DOCKETED	
Docket Number:	18-IEPR-05
Project Title:	Climate Adaptation and Resiliency
TN #:	224631
Document Title:	High Resolution Measurements of Levee Subsidence Related to Energy Infrastructure in the Sacramento-San Joaquin Delta
Description:	Presentation by Benjamin Brooks, United States Geological Survey
Filer:	Raquel Kravitz
Organization:	United States Geological Survey
Submitter Role:	Public Agency
Submission Date:	8/29/2018 1:30:56 PM
Docketed Date:	8/29/2018

High Resolution Measurement of Levee Subsidence Related to Energy Infrastructure In the Sacramento-San Joaquin Delta

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USGS

NCALM
The National Center for Airborne Laser Mapping
University of Houston • University of California, Berkeley

SUMMARY

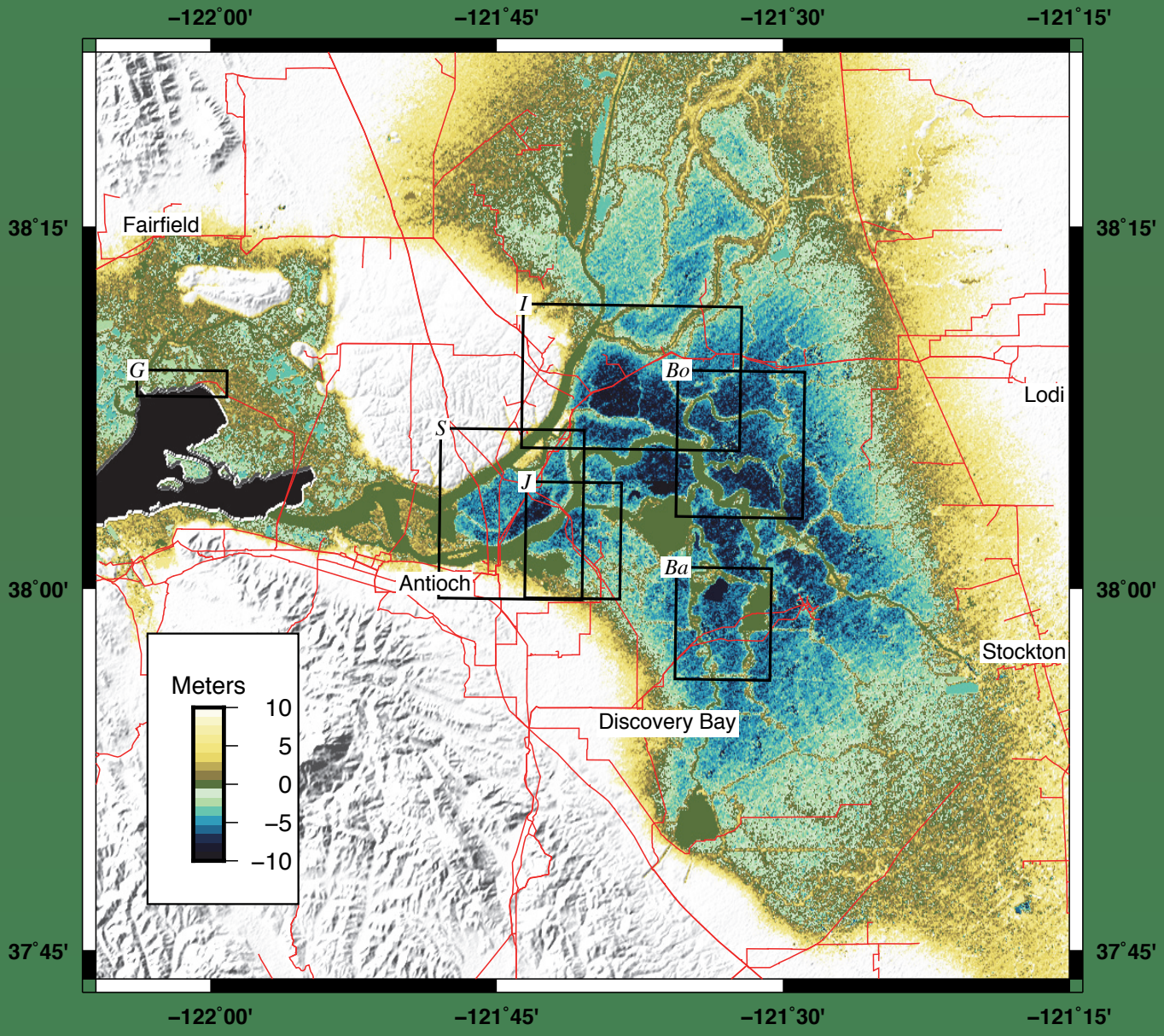
- New measurements find mean subsidence rates for some of the levees in the Sacramento-San Joaquin Delta of ~ 1-2 cm/year (0.4 - 0.8 inches/year)

- This subsidence compounds the risk that SLR and storms could cause overtopping or failure of the levees, exposing natural gas pipelines and other infrastructure to damage or structural failure.

- At this rate of subsidence, the levees may fail to meet the federal levee height standard (1.5 ft. freeboard above 100-year flood level) between 2050-2080, depending on the rate of sea-level rise.

USGS

Sacramento-San Joaquin Delta



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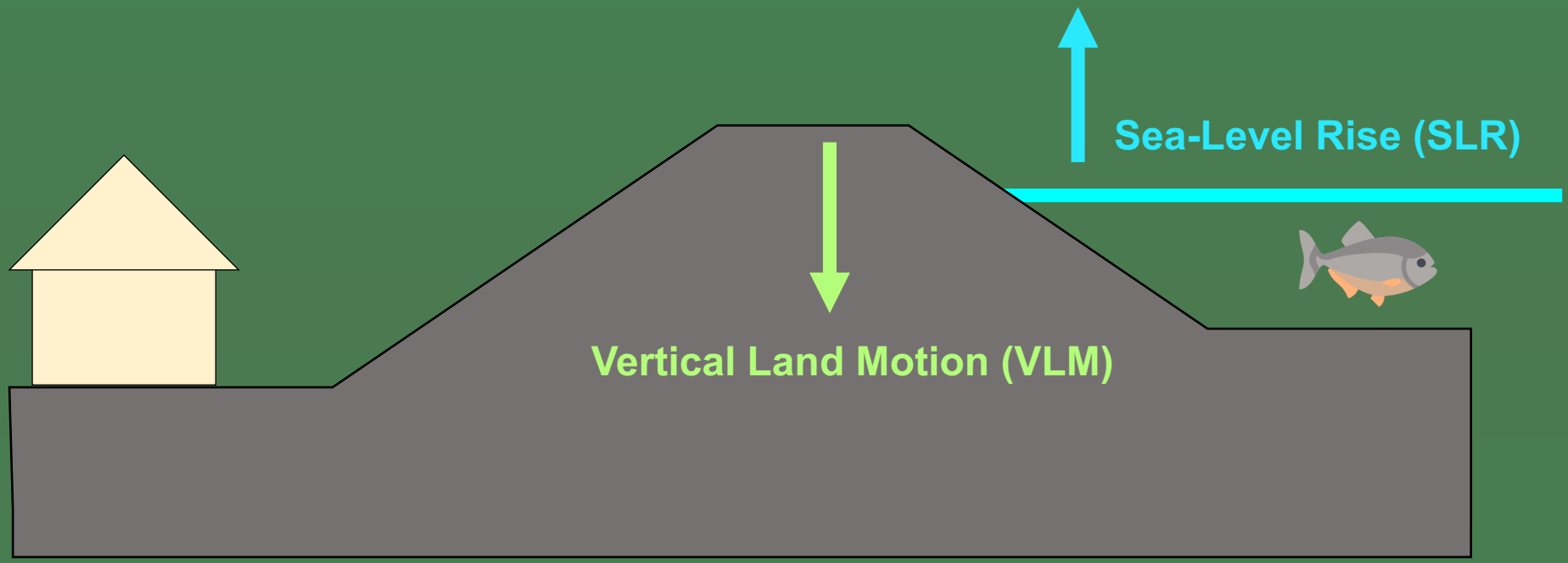
Sea Level Rise & Vertical Land Motion



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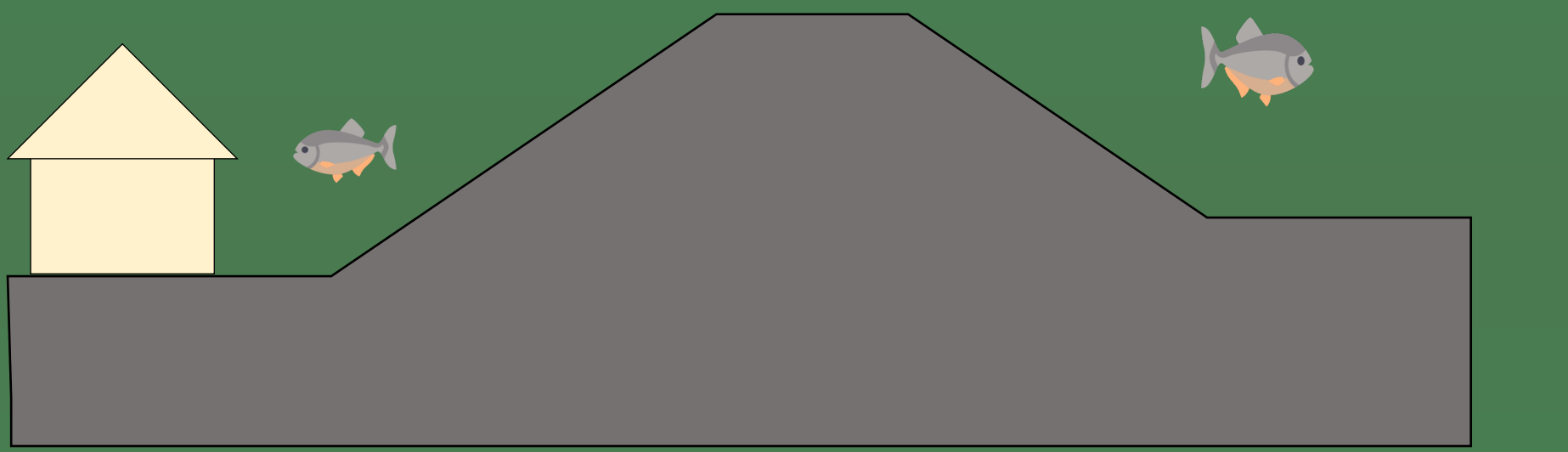
Levee Overtopping



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COMBINED ANALYSIS: TIME-TO-OVERTOPPING

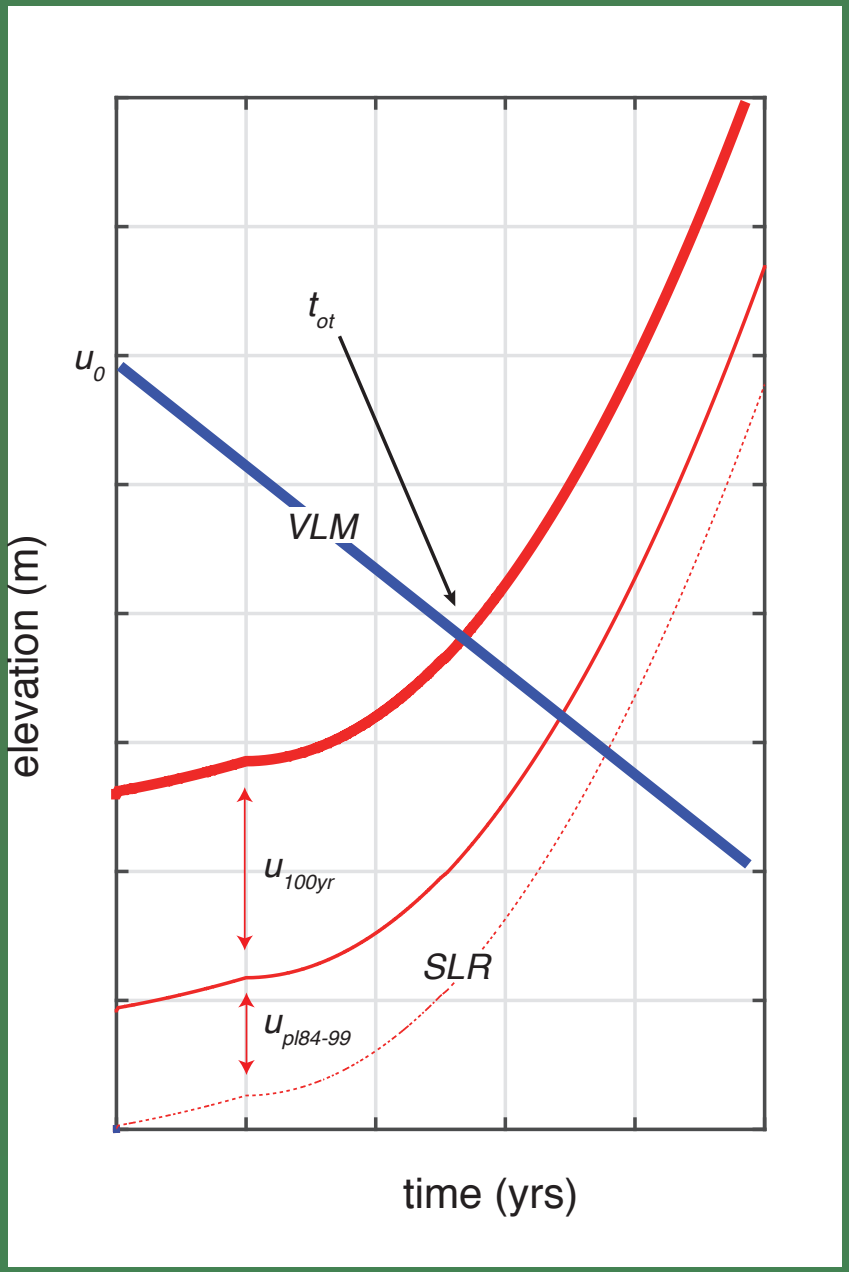
SLR: Sea-Level Rise

$U_{pl84\text{-}99}$: 1.5' above 100 year flood

U_{100yr}: height of 100 year flood

VLM: Vertical Land Motion

t_{ot}: time-to-overtopping



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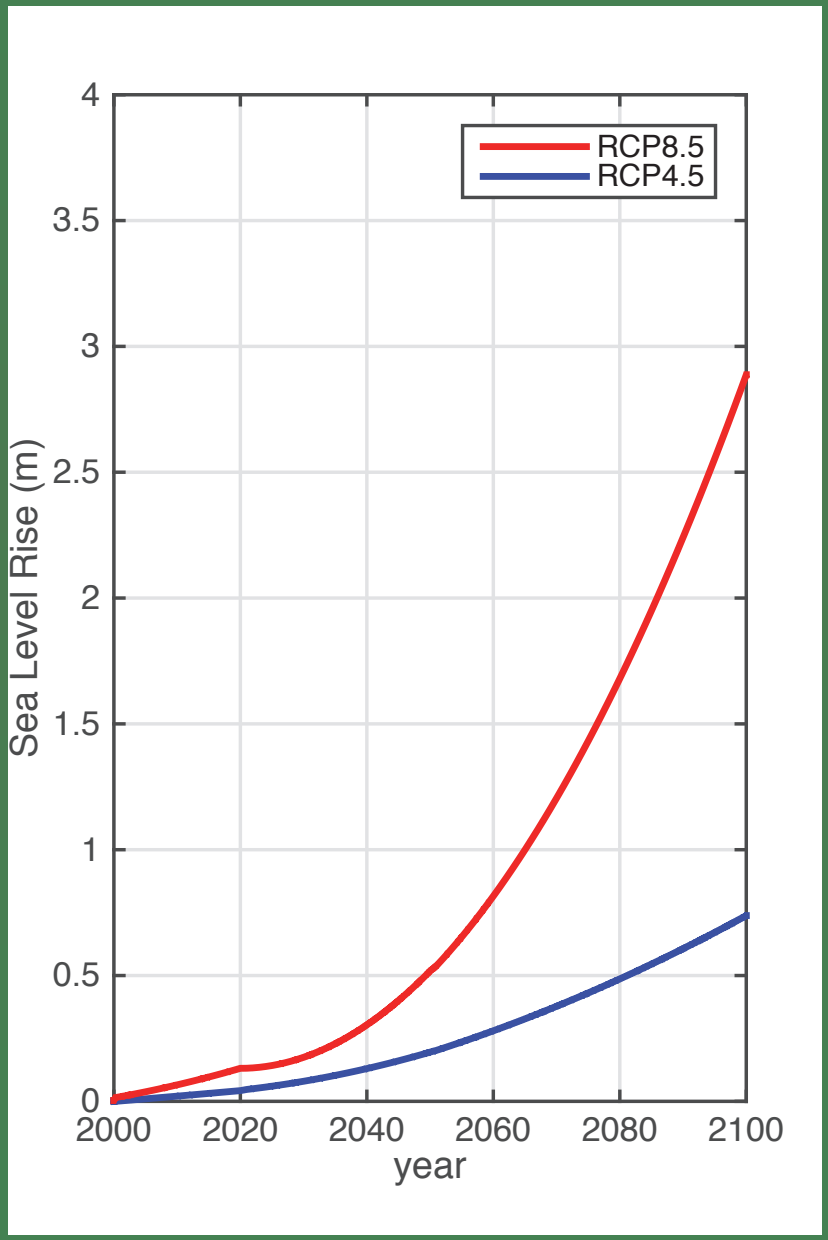
Sea Level Rise Projections

Cayan et al, 2016

Follows Kopp et al, 2014
sampling of time-dependent prob. distribution of independent components,
modified by addition of
West Antarctic Ice Sheet

RCP, representative concentration pathway



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Mobile Laser Scanning (MLS)

& Airborne Laser Scanning (ALS) !

Static GNSS Control

Kinematic GNSS Trajectory

GNSS/INS Integration

Laser Calibration

Boresight/Lever-Arm Calibration

Pointcloud Geo-Referencing

- *Billions*
- *< 2cm accuracy*

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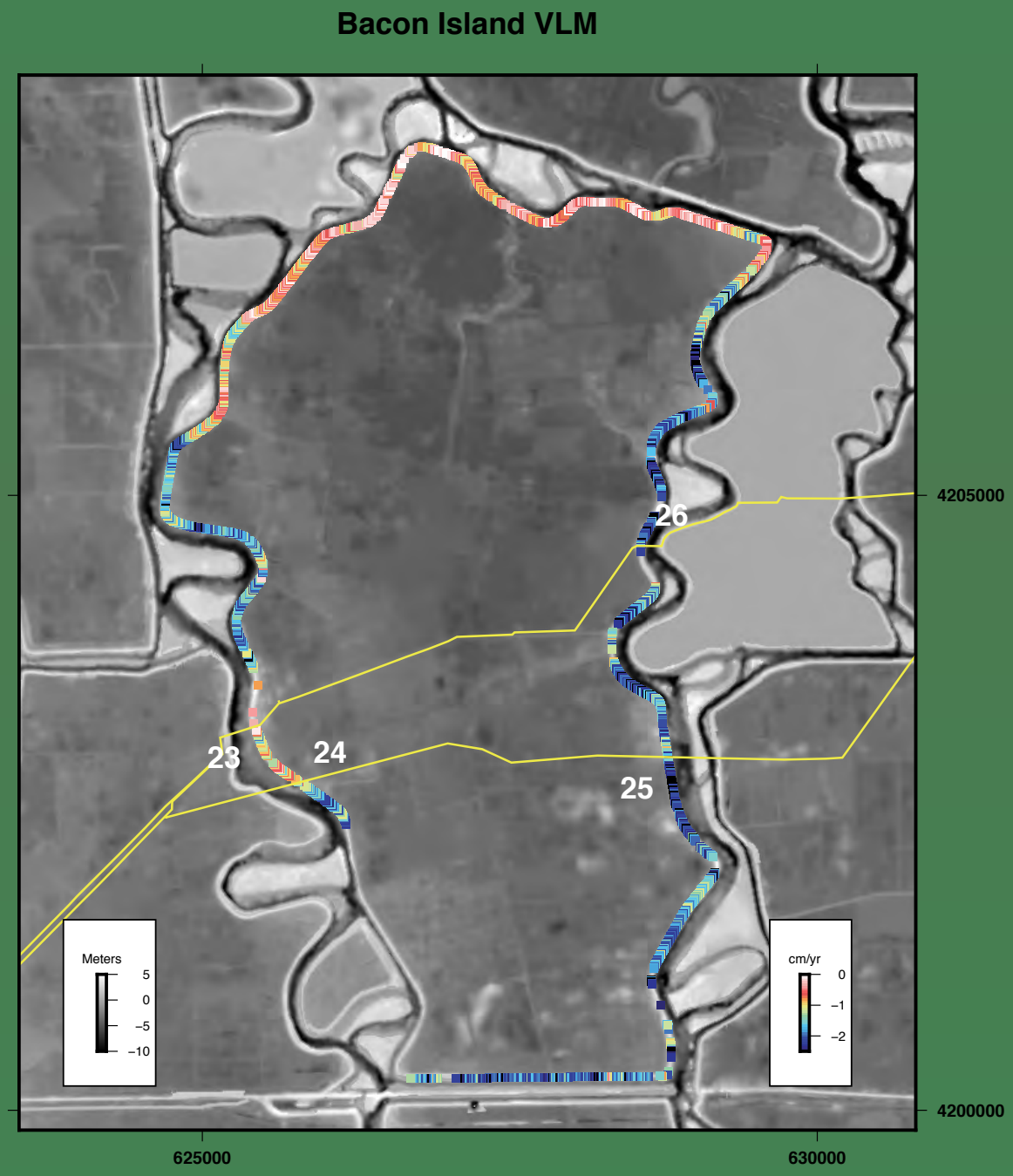
VLM

(REFERENCED TO 2007 DELTA-WIDE ALS DATA SET)



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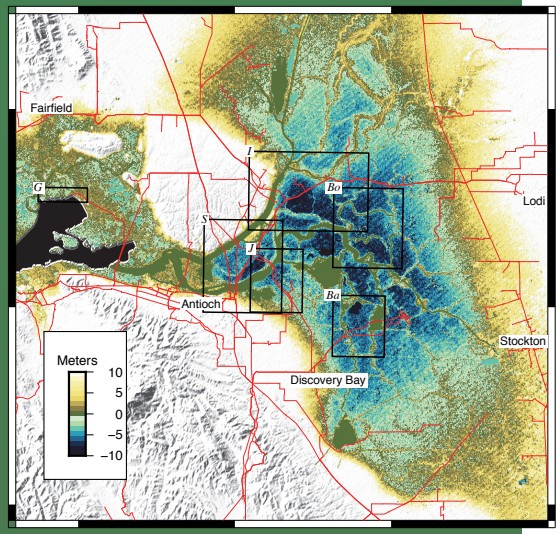
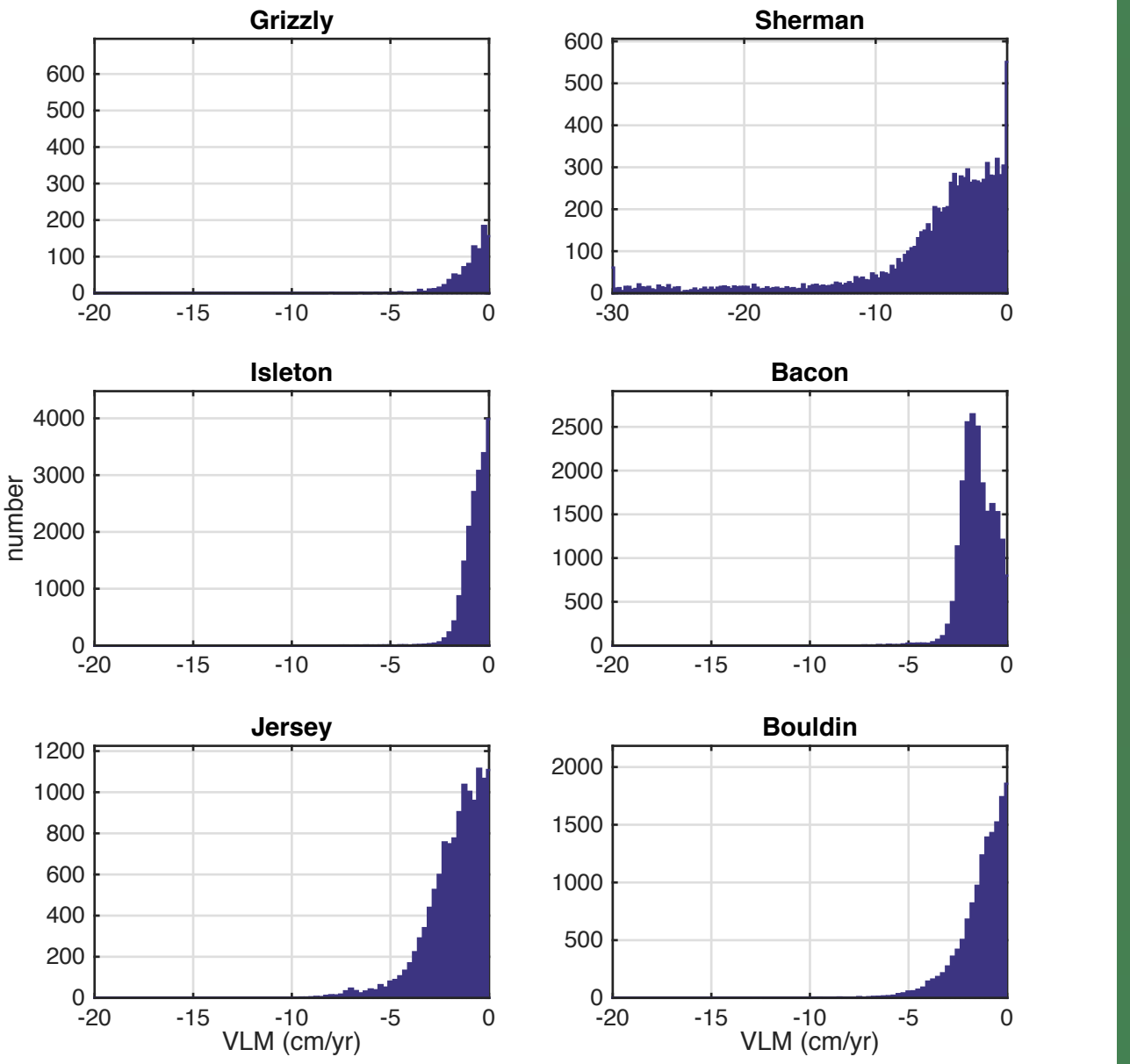
VLM

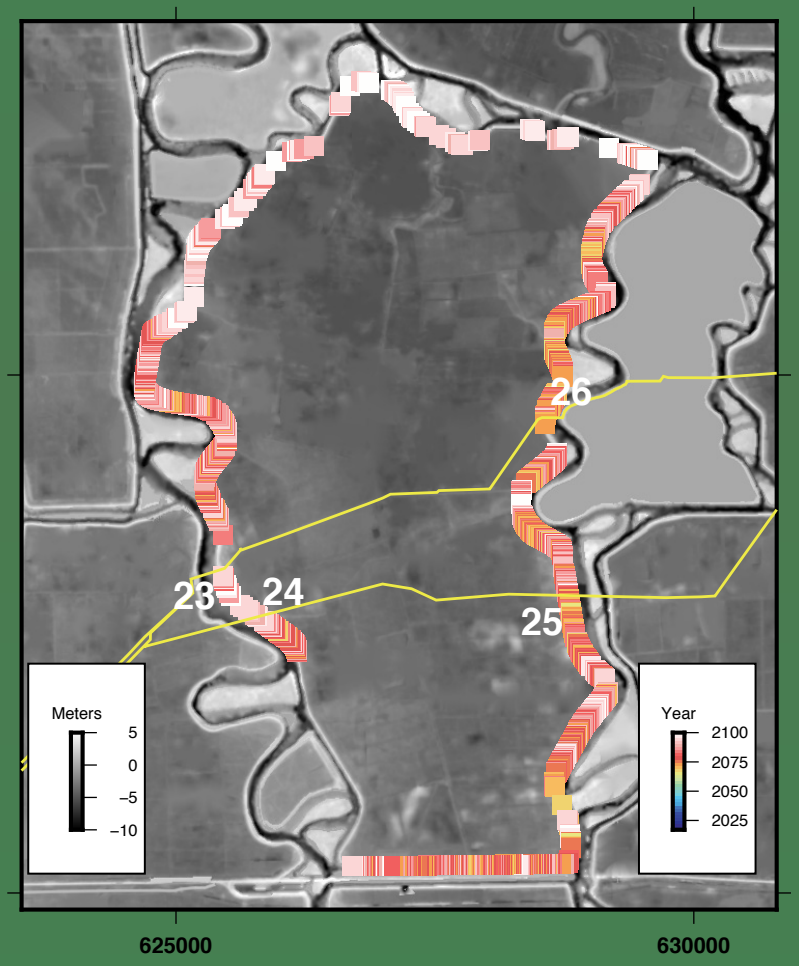

Fairfield
Lodi
Antioch
Stockton
Discovery Bay
Meters
10
5
0
−5
−10


Grizzly
Sherman
Isleton
Bacon
Jersey
Bouldin
number
VLM (cm/yr)
VLM (cm/yr)

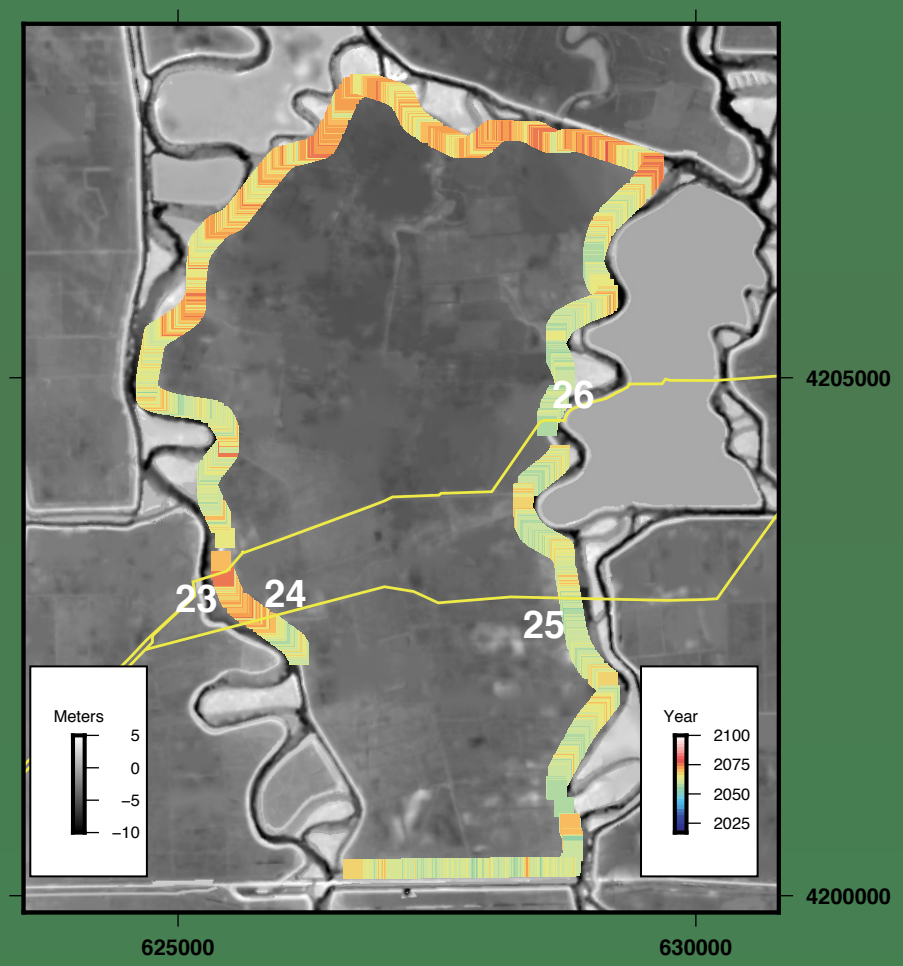
USGS

Time to Overtopping

RCP4.5 50%tile



Bacon Island RCP8.5 99%tile



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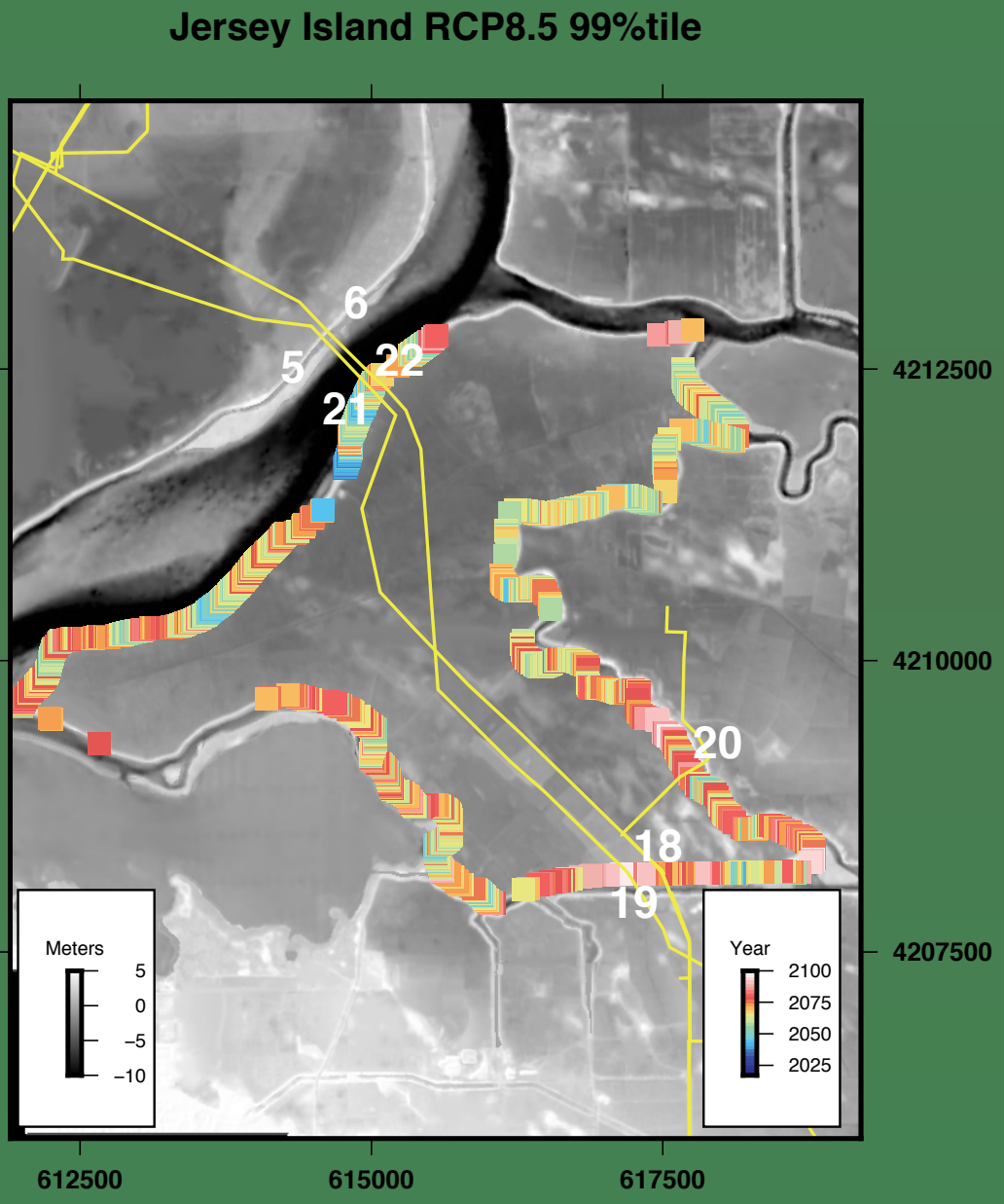
Time to Overtopping



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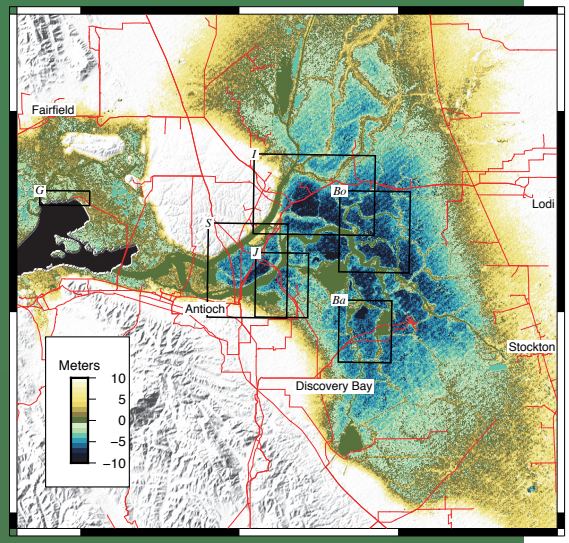
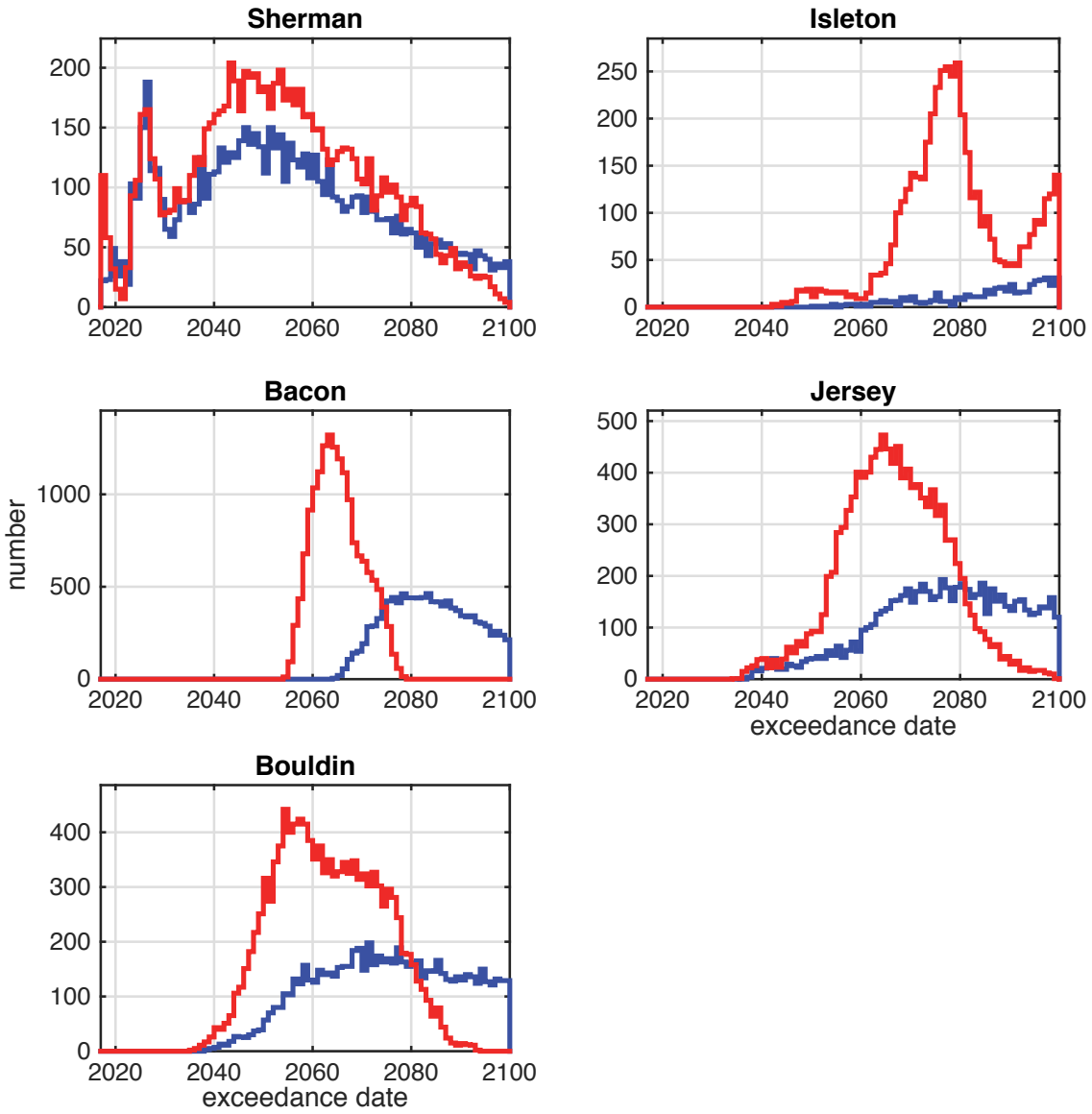
Time to Overtopping





USGS

CONCLUSIONS

- New measurements find mean subsidence rates for some of the levees in the Sacramento-San Joaquin Delta of ~ 1-2 cm/year (0.4 - 0.8 inches/year)

- This subsidence compounds the risk that SLR and storms could cause overtopping or failure of the levees, exposing natural gas pipelines and other infrastructure to damage or structural failure.

- At this rate of subsidence, the levees may fail to meet the federal levee height standard (1.5 ft. freeboard above 100-year flood level) between 2050-2080, depending on the rate of sea-level rise.

- ***Given high spatial variability, a continued program of Laser Scanning would permit updated projections and mitigation prioritization***

USGS