Climate, Change and Flood Planning

CCTAG April 2013

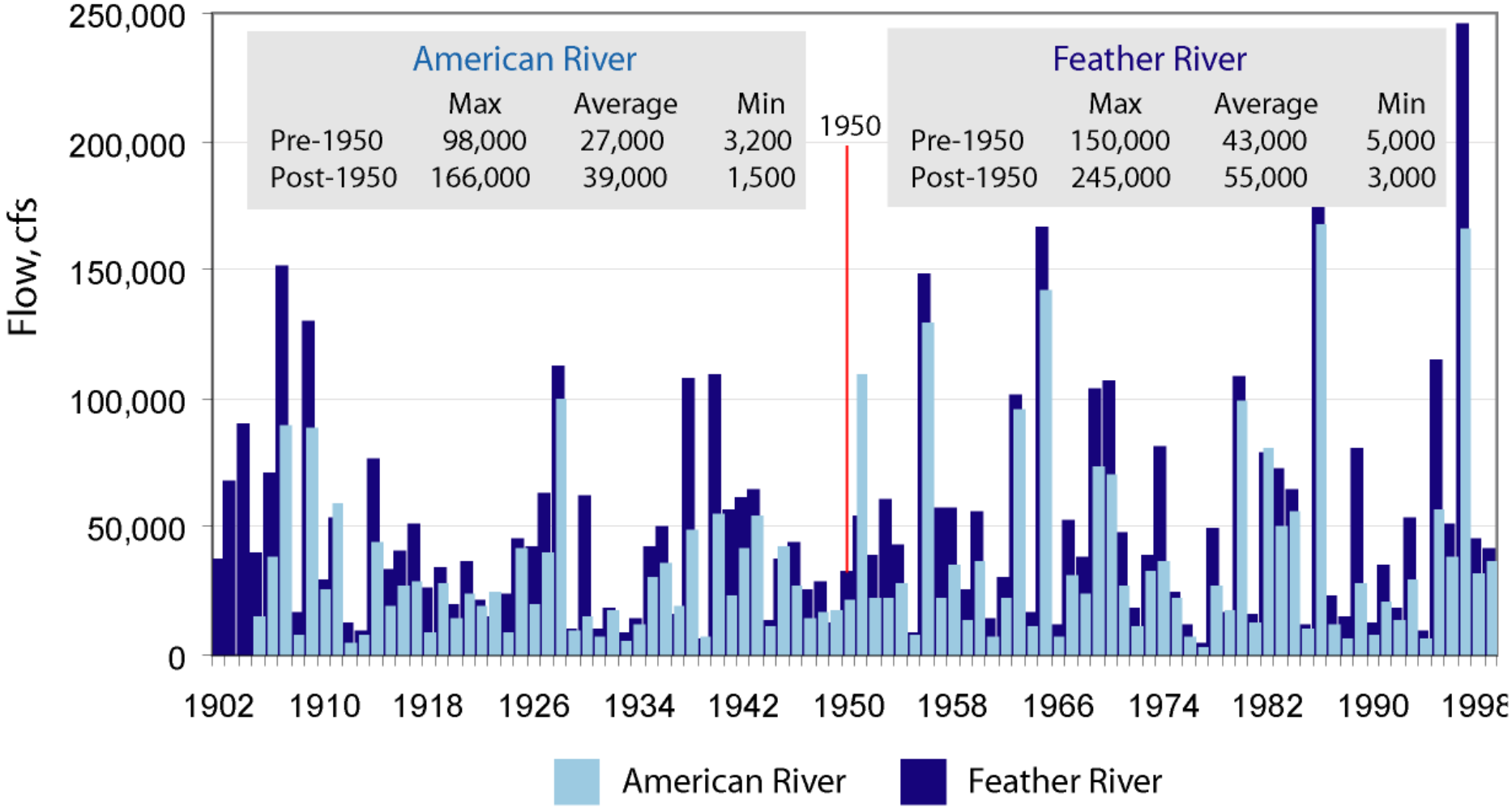
Talk Overview

- Flood Planning Overview
- Atmospheric Rivers Past, Present, and Future
- The Climate Change Design Storm Framework

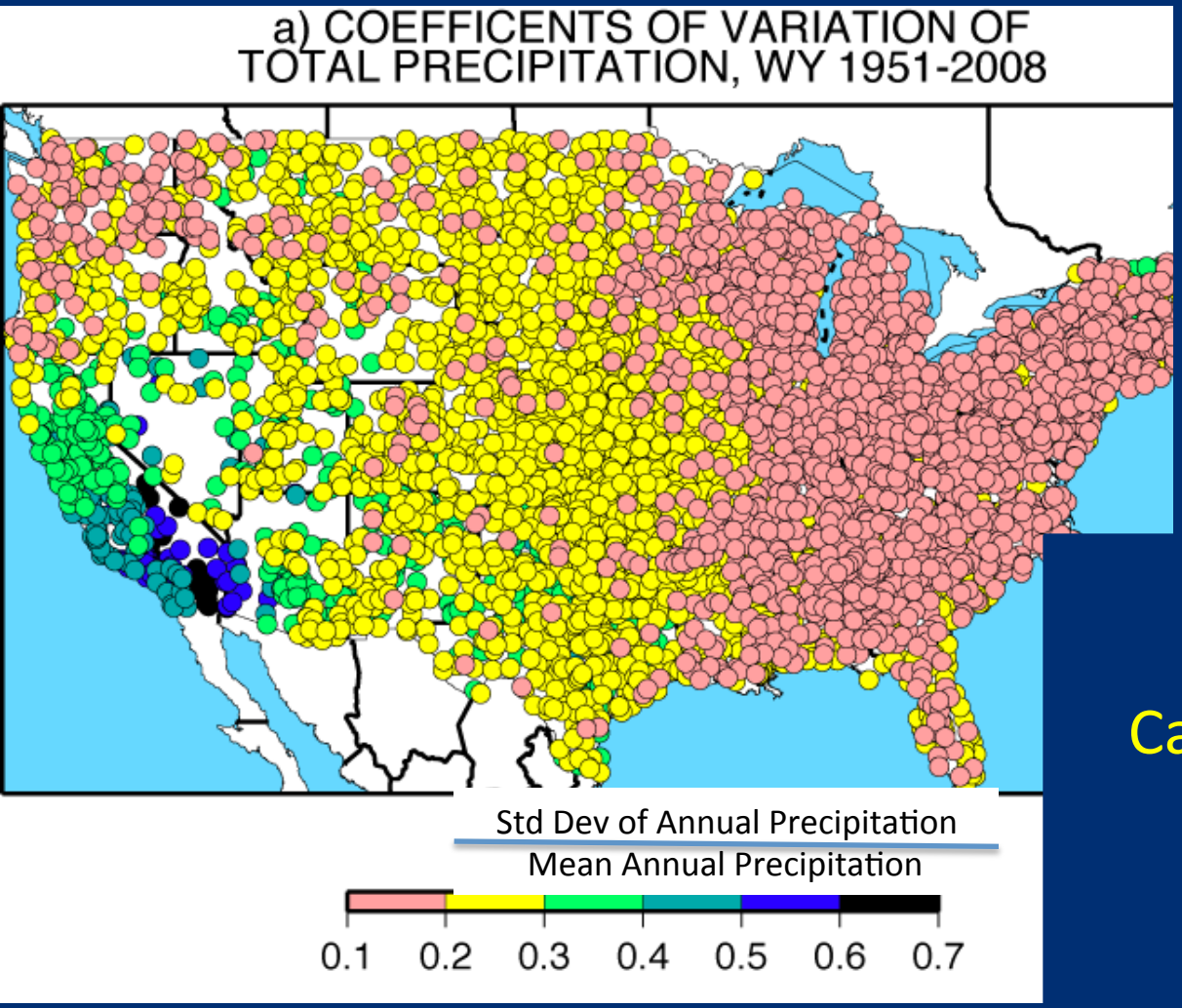
Flood Planning

- Plan to designated threshold stage or flow
- Designation linked to return period (e.g. 100-year flood)
- Bulletin 17-B Guidelines provide means to statistically estimate peak stream flow and volume associated with a given duration (e.g. 3-day volume)
- Methods only consider historical data

20th Century Annual Peak 3-Day Flows without the Influence of Reservoirs



Year to Year Precipitation Variability

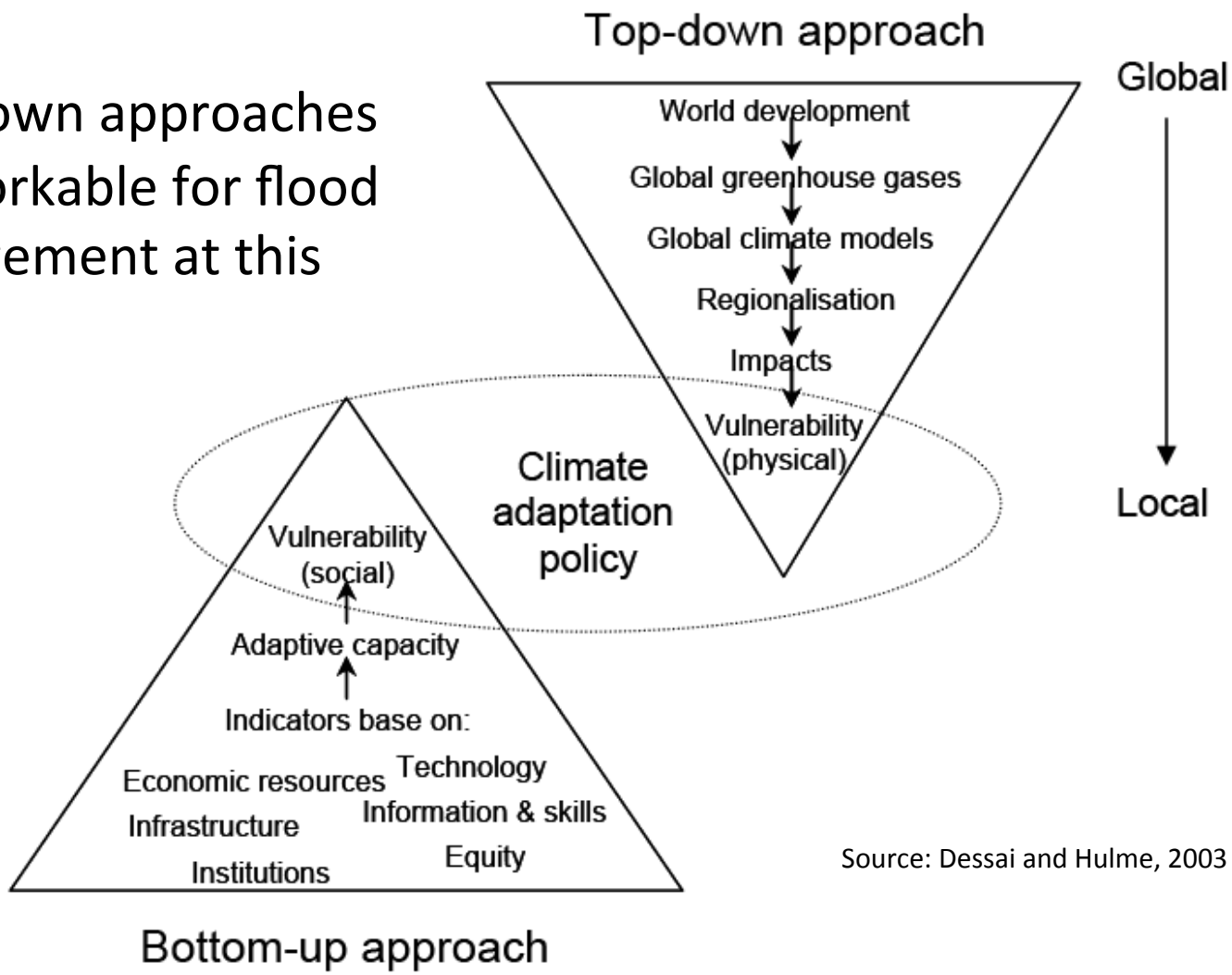


California precipitation is uniquely variable

Dettinger et al, 2011

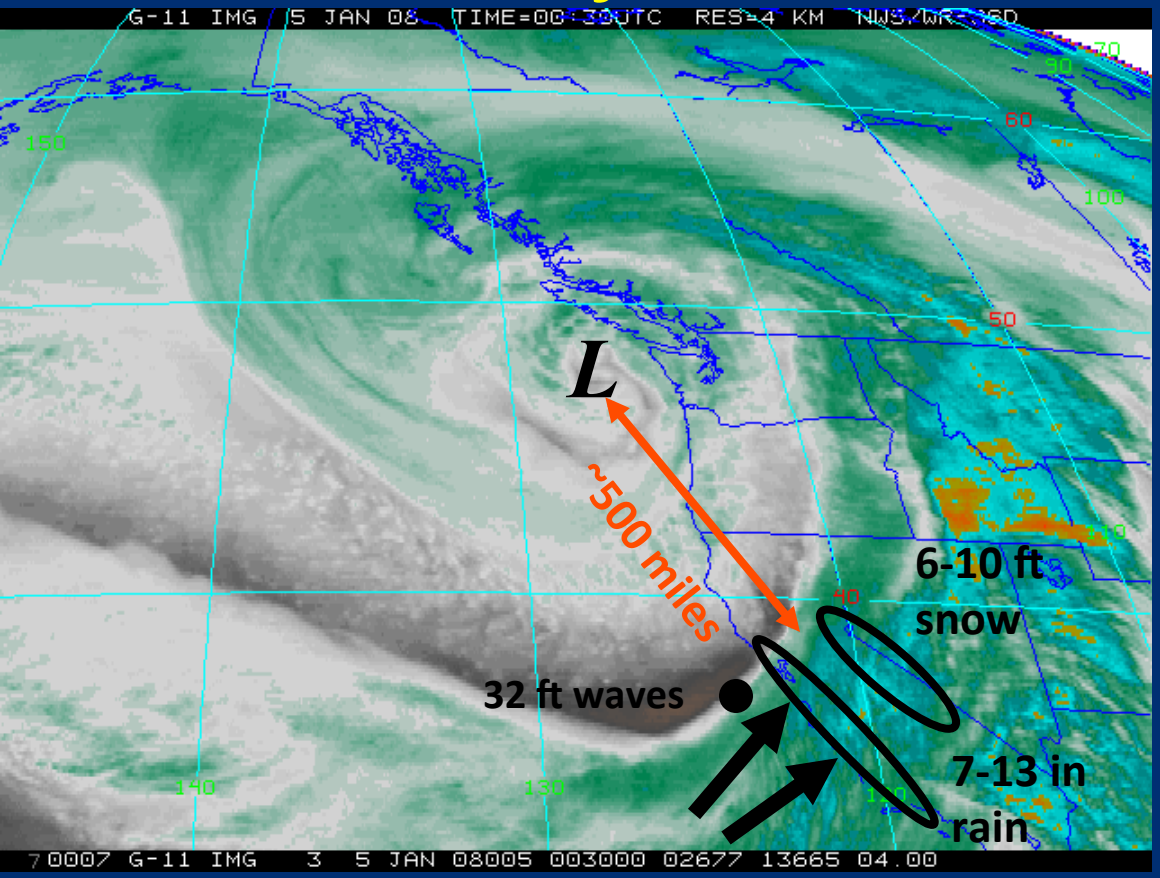
Determining Flood Adaptation Capacity

Top-down approaches not workable for flood management at this time



Source: Dessai and Hulme, 2003

The Storm of 4-5 Jan 2008



Atmospheric river

GOES IR image of major West Coast storm

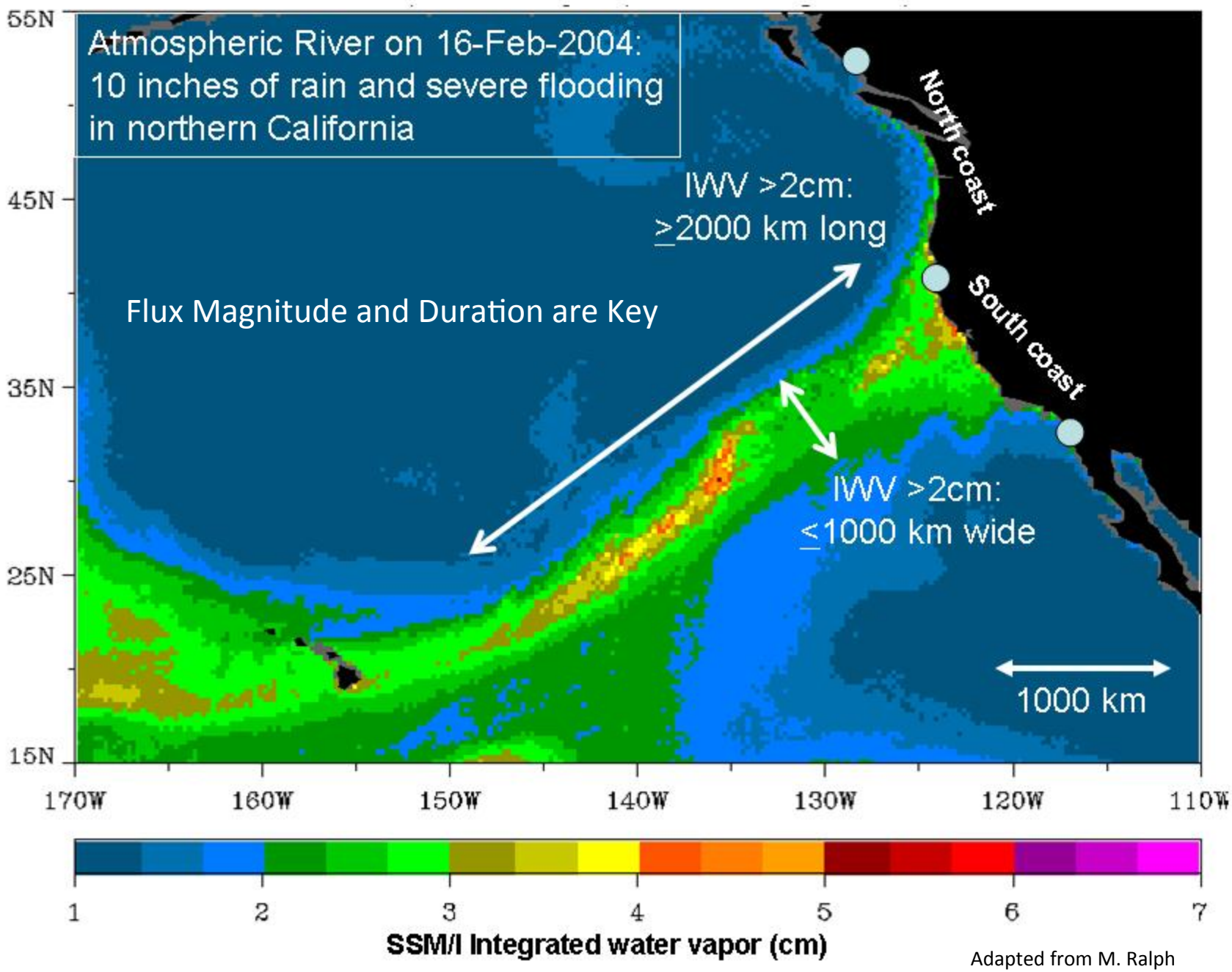
- Time = 0030 UTC 5 January 2008
- Low pressure center is off WA coast

Note that major impacts were focused >500 miles south of the Low pressure center in this storm.

This differs significantly from hurricanes, but the impacts are enormous and spread over a large area

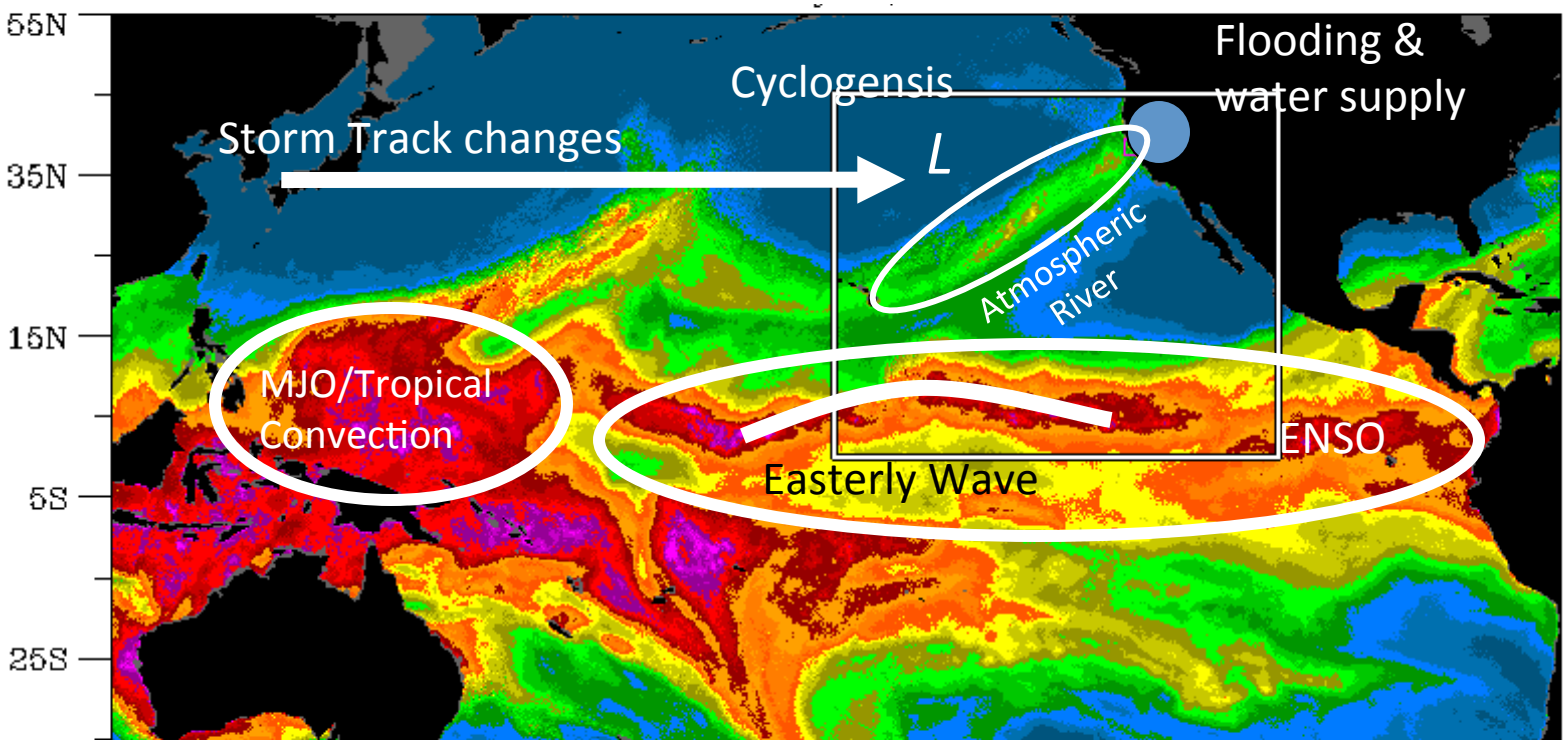
Many major impacts are associated with the landfall of the "atmospheric river" element of the storm, the precise characteristics of which are not operationally monitored offshore or onshore.

Adapted from M. Ralph



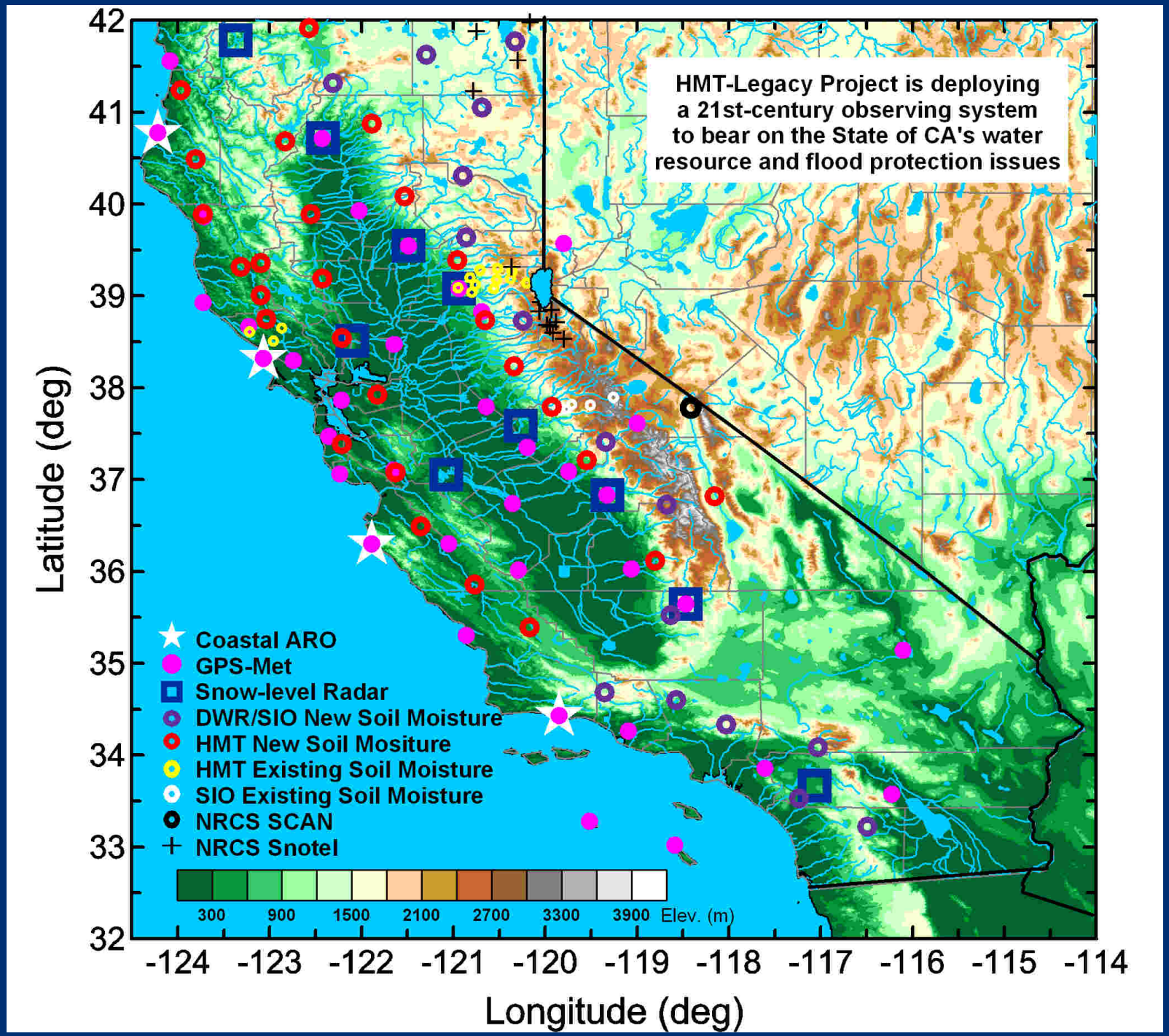
Adapted from M. Ralph

Key Phenomena Affecting California Water Supply/Flooding:

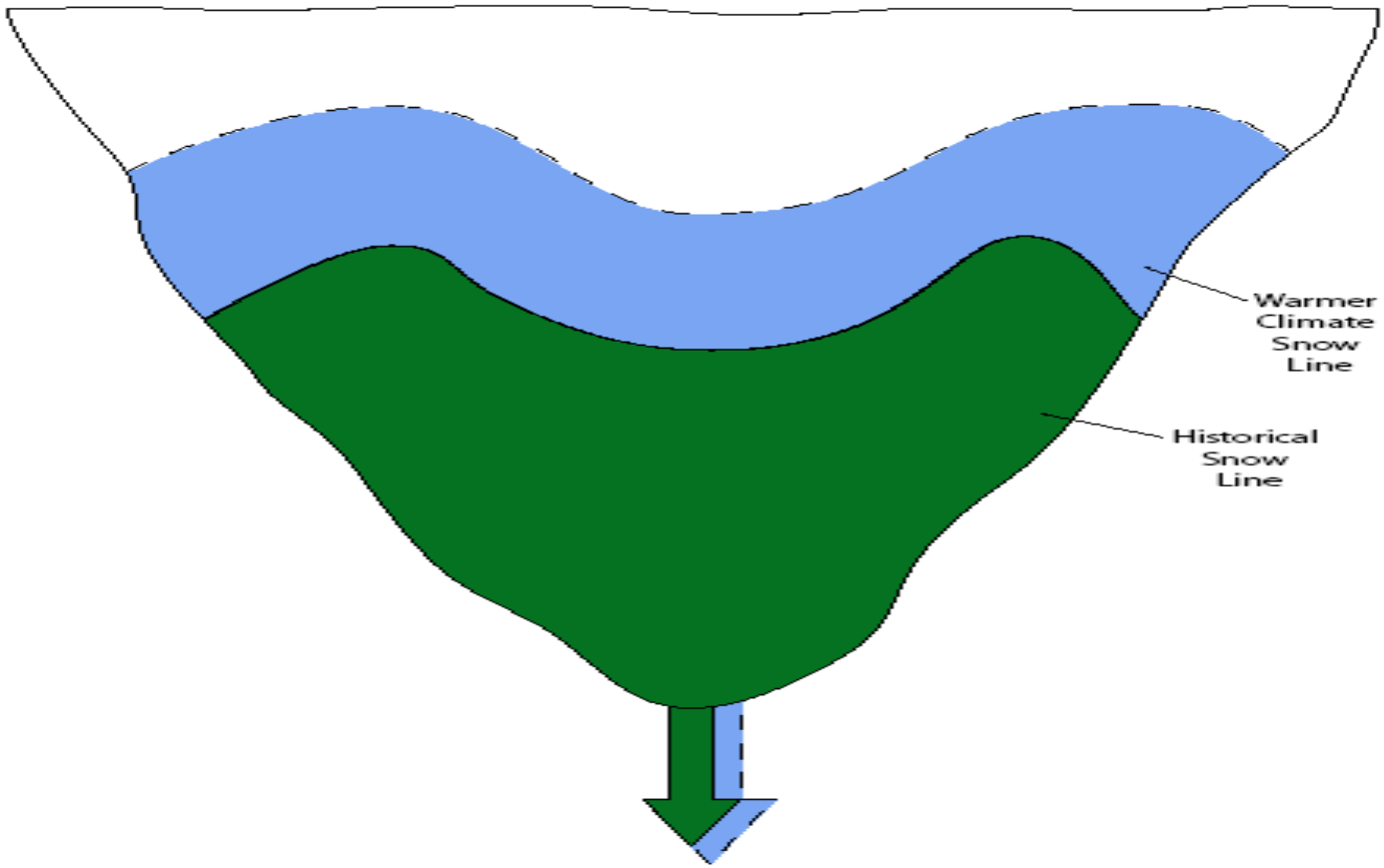


The most extreme CA storm would result from a rare alignment of key processes acting on different space and time scales

Adapted from M. Ralph


HMT-Legacy Project is deploying a 21st-century observing system to bear on the State of CA's water resource and flood protection issues
Coastal ARO
GPS-Met
Snow-level Radar
DWR/SIO New Soil Moisture
HMT New Soil Mositure
HMT Existing Soil Moisture
SIO Existing Soil Moisture
NRCS SCAN
NRCS Snotel
300
900
1500
2100
2700
3300
3900
Elev. (m)
Latitude (deg)
Longitude (deg)
42
41
40
39
38
37
36
35
34
33
32
-124
-123
-122
-121
-120
-119
-118
-117
-116
-115
-114

Climate Change and Floods



Effect of Warmer Climate on Winter Flood Producing Area

Building a Framework for Climate Change and Design Floods

- Central Valley Hydrology Study (USACE)
- Climate Variability Sensitivity Study (USACE)
- Atmospheric River Characteristics Study (Scripps)
- Watershed Controls on Extreme Precipitation Study (UC Davis)
- 21st Century Extreme Precipitation Monitoring Network (DWR/NOAA ESRL/Scripps)

Goal: Design storm that can accommodate climate change

Present and Future Conditions

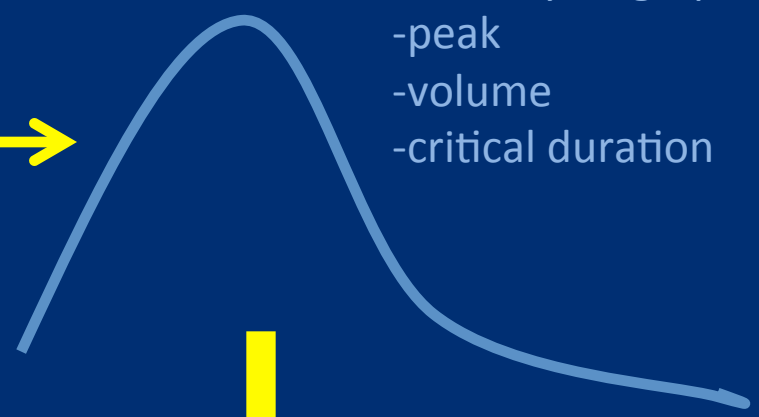
Atmospheric River Event (ARE)
- moisture flux
- duration
- freezing elevation
- direction

Sierra Barrier Jet Characteristics

Watershed Controls
-orographic enhancement distribution
-antecedent conditions
-snow line
-basin wetness

Existing USACE Methods

Design Rainfall Event
-volume and peak
-duration
-spatial distribution



Flood Hydrograph
-peak
-volume
-critical duration

Flood Management
Infrastructure Evaluation