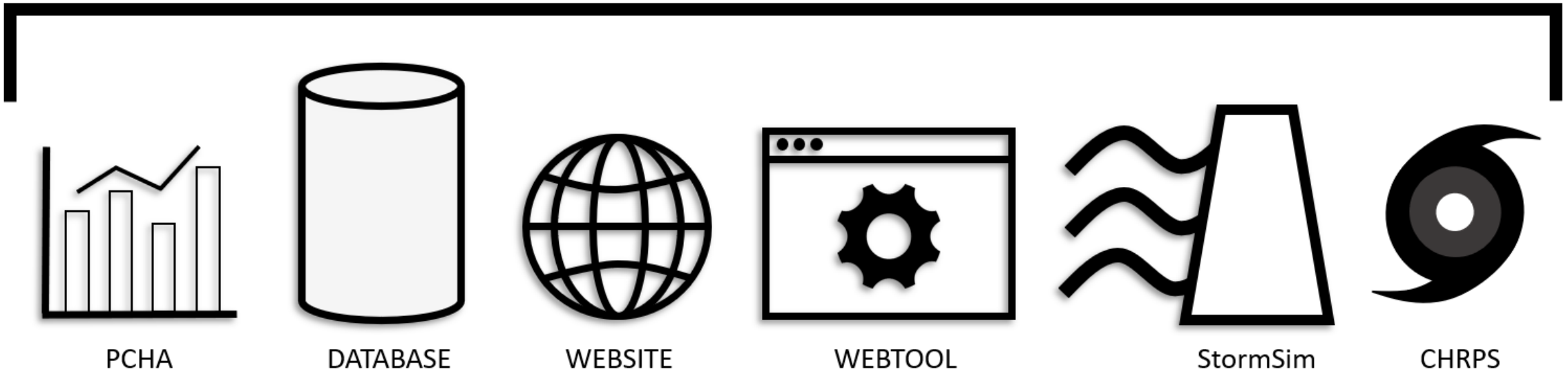
CHS – STATUS OF NATIONAL COVERAGE



AN INTEGRATED COASTAL HAZARDS PLATFORM

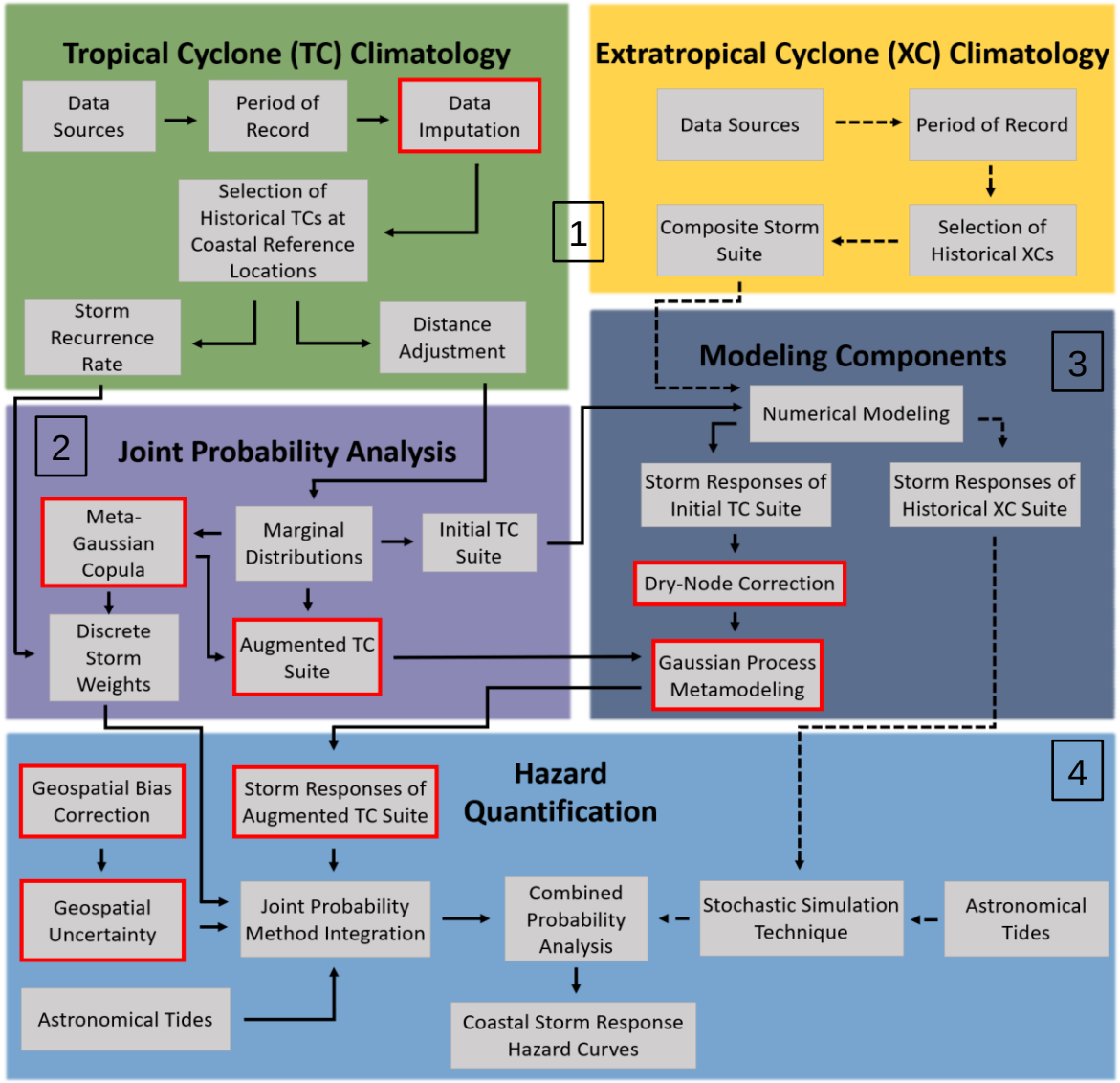
COASTAL HAZARD SYSTEM

COMPONENTS



CHS contains multiple components with the intent of developing, distributing, and applying coastal hazards information

CHS-PCHA WORKFLOW



Probabilistic Coastal Hazard Analysis (PCHA)

1. Storm Climatology Analysis

- Processing of historical TC data at points along the coastline (Ex: TC parameters, historical TC tracks)
- Select suite of historical XCs

2. Joint Probability Analysis

- Develop initial synthetic TC suite (ITCS) for numerical model simulations and assign probability masses
- Develop augmented TC suite (ATCS) to expand coverage of parameter and probability space

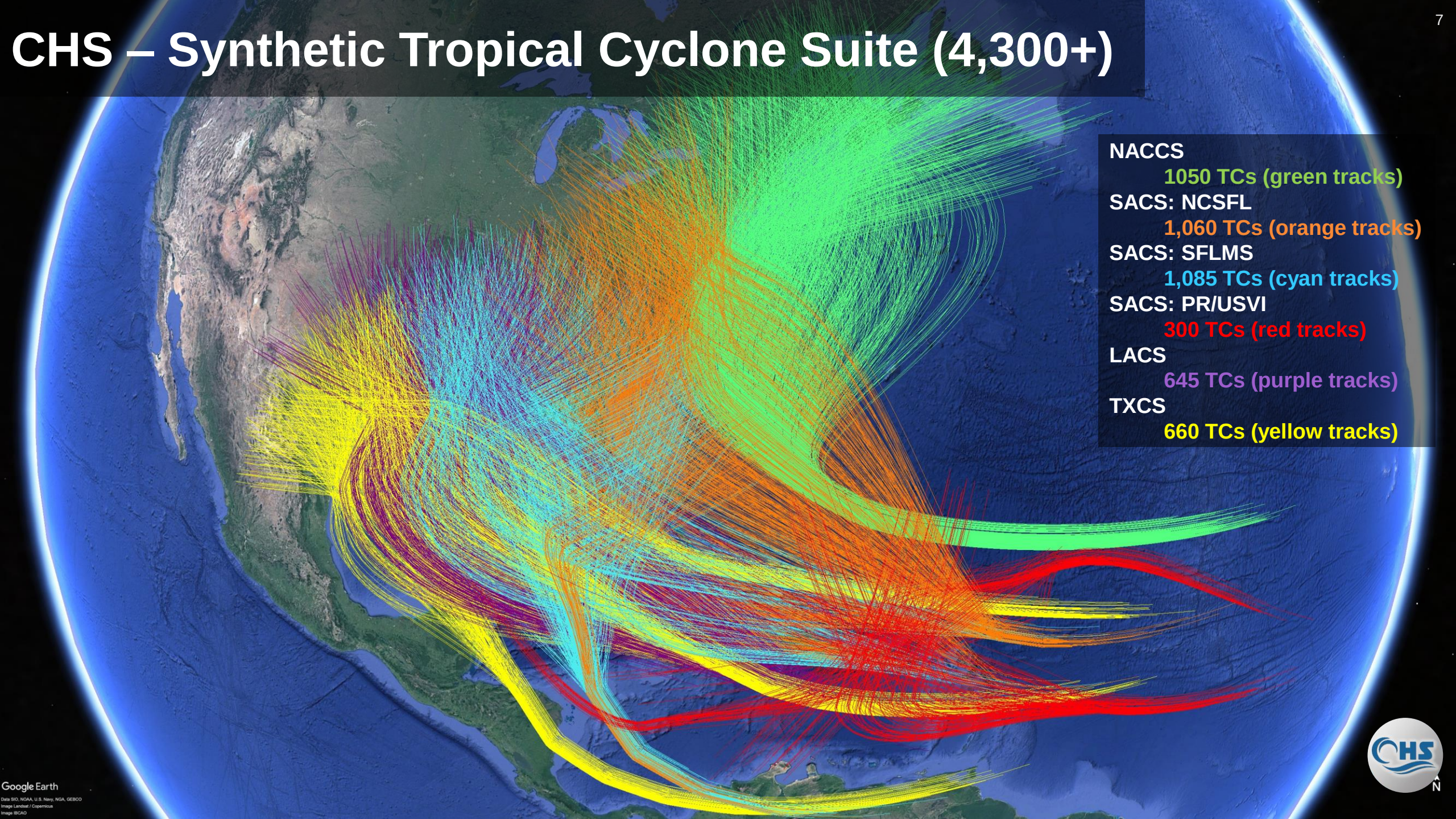
3. Modeling Components

- Simulate storms with high-resolution/fidelity numerical models
- Perform post-processing of data (Dry Node Correction)
- Train Gaussian process metamodel (GPM) on ITCS simulations to predict responses for ATCS

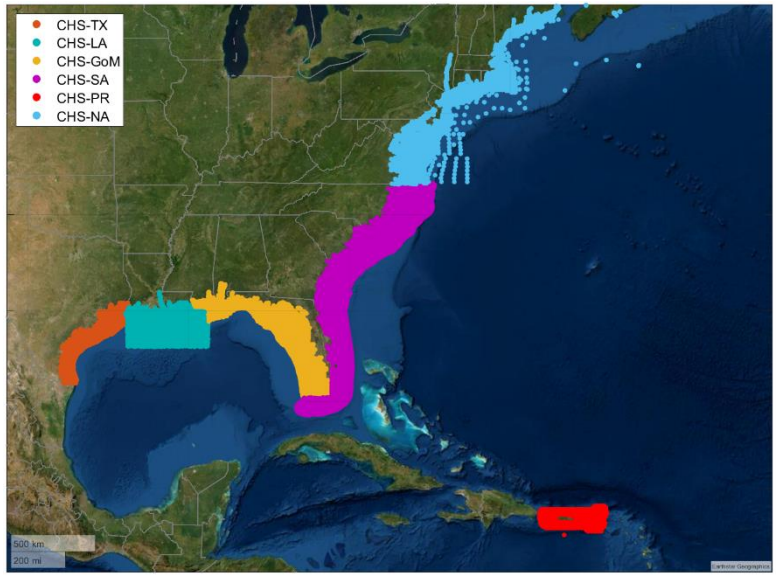
4. Hazard Quantification

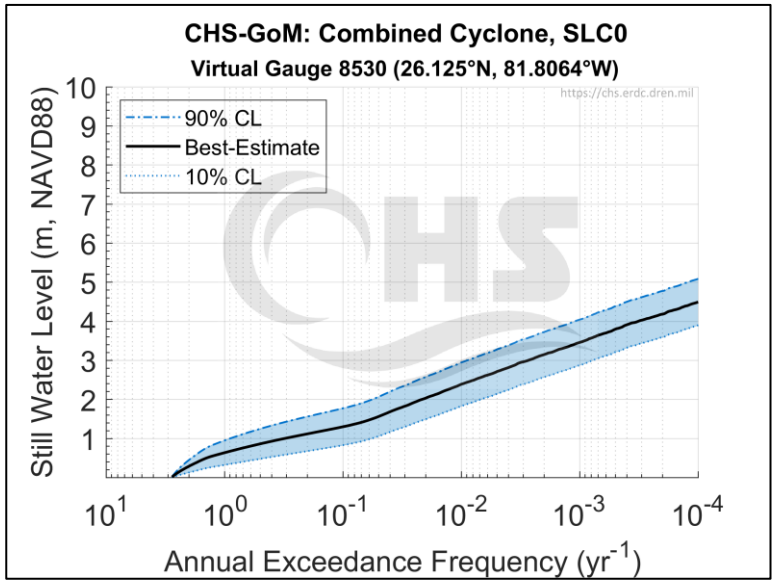
- Quantify modeling and measurement uncertainties
- Quantify storm-induced hazards for TCs and XCs
- Develop hazard curves describing the magnitude of the hazard as a function of annual exceedance frequencies (AEFs)

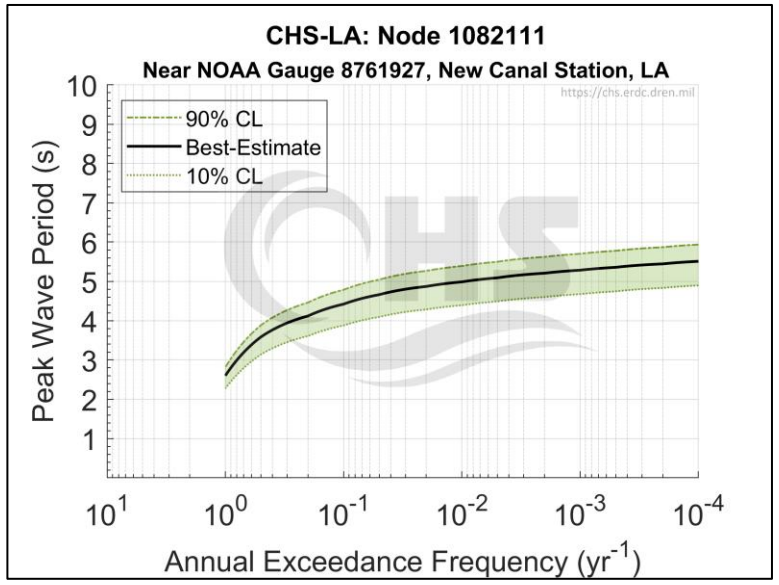
CHS – Synthetic Tropical Cyclone Suite (4,300+)

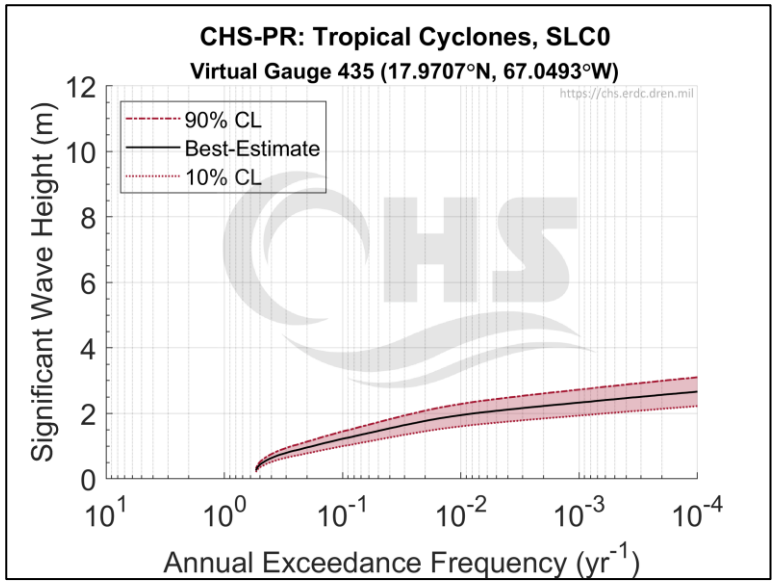


CHS – HAZARD QUANTIFICATION









Updated PCHA Results for U.S. Atlantic Basin including (FEMA IA, ongoing):

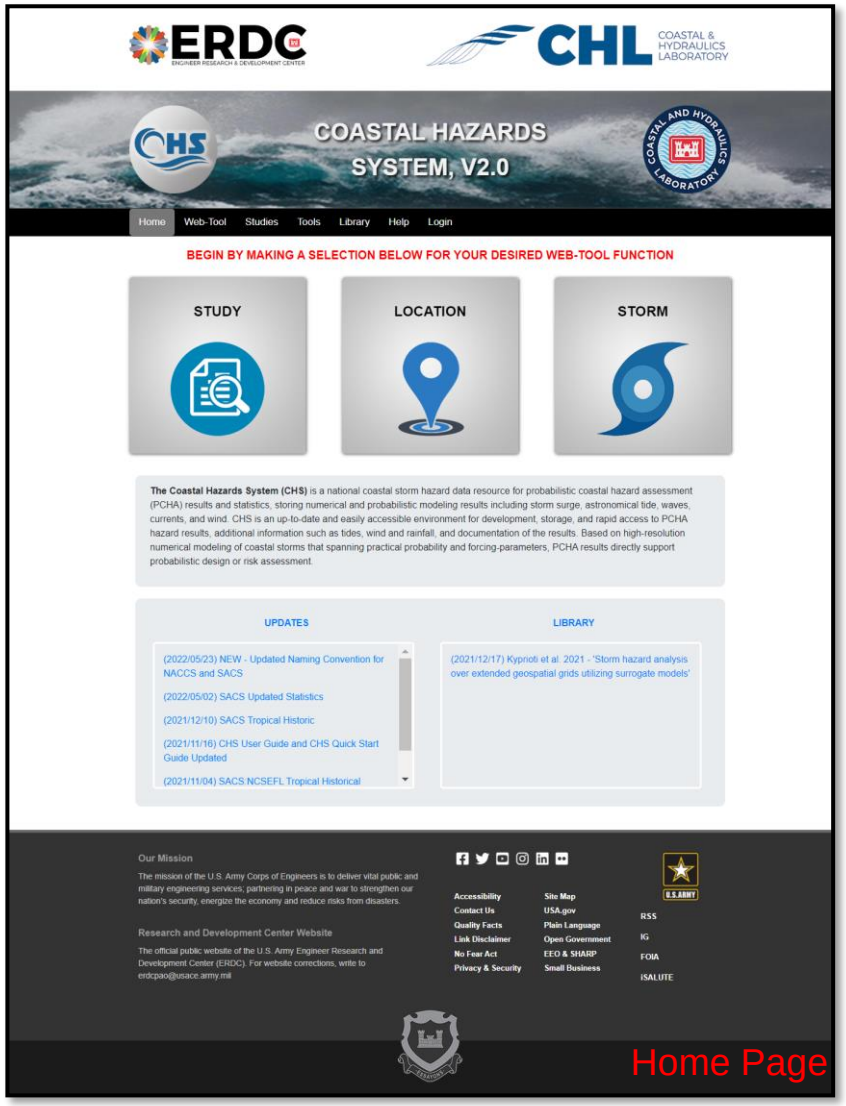
- Coastal Texas (CHS-TX)
- Louisiana (CHS-LA)
- Gulf of Mexico (CHS-GoM)
- South Atlantic (CHS-SA)
- Puerto Rico and U.S. Virgin Island (CHS-PR)
- North Atlantic (CHS-NA)

Consistent probabilistic results include:

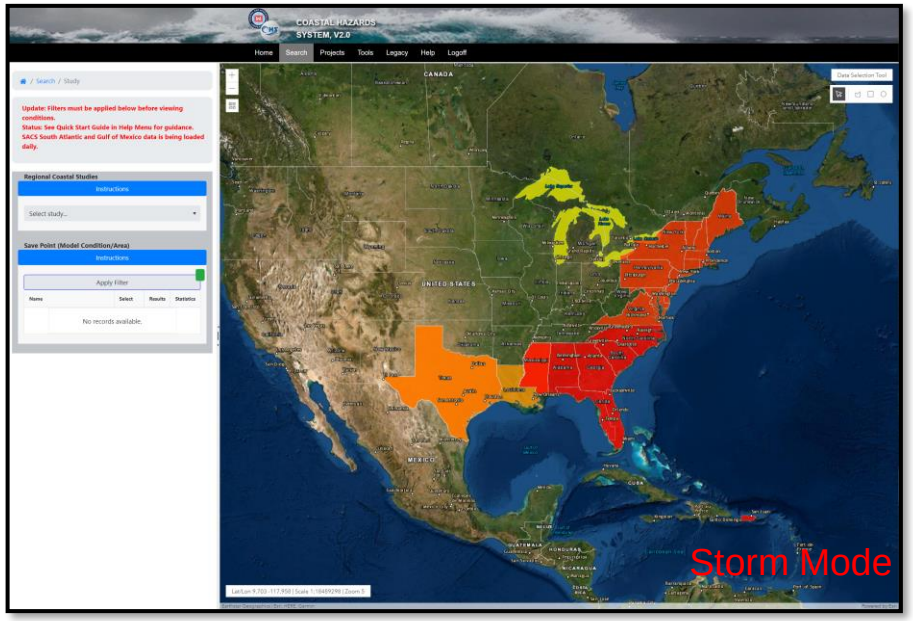
- Annual exceedance frequency estimates
  - Still water level
  - Significant wave height
  - Peak wave period
- Associated aleatory/epistemic uncertainty
- Nodal AEF results
  - CHS-LA
  - SACS preliminary results

CHL COASTAL & HYDRAULICS LABORATORY

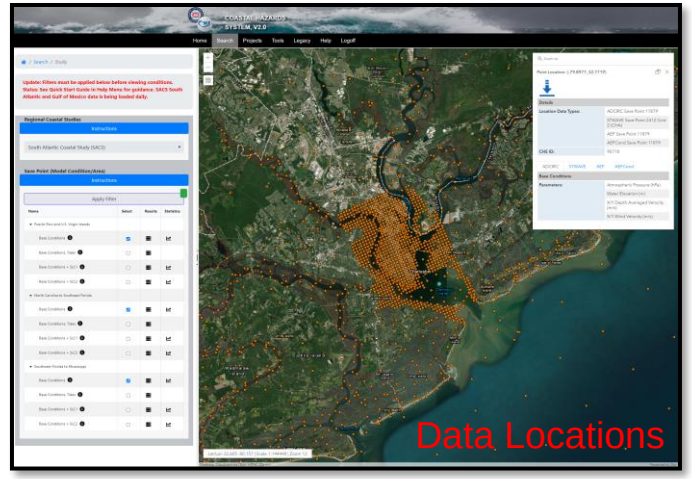
CHS – WEBSITE AND WEBTOOL



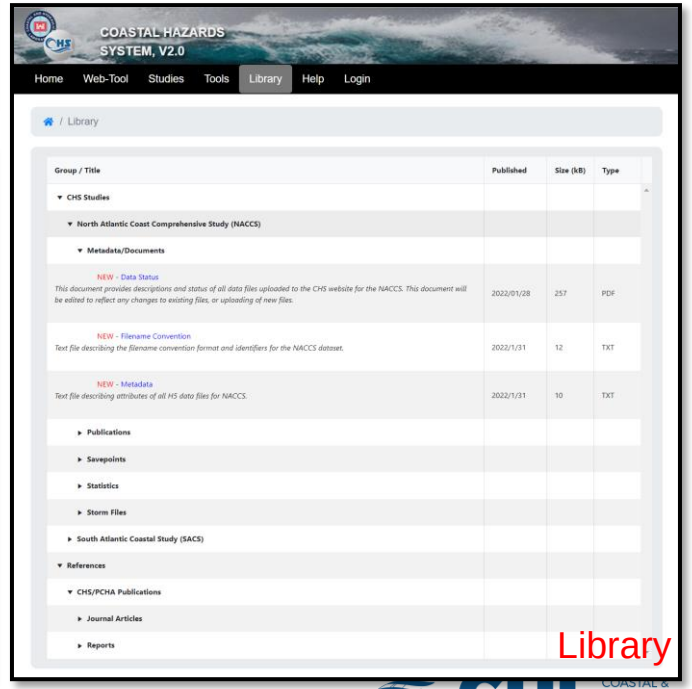
Home Page



Storm Mode



Storm Mode

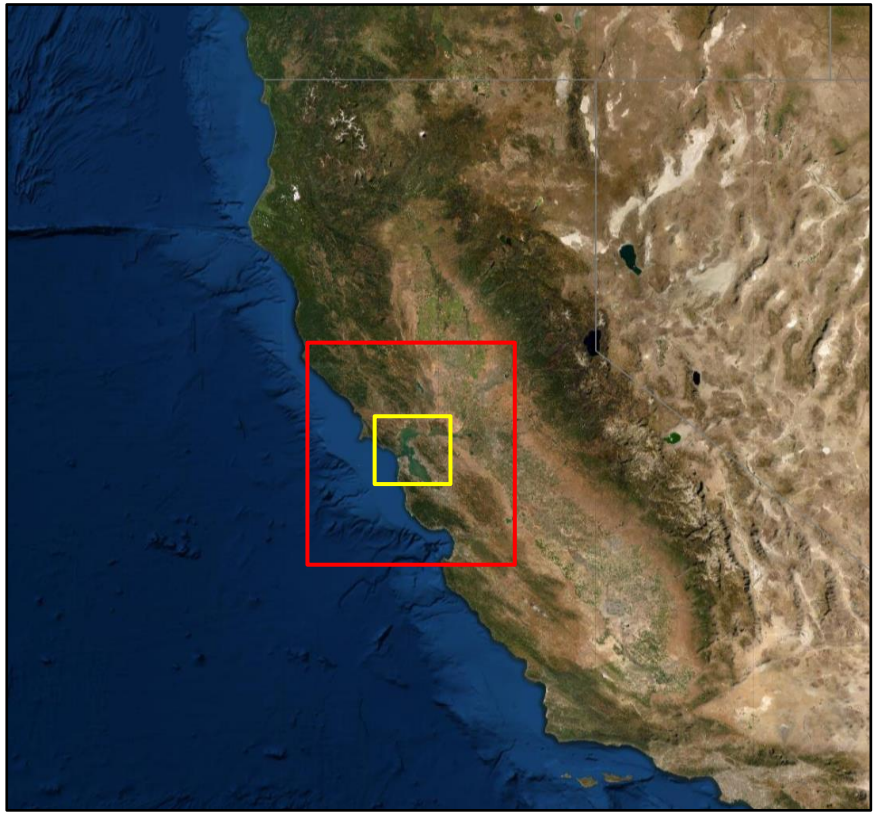


Library

CHS – CURRENT R&D

Expansion to West Coast and the Pacific Basin

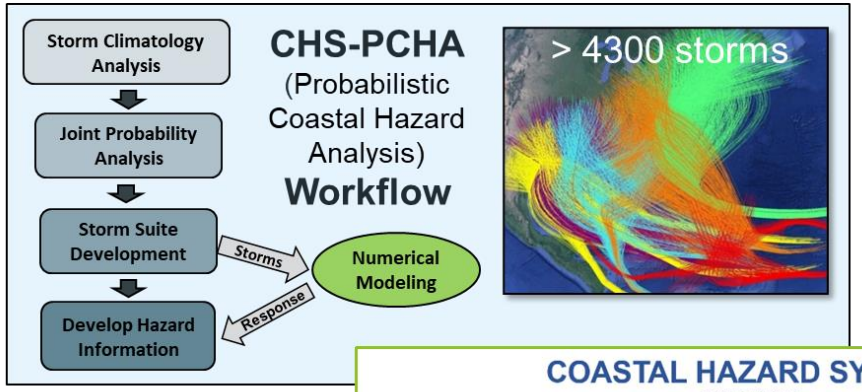
- Framework development for estimating coastal storm induced hazards for U.S. West Coast
- Regional and high-resolution modeling of extratropical cyclones (XCs)
  - WRF modeling for high-resolution areas
  - Ex: San Francisco Bay, Columbia River, Puget Sound, Willapa Bay
- Model domains and grids established for wind/pressure fields and wave spectra for XCs
- Sampling of representative XC suite for West Coast
  - Storm surge, swell, local seas, “king tides”
- Storm climatology of Pacific Islands
  - Hawaii test case



Example Nested WRF Grid Domains for San Francisco Bay

CHS – PACIFIC BASIN: PROPOSED EXPANSION

1. California
2. Oregon
3. Washington
4. Alaska
5. Hawaii
6. Guam
7. Northern Mariana Islands
8. American Samoa
9. Okinawa, Japan
10. Republic of Marshall Islands
11. Republic of Palau
12. Federated States of Micronesia

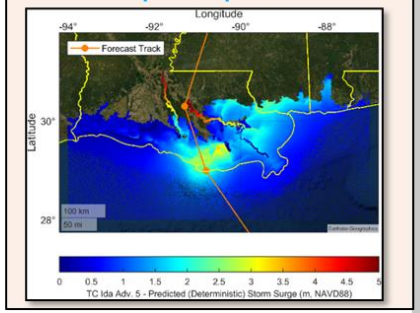


https://CHS.erdc.dren.mil)

Transition from project to institution

10-year refresh cycle
CHS build out
National standards
Increase/improve physics & resolution (BIG data)
Host/distribute/communicate

CHRPS
(Coastal Hazard Rapid Prediction System)
AI-Based Forecasting
https://chrps.erdc.dren.mil



CHS – PACIFIC BASIN: R&D RECOMMENDATIONS

- Goal: consistently high accuracy across all physics and probability models/methods.
- High-fidelity data/tool products, at high geospatial resolutions, spanning physics and probabilistic parameter spaces. Adaptable. Expandable.
  - Accommodate broader use cases (Planning, FEMA, ASCE, etc.)
- Multivariate approach combined with metamodeling techniques to probabilistically quantify coastal and compound hazards, including interior flooding.
  - Define regional drivers: surge + river discharge, waves, high tides, rainfall, groundwater.
  - Address climate change-induced extreme storm events.
- Evaluate relevance of very-high frequency, low intensity coastal forcing events.
  - Intra-year events exacerbated by sea level rise.
- 10-year CHS refresh cycle: Atlantic Basin (5-6 years) + Pacific Basin (4-5 years)

COASTAL HAZARDS SYSTEM (CHS) PACIFIC BASIN

THANK YOU!

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Madison C. Yawn
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Jennifer Wozencraft

Ms. Wozencraft is a Research Physical Scientist in the Coastal and Hydraulics Laboratory of the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center, and Director of the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX). At JALBTCX, she coordinates operations, research, and development in airborne coastal mapping technologies among USACE, Naval Oceanographic Office, National Oceanic and Atmospheric Administration, and U.S. Geological Survey. She also manages the USACE National Coastal Mapping Program, which provides regional scale, engineering-accuracy elevation, depth, and imagery data to support USACE regional sediment management, navigation, environmental restoration, regulatory enforcement, asset management and emergency response activities in the coastal zone. Ms. Wozencraft represents USACE as co-chair of the Interagency Working Group on Ocean and Coastal Mapping. Ms. Wozencraft has enjoyed analyzing and managing the collection and application of airborne lidar bathymetry data for coastal engineering and science since 1994.

Erin Trochim, Ph.D.

Dr. Trochim is a geospatial data scientist and research associate professor at the Alaska Center for Energy and Power. She earned a PhD in remote sensing and hydrology from the University of Alaska Fairbanks. Her postdoc included producing permafrost information for policy applications through the NSF SEARCH program with the Alaska Climate Adaptation Science Center. Present energy-related projects include the Railbelt Decarbonization study, the Arctic Energy Atlas, and creating environmental data for marine and hydrokinetic applications. She was an inaugural Google Cloud Research Innovator in 2021. In 2022, she was a project lead for the University of Washington's Data Science for Social Good program.

Mapping Alaska's Coastline: Research, Development, and Collaborations

Jennifer Wozencraft.
U.S. Army Engineer Research and Development Center
Coastal and Hydraulics Laboratory
JALBTCX
Anchorage, AK

Collaborator
Erin Trochim, Ph.D.
Alaska Center for Energy and Power (ACEP),
University of Alaska Fairbanks
Fairbanks, AK

US Army Corps of Engineers (USACE) has a very robust coastal mapping program for the lower 48. The goal of this research and development is to translate that capability to very challenging Alaska environments. National Coastal Mapping Program (NCMP) is funded by the Navigation Business Line to provide repeat, regional datasets around the sandy shorelines of the conterminous US to support regional sediment management. One of the key findings of the regional sediment management demonstration program at Mobile District (1999) was that USACE needs regional data and the tools to analyze them if we are to successfully manage sediment across projects. The program uses airborne lidar bathymetry technology that was developed by ERDC in collaboration with Canada, other federal partners, industry, and academia. The system was fielded in 1994 and was the first operational airborne lidar bathymetry system in the US. ERDC pioneered and continues to evolve the use of this technology for coastal engineering applications.

NCMP started in Mississippi in 2004 and works counterclockwise around the coast of the US. The program is close to completing its third survey of the west coast and if working on its fourth survey of the eastern Gulf of Mexico and Florida Atlantic coast. NCMP have been used by USACE and partner agencies to survey large areas of coast after major hurricanes. NCMP data accuracy and spatial resolution is not only sufficient for project level work but is particularly well-suited to regional and national applications such as coastal comprehensive studies, as input to regional coastal models, and providing consistent nationwide datasets describing USACE coastal infrastructure and resilience.

In addition to data collection operations, NCMP performs research and development to explore applications of data to coastal engineering practice and to develop data analysis tools. Two major tools just released are the volume change toolbox and the coastal engineering

resilience index toolbox. The volume change toolbox standardizes a workflow to produce consistent elevation, shoreline, and volume change from NCMP and other datasets. The original driver for the toolbox was to provide volumes for input to regional sediment budgets but the volume change toolbox has been used to assess beach volume loss after storms beginning with Hurricane Matthew in 2016. The coastal engineering resilience index toolbox standardizes extraction of coastal geomorphology metrics for beach and dune systems. The metrics are combined with wave and storm surge data accessed from USACE and NOAA authoritative online data sources into an index that describes the resilience of beach and dune systems to storms. The coastal engineering resilience index has been computed for the northern Gulf of Mexico, the norther Outer Banks, Maryland and Delaware, and Long Island.

Alaska's coastal mapping challenge is defined by the sheer size of the state, a relatively short window for survey operations, and environmental constraints specific to airborne lidar bathymetry operations such as persistent snow, ice, clouds, large waves and tidal currents driving water column turbidity, dark, low-reflectivity sediment, and submerged aquatic vegetation. For reference, based on NOAA's 1975 pamphlet "The Coastline of the United States," Alaska has more shoreline (6640 miles) than the US Great Lakes shorelines (4430 miles), and the Atlantic, Pacific and Gulf Coast of the conterminous US combined (4993 miles). A recent gap analysis performed by NOAA for Seabed 2030 (a UN ocean mapping initiative) shows a significant lack of coastal bathymetry data for the state of Alaska.

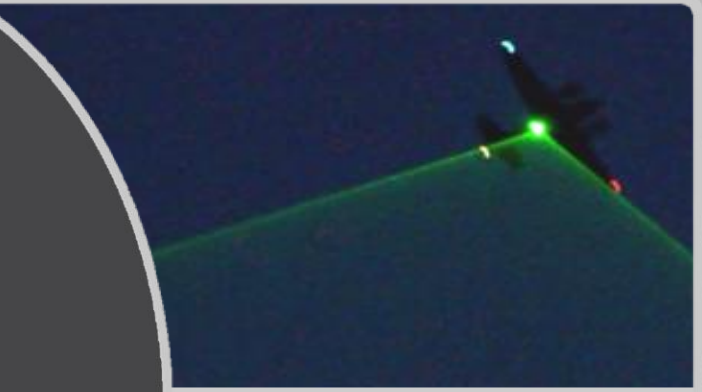
National Coastal Mapping Program has worked to fill this data gap over the past few years. A successful pilot project at Homer, Alaska (2018) utilized our Navy partner's system transiting through the state after surveys in the Pacific. The same system was used in 2019 to collect data for areas identified by Alaska District, AK Department of Natural Resources, AK Coastal Mapping Strategist and federal partners in the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) and Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM). A dedicated aircraft collected requirements in 2021 and 2022. Coastal mapping data collection in Alaska is coordinated through a number of federal and state coordination bodies: JALBTCX coordinates airborne coastal mapping operations among USACE, Naval Oceanographic Office, NOAA, and USGS; IWG-OCM includes the JALBTCX partner agencies and 9 other Federal agencies with interest in collecting and using ocean and coastal mapping data; Coastal Mapping Technical Subcommittee, Alaska Mapping Executive Council, is co-chaired by NOAA and State of Alaska, and maintains the Alaska Coastal Mapping Strategy and Implementation Plan; and Coastal and Ocean Working Group, Alaska Geospatial Council, facilitates stakeholder involvement in state and federal mapping campaigns, ensuring data

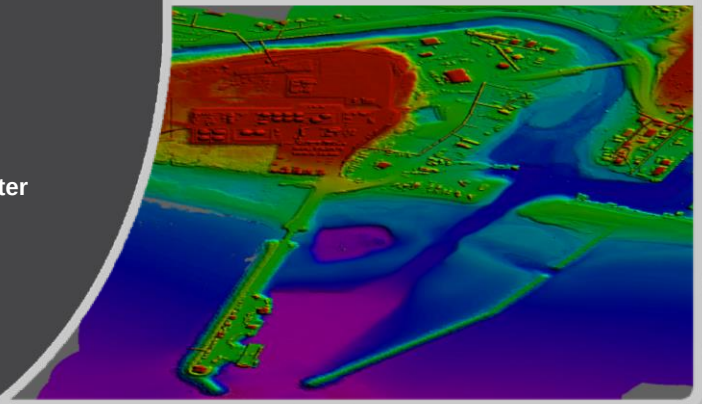
collection efforts meet the needs of Alaskans, reducing duplication of costs and leveraging funding opportunities.

The USACE collaboration with University of Alaska Fairbanks started with the question, “What can we do to get Alaska communities the data they need?” The collaboration is focused on four main areas: data, coordination, applications and products, and capacity building. NCMP cannot meet all the requirements for data given operational constraints. UAF also collects data to fill gaps and validate our airborne data using a variety of technologies. Satellite data and cloud-based geospatial processing offers the opportunity to expand the geospatial footprint and temporal frequency of data. Data is acquired from unmanned aerial systems and autonomous systems operated from vessels of opportunity. NCMP has strong coordination in mapping data collection at the federal level and is improving that coordination at the state level. UAF is playing a key role in expanding coordination and moving NCMP data into collaborations focused on use of data to solve coastal challenges for Alaska communities. NCMP analysis tools were largely developed for sandy shorelines and beach and dune systems. UAF will evaluate these tools and adapt to them Alaska environments where feasible. New analysis tools and capabilities developed for Alaska may in turn be implemented for NCMP in the lower 48. Capacity building is the final goal of the ERDC/UAF collaboration. Students, staff and fellows are learning to process NCMP data which helps NCMP deliver data faster and increases the talent pool in the critical areas of hydrographic survey and coastal data analysis. UxS standard operating procedures for data collection, processing workflows, and product generation can transfer these capabilities to Alaska communities for their own data-on-demand acquisitions.

R&D opportunities of interest include testing of military prototype coastal mapping sensors that could improve NCMP operation in Alaska by providing operational flexibility, autonomous operation, and automated data processing; developing NCMP and other data into information products for use in updating Alaska Environmentally Threatened Communities rankings; and developing new products to support emerging applications of coastal mapping data such as energy planning.

Mapping Alaska's Coastline: Research, Development, and Collaborations





Jennifer M. Wozencraft

- USACE National Coastal Mapping Program Manager
- Joint Airborne Lidar Bathymetry Technical Center of Expertise Director
- Coastal and Hydraulics Laboratory, US Army Engineer Research and Development Center

Dr. Erin Trochim

- Research Assistant Professor
- Alaska Center for Energy and Power (ACEP)
- University of Alaska Fairbanks

Board on Coastal Engineering Research, Anchorage, Alaska, 14 September 2022

US Army Corps of Engineers

UAF

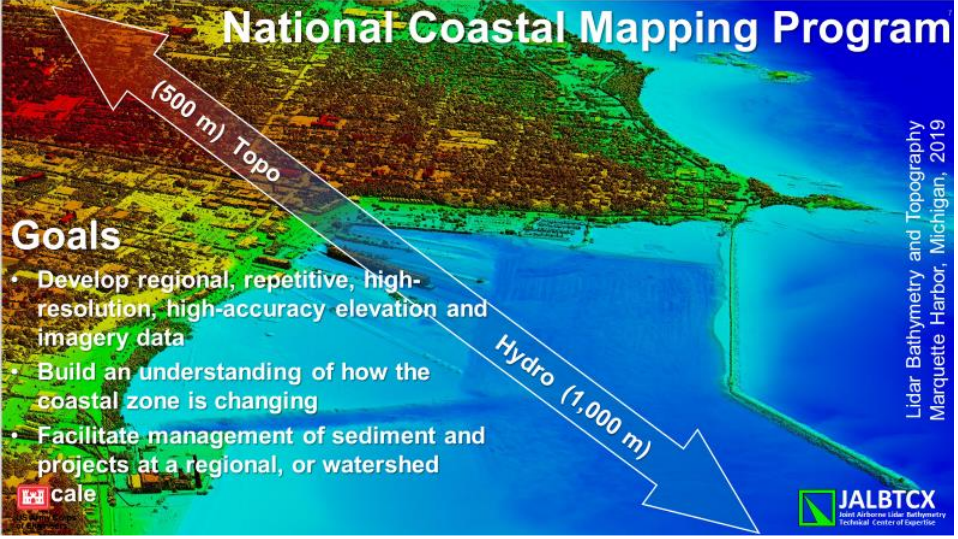
ACEP Alaska Center for Energy and Power

ERDC ENGINEER RESEARCH & DEVELOPMENT CENTER

Bottom line up front

US Army Corps of Engineers has a very robust coastal mapping program for the lower 48.

The goal of this research and development is to translate that capability to very challenging Alaska environments.



USACE Volume Change Toolbox

A standard procedure to compute elevation, volume, and shoreline change consistently on a regional scale

Development history and usage

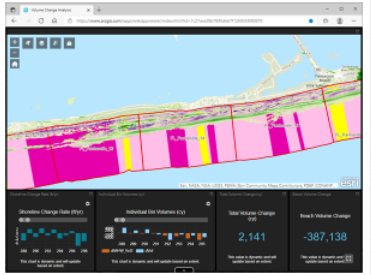
- 2012 pilot project
- 2012 post-Sandy
- 2013 webservices
- 2015 East coast volumes
- 2016 Post-Matthew
- 2017 Post-Irma
- 2018 Post-Maria
- 2018 Post-Michael
- 2020 Post-Sally/Zeta

JALBTCX_quick_response_v2.tbx
- QR 01. Label Baseline and Generate Transects (optional)
- QR 01b. Update Transect Coordinates (optional)
- QR 02. Generate Transect Mask and Clip Mask (optional)
- QR 03. Generate Difference Grid by Clip Mask (optional)
- QR 03b. Clip Difference Grid to Segment (optional)
- QR 04. Calculate Difference Grid Volume by Zonal Statistics
- QR 05. Generate Shoreline (optional)
- QR 06. Label Transect and Mask with MHW Value (optional)
- QR 06b. Generate Mask Between Transect above MHW (optional)
- QR 07. Calculate MHW Volume and Volume above MHW
- QR 08. Calculate MHW Volume Difference and Volume above MHW Di
- QR 09. Calculate Shoreline Change
- QR 10. Generate Final Table
- QR 11. Summarize Table

FY21
- Convert to python 3 for ArcPro
- Improve transect generation
- Automate pdf map making
- Multiple dataset toolbox

FY22
- Create DEMs from beach profile data for use in Toolbox

Access change products through web app.



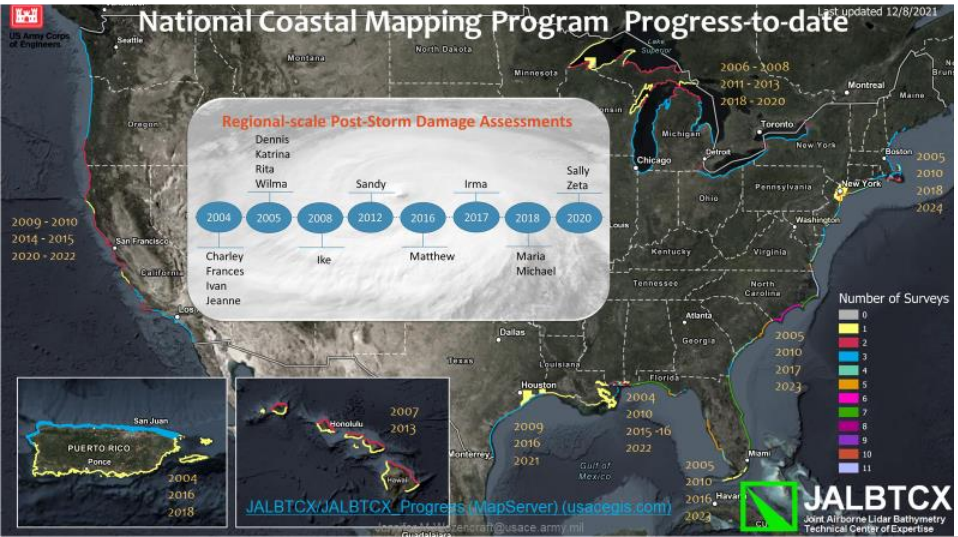
Legacy
https://usace.maps.arcgis.com/apps/webappviewer/index.html?id=d1ee0da4887046edbc9ff05c66d40708

New
https://www.arcgis.com/apps/webappviewer/index.html?id=1c27ace28b7845deb7f126935f490878

JALBTCX
Joint Airborne Lidar Bathymetry
Technical Center of Expertise

US Army Corps of Engineers

Jennifer.M.Wozencraft@usace.army.mil



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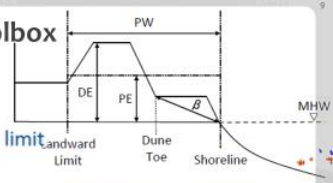
USACE Coastal *Engineering* Resilience Index Toolbox

- Automated – Python in ESRI Arc
- Use existing data – beach profile and LiDAR
- Consistent metrics – shoreline, dune toe, dune crest, landward limit



Inputs
- Beach Profile
- LiDAR
- Wave
- Surge
- MHW
- % Fines

Metrics
- Shoreline
- Dune Toe
- Dune Crest
- Landward limit

Outputs
- Protective Elevation
- Protective Width
- Volume Density
- Wave runup
- Crest Freeboard

Five non-dimensional factors based on beach, storm and wave parameters:

$$a = \frac{PE}{PE_0}; b = \frac{PE + PW + (1-s)}{PE_0 + PW_0}; c = \frac{PW - MR}{PW_0};$$
$$d = \frac{DE - (MS + MHW)}{CF_0}; e = \frac{WR_0}{WR}$$
$$CRI = a + b + c + d + e$$

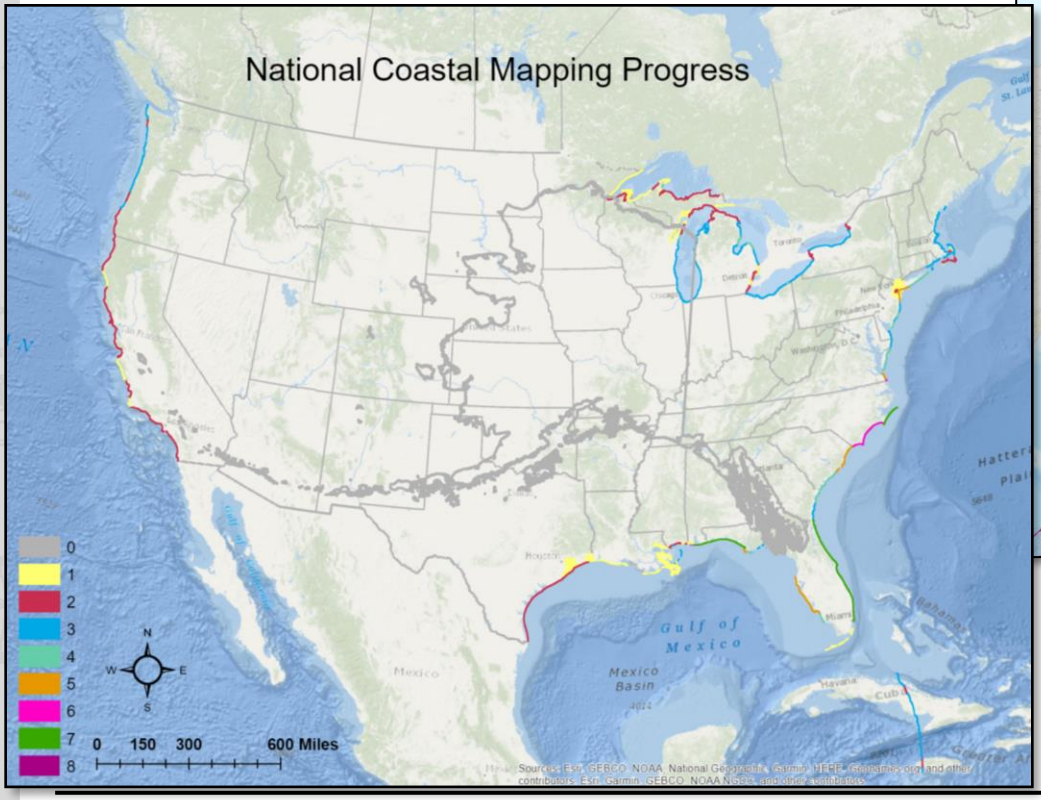
where:
- WR: Wave Run-up
- MHW: Mean High Water
- PE: Protective Elevation
- PW: Protective Width
- s: percentage of fine sediment
- DE: Dune Crest Elevation
- MR: Maximum Shoreline Recession
- MS: Maximum Storm Surge
- PE_0: Protective Elevation; 15 ft
- PW_0: Protective Width; 500 ft
- CF_0: Crest Freeboard; 20 ft
- WR_0: Wave Runup; 2 ft

FY21-22 CERI test areas
- Northern Gulf of Mexico
- Northern Outer Banks
- Long Island, NY
- Cape Cod, MA, to Portsmouth, ME
- Lake Ontario
- 200 miles in Pacific Northwest
- Southern CA

Aerial image of Panama City Beach collected simultaneously with the 2020 JALBTCX lidar data. Dune features are landward limit (LL), high dune (HD), frontal dune (FD), dune toe (DT), first sandbar trough (BarT1), first sandbar crest (BarC1), second sandbar trough (BarT2), and second sandbar crest (BarC2).

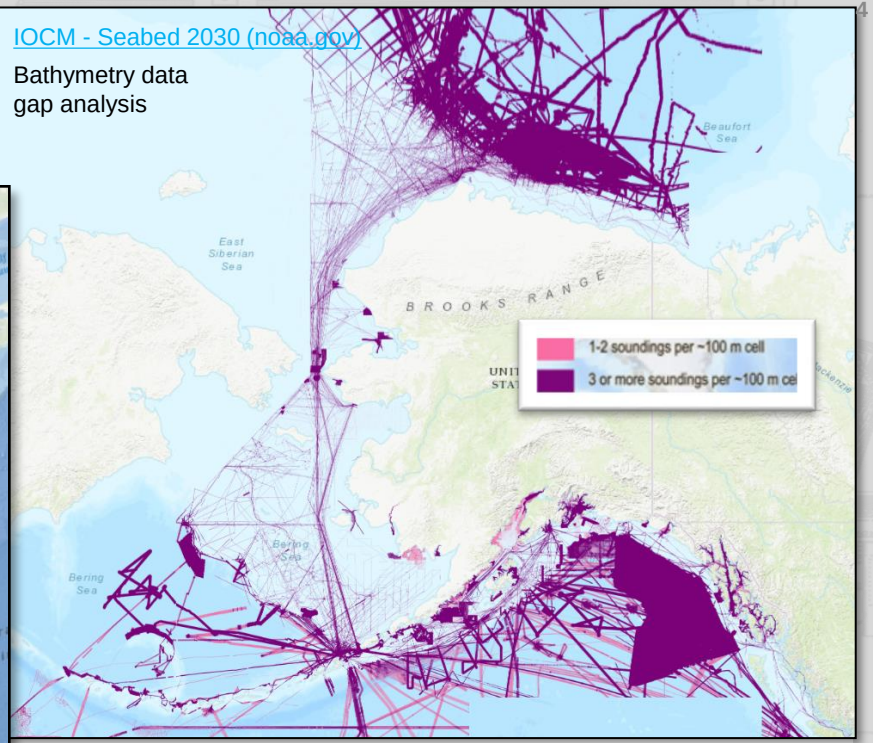
US Army Corps of Engineers
NCMP
JALBTCX
Joint Airborne Lidar Bathymetry
Technical Center of Expertise

Alaska's coastal mapping challenge



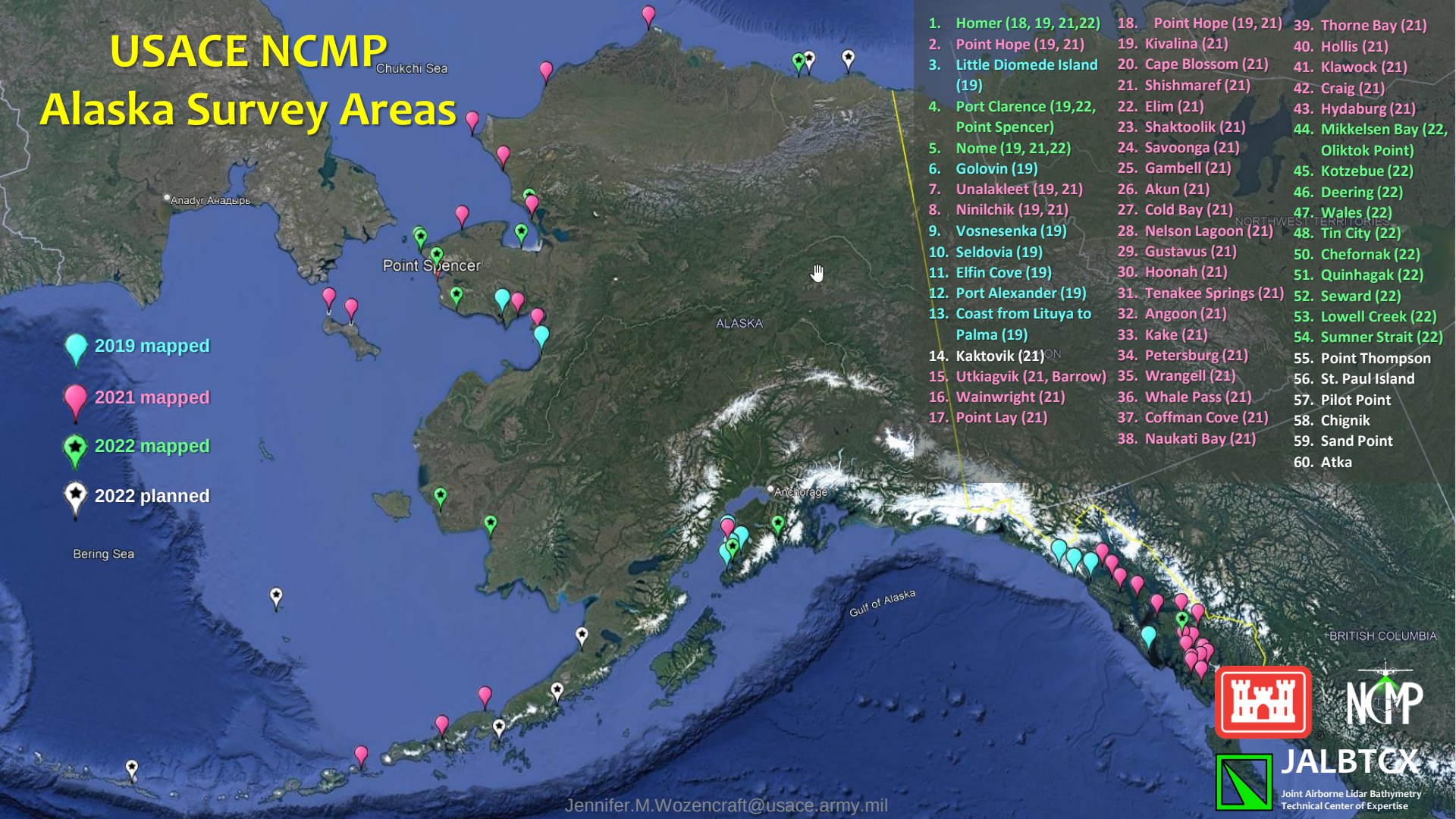
IOCM - Seabed 2030 (noaa.gov)

Bathymetry data gap analysis



- Extended Continental Shelf Grids
- Bathymetric LIDAR
- NOS Hydrography (BAG-formatted + Pre-BAG Multibeam)
- Multibeam Bathymetry
- NOS Hydrography (> 1960)
- Single-Beam Bathymetry (> 1960)
- Crowdsourced Bathymetry

USACE NCMP
Alaska Survey Areas



1. Homer (18, 19, 21,22)
2. Point Hope (19, 21)
3. Little Diomede Island (19)
4. Port Clarence (19,22, Point Spencer)
5. Nome (19, 21,22)
6. Golovin (19)
7. Unalakleet (19, 21)
8. Ninilchik (19, 21)
9. Vosnesenka (19)
10. Seldovia (19)
11. Elfin Cove (19)
12. Port Alexander (19)
13. Coast from Lituya to Palma (19)
14. Kaktovik (21)
15. Utkiagvik (21, Barrow)
16. Wainwright (21)
17. Point Lay (21)
18. Point Hope (19, 21)
19. Kivalina (21)
20. Cape Blossom (21)
21. Shishmaref (21)
22. Elim (21)
23. Shaktoolik (21)
24. Savoonga (21)
25. Gambell (21)
26. Akun (21)
27. Cold Bay (21)
28. Nelson Lagoon (21)
29. Gustavus (21)
30. Hoonah (21)
31. Tenakee Springs (21)
32. Angoon (21)
33. Kake (21)
34. Petersburg (21)
35. Wrangell (21)
36. Whale Pass (21)
37. Coffman Cove (21)
38. Naukati Bay (21)
39. Thorne Bay (21)
40. Hollis (21)
41. Klawock (21)
42. Craig (21)
43. Hydaburg (21)
44. Mikkelsen Bay (22, Oliktok Point)
45. Kotzebue (22)
46. Deering (22)
47. Wales (22)
48. Tin City (22)
50. Chefornak (22)
51. Quinhagak (22)
52. Seward (22)
53. Lowell Creek (22)
54. Sumner Strait (22)
55. Point Thompson
56. St. Paul Island
57. Pilot Point
58. Chignik
59. Sand Point
60. Atka

JALBTCX
Joint Airborne Lidar Bathymetry Technical Center of Expertise

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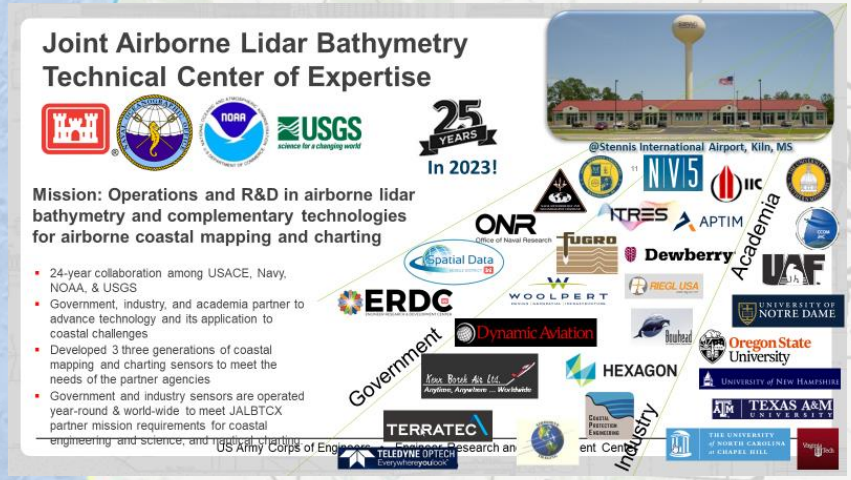
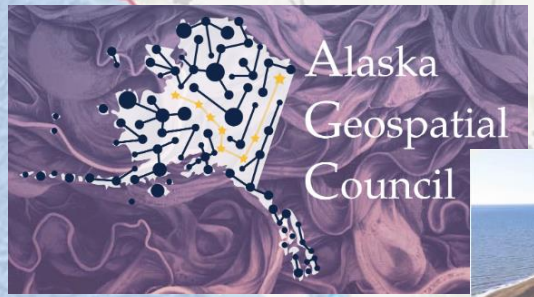
Coordination



Interagency Working Group on Ocean and Coastal Mapping Members



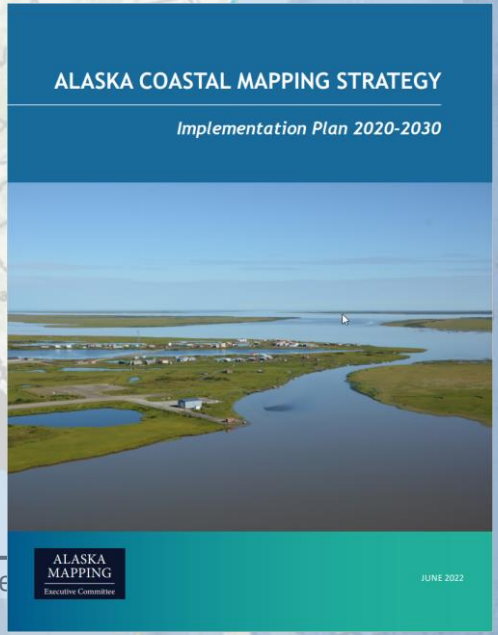
Coastal & Ocean Working Group

ALASKA MAPPING

Executive Committee

AMEC Coastal Subcommittee
(new)

Co-Chairs: NOAA, State of Alaska
Members: USGS, BOEM, BLM, NPS, FWS, USFS, NRCS, USACE, FEMA, USCG, AOOS



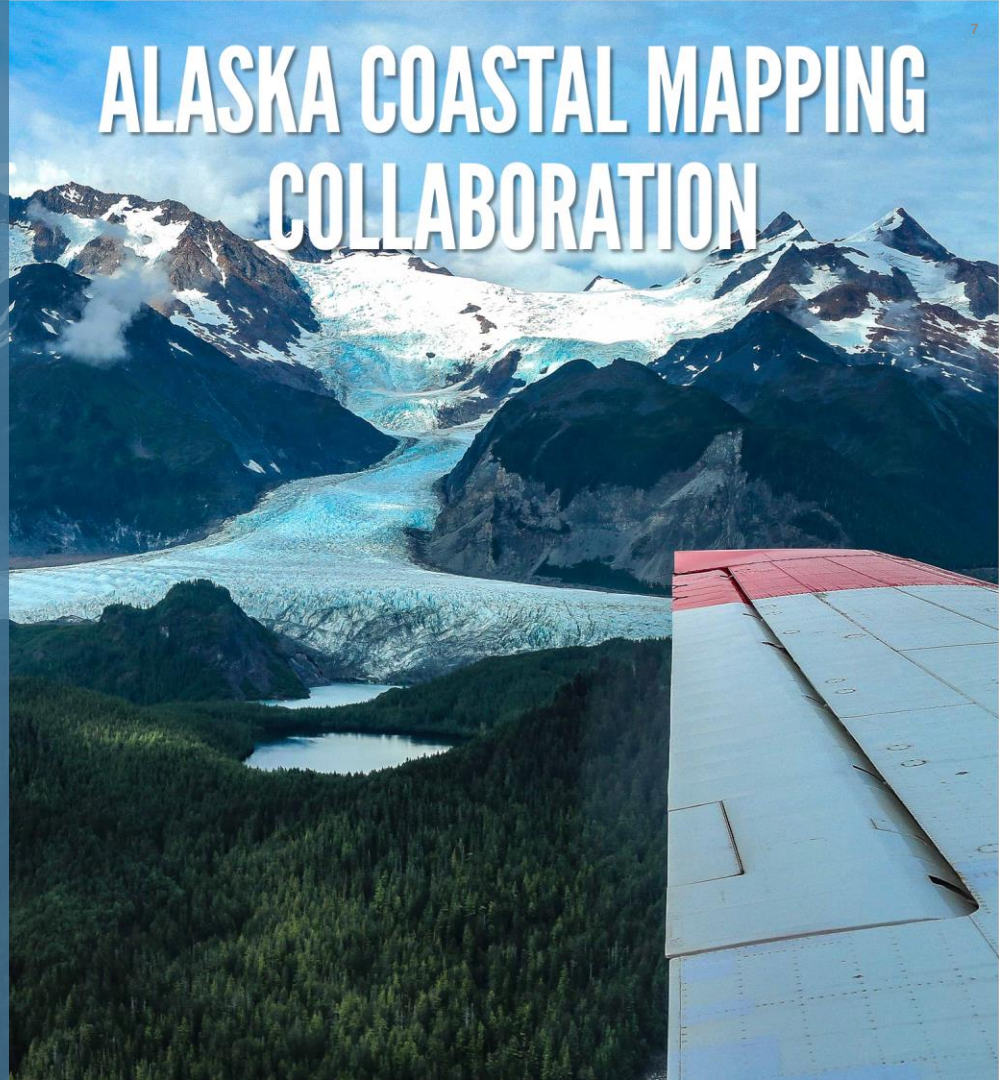
GOALS

- DATA
- COLLABORATIONS
- PRODUCTS
- CAPACITY BUILDING

Coastal Mapping

ACEP Alaska Center for Energy and Power

US Army Corps of Engineers



Alaska partners

FEDERAL

Seascape Alaska

NOAA

Sea Grant Alaska

US Army Corps of Engineers®

USGS

UNIVERSITY

UAF University of Alaska Fairbanks

ACEP Alaska Center for Energy and Power

Alaska Blue Economy Center

CCOM JHC

CICOES

STATE

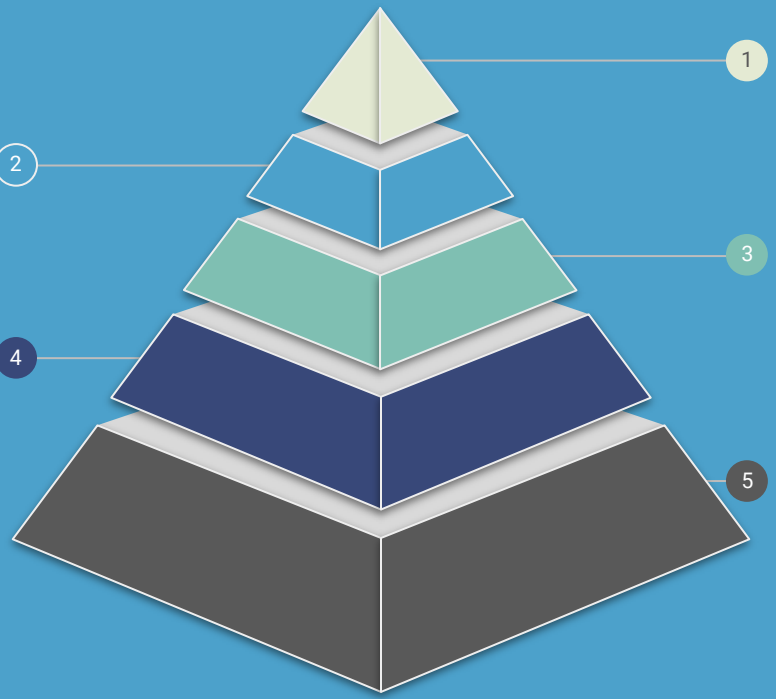
Division of Geological & Geophysical Surveys

Community & Regional Affairs

Student / training pipeline development

Project fellows
Host Sea Grant Alaska fellows supported by cohort program to refine technical skills and leadership ** CURRENT **

Undergraduate interns
Develop interest in coastal applications. Exposure to data, processing and applications ** CURRENT **



Research leadership
Support post-doctoral fellowships to create future research leaders

Graduate students
Tackle specific research topics and techniques while including professional development

Foundation education
Host technical workshops, create processing manuals, knowledge transfer of techniques for applications ** CURRENT **

2022 Undergraduate student intern Joy Lomelino building on her coastal mapping skills learning to fly a UAS

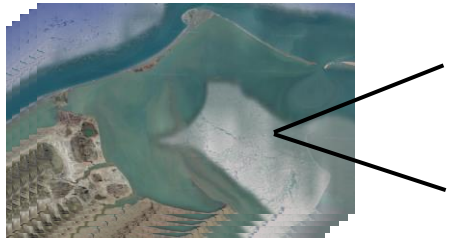
Fieldwork

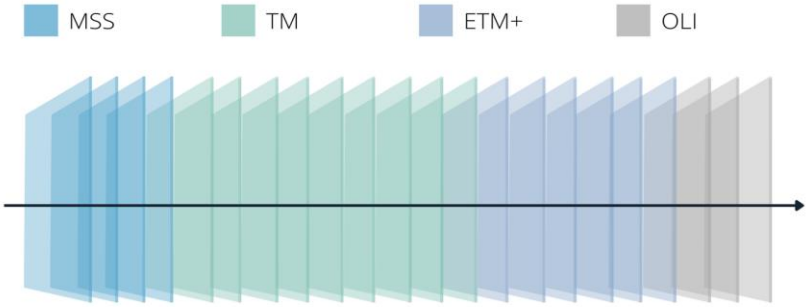
- Overlapping single beam bathymetry in Beaufort
- Expand efforts to Unalakleet
- Verify topo bathymetric lidar using both single & multibeam bathymetry

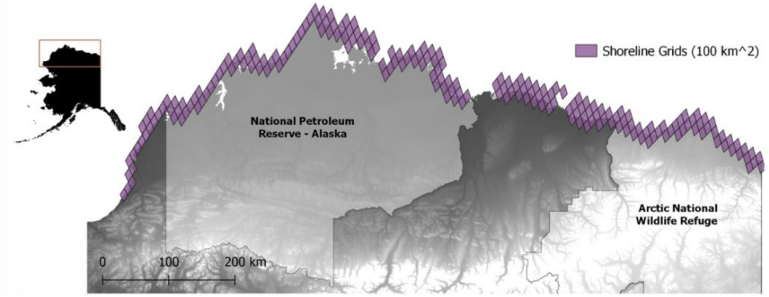
Elson Lagoon bathymetry, surveyed on August 31, 2021 with a hydroball

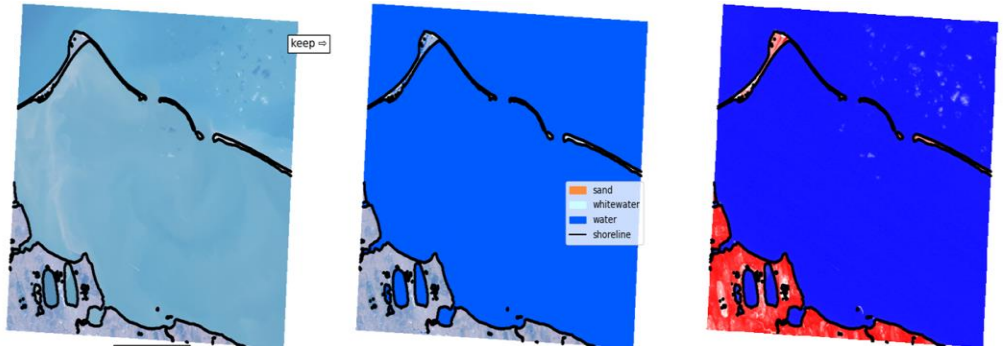
Tracking changing coastlines: CoastSat

Leverage Landsat temporal record to examine coastal change







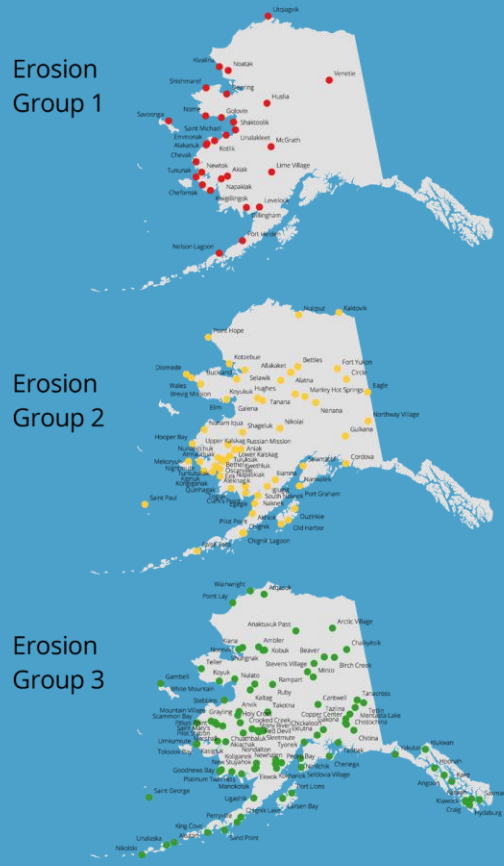


Intersections of bathymetry with other RS products

Input Layers	Feature Engineering	Topobathy Lidar	ML
			
Use high-temporal satellite data like MODIS (band 1) and Sentinel-3 OLI Compare turbidity from Sentinel-2 as necessary	Add additional information including distance from coastline and distance from rivers	Target variable is existing topo bathymetric data with success/fail and date	Different modeling approaches including supervised classification and time series forecasting to estimate likelihood of successful data acquisition

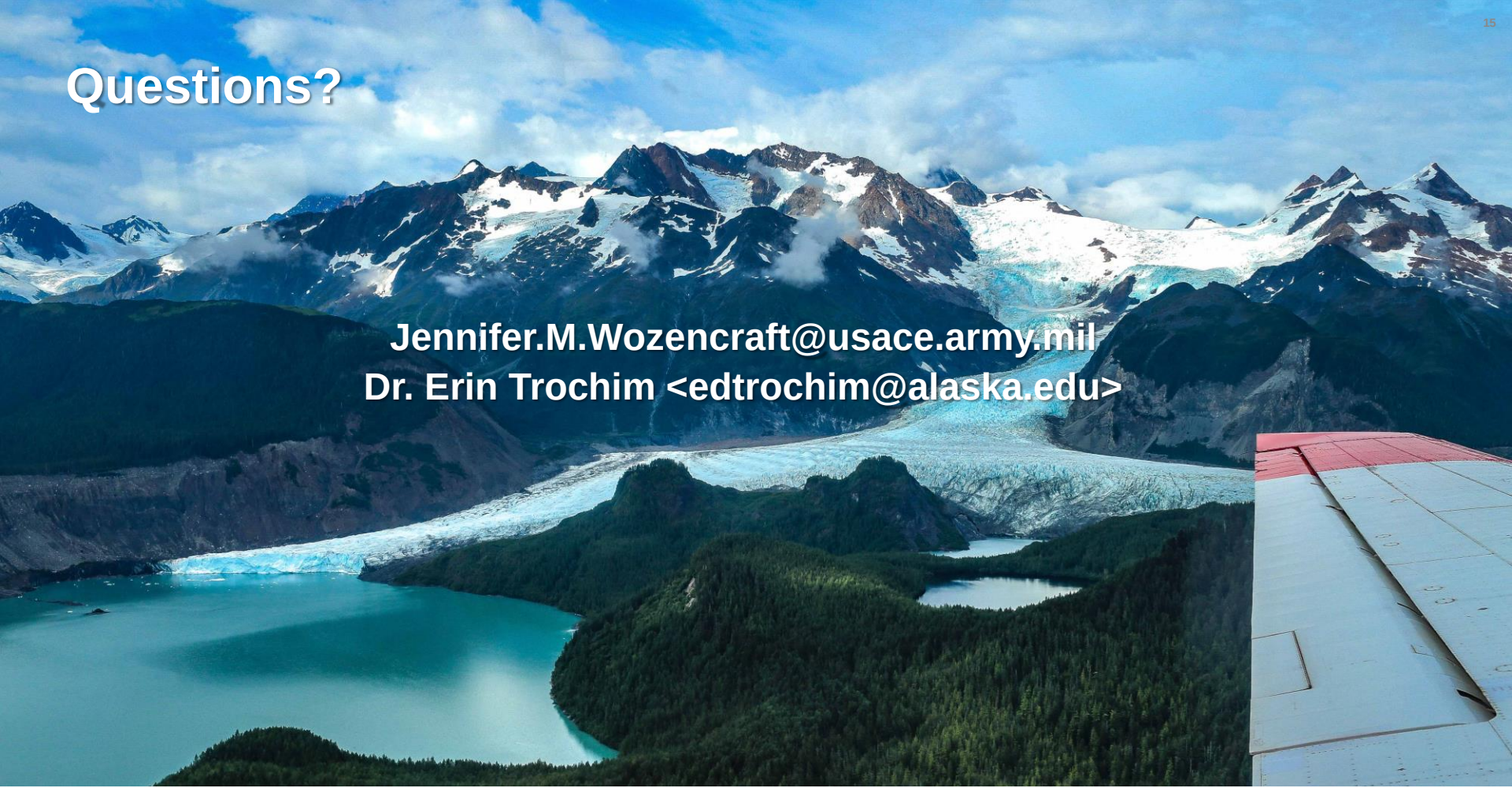
What research and development needs to be done

1. Test military prototype sensors in AK
    a. New high & low altitude available
2. Produce NCMP analysis products
3. Community threats and energy planning
    a. Focus on updating Alaska Environmentally Threatened Communities rankings (left)
4. Capacity development and coordination



Denali Commission Environmentally Threatened Communities coastal erosion rankings

Questions?



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Dr. Erin Trochim <edtrochim@alaska.edu>

Jane McKee Smith, Emeritus ST., Ph.D.

Dr. Smith is an Emeritus Senior Research Scientist at US Army Corps of Engineers, Engineer Research and Development Center (ERDC) in Vicksburg, MS. She earned a PhD from University of Delaware, in Civil Engineering with an emphasis in Coastal Engineering. Her research focus is on coastal hydrodynamics, including nearshore waves and currents, shallow-water wave processes, and storm surge. Her projects include theoretical and numerical studies as well laboratory and field experimentation. Smith has 200 professional publications. Smith is a Research Professor at University of Florida, and she has served on MS and PhD Committees at the University of Florida, Louisiana State University, Texas A&M University, and Mississippi State University. Smith is a Professional Engineer and Coastal Engineering Diplomate (Academy of Coastal, Ocean, Port and Navigation Engineers), and a member of the National Academy of Engineering. Her honors include 2022 International Coastal Engineering Award, ERDC Gallery of Distinguish Employees, ASCE Distinguish Member, ASCE Government Civil Engineer of the Year, Waterways Experiment Station Woman of the Year, Army Achievement Medal for Civilian Service, ERDC R&D Achievement Award, and Army Superior Civilian Service Award.

Summary of Outcomes and Recommendations Aligned with BCER Initiatives

Jane Smith, Emeritus ST., Ph.D.
U.S. Army Engineer Research and Development Center
Coastal and Hydraulics Laboratory
Vicksburg, MS

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (IPCC 2022) highlights climate change-induced processes in the Arctic that exacerbate already difficult coastal engineering challenges in remote, high-energy, cold regions:

1. The Arctic has warmed at more than twice the global rate over the past 50 years, and it is virtually certain that surface warming in the Arctic will continue to be more pronounced than the global average warming over the 21st century.

2. Permafrost warming and thawing have been widespread in the Arctic since the 1980s, and there is high confidence in future permafrost warming, decreasing permafrost extent with increased risk of hazardous impacts.

3. The observed increase in relative sea level rise is virtually certain to continue in Arctic contributing to more frequent and severe coastal flooding and shoreline retreat along sandy coasts.

These physical changes negatively impact human systems in the Arctic, including health and wellbeing, infrastructure, and food production. The changes also pose strong challenges to sustainable use of natural resource, infrastructure, cultures, and lives and livelihood (Meredith et al. 2019). To address these impacts, communities must be included in climate adaption planning and Other Social Effects (OSE) must be included in coastal planning and engineering assessments. The recommendations made by panelists during the 98th Board on Coastal Engineer Research focus on research needs for coastal community resilience in cold regions under a changing climate. These needs include improving understanding of Arctic wave, surge, ice, and morphology change physical processes; improved and expanded field measurement of bathymetry/topography, waves, and water levels; improved coast protection (wave and shoreline protection) methods in the Arctic; consistent, high-fidelity probabilistic risk assessment methods and results; and development of methods to quantify OSE in project planning. These needs align closely with Board priorities on Pacific coast measurements, improving understanding of sediment processes, numerical modeling modernization, risk-based design approaches, and incorporation of social equity into coastal analysis.

The specific R&D recommendations are:

1. Improve understanding of Arctic wave, surge, ice, and morphology change physical processes and modeling of compound flooding, erosion, and thawing permafrost risks

a. Permafrost thawing and erosion, landfast ice formation and movement

b. Coastal migration, barrier island dynamics

c. Complex, co-dependent, nonstationary extreme wave and water levels

d. Icepack impact on short-lived Polar Lows

e. Coupled circulation and wave model with ice

f. Geomorphic modeling with permafrost and ice processes

g. Long-period wave transmission under/through ice

2. Improve and expand field measurements:

a. Expand coastal observation of waves and water levels for climate assessment, project planning, and process/model improvement

b. Fill gaps in coastal mapping with a variety of technologies (hydro survey, satellite, autonomous systems)

c. Test military prototype sensors for coastal mapping in Alaska

d. Use coastal mapping data to assess community threats and energy planning

e. Expand coastal mapping capacity and coordination/collaboration

3. Improve coastal protection (wave and shoreline protection) methods in the Arctic and transition tools to local communities:

a. Develop cost effective Arctic shoreline erosion prevention techniques (“low” cost, constructable, ice resistant, adaptable)

b. Evaluate coastal structure porosity impacts on run up

c. Evaluate structure sensitivity to toe scour conditions

d. Demonstration program for concrete armor units:

i. Scale model test of CORE-LOC demonstration section

ii. Full scale demonstration revetment project at an ice-affected site and monitoring using CORE-LOC units

4. Expand high-fidelity probabilistic risk assessment methods and assessment

a. Update/expand data resources to evaluate risk (Western Alaska Wave Modeling and Coastal Hazard System (CHS))

b. High-fidelity data/tool products, at high geospatial resolutions, spanning physics and probabilistic parameter spaces – adaptable/expandable.

c. Multivariate approach combined with metamodeling to probabilistically quantify coastal and compound hazards, including interior flooding:

i. Regional drivers: surge/river discharge, waves, high tides, rainfall, groundwater

ii. Address climate change-induced extreme storm events

d. Evaluate relevance of very-high frequency, low intensity coastal forcing events.

e. 10-yr CHS refresh cycle: Atlantic Basin (5-6 yrs) + Pacific Basin (4-5 yrs)

5. Develop methods to quantify OSE in project planning

a. Incorporate physical and mental health impacts directly and quantitatively into project alternative assessment

b. Assess network/infrastructure access impacts of flooding/erosion, including disproportional impacts on the socially vulnerable

c. Develop frameworks to promote OSE outcomes within overall benefit assessment

d. Investigate wellbeing impacts of exposure to routine and nuisance flooding/erosion in addition to catastrophic

Summary of Outcomes and Recommendations Aligned with BCER Initiatives

Jane McKee Smith

Emeritus Senior Scientist

Engineer Research &
Development Center
U.S. Army Corps of Engineers

September 13-15, 2022

Coastal Community Resilience Research Needs in Cold Regions under a Changing Climate

Intergovernmental Panel on Climate Change Sixth Assessment 2022

- Arctic has **warmed at more than twice the global rate** over the past 50 years, and it is virtually certain that surface warming in the Arctic **will continue to be more pronounced** than the global average warming over the 21st century
- **Permafrost warming and thawing have been widespread** in the Arctic since the 1980s, and there is high confidence in **future permafrost warming**, decreasing permafrost extent with **increased risk of hazardous impacts**
- The observed increase in **relative sea level rise is virtually certain to continue** in Arctic contributing to **more frequent and severe coastal flooding and shoreline retreat along sandy coasts**

Human System IMPACTS in the Arctic:

- Health and wellbeing: infectious disease, malnutrition, mental health
- Infrastructure: Flood/storm damages in coastal areas, permafrost melting/erosion, damage to infrastructure, damage to key economic sectors, inland flooding/damages
- Food production: Fisheries, aquaculture, animal and livestock

Path Forward: Big Picture

- Very different future cold region environments pose strong challenges to sustainable use of natural resources, infrastructure, cultures and lives and livelihoods
- Strategies to reduce risk and strengthen resilience for cold region ecosystems and people:
  - Do practices and tools to contribute to climate resilient pathways?
  - Translate existing understandings of social-ecological resilience into decision making?
  - What resources are needed for successful adaptation responses?
  - How effective is US Army Corps of Engineers in supporting adaptation?
- Adaption is constrained by limited knowledge, financial resources, human capital and organizational capacity
- Enable involvement of local communities in climate adaptation planning
- Include indigenous and local knowledge to facilitate cooperation in the development, identification, and decision-making processes for responding to climate change, and better understand the challenges facing Indigenous peoples

IPCC Polar Regions Assessment https://www.ipcc.ch/site/assets/uploads/sites/3/2022/03/05_SROCC_Ch03_FINAL.pdf

Shoreline Erosion Challenges

Challenges:

- Policy
  - Sec 117 & Sec 116: Erosion protection projects
  - WRDA 2022 Sec. 402: Ability to pay linked to Economically Disadvantaged Communities
- 31 environmentally challenged communities identified

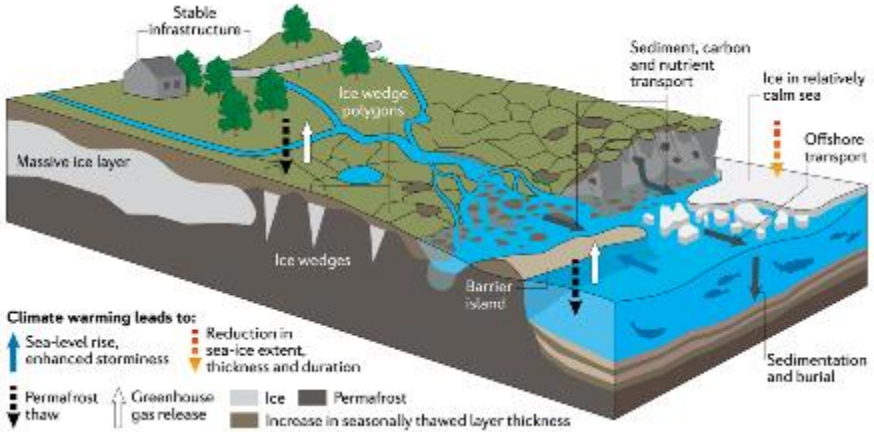
R&D Needs:

- Update/expand data resources to evaluate risk:
  - Western Alaska Wave Model
  - Coastal Hazard System
- Cost effective arctic shoreline erosion techniques
  - “Low” cost, constructable, ice resistant, adaptable

Impacts of Changing Sea Ice

Challenges:

- Reduced sea-ice extent, thickness, duration
- Sea level rise, enhanced storminess
- Permafrost thaw
- Ice push/shove, gouging events
- → Enhanced coastal erosion



R&D Needs:

- Modeling of key process:
  - Permafrost erosion, landfast ice formation and movement
  - Coastal migration, barrier island dynamics
  - Process feedbacks
- Quantifying complex, nonstationary extremes
- More coastal observations/monitoring
- Integration of improved understanding into planning/decision support

Community Coastal Resilience and Social Challenges

Challenges:

- Holistic assessment of project benefits
- Incorporation of local knowledge
- Local community involvement in climate adaptation planning

R&D Needs:

- Incorporate physical and mental health impacts directly and quantitatively into project alternative assessment
- Assess network/infrastructure access impacts of flooding/erosion, including disproportional impacts on the socially vulnerable
- Develop frameworks to promote OSE outcomes within overall benefit assessment
- Investigate wellbeing impacts of exposure to routine and nuisance flooding/erosion in addition to catastrophic

Armor Units for Coastal Protection in the Arctic

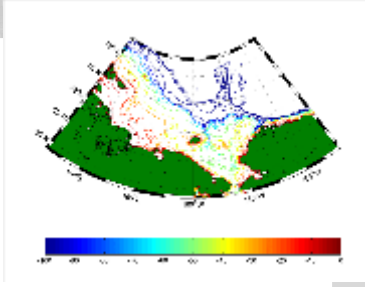
Challenges:

- Concrete armors units needed when economic rock is not available at project site (no local rock source, very large rock for coastal exposure)
- Limited experience in cold regions

R&D Needs:

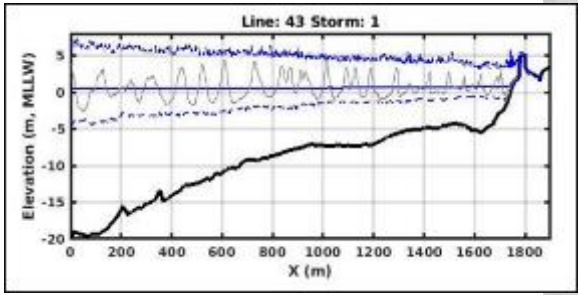
- Resistance to movement under ice loading condition
- Structure porosity impacts on run up
- Structure sensitivity to toe scour conditions
- Demonstration Program
  - Scale model test of CORE-LOC demonstration section
  - Full scale demonstration revetment project at an ice-affected site and monitoring using CORE-LOC units

Storm Selection for Design Event Scenarios



Challenges:

- Defining storm climate for non-linear physical processes interactions in the Arctic (ice extents, wave-water level)
- Phase-resolving wave models required to determine run-up extent
- No erosion model includes interaction of air-water temperature, wave run-up, permafrost degradation, ice wedge failure



R&D Needs:

- Icepack impact short-lived Polar Lows
- Coupled circulation and wave model with ice
- Geomorphic models with permafrost and ice processes
- Long-period wave transmission under/through ice

Coastal Hazards System for the Pacific

Challenges:

- Define coastal hazard waves/water levels for Pacific
- Provide consistent and continuous high-fidelity probabilistic information

R&D Needs:

- High-fidelity data/tool products, at high geospatial resolutions, spanning physics and probabilistic parameter spaces – adaptable/expandable
- Multivariate approach combined with metamodeling to probabilistically quantify coastal and compound hazards, including interior flooding
  - Regional drivers: surge/river discharge, waves, high tides, rainfall, groundwater
  - Address climate change-induced extreme storm events
- Evaluate relevance of very-high frequency, low intensity coastal forcing events.
- 10-yr CHS refresh cycle: Atlantic Basin (5-6 yrs) + Pacific Basin (4-5 yrs)

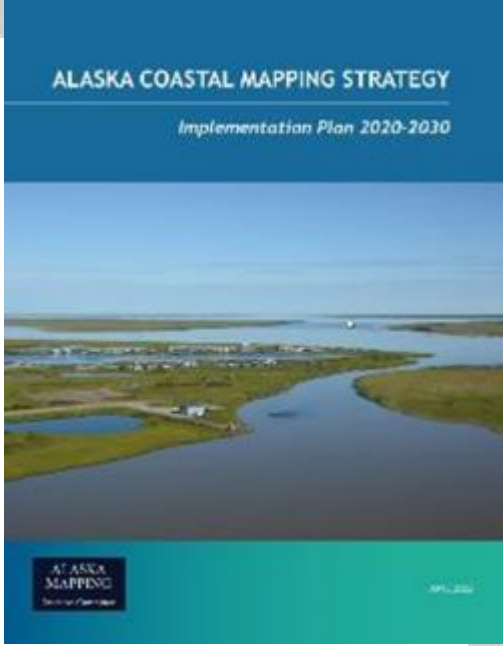
Alaska Coastal Mapping

Challenges:

- Mapping remote, diverse, and vast Alaska shoreline

R&D Needs:

- Fill gaps with a variety of technologies (hydro survey, satellite, autonomous systems)
- Test military prototype sensors in AK
  - New high & low altitude sensors available
  - Produce National Coastal Mapping Program analysis products
- Assess community threats and energy planning
  - Focus on updating Alaska Environmentally Threatened Communities rankings
- Expand coastal mapping capacity and coordination/collaboration



Next Steps and BCER Feedback

R&D Needs:

- Improved Arctic physics (wave, surge, ice, morphology w/ permafrost/ice) and modeling of compound flooding, erosion and thawing permafrost risks
- High-quality measurements: coastal mapping, waves, water levels
- Coastal protection methods suitable for extreme, remote Arctic conditions (“low” cost, constructable, ice resistant, adaptable) and transition of tools to local communities
- Updated/expanded Coastal Hazard System for the Pacific for high-fidelity probabilistic risk assessment
- Methodologies to include Other Social Effects in project planning

Feedback on Priorities
Advocacy for consistent funding (fundamental and applied R&D)
Identification of new measurement technologies/data collection opportunities

Action Items

Action Items: 2020 BCER Executive Meeting, Corvallis, OR, and Full BCER Meeting, Vicksburg, MS					
NUMBER	**ACTION ITEM**	**Due**	**POC(s)**	**Status**	
Executive BCER, Corvallis, OR, March 2-3, 2020					
2020-Exec-1	Provide version of Knowledge Management Portal to enable public access to Civil Works R&D emerging products and research updates	Summer 2020	Sanchez/ Rosati	Completed	
2020-Exec-2	Work with HQ Regional Integration Teams (RITs) to ensure that Water Resource Development Act (WRDA) language enables research and innovation in future Corps projects	Summer 2020	Rosati	Completed; included as part of EC on RD&T	
2020-Exec-3	Reiterate BCER requests to provide input on: Sediment Transport R&D Priorities, and ways to quantify impacts of the U.S. Coastal Research Program to the Corps and Nation	Spring 2020	Rosati / Smith/ Cialone	Completed	
2020-Exec-4	Provide the BCER a summary of FY20 R&D Statements of Need intended for funding as organized by CHL service areas. Identify unfunded needs. Identify gaps as aligned on a spectrum from Fundamental, to Applied-, to Operational activities.	2021 Exec BCER	Rosati	Completed	
2020-Exec-5	Incorporate USACE Data Strategy and CW R&D Big Ideas into CHL Strategy	Summer 2020	Wamsley/ Rosati	Completed	
2020-Exec-6	At 2020 Full BCER, connect researchers with practitioners	2020 Full BCER	Rosati	Completed	
2020-Exec-7	Summarize "Recommendations for CW Coastal Research" for the Chief, Congress, and others	2020 Full BCER	BCER Civilian Board	Completed	

2020-Exec-8	Next BCER Executive meeting to be organized as a business meeting to discuss and close out action items	2023 Exec BCER	Rosati	In process	
2020-Exec-9	Provide new BCER members onboarding briefings including a flowchart of how BCER recommendations are considered and implemented	Summer 2020	Rosati/ Wamsley	Completed	
Full BCER, Vicksburg, MS, August 26-27, 2020					
2020-Full-1	Define Topics for BCER's Strategic Initiatives	Oct-20	Rosati	In process	

Continuing Action Items as Identified by Previous BCERs		
	ACTION ITEM	**Status**
2016-Full-2	Exec Mtg: Summarize coastal products for BCER Members	Continuing
2016-Full-3	Show AK, HI and US Territories on appropriate maps	Continuing
2016-Exec-4	Exec Mtg:: Present annually at the BCER executive session a financial breakdown of coastal R&D as a subset of the CW R&D program. Provide CW RD&T process overview (how research gets submitted, prioritized, and funded; % of coastal R&D as part of total).	Continuing
2015-Full-1	Continue investment in "systems R&D" and development of tools that help design and operate water resources projects in a regional context	Continuing
2015-Full-2	Link the most challenging studies and projects with the latest research and technology to address uncertainties early and produce defensible, innovative solutions	Continuing
2015-Full-3	Share data and tools with stakeholders to build relationships and transparency	Continuing
2015-Full-4	Enhance collaboration across the coastal research community; Exec Session: Update BCER on collaborations (university, agency, industry, international)	Continuing
2018-Full-1	Hold pre-meeting immediately before each BCER meeting to discuss agenda and expected outcomes, review prior recommendations and status, and status on action items	Continuing
2018-Full-2	Provide additional time for BCER members to discuss topics and exchange ideas	Continuing
2018-Full-3	Ensure BCER Member input on meeting agenda	Continuing
2017-Exec-5	Exec Mtg: Provide annual list of peer reviewed publications	Continuing
2017-Exec-10	Establish Action Item archive and track active action items; add due dates for review; transfer ongoing action items into BCER policies document	Continuing
2018-Full-13	Schedule bi-monthly / mid-point meeting between BCER Chair and staff	Continuing
2019-Exec-4	Document BCER Exec & Full Meetings with memo to be sent to the Chief of Engineers	Continuing
2019-Exec-5	Include CHL Presentations on ongoing R&D at BCER	Continuing
2019-Exec-13	Provide annual updates on coastal innovations and ongoing R&D in Supplemental	Continuing
2019-Full-10	Compile R&D Needs that are summarized in each BCER talk	Continuing
2019-Full-11	Send BCER complete list of action items	Continuing
2020-Full-2	Provide BCER Board members monthly to bi-monthly updates	Continuing

Past Memos/ Locations

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

CECW

12 March 2020

MEMORANDUM FOR The Chief of Engineers

SUBJECT: Outcomes from Board on Coastal Engineering Research Board's Executive Meeting, Corvallis, OR

1. From 3-4 March, 2020, the Board on Coastal Engineering Research (CERB) held an Executive meeting in Corvallis, Oregon adjacent to Oregon State University's (OSU) campus, one of the leading coastal engineering and science academic institutions in the nation. The theme of this Executive CERB meeting was *Pacific Northwest Coast Processes and Coastal Resilience* with the intent to identify strategic coastal research priorities for the Pacific Northwest and the Nation. The meeting was structured to provide the Board a status update on previous action items and CERB initiatives; discuss local Corps Navigation, Coastal Storm Risk Management (CSRM), and Ecosystem challenges in the Pacific Northwest; and learn about OSU's ongoing coastal research, facilities, and opportunities to expand partnerships. Attachment A includes action items from the meeting.

2. The CERB was briefed on progress towards priority initiatives identified in previous meetings, including Sediment Transport Research Priorities and the U.S. Coastal Research Program (USCRP), and asked to provide input on these two topics (Action Item 2020-Exec-3).

a. Sediment Transport Research Priorities. Coastal sediment processes of concern for the Corps range from spatial and temporal scales that are short (meters/minutes) to very long (regions/decades). For both cohesive and sandy sediment processes, field and lab data were identified repeatedly as the most important need. These data will inform numerical modeling advancements and fundamental processes to improve Corps studies. The Board was asked for their recommendations to make the greatest leap-forward advancements in fundamental and applied sediment transport knowledge, to identify opportunities to leverage ongoing studies, and recommend approaches to increase coastal sediment research funding.

b. Quantifying the impact of the U.S. Coastal Research Program to the Corps and Nation. The USCRP is a CERB initiative that has expanded in the 5 years since inception, funding $6.3M of academic studies, a large percentage which are being conducted at the Corps' Field Research Facility in Duck, NC as part of a During Nearshore Event Experiment during Fall 2019 and 2020. Congress has recognized the value and impact of the USCRP, increasing the Corps' R&D funding through a Congressional Add by $5M in FY19 and $8M in FY20 for this collaborative research. USCRP funds are congressionally-directed to support coastal academic research that align with federal agency priorities and meet a societal need. The Board was presented with metrics to track the impact of the USCRP to coastal science and engineering in the Nation and Corps, and asked to provide feedback.

3. Briefings on OSU regional research studies were interspersed with local Corps' District coastal projects issues, providing opportunities for sharing knowledge. Attendees visited three OSU and Corps' field sites to illustrate the impact of coastal processes, Corps' challenges, and infrastructure in the region: OSU's Hatfield Marine Science Center in Newport; Yaquina Bay Jetties; and Yaquina Head.

a. OSU's coastal studies include innovations to reduce coastal erosion through natural and nature-based features such as vegetation and biocementation of coastal dunes, remote measurements of nearshore coastal processes, analysis of long-term cyclic coastal change, and tsunami hazard resilience studies and mitigations. Attendees toured a part of OSU's new earthquake-resistant marine science building. This innovative facility will provide vertical tsunami evacuation with stability for up to a magnitude 9.0 earthquake and subsequent tsunami up to 47-ft. A tour of OSU's O.H. Hinsdale Wave Research Laboratory demonstrated capability to generate tsunami waves and test coastal structures in their large wave basin, and provided an opportunity to meet with Masters' and PhD students and learn about their research.

b. Corps projects in the Pacific Northwest that could benefit from these advancements were discussed, including low-use navigation channels, dredging and the need for innovations in dredging capabilities for nearshore placement, planning for long-term sea level and storm climatology, and restoring ecosystem sediment transport and flow in Puget Sound and other locations. Challenges in maintaining jetty stability and safe navigation through the Corps' Yaquina Bay Jetty system were discussed during the site visit. Near the Yaquina Head, attendees visited a naturally-occurring cobble beach that provides a dynamic revetment, a concept utilized in some CSRM projects.

c. The Board discussed ways to more intentionally connect academic research advancements to Corps' District practitioners, and reward innovation. The USACE's Technology Innovation Strategy (in preparation) has proposed a trust fund to reward innovative District practices and sharing. The Board recommended a public-facing version of the Knowledge Management Portal to better communicate ongoing research advancements with academic and others (Action Item 2020-Exec-1), and including Water Resource Development Authorization (WRDA) language that enables innovation in Corps project studies (Action Item 2020-Exec-2).

4. An overarching topic continued from previous CERB meetings: the future of Coastal Engineering and Science R&D. The Board expanded previous recommendations, specifically ways to focus Civil Works R&D research towards Corps priorities, increase the coastal R&D budget, and incorporate fundamental research to spur innovation. There were two main outcomes from this discussion.

a. First, the Board requested an analysis of FY20 coastal R&D that is funded/unfunded as organized by Coastal & Hydraulics Laboratory service areas (Action Item 2020-Exec-4). The intent of this action item is to both analyze the type and number of research needs that are unfunded, and construct a gap analysis on those areas that are funded as related to coastal Navigation, CSRM, and Environmental business areas. This analysis will both serve to inform the next CERB with several new military members, and also highlight gaps in research areas.

b. Second, because this topic has matured through discussions and briefings in recent CERB meetings, the civilian Board members tasked themselves to document their recommendations for Civil Works coastal R&D in a brief report to the Chief (Action Item 2020-Exec-7). This position paper is intended to provide an external, unbiased perspective from the civilian board members with their recommendations on how the Corps' would best proceed in coastal engineering and science research. The report would be directed to the Chief and non-Corps interests.

5. The next Full CERB planned for late summer 2020 will focus on the topic of Compound Flooding (combined coastal storm surge, wind, riverine flow, saturated ground and precipitation) such as has been experienced in populous coastal urban cities such as Houston, TX during Hurricane Harvey, and in Wilmington, NC during Hurricane Florence. This meeting will likely have several new military members, and several action items are directed towards pre-briefing the new CERB members as appropriate (Action Items 2020-Exec-6, 2020-Exec-9).

6. For questions about topics discussed herein, please contact the Designated Federal Officer for the CERB, Dr. Julie Rosati, Julie.D.Rosati@usace.army.mil.

SCOTT A. SPELLMON
Major General, US Army
President, Board on Coastal Engineering Research

CECW
SUBJECT: Outcomes from Board on Coastal Engineering Research Board's Executive Meeting, Corvallis, OR

Attachment A: Action Items from 2020 Executive Session of the Coastal Engineering Research Board, Corvallis OR

Number	Action Item	Due Date	POC
2020-Exec-1	Provide version of Knowledge Management Portal to enable public access to Civil Works R&D emerging products and research updates	TBD	Sanchez/ Rosati
2020-Exec-2	Work with HQ Regional Integration Teams (RITs) to ensure that Water Resource Development Act (WRDA) language enables research and innovation in future Corps projects	TBD	Rosati
2020-Exec-3	Reiterate CERB requests to provide input on: Sediment Transport R&D Priorities, and ways to quantify impacts of the U.S. Coastal Research Program to the Corps and Nation	Spring 2020	Rosati / Smith/ Cialone
2020-Exec-4	Provide the CERB a summary of FY20 R&D Statements of Need, Strategic Needs, and Facility Modernizations intended for funding as organized by CHL service areas. Identify unfunded needs. Identify gaps as aligned on a spectrum from Fundamental, to Applied, to Operational activities.	2020 Full CERB	Rosati
2020-Exec-5	Incorporate USACE Data Strategy and CW R&D Big Ideas into CHL Strategy	TBD	Wamsley/ Rosati
2020-Exec-6	At 2020 Full CERB, connect researchers with practitioners	2020 Full CERB	Rosati
2020-Exec-7	Summarize "Recommendations for CW Coastal Research" for the Chief, Congress, and others	2020 Full CERB	CERB Civilian Board
2020-Exec-8	Next CERB Executive meeting to be organized as a business meeting to discuss and close out action items	2021 Exec CERB	Rosati
2020-Exec-9	Provide new CERB military members onboarding briefings including a flowchart of how CERB recommendations are considered and implemented	Summer 2020	Rosati/ Wamsley

CECW 5 Oct 2020

MEMORANDUM FOR The Chief of Engineers

SUBJECT: Outcomes from Board on Coastal Engineering Research's 97th Meeting, Vicksburg, MS

1. I chaired the 97th Board on Coastal Engineering Research (CERB) meeting from 25-26 August 2020 in Vicksburg, MS. The theme of this meeting was Compound Flooding, Multiple Hazards & Increasing Risk, with the intent to identify Corps coastal research priorities within this theme. Because of the pandemic, the meeting was held in a hybrid virtual format, with in-person attendance limited to Board members and support staff; the agenda is included in Attachment A. The meeting focused on coincident coastal storm, precipitation, and riverine flooding, as well as other hazards, human activities, and coincident occurrences that compound risk in coastal regions. The Engineer Research & Development Center's Coastal and Hydraulics Laboratory (ERDC-CHL) hosted the meeting and provided on-site attendees an opportunity to tour recent innovations in physical model facilities. The following describes the meeting highlights.

2. In your previous role as President of the Board, you requested a modified format that paired district practitioners with Corps and academic researchers to discuss Corps problems and potential solutions associated with the theme of CERB meetings. This practice was successfully implemented with presentations by the New Orleans, Galveston, Jacksonville, and Mobile Districts on their real-world project challenges and the science that is needed to improve planning, engineering and operations.

3. The theme of the meeting was compound flooding, the mix of coastal storm, riverine flooding and extreme precipitation that poses increasing risk to the nation. Several excellent talks illustrated the complex nature of the problem, some of the key science issues that constrain possible solutions, and potential new tools. The success **of pre-calculated high-fidelity storm process databases** such as are used in the North and South Atlantic and the Gulf of Mexico should be extended to other regions and more data acquired to validate and better define associated uncertainties.

4. One of the paired presentations from the Mobile District discussed water resource projects with historical and cultural heritages that have value to society but do not meet economic benefit criteria. Selma, AL has historic and national significance and is impacted by compounding storm events but lacks national economic benefits to justify a project. Similarly, Mexico Beach, FL, was devastated by Hurricane Michael in 2018 but lacks the tax base to justify federal investment. Flood risk management research is underway to develop tools and methods to account for Other Social Effects (OSE) benefits in the planning phase of projects. The Board recognized the **need to move beyond National Economic Development benefits** alone as an important non-technical challenge for the Corps.

5. There was continued discussion led by the civilian members of the Board to emphasize the need for, and impact of, fundamental (basic) research in Civil Works (CW)

R&D, previously noted in our Sep 2019 CERB Outcomes Memo. The discussion was renewed after one of the paired presentations from ERDC-CHL and the Jacksonville District highlighted R&D that is being transitioned into practice to streamline coastal monitoring via the mini-Argus remote camera system. The Board noted that the Argus technology has slowly evolved over decades of basic research. **Investment in fundamental research and collaborations with non-USACE researchers** is needed to facilitate innovation in the Corps. One presenter also discussed disincentives within the USACE reward system for taking innovation risk.

6. We discussed that effective communication and connection within and outside the enterprise is an ongoing need. Other federal agencies, academics, and stakeholders can be partners in providing data and ideas towards solutions. We saw several brief videos highlighting the History of the CERB, the ERDC-CHL physical laboratory facilities, the Field Research Facility (FRF) in Duck, NC, and the U.S. Coastal Research Program (USCRP), one of the CERB's initiatives, that were extremely successful communication mechanisms[1]. These videos can be used to relay USACE's R&D impacts and value to the nation. Meeting discussions are related to USACE 2020 Campaign Plan Goal 2 *Modernize USACE*, Goal 3 *Advance Partnerships and Strengthen Relationships*, and Goal 4 *Revolutionize Program and Project Delivery*.

7. **CERB Strategic Initiatives (CSIs).** The Board discussed the need for focus on topics to advance during their tenure (2-3 years) and use these as themes to frame future meetings. In past CERBs, civilian members of the Board identified several strategic initiatives:

i. Motivating a larger investment in CW coastal R&D;
ii. Motivating CW R&D research that is organized with funding streams spanning fundamental (basic), intermediate, applied, transitional to practice, and strategic;
iii. Focusing USACE priorities in sediment transport research; and
iv. Providing a robust Verification, Validation, and Uncertainty Quantification (VVUQ) process by establishing standards and benchmark datasets such as the Coastal Model Test Bed (CMTB).

8. In addition, the Board discussed the need for far-reaching "Moon Shot" ideas, and recommended future discussion at the next Executive session. The Board requested more regular discussions on progress and plans towards these initiatives and future meetings. Action Item 2020-Full-1 is to request the Board's input, revisions, and concurrence on CSI and "Moon Shot" topics. Action Item 2020-Full-2 is to provide the Board monthly to bi-monthly updates on progress and plans.

9. The next CERB Executive Session will be held 17-18 March 2021 at the ERDC-CHL's Field Research Facility in Duck, NC with the intent to discuss the CSIs and plan to address these. We are planning to convene the 98th Full CERB meeting with the Mississippi River Commission (MRC) to continue discussing needs within CERB and

[1] History of the CERB (https://vimeo.com/453357797); CHL facilities and capabilities (Physical Model Facilities at ERDC-CHL, Vicksburg, MS (https://vimeo.com/453360333); Field Research Facility at ERDC-CHL, Duck, NC (https://vimeo.com/453359560); USCRP (https://uscoastalresearch.org/)

MRC priorities such as sediment transport and compound flooding. I invite you to attend both of our 2021 CERB meetings and consider giving the CERB a Charge to address a coastal topic and provide recommendations. I have several ideas we can discuss at your convenience.

10. For questions about topics discussed herein, please contact the Designated Federal Officer for the CERB, Dr. Julie Rosati, Julie.D.Rosati@usace.army.mil.

WILLIAM "BUTCH" GRAHAM
Major General, US Army
President, Board on Coastal Engineering Research

Attachment A: Agenda

Attachment B: Action Items

Attachment A: Agenda for the 97th Coastal Engineering Research Board Full Meeting, Vicksburg, MS, 25-26 Aug 2020

97th COASTAL ENGINEERING RESEARCH BOARD MEETING

Coastal & Hydraulics Laboratory
Engineer Research & Development Center, Vicksburg, MS
25-26 August 2020

Participant Connection:
Dial-in: 888-251-2949 or 215-861-0694
Access Number: 9767951#
Webinar: https://ems8.intellor.com/login/830002

AGENDA

THEME: Compound Flooding, Multiple Hazards & Increasing Risk

2020 CERB Concept: (1) Virtual CERB (with in-person attendance limited to board members and support staff). (2) Pair practitioners (District problems) with researchers (solutions). (3) Utilize a mix of live/pre-recorded briefs, videos, on-site reports, and virtual interactions to facilitate engagement and sharing with participants.

Meeting Concept: *To identify Corps coastal research priorities related to present and future compound flooding and multiple, coincident hazards that increase coastal risk*

(All Central Time Zone)

Tuesday, 25 August 2020

Meeting Attire: Military-ASU'B; Civilian-Business- Mask required for all in person attendees

0900	Registration (Coastal and Hydraulics Laboratory Atrium)
0930	**Call to Order** Dr. Julie Rosati, Designated Federal Officer (DFO)
0930 – 1000	**Welcome and Opening Remarks** MG William H. "Butch" Graham,, Jr. Deputy Commanding General for Civil and Emergency Operations, Headquarters (HQ), U.S. Army Corps of Engineers (USACE) Welcome to USACE Engineering Research and Development Center (ERDC), Dr. David Pittman, Director, ERDC Dr. Julie Rosati, CHL, Meeting logistics
1000 – 1030	Purpose and History of the CERB - Video/ Presentation Dr. Ty V. Wamsley, SES, Director, Coastal and Hydraulics Laboratory (CHL), ERDC

1030 – 1100 "Orientation to CERB Theme and Research Focus"
Dr. Jane Smith, ERDC/CHL, Army Senior Research Scientist, Hydrodynamic Phenomenon

1100 – 1400 Panel Session #1 / Compound Flooding/ Threats

Moderator: Dr. Katherine Brutsche, ERDC/CHL

1100 – 1130 "Numerical Advancements, Levee Overtopping, and Compound Flooding"
Dr. Gaurav Savant, ERDC/CHL, and Mr. Max Agnew, USACE/ Mississippi Valley Division (MVN)

1130 – 1200 "Compound Flooding: State of Practice, Current Issues and Advancements, with Examples from Galveston District"
Dr. Chris Massey, ERDC/CHL, and Dr. Shubhra Misra, USACE Galveston District (SWG)

1200 – 1300 LUNCH BREAK

1300 – 1330 "HQ Perspective on Compound Events,"
Dr. Kathleen White, USACE/Headquarters (HQ), and Mr. Will Veatch USACE/MVN

1330 – 1400 "Compounding Cultural and Social Issues within a Flood/Storm Decision-Framework"
Ms. Elissa Yeates, ERDC/CHL and Mr. Jeremy LaDart, USACE/Mobile District (SAM)

1400 – 1430 "Delivering Engineering Solutions in a Multi-Hazard World"
Dr. Todd Bridges, ERDC/Environmental Laboratory (EL), Army Senior Research Scientist, Environmental Science

1430 – 1500 Break

1500 – 1700 Panel Session #2 / Physical and Field Facilities Addressing Compound Phenomenon

Moderator: Dr. Brandon Boyd, ERDC/CHL

1500 – 1530 "River loading to coastal zone and Low Sill Model" *on site at Low Sill Model (livestream)*
Mr. Jeremy Sharp, ERDC/CHL

1530 – 1600 "Current Status and Future of Coastal Physical Modeling at CHL,"
Dr. Duncan Bryant, ERDC/CHL

1600 - 1630 "Virtual Tour of CHL Physical/Field Facilities – *Videos*,"
Ms. Leigh Provost, ERDC/CHL; and Dr. Jeff Waters, ERDC CHL-Field Research Facility (FRF)

1630 – 1700 Discussion

1700 Adjourn

Wednesday, 26 August 2020

0800-0900 Optional Local Onsite Tour of Physical Model Facilities

0930 Call to Order
Dr. Julie Rosati, DFO

0930 – 1000 Welcome Day 2
MG William H. "Butch" Graham, Deputy Commanding General for Civil and Emergency Operations, HQ, USACE

Welcome to ERDC: COL Teresa Schlosser, ERDC Commander

1000 – 1130 Panel Session #3 / Delivering Technology to the Field

Moderator: Ms. Mary Cialone, ERDC/CHL

1000 – 1030 "CHL's Technology Transfer Plan,"
Dr. Tanya Beck ERDC/CHL and Ms. Mary Bryant, ERDC/CHL

1030 – 1100 "Research to Tech Transfer: Unmanned Aerial Systems and Mini-Argus,"
Dr. Brittany Bruder, ERDC/CHL; and Mr. Kevin Hodgens, USACE Jacksonville District (SAJ)

1100 – 1130 "US Coastal Research Program,"
Ms. Mary Cialone, ERDC/CHL

1130 – 1230 BREAK

1230 – 1430 Panel Session #4 Future Research Needs in Compounding Risks

Moderator: Dr. Julie Rosati, ERDC/CHL

1230 – 1300 "Compound Flooding: Examples, Methods, and Challenges"
Dr. Thomas Wahl, University of Central Florida

1300 – 1330 "Research Needs in Probability Science to Estimate Compound Risk"
Dr. Norberto Nadal-Caraballo, ERDC/CHL, and Mr. Rob Thomas, USACE/SWG

1330 – 1400 "Strategic Focus Area in Compound Flooding and Research to Advance State of Science"
Dr. Jane Smith, ERDC/CHL, Army Senior Research Scientist, Hydrodynamic Phenomenon

1400 – 1430 Break

1430- 1500 **Public Comment**

1500 – 1530 **Closing Remarks**

1530 **Adjourn 97th CERB**

1600 - 1700 **Executive Session**

97th COASTAL ENGINEERING RESEARCH BOARD MEETING
Executive Session

Purpose: *Review Action Items from 97th CERB, Update Board on any older Action Items needing briefs, plan for 2021 Exec Session and 98th CERB*

1600 – 1630 Review Action Items

1630 – 1700 Plan for 2021 Exec Session and 98th CERB

1700 Adjourn

Attachment B: Action Items from 97th Coastal Engineering Research Board Full Meeting, Vicksburg, MS, Aug 2020

NUMBER	ACTION ITEM	DUE
2020-Full-1	Define Topics for CERB's Strategic Initiatives (CSIs)	Oct 2020
2020-Full-2	Provide CERB Board members monthly to bi-monthly updates	Sep 2020; Ongoing

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

2 May 2022

MEMORANDUM

SUBJECT: Summary of USACE Coastal R&D Partnership Meeting, 16-17 March 2022

1. A Coastal R&D Partnership Meeting was held from 16-17 March 2022, at the U.S. Army Corps of Engineers' (USACE) Galveston District, in Galveston, Texas. The meeting was chaired by Major General William "Butch" Graham, USACE Deputy Commanding General for Civil and Emergency Operations with a focus on critical coastal resilience research needs in Coastal Storm Risk Management (CSRM) with application to Galveston's Coastal Texas Study. The Honorable Michael L. Connor, Assistant Secretary of the Army for Civil Works (ASA-CW), serving as the principal advisor to the Secretary of the Army on all matters related to the Army's Civil Works Program, was an honored guest. Other attendees included USACE Major Subordinate Command (MSC) Commanders from Coastal MSCs, USACE District experts and practitioners, Engineer Research and Development Center (ERDC) senior leaders and researchers, Institute of Water Resources Managers, as well as invited external partners from academia, and state and local organizations.

2. The meeting agenda is included in Enclosure 1 and included an overview of the CW R&D Strategy, summaries of ongoing CSRM research and decision-support tools, and an overview and tour of the Coastal Texas Study by the USACE Galveston District.

3. Key discussion topics and outcomes included the following.

a. **R&D Account is Key to Innovation in the USACE.** The CW R&D Strategy is fundamental to meeting today and tomorrow's challenges facing the Nation for resilience of the USACE's water resources missions. Establishment of an R&D Account including Tactical and Strategic R&D is key to provide transparency and visibility to the USACE's R&D mission. Strategic focus areas to address grand challenges facing the USACE, including those such as required for the Coast of Texas Study include: Novel materials and modernized repair and adaptability for infrastructure; broadening benefits to include underserved communities, ecosystems, and threatened and endangered species; increasing Beneficial Use within the USACE and guidance for Engineering With Nature; Comprehensive watershed assessments and risk-informed analyses including life-cycle performance of Natural and Nature-Based Features; and more proactive crisis management, amongst others.

Invited external academic attendees noted: "The current strategy of USACE R&D funding involves a miniscule budget, unpredictable congressional adds, and lack of solid basis for future planning. Most large agencies and institutions, including war-fighter departments, spend between 1 and 10% on R&D for competitive advantage or even survival. In contrast, USACE underfunds R&D by a factor of between 6 and 60 and provides funding in an unpredictable way. We unanimously support the

creation of a protected R&D account (like sister agencies) with tiered investment including in fundamental (6.1) research. We recommend the creation of an informational one-pager that quantifies the value of ERDC R&D to the nation and explains the urgency for this account (i.e., the cost of inaction). Many design decisions would have to be made, but we heard unanimous support and we offer our help, should that be useful."

b. **Need to Increase Inclusion of Underserved Communities.** Mr. Connor emphasized a need to listen to and provide quantitative methods to include traditionally underserved populations that historically may not have had a voice in USACE projects. He emphasized that solutions to these social issues are founded in embracing a wide range of communities, collaborators, and partners; followed by active listening and building trust over time; using partners and collaborators to tell our story on our behalf; and implemented through science to guide policy decisions.

c. **Coastal Storm Risk Management R&D.** Existing CSRM products have been sporadically supported over the past decade while planning, engineering, community challenges for resilient systems, cross-mission benefits of natural and nature-based systems, and associated policy (e.g., rapid SMART planning timelines) have evolved. Next-Generation (NG) CSRM research is underway to advance the state of nearshore coastal morphologic and coastal storm impact assessments with modern, modular approaches. However, there is a lack of sufficient, sustained funding to support the broad NG CSRM team required including coastal process, economic, and social expertise to develop a modern, rapid, modular system. MG Graham requested a multi-year listing of requirements, time, and cost for NG CSRM development.

   The USACE's Institute of Water Resources is leading an assessment of CSRM "Damages Prevented" by leveraging NG CSRM approaches. The CSRM Damages Prevented tool will document the economic benefits of coastal storm risk management beach and dune projects in reducing coastal storm impacts.

d. **Future Scenarios for USACE CW Investments**. MG Graham discussed concerns about CW preparedness for the upcoming decades. He sketched a diagram of the historical national investment in Civil Works infrastructure over time (Figure 1), showing heavy investments from the 1920s to 1970s, followed by a steep drop off in the 1970s after passage of the Clean Water Act and a shift to a maintenance mentality and funding profile that continues to this day. At this point, most of this infrastructure is at, or has exceeded its design lifetime of 50 years. Combined with the rising stresses due to climate change and increasing population pressure, especially along coasts, and it is clear that "business as usual" will leave the nation vulnerable to predictable disasters.

   MG Graham then gave an implicit challenge to attendees to think about how CW should position itself for these future problems. Proposed strategies could be scenario based and should include potential plans for R&D investment within and beyond USACE CW as well as long-term thinking about the human resources that will be needed, including expected CW hiring needs to face the upcoming decades and coordination with universities to ensure a clear supply pipeline.

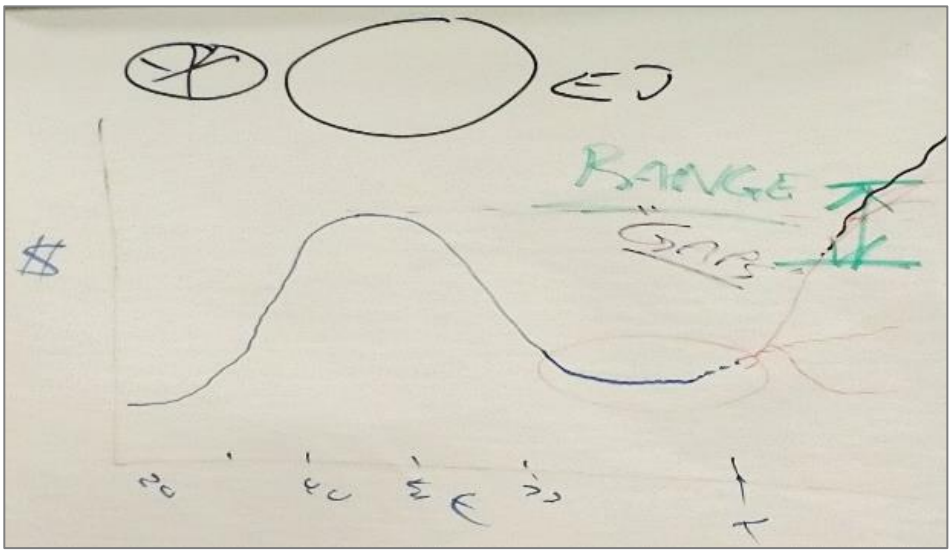


Figure 1. MG Graham's Sketch of Time vs. Investment in Civil Works Infrastructure, approximately 1920 to present "T" (Today). Future scenarios are shown by three divergent lines to the right of the "T": increased investment, business-as-usual, or decreased investment. The top images illustrate a conceptual fiscal pie traditionally divided one way (left); future divisions given increased focus on Environmental Justice (EJ) and social equities may differ (right).

4. **Discussion and Next Steps.** Next discussions will focus on traditionally underserved coastal communities that are disproportionally affected by climate change; revisiting future CW investment scenarios as shown in Figure 1; and assessing requirements for NG CSRM technologies.

Enclosure 1. Coastal R&D Partnership Meeting Agenda

Coastal Partnership R&D Meeting

16-17 March 2022
Galveston District Jadwin Building
2000 Fort Point Road, Galveston, Texas 77550

WebEx
https://usace1.webex.com/meet/StrategicEngagements
Join by phone
+1-844-800-2712 US Toll Free
+1-669-234-1177 US Toll
Access code: 199 698 5964

Purpose: *Identify critical coastal resilience research needs with focus on Coastal Storm Risk Management research and State-of-Practice in Galveston's Coastal Texas Study.*

Agenda

Tuesday March 15, 2022, Meet and Greet/ Registration

1800	2000	Registration Tremont Hotel Lobby/Social Hour	
1830	2100	Dinner for General Officer and Guests: Hearsay on the Strand	

Wednesday 16 March 2022 Galveston District Jadwin Building

Meeting Attire: Military- Cammies/OCP; Civilian-Business Casual

0700	0800	Registration Jadwin Building	
0730	0830	Breakfast	
0830		Call to Order	Dr. Julie Rosati Coastal & Hydraulics Laboratory
0830	0845	Welcome and Introductions	MG William H. "Butch" Graham, Jr BG Christopher Beck, SWD Commander Dr. Ty V. Wamsley, Director of Coastal & Hydraulics Laboratory
0845	0945	USACE CW RD&T Strategy	Dr. Ty Wamsley, CHL
0945	1045	Coastal R&D Strategic Focus Area Priorities	Dr. Jane Smith, CHL
1045	1100	**Break**	
1100	1200	Academic Perspective	Dr. Rob Holman, OSU Dr. Ed Link, UMD

1200	1245	**Break for Lunch** *(Box Lunch from YAGAS Café)*	
1245	1400	SWG Coastal R&D Project Overview: Coastal Texas Study Deep Dive CTX Ring Barrier Tour-Pre-brief	Dr. Kelly Burks-Copes
1415	1430	Break: Changing rooms/showers available	
1430	1730	Board Tour Buses/CTX Ring Barrier Tour (Agenda and map will be provided)	COL Timothy Vail Dr. Kelly Burks-Copes, Byron Williams Rob Thomas
1730	1800	Return to Hotel	
1830		Dinner Social at Riondo's Ristorante (Individual Pay)	

Thursday, 17 March 2022 Galveston District Jadwin Building

Meeting Attire: Military- Cammies/OCP; Civilian-Business Casual

0700	0800	Registration Jadwin Building	
0730	0830	Breakfast	
0830	0845	Comments and Thoughts on Day 1	MG William H. "Butch" Graham, Jr.
0845	0945	Vision for Integrated Coastal Storm Risk Management Capability	Mr. John Winkelman CWG Chair
0945	1045	Storm Damages Prevented Tool	Ms. Marriah Abellera, Program Manager, Institute for Water Resources
1045	1100	**Break**	
1100	1200	USACE FRM Viewers and R&D Tech Transition	Ms. Lisa Kiefel, Flood Risk Management Business Line Manager
1200	1230	Summary: FY21 Coastal R&D and Technologies	Dr. Julie Rosati
1230	1330	Working Lunch	
1330	1400	Academic Partner Recommendations	Invited Academics

1400	1430	Military Attendee Recommendations	Military Attendees
1430	1500	**Break**	
1500	1530	Summary of New Action Items	Dr. Julie Rosati
1530	1600	Closing Comments	MG Graham
1600		Adjourn	

LOCATIONS AND THEMES FOR PAST CERB MEETINGS

	DATE	LOCATION	THEME
48th	4- 6 Nov 87	Savannah, GA	Sea Level Rise
49th	18-20 May 88	Oconomowoc, WI	Coastal Engineering Implications of Changes in the Great Lakes Water Levels
50th	15-17 Nov 88	Virginia Beach, VA	Long-Range Research Needs in Coastal Engineering
51st	9-11 May 89	Wilmington, NC	Shoreline Erosion and Restoration
52nd	17-19 Oct 89	Redondo Beach, CA	Pacific Coastal and Navigation Challenges
53rd	5- 7 Jun 90	Fort Lauderdale, FL	Coastal Inlets
54th	4- 6 Jun 91	New Orleans, LA	Coastal Flood Protection
55th	30 Oct-1 Nov 91	Mashpee, MA	Dredging
56th	9-11 Jun 92	Newport, OR	Coastal Structures
57th	27-29 Oct 92	Honolulu, HI	Pacific Islands Coastal Engineering
58th	15-17 Jun 93	Atlantic City, NJ	Coastal Data Collection
59th	16-18 Nov 93	Point Clear, AL	Coastal Wetlands
60th	8-10 Nov 94	Vicksburg, MS	Coastal Research and Development
61st	10 May 95	Galveston, TX	Coastal Zone Management
62nd	25-26 Oct 95	Fort Lauderdale, FL	No theme (Civilian)
63rd	11-12 Jun 96	San Diego, CA	The Direction of Coastal Engineering in the Corps and the Resulting Impact on R&D
64th	14-16 Jan 97	Morro Bay and San Francisco, CA	No theme (Civilian)
65th	24-26 Jun 97	Chicago, IL	Coastal Engineering in the Great Lakes
66th	16-17 Oct 97	New York, NY	No theme (Civilian)
67th	13-14 May 98	Fort Lauderdale, FL	Regional Sediment Management
68th	14-15 Oct 98	Wilmington, NC, and Norfolk, VA	No theme (Civilian)
69th	24-16 Apr 99	Honolulu, HI	Military Applications of Coastal Engineering
70th	27 Oct 99	Dauphin Island, AL	Regional Sediment Management

71st	13-15 Jun 00	Dana Point, CA	Regional Sediment Management
72nd	31 Jul - 1 Aug 01	Galveston, TX	Muddy Coasts
73rd	5-6 Mar 02	Avalon, NJ	Beach Nourishment Performance
74th	10-11 Sep 02	Duck, NC	Field Data Collection
75th	16-18 Jun 03	Lafayette, LA	Louisiana Coastal Area Ecosystem Restoration
76th	28-30 Oct 03	Portland, OR	Navigation and Regional Sediment Management in the Northwest
77th	7-9 Jun 04	Traverse City, MI	Great Lakes System Management
78th	3-4 Nov 04	Silver Spring, MD	No theme
79th	7-9 Jun 05	Anchorage, AK	No theme
80th	2-4 Nov 05	St. Petersburg, FL	No theme (emphasis on Hurricane Katrina)
81st	17-19 Jul 06	Vicksburg, MS	Joint meeting with Chief of Engineers Environmental Advisory Board
82nd	11-13 Oct 06	Long Branch, NJ	Challenges in Coastal Protection and Restoration
83rd	6-7 Sep 07	Alexandria, VA	Fact-Finding Mission to Europe and Implications for USACE Directions
84th	2-4 Apr 08	New Orleans, LA and Mobile AL	Regional System-wide Analysis Lessons Learned from LACPR and MsCIP
85th	23-25 Sep 08	Portland, OR	System-based Perspectives of the Coast: A Focus on Pacific Northwest
86th	3-4 Jun 09	San Diego, CA	Coastal Data: Requirements and Use
87th	22-24 Jun 10	Jersey City, NJ	Climate Change and USACE Mission Considerations
88th	26-28 Jul 11	Niagara Falls, NY	Adapting Coastal Systems for the Challenges of the Future
89th	18-20 Sep 12	Jacksonville, FL	Regional Sediment Management – Uniting Navigation, Beaches, and the Ecosystem
90th	4-6 Sep 13	Long Branch, NJ	Hurricane Sandy – Response, Recovery and Resilience
91st	8-11 Sep 14	San Francisco, CA	Coastal System Resiliency – Linking Navigation Dredging, Beneficial Use, Ecosystem Restoration and Coastal Storm Risk Management

92nd	1-3 Sep 15	Galveston, TX	Coastal Navigation – Driving the U.S. Economy by Integrating Marine Transportation Infrastructure with Natural Coastal Systems
93rd	9-11 Aug 16	San Juan, PR	A Systems Approach along Heterogeneous Coasts
94th	27- 29 June 17	Honolulu, HI	Coastal Structures in a Sea of Change
95th	7-9 Aug 18	Providence, RI	Coupling Coastal Engineering Solutions with Social & Ecological Predications
96th	13-15 Aug 19	Detroit, MI	Sediment Transport and Regional Sediment Management
97th	25-26 Aug 20	Vicksburg, MS	Compound Flooding, Multiple Hazards & Increasing Risk
98th	13-15 Sep 22	Anchorage, AK	Coastal Community Resilience Research Needs in Cold Regions under a Changing Climate

THANK YOU FOR ATTENDING THE 98TH BCER

Anchorage, AK