

# ARkStorm: A West Coast Storm Scenario

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## BIOGRAPHICAL SKETCH

Dale A. Cox is the Project Manager of the USGS Multi-Hazards Demonstration Project (MHDP) and Region 9 Lead of the Department of Interior, Regional Emergency Coordination Council. In 2008, Cox coordinated the work of over 300 scientists and experts to create the ShakeOut Earthquake Scenario, the most comprehensive earthquake scenario ever devised. He is one of the creators of the "The Great Southern California ShakeOut", the largest emergency response exercise in the Nation's history. Cox also coordinated the USGS 2007 Firestorm Response that included ash chemical analysis, endangered species assessment and recovery, and a real-time debris flow warning system completed in time for the first rains. Cox is responsible for interdisciplinary working groups, community partnerships, interorganizational collaboration, and is presently leading ARkStorm, a disaster scenario examining modern impacts of a storm analogous to those that impacted California in 1861-62.

Cox joined the US Geological Survey in 1994, where he surveyed and reported on the hydrologic conditions of the High Plains Aquifer. While in Nebraska, he helped to create Groundwater Guardian, an international collaborative partnership between the USGS and the Groundwater Foundation. Cox later served as Chief of Communications at the USGS California Water Science Center. He was a coordinator of the Lake Tahoe Presidential Forum and the bathymetric mapping of Lake Tahoe. Cox also served as a coordinator of the National Oceans Conference, another presidential forum to raise awareness and develop global partnerships to tackle ocean issues. Later, Cox served as the USGS Western Publishing Manager.

Cox is a graduate of the University of Nebraska and is married to Kristin Cox, a middle school math and science teacher in El Dorado Hills, CA. He is the father of five daughters, Kathryn, Elizabeth, Suzanne, Madeline, and Amelia.

## ABSTRACT

The United States Geological Survey (USGS) Multi-Hazards Demonstration Project (MHDP) is preparing a new emergency-preparedness scenario, called ARkStorm, to address massive U.S. West Coast storms analogous to those that devastated California in 1861–62. Storms of this magnitude are projected to become more frequent and intense as a result of climate change.

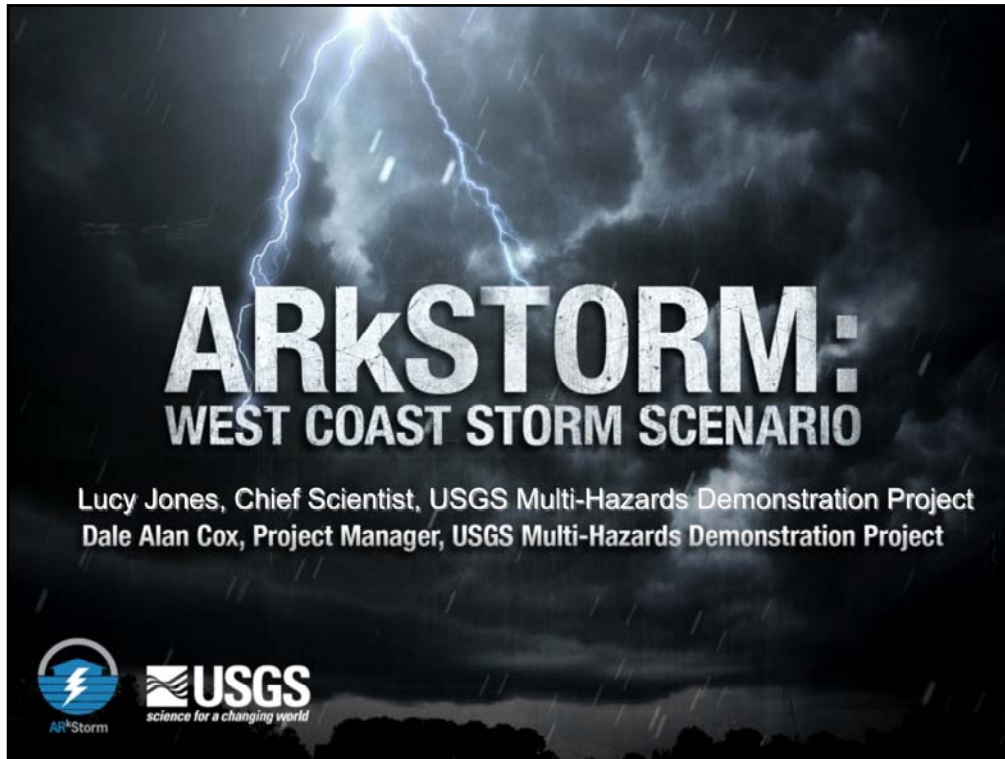
The MHDP has assembled experts from the National Oceanic and Atmospheric Administration (NOAA), USGS, Scripps Institute of Oceanography, the State of California, California Geological Survey, the University of Colorado, the National Center for Atmospheric Research, and other organizations to design the large, but scientifically plausible, hypothetical storm scenario that would provide emergency responders, resource managers, and the public a realistic assessment of what is historically possible.

The ARkStorm is patterned after the 1861–1862 historical events but uses modern modeling methods and data from large storms in 1969 and 1986. The ARkStorm draws heat and moisture from the tropical Pacific, forming Atmospheric Rivers (ARs) that grow in size, gain speed, and, with a ferocity equal to hurricanes, slam into the U.S. West Coast for several weeks. Using sophisticated weather models and expert analysis, precipitation, snowlines, wind, and pressure data the modelers will characterize the resulting floods, landslides, and coastal erosion and inundation. These hazards will then be translated into the infrastructural, environmental, agricultural, social, and economic impacts. Consideration will be given to catastrophic disruptions to water supplies resulting from impacts on groundwater pumping, seawater intrusion, water

supply degradation, and land subsidence. Possible climate-change forces that could exacerbate the problems will also be evaluated.

In contrast to the recent U.S. East and Gulf Coast hurricanes, only recently have scientific and technological advances documented the ferocity and strength of possible future West Coast storms. A task of ARkStorm is to elevate the visibility of the very real threats to human life, property, and ecosystems posed by extreme storms on the U.S. West Coast. This enhanced visibility will help increase the preparedness of the emergency management community and the public to such storms.

ARkStorm is scheduled to be completed by September 2010 and will be the basis of a statewide emergency response drill, Golden Guardian, led by the California Emergency Management Agency in 2011.



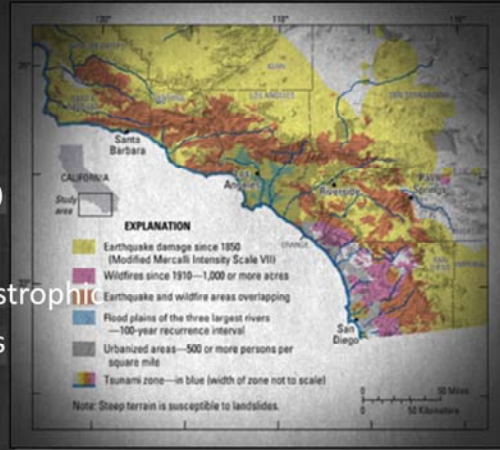
I will be talking about ARKStorm, a hypothetical massive, but scientifically plausible and defensible, winter storm scenario for California,

1. The Multi-Hazards Demonstration Project
2. The products of the project, including ShakeOut, which is the model for ARKStorm.

## MULTI-HAZARDS DEMONSTRATION PROJECT

### Southern California

- Eight counties
- ~ 23 million people
- Growing at around 276,000 people a year.
- Great risk for extreme catastrophic losses from natural hazards



UrbanEarth was formed, but Lucy and Mike Shulters, Director of the California Water Science Center, and now Southwest Regional Executive, took it higher and got it funded as The Multi-Hazards Project began in late 2006 and was actually funded in early 2007 to focus on Southern California to help communities reduce their vulnerability to natural hazards through the application of science and engineering to community planning and response.”

The great risk in LA is hazards. So to that end Lucy Jones and Mike Shulters wrote the original plan for the MHDP.

A five year experiment

## MULTI-HAZARDS DEMONSTRATION PROJECT

- Earthquakes
- Landslides
- Floods
- Tsunamis
- Wildfires
- Coastal Erosion



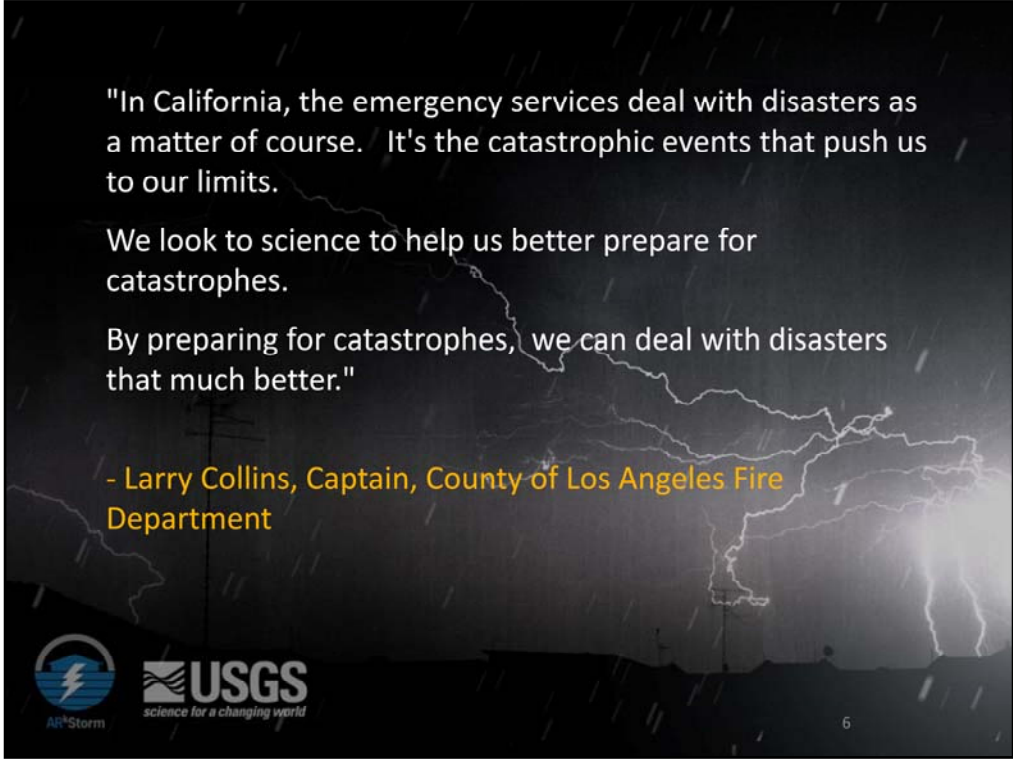
**USGS**  
science for a changing world

## Multi-Hazards Approach

The goal of the Multi-Hazards Demonstration Project is to improve community resiliency to natural hazards through the application of multi-discipline science.



To better understand what science could do to help the community to better cope with disasters, we brought together emergency responders, land use planners, and decision makers to find out what they needed.



"In California, the emergency services deal with disasters as a matter of course. It's the catastrophic events that push us to our limits.

We look to science to help us better prepare for catastrophes.

By preparing for catastrophes, we can deal with disasters that much better."

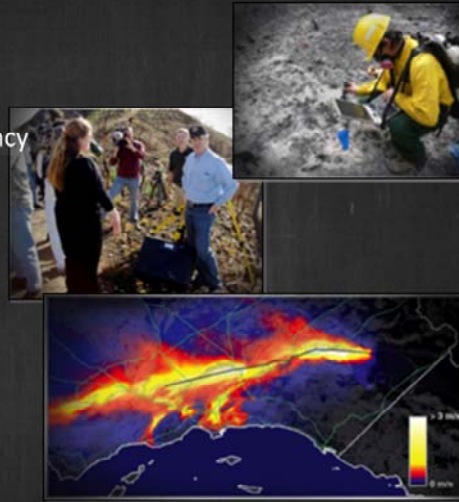
- Larry Collins, Captain, County of Los Angeles Fire Department



As risk managers we know that we manage risk, we don't eliminate it. You put in levees to protect to some level, and you put in emergency planning to protect you beyond that. One of the major projects of MHDP has been the application of science to support to create scenario that support emergency managers to prepare for events that exceed the capacity of our control systems. Because our control systems are so good these extreme event are rare and often beyond living memory. We create scenarios to help emergency managers prepare for events that that are beyond living memory.

## MULTI-HAZARDS DEMONSTRATION PROJECT

- **Earthquake / Tsunami:**  
Earthquake Scenario  
and Tsunami Scenario
- **Community Interface:**  
Tools and Information for emergency  
responders and decision makers.
- **Fire / Debris Flow:**  
A debris flow warning system  
Fire Scenario: Risk Analysis
- **Winter Storm:**  
Winter storm scenario



The Multi-Hazards Project is composed of 4 hazards themes and the products that we set out to accomplish.

Earthquake scenario (check) Talk about that in a minute

Tsunami scenario (kicked off two weeks ago I - led my Holly Ryan and Ken Hudnut)

Community Interface (check) I'll talk more about the The Great Southern California ShakeOut in a bit

Fire Debris flow - (check) Sue Cannon with the help of NOAA NWS in Oxnard devised a model and system of forecast and public warning that was used recently at the station fire in southern California in just the past several week. We also coordinated the 2007 southern California Firestorm response and are kicking off a Fire Scenario (not planned) more of a utopian scenario that the dystopia detailed in the ShakeOut. Not for exercise, but for planning to reduce the vulnerability of fire. Understanding the factors that effect the probability of fire, i.e. factors in the ignition of fire, patterns of development, materials, landscaping

Winter storm (I'm giving myself a check there)

# THE GREAT SHAKEOUTS

- **Great Southern California ShakeOut:**  
November 13, 2008  
5.4 Million Participants  
Based on ShakeOut Earthquake Scenario  
Over 2,500 Golden Guardian Participants

- **Annual Statewide Great California ShakeOut:**

October 15, 2009  
6.4 Million Participants

Events and products designed to inspire Californians to improve their earthquake resiliency



Lucy in talking with Steve Sellers, a senior official with OES, now CalEMA, who has been sort of a Godfather of MHDP, said "if we do this earthquake scenario - will you use it?"

Sellers said he would OES and the Governors Office of Emergency Services agreed to use it as the centerpiece of the 2008 Golden Guardian Exercise that would happen on November 13, 2008 and extend days beyond that.

Lucy went one step further and said "let's get the public involved " and we formed ShakeOut Steering committee to work toward the goal of getting 5 million people to take part in the exercise by doing one drill "drop, cover, and hold on.

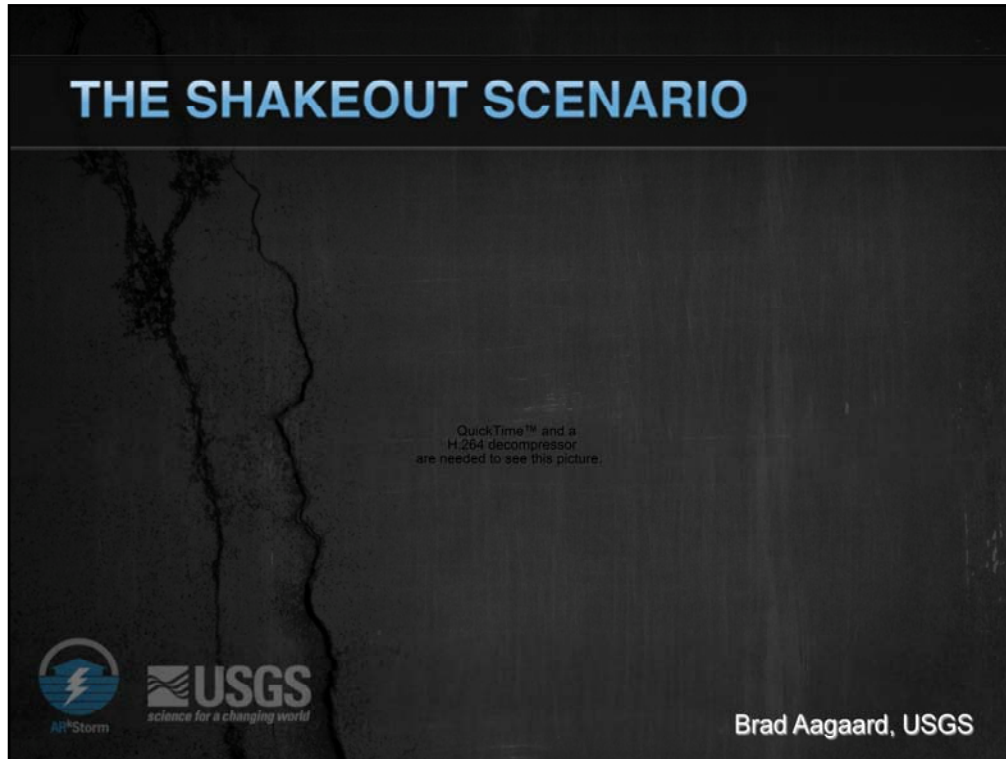
All included events LA Get Ready, at the Nokia Center the night of the ShakeOut, a earthquake book design by renown designer Stefan Segmeister, an online role playing game from the Institute for the Future, and movie titles, "Preparedness Now," from up and coming director, Theo Alexopolous. All of these came through the Art Center College of Design.

"This is the best single effort in emergency preparedness in my nearly 20 years in the business. The Golden Guardian / Great Shake Out project did more to prepare our cities than all previous efforts combined for many years past. I have never had so much participation and interest in disaster preparedness. And it continues!"

- Mike Martinet, Los Angeles County Emergency Manager



[read the slide]



190 miles from Salton Sea to around Lake Hughes

Realtime - Mercalli Scale, light blue representative of the p - wave moving faster than the secondary waves with shaking intensity of 9.

Those blue waves are getting some people's attention - while the waves in higher intensities are capable of bending steel rails.

Maximum velocity of 1 - 5 feet per second

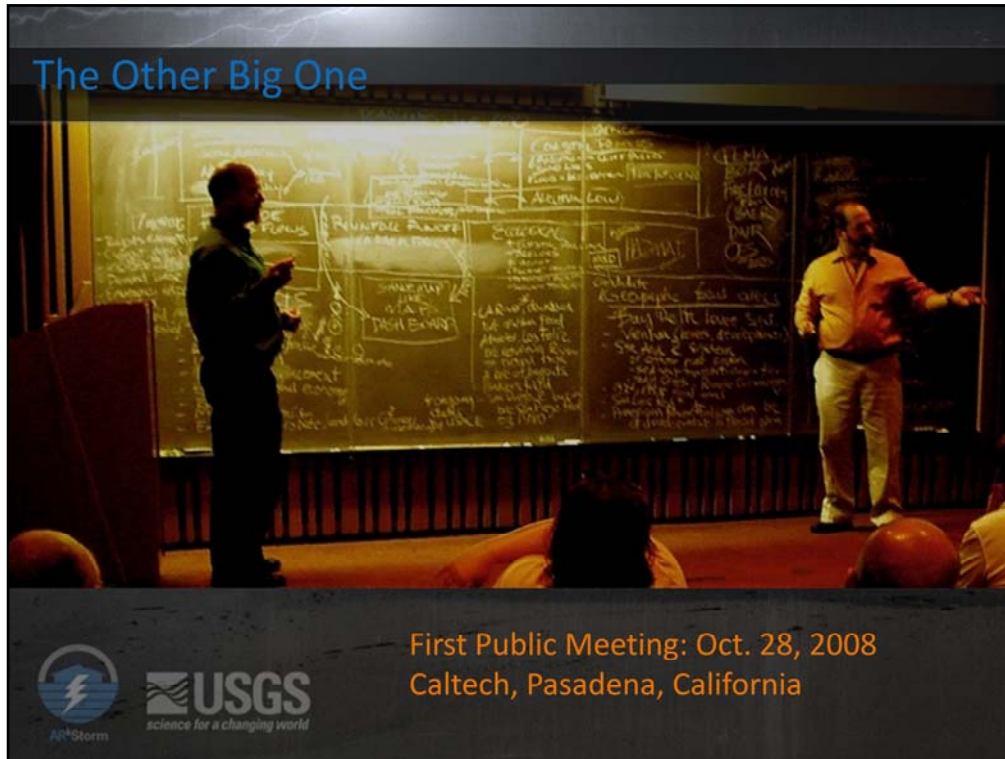
Maximum displacement 1 - 6 feet

Slip across the fault is anywhere from 6 - 23 feet.

All lifeline cross the fault, railroads, highways, pipelines, telecommunications, electrical transmission

Lifeline interactions. Loose electricity and you loose water with the pumps stop, loose natural gas and there goes public transportation.

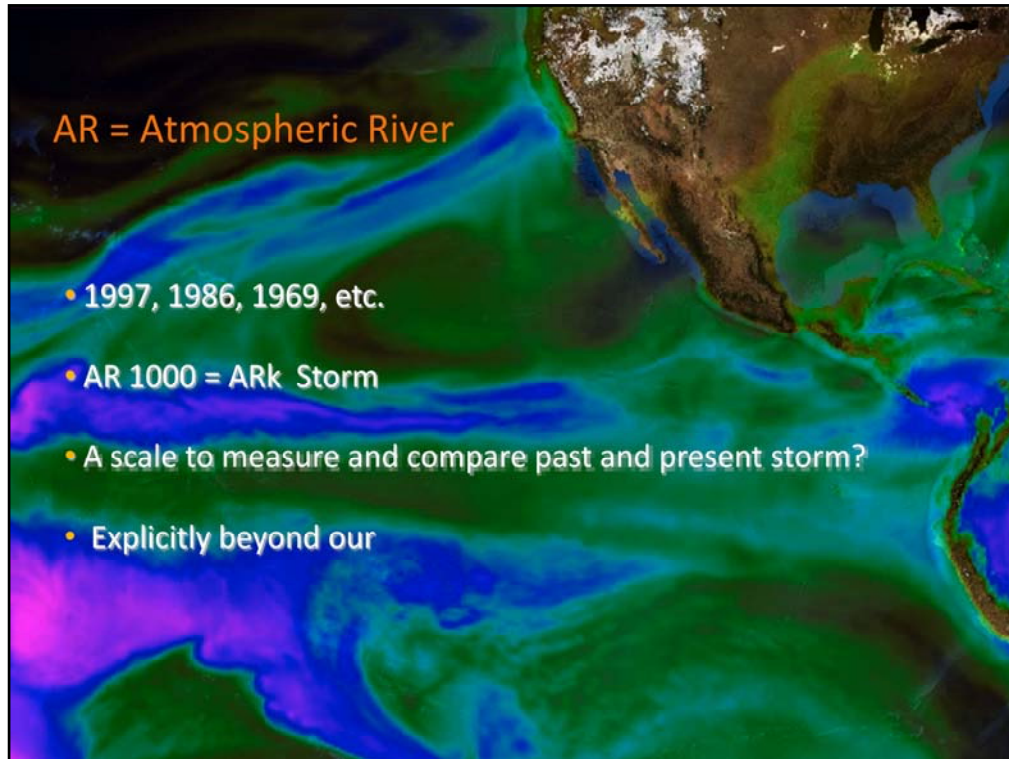
Nearly 300,000 people cross the fault on their way to work.



There was discussion as to whether devise a scenario that expanded beyond the scope of southern California. We decided to take it to the community.

Our first meet 3 weeks prior to the Great Southern California ShakeOut

Once again, pulled together meteorologist, geologists, hydrologists, emergency responders, emergency managers, resources managers, lifeline continuity operators, land use planners, and decision makers.



ARkStorm gets its name from ARs - and homage to Noah's Ark - which is understandable to many when it comes to big floods. There is no scale for major storms on the West Coast - we tend to say, "1969, 1986, 1997, 2005" and expect people to know what we mean. Hydrologist and meteorologists. So the AR in ARkStorm was my creation to somehow scale the ARkStorm to measure past and present storms.

To improve our understanding of the past storms we are pulling together a team led by Justin Ferris to examine the paleoflood record. Researchers like Arndt Schimmelmann of Indiana University and Frances Malamud-Roam have examined data collected in the Santa Barbara and San Francisco Bay area that suggest Megastorms that have occurred on average in 300 year intervals during the following years: 212, 440, 603, 1029, 1418, and 1605. 1861-62 did not even register in the data.

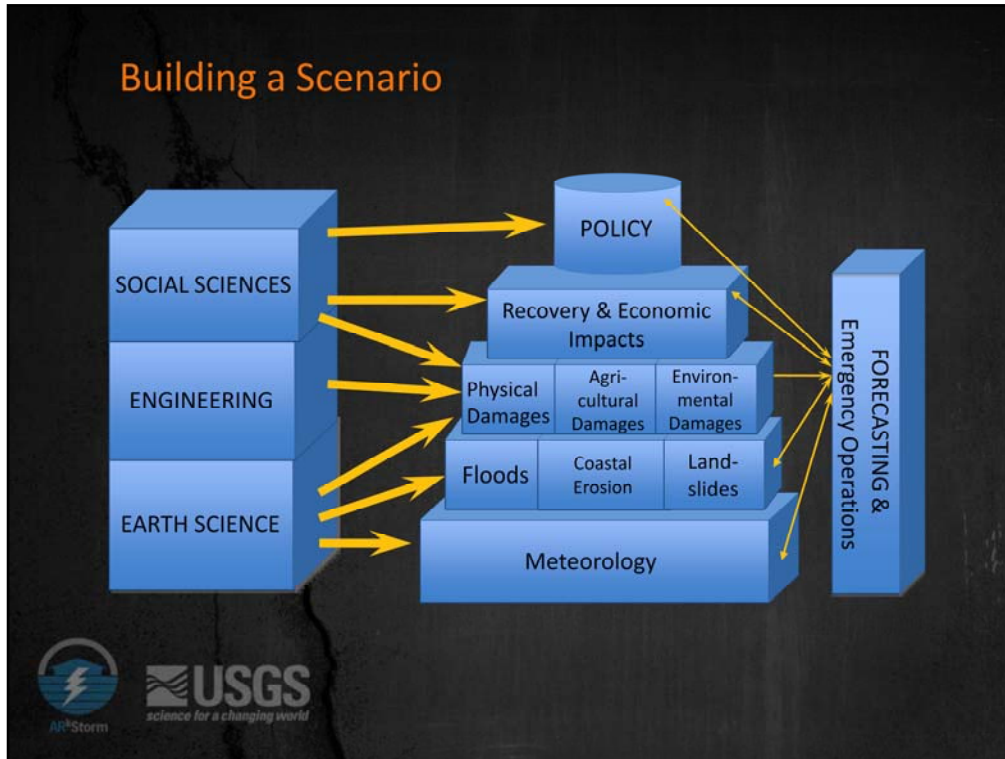
# Great Storms in California

- 1861-1862: Largest storm in historic record
- Geologic record in Santa Barbara Channel shows 6 events 212-1605 AD with massive sediment deposits
- 1861-2 produced no significant deposits in the Santa Barbara Channel
- Storms bigger than 1861-2 have occurred repeatedly.



K Street Sacramento, looking east





To apply MHDP goals to increase community resiliency - by providing one realistic outcome.

Define the environmental excitations, winds, rains,

Anne Wein: What are we going to do about the evacuations?

## ARkStorm Coordinators

- Atmospherics: Mike Dettinger, USGS Scripps
- Atmospherics: Marty Ralph, NOAA Research/ESRL/PSD
- Historical Flood: Cary Mock, University of South Carolina
- Historical Flood: Marcia Eymann, Center for Sacramento History
- Paleoflood: Justin Ferris, USGS California Water Science Center
- Paleoflood: Robert Jarrett, USGS National Research Program
- Floods: Bill Croyle, DWR Flood Operations Center
- Floods: Justin Ferris, USGS California Water Science Center
- Floods: Kathleen Schaefer, FEMA
- Floods: Keith Porter, University of Colorado



## ARkStorm Coordinators

- Landslides: Chris Wills, California Geological Survey
- Landslides: Jon Stock, USGS Earth Surfaces Processes Team
- Coastal: Patrick Barnard, USGS Coastal Marine Geology
- Coastal: Dan Hoover, USGS Coastal Marine Geology
- Physical Damages: Keith Porter, University of Colorado
- Environmental: Geoff Plumlee, USGS Minerals Program
- Environmental: Charles Alpers, USGS California Water Science Center
- Forecast: David Reynolds, NOAA NWS, San Francisco
- Emergency Response: Mitch Miller, CalEMA
- Emergency Response: Sue Perry, USGS MHDP



## ARkStorm Coordinators

- Policy: Ken Topping, California State Polytechnic, San Luis Obispo
- Policy: Laurie Johnson, Laurie Johnson Consulting
- Economics: Anne Wein, USGS Western Geographic Team
- Economics: Adam Rose, University of Southern California
- Visualization: James Done, National Center for Atmospheric Research
- GIS: David Strong, USGS, Eastern Geographic Science Center



## What's Next

- July 15 Content: Content Roundup
- October 1, 2010: ARkStorm Published
- November: ARkStorm Conference
- May 17, 2011: Golden Guardian 2011 Exercise

