Enhancing NFIP Resources to Support Coastal Community Efforts to Plan for and Adapt to Sea Level Rise

Moderator
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CA Dept of Water Resources, Southern Region

2015 FMA ANNUAL CONFERENCE
Breaking Down RISK – Resiliency, Integration, Sustainability, and Knowledge in a Climate of Extremes
September 10, 2015 Workshop Session
NFIP Resources to Support Coastal Modeling Efforts to Plan for and Adapt to Sea Level Rise

TMAC and Climate Change / Future Conditions

Scott K. Edelman AECOM

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September 10, 2015 Workshop Session
All the information contained within this presentation is available publicly. No confidential or TMAC only discussions are contained within this presentation.
What is TMAC?

The TMAC provides advice and recommendations to the Administrator of FEMA.

TMAC = Technical Mapping Advisory Council

The duties of the TMAC are solely advisory in nature.
TMAC Overview

- Federal advisory committee
- Established by the *Biggert-Waters Flood Insurance Reform Act of 2012*
- Amended by the *Homeowner Flood Insurance Affordability Act of 2014*
TMAC Schedule
Technical Mapping Advisory Council

The Technical Mapping Advisory Council (TMAC) is a federal advisory committee established to review and make recommendations to FEMA on matters related to the national flood mapping program authorized under the Biggert-Waters Flood Insurance Reform Act of 2012. This page is intended for TMAC members and other parties interested in learning more about the purpose and activities of the TMAC.

The national flood mapping program provides flood maps to inform communities about the local flood risk and help set minimum floodplain standards so communities may build safely and resiliently. The Flood Insurance Reform Act of 2012 authorized the Federal Emergency Management Agency (FEMA) to determine whether a community is in a flood plain and requires participating communities to adopt and enforce floodplain management regulations in order to receive Federal assistance. The regulations promulgated under this Act provide the legal basis for the Flood Insurance Study (FIS) and Flood Hazard Determination Report (FHDR).
1: Future conditions should be performed in a consistent manner
2: Uncertainty needs to be considered
3: For coastal areas long term erosion and sea level rise must be considered
4: For riverine areas, development must be considered and climate science is not advanced for actionable science
5: Future conditions must be framed correctly
6: Demonstration projects are needed
7: Care must be taken in obtaining data for future conditions
Public Coastal Discussions

1. Scenario approach should be used

2. National Climate Assessment (NCA) or similar* global mean sea level scenarios, adjusted to reflect local conditions, including any regional effects (Local Relative Sea Level) should be used

3. Work with other federal agencies, the U.S. Global Change Research Program, and the National Ocean Council to provide a set of regional sea-level rise scenarios to 2100

4. Prepare map layers displaying the location and extent of areas subject to long-term erosion and make the information publicly available
Public Coastal Discussions

5. Additional research is needed to characterize how a changing climate will result in changes in wave conditions along the Pacific Coast.

6. Future coastal flood hazards should build upon the existing current conditions flood hazard analyses prepared by FEMA for the NFIP.

7. Maps displaying the location and extent of areas subject to long-term coastal erosion and future sea level rise scenarios should be advisory (non-regulatory) in nature for Federal purposes.
9. Local Relative Sea Level Rise scenarios should be incorporated into the existing FEMA coastal flood insurance study process in the following ways:

a. Direct Analysis – Incorporate sea level rise directly into process modeling (ex. surge, wave setup, wave runup, overtopping, and erosion) for regions where additional sea level is determined to impact the base flood elevation non-linearly (ex. 1FT SLR = 2FT + BFE increase, 2FT SLR = 4FT BFE etc.).

b. Linear Superposition – Add sea level to the final calculated total water level and redefine base flood elevation for regions where additional sea level is determined to impact the base flood elevation linearly (ex. 1FT SLR = 1FT + BFE, 2FT SLR = 2FT BFE etc.).

c. Wave effects should be calculated based on the higher stillwater elevation
How can FMA help?

- Contribute on areas that can be improved
- Submit a whitepaper on FMA position
- Be available for SME’s
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Addressing Future Conditions in Coastal Floodplain Management under the NFIP

Marisa Villarreal
California Ocean Science Trust

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Ocean Science Trust

To advance a constructive role for science in decision-making by promoting collaboration and mutual understanding among scientists, citizens, managers, and policymakers working toward sustained, healthy, and productive coastal and ocean ecosystems.

**MAKING SCIENCE USEFUL.**

We empower broad participation in policy and management decisions with useful, reliable science.

**PARTNERS IN GOOD GOVERNANCE.**

Our position—-independent of academia and the state but linked to both—is a new model for the future of science-informed policy.

**LINKED TO THE STATE.**

Our organization is novel. We are an independent non-profit created by a California statute that recognized the value of independent science to support decisions.

**FINDING COMMON GROUND.**

Connecting government, science, and communities is hard—and the reason for our existence. We work across traditional boundaries to build trust.
Talk Overview

1. Project overview
2. How it came about
3. Project process and components
4. Final products
Project Overview

Develops useful guidance and information products that support and better prepare local communities to plan and adapt to future conditions/sea-level rise (floodplain managers, city planners, decision-makers).

A. DWR NFIP Quick Guide Sea-Level Rise Appendix
B. Technical Methods Manual
C. Summary/‘Comprehensive’ Report
Policy Drivers (2013)

Reauthorization of FEMA NFIP (2012)

Technical Mapping Advisory Committee

Executive Order S-13-08 (2008)

An opportunity

- DWR saw an opportunity to address future conditions planning/sea-level rise in the context of the NFIP.

- DWR engaged Ocean Science Trust for support in translating science, assessing user needs, and coordinating across different groups that would need to be involved.

- Funded through the NOAA Coastal Ocean Climate Applications Program (2013).
Project components

- **Focus Group**
  (Summer 2014-Summer 2015)

- **User Needs Assessment**
  (Fall 2014)

- **Sea-Level Rise Modeling**
  (Winter 2014-Spring 2015)

- **Guidance & Information products**
  (Summer 2015)

- **Workshops/Trainings**
  (Fall – Winter 2015)
Building products with user input

- Focus Group
- User Needs Assessment
- Sea-Level Rise Modeling

Guidance & Information products

Workshops/Trainings
What we learned

Guidance and information products should...

...Be relevant to management decision-making frameworks

...Include information on shoreline erosion and geomorphic response, in the context of sea-level rise

...Identify incentives that can support the development and use of information.
We also learned...

...Translating sea-level rise information into mapping products is valuable

...It’s a crowded landscape:

Sea-level rise tools, models, guidance
Future conditions mapping efforts
Inter-agency working groups
Agency mandates and regulatory frameworks

...The types of information needed and used by managers and planners can differ greatly.

...Need to balance sophistication with simplicity.
What we’re developing
A series of products

Summary/‘Comprehensive’ Report

• Informational
  • Audience: Range of coastal decision-makers, local – state
  • Narrative/Summary of project components
  • Other future conditions mapping/modeling efforts
  • Funding sources and other resources

DWR California NFIP Quick Guide
Sea-level Rise Appendix

• Conceptual
  • Audience: Floodplain managers, city officials, property owners
  • High-level
  • Basic sea-level rise concepts
  • Basic/high-level resources and approaches for sea-level rise planning.

Technical Methods Manual

• Technical
  • Audience: Local planners, environmental managers, technical practitioners.
  • Relates Scripps (or other) modeling outputs to FEMA hazard mapping guidelines
  • Provides Scripps methodology.
Thank you!

marisa.villarreal@oceansciencetrust.org
www.oceansciencetrust.org

Ryan Meyer
Aaron McGregor
Quick Guide Coastal Appendix: Planning for Sea-Level Rise

Steve Cowdin, Ford Engineers

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Why a QG Coastal Appendix?

- Intended for communities exposed to higher levels of flood risk many of which may also be affected by future sea-level rise
- NFIP coastal flood zones described in 2007 Quick Guide reflect existing conditions
- Appendix objective—provide “high level” overview of sea-level rise issues from CA perspective and NFIP implications
What’s included?

- Why should we consider sea-level rise?
- How does FEMA map existing coastal flood hazards?
- How will FEMA map future coastal flood hazards?
  - Non-regulatory (RiskMAP)
  - Regulatory (guidance being developed)
- What is sea-level rise and what contributes to it?
What’s included (cont’d)?

• Why should communities plan for future sea-level rise?
• How can a community plan for sea-level rise?
• General approaches for mapping sea-level rise:
  • Use State guidance
  • Analyze increased flood scenarios
  • Apply climate-informed science models
What’s included (cont’d)?

- What resources are available?
  - Background science
  - State guidance
  - Example tools
    - Models
    - Map viewers
  - Example CA sea-level rise planning efforts
- References
Thank you!
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Technical Methods Manual:
Bob Battalio, PE
Environmental Science Associates (ESA)

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Targeted Products with Broad Impacts

Comprehensive Report
- Audience: Range of coastal decision-makers, local – state
- Narrative/Summary of project components
- Information needs from Needs Assessment
- Other future conditions mapping/modeling efforts
- Incentive programs, funding sources.
- Includes list of resources for sea-level rise planning and management.

DWR California NFIP Quick Guide Supplement
- Audience: Floodplain managers, city officials, property owners
- High-level, comprehensive overview on sea-level rise and flood management.
- In the style and form of the original Quick Guide document
- Other future conditions mapping and modeling efforts
- Resources for sea-level rise planning.

Technical Methods Manual
- Audience: Local planners, environmental managers, technical practitioners (consultants)
- A resource for local communities that connect SIO (or other) modeling outputs to FEMA hazard mapping guidelines
- Presents SIO modeling methodology so it can be replicated in other regions
- Approaches to relate SIO modeling to existing FEMA future conditions mapping

Quick Guide
Coastal Appendix

2015
The National Flood Insurance Program, California

Institute of Oceanography, Scripps Institution of Oceanography, University of California, La Jolla
1. Audience consists of local (municipal) planners and their technical supporters / practitioners.

2. Relates the Scripps Institution of Oceanography (SIO) future conditions flood level outputs to FEMA existing conditions flood maps.

3. Relates other future flood hazard projections to FEMA maps in general terms
LEVELS of Application of Future Conditions Hazards to FEMA Hazard Maps

• There are several levels of application that entail a range of effort and information.
• The lower levels of application are simpler to apply and the adjustments to the future conditions hazards information are limited.
• Higher levels require more effort but more accurately relate future and existing hazards. Higher levels require more information and capability.
• The levels are:
  1. Comparison
  2. Adjust V-Zones
  3. Address other hazard zones and geomorphic processes
  4. Apply FEMA methods using SIO outputs instead of “existing conditions”
Total Sea Level + Runup
Mean of CCSM3 A2, CCSM3 A1B, CNRMCM3 A2, EH4 A2

Range (shaded) = max & min of the four GCM projections
Mean levels spanning winters 2045-2055 and 2089-2099
### Climate Scenarios – Sea Level Rise

Based on NRC 2012: change from year 2000 in cm

<table>
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<th>Year</th>
<th>Norther CA</th>
<th>Central CA</th>
<th>Southern CA</th>
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<td>San Francisco (South of Cape Mendocino)</td>
<td>Los Angeles</td>
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<tr>
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<td>11.7</td>
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Climate Sea Level Rise Scenarios – Southern CA

Los Angeles sea level NRC committee (black)
NRC lo (green) and hi (red)
Total Water Level = Wave Runup + Ocean Level
Methods - Discussions of “prorating” methods

Conceptually:

Future Hazard Estimate =
Existing Hazard (FEMA) * {Future Hazard (SIO) / Existing Hazard (SIO)}

and/or

Future Hazard Estimate =
Existing Hazard (FEMA) + {Future Hazard (SIO) - Existing Hazard (SIO)}

Ideally:

\[ TWL_{\text{future}} = SWL_{\text{FEMA}} + (RWL_{\text{future}} - RWL_{\text{existing}}) + R_{\text{FEMA}} \times \frac{R_{\text{future}}}{R_{\text{existing}}} \], where

\{(RWL_{\text{future}} - RWL_{\text{existing}})\} = \text{increase in reference water level due to climate change}

\{R_{\text{future}}/R_{\text{existing}}\} = \text{relative increase in wave runup due to climate change}
V-Zone elevation = TWL

V-Zone extends inland until $hV^2 < 200 \text{ ft}^3/\text{sec}^2$ where $h$ is depth and $V$ is velocity of the flowing water. The future inland extent can be prorated by TWL increase:

$$Y_{\text{future}} = \left(\frac{\Delta R_{\text{future}}}{\Delta R_{\text{existing}}}\right)^{0.5} * Y_{\text{existing}}$$

where

$Y_{\text{existing}}$ = the existing horizontal distance from crest to inland extent of V-zone and

$\Delta R$ = negative freeboard = TWL minus the crest elevation.
Expanded inland extent of wave action due to increased overtopping for a range of negative freeboard of $\Delta R_{\text{future}}/\Delta R_{\text{existing}}$ between 1.1 and 3 and $Y_{\text{existing}}$ between 5 and 100 feet.
a. The effective FEMA flood map published in 2008 indicates these apartment buildings are not in a hazard zone (Source: FEMA).

b. The buildings were red-tagged after erosion in 2009-2010 undermined the buildings (photograph by Bob Battalio 2010).

c. Erosion projections map published one year after the FEMA DFIRM and one year before the erosion events indicates a high erosion hazard (Source: Pacific Institute, PWA, State of California, 2009).
Speaker: Bob Battalio
Professional Civil Engineer (CA, WA, LA, OR)
Coastal Processes training from UC Berkeley, 1985
Chief Engineer, Vice President @ ESA, San Francisco
Engineering Criteria Review Board, BCDC

Practices Coastal Zone Engineering and Management

Vice President, California Shore and Beach Preservation Association (Non profit)

Surfer

Photographs copyright Colin Brown
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California’s Efforts to Invest in an Integrated and Coordinated Approach for Modeling Sea Level Rise

Mary Small
State Coastal Conservancy

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Pacific Institute Study “Impacts of Sea Level Rise on California Coast” 2009
“Sea-Level Rise for the Coasts of California, Oregon, and Washington”
National Research Council 2012
NOAA Sea Level Rise Viewer

Hydrological connectivity

Tides only (MHHW)

Excellent elevation data, datum control

Wetland migration model, socioeconomic impacts

Screening tool, available statewide
CoSMOS – Dynamic Model

GCM ensemble forcing

Includes wind, waves, sediment transport, fluvial discharge, and vertical land movement rates

Range of SLR and storm scenarios

Flooding extent explicitly modeled, hydrological connectivity

Our Coast Our Future: www.prbo.org/ocof
Coastal Vulnerability Considerations

Global factors:
  • Eustatic sea level

Regional factors:
  • Ocean circulation patterns
  • Glacial fingerprinting
  • Tectonics (large-scale)
  • Isostasy

Local factors:
  • Subsidence
  • Local tectonic deformation
  • Fluvial discharge AND sediment supply changes
  • Development and restoration

Seasonal and storm impacts:
  • Steric effects
  • Waves and storm surge
  • River discharge
Identifying Future Risk with CoSMoS

1. Global forcing using the latest climate models

2. Drives global and regional wind/wave models

3. Scaled down to local hazards projections
CoSMoS Version 1.0- SoCal

- Outer coast focus- protected bays not modeled
- Flooding based on maximum wave run-up
- Limited set of scenarios
  - ArKStorm
  - January 2010 hindcast
  - January 2010 hindcast + 50 and 100 yr SLR per Rahmstorf (2007)
CoSMoS 2.0 - CenCal/NorCal

http://data.prbo.org/apps/ocof/  (Our Coast - Our Future)
CoSMoS 2.1 - SF Bay
CoSMoS 3.0 Southern California

Global conditions of future climate scenarios

- GCM winds
- WW3 wave model

Regional:
- Tides, water levels, and regional forcing
  - SWAN wave model
  - Regionalized storm response
  - 20-year storm return

Local:
- High resolution hydrodynamics and waves
  - Delft FLOW-WAVE

Coastal change
- Fluvial discharge
- VLM

Open coast results
- XBEAC
- projected onto hi-res DEM
Future Shoreline Change

- Rising sea level will drive shorelines further inland, increasing physical and economic impacts.
- Reduced sediment supply from dams, dredging, shoreline armoring, etc., likely to further exacerbate the problem.
- For CoSMoS 3.0: focus on both sandy beach and cliff changes, and integrating those projections into the future flood scenarios.
Coastal Resilience Ventura

*Depth is calculated as the difference between the ground surface elevation and the water surface elevation of "Extreme High Water." Extreme High Water is an average of the highest observed tides on a monthly basis.
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