2014 RSM & EWN IPR and Working Meeting

ERDC
Engineer Research and Development Center

Flood Risk Management RD&T

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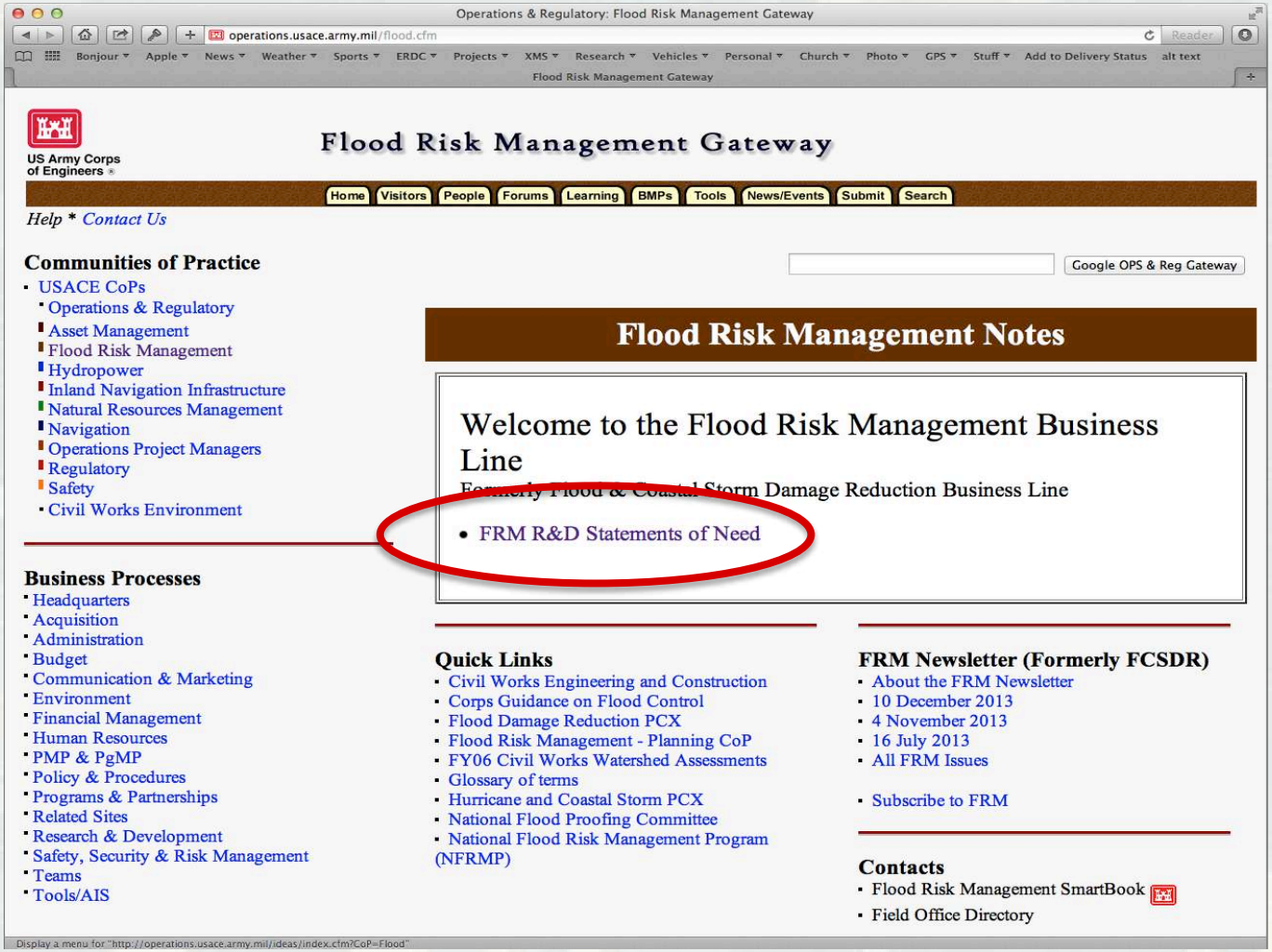
July 22, 2014

US Army Corps of Engineers
BUILDING STRONG®

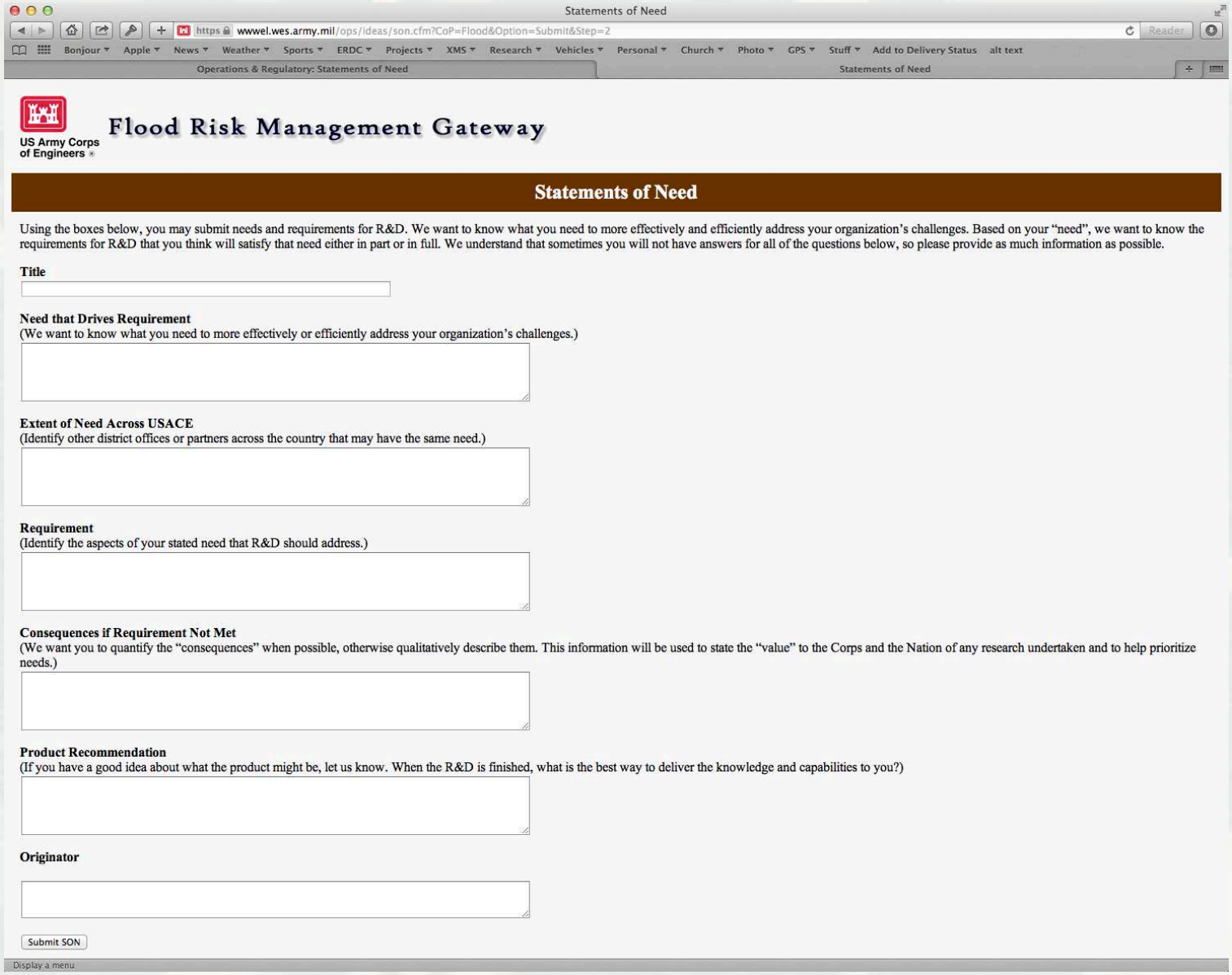
Get Involved in R&D!

http://operations.usace.army.mil/flood.cfm



R&D Statements of Need

http://operations.usace.army.mil/flood.cfm



Flood Risk Management Doctrine

Overarching Approach

Adaptive Management

Measure responses to interventions within systems to adjust planning, construction and operations in response to changing conditions.

Risk-Informed Decision Making and Communication

- Consequence analysis (especially populations)
- Forestall possible failure mechanisms
- Quantify / communicate residual risk
- Ask which projects will fail to perform as designed, the likelihood of failure, and the consequences
- Recognize limits in disaster prediction
- Recognize limits in structural protection

Integrated Water Resources Management

State-of-the-Art Technology

- Improve resiliency of structures
- Update design criteria
- Improve approaches to planning / design
- Leverage remote sensing / GIS / nanotechnology / . . . .
- Coastal / River Information System

Systems Approach

- River basins / Watersheds / Coastal zones
- From INDIVIDUAL projects to INTERDEPENDENT systems
- From IMMEDIATE to LONG-TERM solutions
- Single actions trigger ≥1 system responses / reactions

Collaboration and Partnering

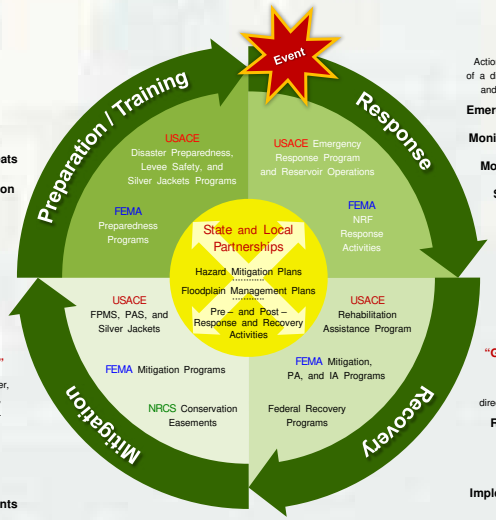
- Multiple organizations contribute to problem-solving
- Leverage funding, data, and talent
- Efficiencies, given scarce resources
- Sophisticated state / interstate organizations
- Tribes, local governments, non-profit organizations
- Partnering with profit-making organizations a next step

Life-Cycle Risk Management

"Getting Ready"

Actions taken BEFORE the event, including planning, training, and preparations

- Flood Risk Management system assessment / inspections
- Monitoring / forecasting threats
- State and Local Coordination
- Reservoir operations
- Flood Fight Preparation



"The Flood Fight"

Actions taken DURING the initial impact of a disaster, including those to save lives and prevent further property damage

- Emergency system strengthening
- Monitor and report flood impact
- Monitor system performance
- Support State / Local FF

"Driving Down the Risks"

Activities that PREVENT a disaster, reduce its chance of happening, or reduce its damaging effects.

- Modify mitigation plans
- Identify future mitigation opportunities
- Develop system improvements

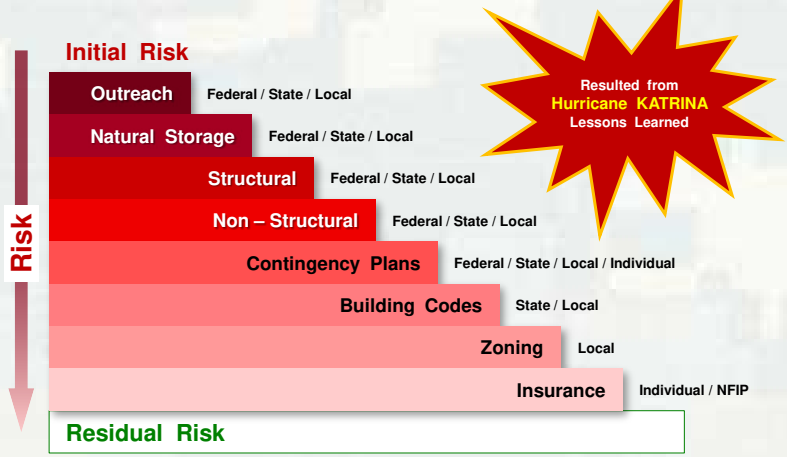
"Getting back on our feet"

Actions taken AFTER the initial impact, including those directed toward a return to normalcy.

- Repair damaged systems
- Assess and document system performance
- Implement mitigation measures / system improvements

Shared Disaster Risk Management

" Driving Down the Risks with an Informed and Engaged Public "



All Stakeholders contribute to reducing risk !

Risk-Informed Decisionmaking

RISK = expected value of an unwanted event which may or may not occur

Step 1: Screening — **Consequences** ("Threat – Agnostic")

x

Step 2: P (Consequence | Threat) — **Vulnerability** (Internal)

x

Step 3: P (Threat) — **Threat** (External)

A rigorous process of:

- "Threat-Agnostic" Consequences Prioritization
- "Threat-informed" Vulnerability Assessment
- Probabilistic Prioritization of Investments
- Consistent Analysis of Alternatives
- Common Operating Picture
- Systems / Portfolio "Mastery"

Relative Risk Value Matrix (1-5 Matrix)

Consequence Category		Overall Project Condition Classification: F (1) Failed	D (2) Inadequate	C (3) Probably Inadequate	B (4) Probably Adequate	A (5) Adequate
1	High	1	1	2	2	3
2	Medium High	1	2	2	3	4
3	Medium	2	2	3	4	4
4	Low	2	3	4	4	5
5	Minimal	3	4	4	5	5

Value to the Nation
USACE Flood Risk Management

Operates 707 dams, 383 major lakes and reservoirs

- 376M visitors/yr, $15B in economic activity, 500,000 jobs
- 24% US hydropower capacity, 3% of US electricity, $500M in sales

25,000+ km of levees (some coastal)

100 coastal storm damage reduction and related projects including 650 km of shore protection

Water Supply from 153 projects for cities including Washington, DC

~12 Emergency responses per year

(Electricity, debris removal water/ice distribution, temporary roofing, flood fight…)

National Challenge:
Flood-Prone Areas

- Development continues to increase
- Rapid growth in at-risk coastal areas
- Investments decreased by ~70% in real terms over past 3 decades.
- Over $15 billion awaiting construction

Greenville, MS, Matfield

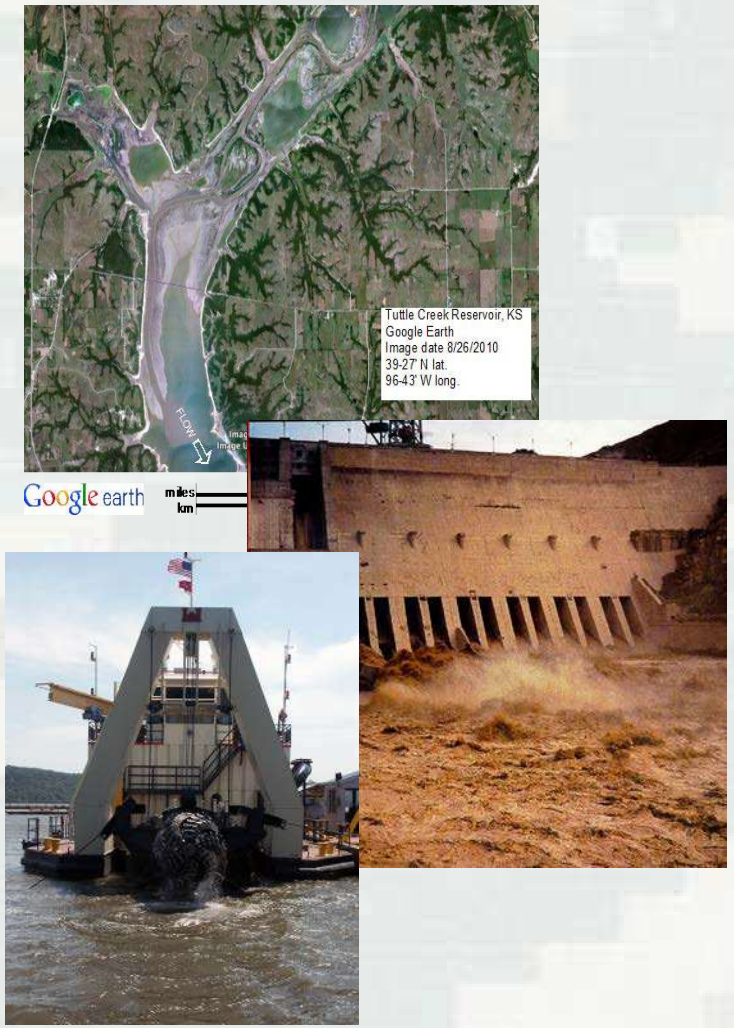
Bolivar Peninsula, TX

National Challenge:
Aging Water Infrastructure

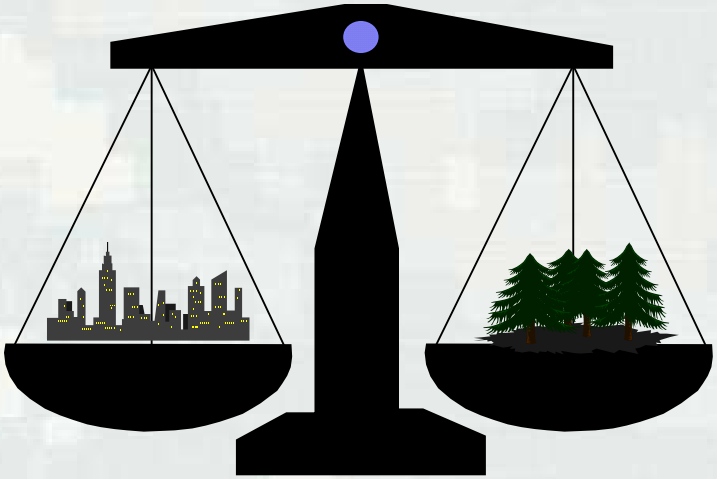
- Many infrastructure projects 50+ years old
- Investments in water resources infrastructure declining in real terms
- Result: more frequent closures for repairs, decreased performance & costly delays

National Challenge:
Asset Management & Infrastructure Recapitalization

- Deliver reliable infrastructure through use of risk-based assessments
- Risk-informed strategy applied to budget process
- Optimize use of limited resources across multiple business lines



National Challenge:
Environmental Sustainability



- Balance between economic development, environmental stewardship
- Water quality threatened on 8% of nation's rivers and streams
- Corps has authority and programs for ecosystem restoration.

National Challenge:

Integrated Water Resources Management

- Planning based on watershed/ regional approach
- Ecosystem restoration
- Environmental sustainability
- Interagency coordination
- Involve all stakeholders

Key 2011/2012 Responses

Severe Weather – Midwest Mar 2012

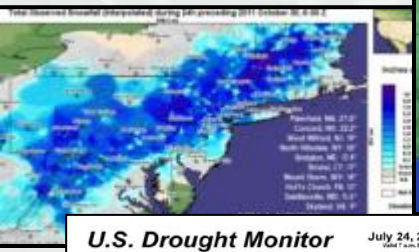
FEST Deployments Jan – Mar 2011 & OEF/OND

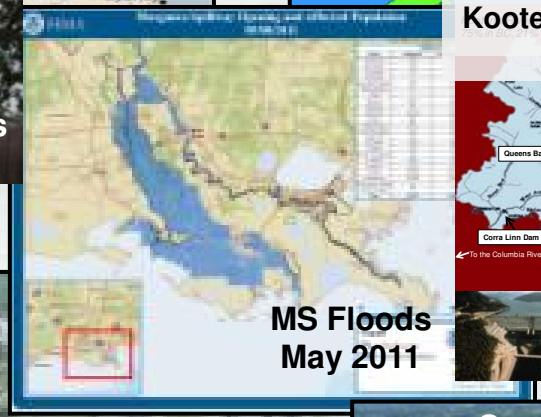
Queensland, Australia Flood - Jan 2011

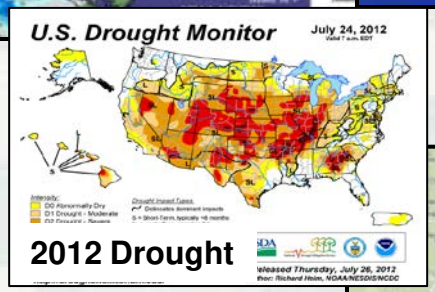
Christchurch, New Zealand Earthquake - Feb 2011

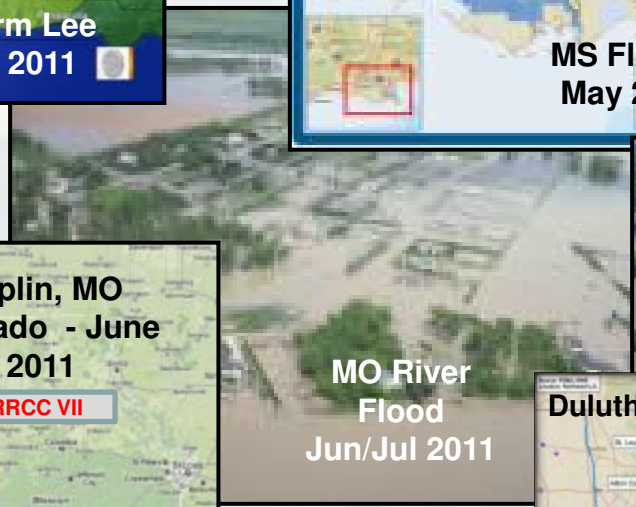
Japan EQ & Tsunami - Mar 2011

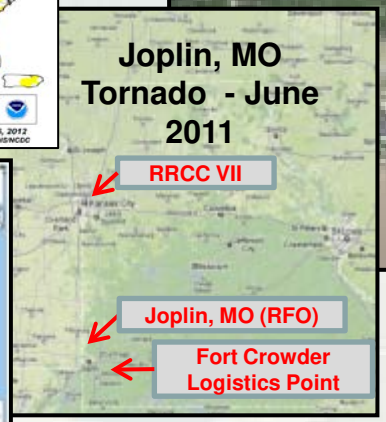
Northeast Snow Storm Oct 2011





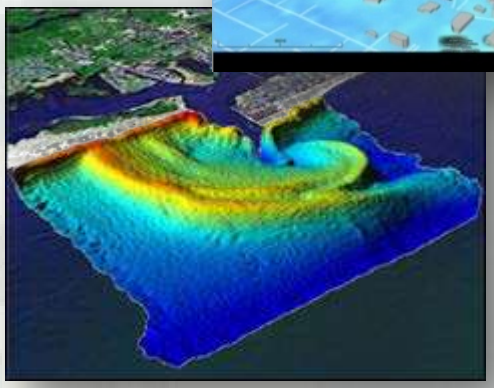


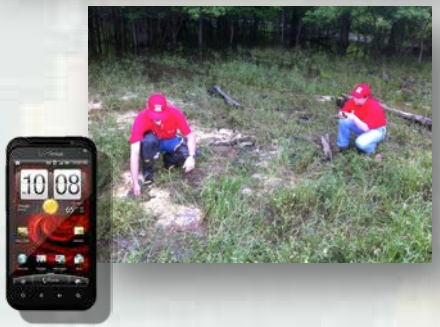




FRM and R&D Nexus
Strategic Needs & Priorities

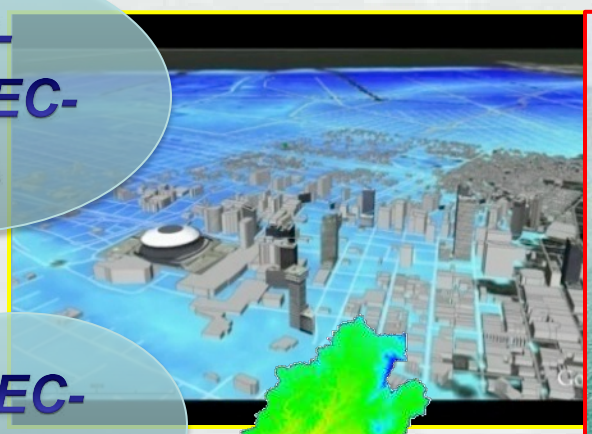
- Determine Risk & Uncertainty for Project Alternatives Evaluation & Performance
- Optimize Design & Management of Resilient Coastal & Estuarine Resources
- Assess Comprehensive & Multidisciplinary Management of Watersheds
- Improve Flood Risk Management & Water Control Infrastructure Resiliency & Reliability
- Enable effective disaster preparation, response & recovery
- *Engineering with nature to enhance ecosystem and processes, benefits and services*
- *Deliver sound engineering and scientific solutions that meet Planning Modernization guidelines*





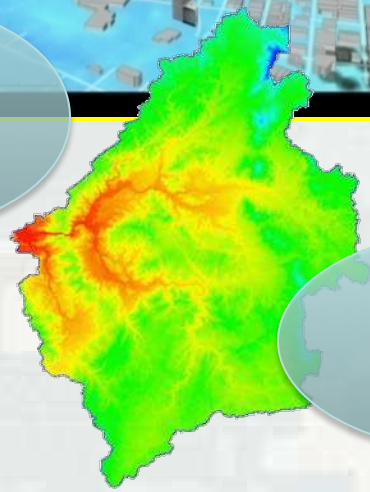
Risk and Uncertainty Frameworks for Project Alternatives Analysis

HEC-WAT/HEC-FRA



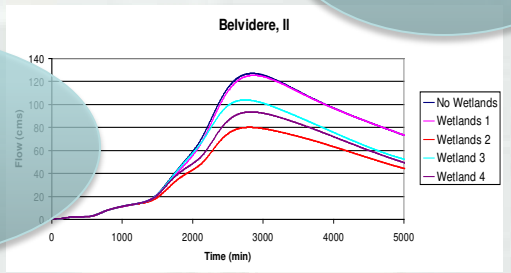
CSTORM-DB

HEC-FIA



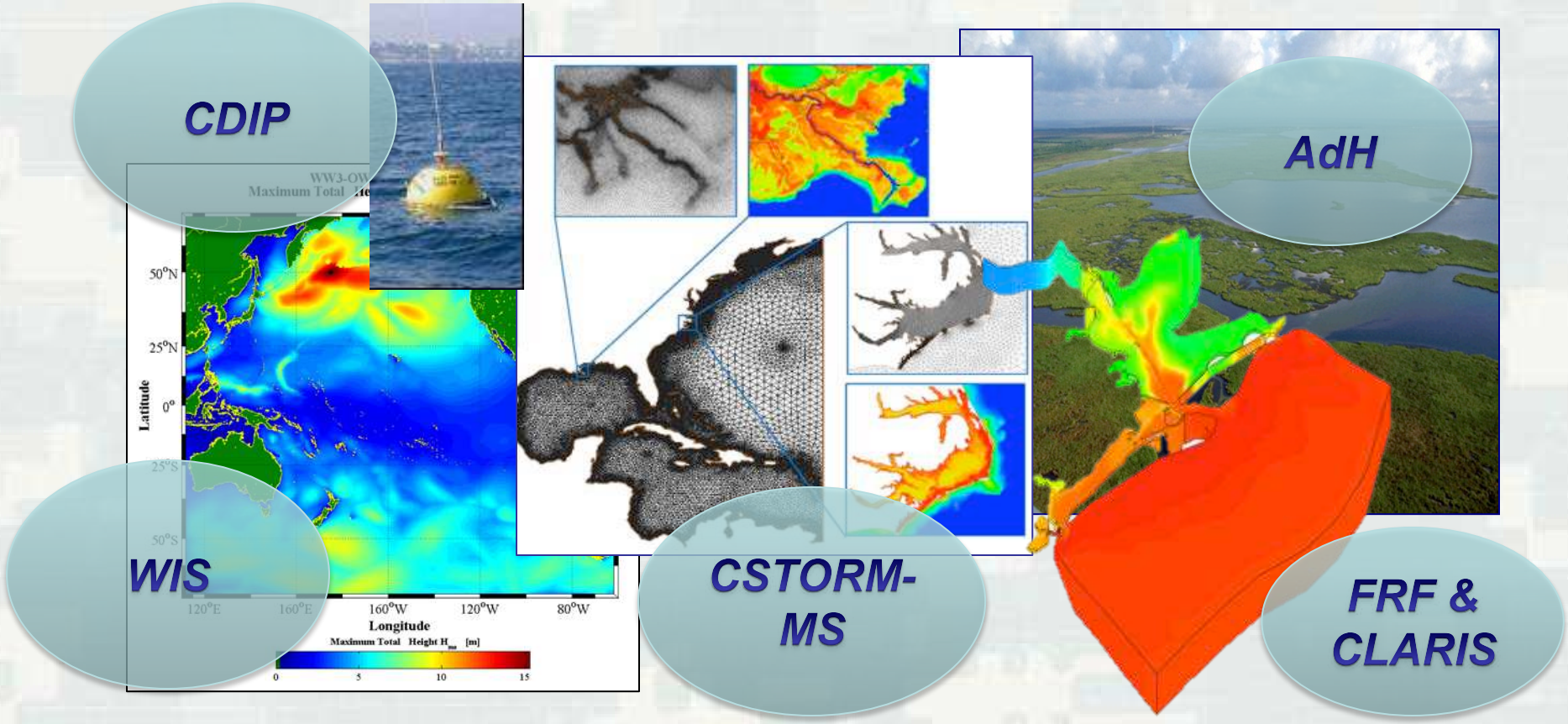
Beach-fx

H&H Models



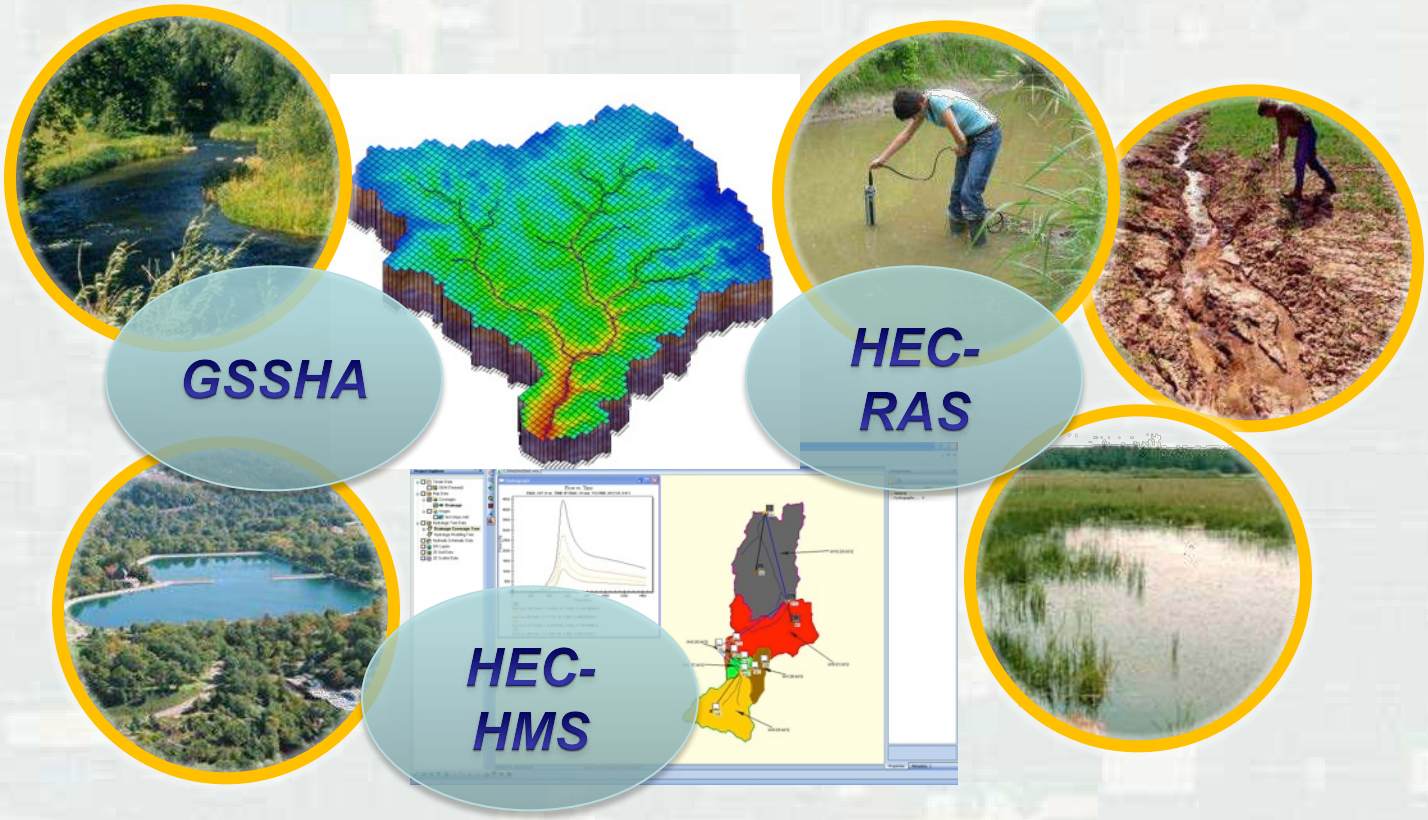
Improve Corps' planning, design and formulation capability through advanced software that integrates engineering computations with FRM analysis tools. Software is designed to enhance evaluation and comparison of project alternatives in a risk and uncertainty framework

Coastal Systems



Provide USACE and its partners and stakeholders the framework and analytical tools to balance human development activities with natural system requirements in a sustainable manner through regional management of coastal and estuarine water and sediment resources

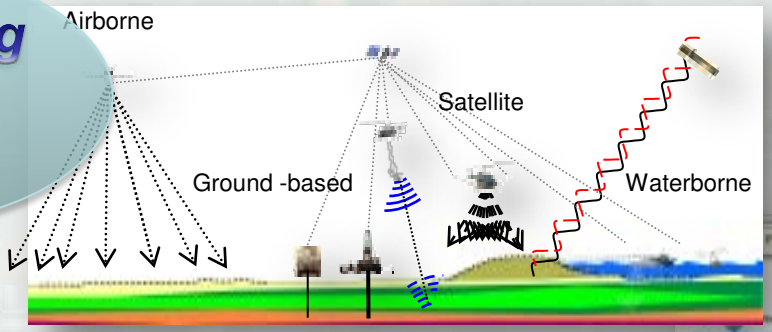
Watershed Systems



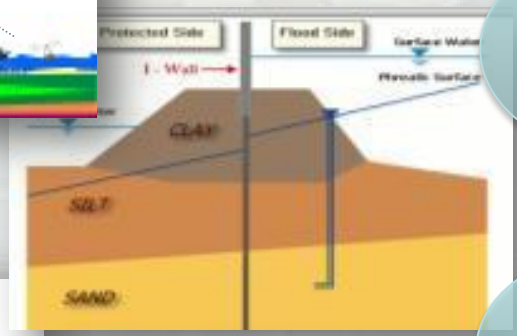
Provide capability to Districts and stakeholders to conduct holistic studies on watersheds, rivers, reservoirs and estuaries for multidisciplinary water resources management. Capability includes interoperable hydrology, hydraulics, sediment and material transport and ecologic processes

Infrastructure Resiliency & Reliability

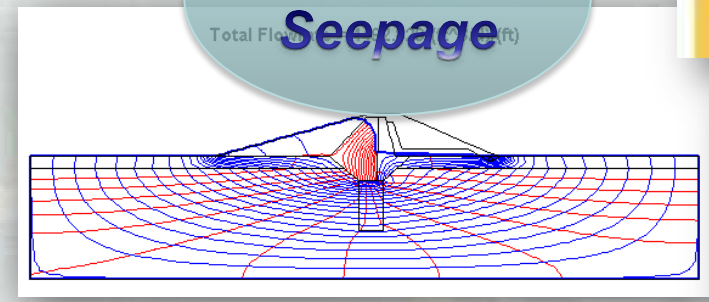
Monitoring and Sensing



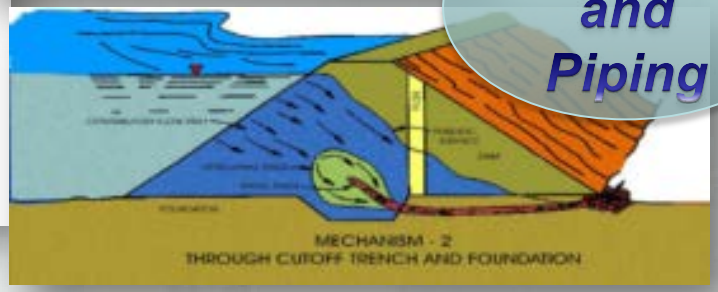
Corps I-Wall



Transient Seepage

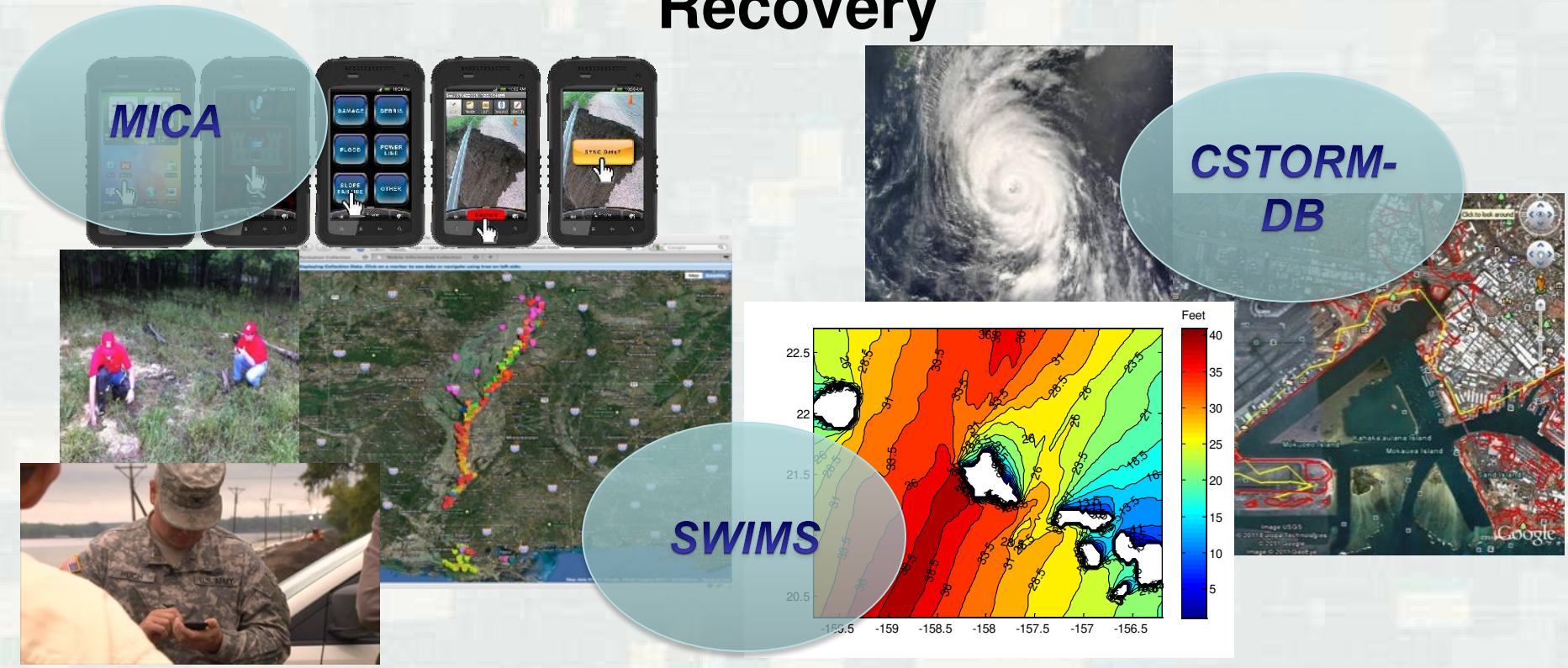


Seepage and Piping



Identify near term opportunities for gaining new capability and longer term science-based initiatives to make greater strides in improving the condition and functioning of infrastructure.

Effective Disaster Preparation, Response & Recovery

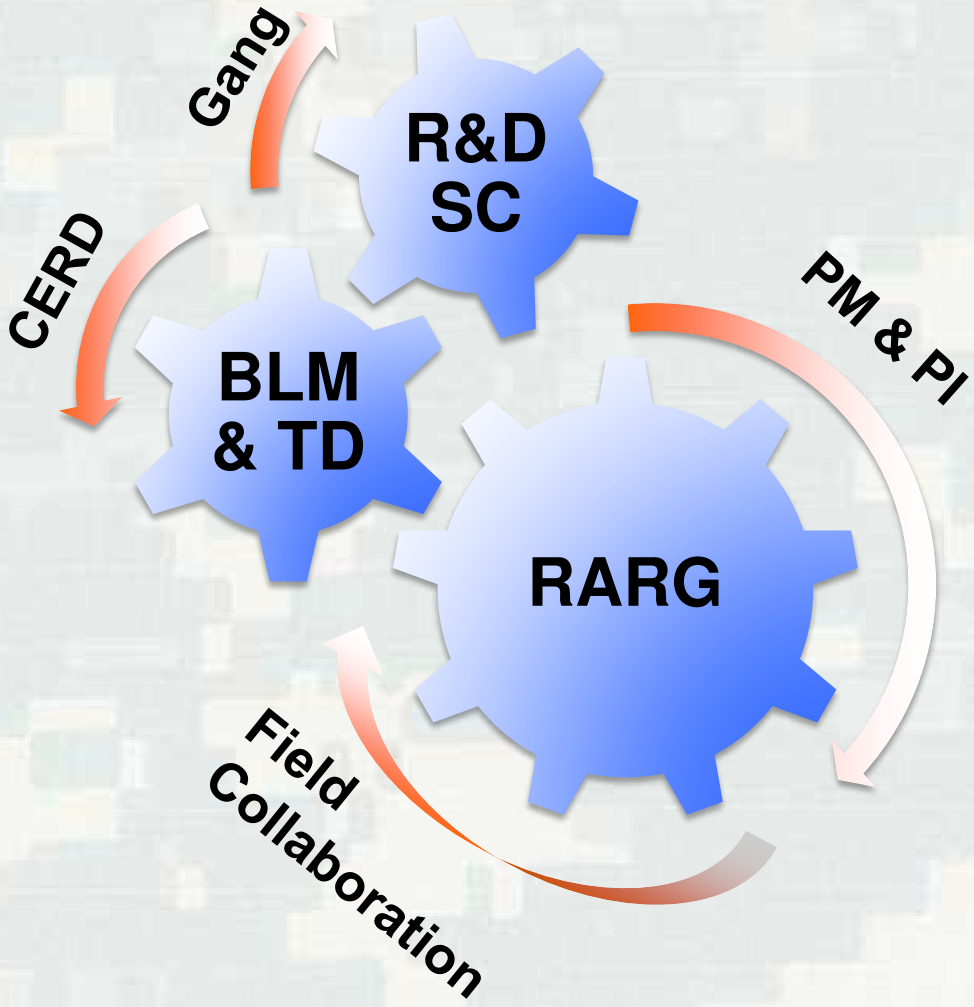


Enable expedient, efficient, and effective data acquisition, data management and information dissemination for life-cycle public safety and all hazard risk mitigation. Capability includes rapidly deployed models and reliable damage assessment technologies

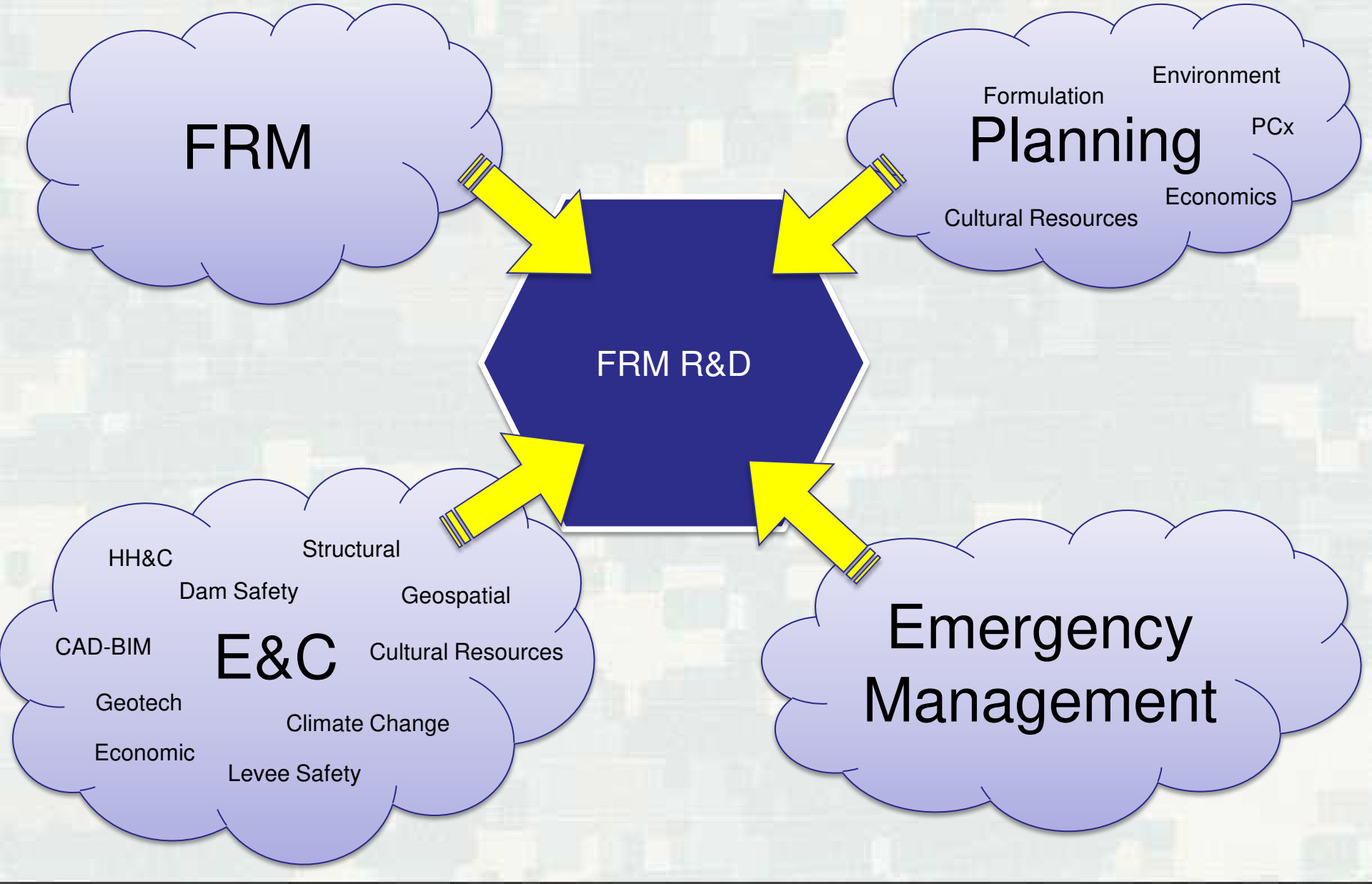
https://technology.erdc.dren.mil

Civil Works R&D Process

- Produces requirement-driven program
- Short-term requirements
- Strategic requirements
- Leverages other Corps programs
- Collaborate with field and others
- Documentation: SOP



FRM RARG (CoP Input)



2014 RARG Preliminary Ranking

Title	Weighted Avg
Evaluation and Comparison of the Grouting Effectiveness of Conventional Cement Grouts and Balanced Stable Grouts for use in Grouting Rock Foundations of Dam Safety Projects	4.3
High velocity stage-damage curves	3.8
The Impact of Vegetative Roots on Seepage and Piping in Levees	3.8
Methods for Determining Drought Recurrence Intervals	3.4
Load and Resistance Factor Design for Flood & Retaining Structures	3.4
Physics based atmospheric models for probable maximum precipitation estimation	3.4
Quantification of Nearshore Transient Water Level Induced by Storm Wave Action	3.3
Geotechnical site characterization of complex foundations under extremely long levees	3.2
Hydraulic Model Workflow Improvements - Topographic/Geometry Data Management, Streamlining of Editing Capabilities, Automation of Repetitive Analyses, and Improvement in Model Runtime Capabilities	3.0
Rapid Pre-Storm Coastal Survey Ability for Improved Storm Impact Assessment and Prediction at USACE Coastal Storm Damage Reduction (CSDR) Projects	3.0
Short-term forecasting and project risk tradeoffs	3.0
Need for GIS-Based Meteorologic Modeling Tool	3.0

Title	Weighted Avg
Accretion rate of coastal wetlands experiencing relative sea level rise	2.8
Repair/Replacement of failed in-service water stops for Civil Works structures	2.8
Mold Flood Damage Functions	2.8
Evaluation of Fully Grouted Piezometer Installations	2.8
Alternative Methods for Apportioning Sediment Transport Capacity	2.7
Development of tools to improve efficiency of hydraulic analysis and mapping for large areas	2.6
Multi-dimensional Numerical Hydraulic Modeling of Bridges	2.4
Ice Engineering Tool Development	2.3
Erosion and Mass-Wasting Failure of Cohesive Sediment	2.2
Integrating Non-Monetary and Life Cycle Risks for Improved FRM Decision Making	2.1
Improved instream structures for vertical stability, energy dissipation, floodplain function, and ecological connectivity	2.0
National Emergency Costs—Quantification and depth damage curves	2.0
Sediment Impact Assessment for Dam Removal Activities	1.6
Quantifying Effects of Ice-Jam Flooding	1.3
Estimating impacts of small water withdrawals at reservoir projects	1.3
Urban watershed application of systems approach developed for Demonstration Erosion Control (DEC) watersheds	1.2
Applications for a Catastrophic Impact Model (CIM)	1.0
Climate change induced increases in bank erosion impacts to archaeological sites	1.0

Thank you

http://operations.usace.army.mil/flood.cfm