The Tijuana River Estuary: The Good, the Bad, and the Warming

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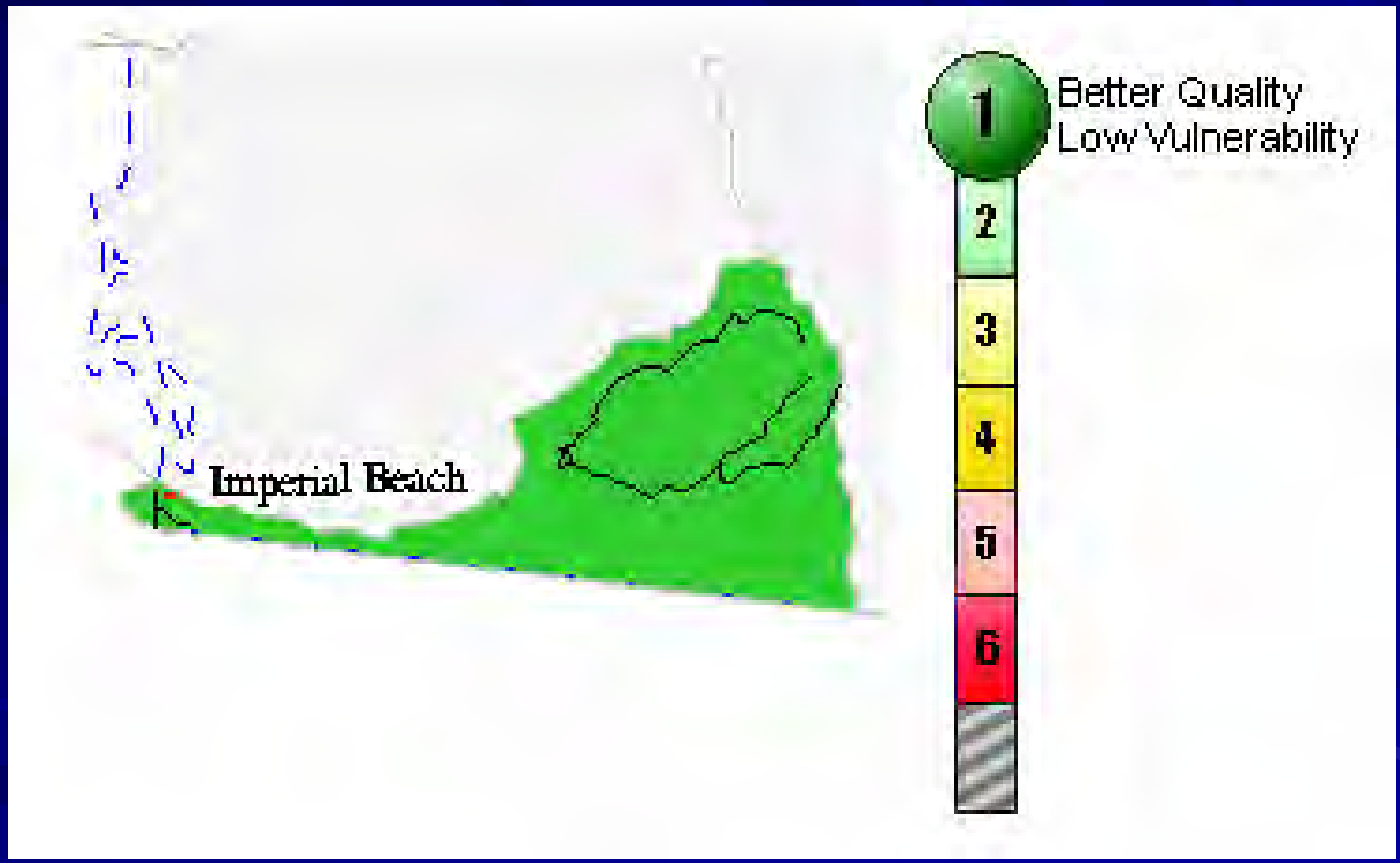
Tijuana River Watershed
Oceanside
California
San Diego
Pacific
Chula Vista
United States of America
Estados Unidos Mexicanos
Tecate
Tijuana
Ocean
Rosarito
N
Baja California


Imperial Beach
1
Better Quality
Low Vulnerability
2
3
4
5
6

Water Pollution and the Tijuana River

- Stormwater contamination from wet weather runoff events
- Sewage collection system: Not all of the population of Tijuana is connected to sewers (perhaps as much as 25% of the population).
- Discharge from a variety of maquiladoras and other industrial and commercial land use activities.
- Point source discharge into the Tijuana River watershed (e.g. Tecate brewery and wastewater treatment plant).

The Good- Industrial (Maquiladora) Pollution

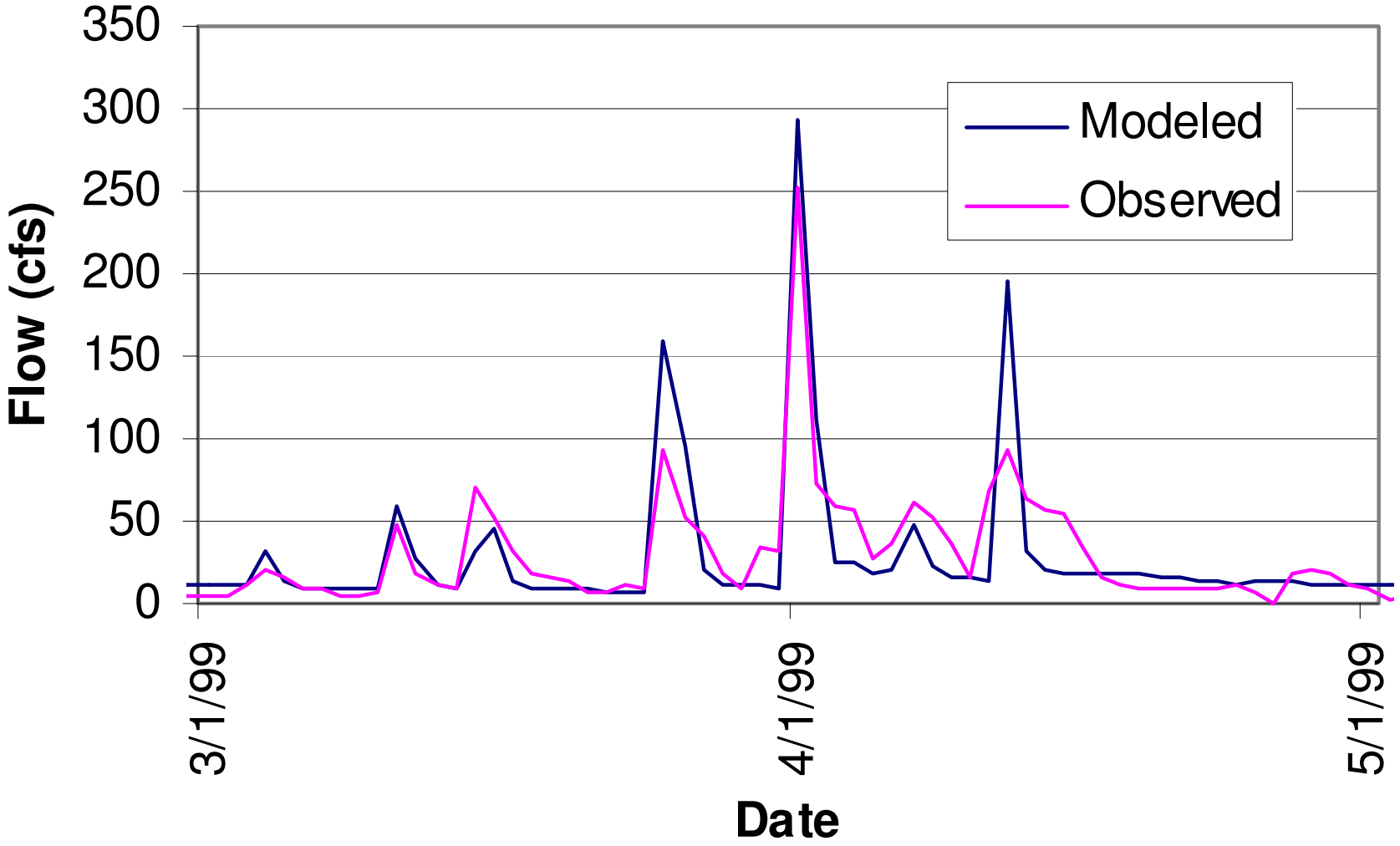
Use of the BASINS Model to Estimate Loading of Heavy Metals from the Binational Tijuana River Watershed.

Rick Gersberg and Amy King, School of Public Health, SDSU

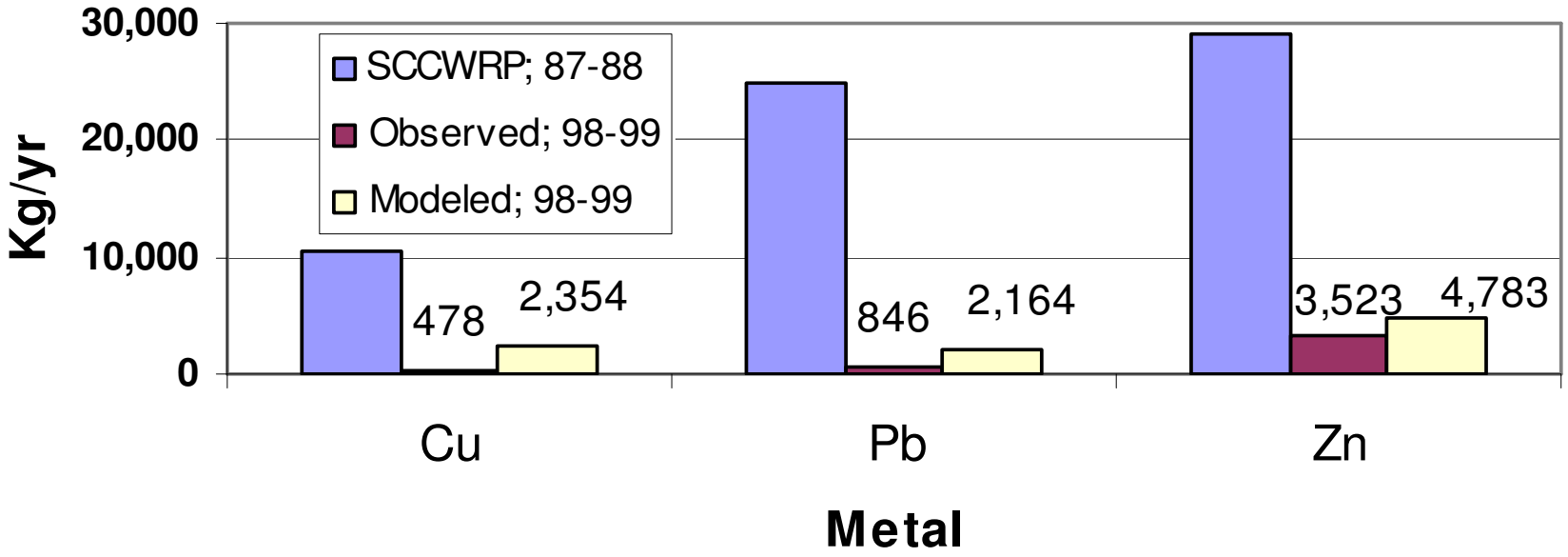
Jerome Pitt, College of Engineering, SDSU

Harry Johnson and Richard Wright, Dept. of Geography, SDSU

Modeled and Observed Flow for Tijuana River

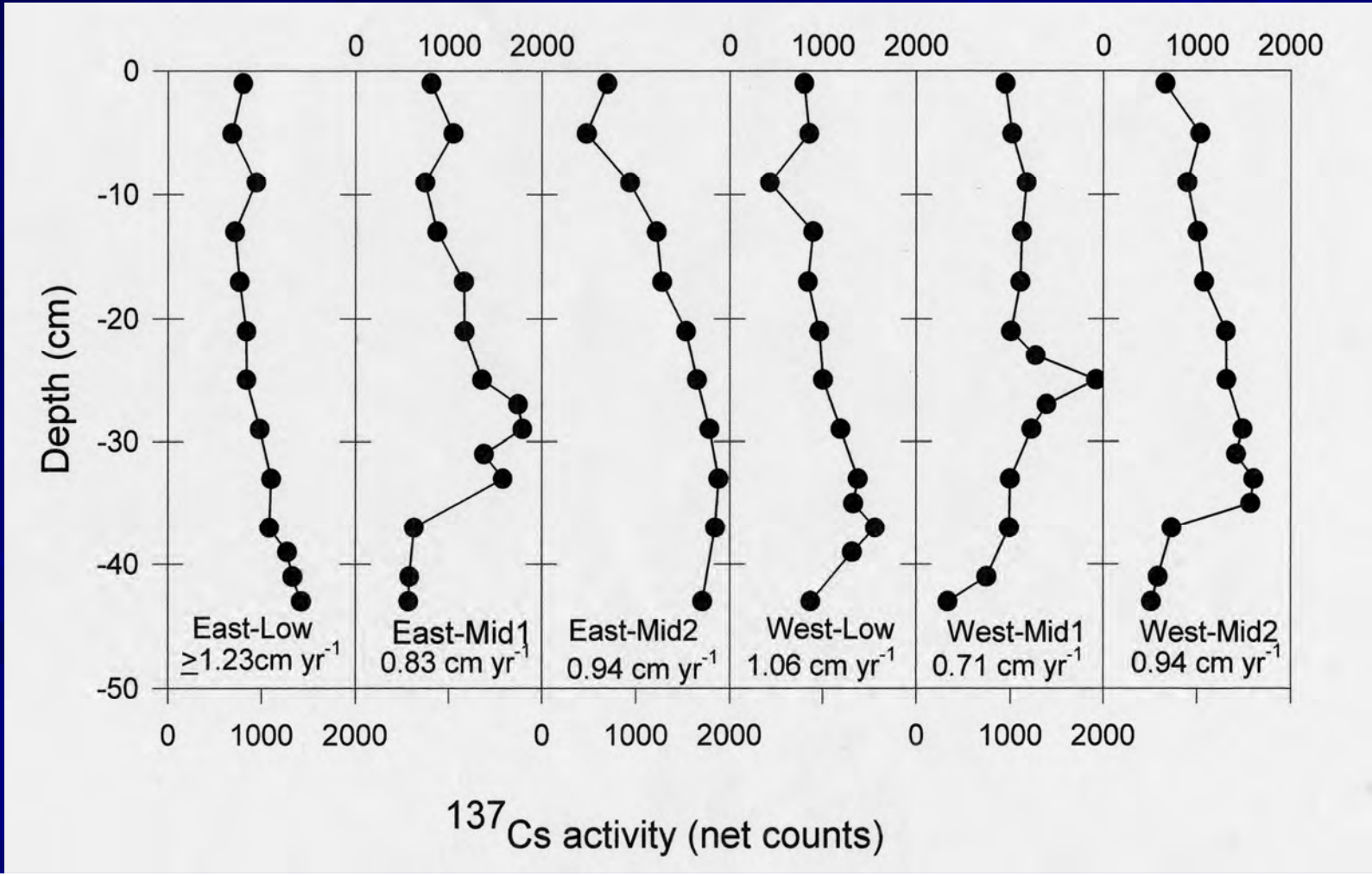


Modeled and Observed Metal Loading for Tijuana River

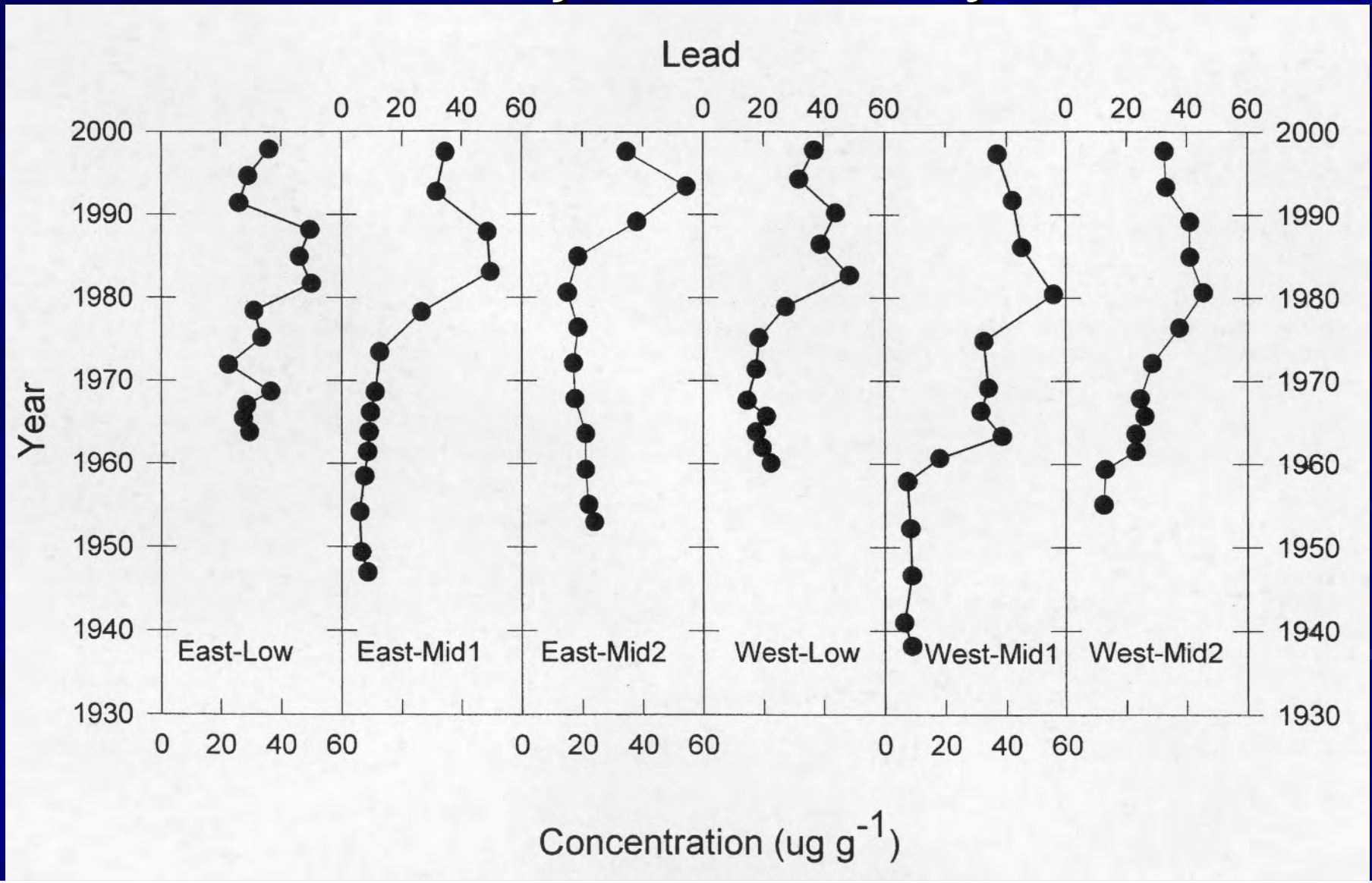


Radioisotope Dating of Sediments in the Tijuana Estuary

Weis, D.A., Gersberg, R.M. and J. Calloway. 2001. Vertical accretion rates and heavy metal chronologies in wetland sediments of the Tijuana Estuary. Estuaries 24 (6), 840-850.



Lead Chronologies in Sediments of the Tijuana Estuary



Chromium Chronologies in Sediments of the Tijuana Estuary

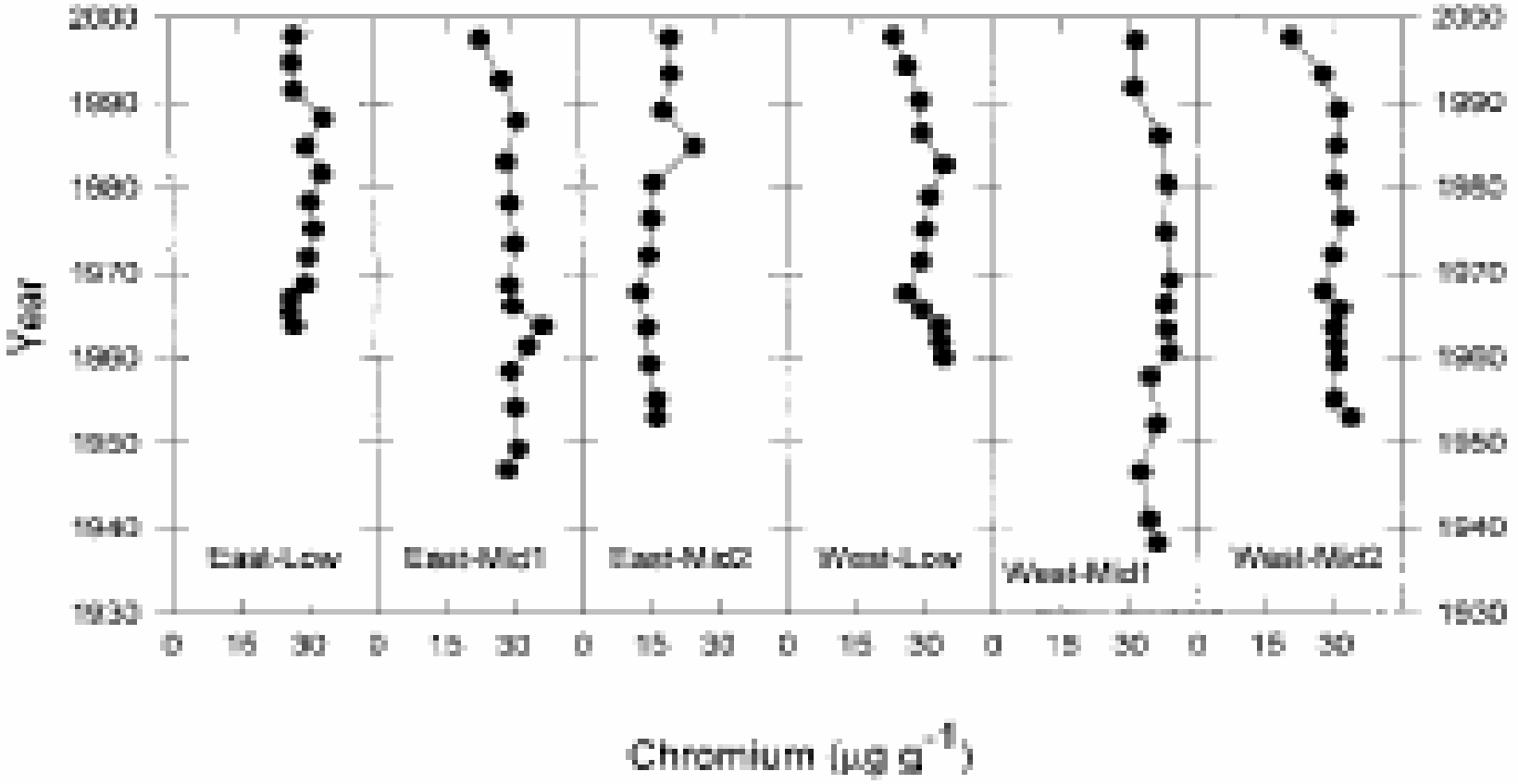


Fig. 4. Sediment chronologies of chromium for the six dated cores.

The Bad- Sewage (and Trash) Pollution

AP / Lenny Ignelzi


DANGER
CONTAMINATED WATER
AVOID WATER CONTACT
FROM THIS POINT SOUTH
TO THE
INTERNATIONAL BORDER
PELIGRO
AGUA CONTAMINADA
/ ALEJESE
EVITE CONTACTO
CON EL AGUA HASTA
LA LINEA INTERNACIONAL

Tijuana River Mouth

- Watershed drains 1,735 square miles.
(70% of which is in Mexico)
- Estimated 565,000 persons are not connected to sewer.

Source: http://www.coastalconservancy.ca.gov/scwrp/SitePics/01-12_tj_mouth.jpg

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0099-2240/06/$08.00+0 doi:10.1128/AEM.01024-06

Quantitative Detection of Hepatitis A Virus and Enteroviruses Near the United States-Mexico Border and Correlation with Levels of Fecal Indicator Bacteria[▽]

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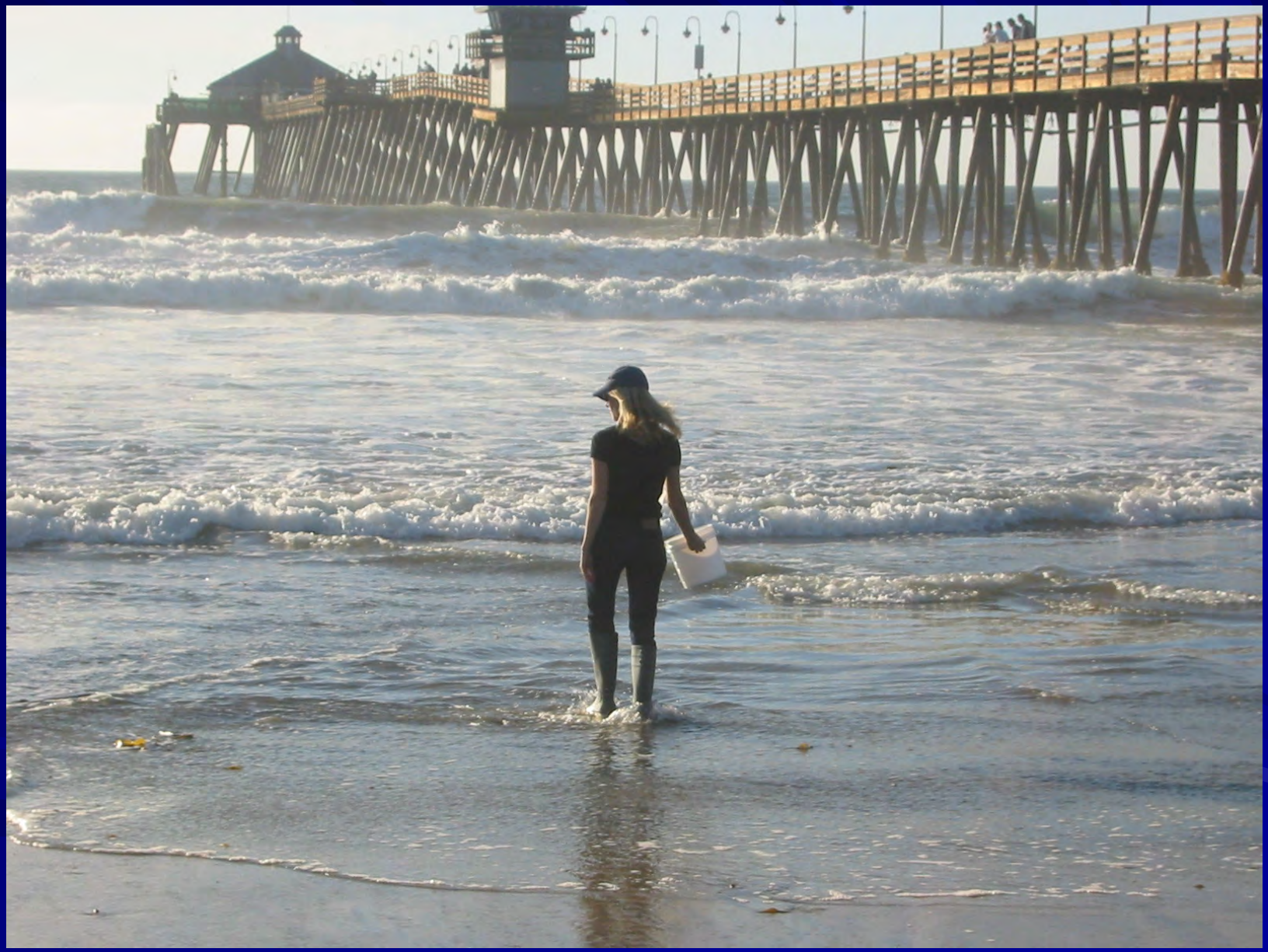
For decades, untreated sewage flowing northward from Tijuana, Mexico, via the Tijuana River has adversely affected the water quality of the recreational beaches of San Diego, California. We used quantitative reverse transcription-PCR to measure the levels of hepatitis A virus (HAV) and enteroviruses in coastal waters near the United States-Mexico border and compared these levels to those of the conventional fecal indicators, *Escherichia coli* and enterococci. Over a 2-year period from 2003 to 2005, a total of 20 samples were assayed at two sites during both wet and dry weather: the surfzone at the mouth of the Tijuana River and the surfzone near the pier at Imperial Beach (IB), California (about 2 km north of the mouth of the Tijuana River). HAV and enterovirus were detected in 79 and 93% of the wet-weather samples, respectively. HAV concentrations in these samples ranged from 105 to 30,771 viral particles/liter, and enterovirus levels ranged from 7 to 4,417 viral particles/liter. The concentrations of HAV and enterovirus were below the limit of detection for all dry weather samples collected at IB. Regression analyses showed a significant correlation between the densities of both fecal bacterial indicators and the levels of HAV ($R^2 > 0.61$, $P < 0.0001$) and enterovirus ($R^2 > 0.70$, $P < 0.0001$), a finding that supports the use of conventional bacterial indicators to predict the levels of these viruses in recreational marine waters.

Sampling Sites



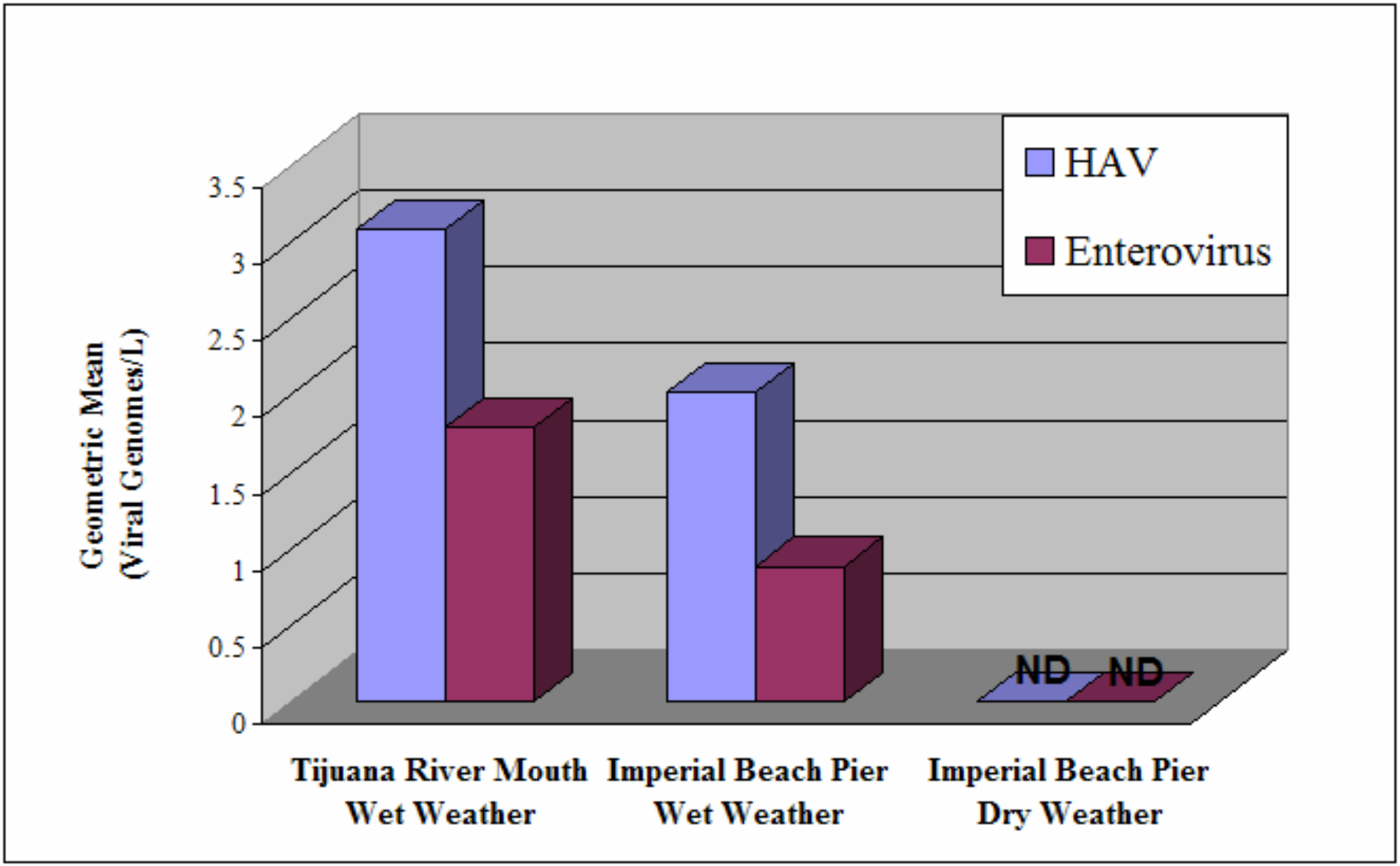


Figure 5. Average viral loads of HAV and enterovirus at the Tijuana River mouth and Imperial Beach pier during wet and dry weather determined using real-time RT-PCR

Risk Assessment for Swimming at Imperial Beach, CA During Wet Weather

$$Pi = 1-(1+\frac{\mu V}{\beta})^{-\alpha}$$

α = 0.409
B = 0.788

194 copies/L/ 55 (# of infectious particles per copy number)
= 3.53 infectious particles per L
=0.353 particles per 100 mL or

$$Pi = 1-(1+\frac{0.00132}{0.788})^{-\alpha}$$

Pi= 1-(0.8595)
Pi= 1.4×10^{-1}

Risk (Pi) of Infection is 1.4 per ten swimmers. Risk of disease is lower , perhaps on order of 1 in 100

Risk Assessment for Swimming at Imperial Beach, Ca During Dry weather

$$Pi = 1-(1+\frac{\mu V}{\beta})^{-\alpha}$$

α = 0.409
B = 0.788

<2 copies/L/ 55 (# of infectious particles per copy number)
= < 0.036 infectious particles per L
=<0.0036 particles per 100 mL

$$Pi = 1-(1+\frac{0.0036}{0.788})^{-\alpha}$$

Pi+ 1-(0.9981)
Pi= 1.86 x 10^{-3}

Risk (Pi) of Infection is slightly less than 2 in one thousand
Risk of disease is lower, perhaps on the order of less than 2 in 10, 000

Conclusions

- During and after wet weather, both HAV and enteroviruses are found at significant concentrations both at the mouth of the Tijuana River, and also in the surfzone at Imperial Beach, Ca.
- The fecal indicator bacteria *(E. coli* and enterococci) appear to be good predictors of virus (HAV and enteroviruses) contamination in the area of the Tijuana Estuary which is impacted by fecal contamination from Mexico.
- Fecal contamination of Imperial Beach does exert a significant health risk after rain events, but viruses were never detected at this site during dry weather

Global Climate Change: Sea-Level Rise, Critical Coastal Habitats, and Coastal Water Quality in the San Diego Region

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San Diego State University

San Diego Foundation's Regional Focus 2050 Study

- Comprehensive assessment of the multi-faceted effects of global climate change on the San Diego Region
- To inform local and regional decision-makers, and to serve as an input to the second bi-annual climate change impacts assessment to be conducted by the California Climate Change Center and the state Energy Commission.

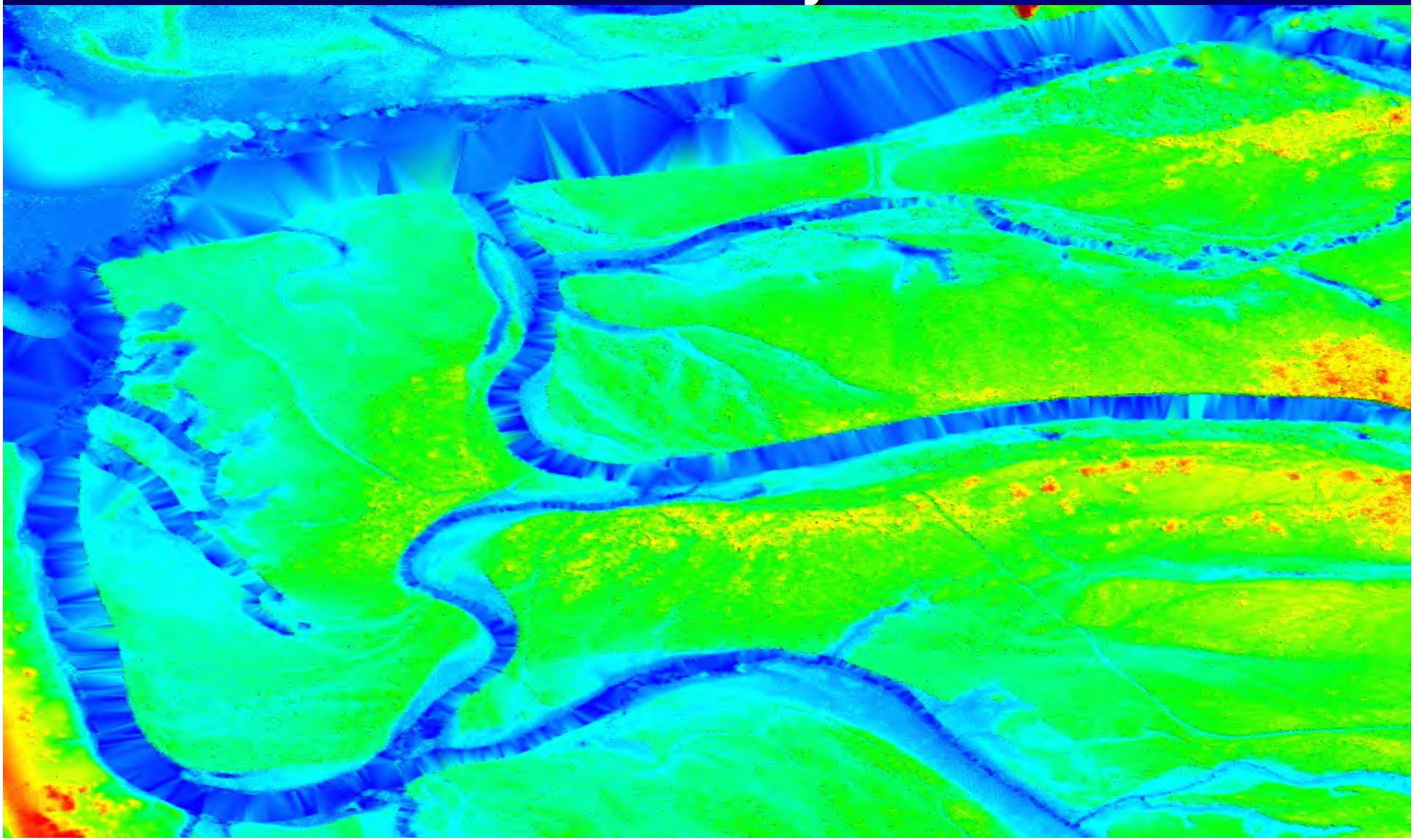
The Sea Level Rise Affects Marshes Model (SLAMM)

- Will be used to predict changes in marsh area resulting from submergence and habitat conversion. The effects of climate variability will be evaluated by analysis of wetland inundation (and associated habitat change) under the range of plausible scenarios presented in the Climate 2050 Report.

San-Diego Analysis will be Unique

- The updated SLAMM model has not been applied to the geographic region of San Diego
- No detailed regional simulation of the effects of sea level rise on wetland habitat and water quality has been performed for the San Diego area.

DEM of Tijuana River National Estuary



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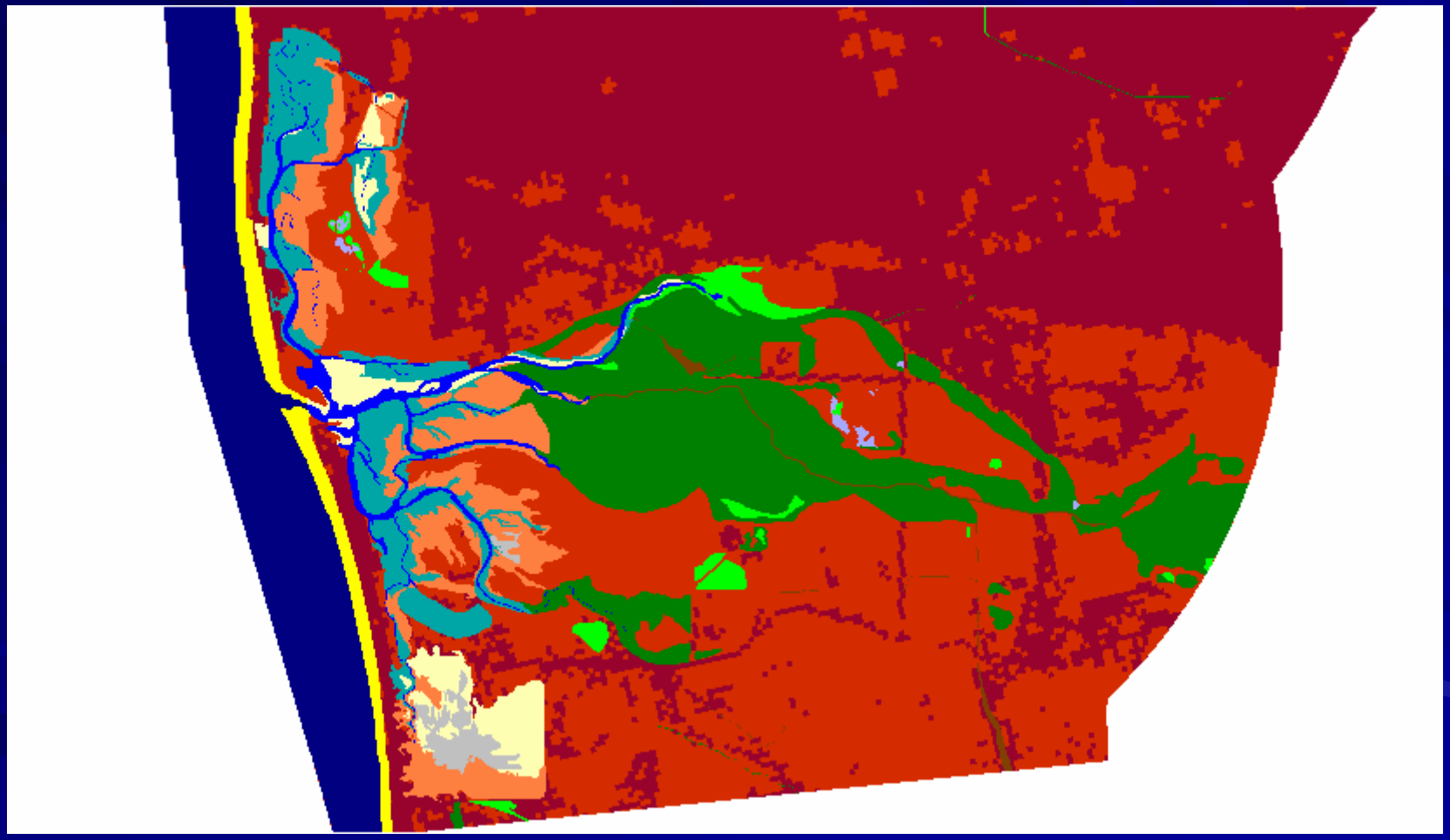

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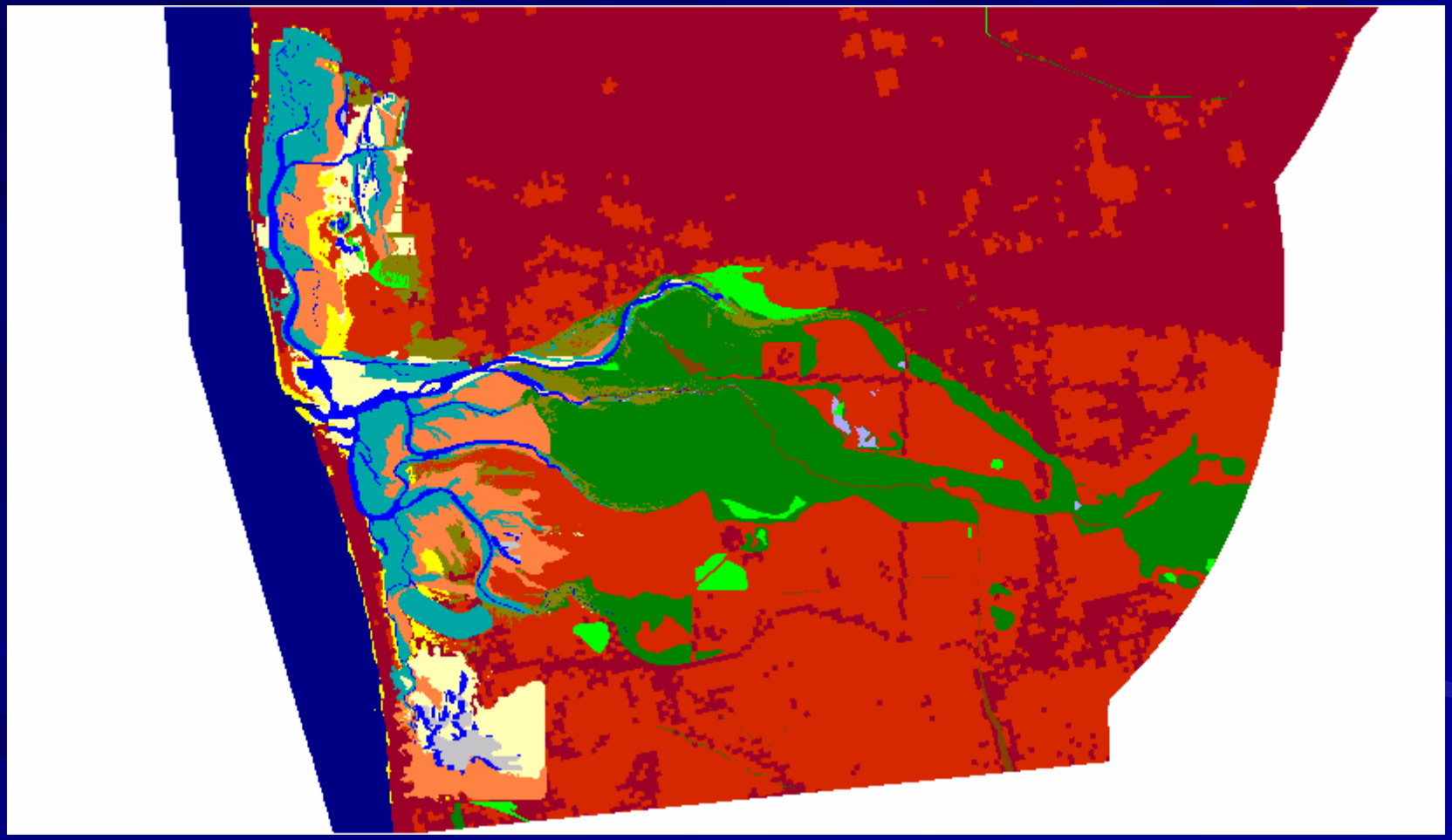

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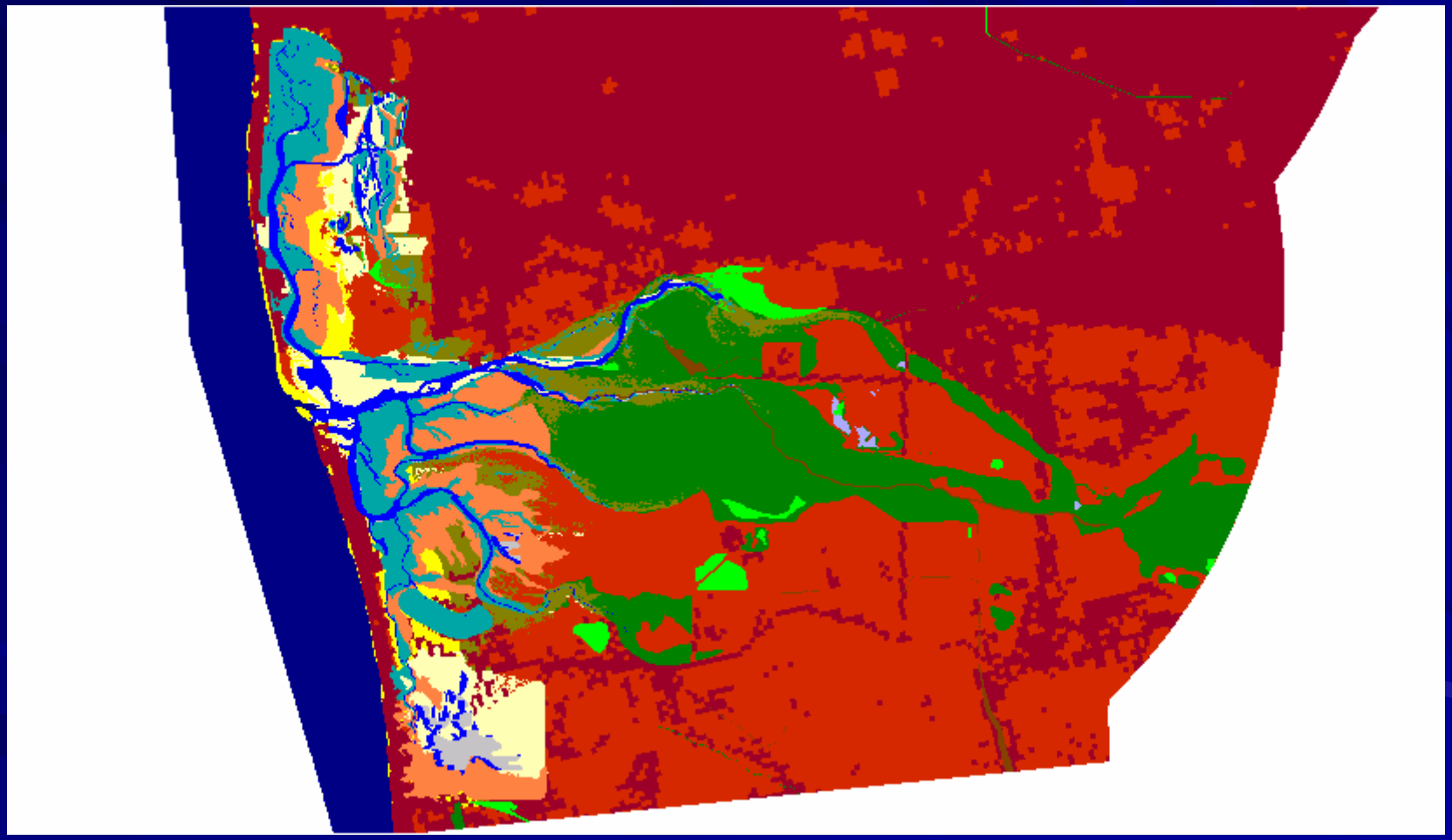

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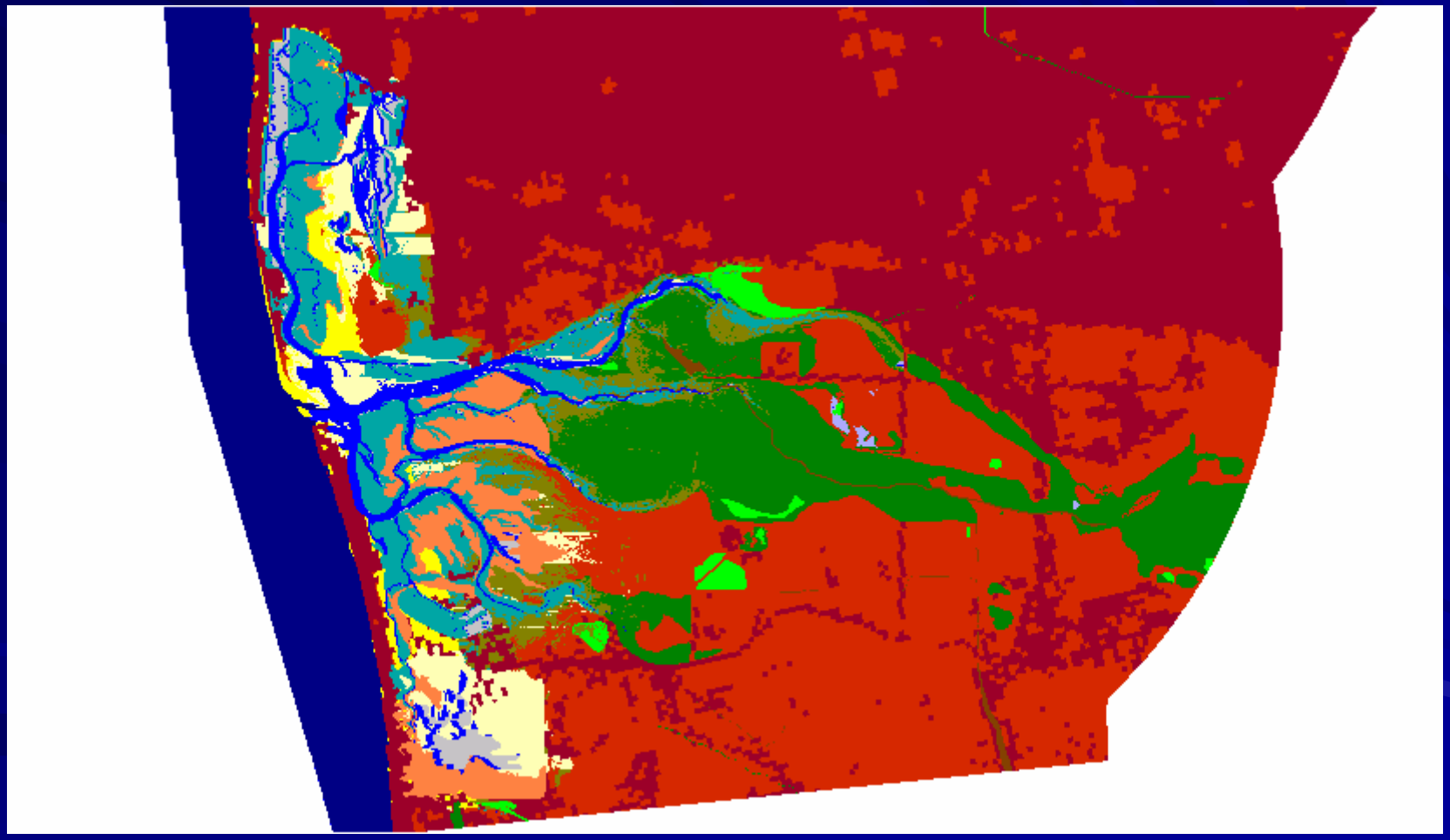

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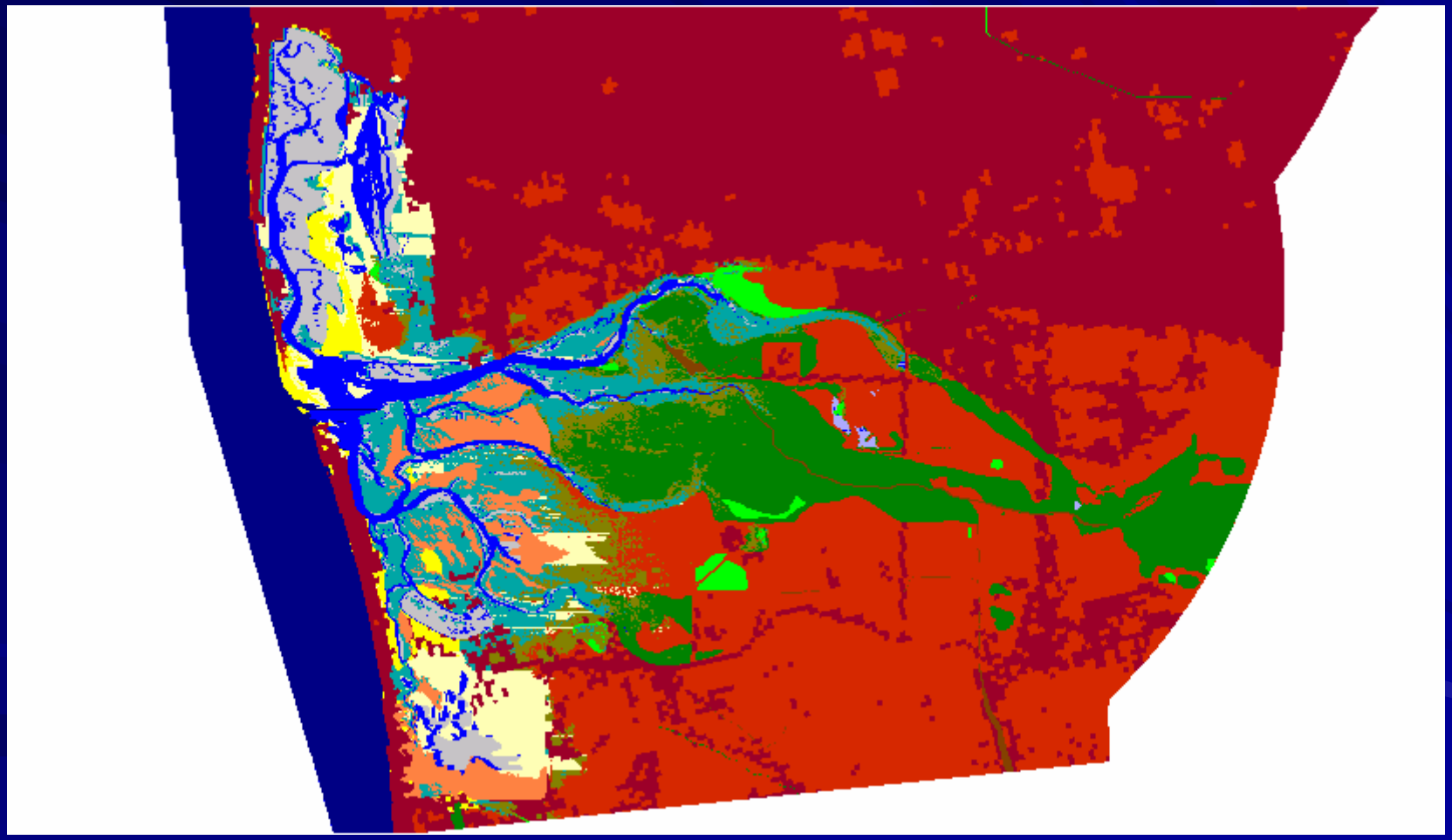

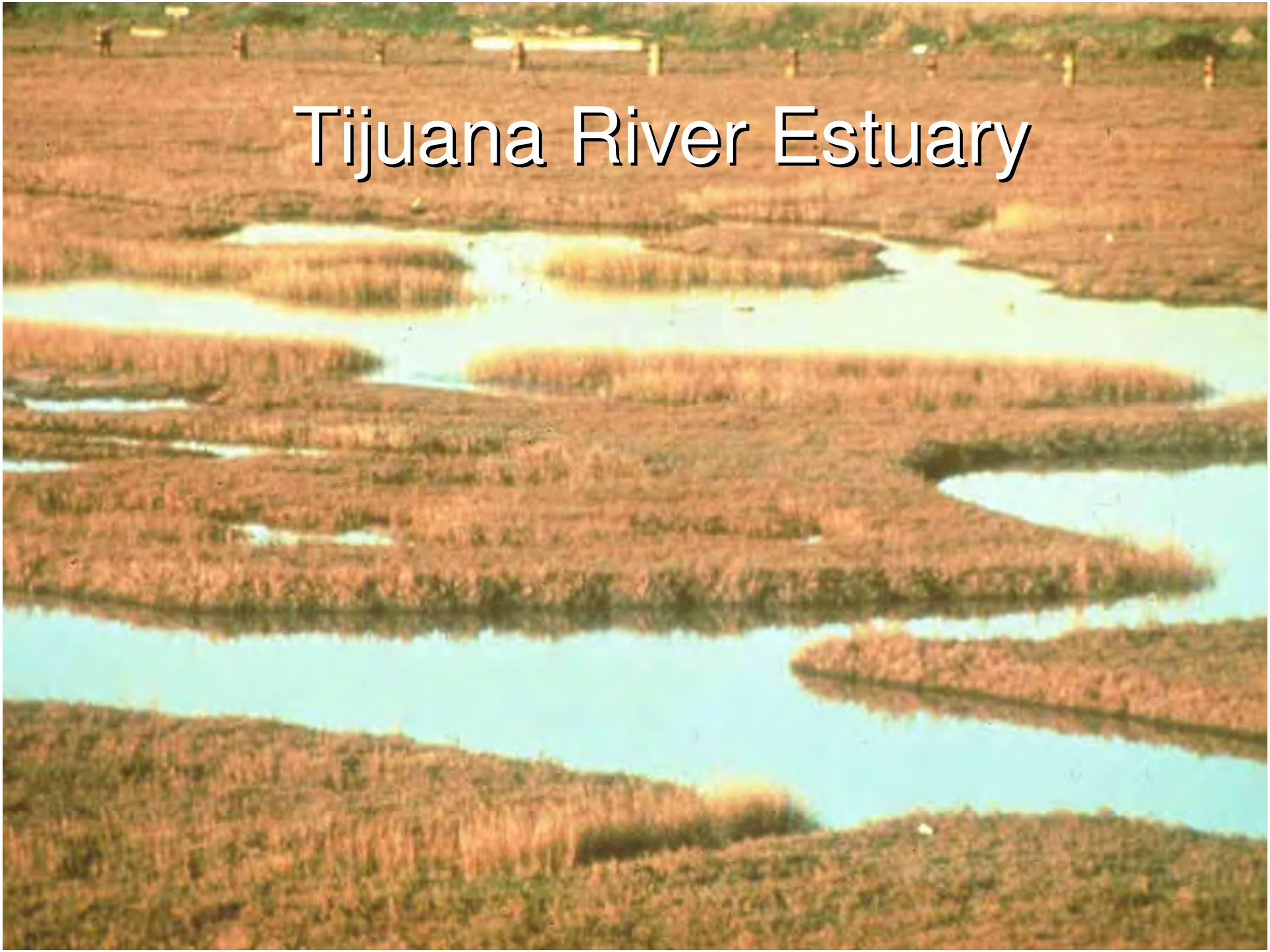
Tijuana River Estuary

Conclusions

- Global Climate Change will become the greatest stressor (and not pollution) to the ecological health of the Tijuana Estuary
- In this new regime, perhaps high rates of sedimentation are good, and will keep the estuarine habitat from being inundated in the future