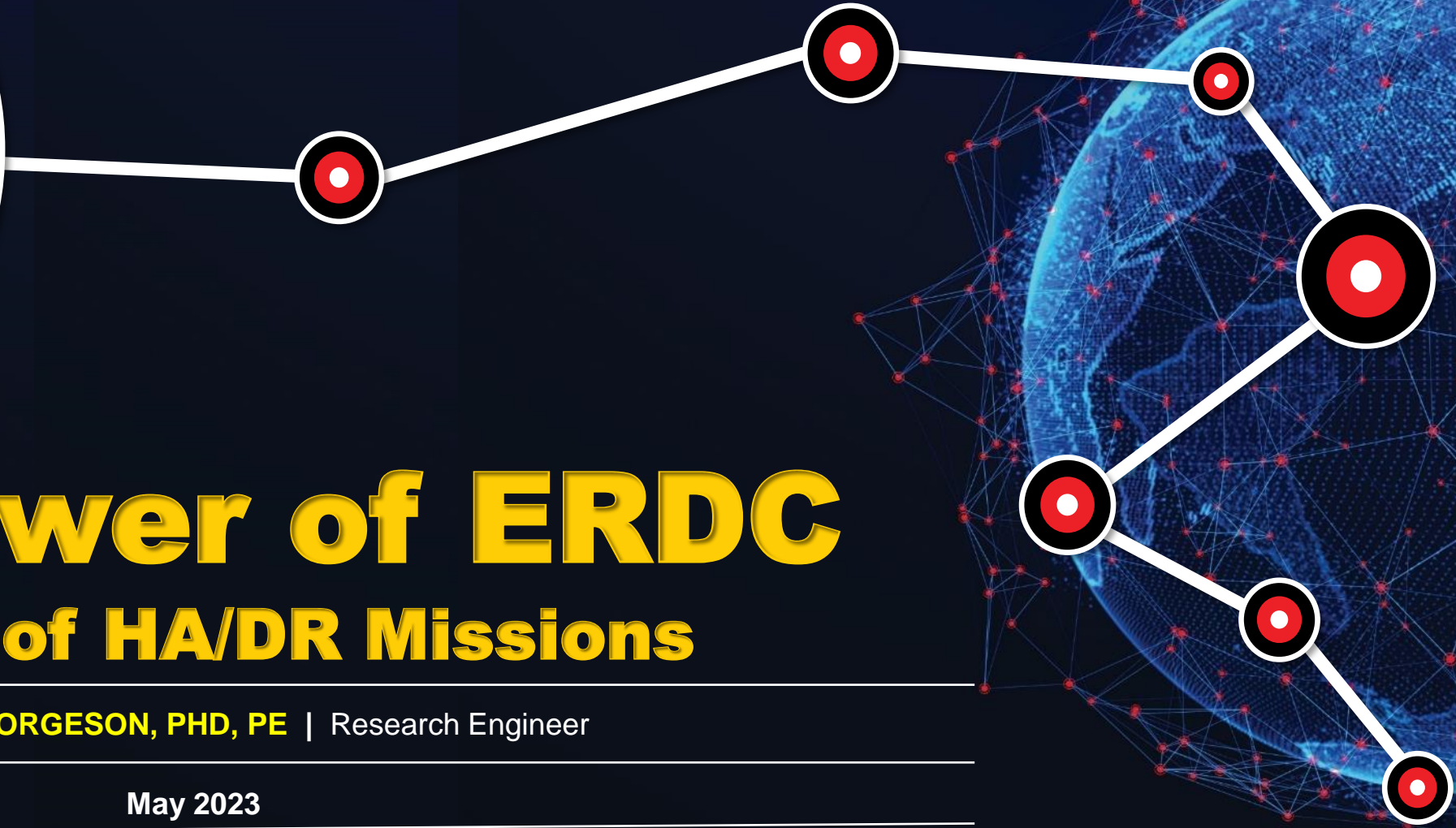


**CONNECTING  
THE DOTS TO  
INNOVATION**



# The Power of ERDC

## Support of HA/DR Missions

**JEFFREY D. JORGESON, PHD, PE** | Research Engineer

May 2023

Controlled by: USACE/CEERD-ZBS | Category: Approved for Public Release, Distribution Statement: A  
POC: ERDC Strategic Integration Office, 601-634-5239, Martin.C.Kittrell@usace.army.mil

# U.S. Army Corps of Engineers

SERVICE TO THE NATION SINCE 1775

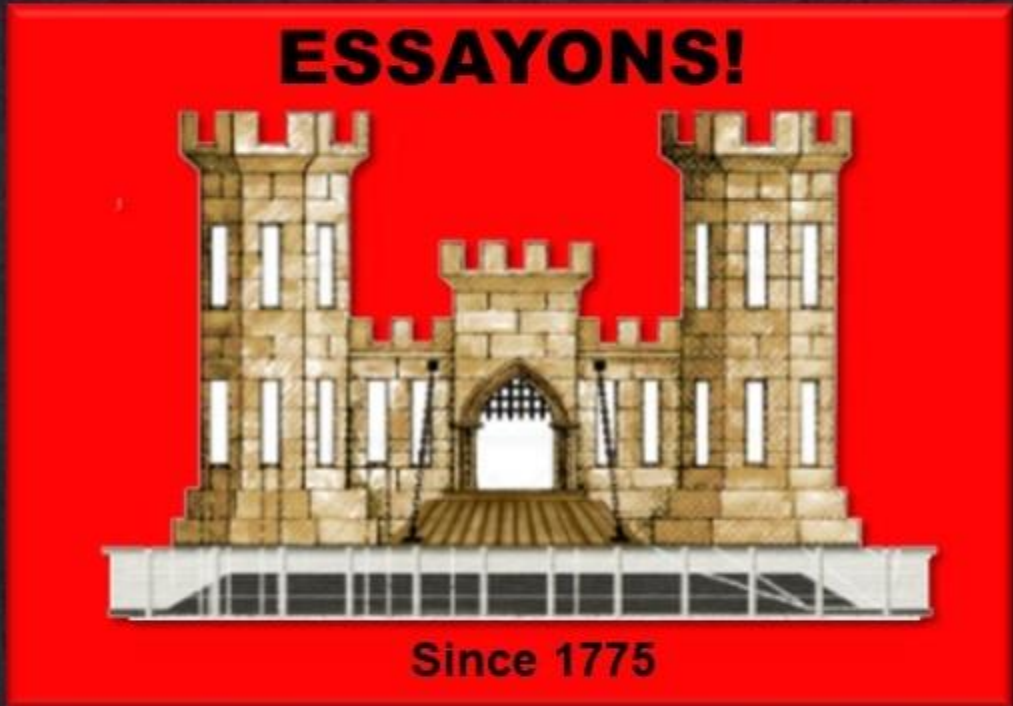
U.S. Capitol - 1800  
Washington Monument - 1884  
Lincoln Memorial - 1922



Military Construction and Combat



The Pentagon - 1941



Panama Canal - 1914



Bonneville Dam - 1937

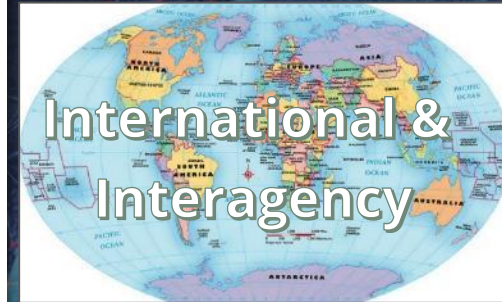
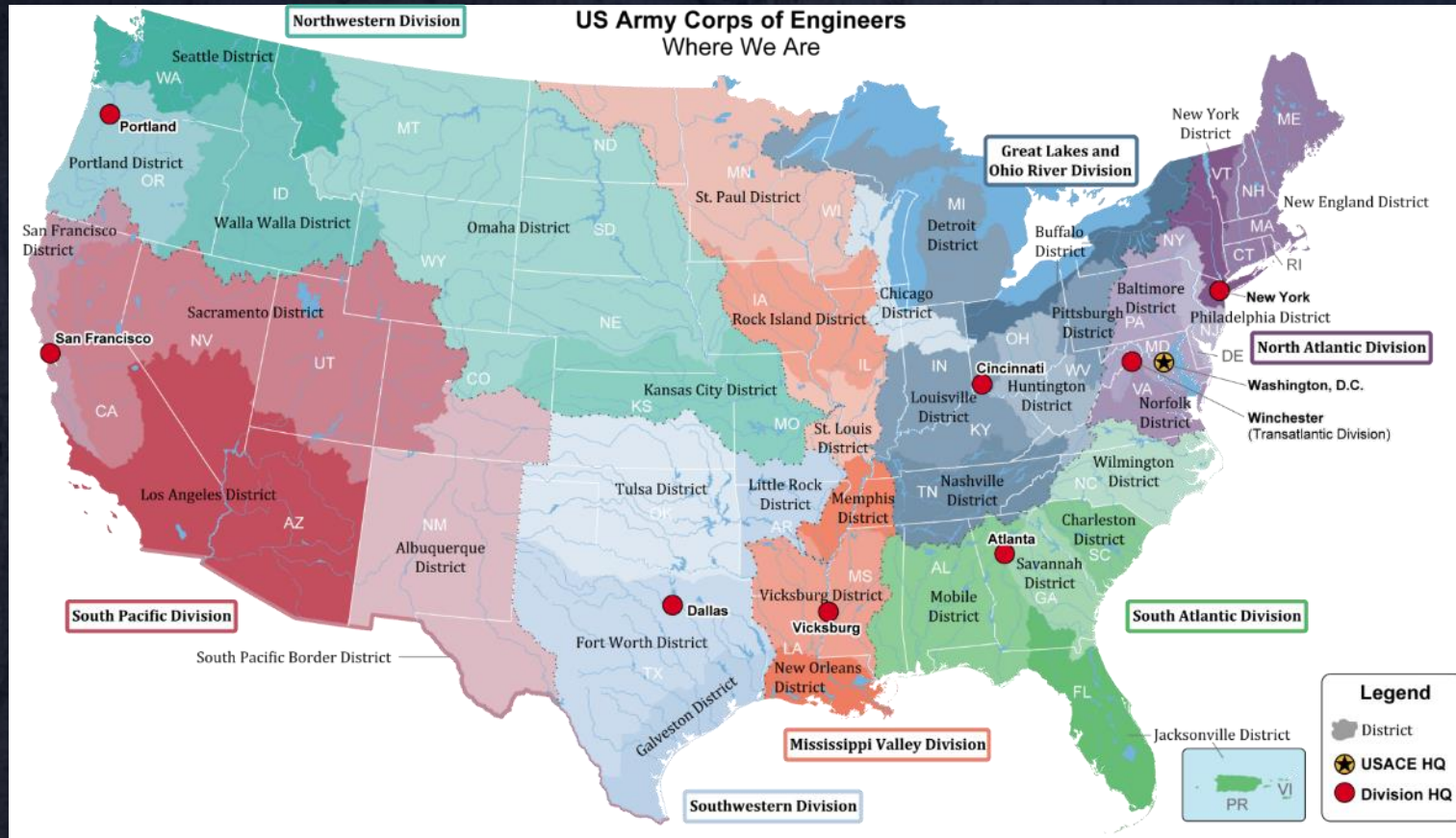
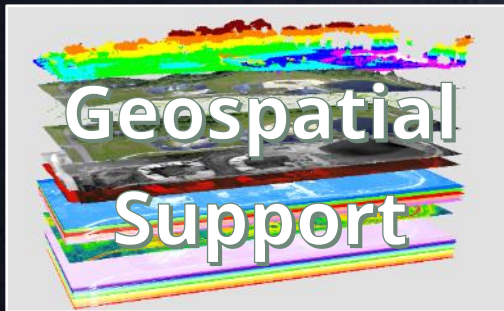


Mississippi River and Tributaries Project - 1928-Present



Kennedy Space Center - 1962

# USACE Missions and Organization



# ERDC: USACE's Corporate Labs

ERDC SUPPORTS USACE DELIVERING A MASSIVE **\$91B+** PORTFOLIO OF PROGRAMS, PROJECTS

**DA**



**The Engineer Regiment**  
**90,000** members of the  
 Total Engineer Force



**DA MILCON and  
 Installation Support**  
**\$4.9B** / **3M** service men and women  
 / **287** Installations



**Civil Works**  
**\$8.343B** / **~1,900** projects  
**\$17.44B** Disaster Supp/**\$3.3B** Disaster Relief (HR 2157)  
**\$5.7B** Emergency Assistance (HR 5305)  
**\$17.1B** = Infrastructure Act - IIJA (HR 3684)



**Research & Development**  
**\$1.87B** / **2,000+** projects  
 Supporting DA, CW, DoD, IIS



**DoD**



**COCOM Support**  
**\$5B** to COCOMS & Interagency  
 In 110 countries



**Missile Defense Agency**  
**\$875M** to **5** critical projects  
 Romania, Poland and Alaska



**USAF / USN / DHA / DLA**  
**\$10.7B** installation infrastructure for  
 DoD and Sister Services



**DOD/AF/Army/EPA/DOE**  
**\$2B** in national  
 environmental cleanup

**IIS**



**Natural Disaster Response**  
**\$4.5B** response to disasters in  
 CA, TX, FL, PR, USVI, NC, LA



**Veterans Affairs Program**  
**\$8.7B** Design & construct  
**22** Projects



**Foreign Military Sales**  
**\$3.7B** Design, construction, engineering  
 services & training  
 in **35** countries



**COVID-19 Response**  
**\$1.9B** COVID Response (**38** ACFs)  
 Support to Vaccine Production  
 Mass Vaccination Centers

# The History of ERDC

MAKING THE WORLD BETTER AND SAFER HAS BEEN OUR MISSION FROM YEAR ONE



Flood of 1927 –  
Origin of  
CHL



WWII –  
Portable Airfields –  
Precursor  
to GSL 1932



Arctic Research –  
Origin of CRREL  
in 1961



Topographical  
Engineering –  
Origin of GRL  
in 1967



Construction  
Engineering  
Research –  
Origin of CERL  
in 1968



1970s  
Environmental  
Research –  
Origin of EL



1980s  
First  
Supercomputer  
– Origin of ITL



1999  
**ERDC**  
established

## Milestone Work

- **2001** ERDC research saves lives during 9/11
- **2005** Post-Katrina Analyses
- **2017** Hurricane Recovery (Harvey, Irma & Michael)
- **2020** COVID-19 Pandemic Response

# ERDC Support To The Nation

RESEARCH SUPPORTING THE USACE R&D PRIORITIES

**1** Mitigate and Adapt to **Climate Change**



*Forecast-Informed Reservoir Operations (FIRO)*

**2** Win **Future Wars**



*Blast and Weapons Effects R&D Supporting US Bases Overseas*

**3** Modernize our Nation's **Infrastructure**



*Structural Health Monitoring*

**4** Support Resilient **Communities**



*Coastal Hazards Rapid Detection System*

**5** Enable Smart and Resilient **Installations**



*3D Printing of Concrete Buildings*

**6** Ensure **Environmental Sustainability** and Resilience



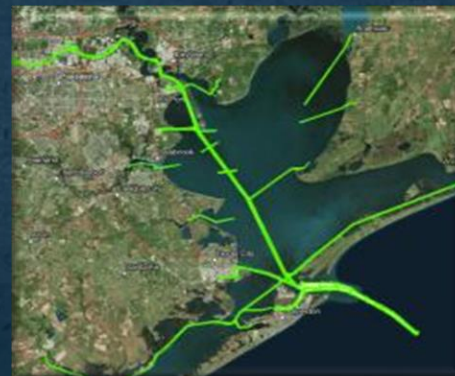
*Engineering with Nature® – Lagoon created at Deer Island, Mississippi Sound*

**7** Secure Reliable Installation **Energy**



*Energy Resilience/Energy Performance Contracts*

**8** Revolutionize and Accelerate **Decision Making**



*Dredging Optimization*

**9** Improve Cyber and Physical **Security**



*Cyber City: First-Generation Virtual Environment that Enables Cyber Vulnerability Research and Testing*

**10** Protect and Defend the **Arctic**



*Hydraulic & Hydrology Modeling of Snowpack Thaw and Runoff*

# ERDC Locations

SEVEN LABORATORIES ACROSS FOUR STATES

**ERDC Headquarters**  
Vicksburg,  
Mississippi



**Coastal and Hydraulics Laboratory (CHL)**



**Environmental Laboratory (EL)**



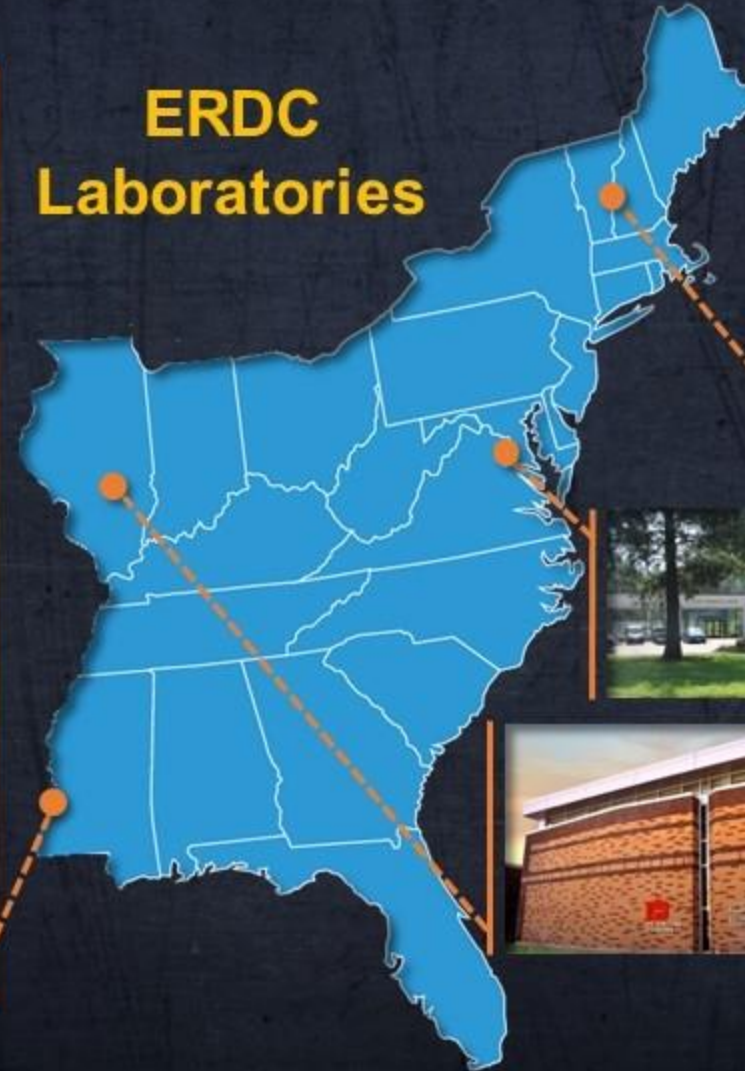
**Geotechnical and Structures Laboratory (GSL)**



**Information Technology Laboratory (ITL)**



## ERDC Laboratories



**Cold Regions Research and Engineering Laboratory (CRREL)**  
Hanover, New Hampshire



**Geospatial Research Laboratory (GRL)**  
Alexandria, Virginia



**Construction Engineering Research Laboratory (CERL)**  
Champaign, Illinois

## Field Offices

**Permafrost Tunnel Research Facility**  
Fox, Alaska

**Alaska Research Office**  
Fairbanks, Alaska

**Lewisville Aquatic Ecosystem Research Facility**  
Lewisville, Texas

**Contingency Base Integration Technology Evaluation Center (CBITEC)**  
Fort Leonard Wood, Missouri

**Field Research Facility**  
Duck, North Carolina

**Corbin Field Station**  
Woodford, Virginia

**Extreme Exposure Station**  
Treat Island, Maine

**ERDC International Research Office**  
London, England

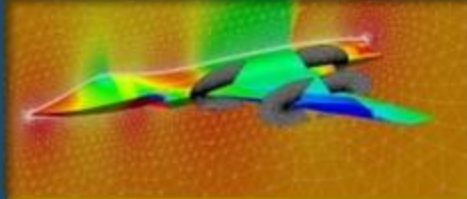
# ERDC Delivers Innovative Solutions

ERDC'S PROGRAMMATIC APPROACH BACKED BY ITS CORE COMPETENCIES FOR THE ARMY

## RESEARCH & DEVELOPMENT AREAS



CIVIL WORKS



ENGINEERED  
RESILIENT  
SYSTEMS



GEOSPATIAL  
RESEARCH &  
ENGINEERING



INSTALLATION  
AND OPERATIONAL  
ENVIRONMENTS



MILITARY  
ENGINEERING

## CORE COMPETENCIES

SPECIALIZED ERDC KNOWLEDGE THAT ENABLES OUR RESEARCH AND DEVELOPMENT AREAS



BATTLESPACE  
TERRAIN MAPPING AND  
CHARACTERIZATION



BLAST AND  
WEAPONS EFFECTS  
ON STRUCTURES AND  
GEO-MATERIALS



CIVIL AND  
MILITARY  
ENGINEERING



COLD REGIONS  
SCIENCE  
AND  
ENGINEERING



COASTAL, RIVER,  
AND  
ENVIRONMENTAL  
ENGINEERING



COMPUTATIONAL  
PROTOTYPING OF  
MILITARY  
PLATFORMS



MILITARY  
INSTALLATIONS  
AND  
INFRASTRUCTURE



# The Power of ERDC

ERDC EXCELS AT CREATING SYNERGIES BETWEEN TECHNICAL SOLUTIONS AND APPROACHES ACROSS VASTLY DIFFERENT MISSION SPACES

## Ship Simulator: Civil Works



A civilian pilot practices guiding barges down a river

*The same Ship Simulator facility and research team that supports our Navigation mission in Civil Works R&D....*

CIVIL WORKS

HABITATS

SUPPORT FOR OTHERS

Blue Roof

THE POWER OF ERDC

Ship Simulator

Structural Hardening

INSTALLATIONS & OPERATIONAL ENVIRONMENTS

WARFIGHTER SUPPORT

## Ship Simulator: Warfighter Support



A Warfighter pilot practices nearshore maneuvers

*... also supports our warfighters as they plan logistics-over-the-shore operations overseas.*

# ERDC Partnerships

ERDC HAS HUNDREDS OF GOVERNMENT, ACADEMIA, INDUSTRY AND INTERNATIONAL PARTNERS



### GOVERNMENT PARTNER EXAMPLES

### ACADEMIA PARTNER EXAMPLES

### INDUSTRY PARTNER EXAMPLES

### INTERNATIONAL PARTNERS

11 Countries  
 2 Active CRADAs  
 15 Active DEAs/IEAs  
 1 Active MOAs/MOUs  
 4 Active PAs

### CONNECT: Mechanisms & Authorities

Other Transaction Authority (OTA)

Broad Agency Announcement (BAA) Authority

Cooperative Ecosystem Studies Units (CESU) National Network

# USACE Reachback Operations Center (UROC)



24/7 Reachback Operations

Deployable Communications



Recon Tools

Reachback Engineer Data Integration (REDi)



Providing Relevant Solutions to the Armed Forces and the Nation

Connecting deployed engineers worldwide to Subject Matter Experts via Reachback through the UROC

# UROC Humanitarian Assistance / Disaster Relief Support

- Indian Ocean Tsunami – 2004
- Hurricanes Katrina and Rita – 2005
- Hurricanes Gustav and Ike – 2008
- Haiti Earthquake – 2010
- Pakistan Flooding – 2010
- Hungary Toxic Sludge – 2010
- Japan Earthquake – 2011
- MS Valley Spring Flooding – 2011
- Hurricane Sandy – 2012
- Super Typhoon Haiyan -2013
- Afghanistan Landslides – 2014
- Hurricane Harvey – 2017
- Hurricanes Irma and Maria – 2017
- Hurricane Michael – 2018
- Hurricane Ian – 2022



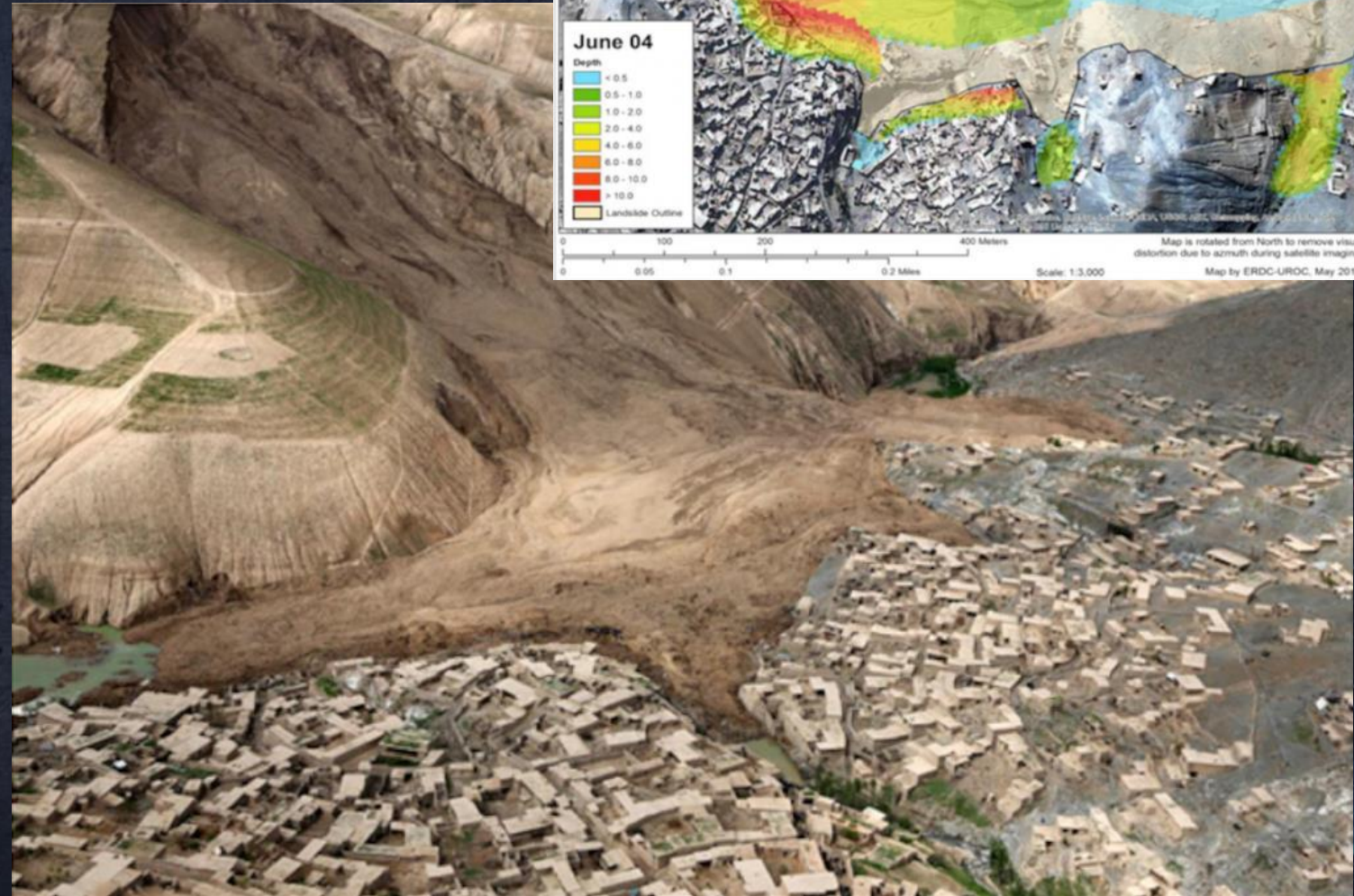
# Tsunami Support – Sumatra

- Transportation infrastructure severely damaged making ground reconnaissance nearly impossible. UROC recon system used to conduct aerial survey of over 220 km of roadway in ~2.5 hours.
- UROC facilitated structural engineers on the ground evaluating damage.



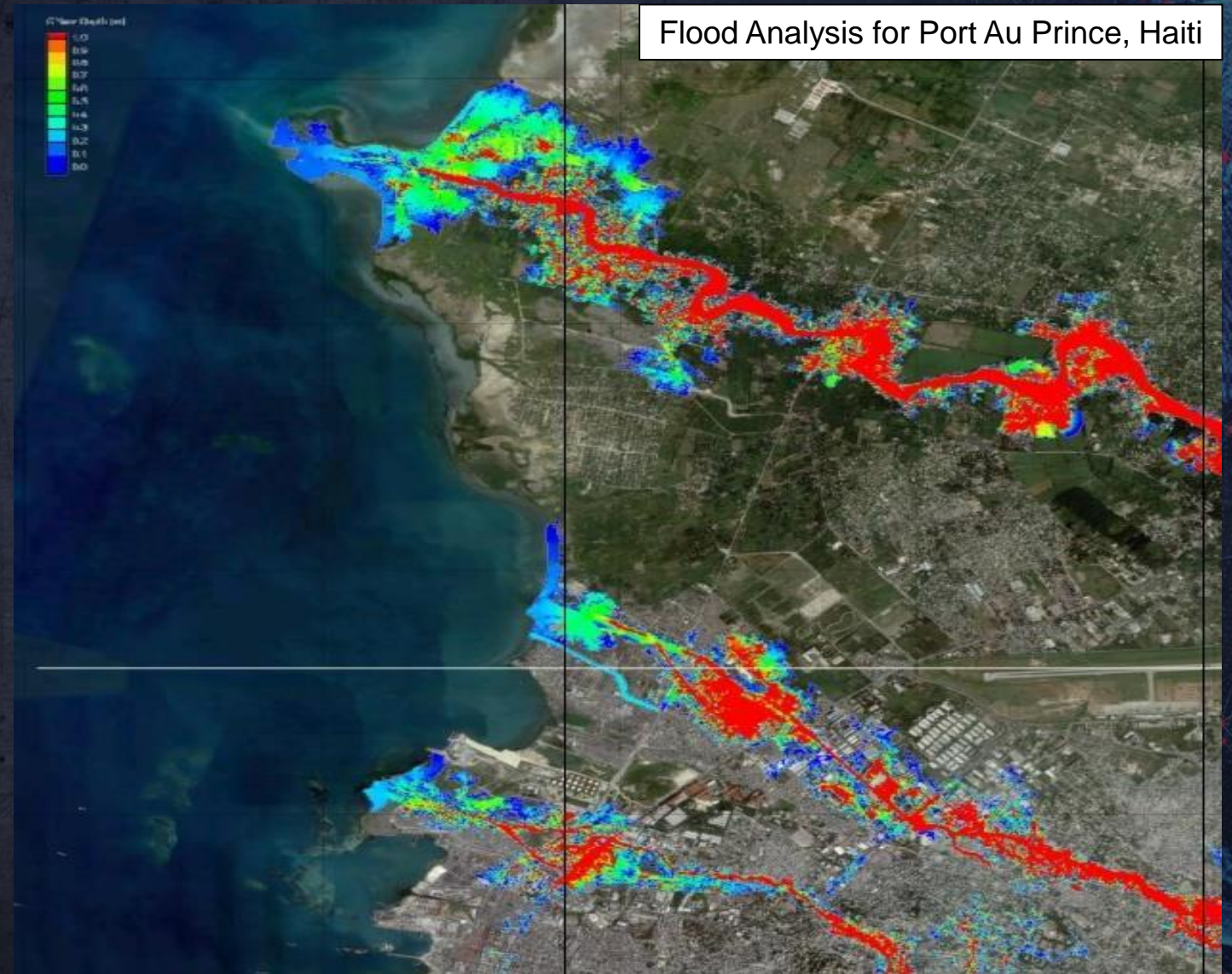
# Landslide Support – Afghanistan

- Landslide blocked river creating artificial dam and localized flooding, in addition to devastating local village.
- Within days, ERDC hydraulic and geotechnical engineers evaluated the potential extent of flooding as the river backed up behind the new dam and the risk of catastrophic failure of the dam.
- Findings indicated low risk of significant flooding and low risk of catastrophic dam failure, and solutions were provided to reduce risk even further.



# Earthquake Support – Haiti

- In the aftermath of the earthquake, locations for logistical support and humanitarian assistance relief were being selected in areas at risk of flooding due to heavy rainfall.
- ERDC engineers conducted flood modeling and provided guidance to help minimize risk to local citizens and relief workers during the response operations.



# USACE Preparedness, Response, and Recovery Capabilities



**US Army Corps of Engineers**

## Disaster Preparedness

Development of and participation in, exercises and training in the inter- and intra-agency arena

## PL 84-99: INITIAL ELIGIBILITY INSPECTIONS

Initial Eligibility Inspections conducted on an inactive flood risk management project segment/system based on established criteria. Inspection determines if the public sponsor is qualified to enter the Rehab Program and the project meets engineering and maintenance criteria

## SUPPORT TO FEMA: URBAN SEARCH AND RESCUE STRUCTURES SPECIALIST CADRE

Rescue engineering capability to provide technical support and advice to task force leaders and commanders to assess damage, mitigate hazards, enable safe entry, and assure mobility throughout a disaster site to enable rescue and life-saving operations

## SUPPORT TO FEMA: TEMPORARY ROOFING

Provide technical assistance to FEMA, State and local governments, and/or manage and contract for the installation of blue plastic sheeting onto roofs of damaged homes

## SUPPORT TO FEMA: TEMPORARY HOUSING

Oversee the placement of temporary housing units at individual home sites, existing mobile home parks or newly designed and constructed mobile home parks when an event has rendered existing homes uninhabitable

## USACE Preparedness, Response, and Recovery Capabilities

## SUPPORT TO FEMA: DEBRIS CLEARANCE AND REMOVAL

Provide capabilities such as removal, reduction and disposal of disaster debris and technical assistance to FEMA and local governments through either Direct Federal Assistance (DFA) or Federal Operations Support (FOS) Mission Assignments

## SUPPORT TO DoD: SUPPORT TO MILITARY INSTALLATIONS

Engineering support to Specific Military Installations damaged by disasters, as requested

## SUPPORT TO FEMA: TEMPORARY EMERGENCY POWER

Provide state and local officials, Tribal Nations and U.S. Territories broad support for their unmet temporary emergency power needs, from technical expertise/assistance through complete management of temporary emergency power mission including the hauling, installation, operation, maintenance, fueling, and de-installation of generators

## PL 84-99: ADVANCE MEASURES AND HAZARD MITIGATION

Preventive work through technical or direct assistance performed due to imminent threat of unusual flooding. USACE participation in FEMA-led hazard mitigation effort intended to identify post-disaster mitigation opportunities, and establish framework for recovery

## SUPPORT TO FEMA: CRITICAL PUBLIC FACILITIES

Provide critical public facilities such as government office space, police stations, fire stations, medical clinics, and school classrooms; units may be modular, interior office space constructed within a large warehouse type building, pre-engineered steel buildings, or large soft sided structures

## PL 84-99: FLOOD RESPONSE OPERATIONS

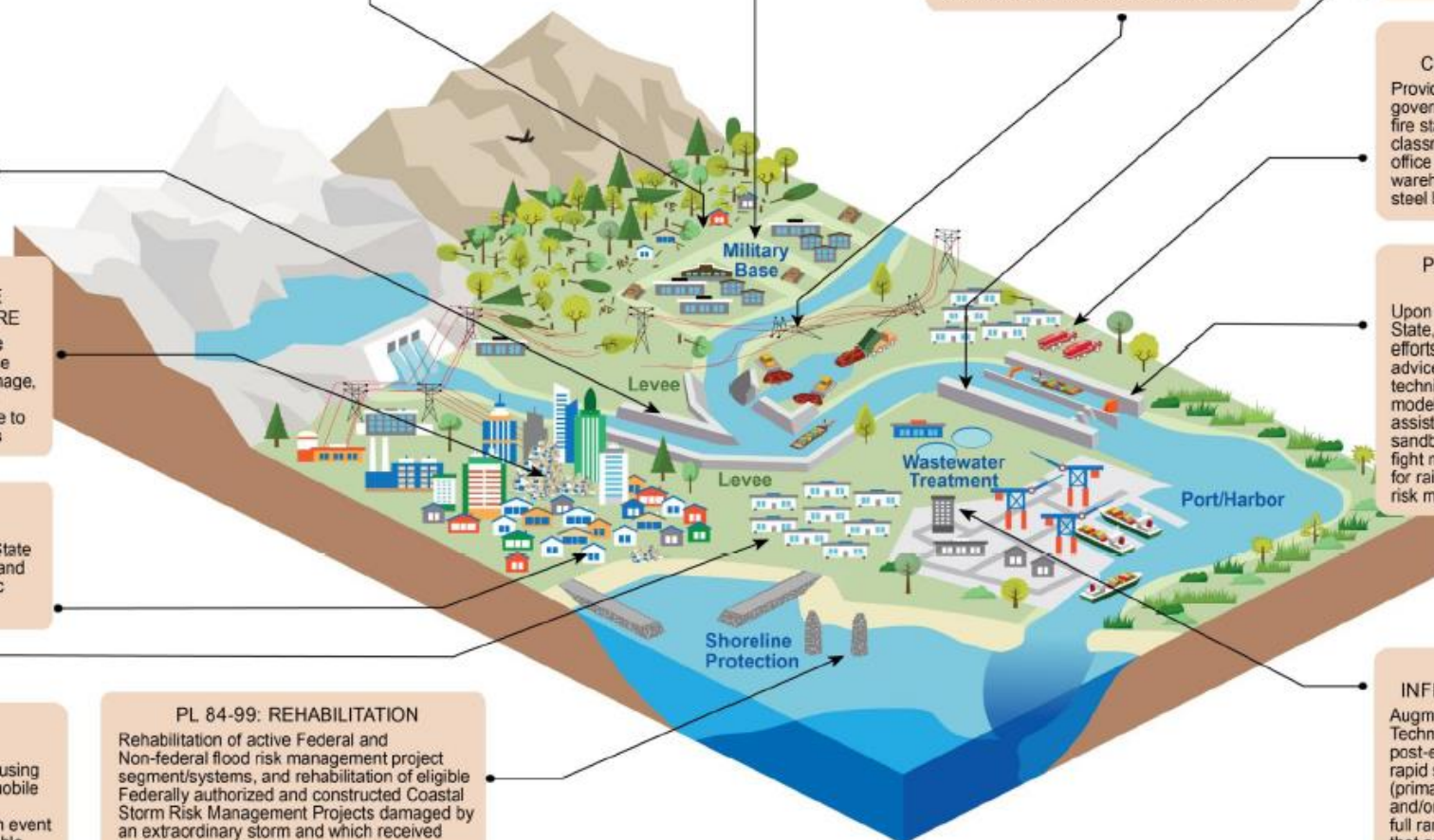
Upon request USACE may supplement State, Tribal, or Territorial flood response efforts. Technical assistance includes advice on flood fighting methods and techniques, inundation mapping, flood modeling, and historical data. Direct assistance includes the provision of sandbags, pumps, and other types of flood fight materials, and emergency contracting for raising and stabilizing threatened flood risk management projects.

## SUPPORT TO FEMA: INFRASTRUCTURE ASSESSMENT

Augment local public works Applied Technology Council-20 (ATC-20) post-earthquake (or ATC-45 post-flood) rapid structural assessment capabilities (primarily residential) following a disaster; and/or to provide a management cell for the full range of technical assistance missions that are not covered by other PRTs

## PL 84-99: REHABILITATION

Rehabilitation of active Federal and Non-federal flood risk management project segment/systems, and rehabilitation of eligible Federally authorized and constructed Coastal Storm Risk Management Projects damaged by an extraordinary storm and which received significant damages





# USACE Temporary Roofing Program in Support of FEMA



USACE Common Operating Picture (CorpsNet)

uCOP ▾

CIV ▾

DCO ▾

IIS ▾

MIL ▾

MSC ▾

## Blue Roof Management System



The U.S. Army Corps of Engineers assists local and state requests for support in coordination with FEMA, providing temporary Blue Plastic Roofs to residences to prevent additional damage after a windstorm. The capabilities extend from Technical Expertise and Assistance through complete management of a Temporary Roofing Mission including the scoping, procurement and installation of temporary roofing repairs. Assets utilized to fulfill temporary roofing requirements include Corps contracted forces and Temporary Roofing Planning & Response Teams from across USACE.

# ERDC Support to Temporary Roofing Program

- In 2010 ERDC began development of a fully digital data collection and data management system called the Field Management System (FMS) to support the Temporary Roofing program and replace the carbon copy paper form process.
- The FMS was first used in 2017 after hurricanes Irma and Marie, and it has since evolved into the current Blue Roof Management System (BRMS).
- The FMS and BRMS have greatly improved the efficiency of the Temporary Roofing program and have been used to assist well over 100,000 homeowners.
- Similar digital data collection and management tools are being integrated for other missions that USACE supports such as temporary housing, debris removal and clearance, and infrastructure assessment.



# Hurricanes Irma and Marie - 2017

## HURRICANE IRMA & MARIA RESPONSE

Updated as of 07 MAY 18

MISSION ASSIGNMENTS / CUMULATIVE COST / PERSONNEL ON GROUND



PUERTO RICO



US VIRGIN ISLANDS

mission assignments issued by FEMA: 34 / \$3.2 billion / 324

mission assignments issued by FEMA: 25 / \$267 million / 16



TEMPORARY ROOFING



100%

59,469 roofs repaired

59,469 blue roof installs completed out of 59,469 eligible requests



100%

3,658 roofs repaired

3,658 blue roof installs completed out of 3,658 requested



TEMPORARY EMERGENCY POWER



99%

2,180 taskings complete out of 2,190 total sites



812 generators currently installed

58%

1725 total facilities; 1001 de-installed/released to FEMA



100%

180 generators installed

# Hurricane Ian - 2022

## U.S. ARMY CORPS OF ENGINEERS HURRICANE IAN

LANDFALL: SEPTEMBER 28, 2022

### FEMA MISSION ASSIGNMENTS

12 OPEN 9 CLOSED

### FUNDING TO DATE

\$213.3M FEMA \$4.9M FCCE

### PERSONNEL DEPLOYED

150 CIVILIAN 1 MILITARY 203 CONTRACTORS



54  
RESPONSE DAY  
(22-SEP-2022)

### TEMPORARY ROOFING | BLUE ROOF INSTALLS

RIGHTS OF ENTRY REQUESTS: 36,916

100%

% COMPLETE FOR BLUE ROOF INSTALLS | ASSESSMENT START DATE: 04 OCT 2022 |  
INSTALLATION START DATE: 08 OCT 2022

20,125  
ROOFS  
INSTALLED

VALIDATED RIGHTS OF ENTRY: 20,115 COMPLETED ASSESSMENTS: 20,201 READY FOR CONTRACTOR: 20,125

### INFRASTRUCTURE | ASSESSMENTS

100%

% ASSESSMENTS COMPLETE

ASSESSMENTS REQUESTED: 347 ASSESSMENTS CANCELLED: 0 ASSESSMENT TO BE COMPLETED: 0

347  
ASSESSMENTS  
COMPLETE

### ATC-45 | SAFETY EVALUATIONS

100%

% ASSESSMENTS COMPLETE

EVALUATIONS REQUESTED: 9,566  
EVALUATIONS COMPLETED: 9,566

### TEMPORARY EMERGENCY POWER | GENERATOR ASSESSMENTS/INSTALLS

100%

% COMPLETE FOR ASSESSMENTS

ASSESSMENTS  
COMPLETE 260

100%

% COMPLETE FOR GENERATOR INSTALLS

INSTALLS  
COMPLETE 12

ASSESSMENTS REQUESTED: 331 ASSESSMENTS CANCELLED: 71 INSTALLS REQUESTED: 12

### PORT | STATUS

13  
OPEN

### FCCE FUNDED MISSIONS (PL 84-99)

#### FLOOD RESPONSE | EFFORTS

12  
PUMPS PROVIDED

181,000  
GALLONS/MIN PUMPING CAPACITY

#### BEACH | ASSESSMENTS

28  
ASSESSED



## BUILDING STRONG®

OPERATION BLUE ROOF: 888-ROOF-BLU (766-3258)

TEMPORARY EMERGENCY POWER GENERATOR HOTLINE: 877-214-9112

FINAL (AS OF: 14-NOV 1200)

# USACE Aviation / UAS Cadre

**Our Mission** Providing planning support, guidance, coordination, and execution of aviation assets necessary to all USACE elements conducting/supporting emergency response and contingency operations requiring aviation reconnaissance, airlifting of supplies, and travel during an USACE All-Hazard response.

Supporting USACE leaders to include aviation early in their planning efforts to save time and money

78

National  
Cadre  
Volunteers

**Blue Team** East Coast  
**Red Team** Central US  
**Green Team** West Coast

41

USACE  
Districts, Labs  
& Centers with  
aviation assets

164

Unmanned  
Aerial Systems  
(UAS)

16

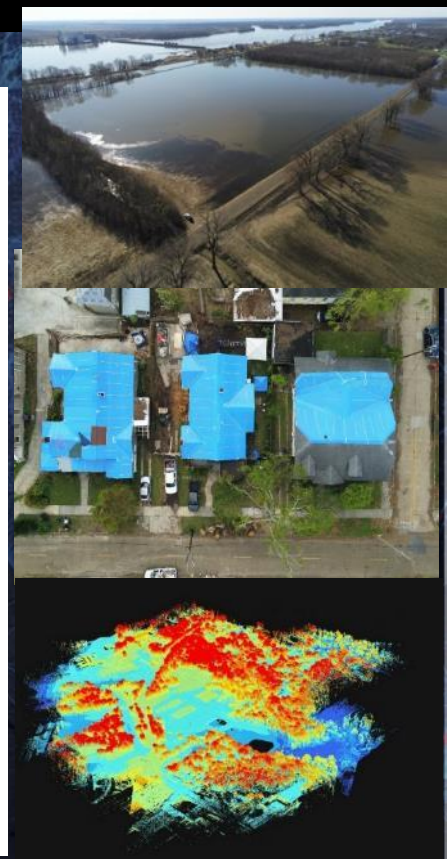
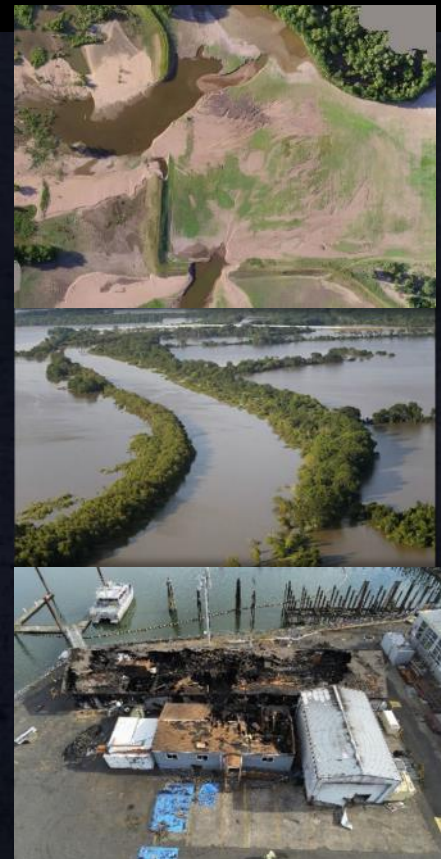
Manned  
Aircraft

## Ready for Deployment

- From its creation in 2017, the USACE Aviation Cadre has matured into a **ready-to-deploy**, standardized emergency response asset.
- Aviation Cadre are **trained and qualified teams** of Aviation SMEs and Remote Pilots available to provide mission support.
- **Activated and deployed for Blue Roof missions** following Hurricanes Michael, Laura, Delta, and Ida for up to 3 months.
- **Deployed Aviation Cadre to Florida after Hurricane Ian** for 15 days and conducted more than 100 flights, collecting more than 70,000 images covering 23,000 acres.

## UAS Capabilities

- **Mission planning, tracking, and archiving** through the Management Information System for Aviation & Remote Systems (MARS).
- Utilizing UAS to conduct final **Quality Control/ Quality Assessments inspections of homes with blue roofs** during restoration efforts and supporting public affairs.
- **Digital elevation & surface models** for improved measures of shoreline erosion, waterway trafficability assessments & volume estimates to support restoration efforts.
- **3D terrain modeling** to facilitate surveys and debris identification & removal.
- Thermal Cameras and Light Detection and Ranging (LiDAR) sensors provide **advanced data collection capabilities**.

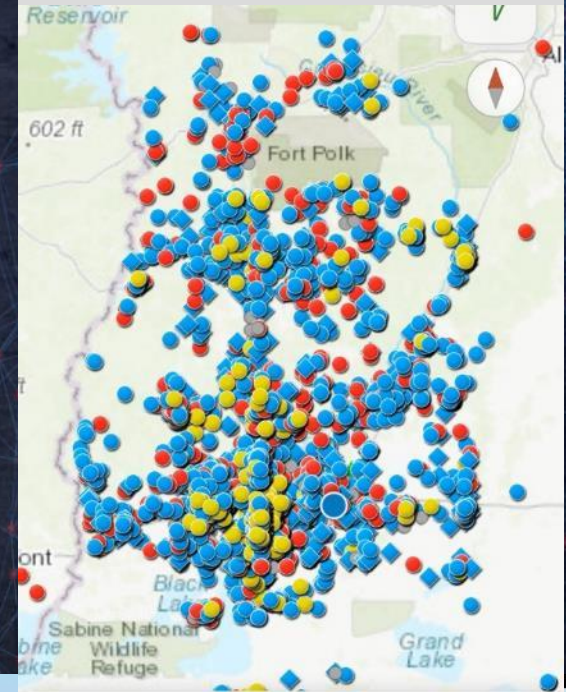


# Utilizing UAS for Temporary Roofing Inspections

- The Temporary Roofing program traditionally required USACE staff to conduct on-site roof inspections to initially assess the extent of damage and then to conduct final QC inspections of completed work.
- The use of UAS to conduct these inspections reduces manpower requirements, can reduce the amount of time that homeowners are displaced from their homes, and improves the overall efficiency of the program.



Possible AOI Request  
Over 9,900 Homes in LA



# Pre/Post Storm UAS Data used to Train USACE Temporary Roofing Staff

**Purpose:** UAS pilots collected aerial imagery of homes that were equipped with temporary blue roofing material to train incoming QA/QCs on roof assessments.

**Impact:** Utilizing UAS to conduct final inspections of homes with blue roof decreased the need for personnel to climb on top of homes to conduct inspections which in turn decreased time on the site, personnel in the field, and safety of personnel.

**Products:** High-quality imagery and videos that could be used for multiple purposes for in-coming trainees for Blue Roof.



# Utilizing UAS for Broader Disaster Relief Missions

**Purpose:** Provides a force multiplier in disaster response.

**Impact:** Utilizing UAS to collect aerial imagery and videos of neighborhoods, to assist with individual roof inspections and to provide information supporting USACE PAO.

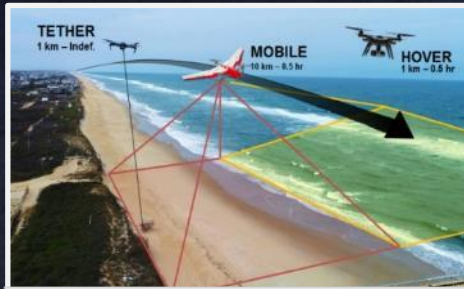
**Products:** High quality imagery and videos that could be used for multiple purposes for incoming trainees for Blue Roof, Temporary Housing, Debris Removal and

**Outcomes:** After Hurricane Laura, teams were being trained with imagery for the upcoming disaster response for Hurricane Delta. Providing awareness of UAS availability and capabilities to USACE, FEMA and other Emergency Support Functions groups can decrease manpower requirements, enhance the safety of personnel, and provide immediate visual feedback from the field to support mission requirements and decision makers.





# Other UAS Applications



**Multimodal Environments**

## Terrain Sensing

- Survey grade remote sensing
- Hazard identification
- Seamless beach topography & bathymetry
- Field Force Engineering/EnVST/ Blue Roof

## Situational Awareness

- Object Detection and Avoidance
- Teaming compatible
- Autonomous aerial imagery
- Route Reconnaissance



**Mobility in Complex Urban Environments**

## High Resolution

- Image
- Installations of the Future
- Geospatial Models



**3D Models/ Digital Twin**



**Unmanned Aircraft System**

## Modular

- Payload agonistic
  - Thermal
  - Infrared
  - Multispectral
  - LiDAR
  - High Resolution RGB



**Environmental Monitoring**

## Site Characterization

- Change detection
- UXO detection/ID
- Multimodal environmental characterization

## Adaptable

- Active/passive systems
- Coastal Mapping
- Innovative Sensor Technology



**Data Collection and Processing**

**Installations, Operations, and Environment**  
 OTD POC: [Elizabeth.a.ferguson@usace.army.mil](mailto:Elizabeth.a.ferguson@usace.army.mil)  
 Tech POC: [Jennifer.G.Laird@usace.army.mil](mailto:Jennifer.G.Laird@usace.army.mil)

**Civil Works**  
 OTD POC: [jennifer.m.seiter-moser@usace.army.mil](mailto:jennifer.m.seiter-moser@usace.army.mil)  
 Tech POC: [Jennifer.G.Laird@usace.army.mil](mailto:Jennifer.G.Laird@usace.army.mil)



# ERDC

ENGINEER RESEARCH & DEVELOPMENT CENTER

**DISCOVER • DEVELOP • DELIVER**

*New ways to make the world safer and better*

**Jeffrey D. Jorgeson, PhD, PE**

Research Engineer

USACE Reachback Operations Center

U.S. Army Engineer Research and Development Center

U.S. Army Corps of Engineers

**Connect to ERDC online**



LinkedIn



YouTube



*Scan this QR code with your phone for instant access*



"DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited."