Sediment Supply from Local Tributaries to the San Francisco Bay

Tan Zi (tanz@sfei.org), Lester McKee, Melissa Foley

SFEI

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San Francisco Estuary Institute (SFEI)

- Applied science think-tank
- CA focus, national impact
- Water Quality, Historical Ecology, Landscape-scale Ecological Planning, Shoreline Adaptation, GSI Planning, Urban Biodiversity…

RMP

EcoAtlas™

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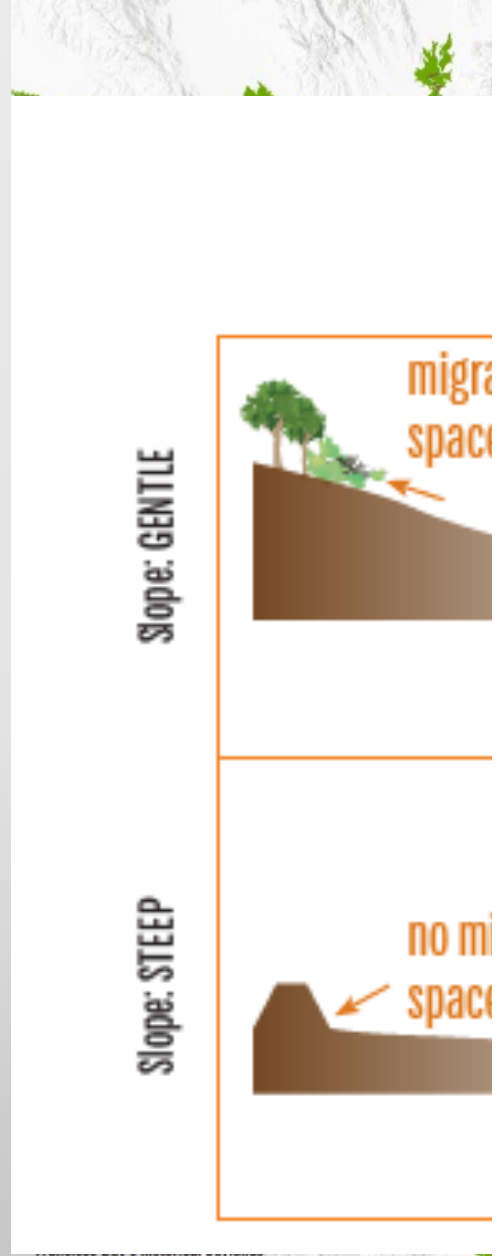
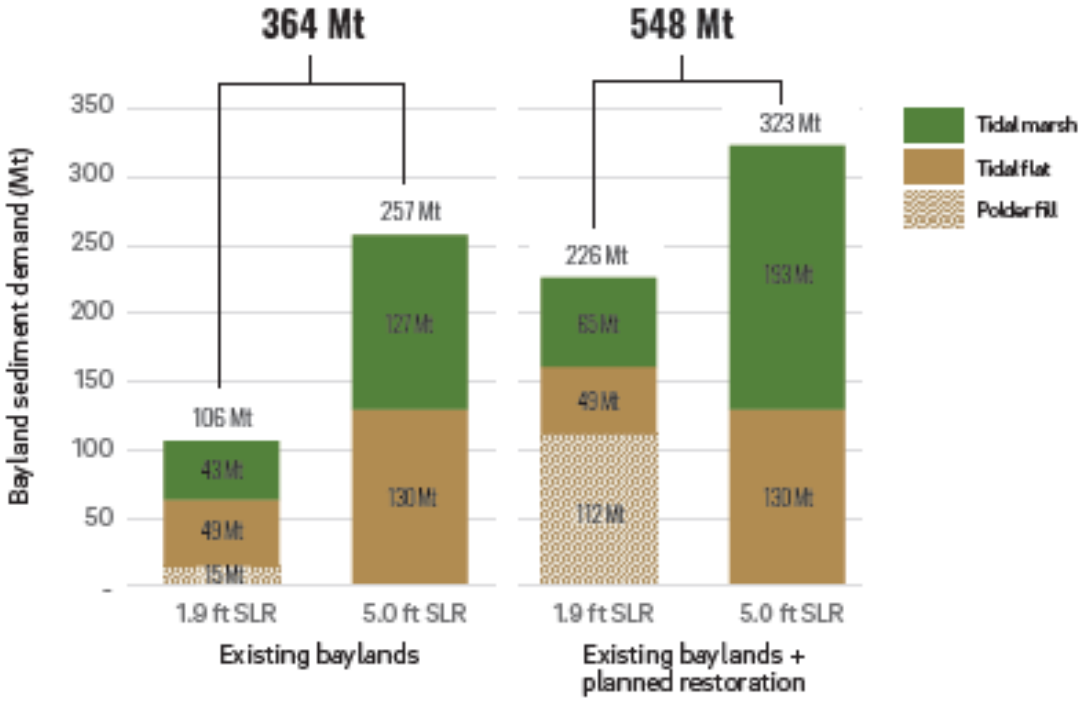
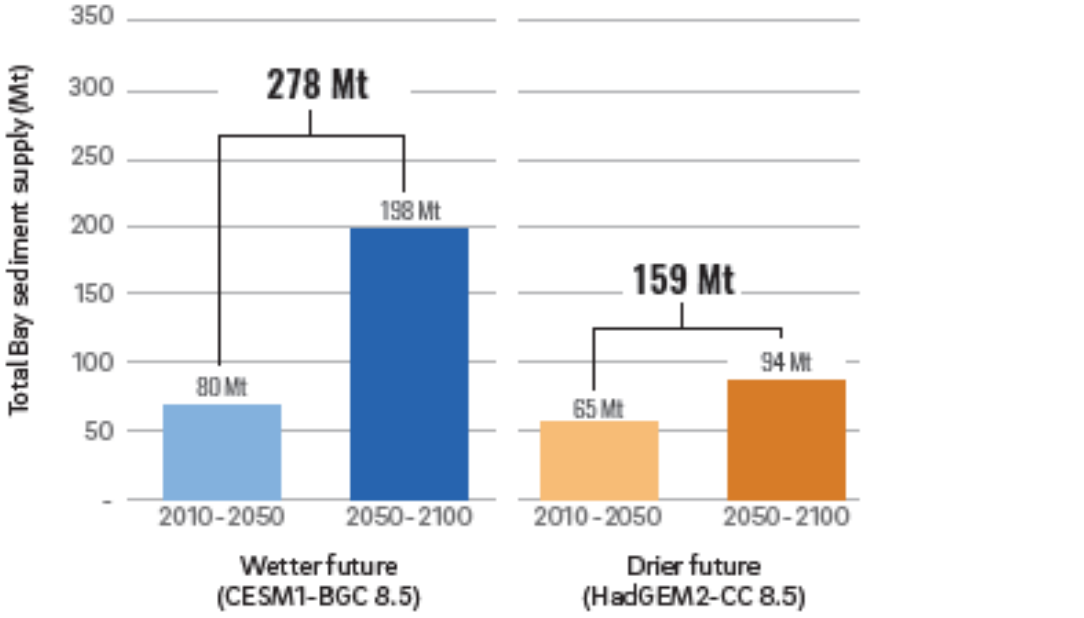
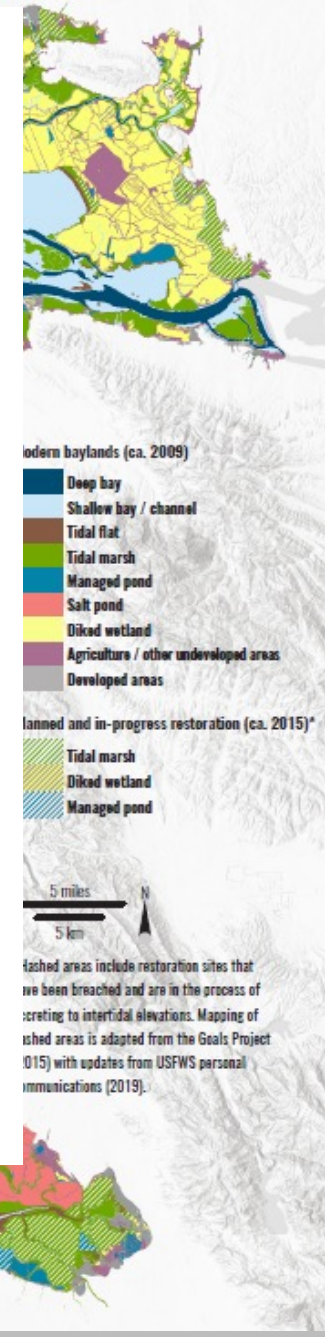


ca. 1800 with modern and planned bayland extents (facing page) [Data sources: Goals Project 2015, SFEI 2017b].







Dusterhoff et al., 2021

Sediment Supply

Dusterhoff et al., 2021

- Local tributaries: 1.3 Mt/yr
- Delta: 0.7 Mt/yr

(Schoellhamer et al. 2018)

The sediment supply from local tributaries was estimated using the derived relationship between flow rate and SSL from gauged watersheds and then extrapolated to ungauged watershed.

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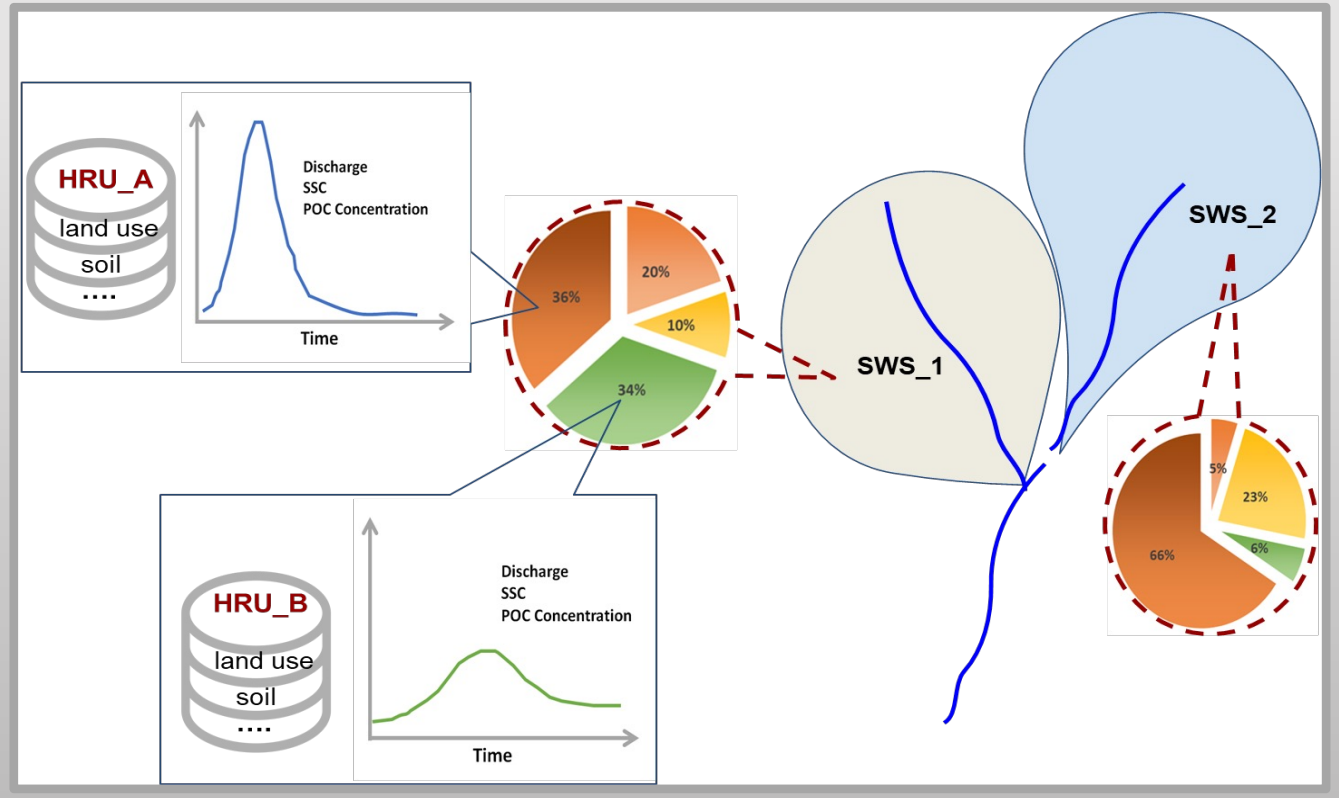
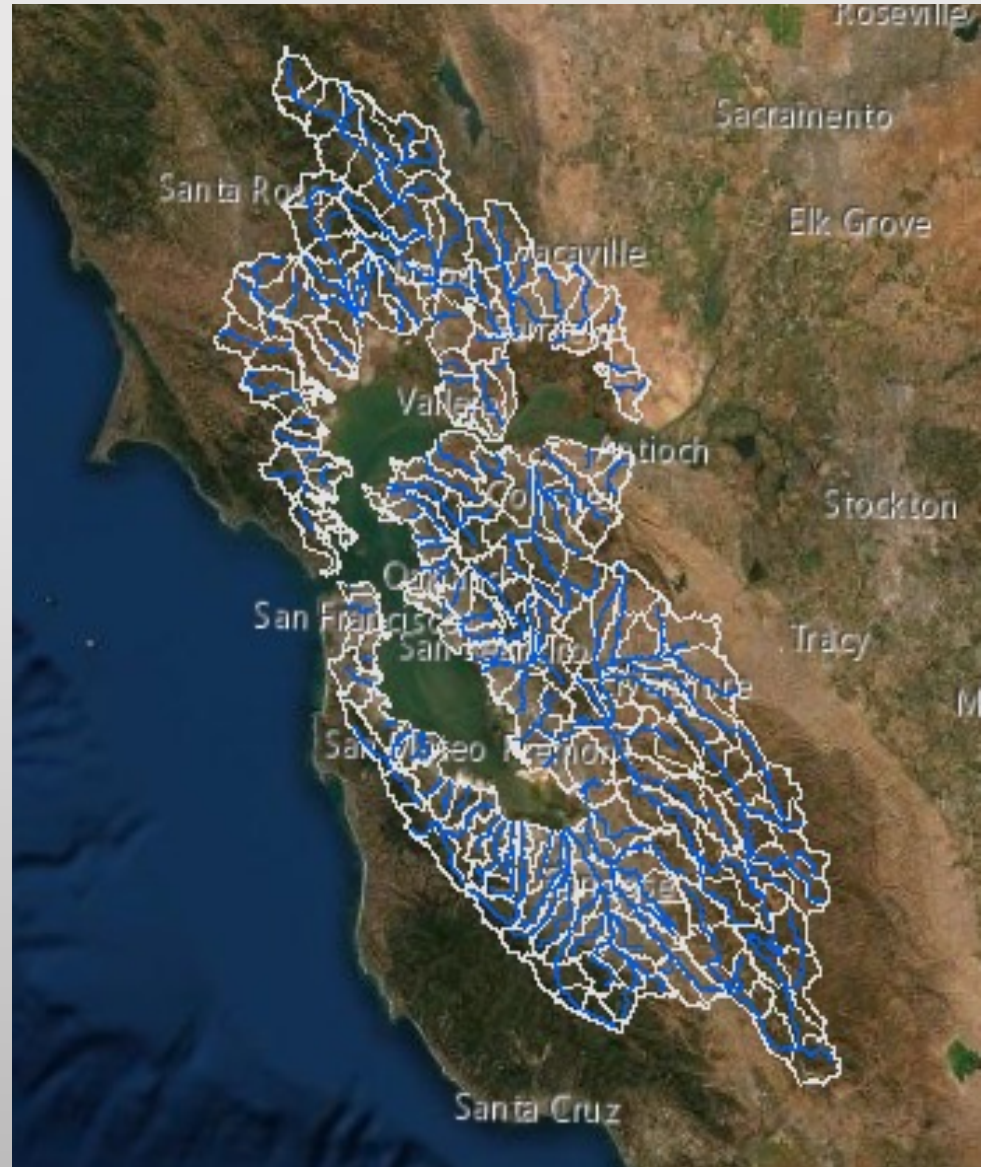
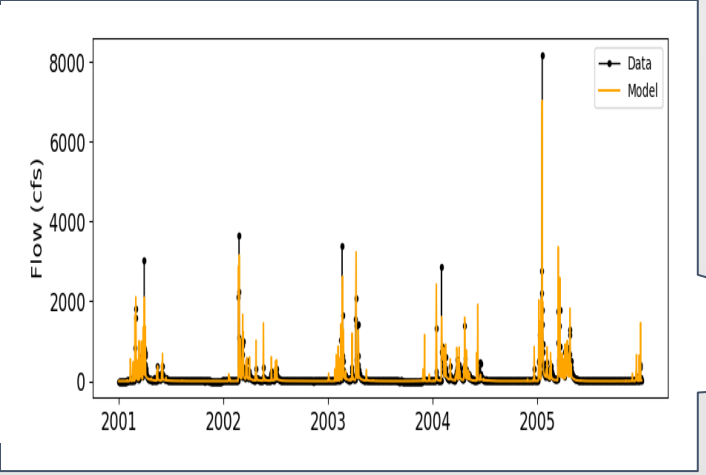
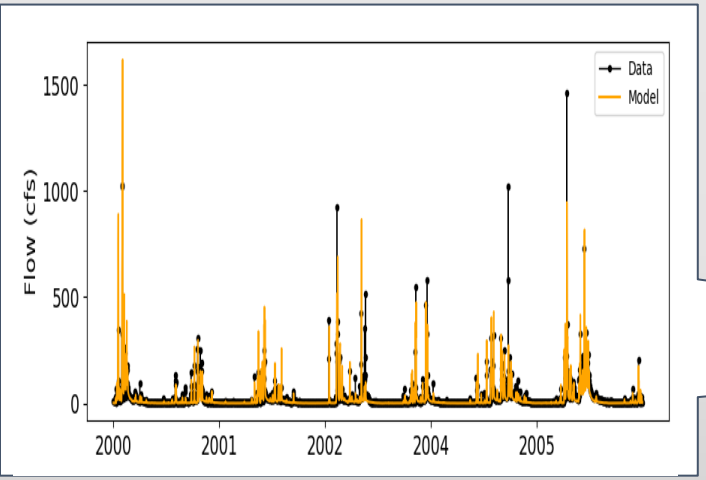
SF Bay Watershed Dynamic Model (WDM)

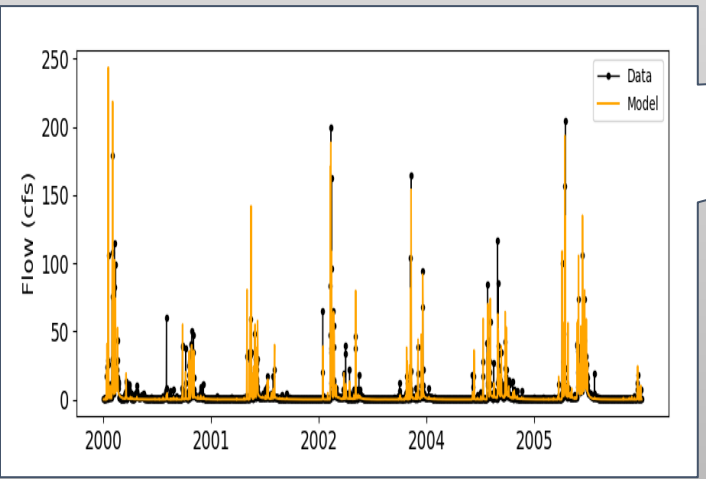
- LSPC
- HRU based
- Local watersheds drain to the Bay
- 1995 to 2020, Hourly time step

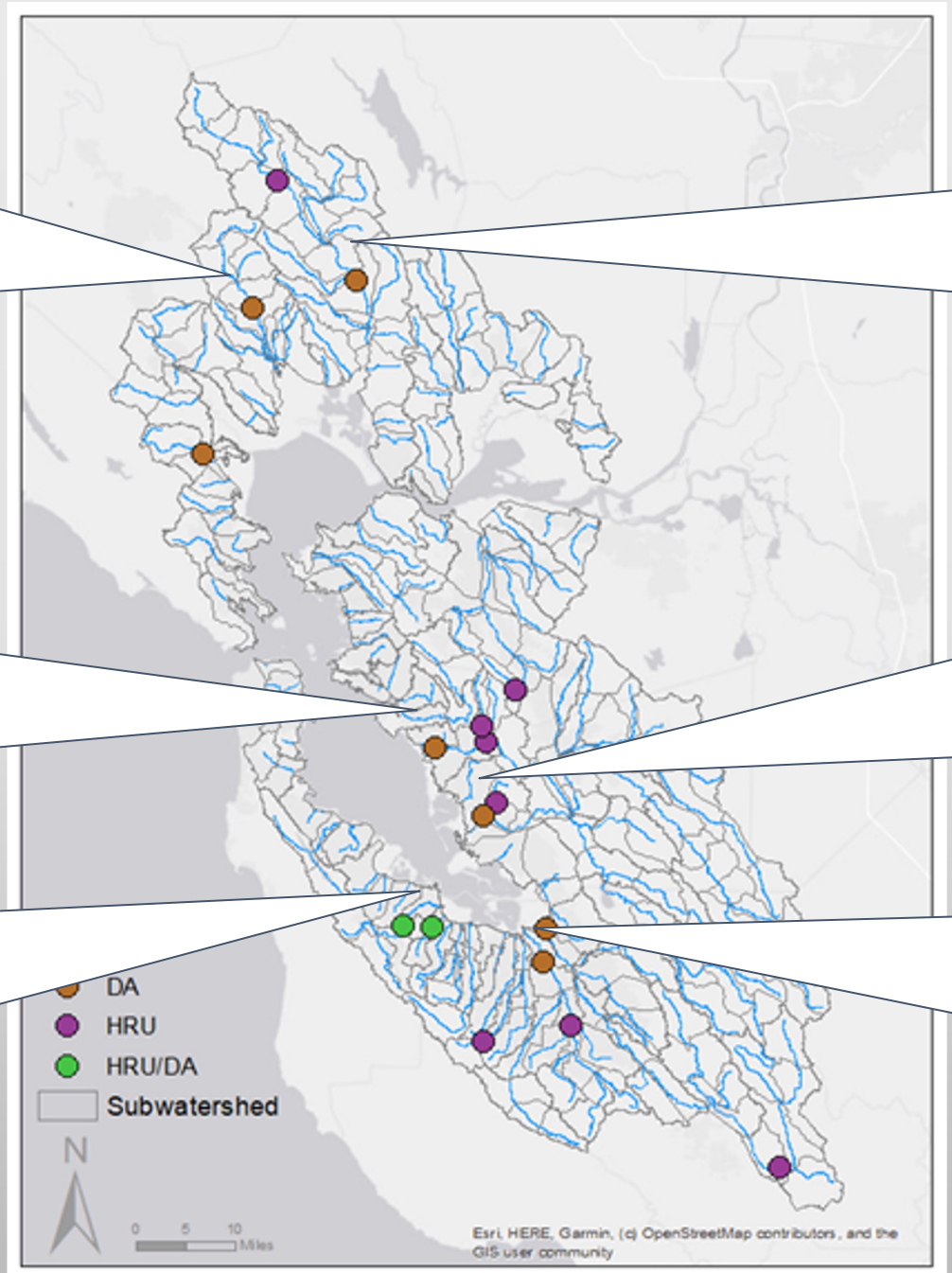


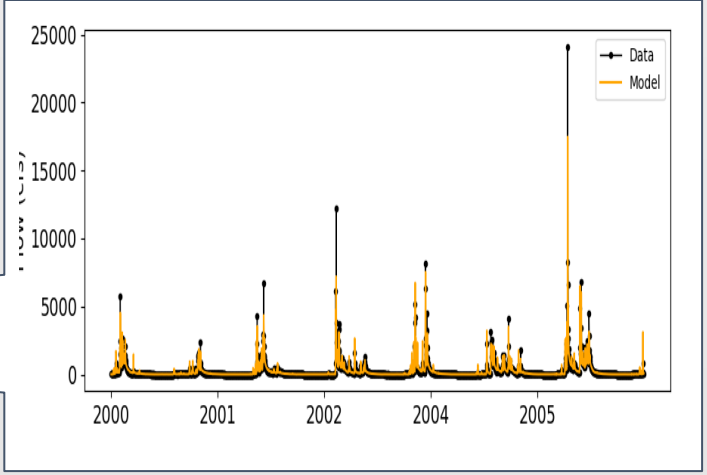


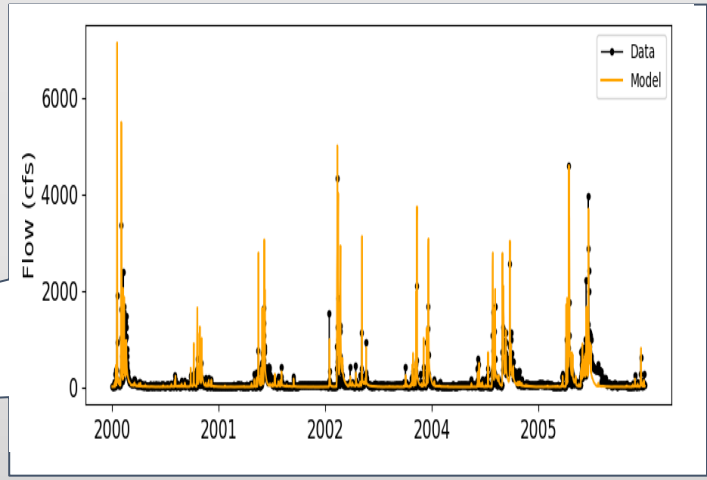

Flow (cfs)
Data
Model
8000
6000
4000
2000
0
2001
2002
2003
2004
2005

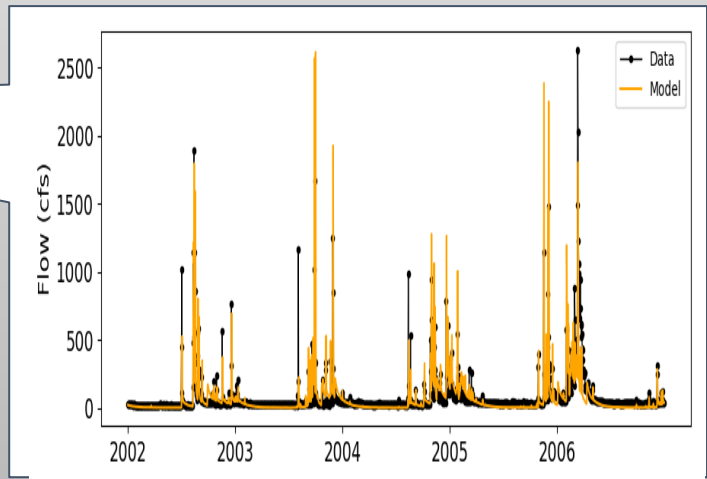

Flow (cfs)
Data
Model
1500
1000
500
0
2000
2001
2002
2004
2005


Flow (cfs)
Data
Model
250
200
150
100
50
0
2000
2001
2002
2004
2005

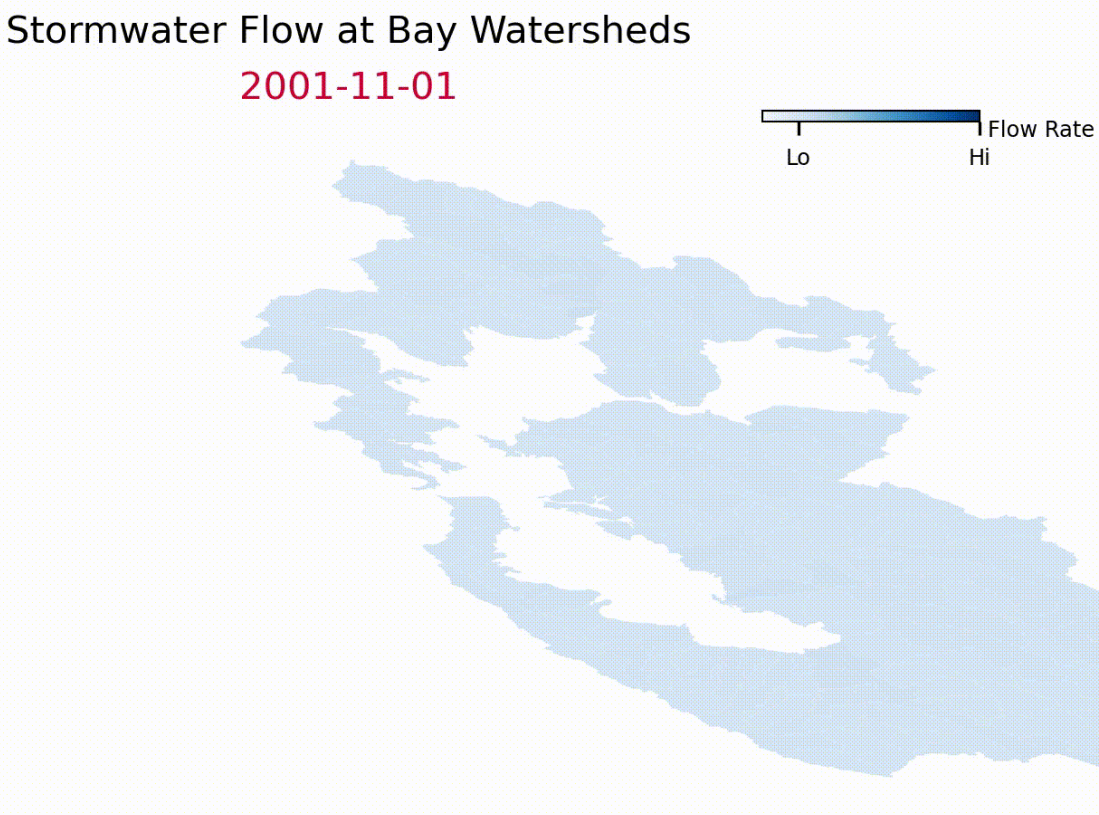

DA
HRU
HRU/DA
Subwatershed
N
0
5
10
Miles
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

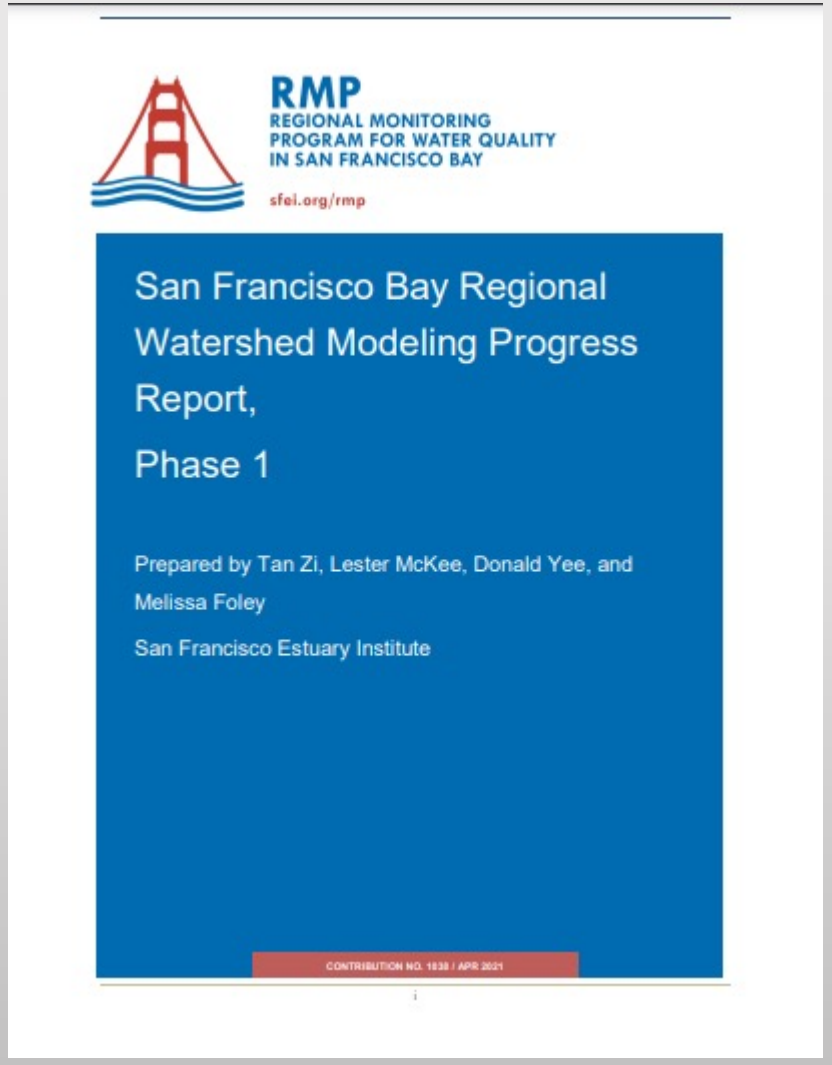

Data
Model
25000
20000
15000
10000
5000
0
2000
2001
2002
2004
2005


Flow (cfs)
Data
Model
6000
4000
2000
0
2000
2001
2002
2004
2005


Flow (cfs)
Data
Model
2500
2000
1500
1000
500
0
2002
2003
2004
2005
2006

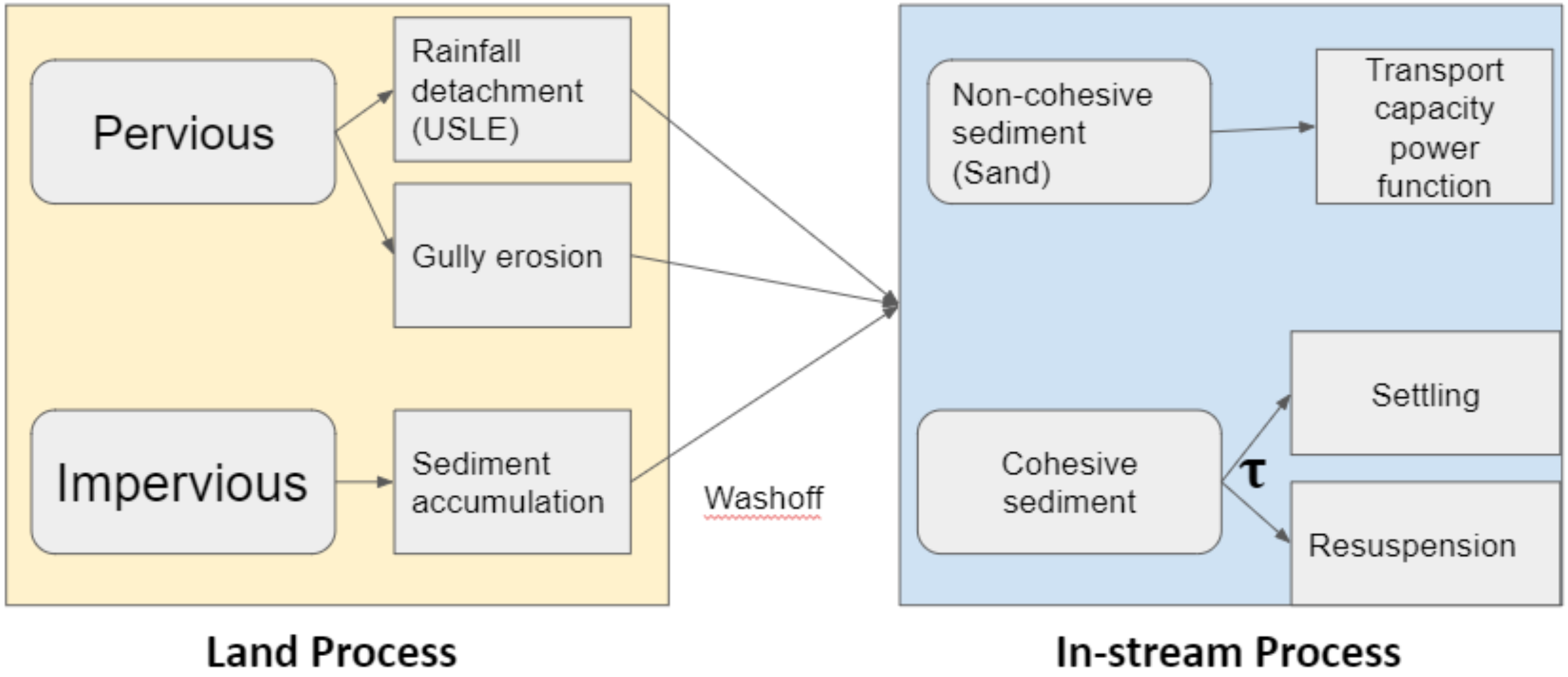
Hydrology simulation





https://www.sfei.org/documents/san-francisco-bay-regional-watershed-modeling-progress-report-phase-1

Sediment modeling general approach



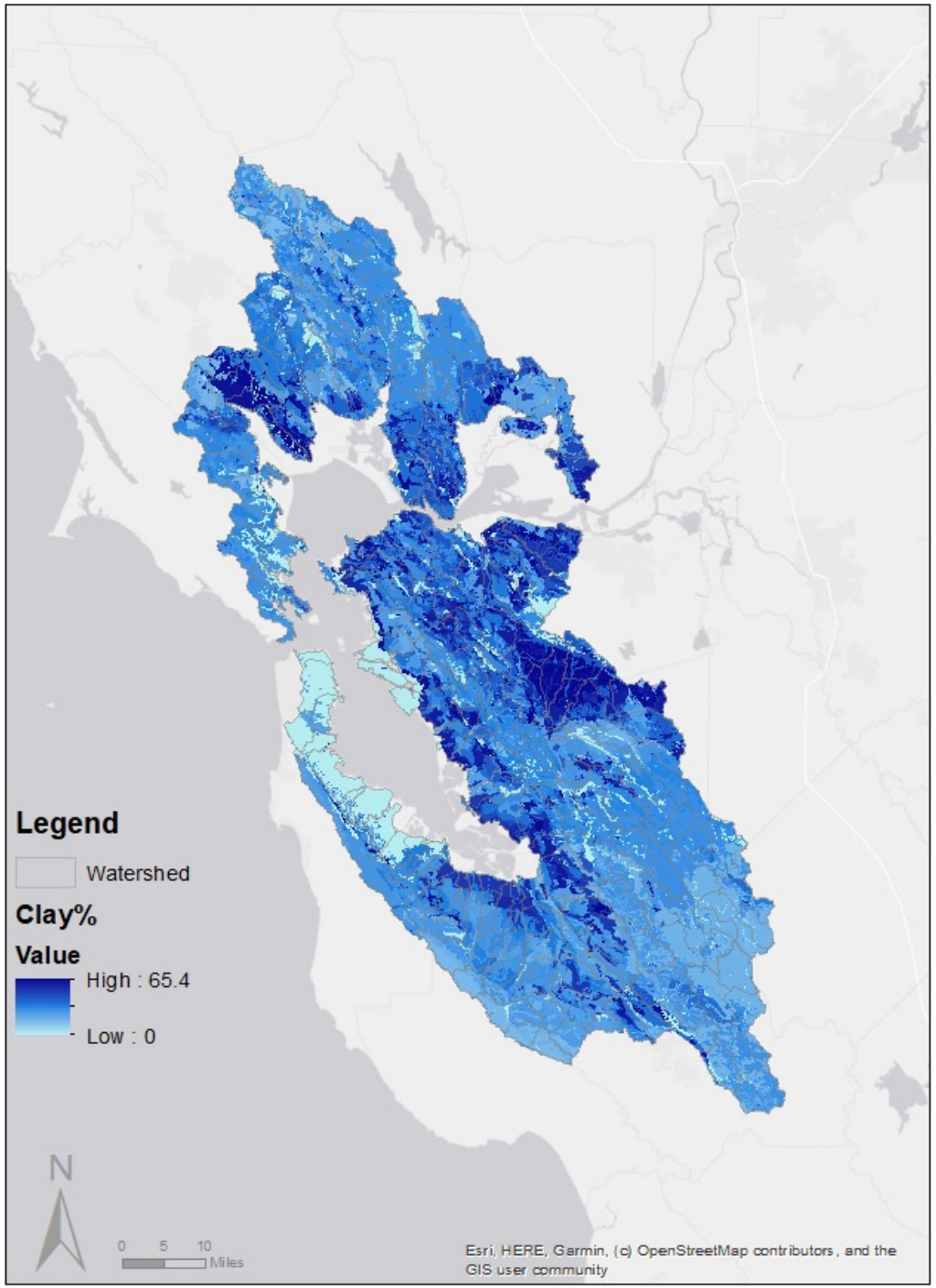
Upland erosion

- K factor (SSURGO database)
- LS factor (SSURGO database)
- Portion of Sand, Silt, and Clay (SSURGO database, sampling data)

USLE -> Soil detachment and transport at field scale

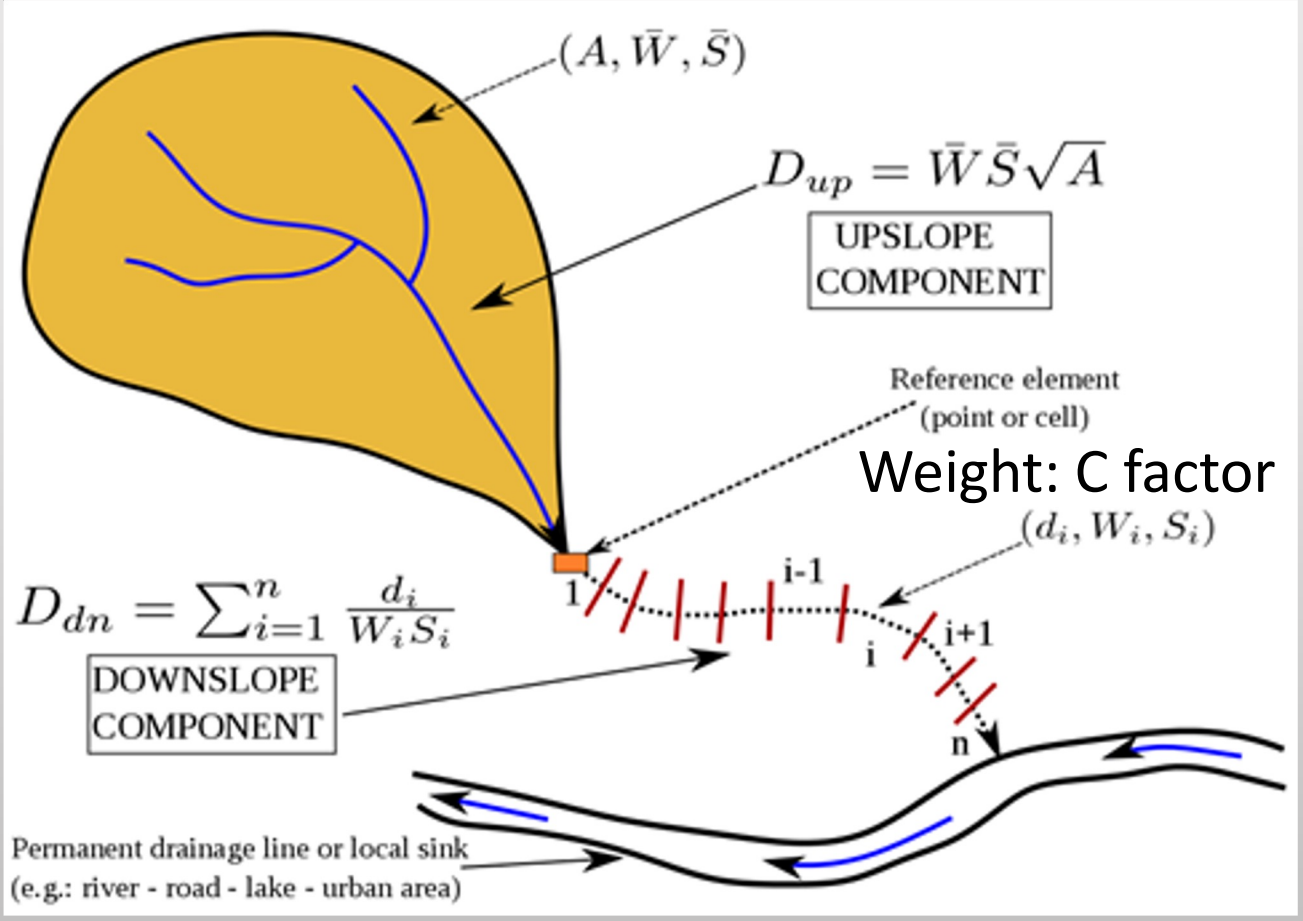
SDR within a subwatershed

Sediment delivered at the edge of stream

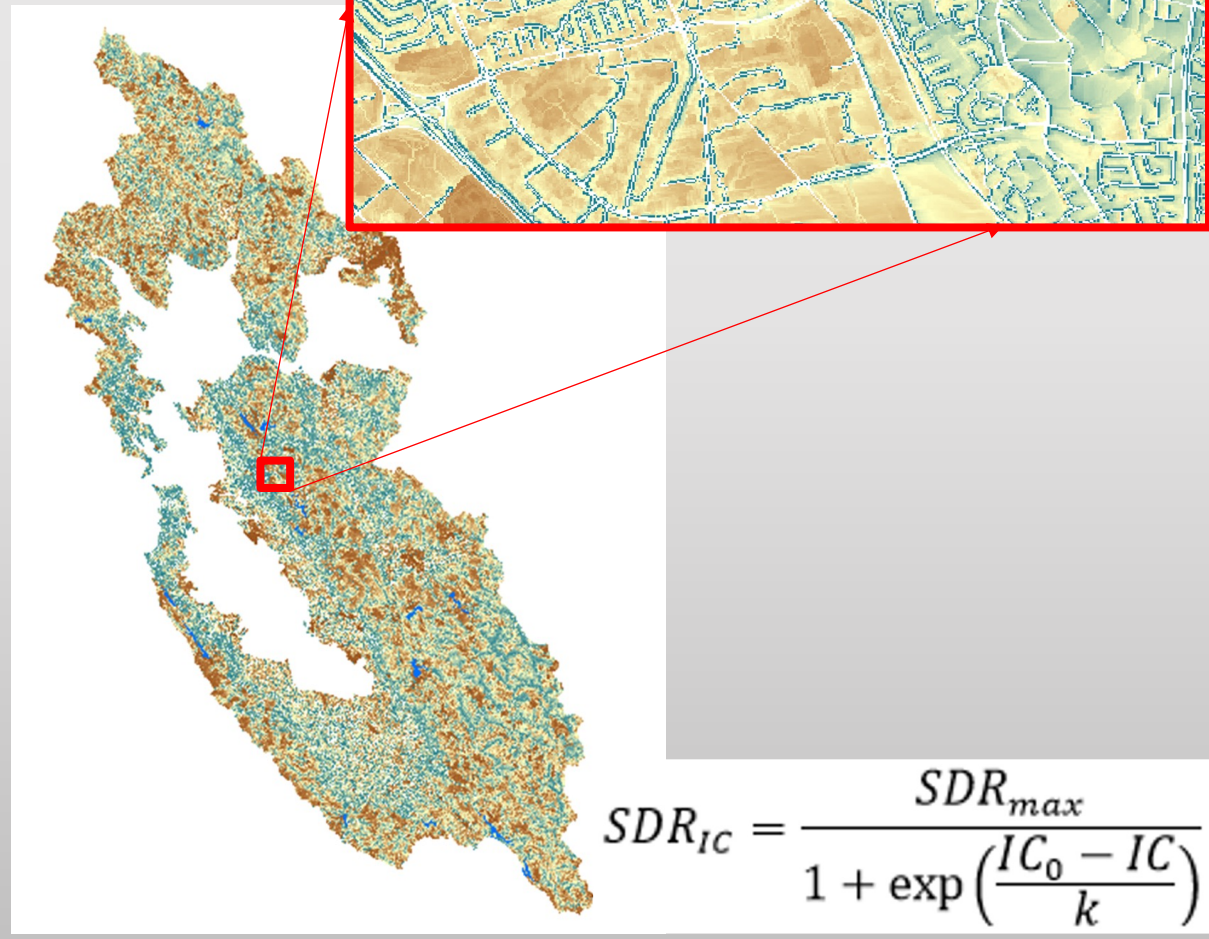


Upland erosion

- Index of connectivity $IC = \log(D_{up}/D_{dn})$



Weight: C factor



$$SDR_{IC} = \frac{SDR_{max}}{1 + \exp\left(\frac{IC_0 - IC}{k}\right)}$$

O. Vigiak et al., 2012

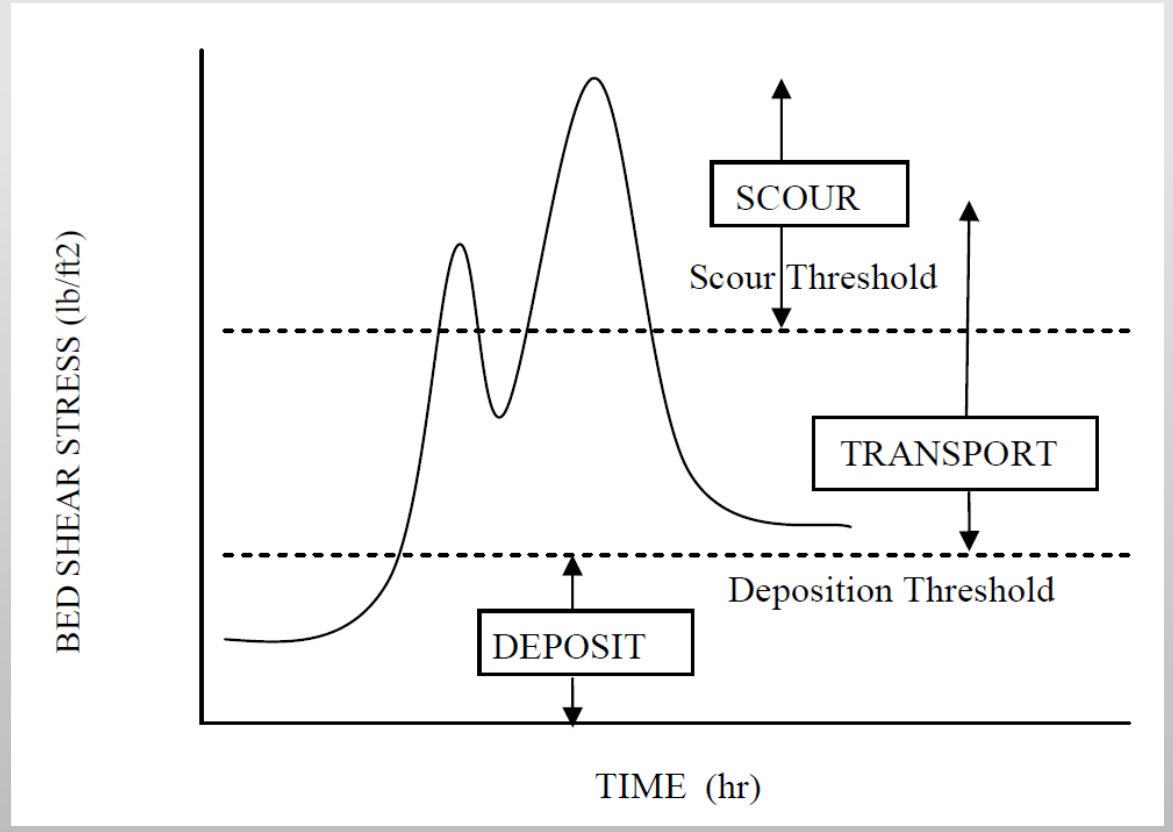
Sediment Yield from Different Land Uses

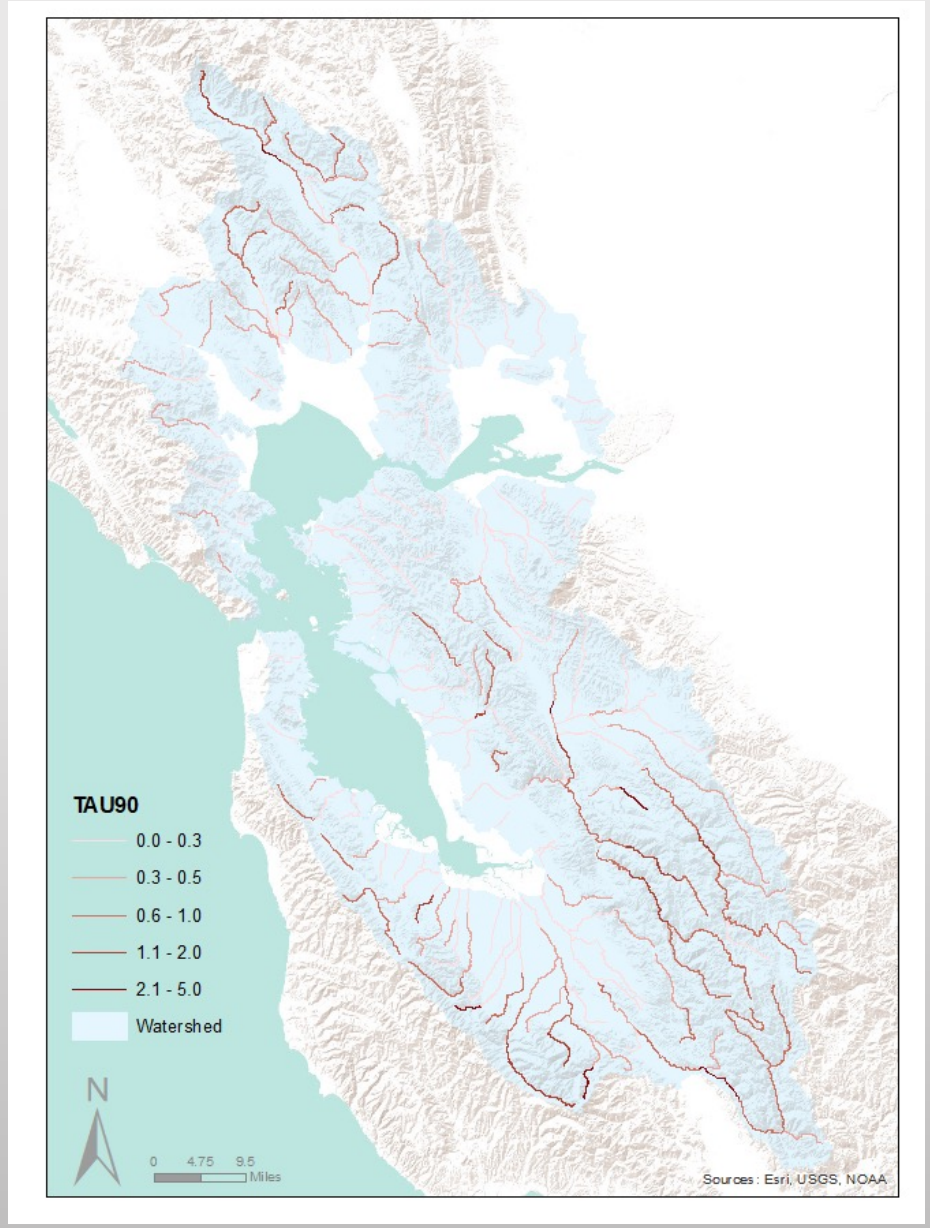
Land Use	SSY from previous studies* (t/km2/yr)			Modeled results
	Min	Mean	Max	Mean
Natural	0.3		72	22
Agricultural		2461		582
Urban	21		996	152
Industrial		1836		383
Commercial		112		145

*McKee et al., 2009

Reach transport process

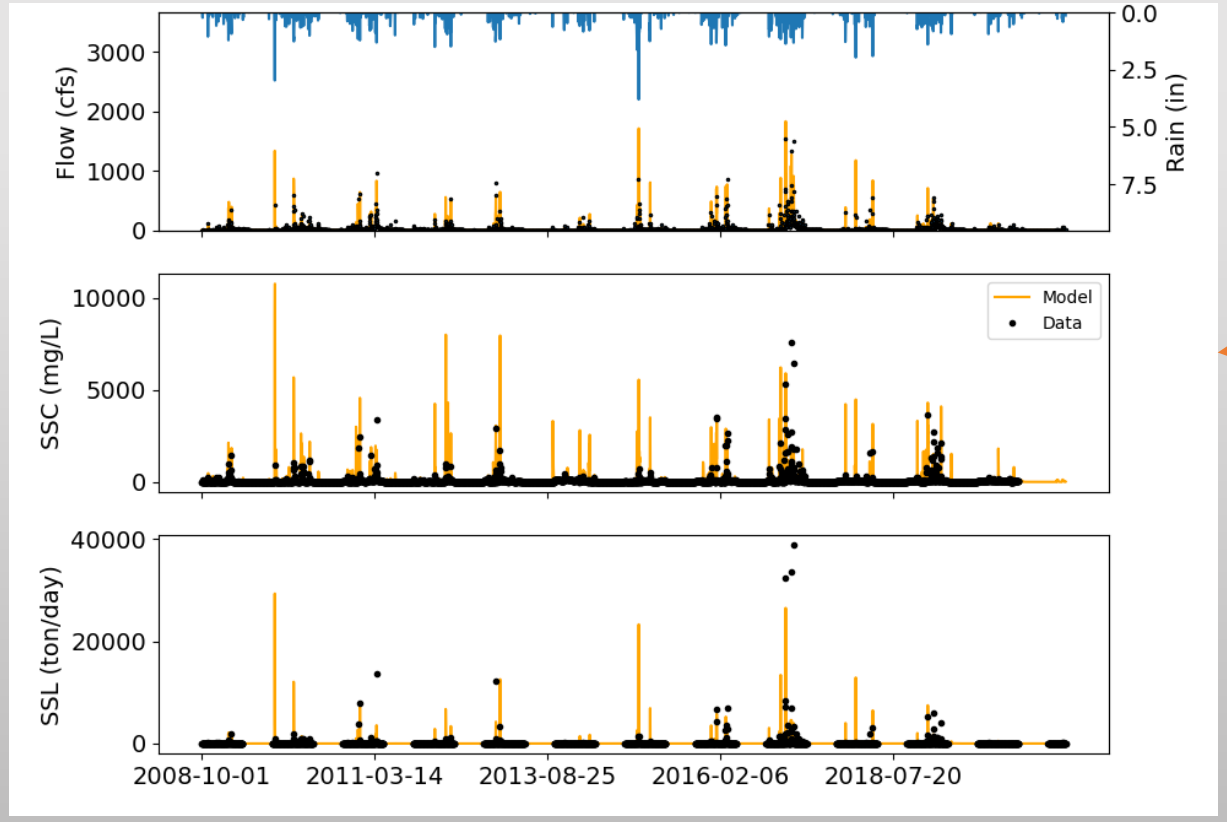
- Hydraulic based calculation
  - USGS rating curves
  - Customized F-table

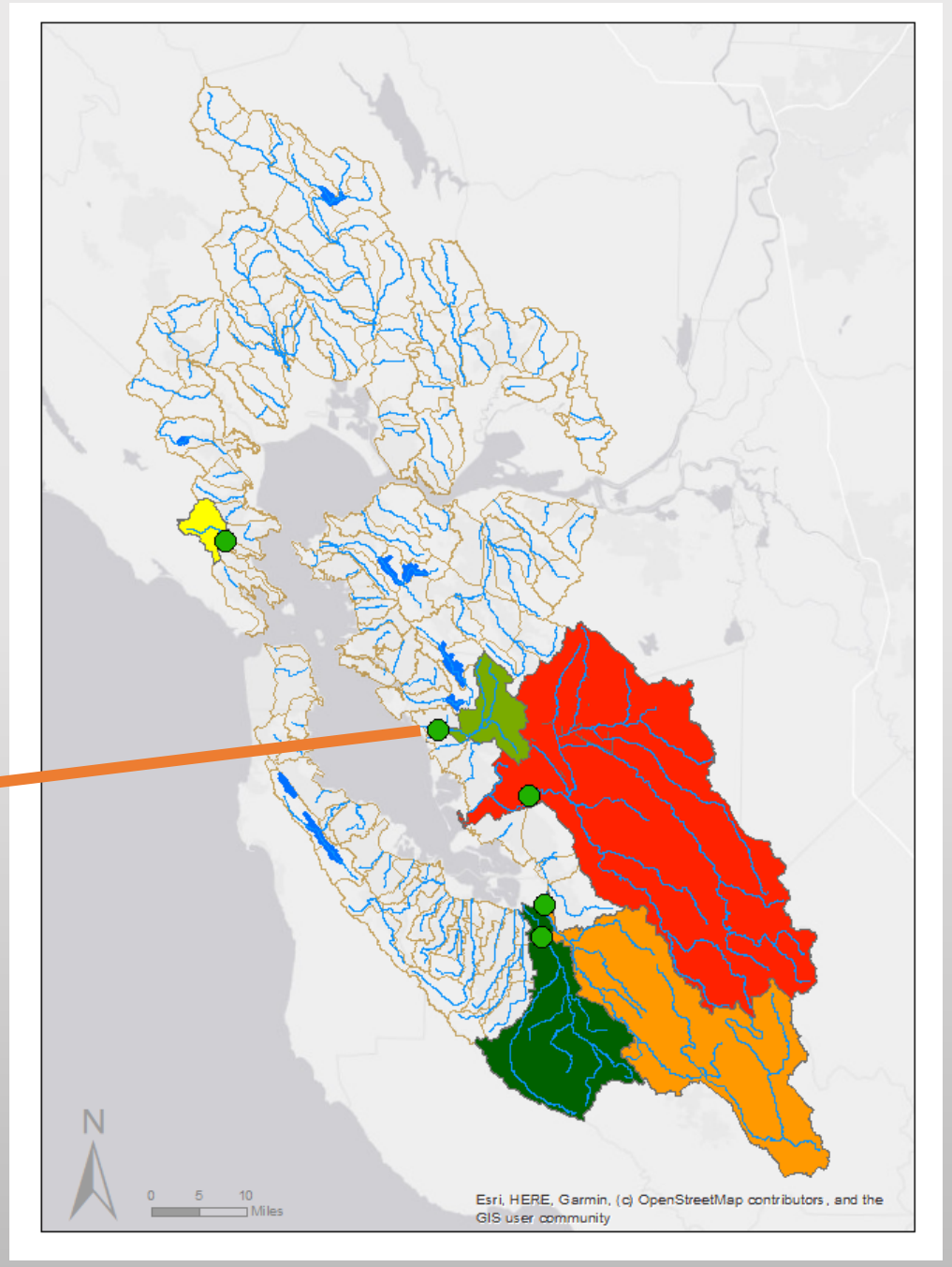




Sediment load calibration

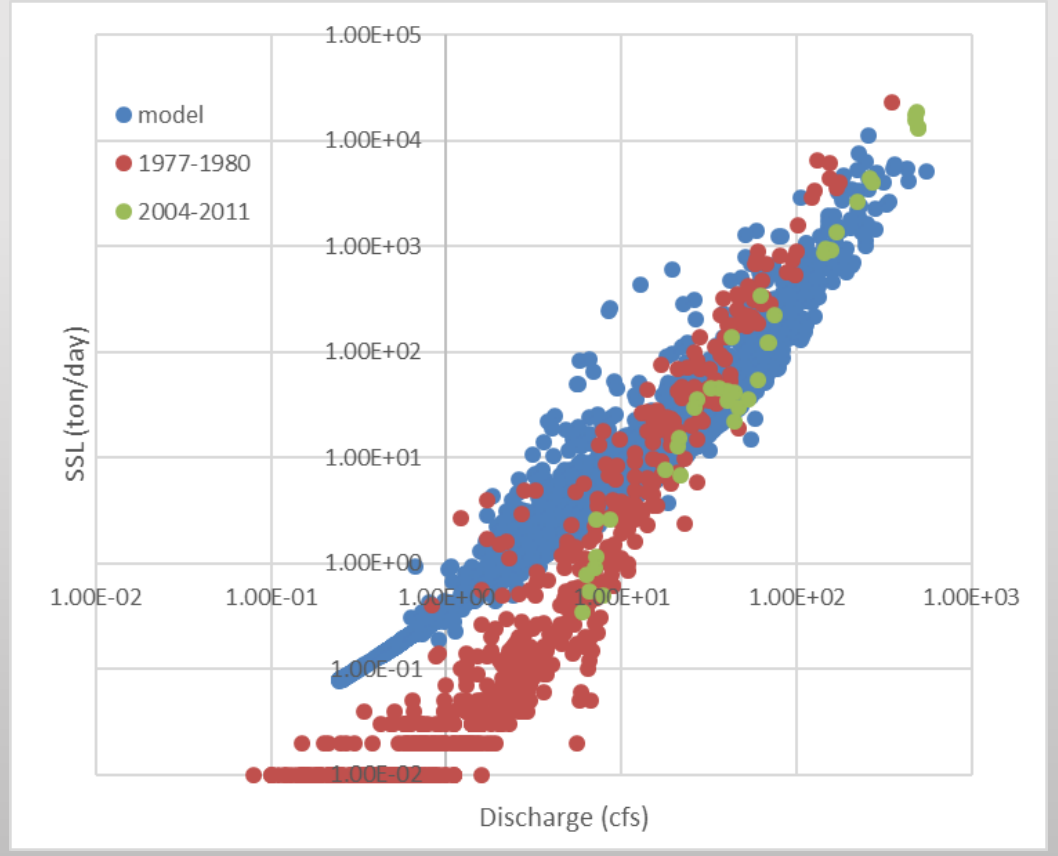
- Five gauged watersheds
- USGS Daily SSL time series





Sediment load calibration

Gage No.	Gage Name	Hydro-NSE	Hydro-RE	Sed-RE	Sand Percentage
11169025	GUADALUPE R ABV HWY 101 A SAN JOSE CA	0.87	6%	-3%	17% (16%)
11172175	COYOTE C AB HWY 237 A MILPITAS CA	0.57	1%	-16%	27% (26%)
11179000	ALAMEDA C NR NILES CA	0.79	-2%	-7%	14% (16%)
11181040	SAN LORENZO C A SAN LORENZO CA	0.92	4%	16%	19% (23%)
11460000	CORTE MADERA C A ROSS CA	0.91	4%	-4%	19% (21%)

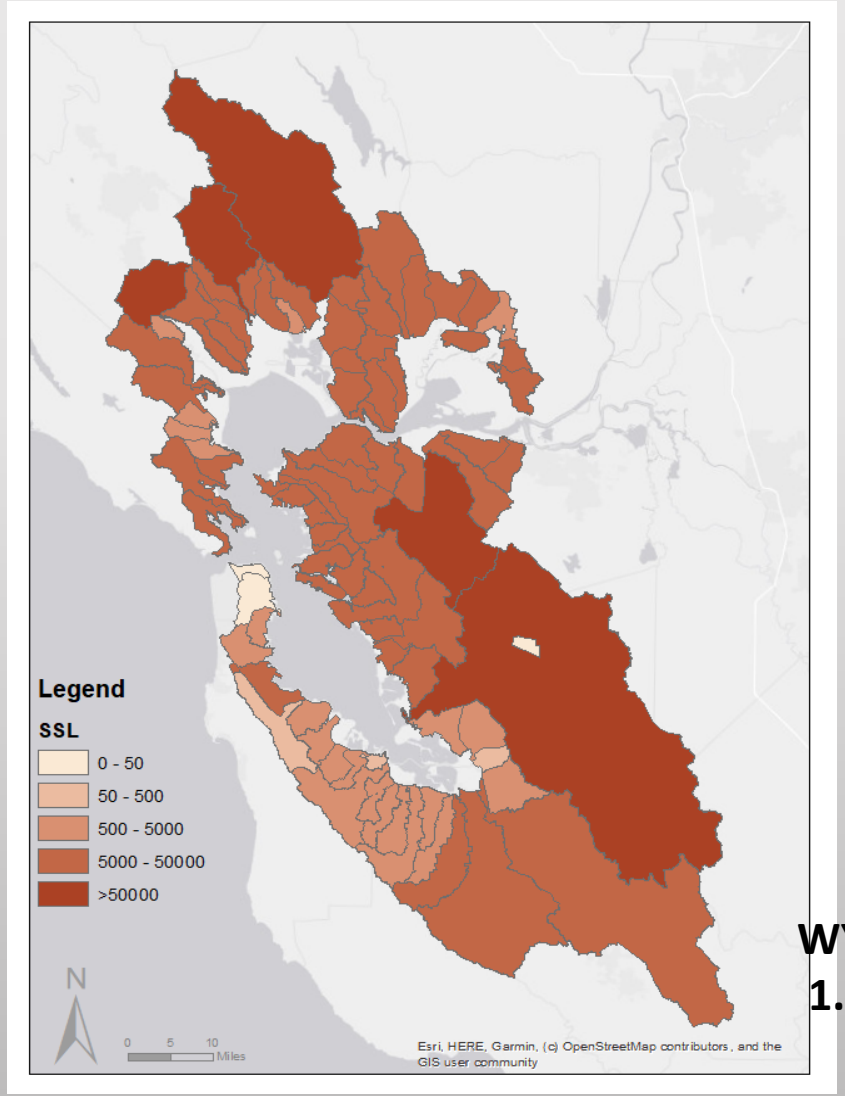


Wildcat discharge-SSL correlation check

Sediment supply from local tributaries

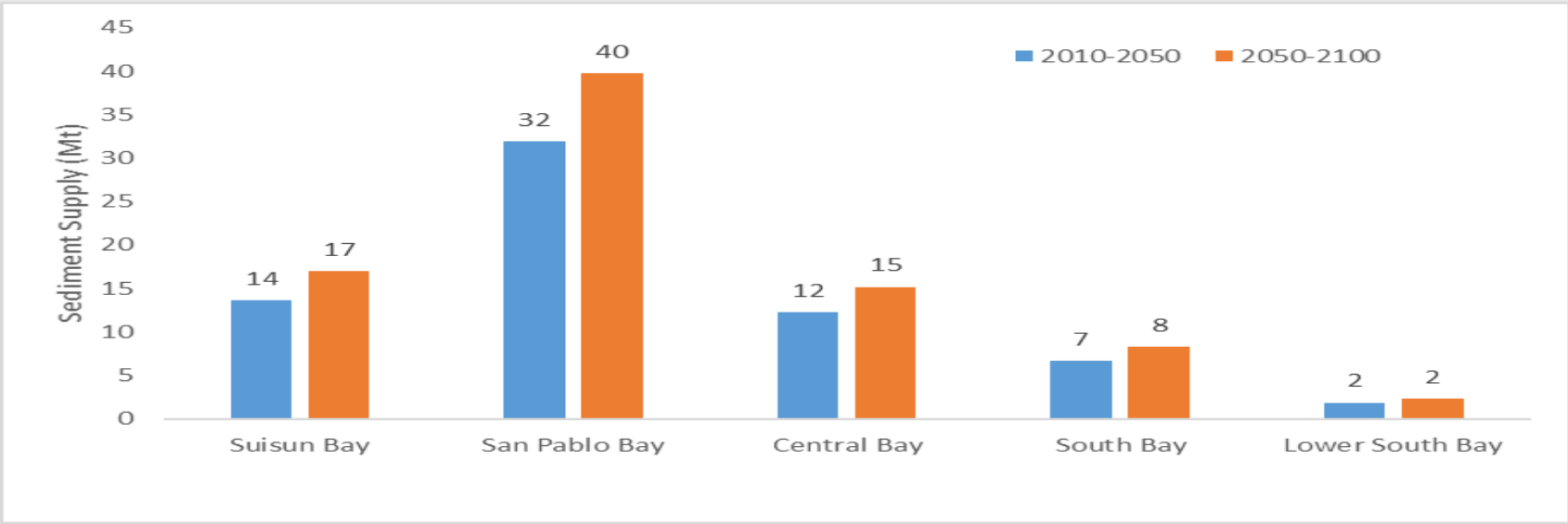
Dusterhoff et al., 2021

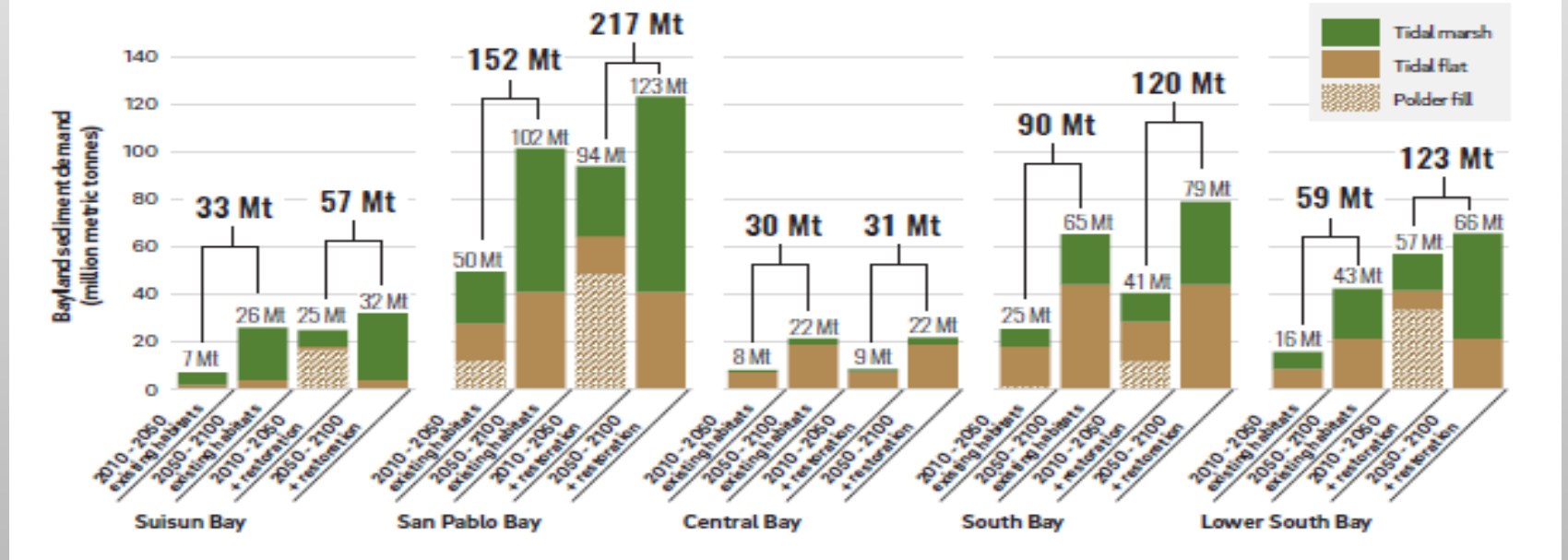
WY 1995-2016
1.3 Mt/yr
(Schoellhamer et al. 2018)



WY 1995-2020
1.6 Mt/yr

Sediment supply from local tributaries





Sediment Supply from Delta:
2010-2050: 65 - 80 Mt
2050-2100: 94 - 198 Mt

Dusterhoff et al., 2021

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What's next?

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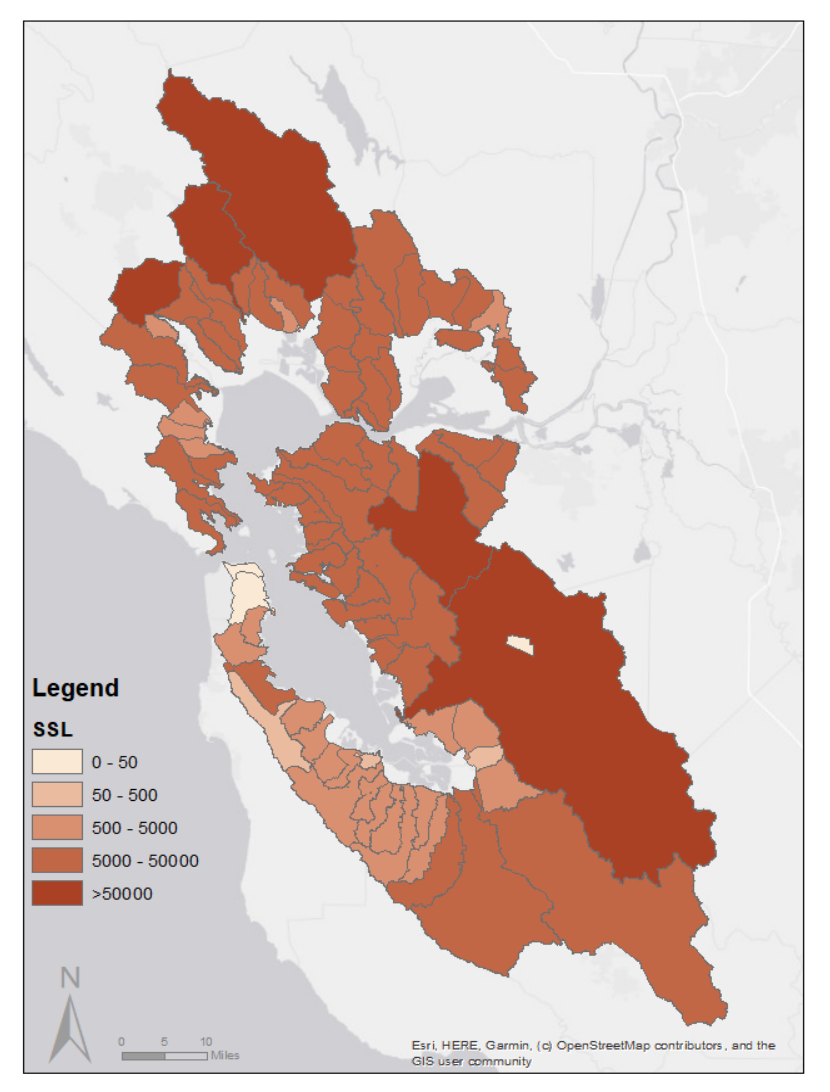
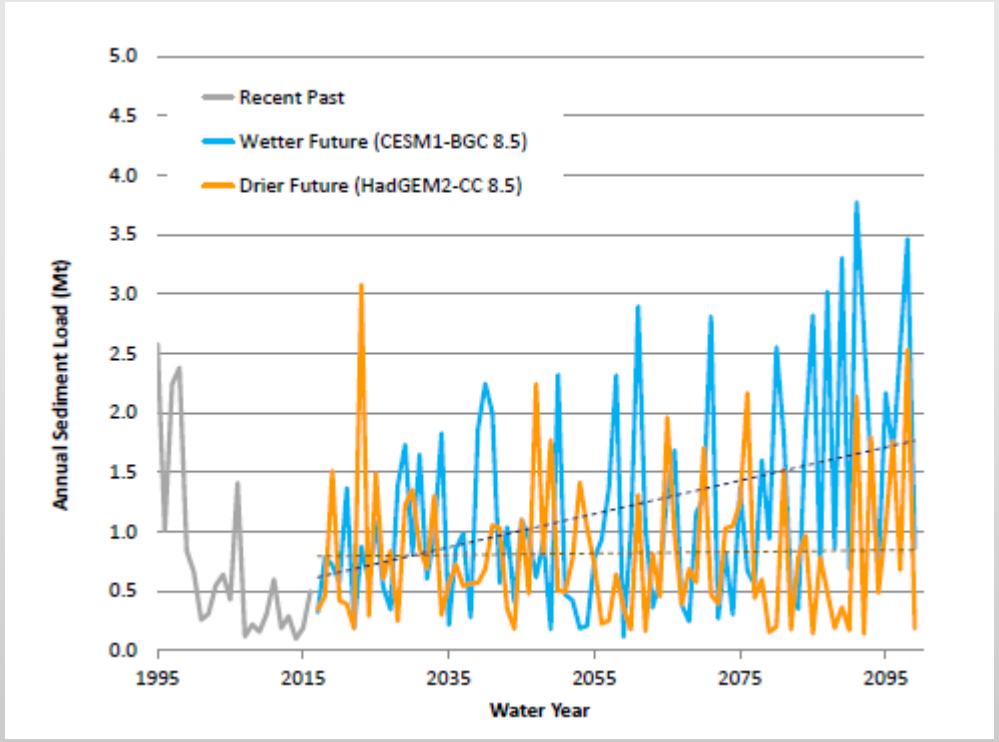
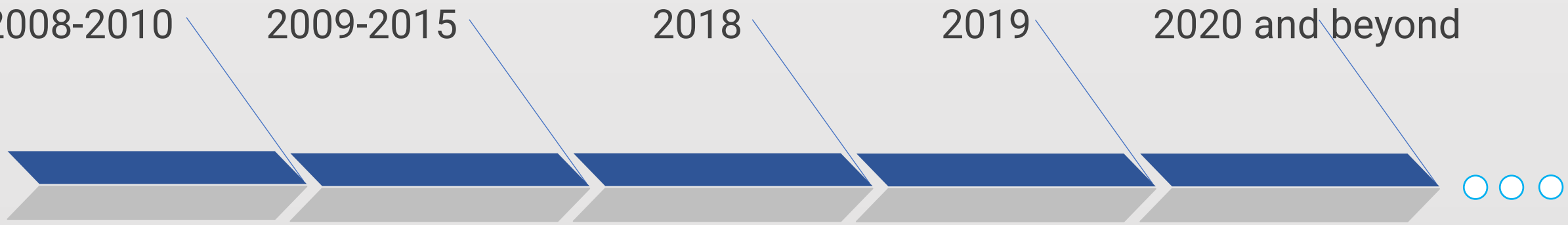
Local sediment supply in future





SF Bay Watershed Dynamic Model (WDM)



PCB Hg TMDLs

50% reduction in Hg loads by 2028

90% reduction in PCB loads by 2030

MRP

Implementation of control measures to reduce PCB and Hg loads from urbanized tributaries

STLS Strategy

Outlined management questions

MIP

Prioritized the development of regional watershed model for POC trends evaluation

SF Bay Watershed Dynamic Model (WDM)

Hydrology

Sediment

POCs

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2009-0076

APPROVING AN AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE SAN FRANCISCO BAY REGION (BASIN PLAN) TO ESTABLISH A TOTAL MAXIMUM DAILY LOAD (TMDL) FOR POLYCHLORINATED BIPHENYLS (PCBs) IN THE SAN FRANCISCO BAY

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

RESOLUTION R2-2006-0052

AMENDING THE WATER QUALITY CONTROL PLAN FOR THE SAN FRANCISCO BAY REGION TO ESTABLISH NEW MERCURY WATER QUALITY OBJECTIVES AND TO AMEND THE TOTAL MAXIMUM DAILY LOAD AND IMPLEMENTATION PLAN FOR MERCURY IN SAN FRANCISCO BAY

California Regional Water Quality Control Board
San Francisco Bay Region
Municipal Regional Stormwater NPDES Permit

Order No. R2-2015-0049
NPDES Permit No. CAS612008
November 19, 2015

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Multi-year Model Implementation Plan

- Hydrology (2020)
- Sediment (2021)
- Water Quality
  - PCBs, Hg (2022 -2023)
  - Emerging Contaminants
  - Metals
  - Microplastics
  - Pesticide
  - Pathogen
  - Nutrients
- Stream Temperature

Beyond 2023

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Integrated Watershed Bay Modeling Strategy

A strategy that integrates, links, and advances modeling tools to evaluate transport and loading of pollutants and sediment to San Francisco Bay

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Thank you!
Questions?

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