Integrating Multiresolution LiDAR and Bathymetry Data into a Continuous Surface of the Sacramento – San Joaquin Delta

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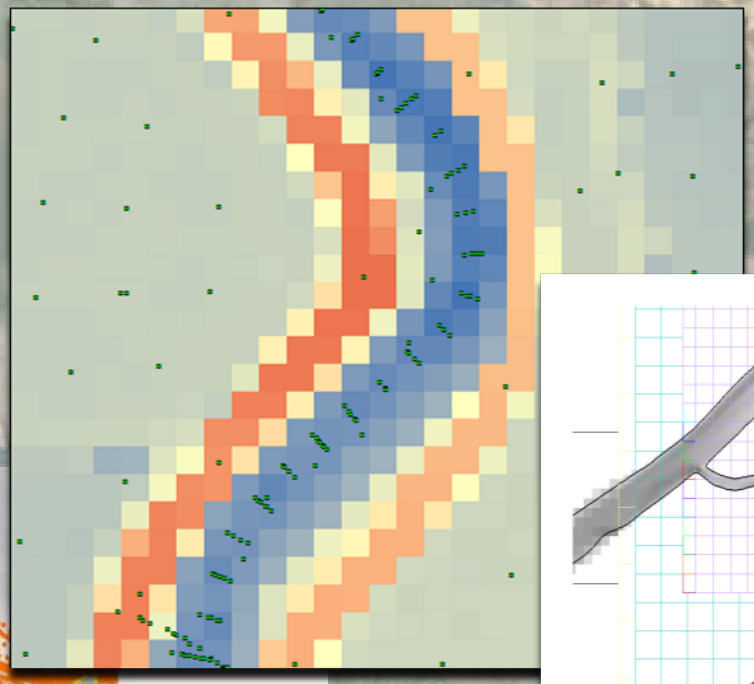
River Estuary And Land Model

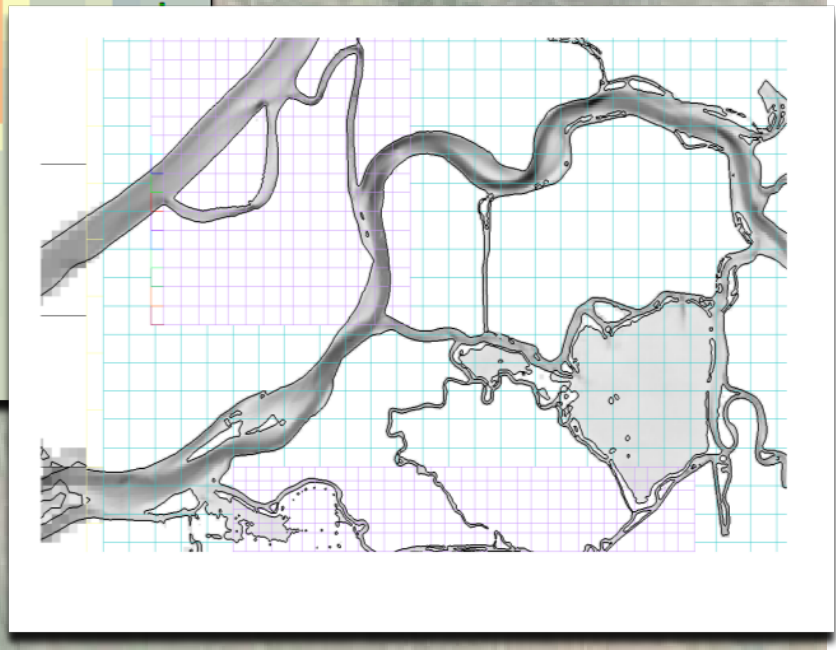
Motives

We are end-users of elevation models

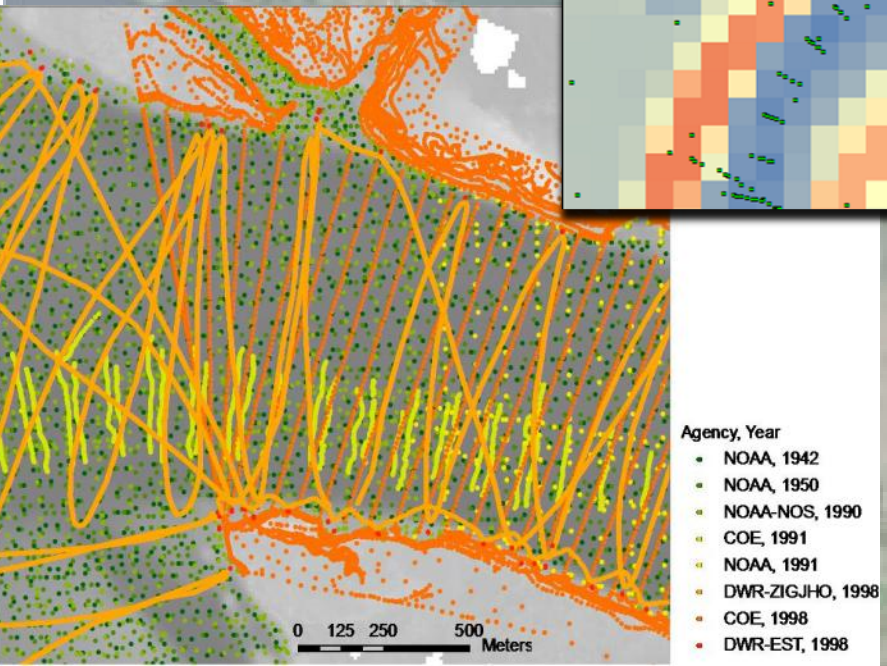
Elevation model



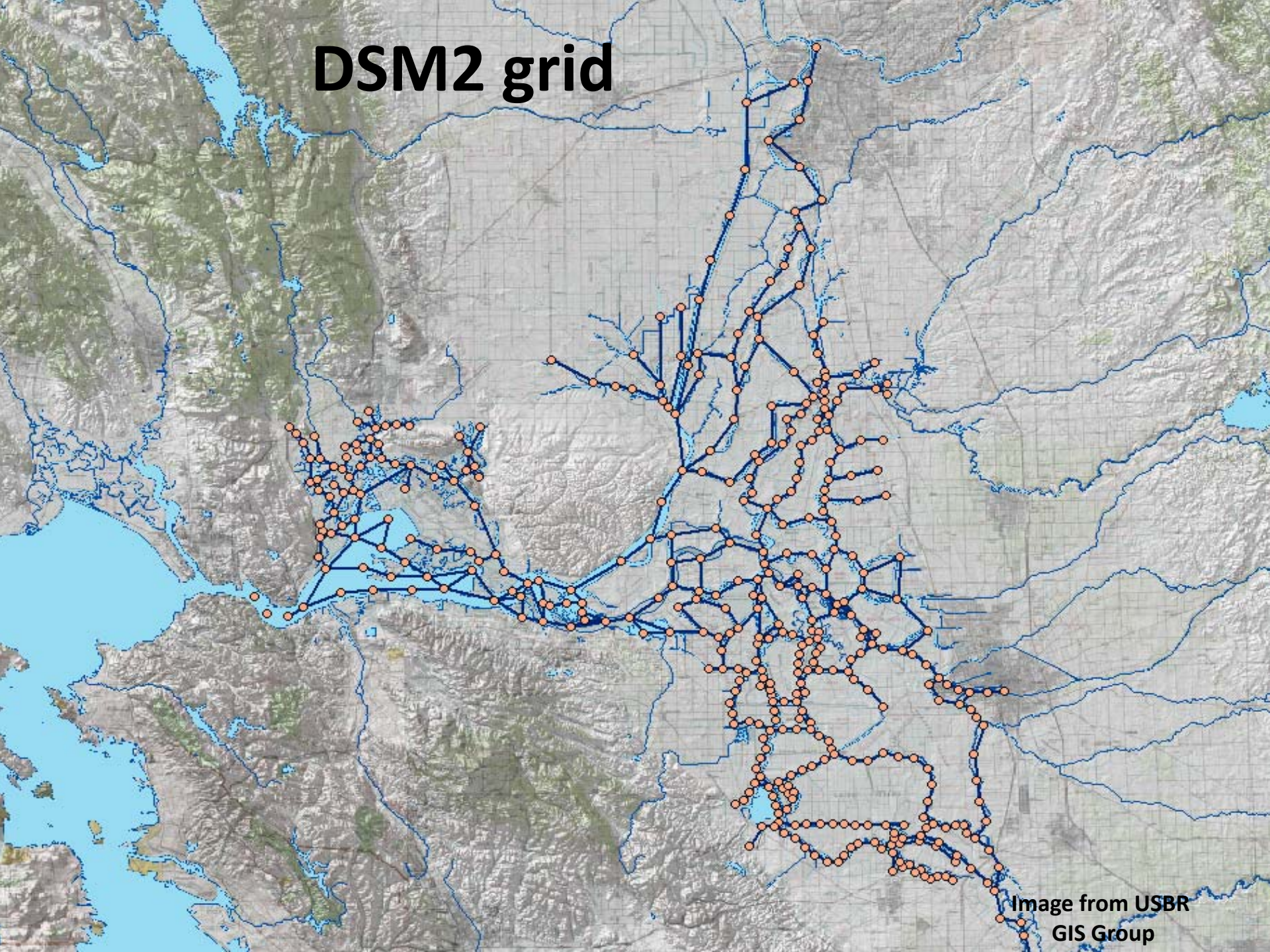
Model input



Corrected data

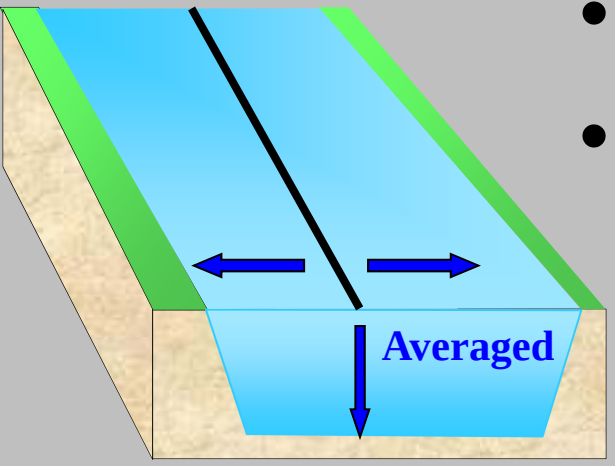


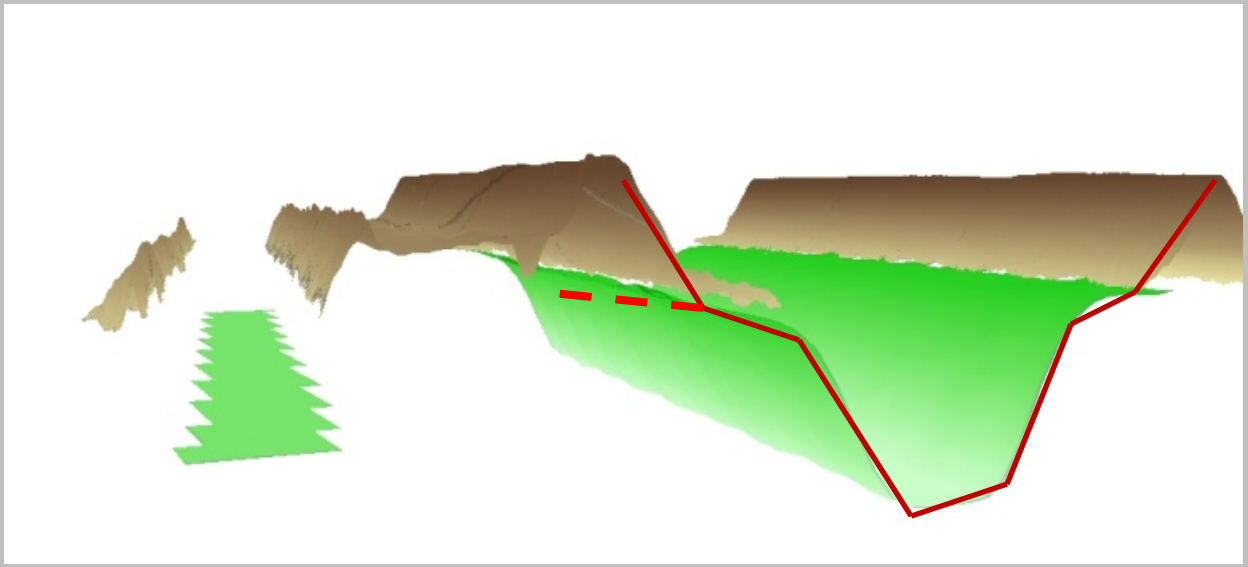
DSM2 grid



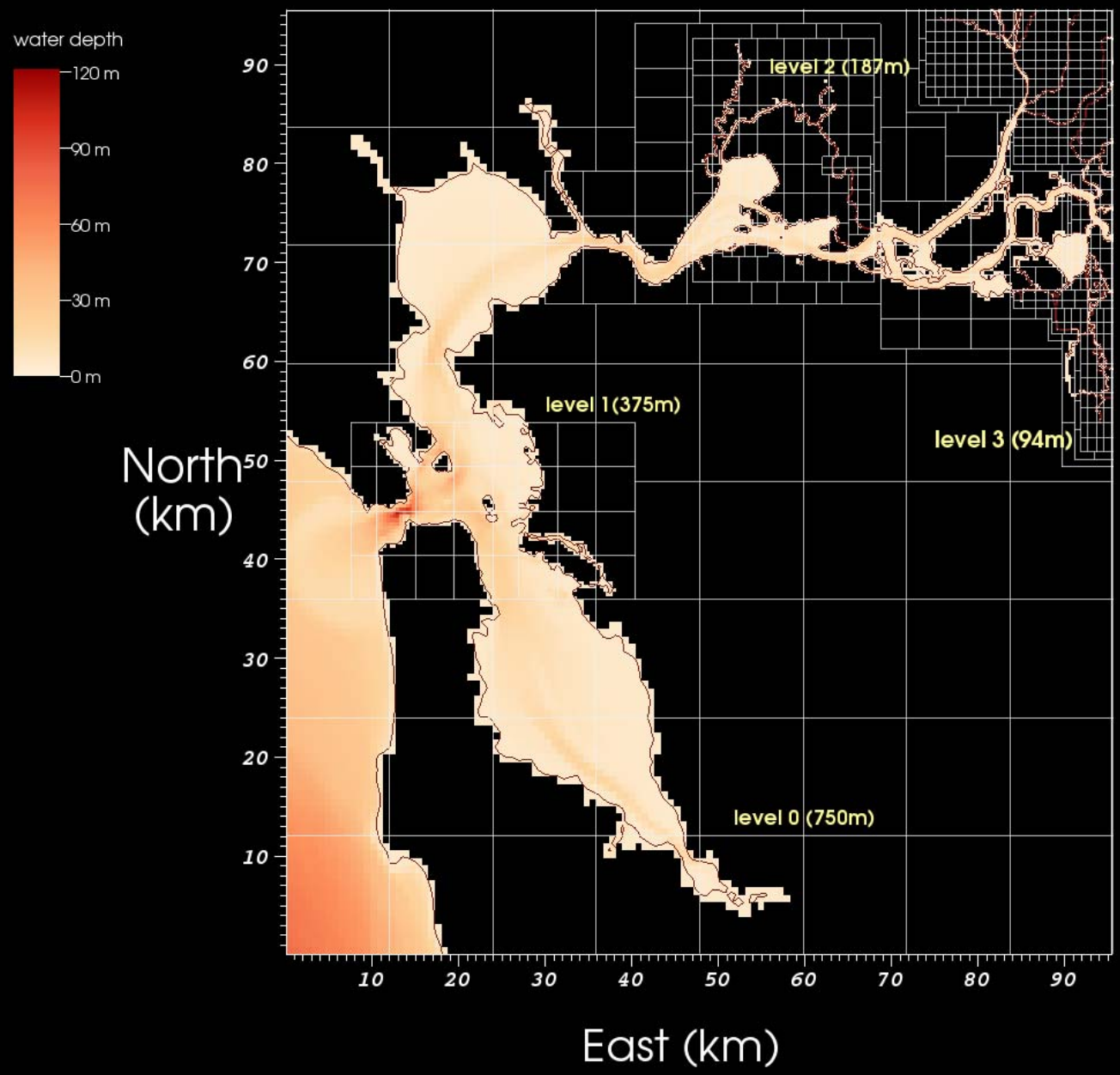
DSM2 geometry

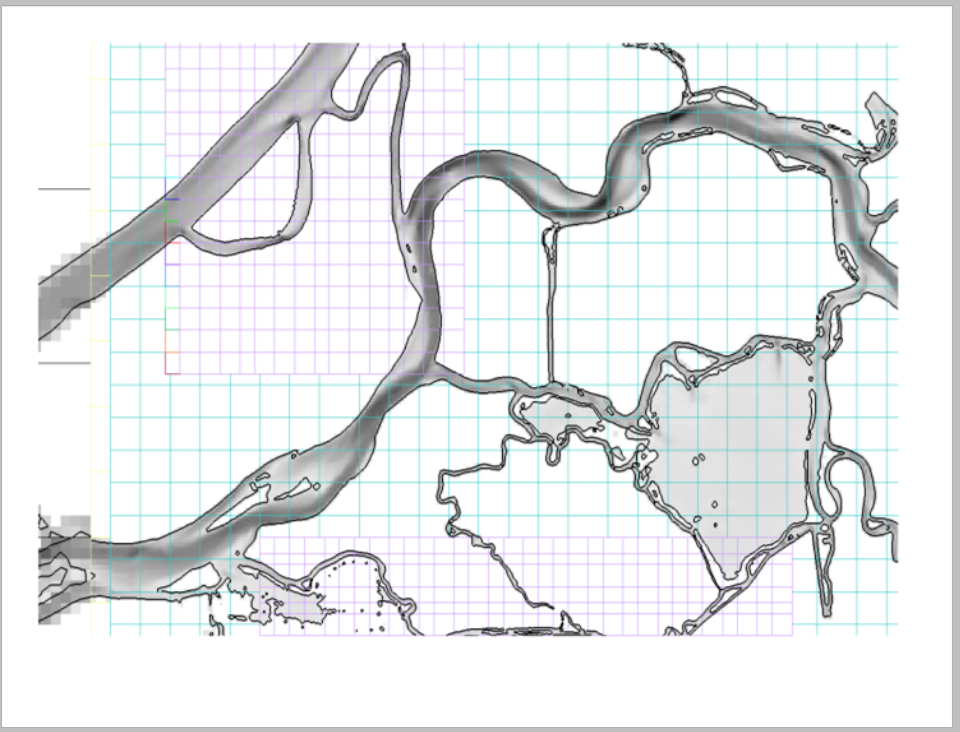
- Cross-sections
- Geometry: topo or flow model?
- Land-water interface





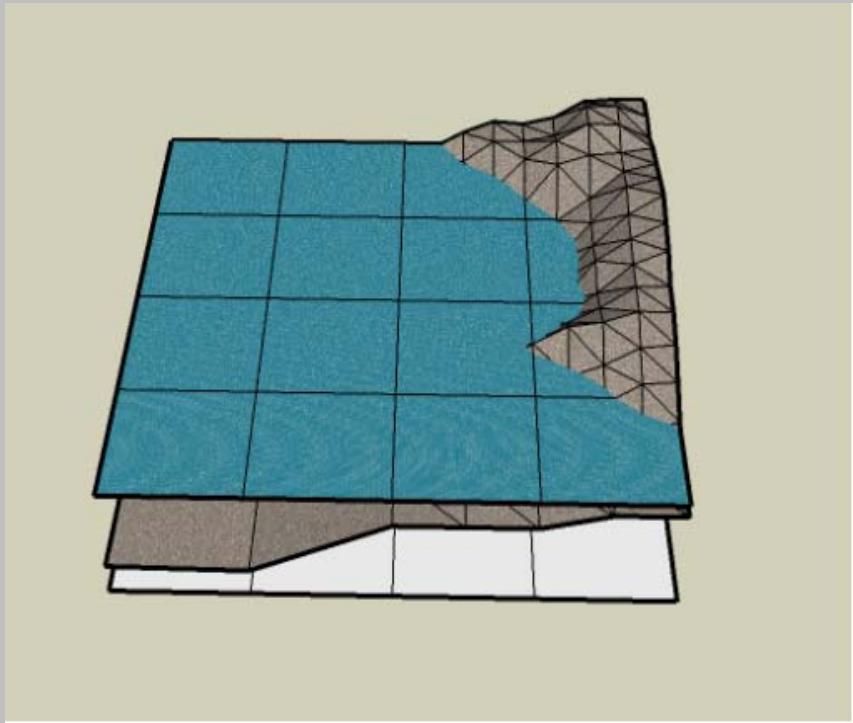
REALM


water depth
120 m
90 m
60 m
30 m
0 m
level 2 (187m)
level 1(375m)
level 3 (94m)
level 0 (750m)
North (km)
East (km)
10
20
30
40
50
60
70
80
90



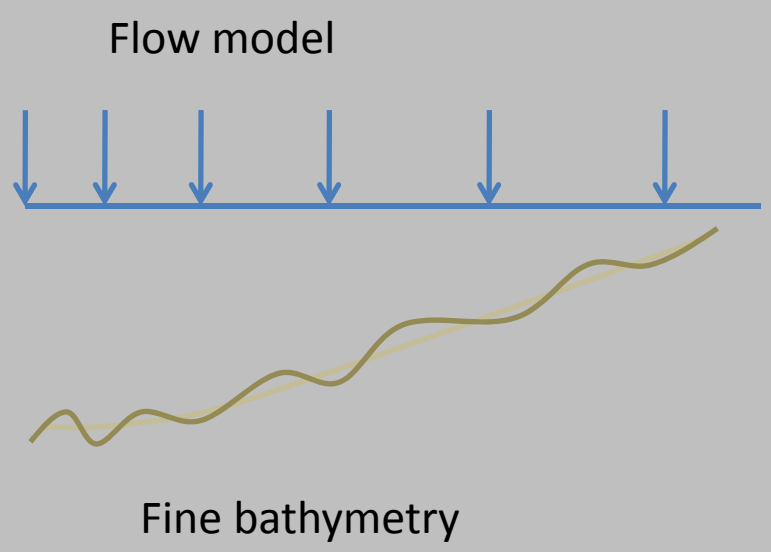
REALM

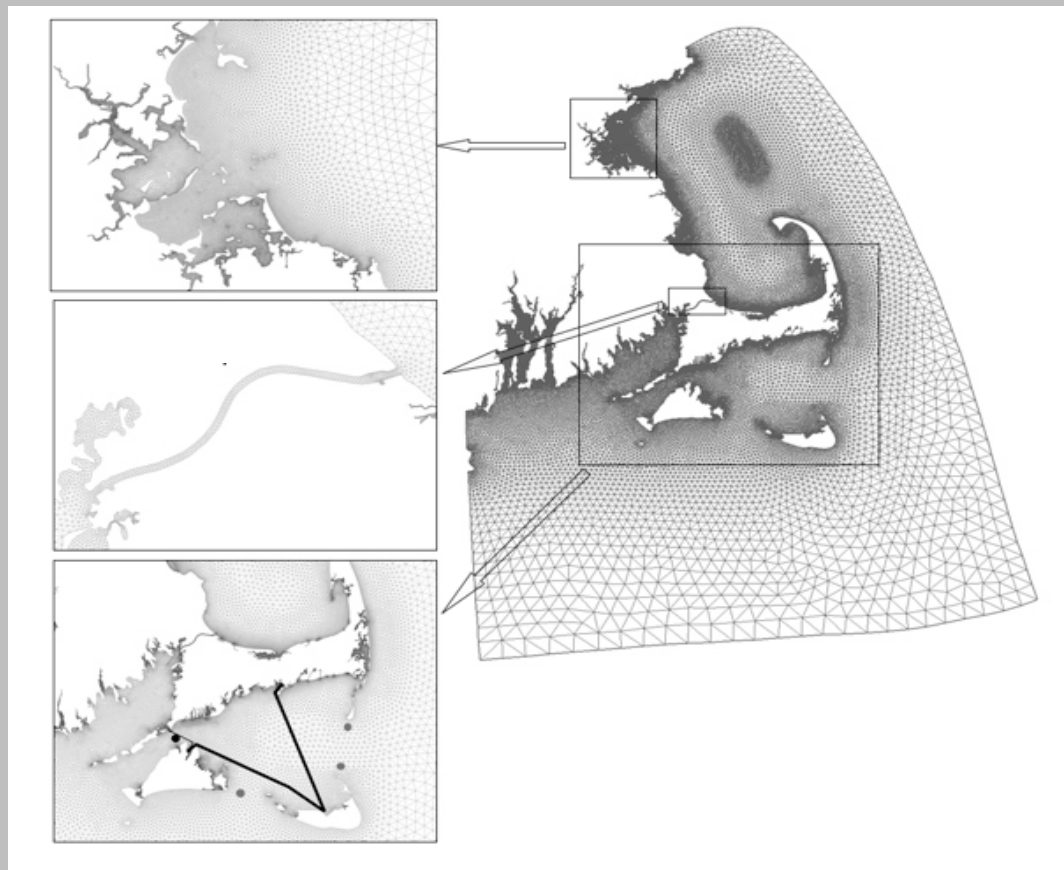
- Boundary from elevations
- Very high resolution
- Land-water interface must be accurate



SELFE

- Unstructured 3D
- One elevation stored per computational node





The Project

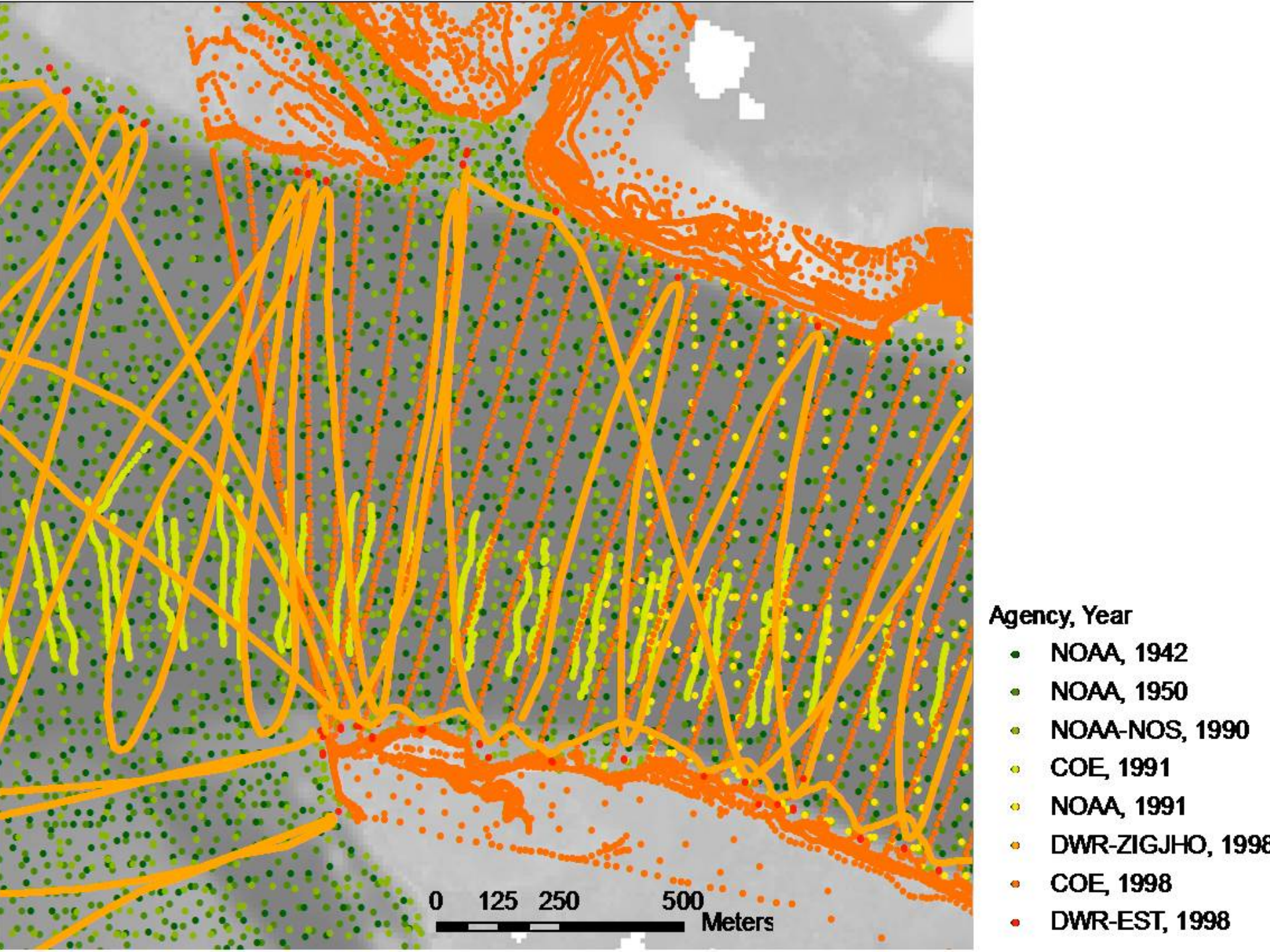
Goals

- High quality bathymetry-topographic digital elevation model (DEM) for models
- Separation of raw data, elevation models, and model-centric products
- Work flow for integrating new data
- Identify areas for improvement

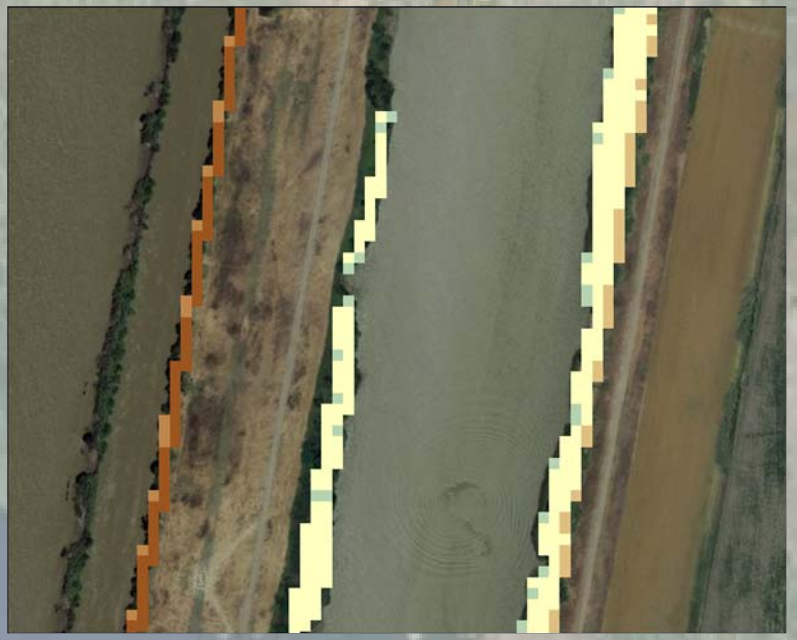
Project scope

- Existing data: use well, revise often
- “Help” obtain new data
  - We can request this for studies – usually only local
  - There is low hanging fruit that is fermenting
- Cognizant of overlapping efforts:
  - USGS is talking about 2m models
  - DWR has started land part of 1-2-10m surface models

Challenges

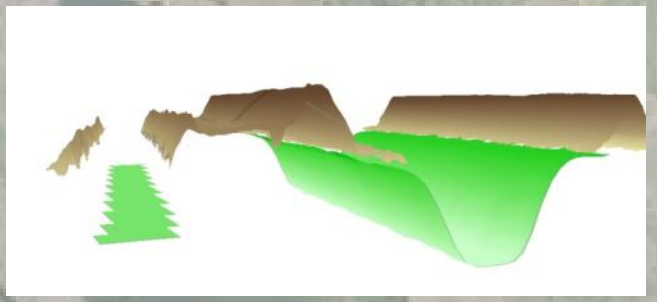

0 125 250 500
Meters
Agency, Year
NOAA, 1942
NOAA, 1950
NOAA-NOS, 1990
COE, 1991
NOAA, 1991
DWR-ZIGJHO, 1998
COE, 1998
DWR-EST, 1998

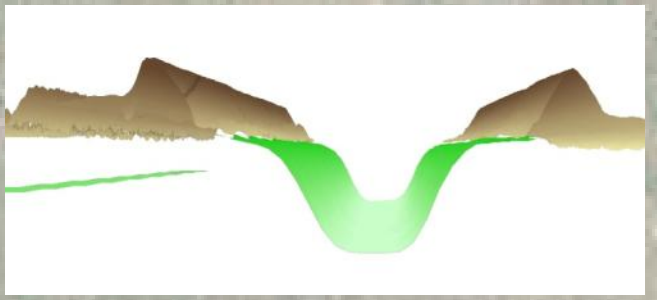
Land and water: 2010



Overlaping Areas
Elevation Diff (m)

- -14 - -6.4
- -6.3 - -4.4
- -4.3 - -2.5
- -2.4 - -0.57
- -0.56 - 1.4
- 1.5 - 3.3
- 3.4 - 3.7





Land and water: 2010

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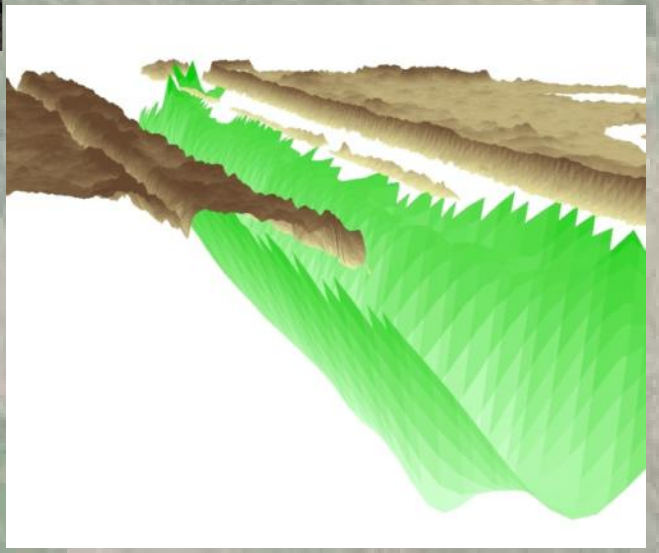


Land and water:
2012

Technical challenges

- Disparate data sources
- Ambiguous/ inconsistent georeference
- Incomplete metadata
- Variable data coverage and quality
- Shoreline lies at seam of land and water-derived data sets
- Challenges change over time

Approach

Our process

(1) Combine Existing Integrated Data Sources

(2) Make Patches from New and Old Data (Ongoing)

(3) Post Processes :

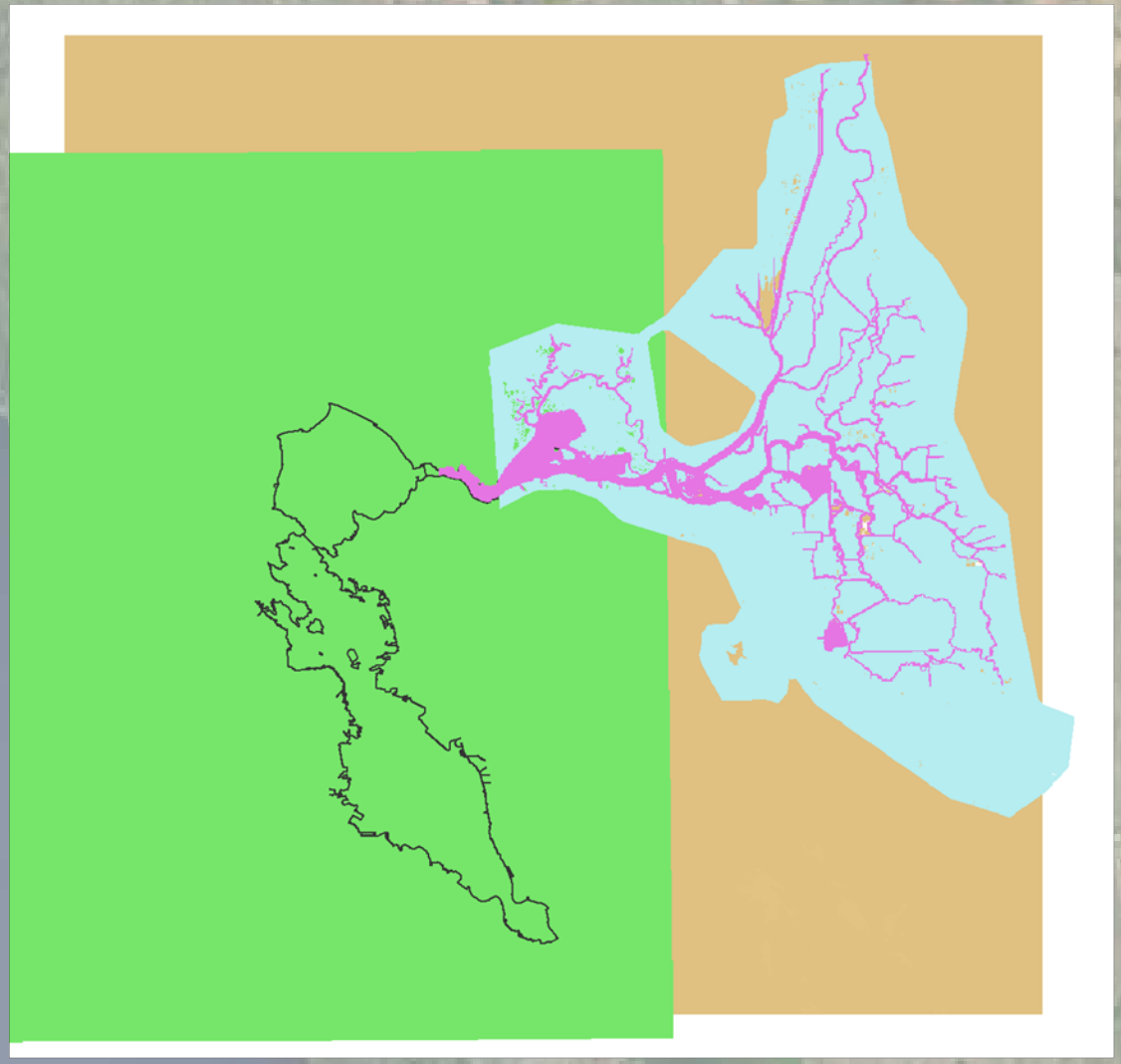
I. Insert Patch

II. Fill in Missing Data along the Water and Land Interface

III. Enforce Levee Crest Elevations

Version of Integrated Bathymetry

Previous integrated data sources



Suisun Bay and Delta Bathymetry
a) DSM2 point database
b) USGS, Foxgrover, Smith, and Jaffe (2005, 10 m resolution, NGVD29)

DWR LiDAR (2007-2008,1 m resolution, NAVD88)

NOAA National Geophysical Data Center 2010 Tsunami Inundation DEM (1/3 arc-second, NAVD88)

USGS National Elevation Dataset (1/3 arc-second, NAVD88)

Modified regions

(1) New Data

- North Sacramento River (DWR, 90'/LiDAR & 2008-2009)
- Sacramento & Stockton Ship Channels (Towill, Inc. for US Army Corps of Engineers, 2009)

(2) DSM2 Point

- Vernalis
- Clifton Court

(3) Manually Digitized Data

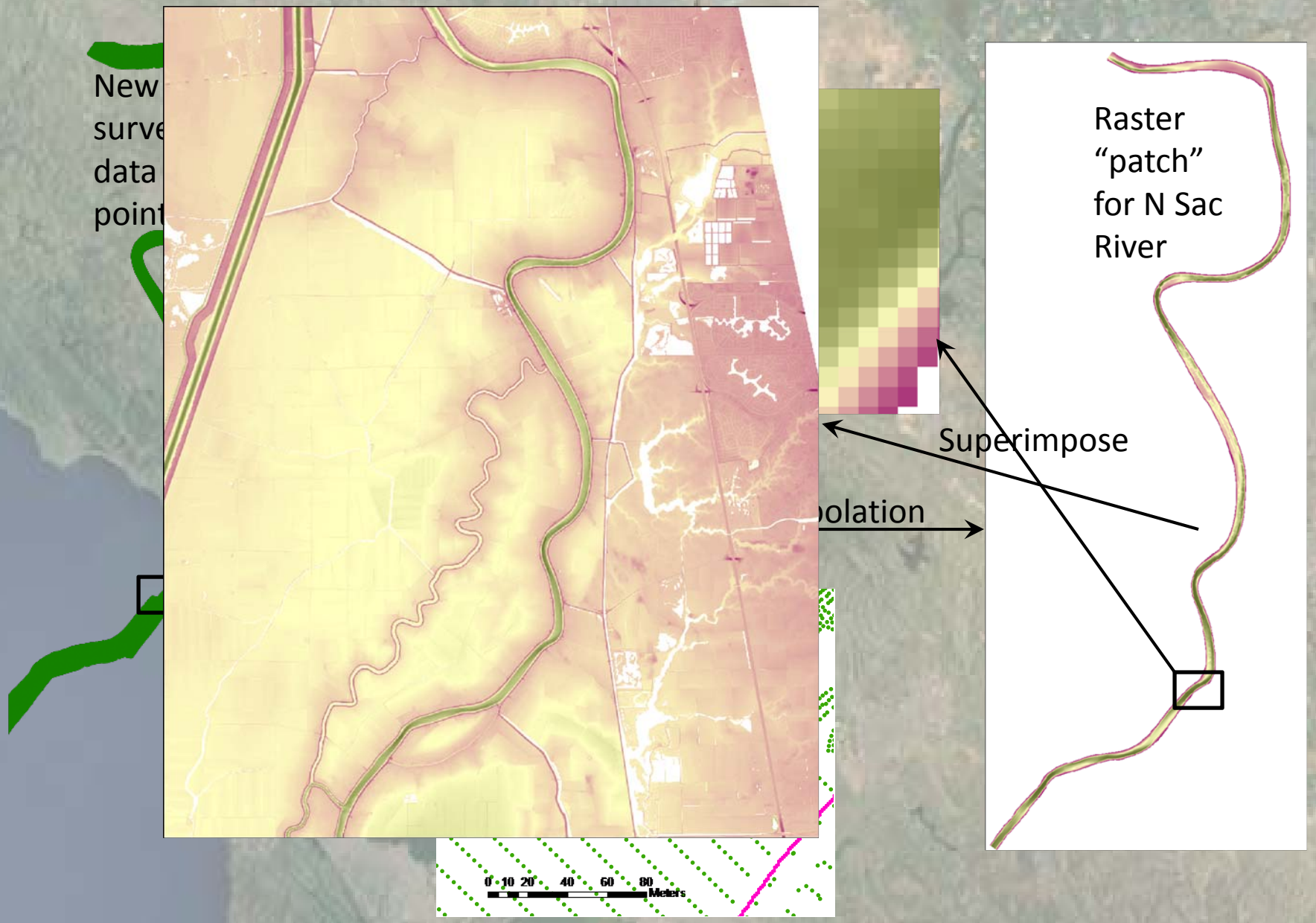
Based on work done by Peter E. Smith, USGS

- Mildred Island
- Discovery

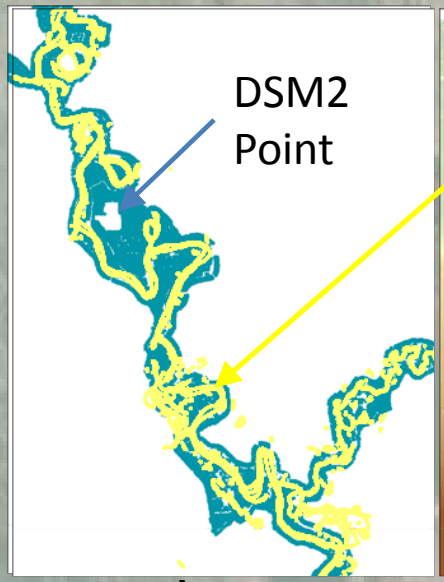
Based on USGS Topo Map

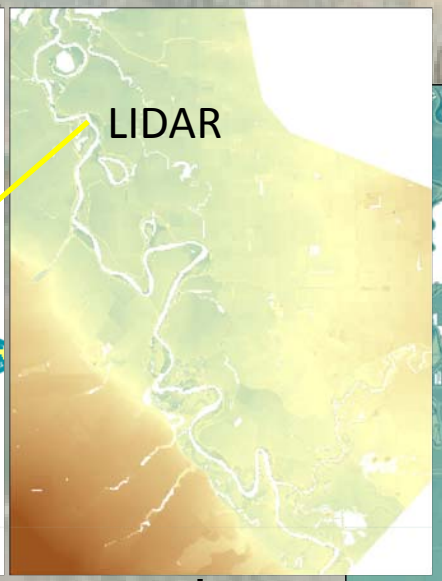
- Liberty Island
- Little Mandeville Island

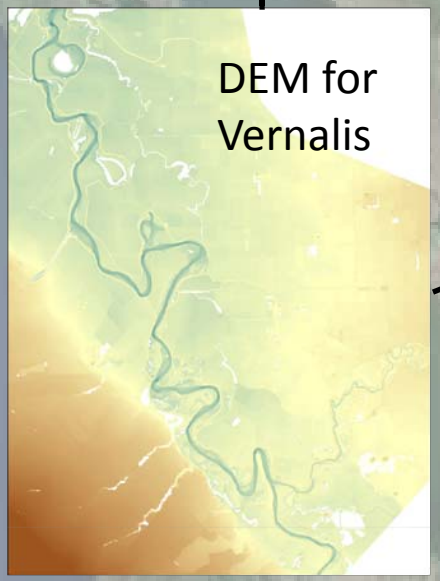
Example 1 – New data on N Sac River



Example 2 – Vernalis reinstated







Merge
with

Example 3 – Mildred

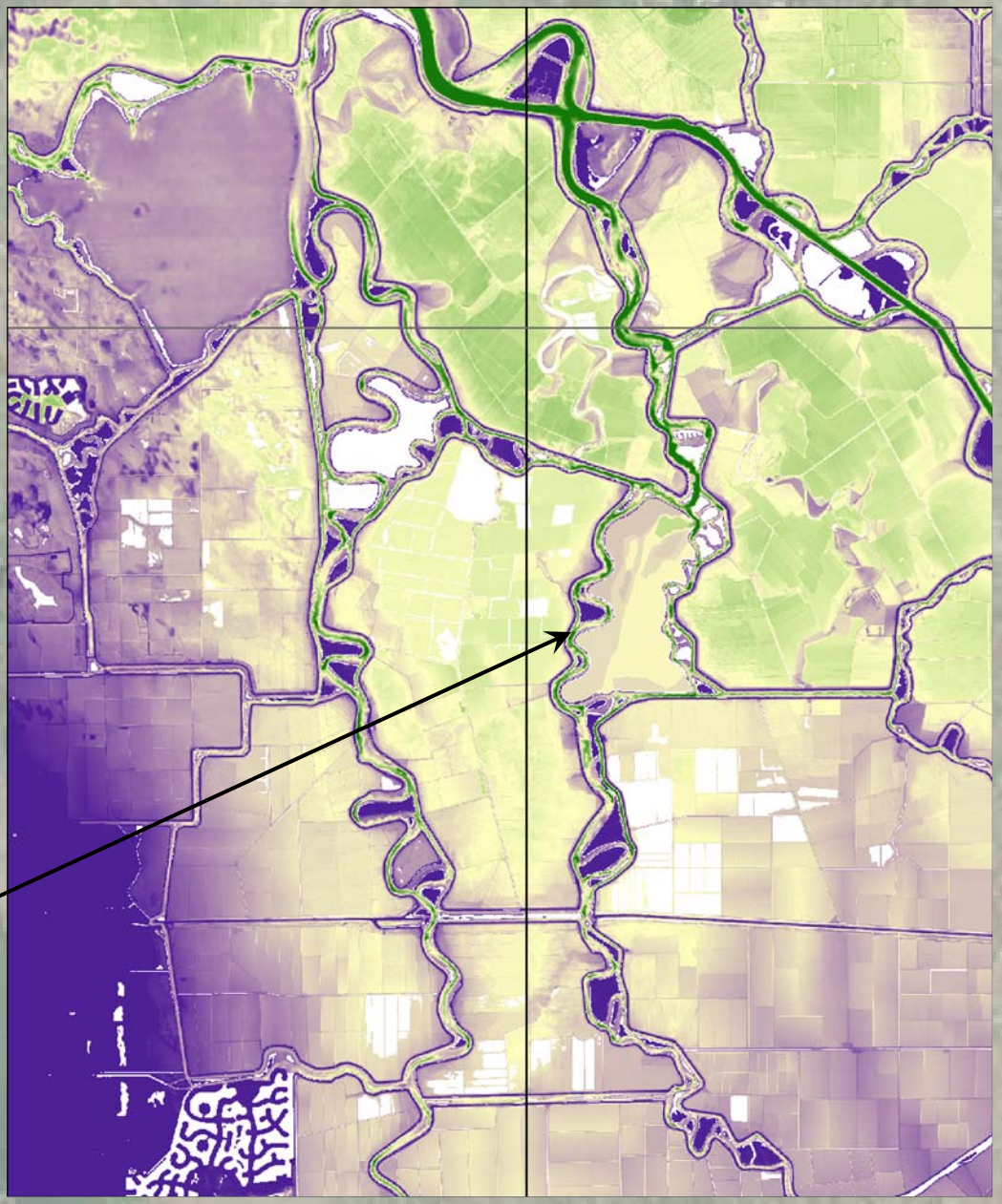
Source Data from Peter Smith (USGS) – 10m elevation grid as text file

File Format Conversion

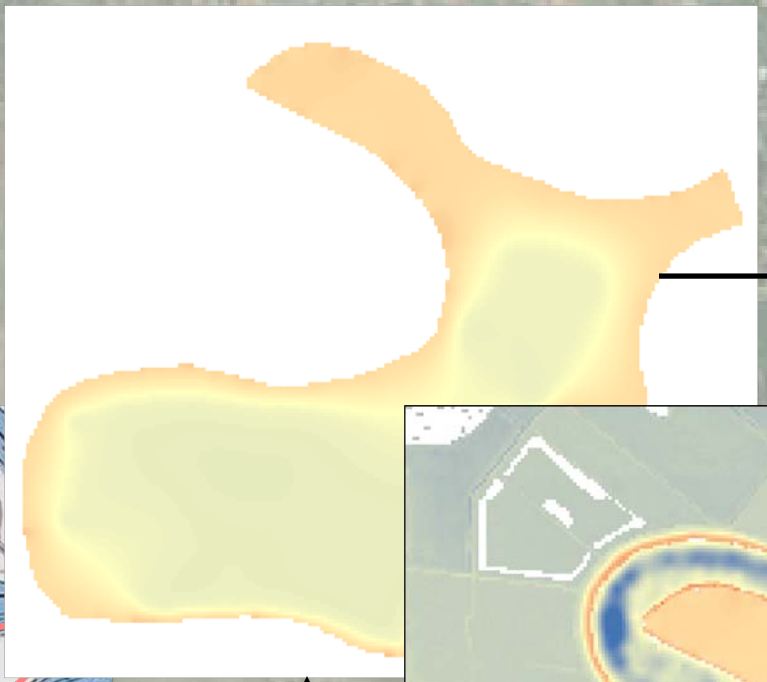
ASCII file (ArcMAP compatible)

Spatial Adjustment

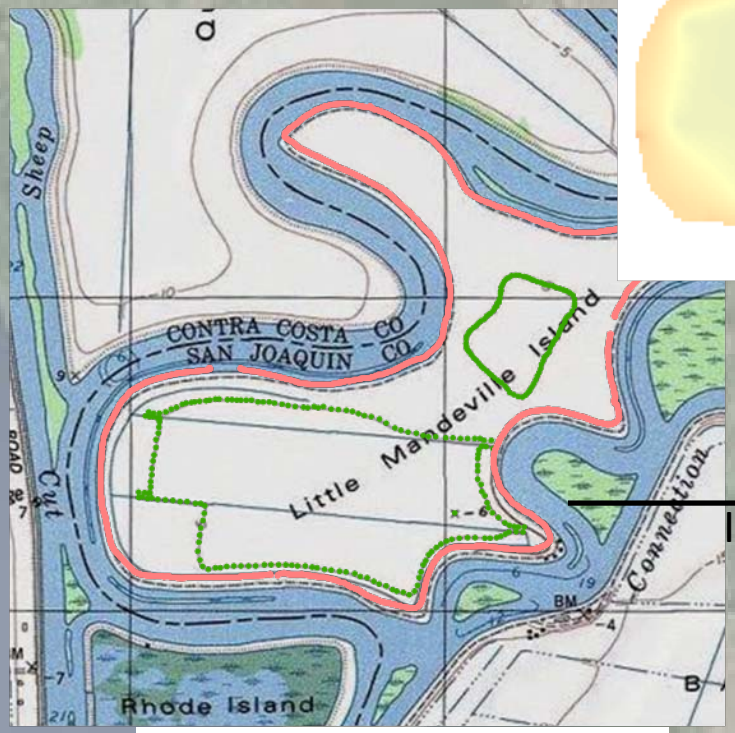
Merge



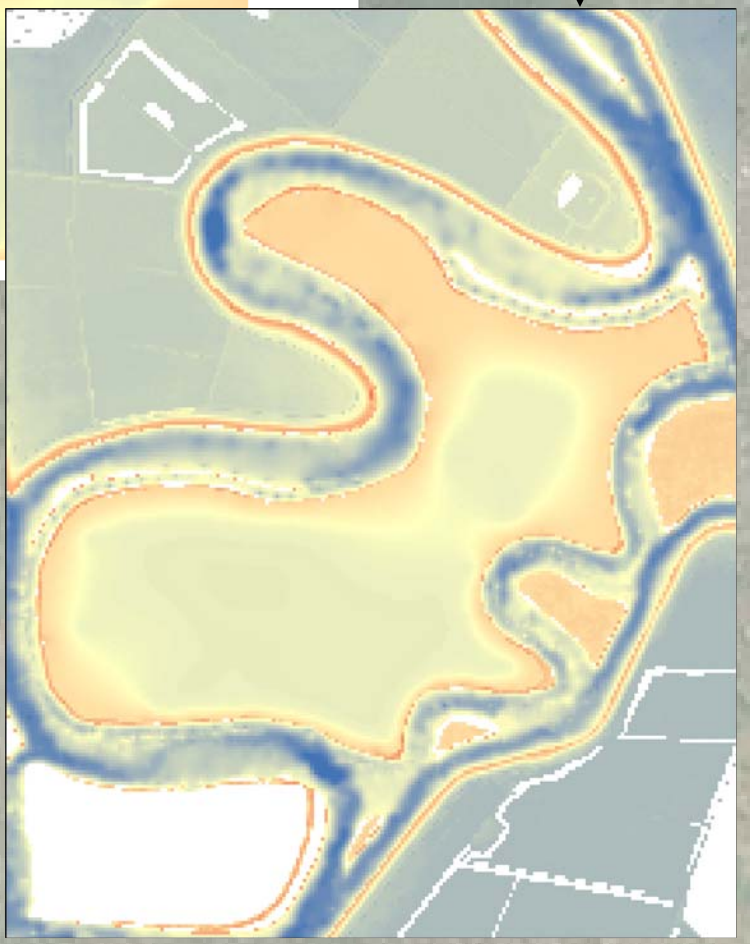
Example 4 – Little Mandeville Island



Merge with



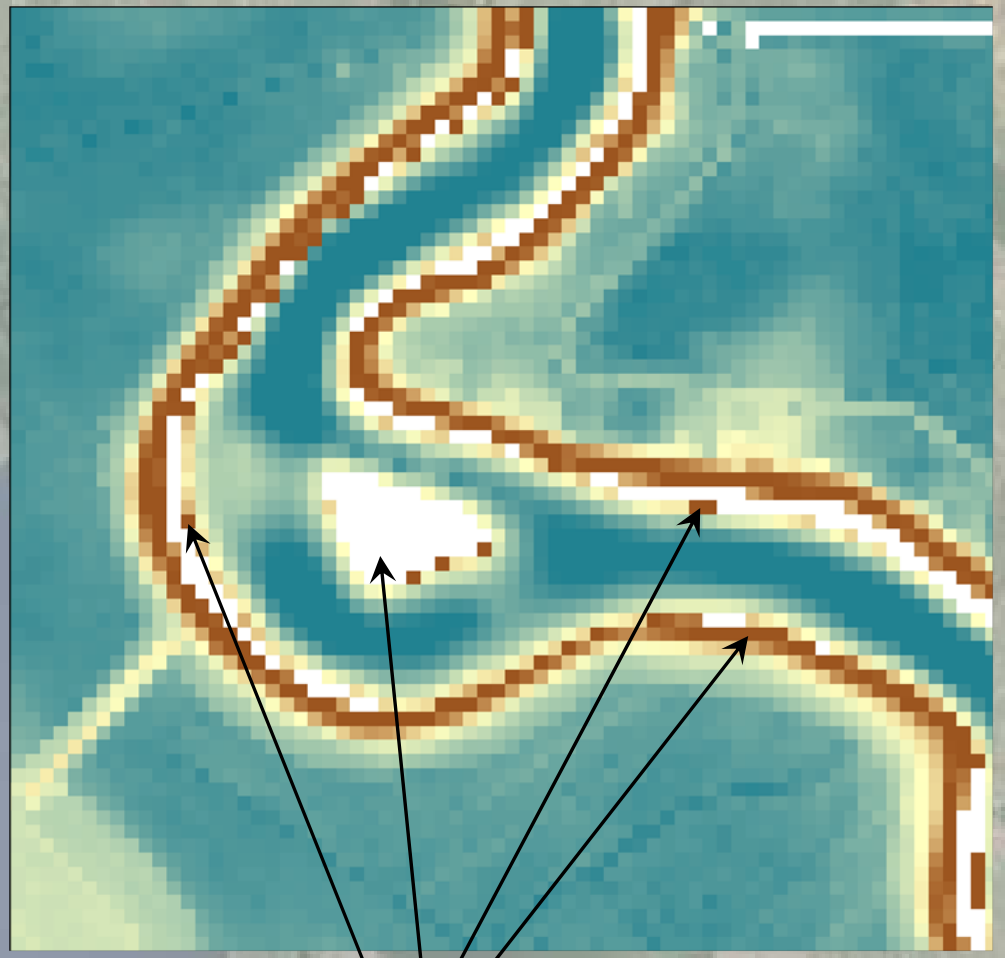
Interpolation



Manually digitized points

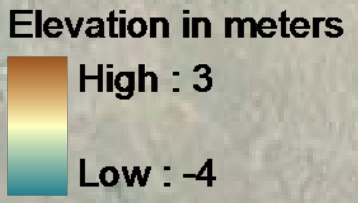
Shoreline points derived from LiDAR

Post-process – fill in missing data



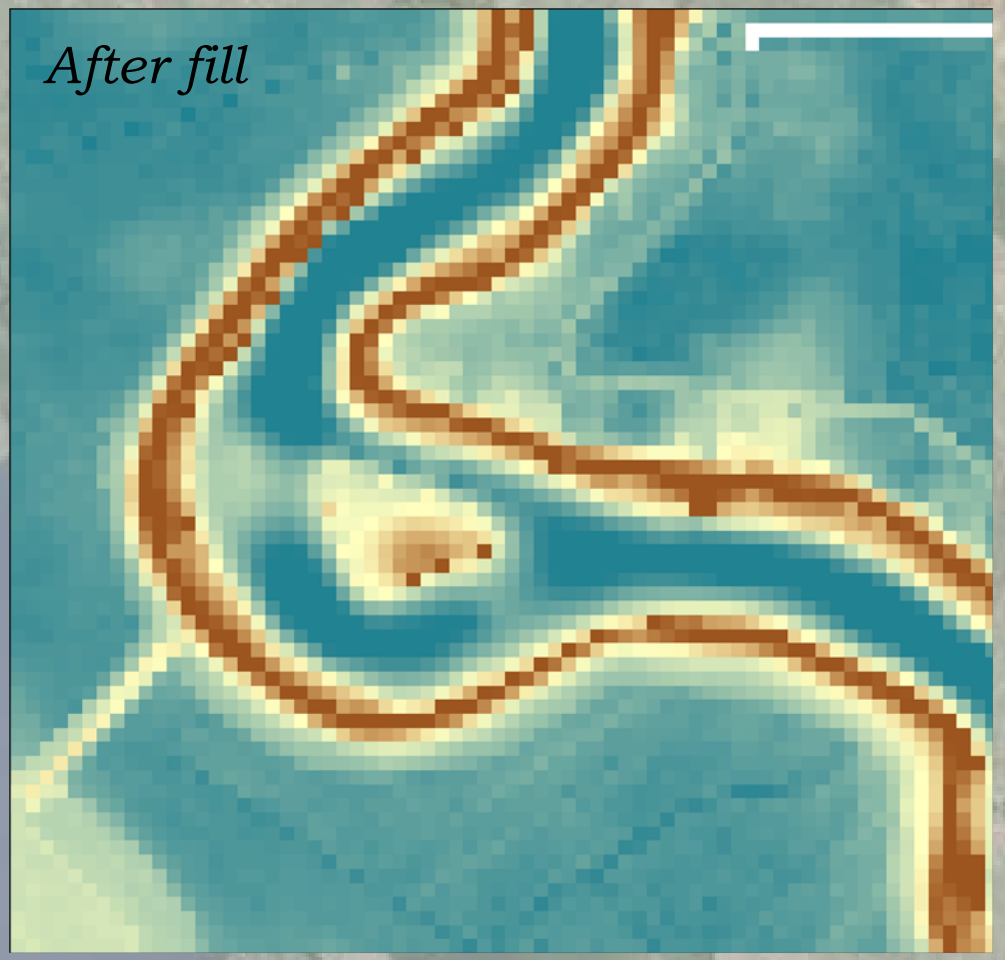
The Challenge

Data gaps lead to "no data" cells in the bathymetry map – particularly along shorelines where water meets the land.



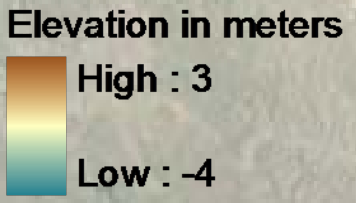
Before fill: "no data" regions shown in white

Post-process – fill in missing data



The Solution

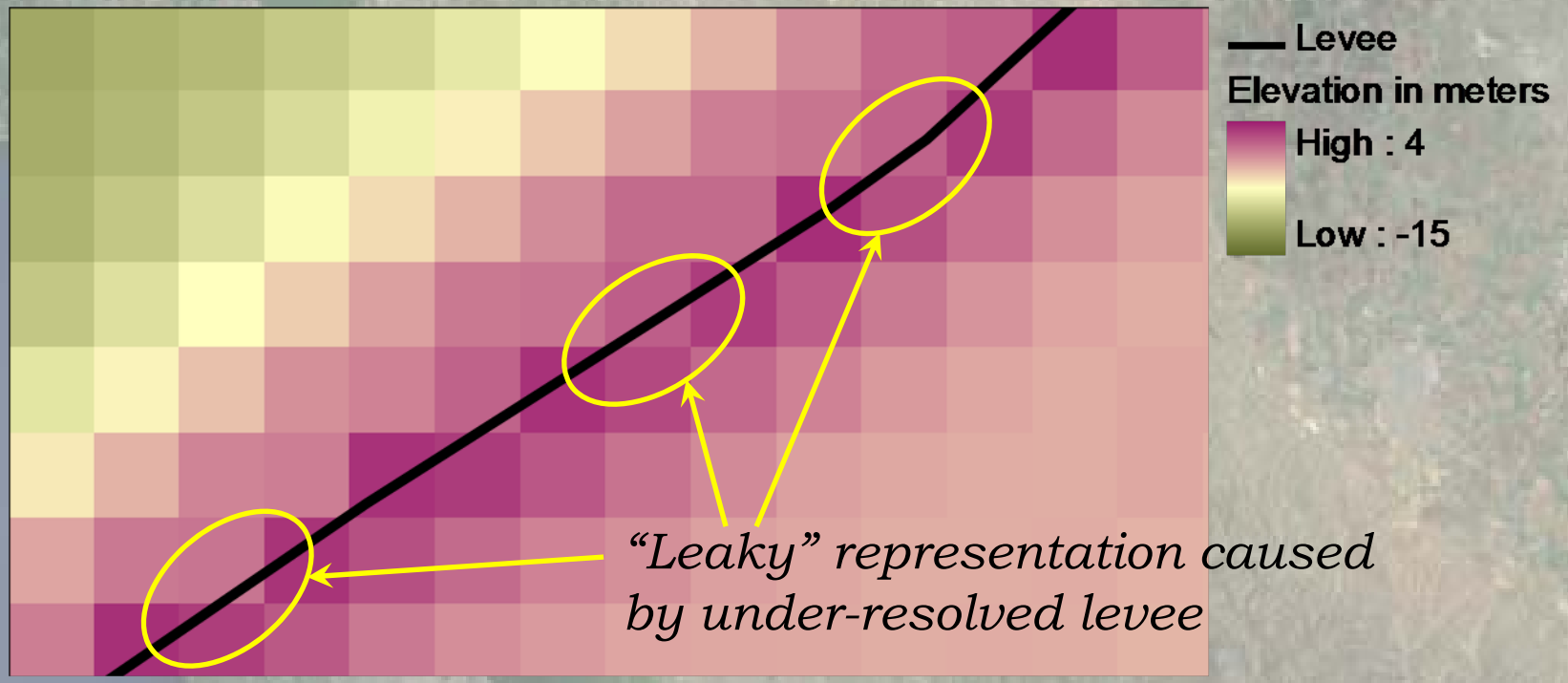
Fill missing cells with kernel-averaged values of surrounding cells



Enforce levee crest elevations

The Challenge

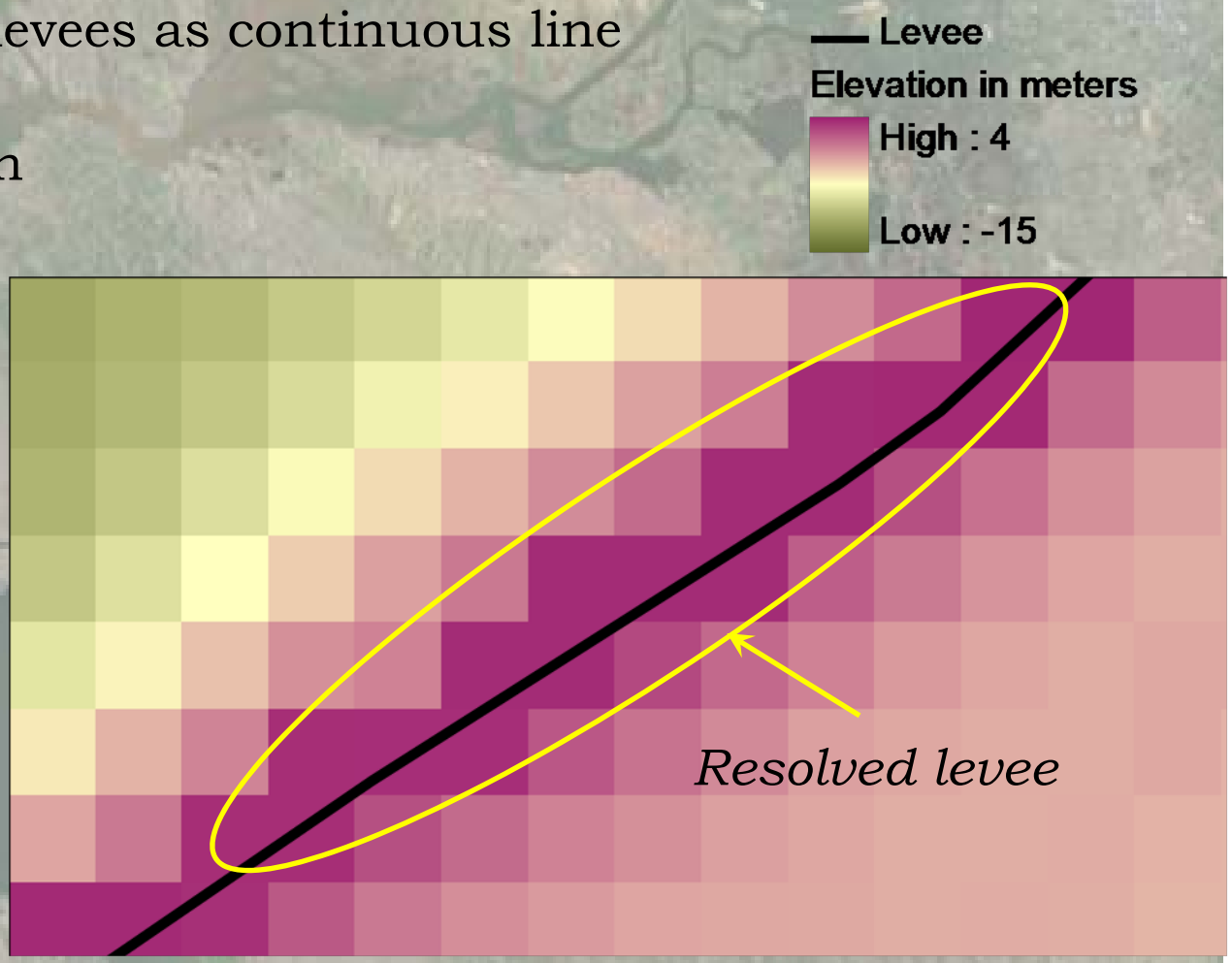
Ten meter sampling can lead to gaps in line features such as levee crests



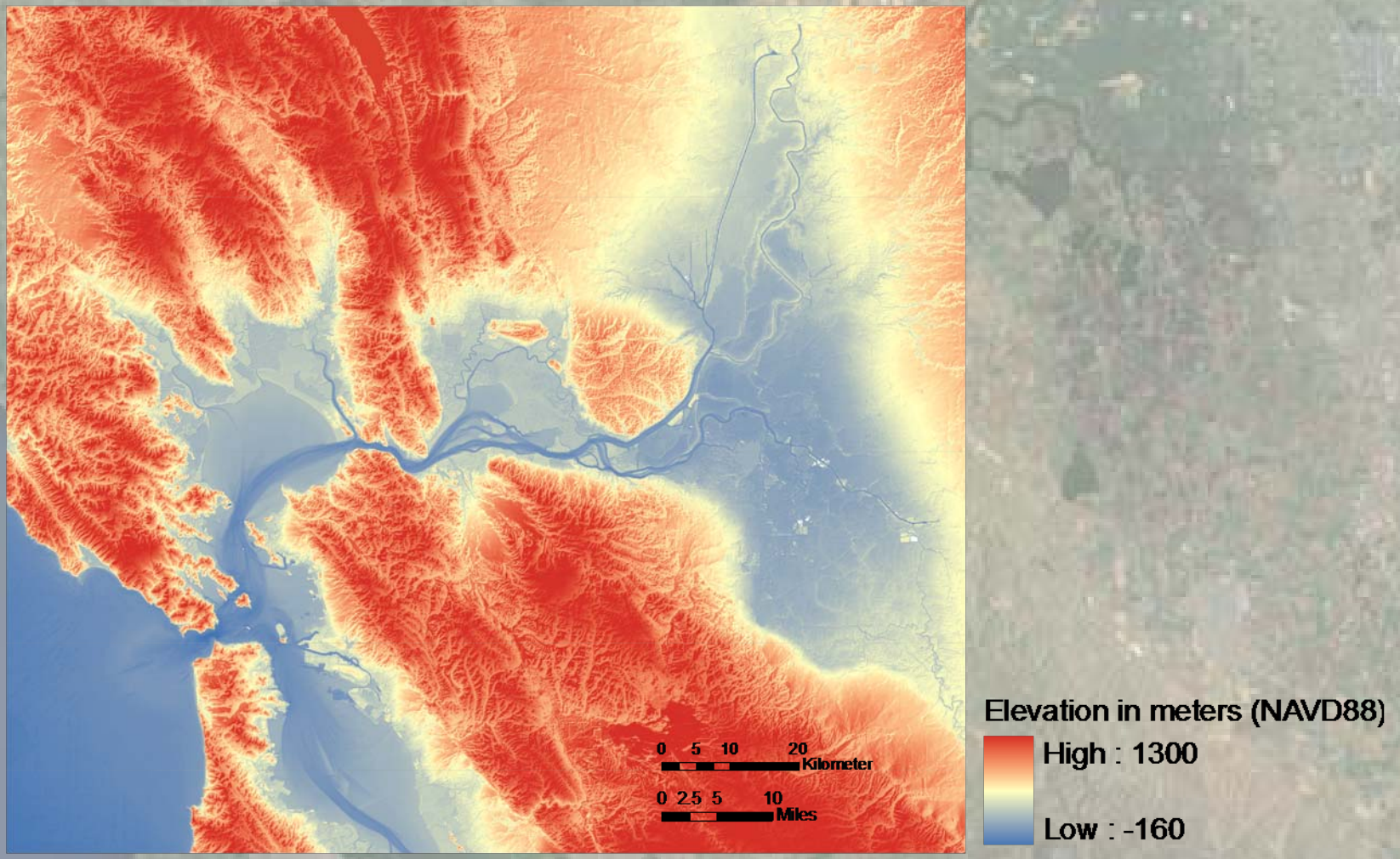
Enforce levee crest elevations

The Solution

- Manually identify levees as continuous line features
- Use high resolution LiDAR raster to produce a 10-m representation of levee crests, with gaps enforced by local crest elevations
- Superimpose the levee raster on the integrated DEM



REALM Bay-Delta elevation map



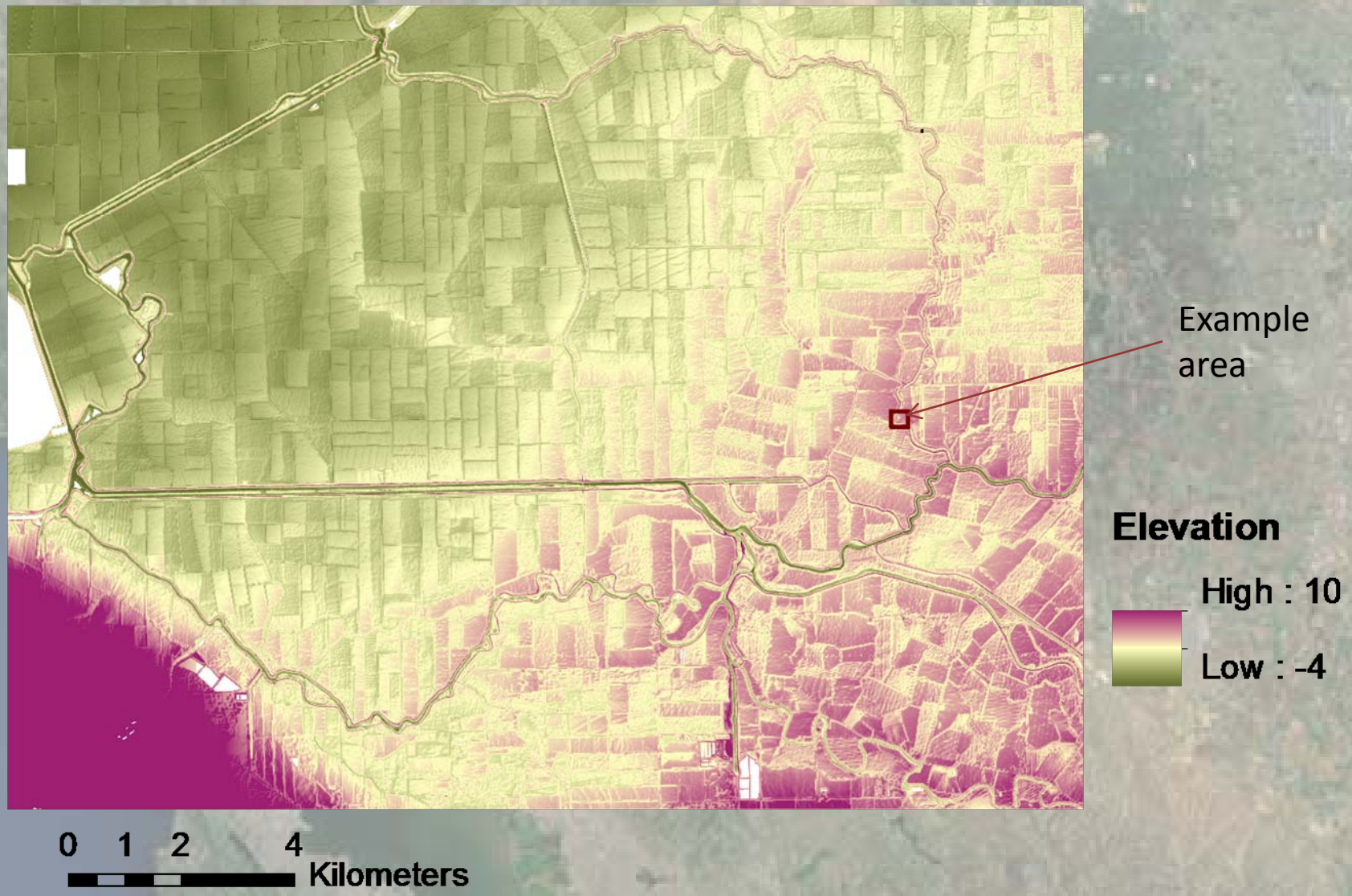
Accomplishments

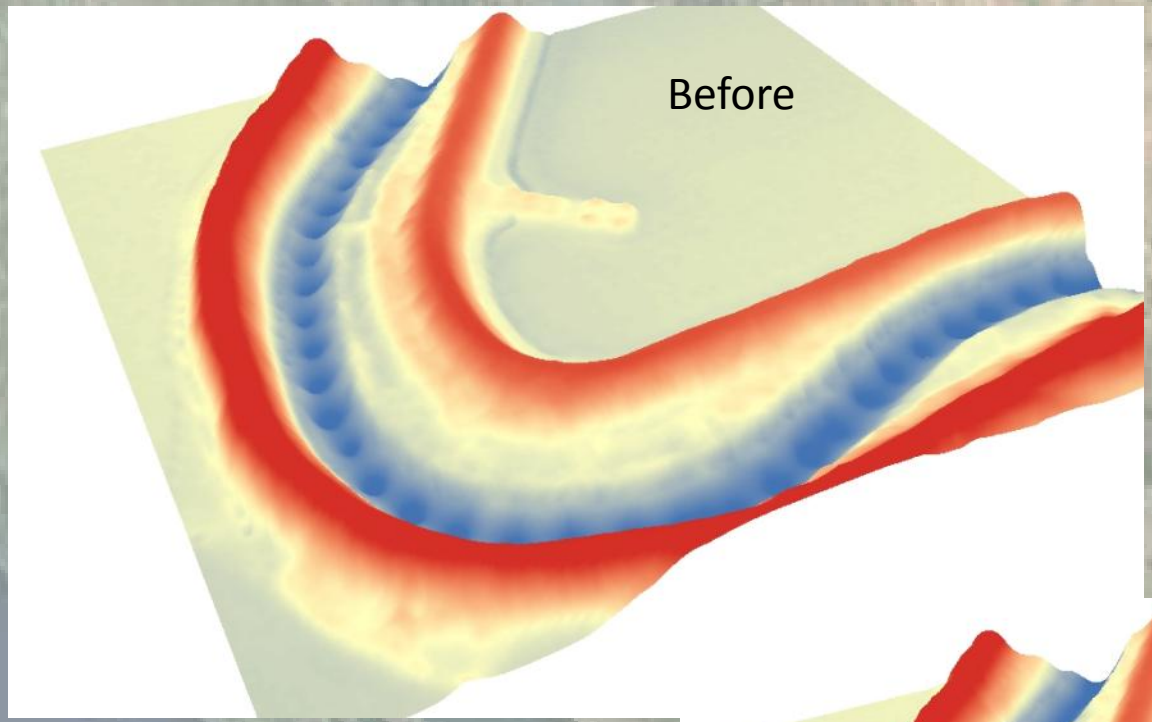
- Integrated 10m DEM for the Bay-Delta
- Methods for bringing high and low resolution data into a 10m map
- Smooth dataset transitions at shore
- Reinforcement of levees
- Organization of original data and patches, reproducible techniques

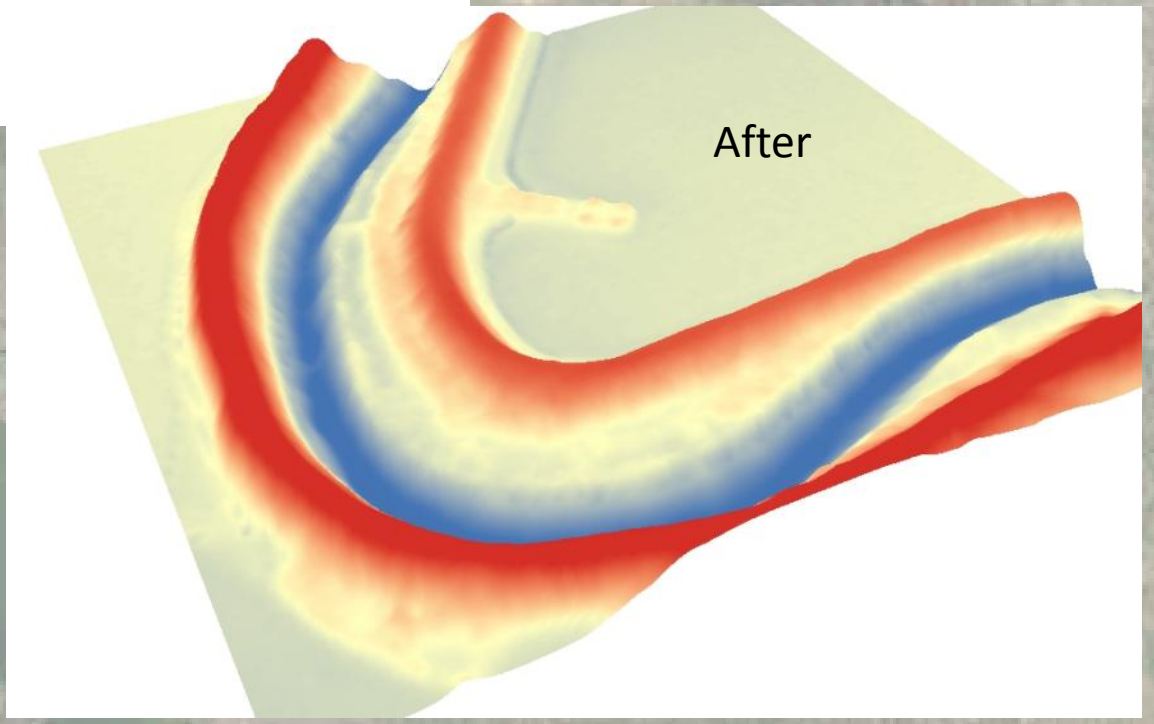
The future of the data

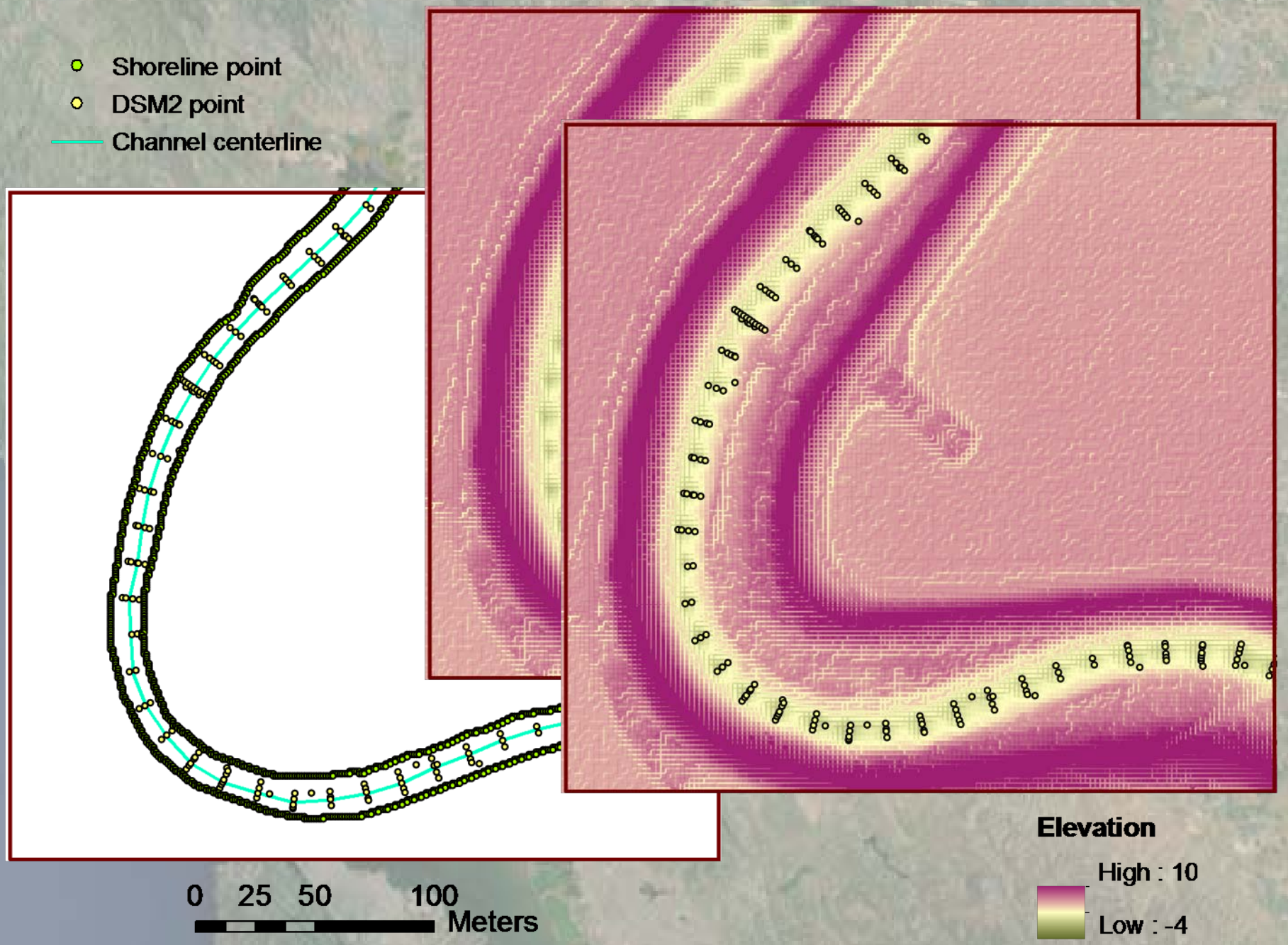
- Mishmash of sources will be tossed for one set
- Overlapping data reconciled (easy)
- Coarsening (2-10m) will still be an issue
- Need to discriminate *version* and *date*
- Lots of data
  - And the DEM itself may be a prejudice

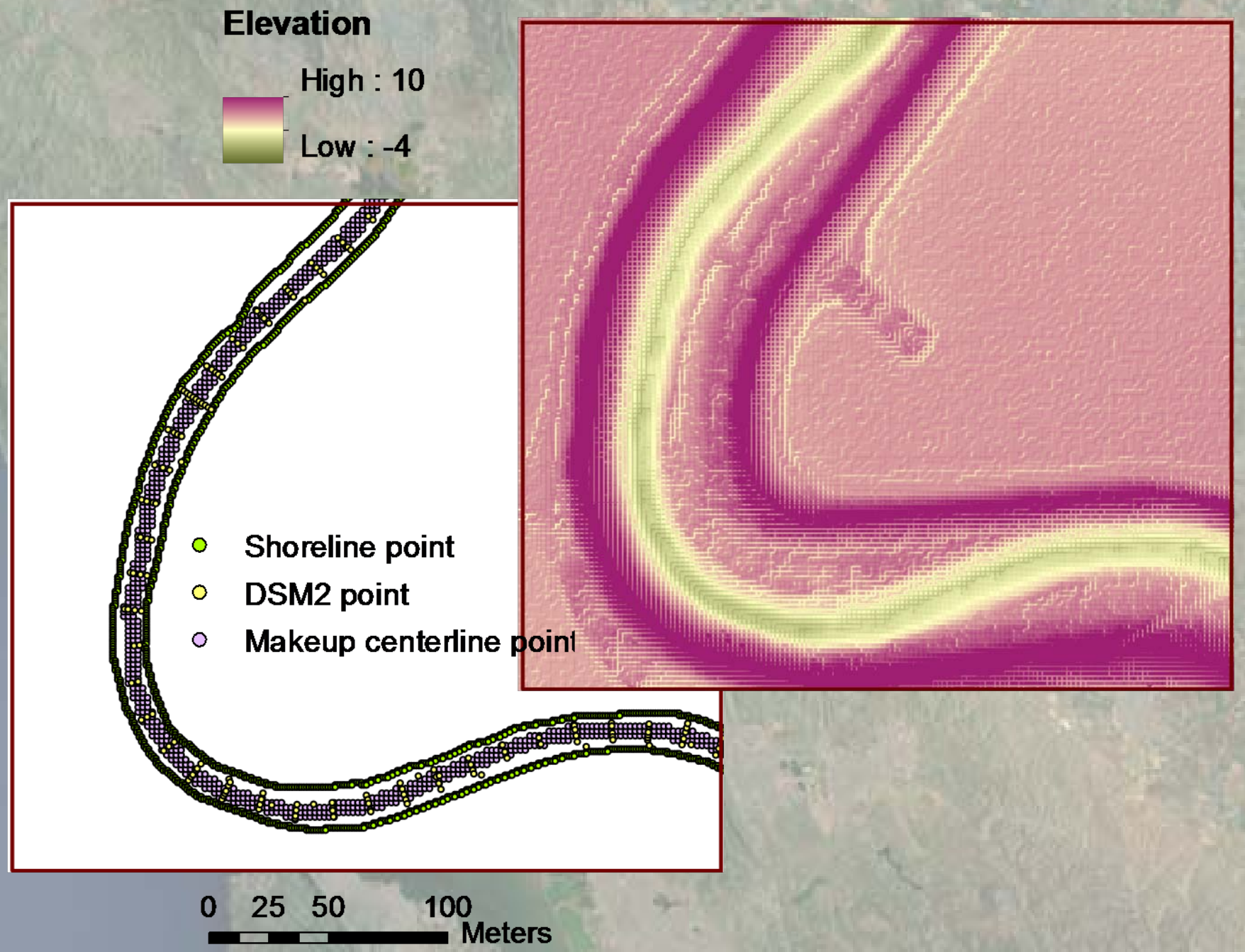
Towards high resolution (2m)




Before


After


Shoreline point
DSM2 point
Channel centerline
0 25 50 100
Meters
Elevation
High : 10
Low : -4


Elevation
High : 10
Low : -4
Shoreline point
DSM2 point
Makeup centerline point
0 25 50 100
Meters

Aspirations

- Fix data gaps
- Better resolution in places
  - e.g.the South Delta
  - but… cost-benefit issues
- Migrate to ArcGIS Terrain?
- Continue Heinzer training courses
- Issue tracking (outward facing)
- Collaborate with similar projects
- Public release in 2011

For more information

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- rwang@water.ca.gov