Building Flood Wisdom With Flood Knowledge

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The “Design” Process

- Iterative Refinement
- Forging – Forming/Inspection/Adjustment
- Avoid Error from Previous Trials (Experience)
Flood Wisdom

- Built upon Knowledge of the Past
- Also, Looking into the Future
- But, Also Analyzing our Methods of Analysis
US Flood Response

- Flooding
- Flood Fighting and Recovery
- Analysis
- Legislation
- Action

Note: Sometimes ordered differently. Which is fun!
CA History of Flooding

- 1950’s and 1960’s – There were numerous floods
CA History of Flood “Control”

- Flood Storage was Constructed
Levee Construction

- No Design
- Design
- Improved Design accounting for Geotechnical
- Increased Design Standards (200-yr)
- Certification
- Future Design? (Vegetation, O&M)
Flood Insurance

- Self - Insurance
- Government Recognition and Analysis
- Government Disaster Assistance
- Legislation for National Flood Insurance Program
- Reauthorizations and Funding Shortfalls
- Biggert-Waters
- Homeowner Flood Insurance Affordability Legislation
- 2019 Reauthorization and Reform
- Private/Regional Insurance?
Legislation

- Flood Control Act of 1965
- National Flood Insurance Act of 1968
- Flood Disaster Protection Act of 1973
- Disaster Relief Act of 1974
- Too many to list
FEMA (Highlights)

- Formation of FEMA (1978)
- Activated in 1979 (Carter)
- Reformation of FEMA – 1993 (Clinton)
- Reorganization of FEMA – 2003 (Bush)
- Katrina - 2005
- Provisional Accreditation of Levees
- LAMP and Levee Certification
- Sandy - 2012
- Insurance Reform
Flood Estimation Methods Progression

- Flood of Record (plus?)
- Flood Frequency
  - Statistical Stream Flow (LP3 Distribution)
- Rainfall/Runoff (Rational/Lumped/Distributive)
  - Statistical Rainfall
- Hydraulic Analysis
  (Point/Profile/Steady/Unsteady/1D/2D/3D)
Recorded Data is Information
Local Community

- Land Use Authority

- Numerous (Competing?) Interests
  - Planning, Emissions, Noise, Circulation, Jobs Creation, Water Supply, Environmental Constraints, etc., etc., etc.

- Varying Areas of Expertise/Understanding
The Feedback Loop

- NFIP $\rightarrow$ Local Land Use Decisions
- NFIP $\rightarrow$ Local Design Standards
- Local Design Standards $\rightarrow$ Analytics
- All of the Above $\rightarrow$ Cost
- Cost $\rightarrow$ Analytics
- Analytics $\rightarrow$ Local Design Standards
- Local Design Standards $\rightarrow$ NFIP
History of Flood Prediction

- Direct Measurements – High Water (Past)
- Statistical Analysis of Peak Flow (Projected Past)
- Variable Ground/Infiltration/Watershed Conditions with Statistical Rainfall (Projected Past with Changes)
Progress is Hard Work!

- Flood Insurance
- Levees
- Dams, etc.

- Then comes ....
Major Game Changer

- The Climate is Changing!
- Analysis Must Change!

- But How?
Initial Response

- Analyze Historical Trends
- Project Trends Into the Future
- Is this Sufficient?
  - Does this Capture Recent Acceleration?
Case Study – Wild Fires

• **Claim:** Robust interannual relationships between VPD and summer forest burned area strongly suggest that nearly all of the increase in summer forest-fire area during 1972–2018 was driven by increased VPD – Study cited on CNN News Wire

• Does Correlation Prove Causation?
• Is There More Going On?
Latest Response

- Create Data Representing the Future, Based on Climate Understanding and Targeted Amplifications
- Perform Analysis on the Future
Information <-> Inference

- Systems are Always More Complicated than We Know

- Language is Important:
  - Certainty – Confidence
  - Uncertainty - Doubt
  - Balance?

How Do We Perform QA?
....very carefully?
KEEP HAMMERING!

- Questions/Comments?