DICU Model

Towards Improving Modeling the Delta: Pilot Study at Fabian Tract

California Water and Environmental Modeling Forum

University of California at Davis, August 10, 2012

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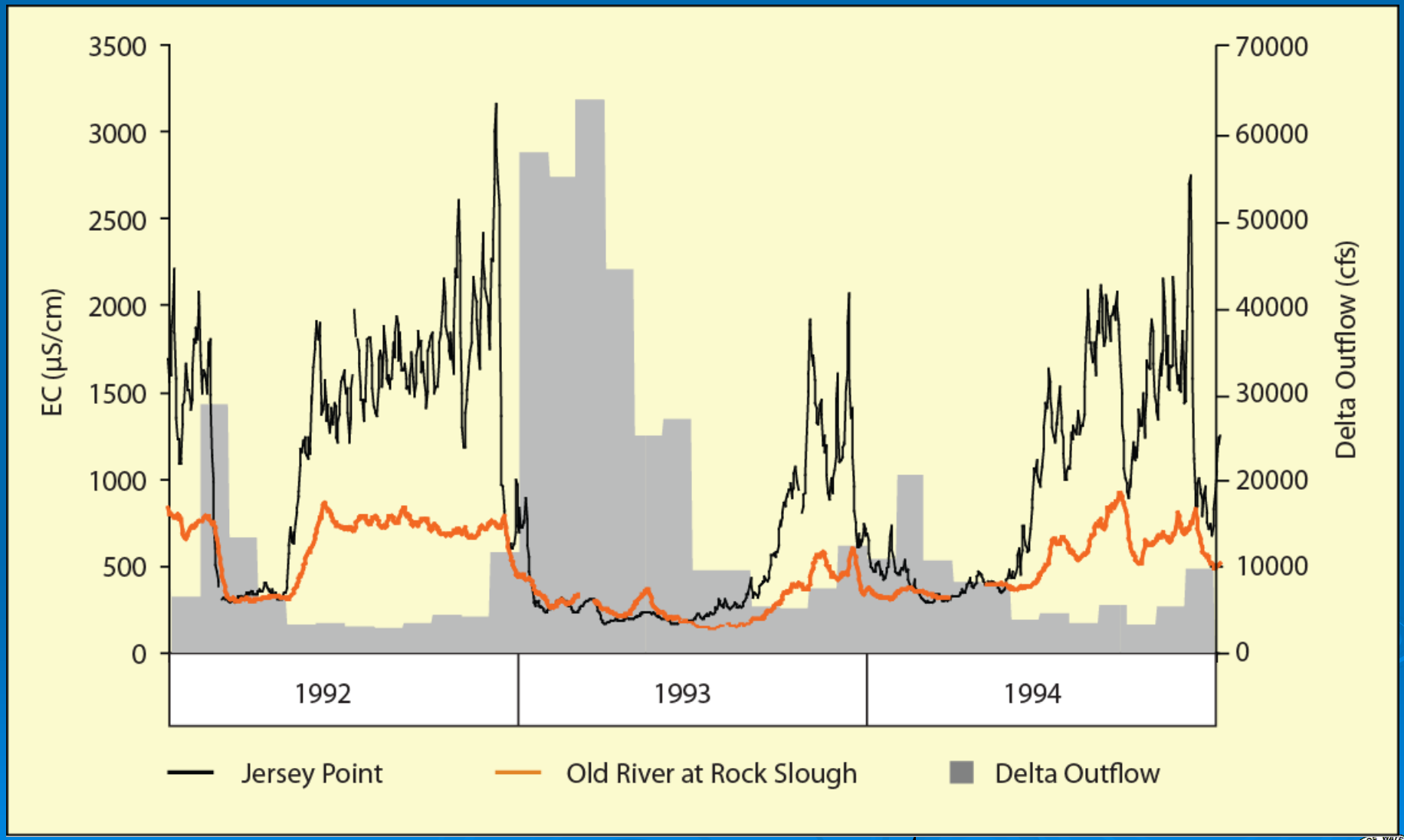
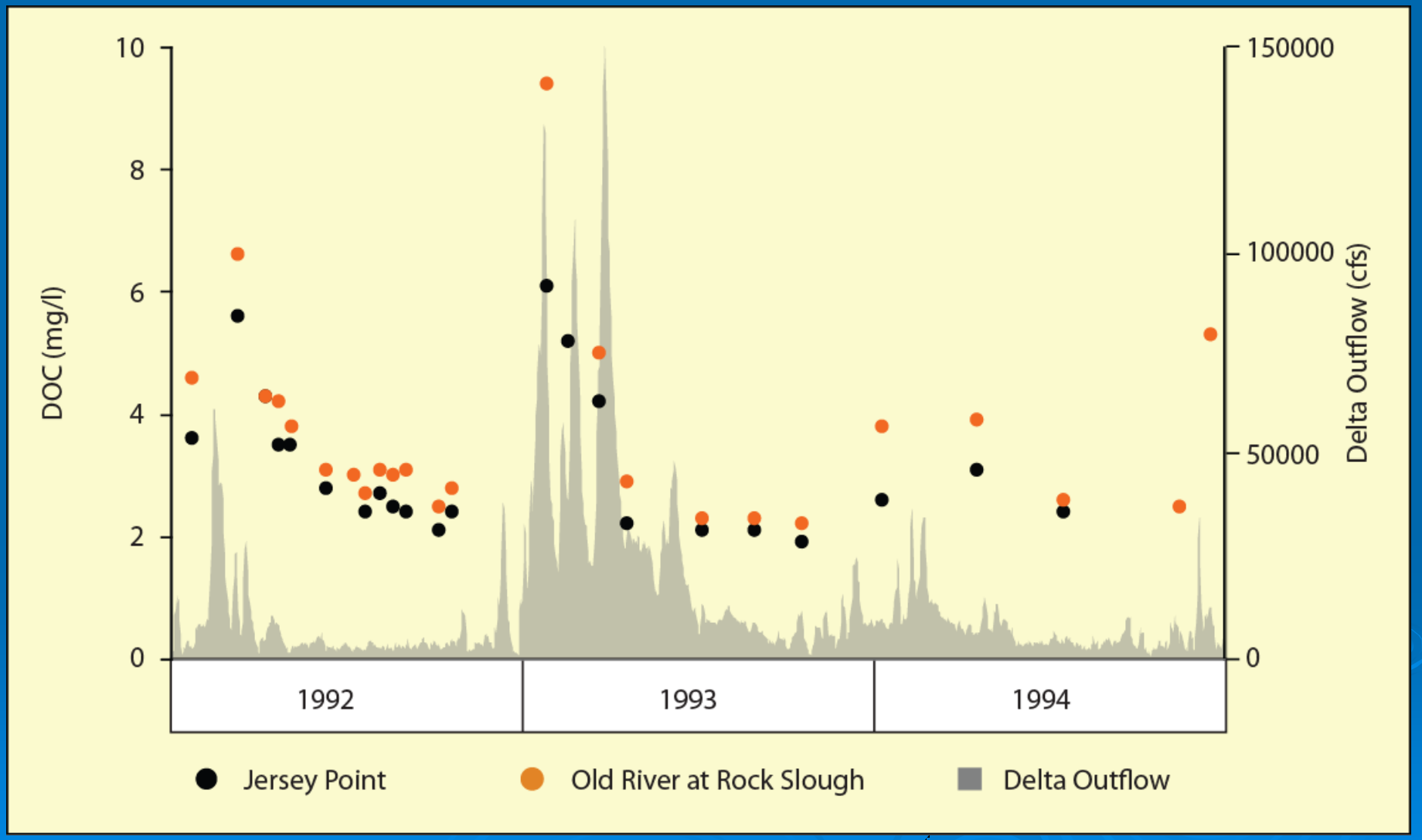
DSM2 Modeling of Delta Hydrodynamics and Water Quality using output from the Delta Island Consumptive Use Model

Observed EC at Jersey Point and Old River at Rock Slough and Estimated Delta Outflow



Sources: Delta outflow: DAYFLOW, EC: IEP database

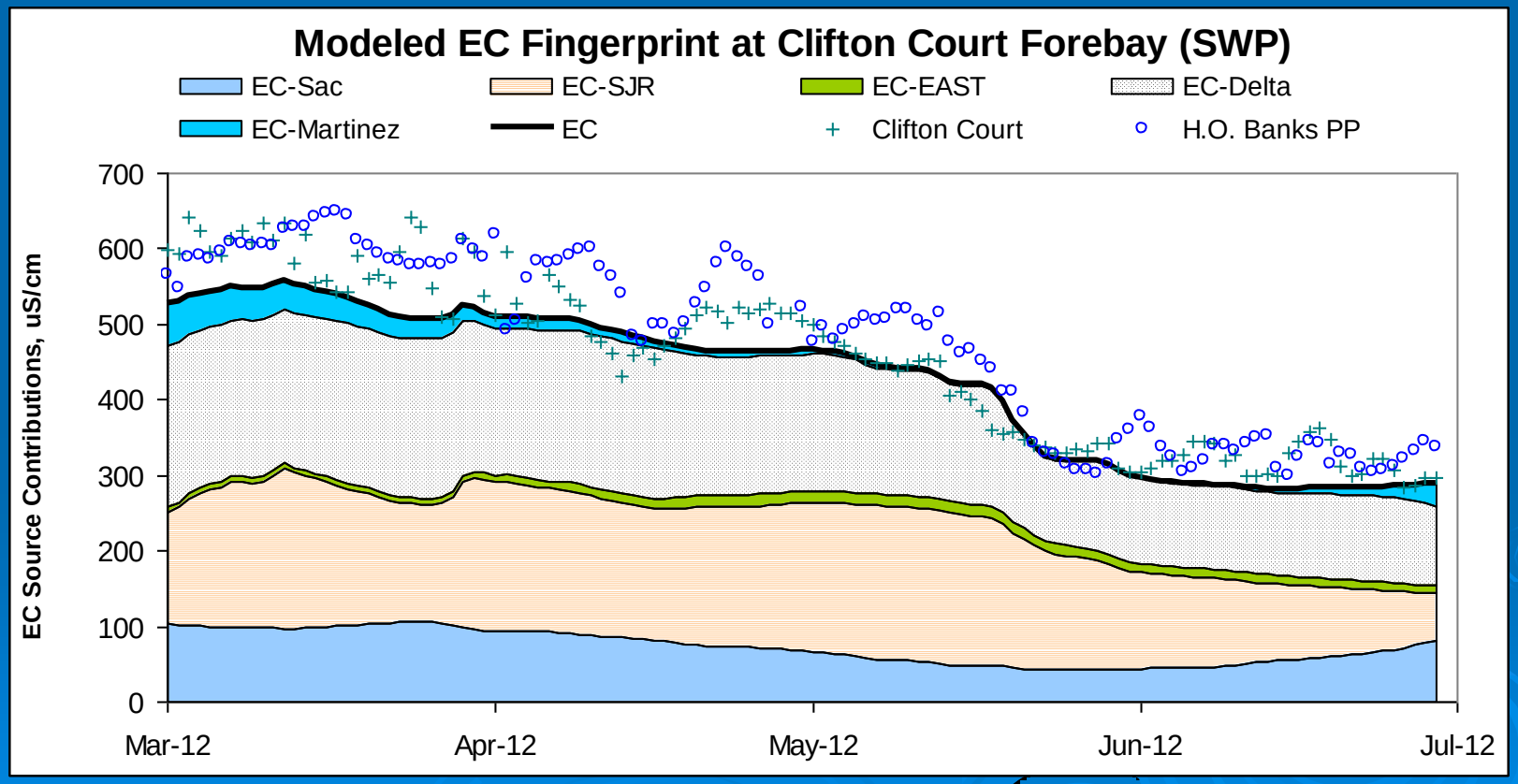
Observed DOC at Jersey Point and Old River at Rock Slough and Estimated Delta Outflow



Sources: Delta outflow: DAYFLOW, DOC: Water Data Library

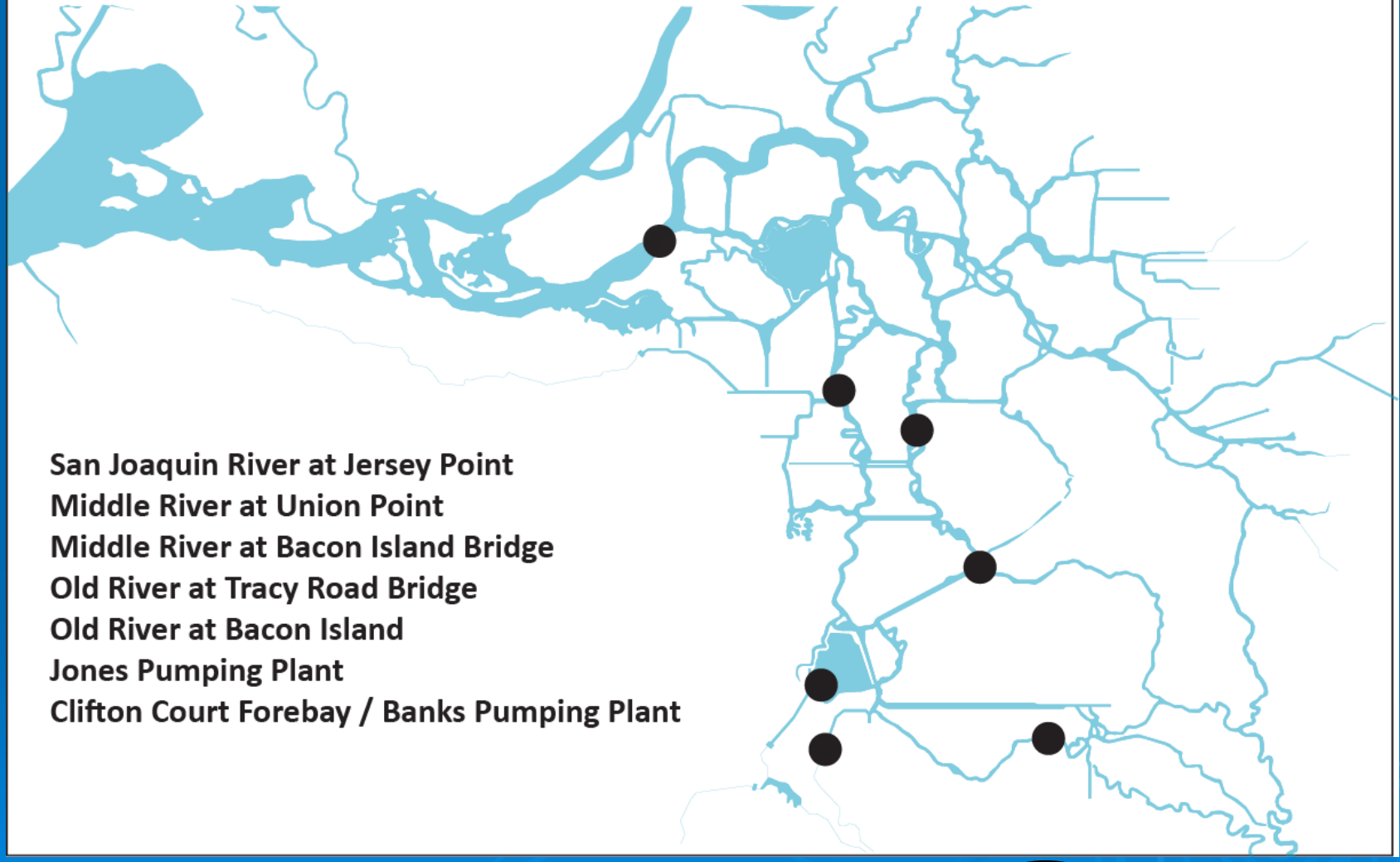
Modeling Delta EC and DOC Fingerprints

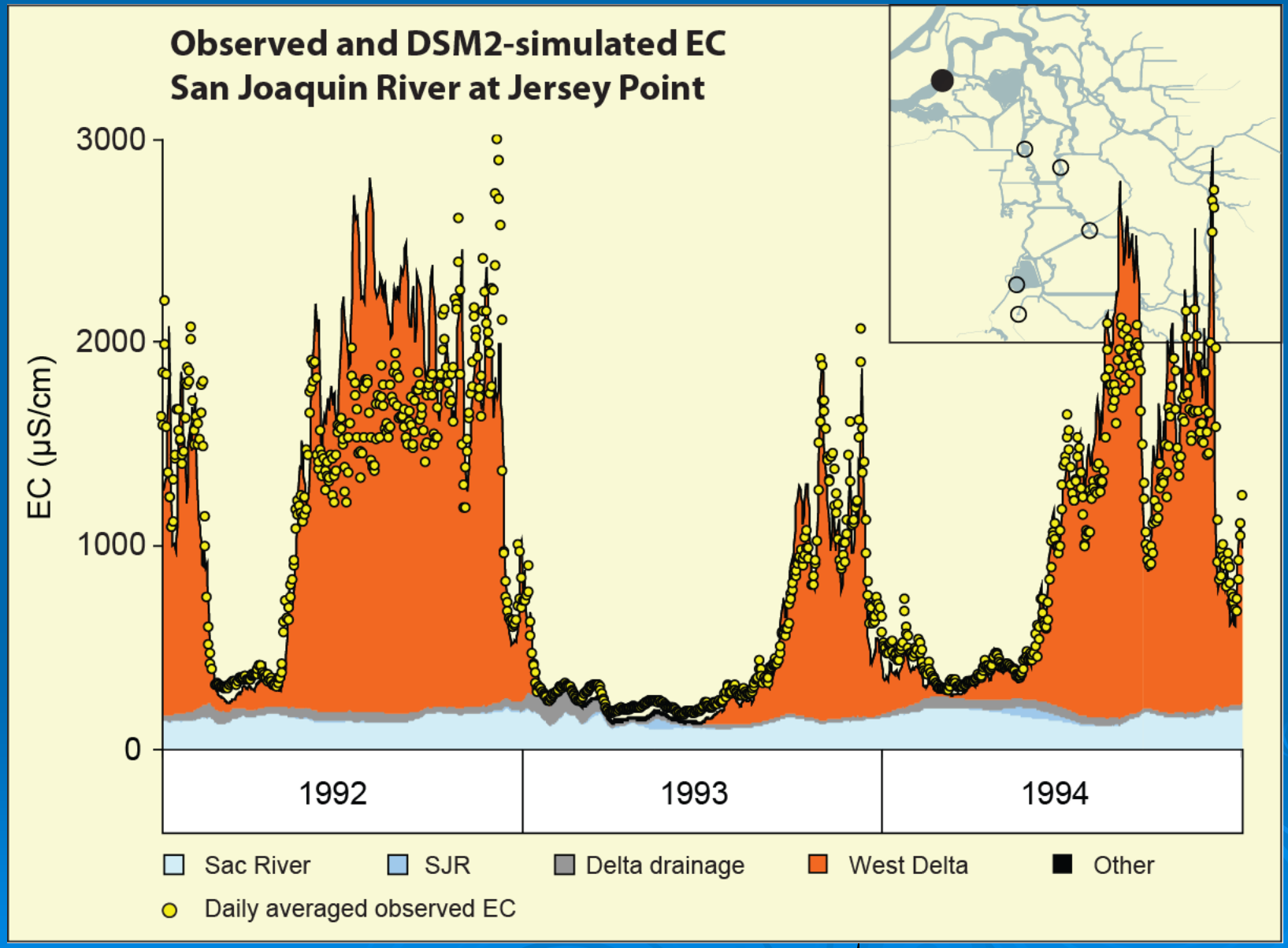
- Run Water Quality module of DSM2 with tracers at boundaries
- DOC treated as conservative constituent
- Documented: 2002 Delta Modeling Report to Control Board

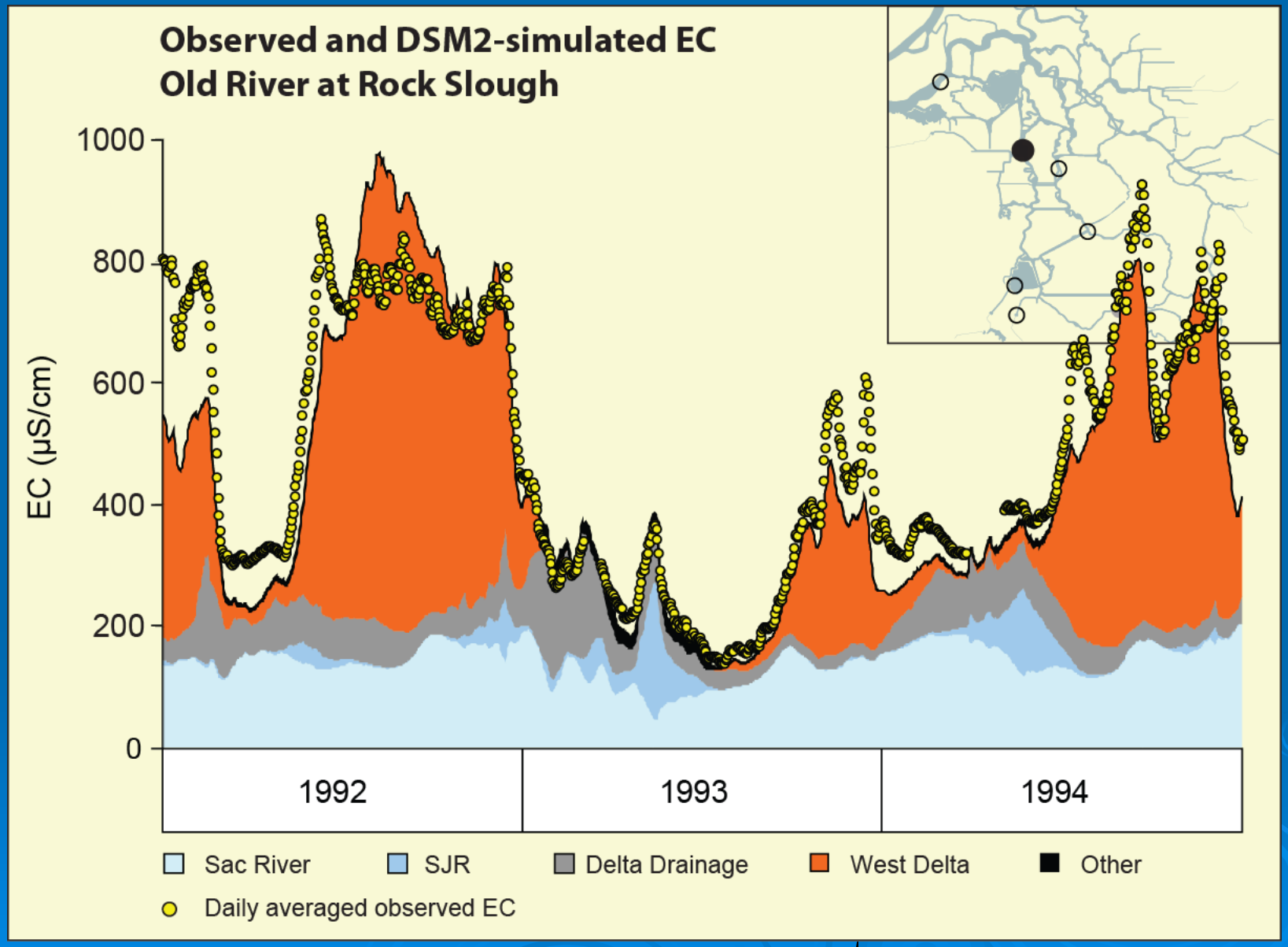


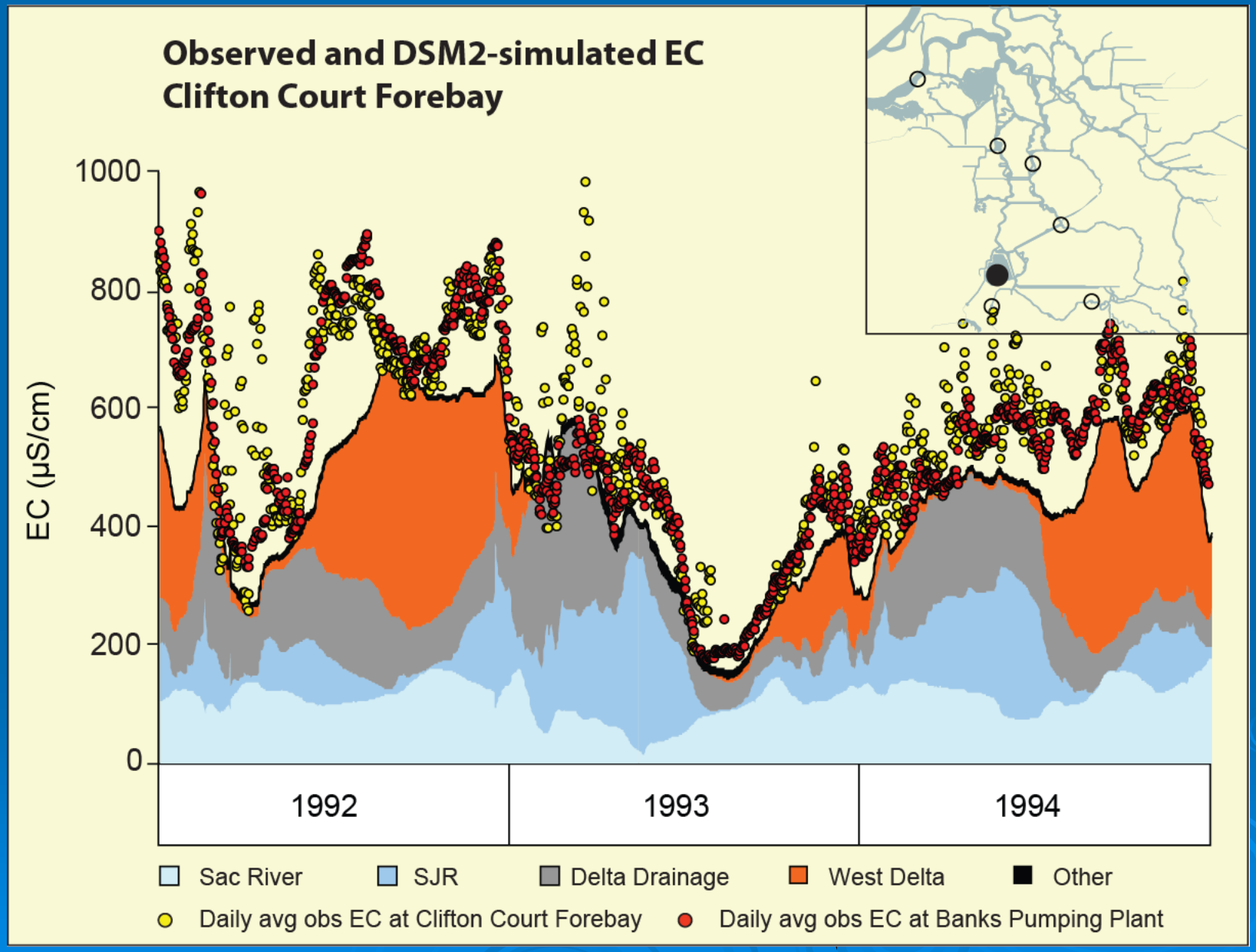
Source: DWR MWQI Real Time Data Forecasting (RTDF) Project June 2012 Update

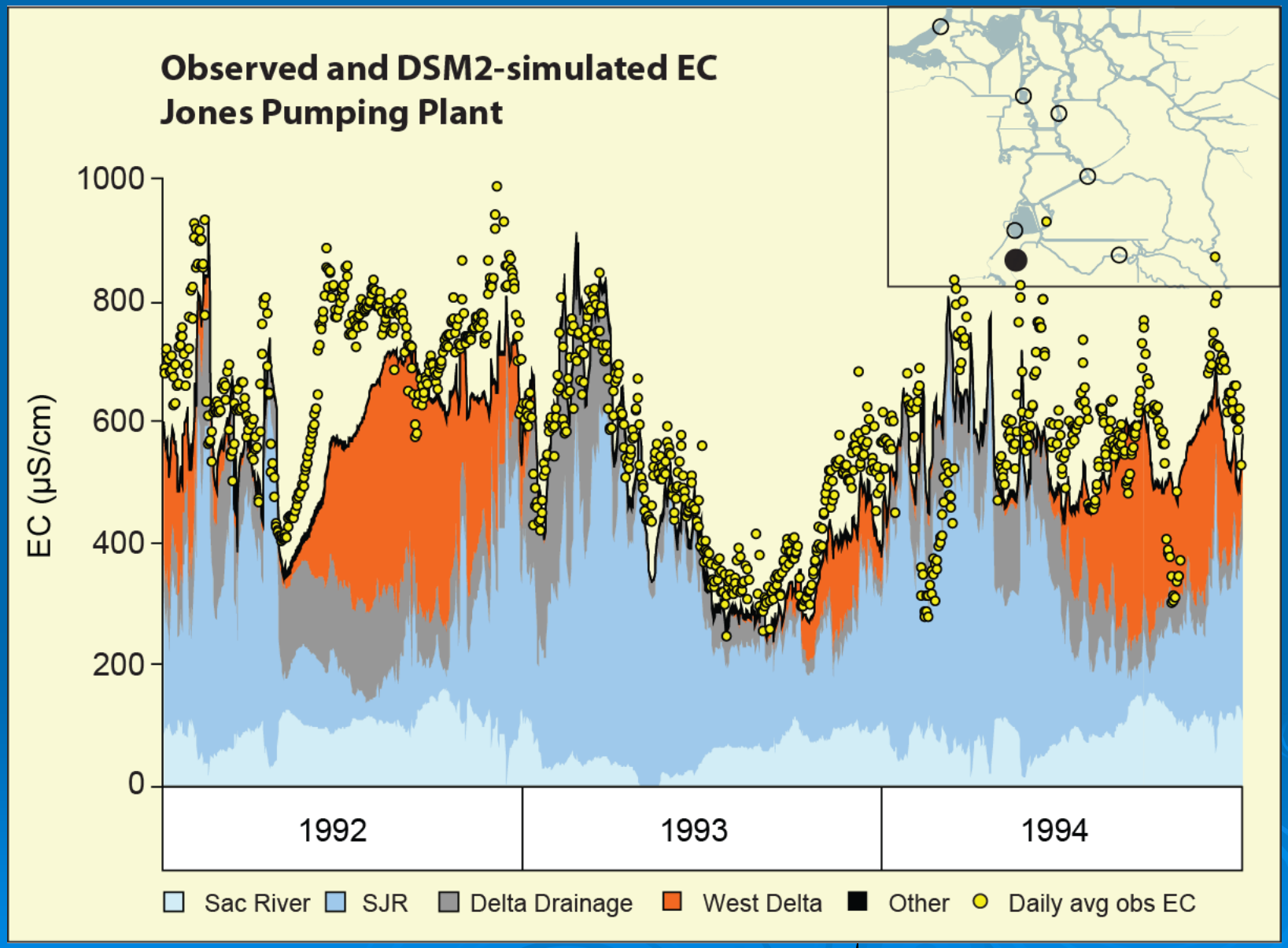
Locations observed and DSM2-simulated EC and DOC fingerprints presented, 1992 - 1994

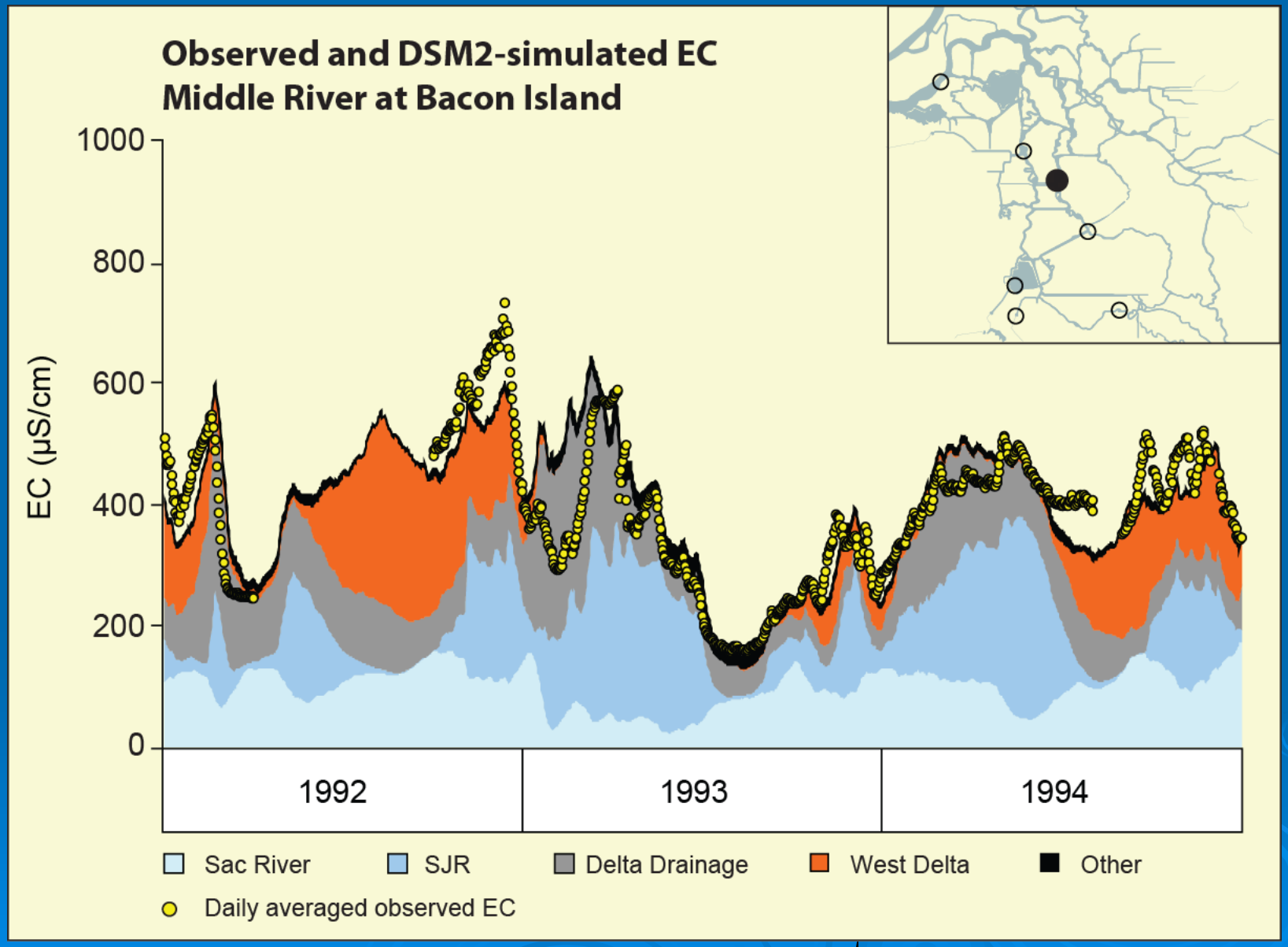


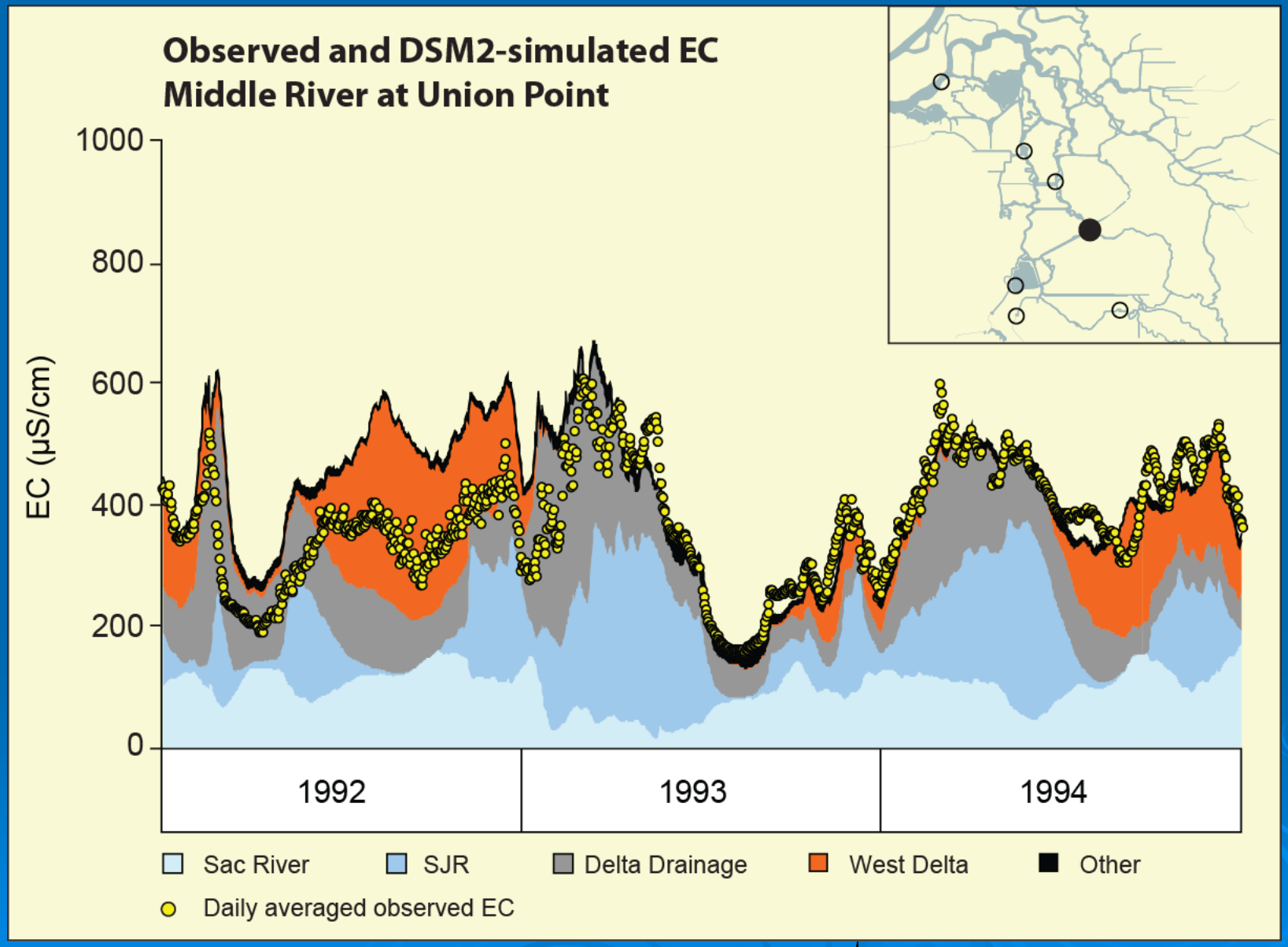

Observed and DSM2-simulated EC
San Joaquin River at Jersey Point
EC (µS/cm)
3000
2000
1000
0
1992
1993
1994
Sac River
SJR
Delta drainage
West Delta
Other
Daily averaged observed EC

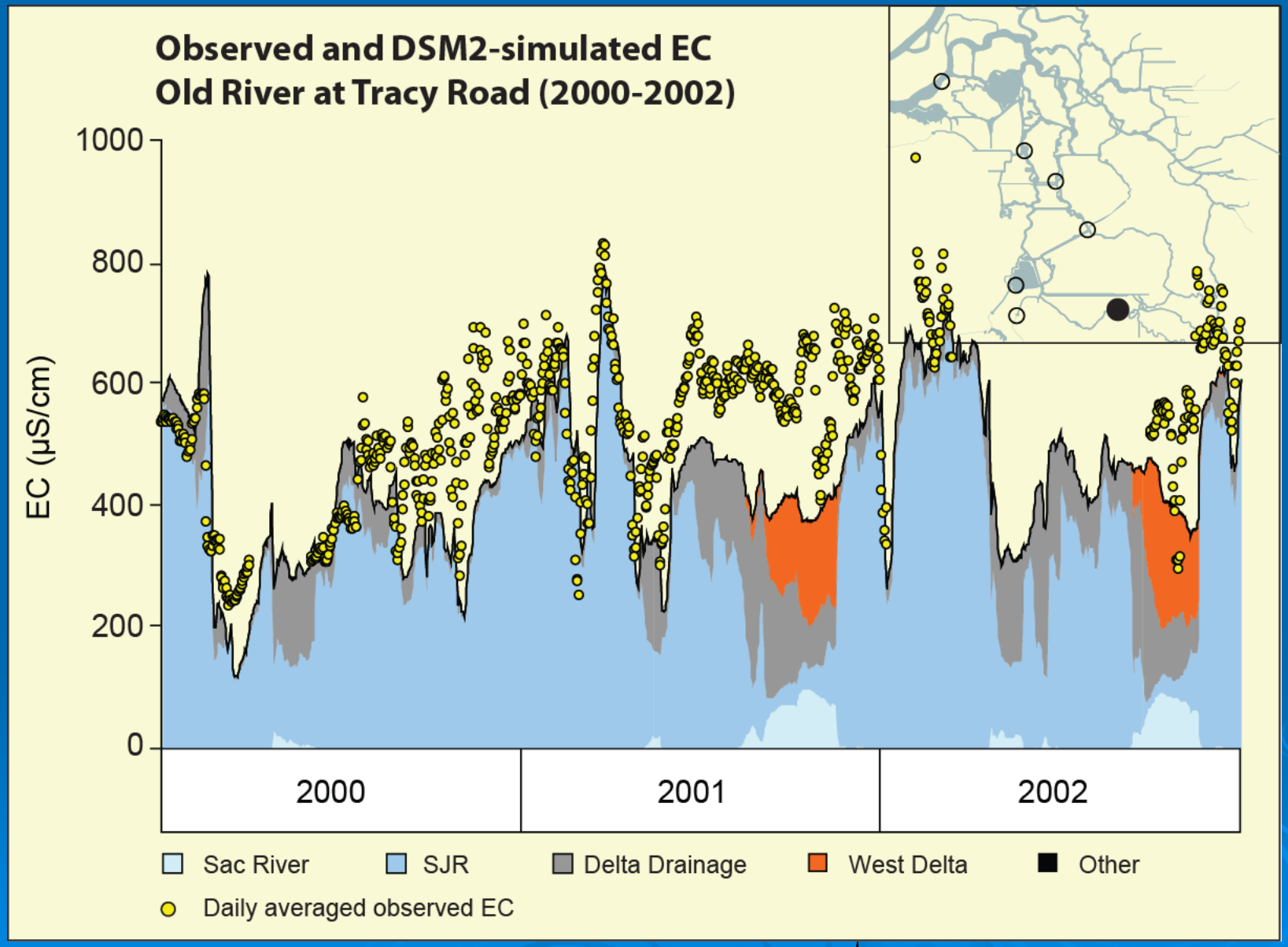

Observed and DSM2-simulated EC
Old River at Rock Slough
EC (µS/cm)
1000
800
600
400
200
0
1992
1993
1994
Sac River
SJR
Delta Drainage
West Delta
Other
Daily averaged observed EC

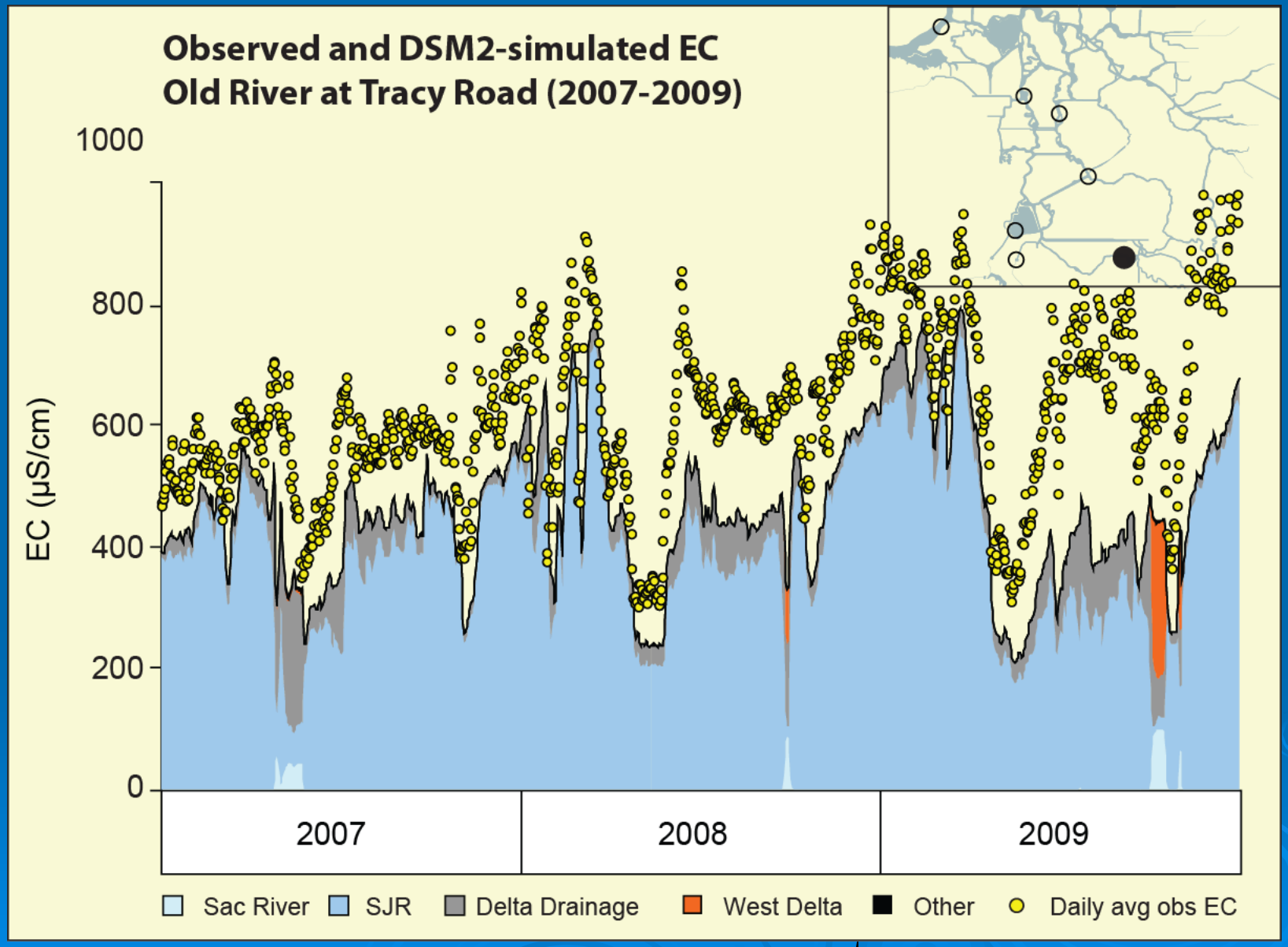

Observed and DSM2-simulated EC
Clifton Court Forebay
EC (µS/cm)
1000
800
600
400
200
0
1992
1993
1994
Sac River
SJR
Delta Drainage
West Delta
Other
Daily avg obs EC at Clifton Court Forebay
Daily avg obs EC at Banks Pumping Plant

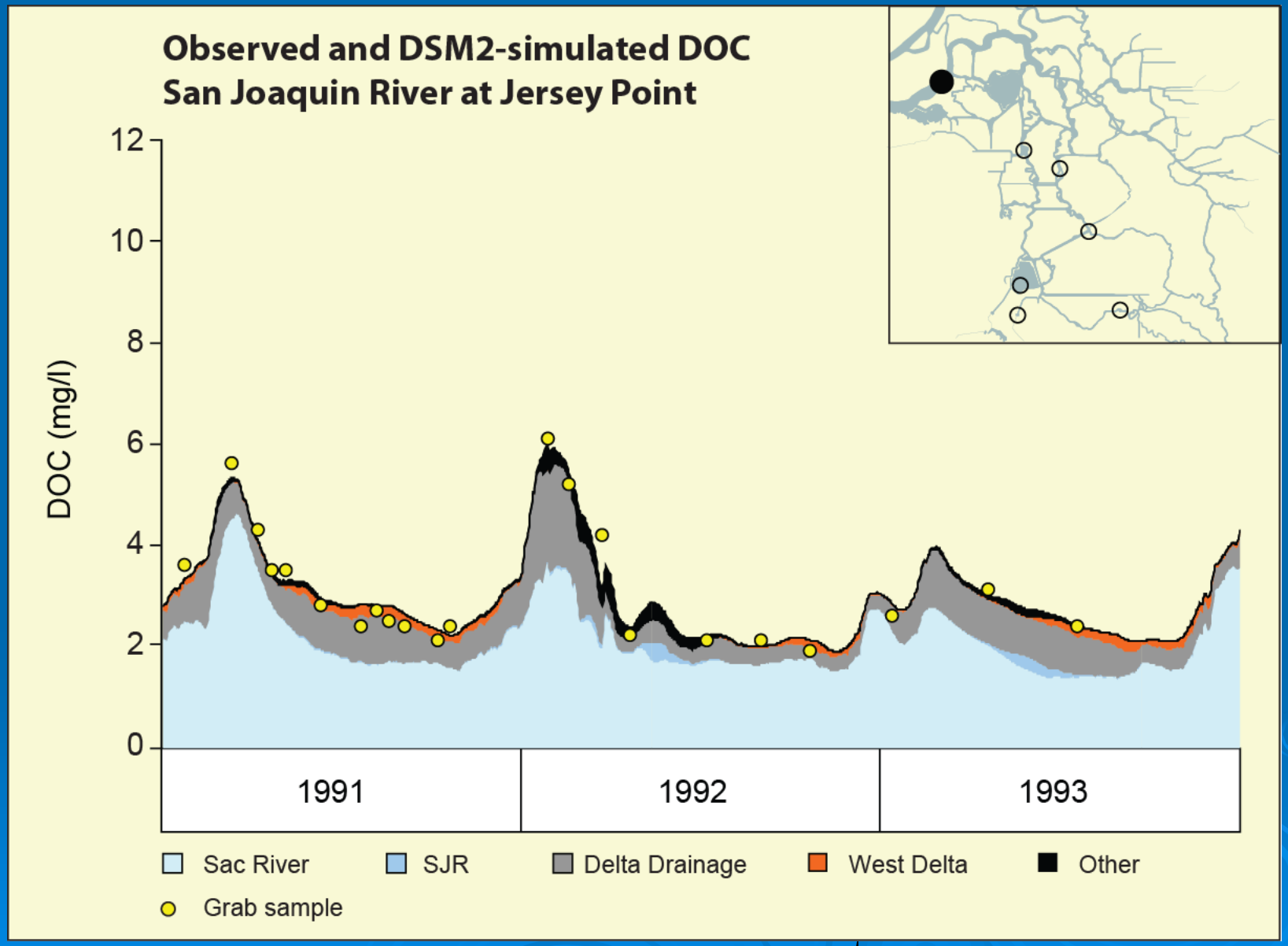

Observed and DSM2-simulated EC
Jones Pumping Plant
EC (µS/cm)
1000
800
600
400
200
0
1992
1993
1994
Sac River
SJR
Delta Drainage
West Delta
Other
Daily avg obs EC

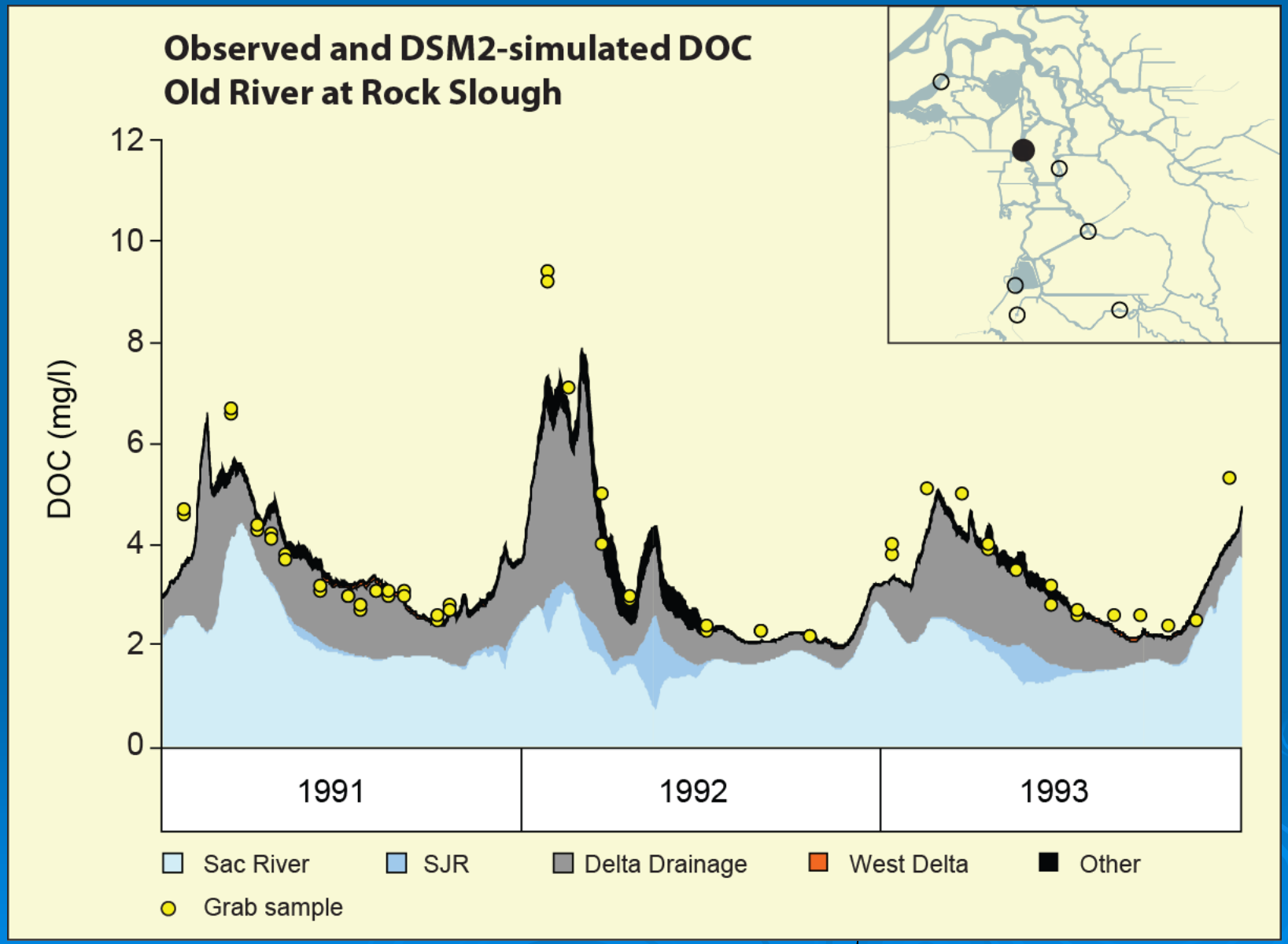

Observed and DSM2-simulated EC
Middle River at Bacon Island
EC (µS/cm)
1000
800
600
400
200
0
1992
1993
1994
Sac River
SJR
Delta Drainage
West Delta
Other
Daily averaged observed EC

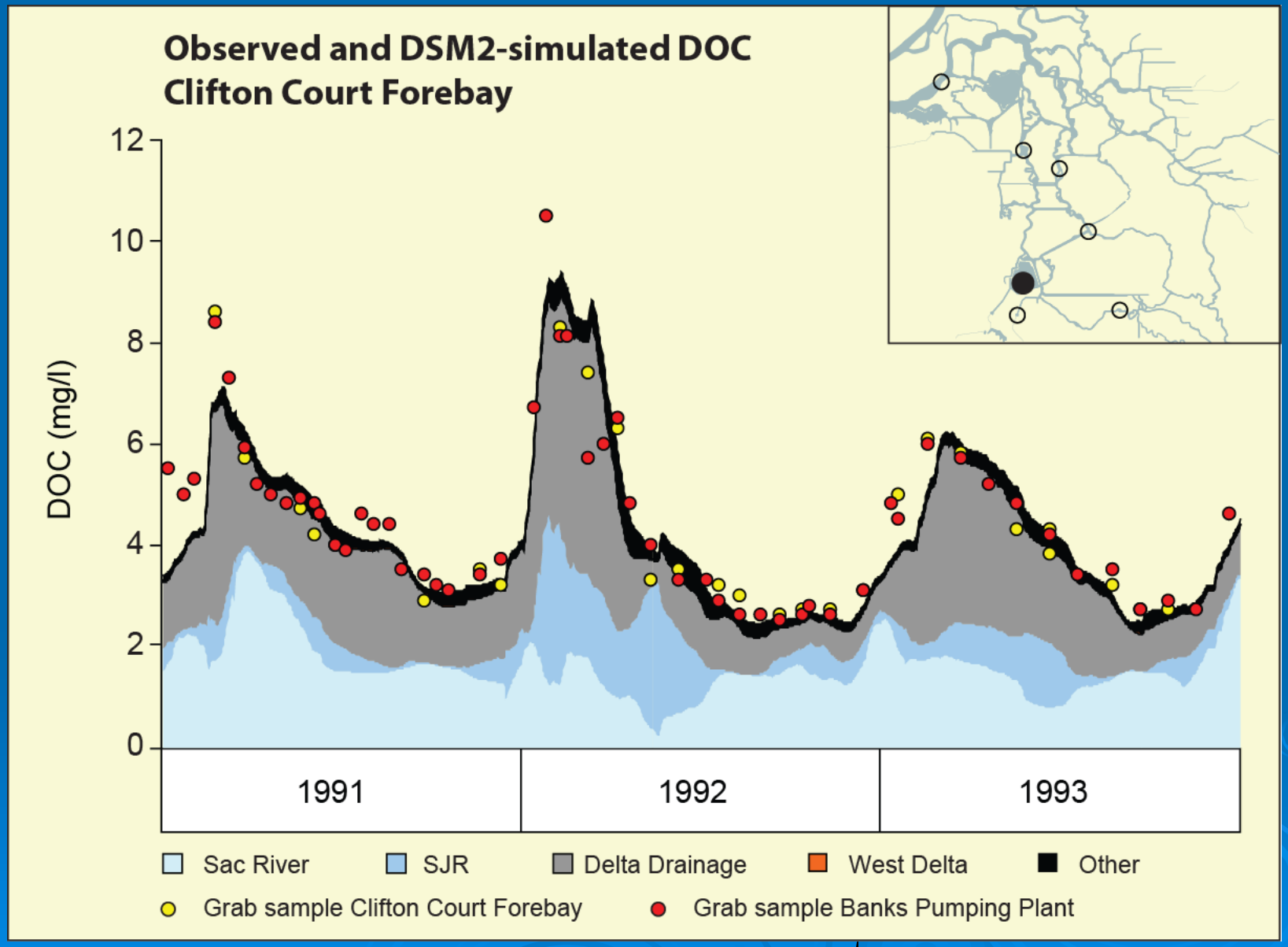

Observed and DSM2-simulated EC
Middle River at Union Point
EC (µS/cm)
1000
800
600
400
200
0
1992
1993
1994
Sac River
SJR
Delta Drainage
West Delta
Other
Daily averaged observed EC

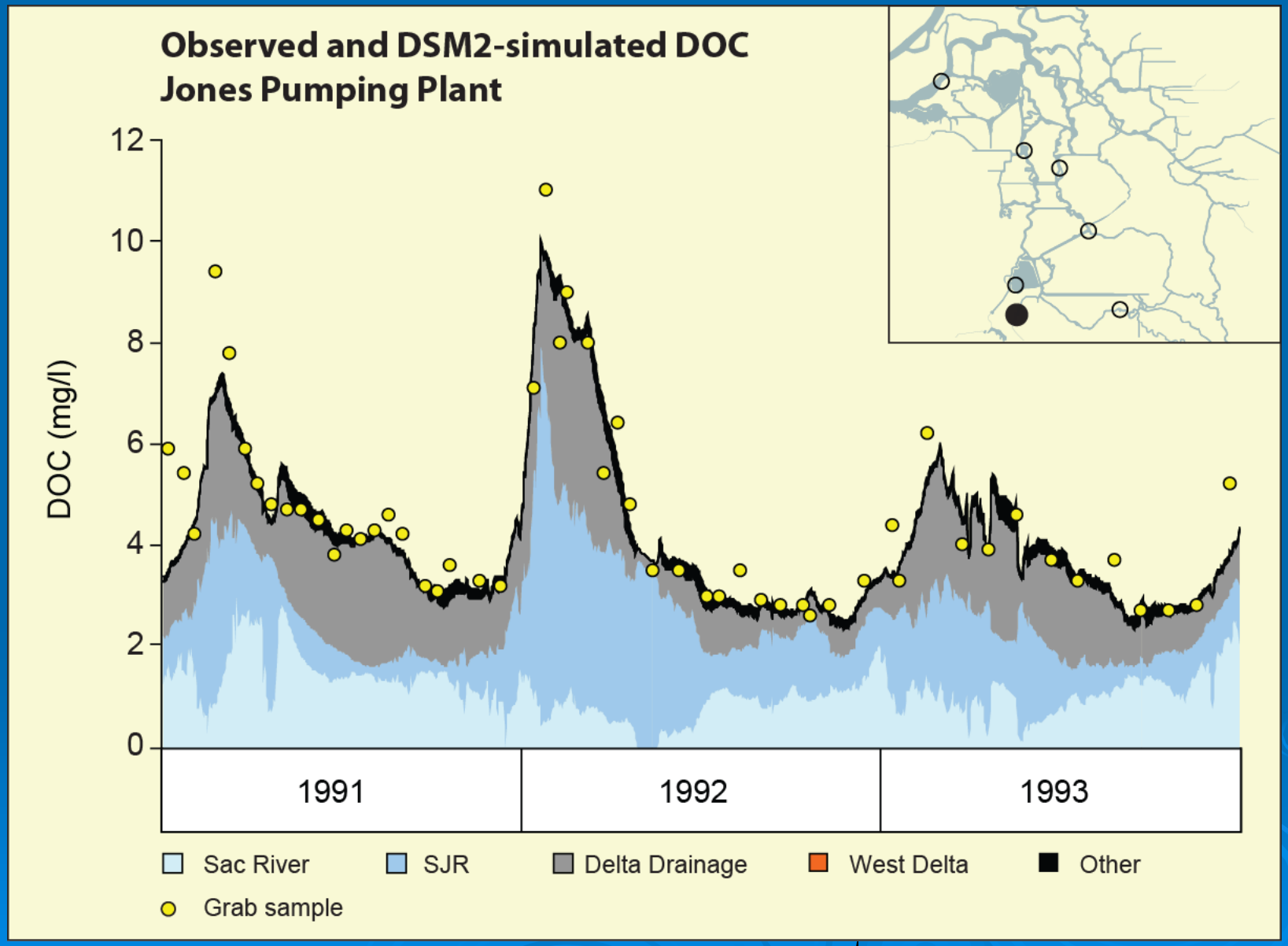

Observed and DSM2-simulated EC
Old River at Tracy Road (2000-2002)
EC (µS/cm)
1000
800
600
400
200
0
2000
2001
2002
Sac River
SJR
Delta Drainage
West Delta
Other
Daily averaged observed EC

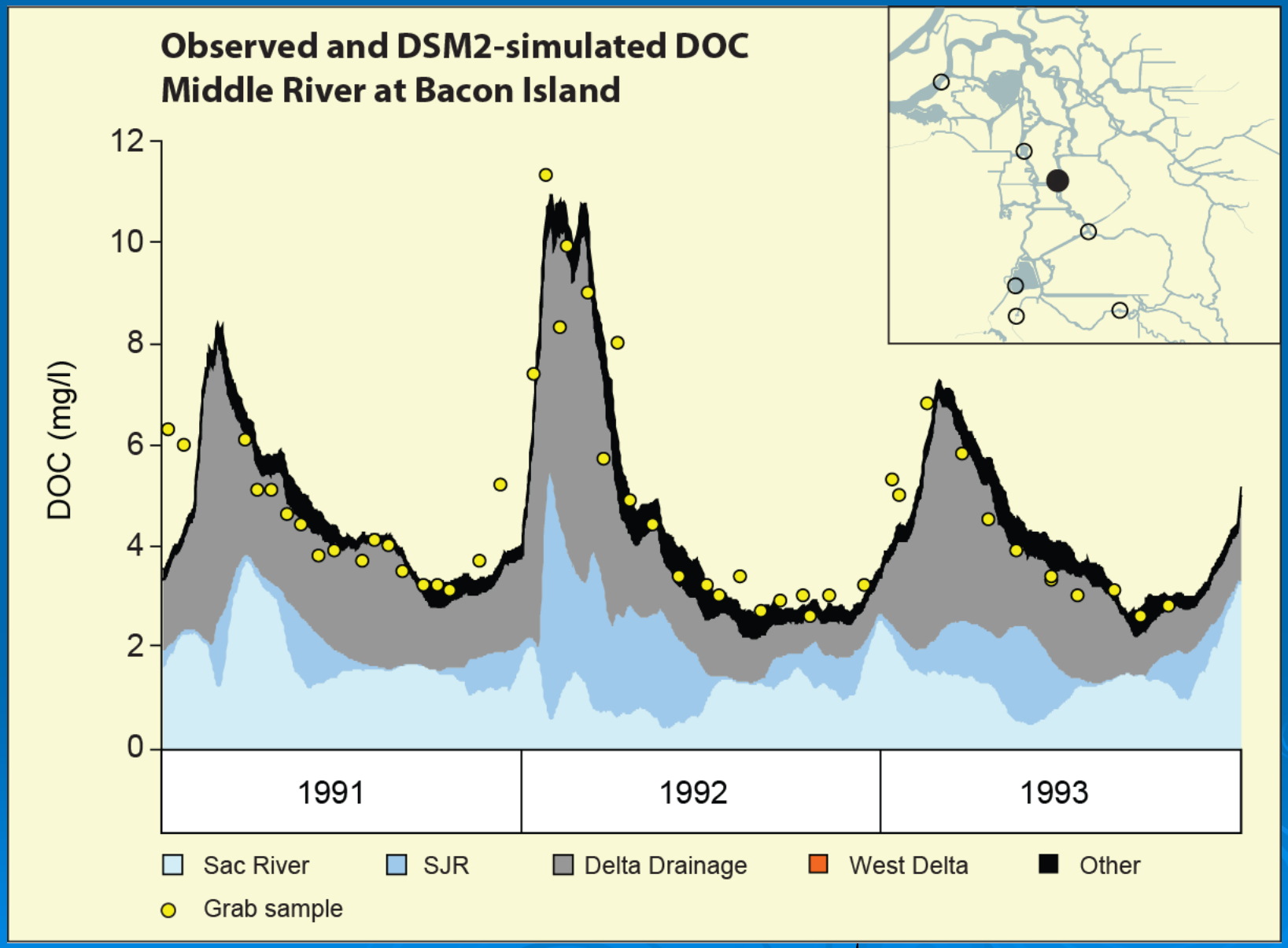

Observed and DSM2-simulated EC
Old River at Tracy Road (2007-2009)
EC (µS/cm)
1000
800
600
400
200
0
2007
2008
2009
Sac River
SJR
Delta Drainage
West Delta
Other
Daily avg obs EC


Observed and DSM2-simulated DOC
San Joaquin River at Jersey Point
DOC (mg/l)
12
10
8
6
4
2
0
1991
1992
1993
Sac River
SJR
Delta Drainage
West Delta
Other
Grab sample


Observed and DSM2-simulated DOC
Old River at Rock Slough
DOC (mg/l)
0
2
4
6
8
10
12
1991
1992
1993
Sac River
SJR
Delta Drainage
West Delta
Other
Grab sample


Observed and DSM2-simulated DOC
Clifton Court Forebay
DOC (mg/l)
0
2
4
6
8
10
12
1991
1992
1993
Sac River
SJR
Delta Drainage
West Delta
Other
Grab sample Clifton Court Forebay
Grab sample Banks Pumping Plant


Observed and DSM2-simulated DOC
Jones Pumping Plant
DOC (mg/l)
0
2
4
6
8
10
12
1991
1992
1993
Sac River
SJR
Delta Drainage
West Delta
Other
Grab sample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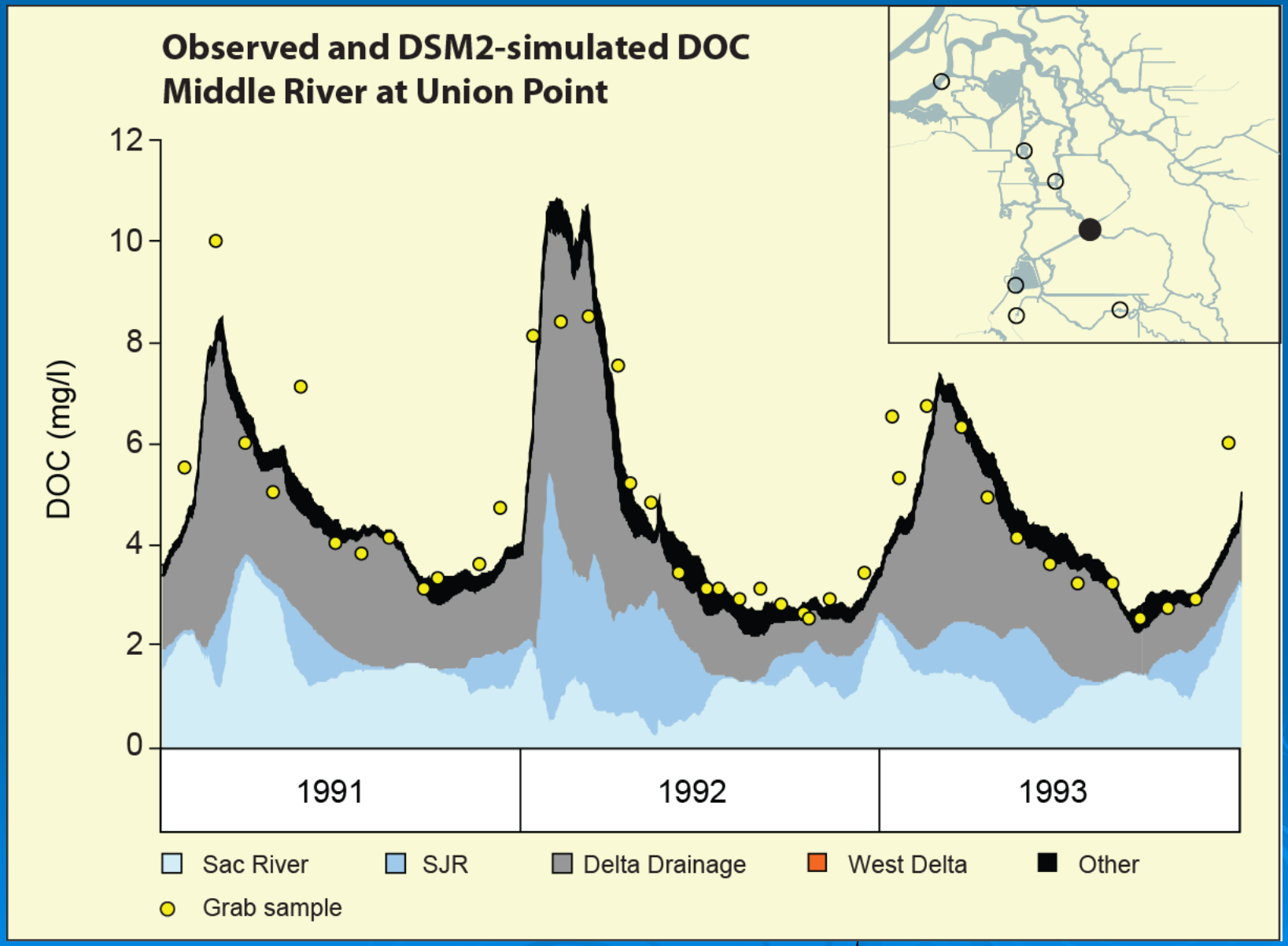
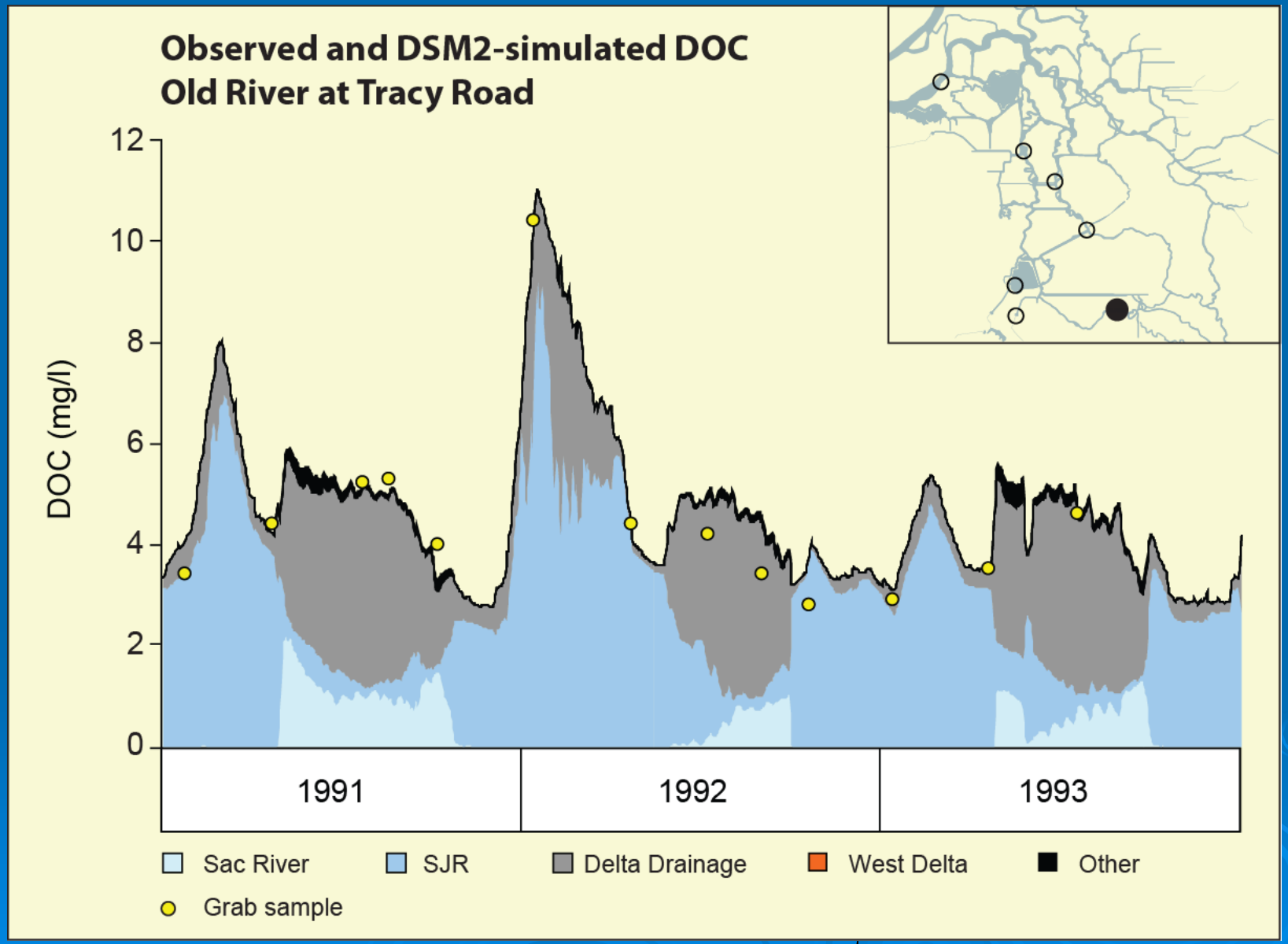
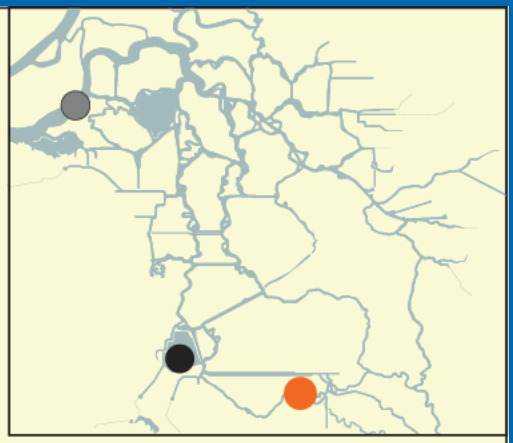
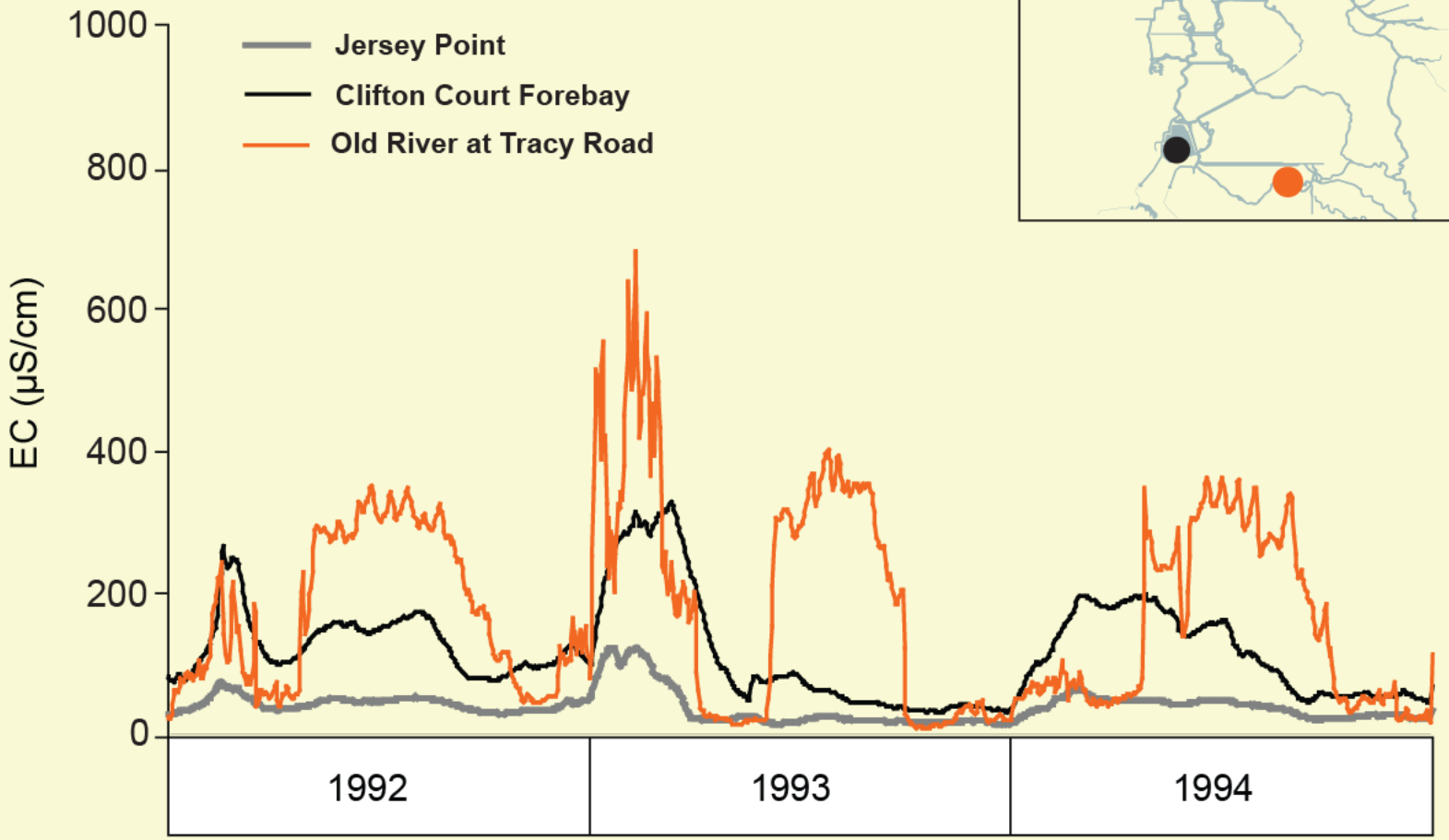
Middle River at Bacon Island
DOC (mg/l)
0
2
4
6
8
10
12
1991
1992
1993
Sac River
SJR
Delta Drainage
West Delta
Other
Grab sample

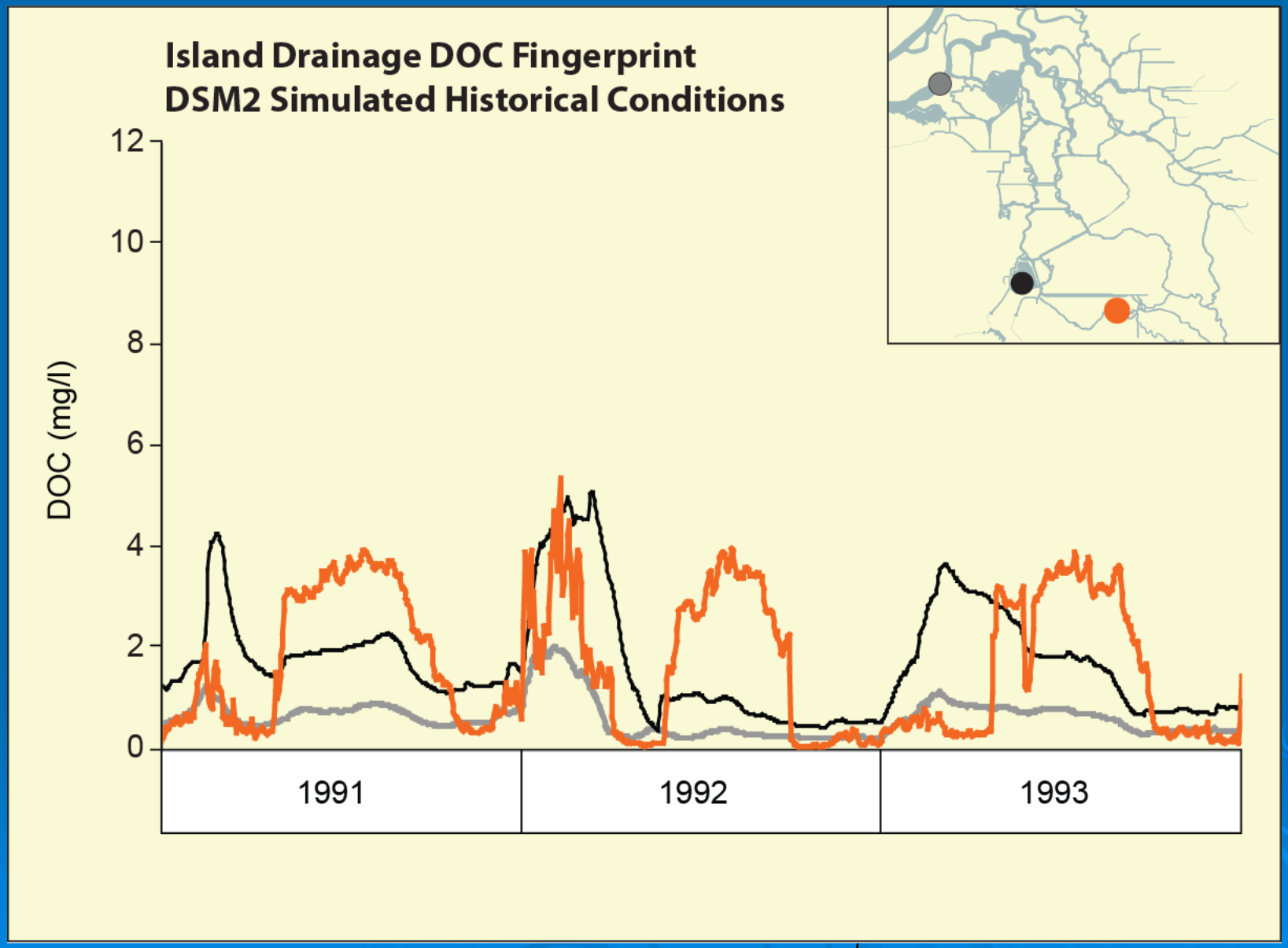

Observed and DSM2-simulated DOC
Middle River at Union Point
DOC (mg/l)
0
2
4
6
8
10
12
1991
1992
1993
Sac River
SJR
Delta Drainage
West Delta
Other
Grab sample

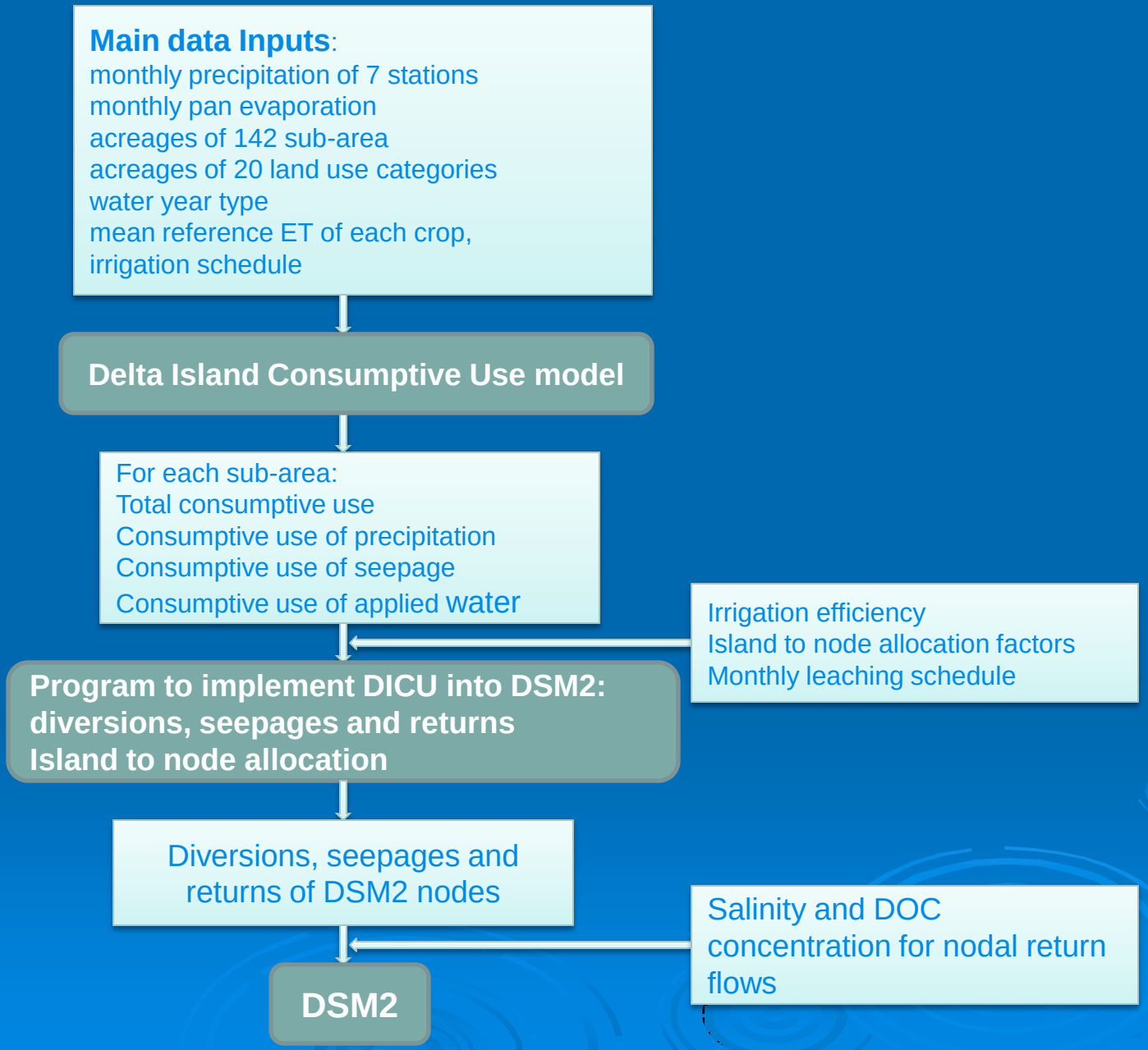

Observed and DSM2-simulated DOC
Old River at Tracy Road
DOC (mg/l)
0
2
4
6
8
10
12
1991
1992
1993
Sac River
SJR
Delta Drainage
West Delta
Other
Grab sample

Island Drainage EC Fingerprint
DSM2 Simulated Historical Conditions






Island Drainage DOC Fingerprint
DSM2 Simulated Historical Conditions
DOC (mg/l)
12
10
8
6
4
2
0
1991
1992
1993


Main data Inputs:
monthly precipitation of 7 stations
monthly pan evaporation
acreages of 142 sub-area
acreages of 20 land use categories
water year type
mean reference ET of each crop,
irrigation schedule
Delta Island Consumptive Use model
For each sub-area:
Total consumptive use
Consumptive use of precipitation
Consumptive use of seepage
Consumptive use of applied water
Irrigation efficiency
Island to node allocation factors
Monthly leaching schedule
Program to implement DICU into DSM2:
diversions, seepages and returns
Island to node allocation
Diversions, seepages and returns of DSM2 nodes
Salinity and DOC concentration for nodal return flows
DSM2

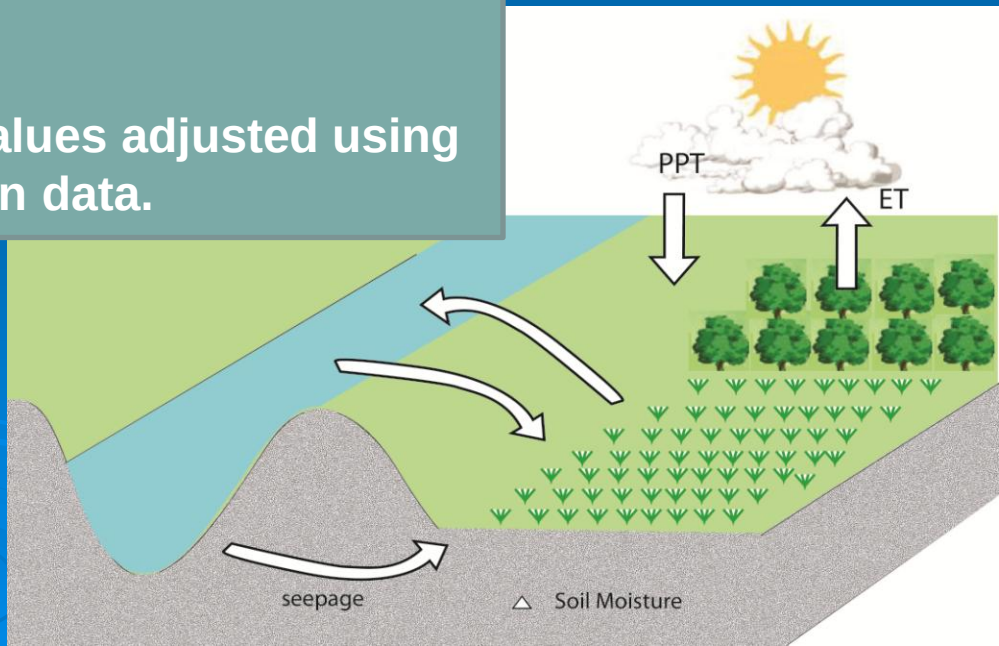
Estimating Delta Island Consumptive Use with DICU model

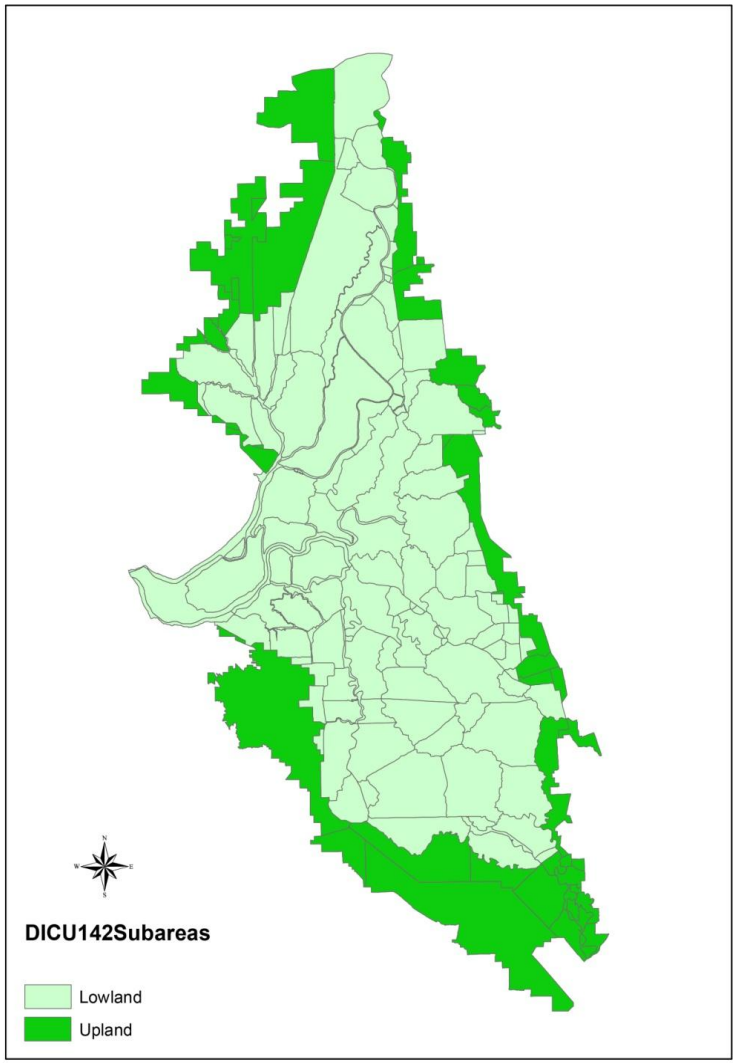
- **Water balance for each sub-area:**

$$TCU = CUp + CUs + CUaw + \Delta SM = ET + \Delta SM$$

TCU - Total consumptive use
CUp - Consumptive use of precipitation
CUs - Consumptive use of seepage
CUaw – Consumptive use of applied water
ΔSM - Soil moisture change

- **Reference ET:**
  The fixed long term average ET values adjusted using monthly averaged pan evaporation data.





DICU model inputs

- 142 sub-areas
- Uplands and lowlands
- Only lowlands have seepage
- Seepage rate:

  0.3 inches/foot of crop rooting depth/month
- 20 Land use categories
- Land use acreages

  Critical and non-critical

  historical

Implementing DICU into DSM2 simulations

- **channel depletion to island and drainage from island to channel**

$Ia = Ir/\eta = CUaw/\eta$

channel depletion $= Ia + La + CUs$

Island drainage $= (1-\eta)Ia + Ld + runoff$

η - irrigation efficiency
Ir – minimum irrigation requirement
Ia – applied irrigation water
La – applied leach water
Ld – drained leach water

Implementing DICU into DSM2 simulations

- **Island to DSM2 Node Allocation**

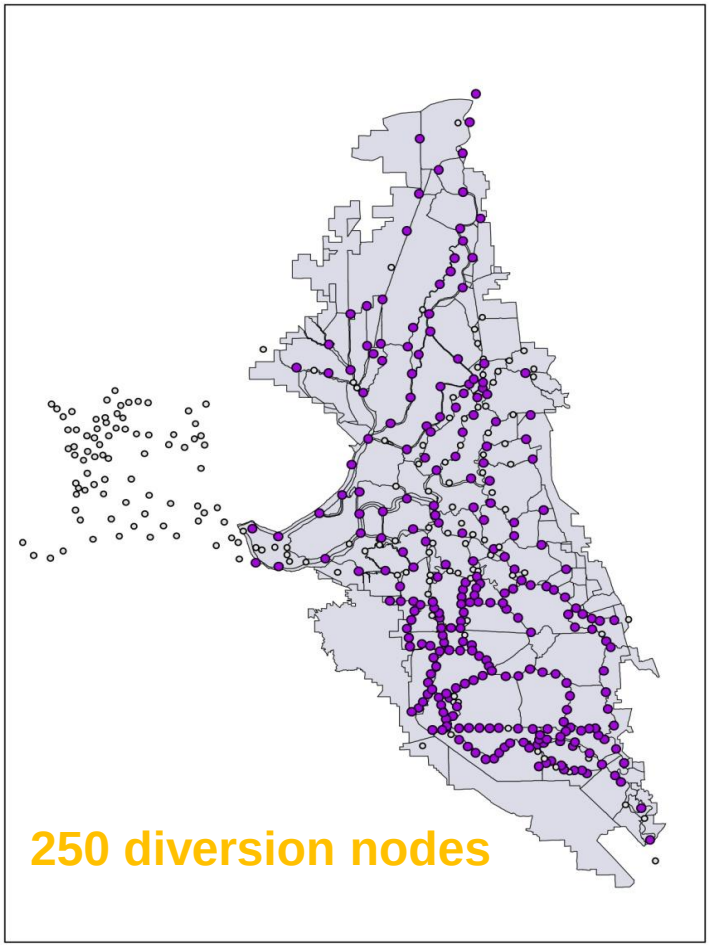
Node diversion = ∑(related island diversion * div%)

Node drainage = ∑(related island drainage * drn%)

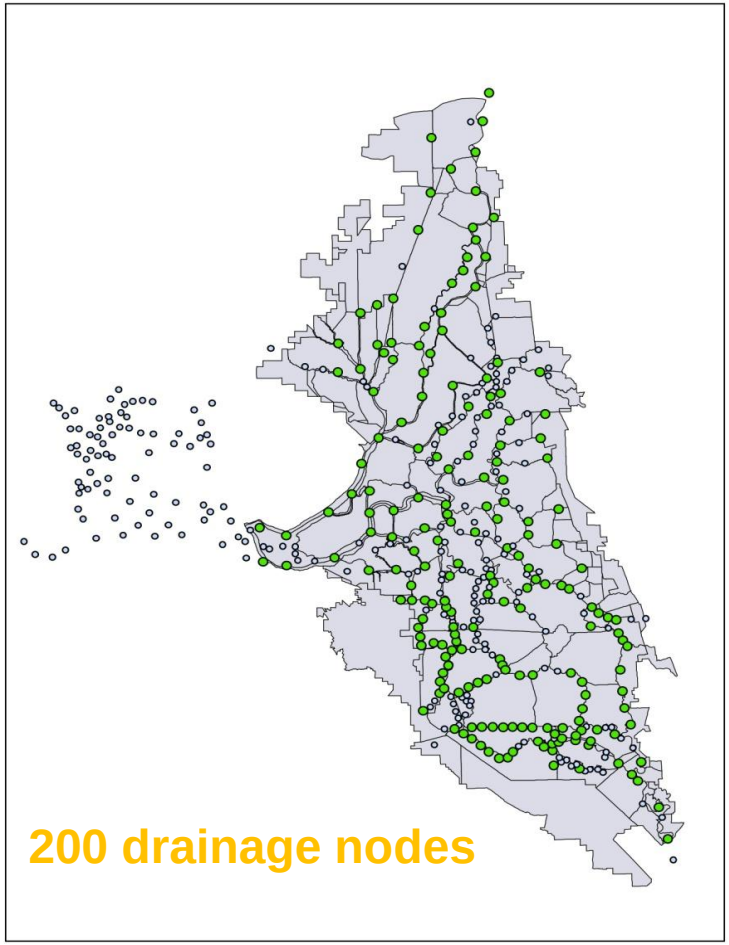
Node seepage = ∑(related island seepage * div%)

div% - diversion percent from island to node
drn% - drainage percent from island to node

Island to node allocation sites



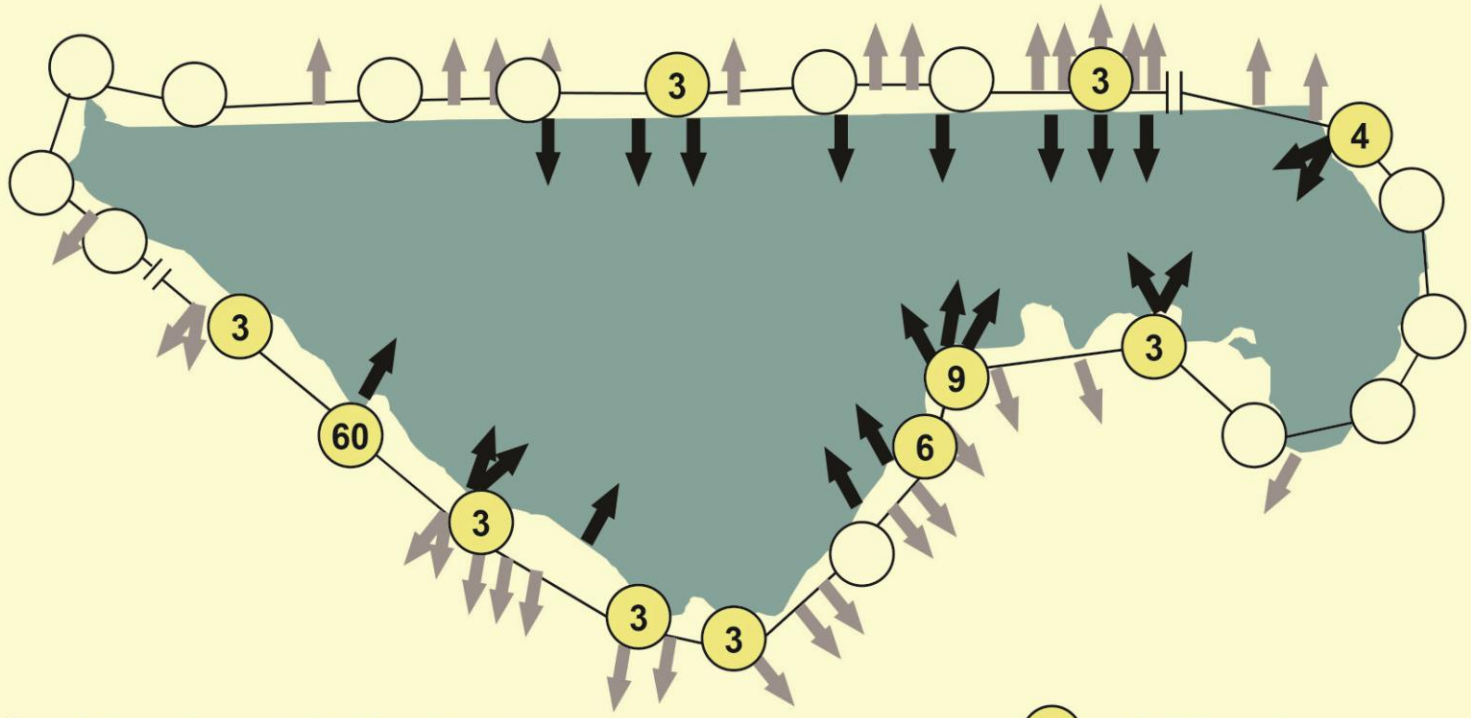
250 diversion nodes



200 drainage nodes

- The subarea to node allocations are based on the survey conducted 1986 -1987 by G. Sato el at. DWR.
- The allocation factors are mainly determined by 1977 land use sepia map with entities delineated by cutting lines in conjunction with a 1987 inventory of irrigation and drainage facilities.

Allocation of Diversions to Fabian Tract to DSM2 Nodes (percentage of total)



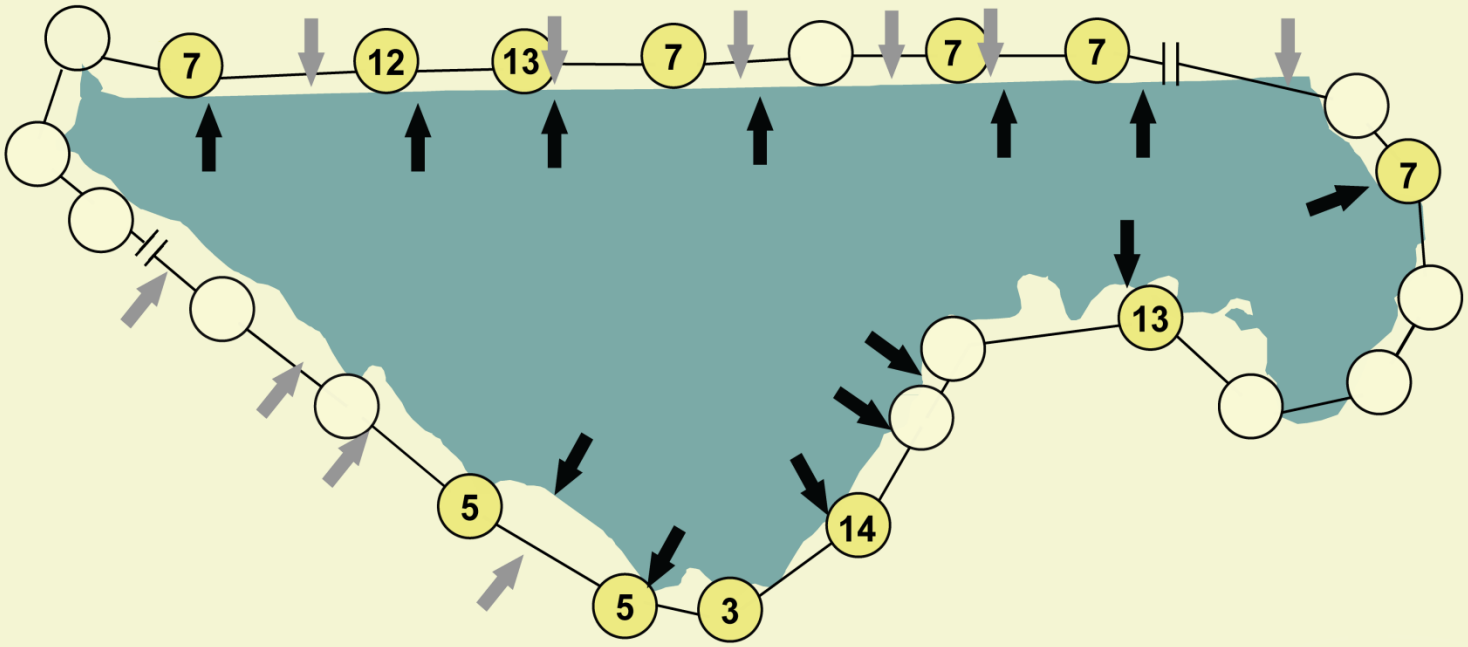
Diversions to Fabian Tract

Diversions to adjacent island

One or more siphons, pumps, floodgates
Locations based on 1986-87 DWR Survey

3 **DSM2 node**
Value is percentage of total island diversion from channel

Allocation of Drainage from Fabian Tract to DSM2 Nodes (percentage of total)



Drainage pumps on Fabian Tract (one or more)

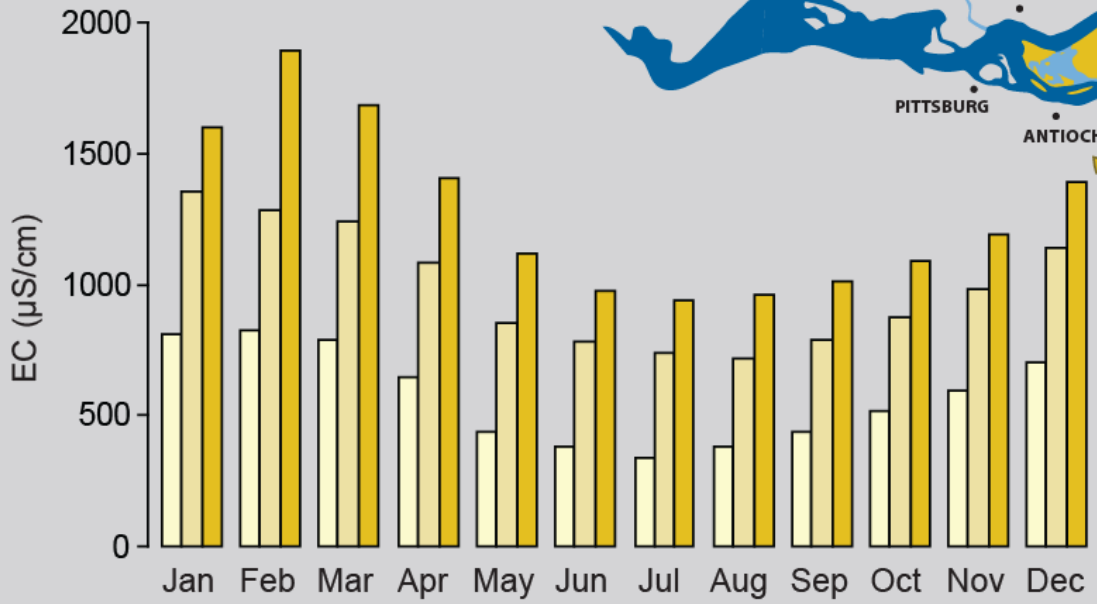
Drainage pumps on adjacent islands

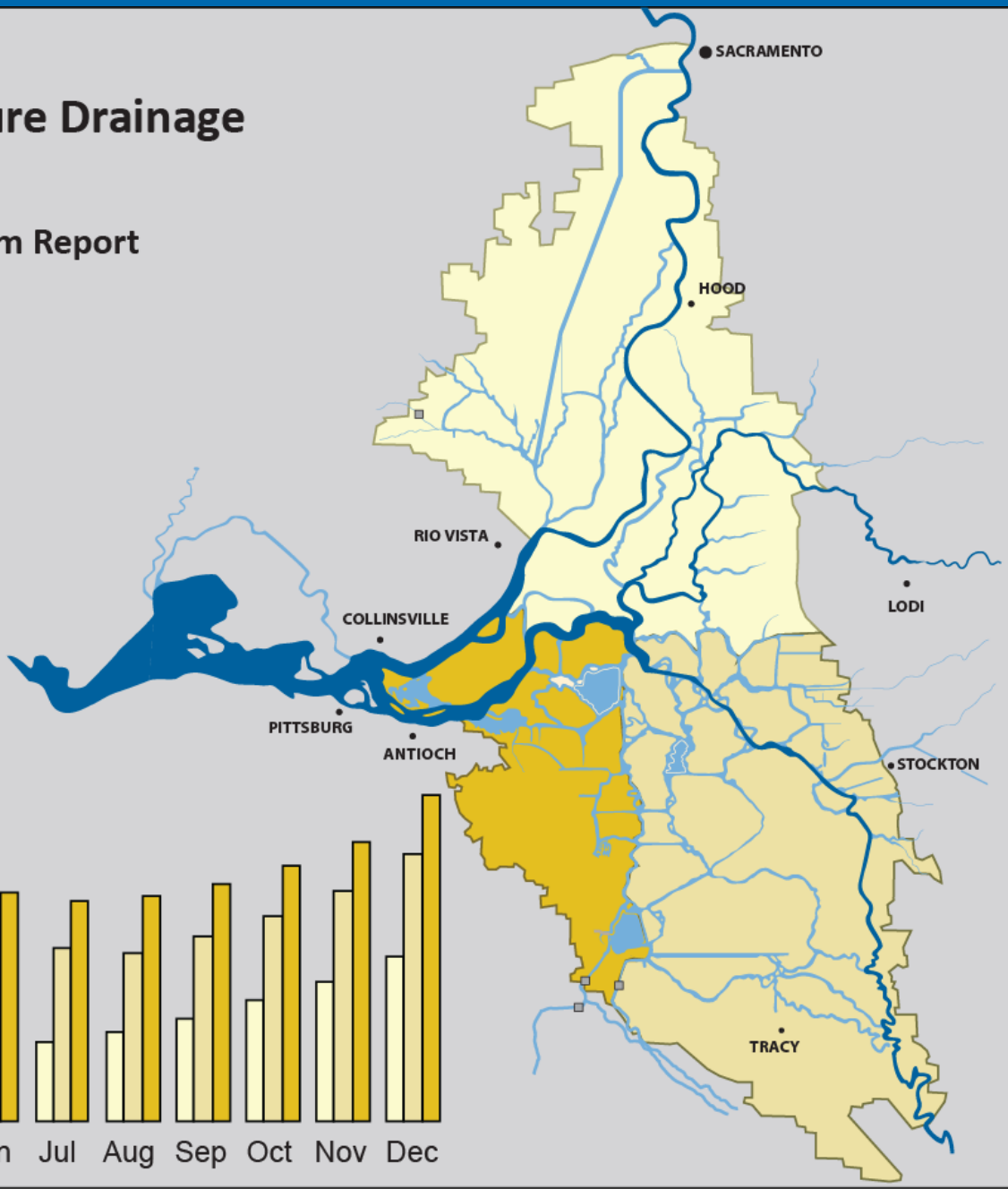
Locations based on 1986-87 DWR Survey

5 **DSM2 node**
Value is percentage of total island drainage

Assumed EC in Agriculture Drainage for DSM2 Simulations

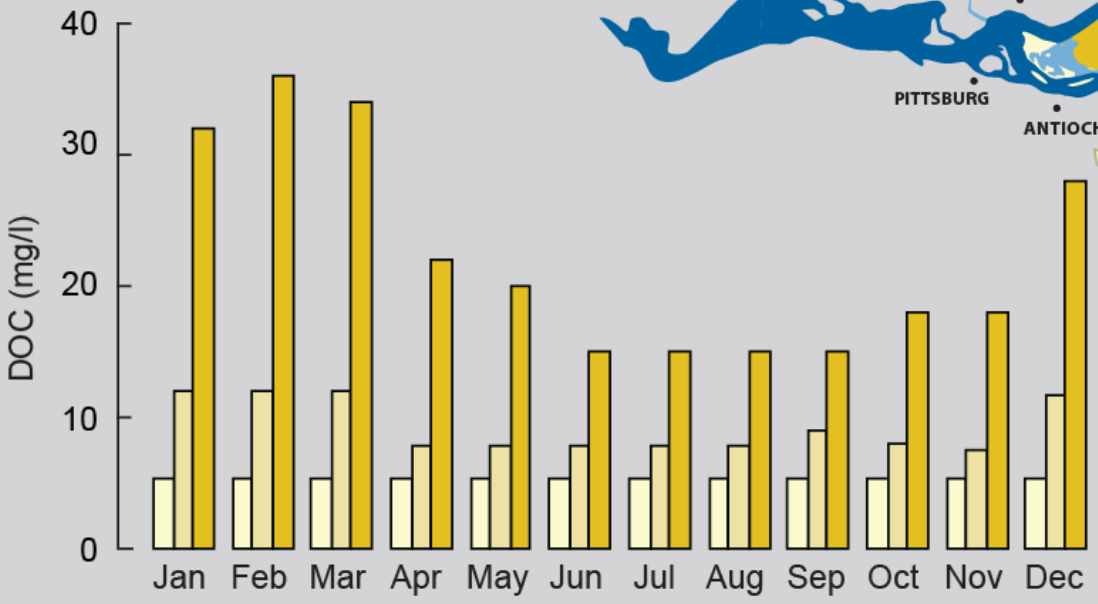
Source: 1995 DWR Memorandum Report

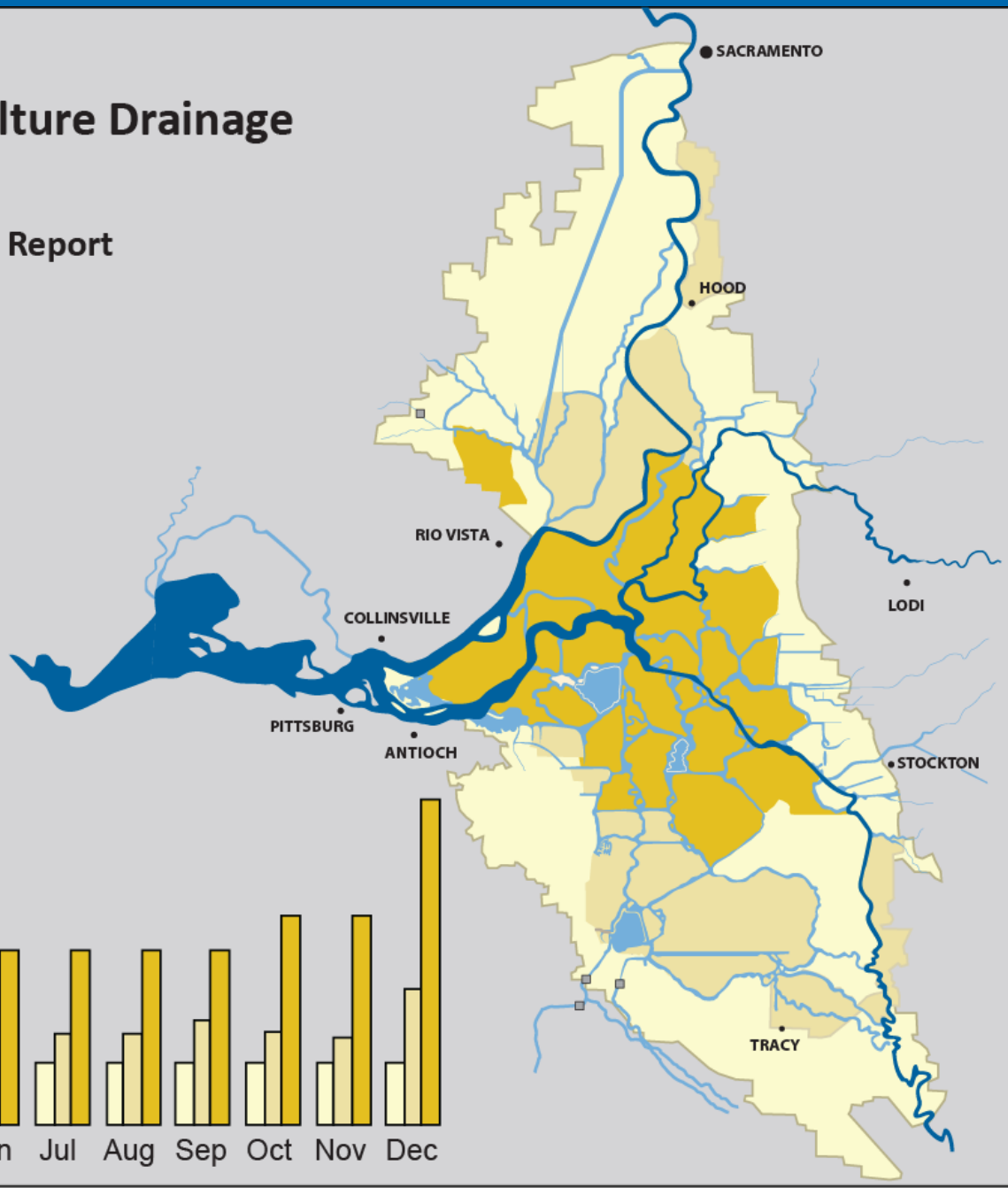




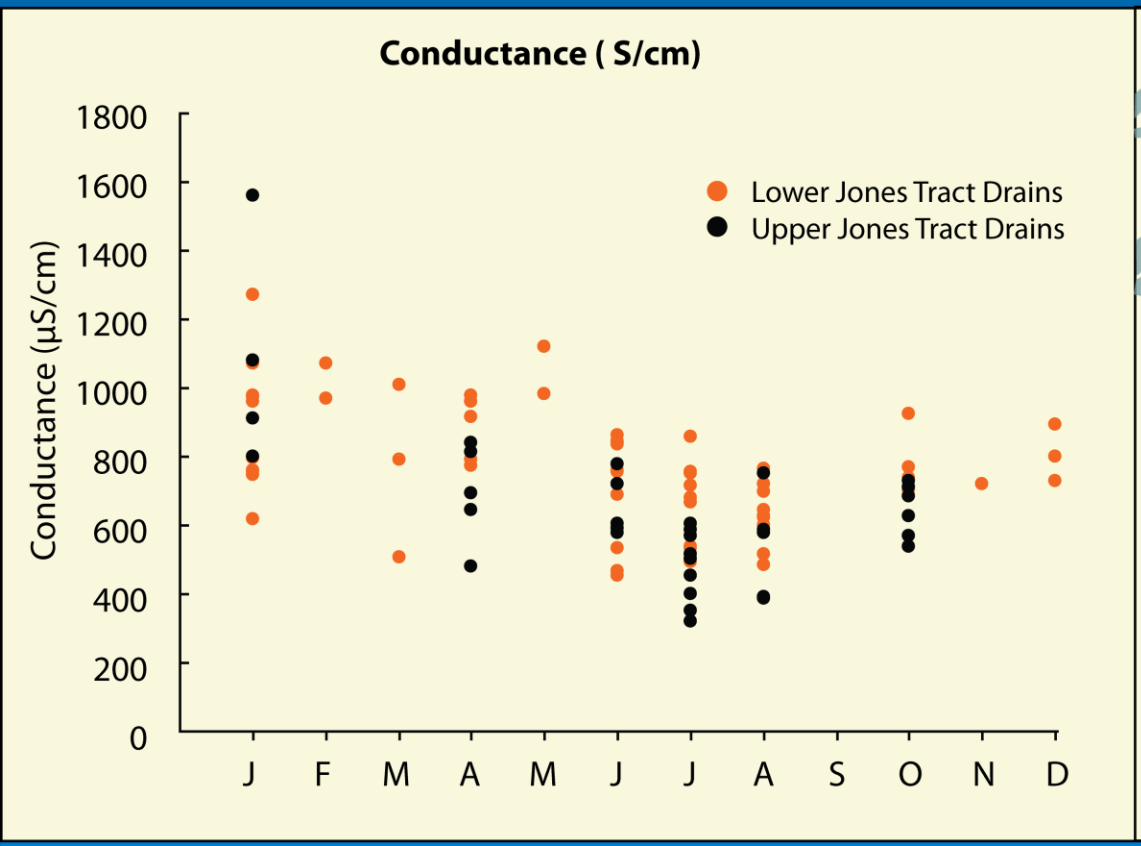
Assumed DOC in Agriculture Drainage for DSM2 Simulations

Source: 2000 MWQI Consultant Report



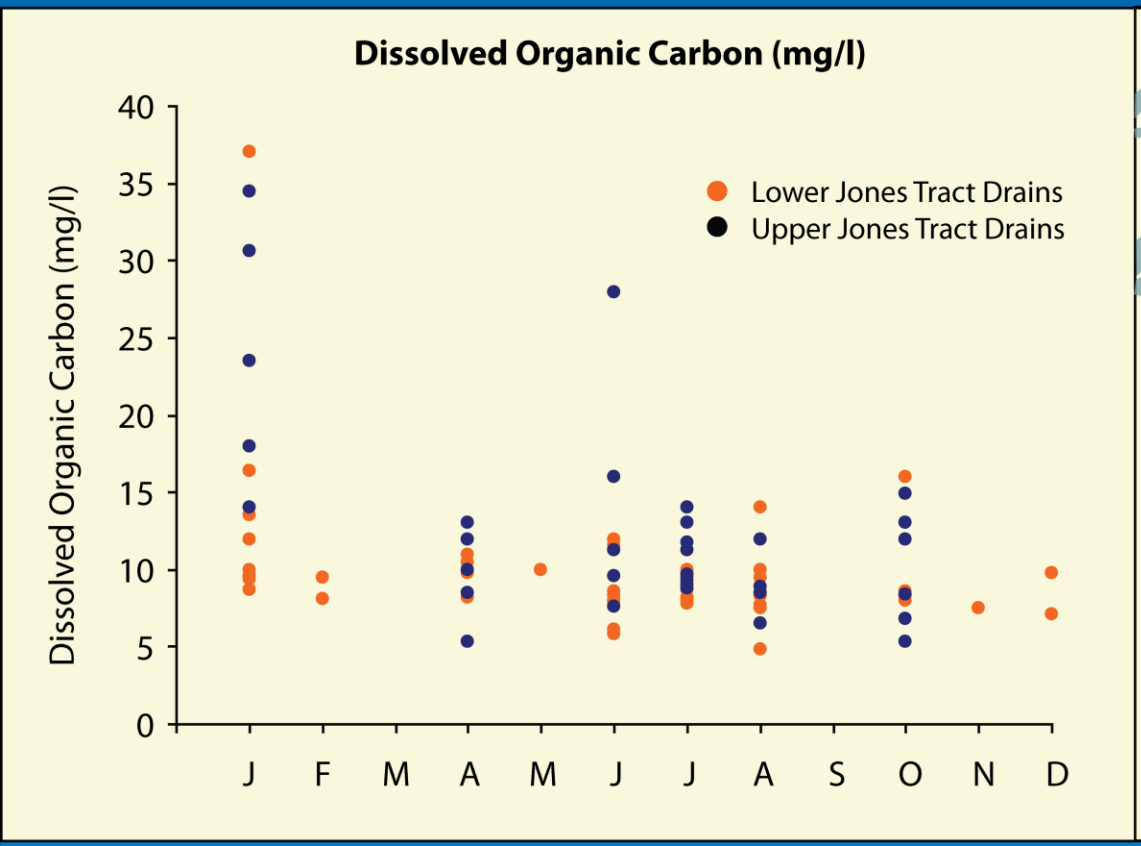


Grab Samples of Agriculture Drainage, 1987 - 1994
Jones Tract



Source: DWR Water Data Library

Grab Samples of Agriculture Drainage, 1987 - 1994
Jones Tract



Source: DWR Water Data Library

Thank You