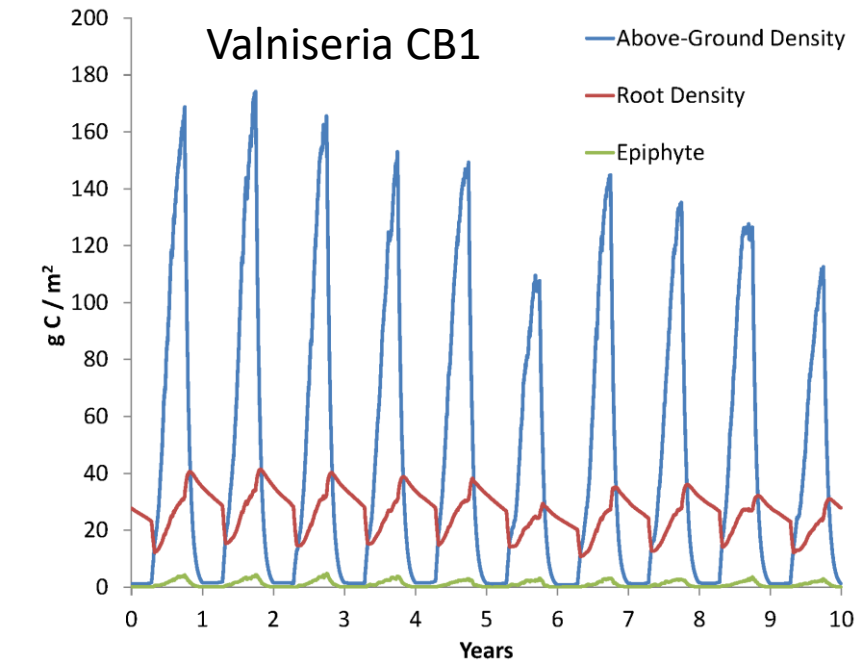
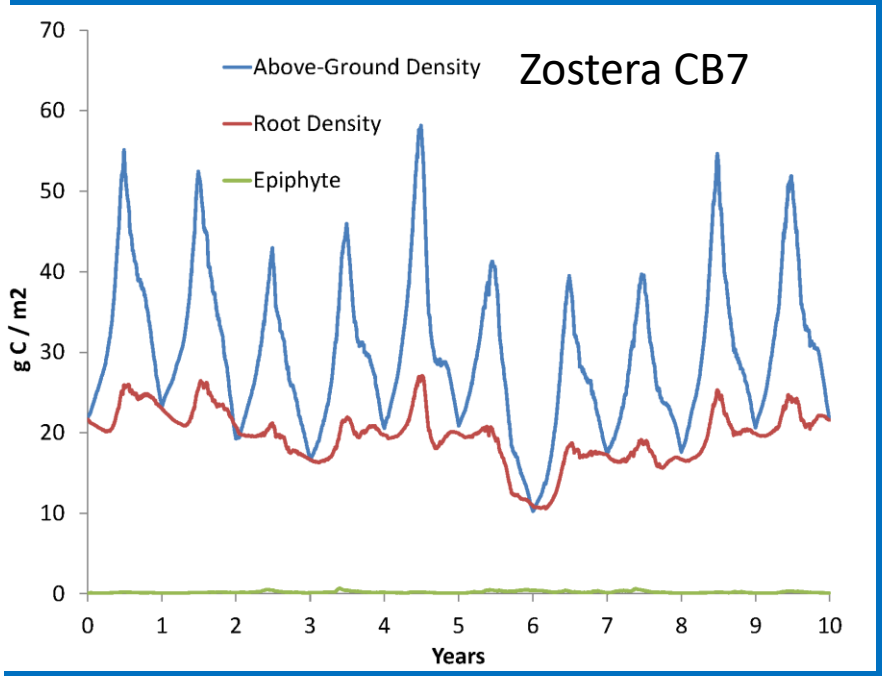
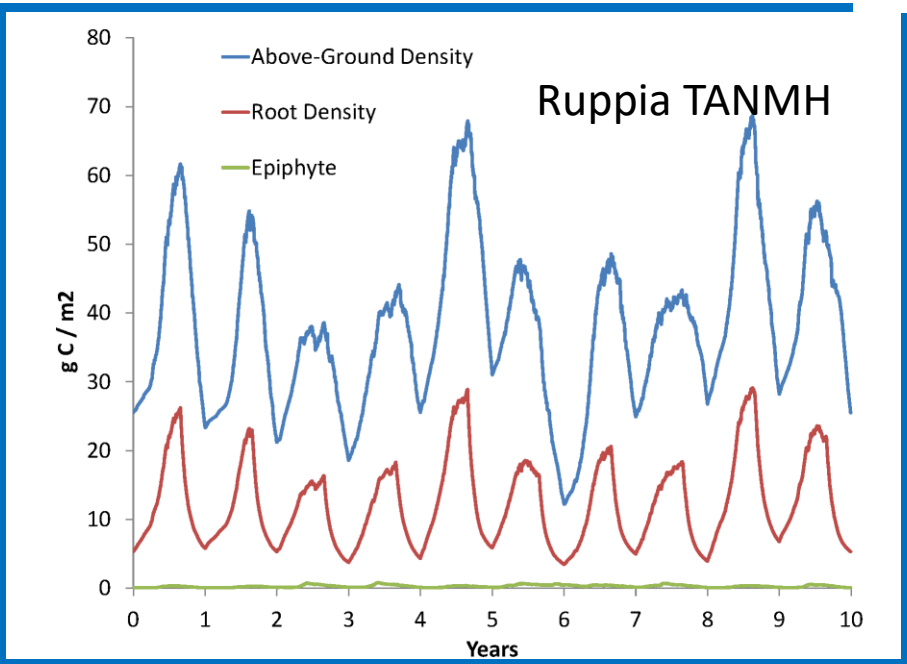
Influence of Submerged Aquatic Vegetation on Sediment-Water Nutrient Fluxes

Previously, we have examined how SAV affects sediment-water nutrient fluxes.

Now we're starting to examine how SAV influences parameters of interest, especially dissolved oxygen (DO).



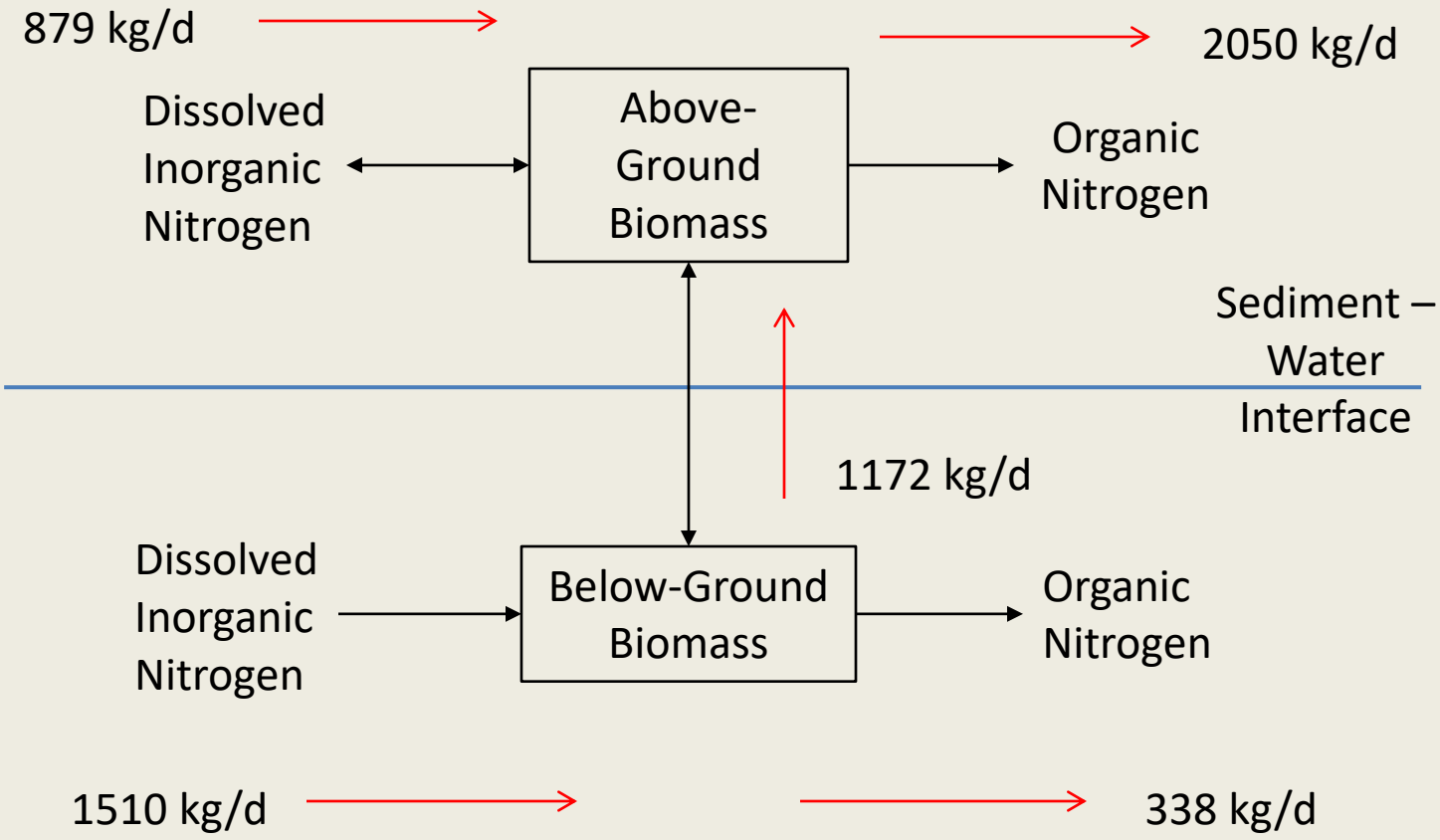




We model three mutually-exclusive SAV communities.

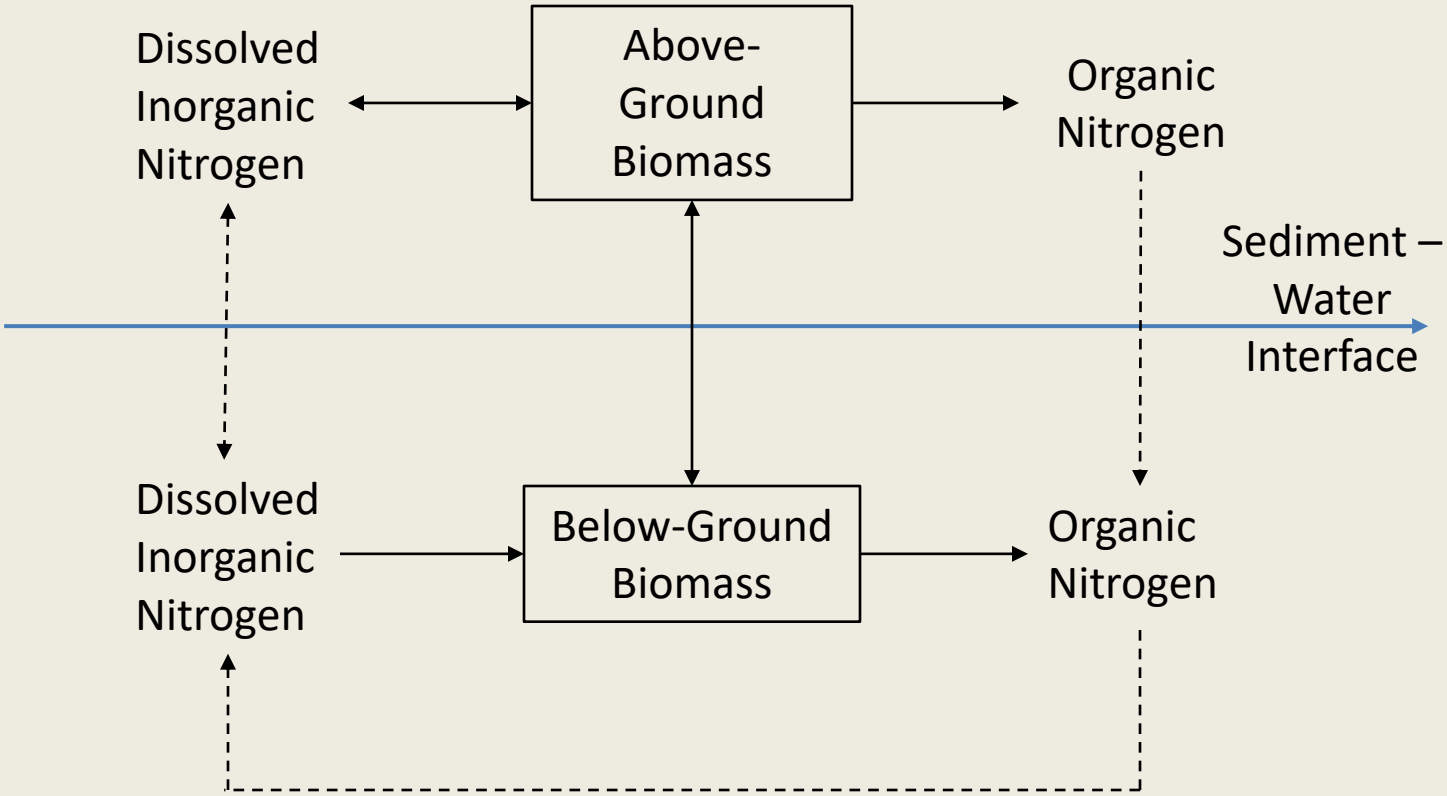
Cerco, C., and Moore, K. (2001) "System-Wide Submerged Vegetation Model for Chesapeake Bay," Estuaries 24(4) 522-534.

The Nitrogen Cycle

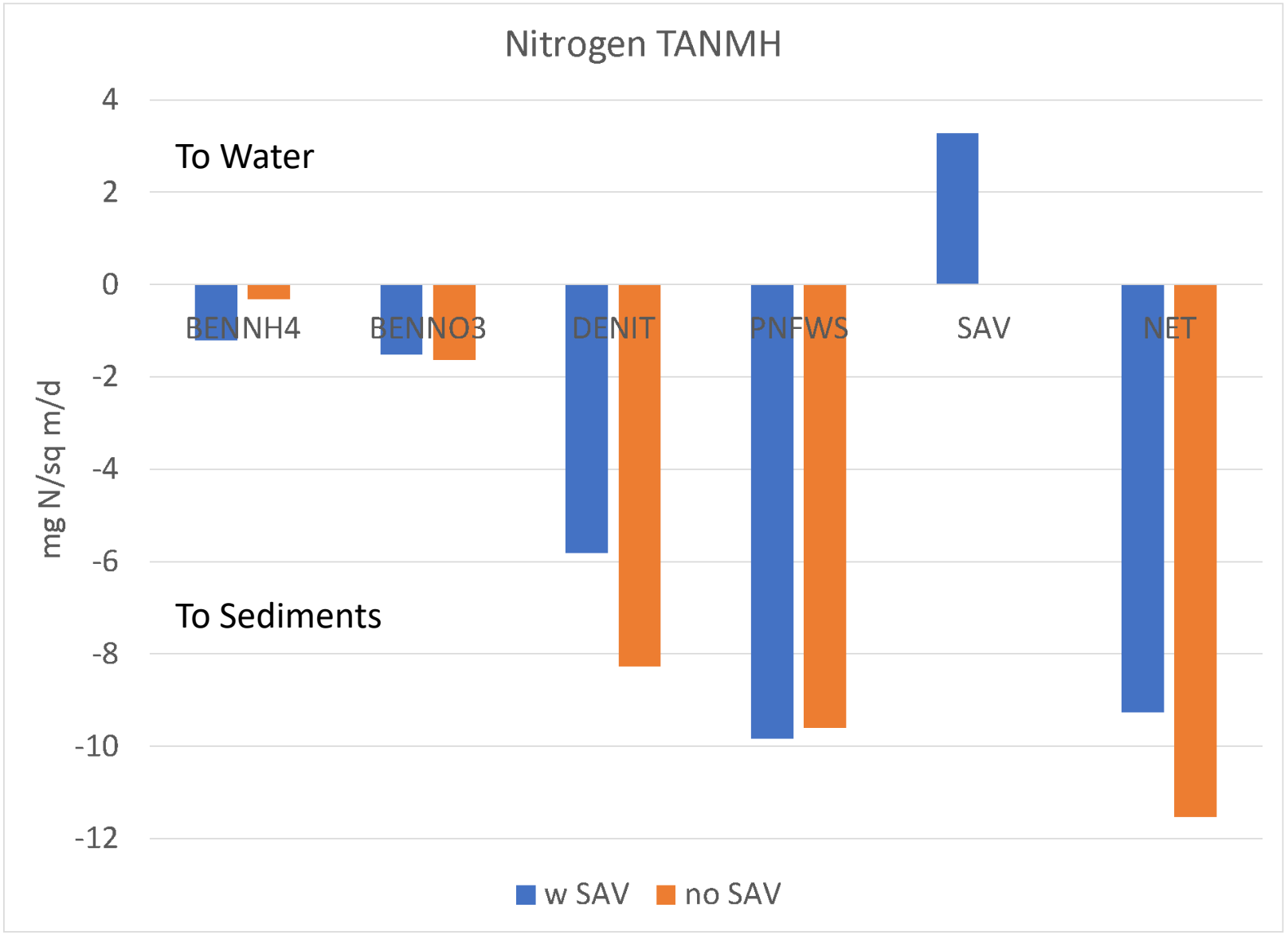


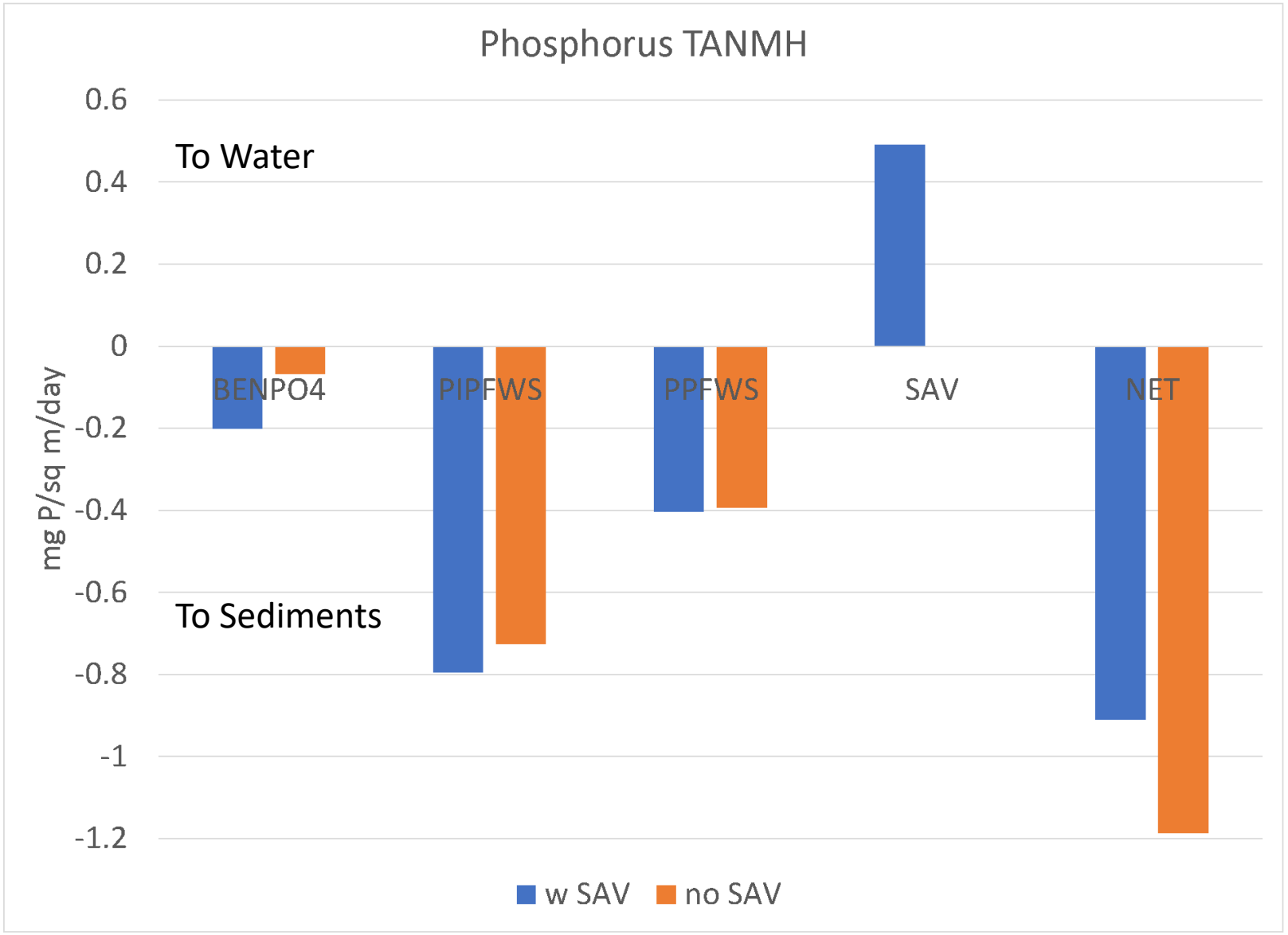
We quantify and can report out the indicated fluxes (CB1TF, vallisneria).

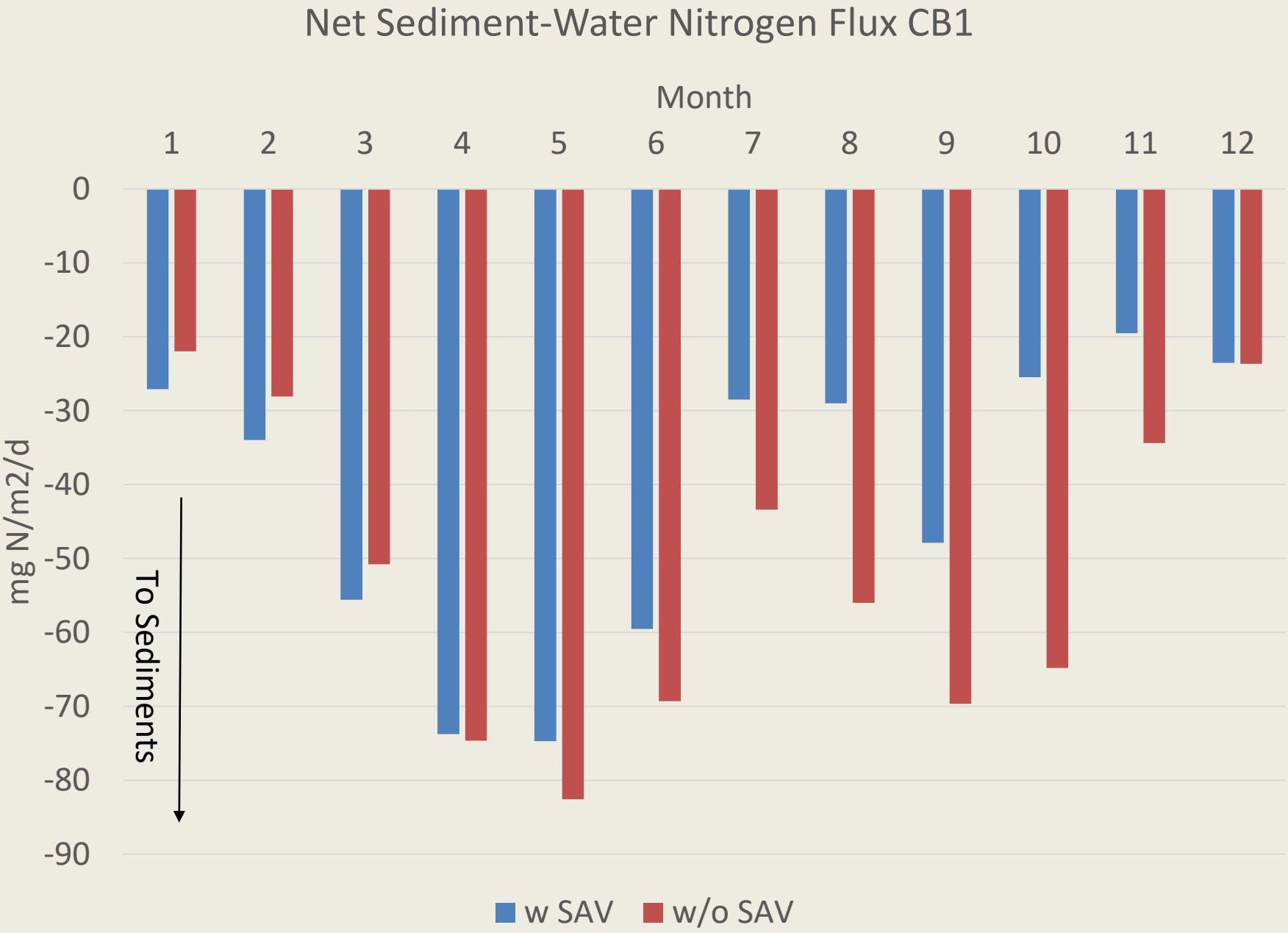
Complications

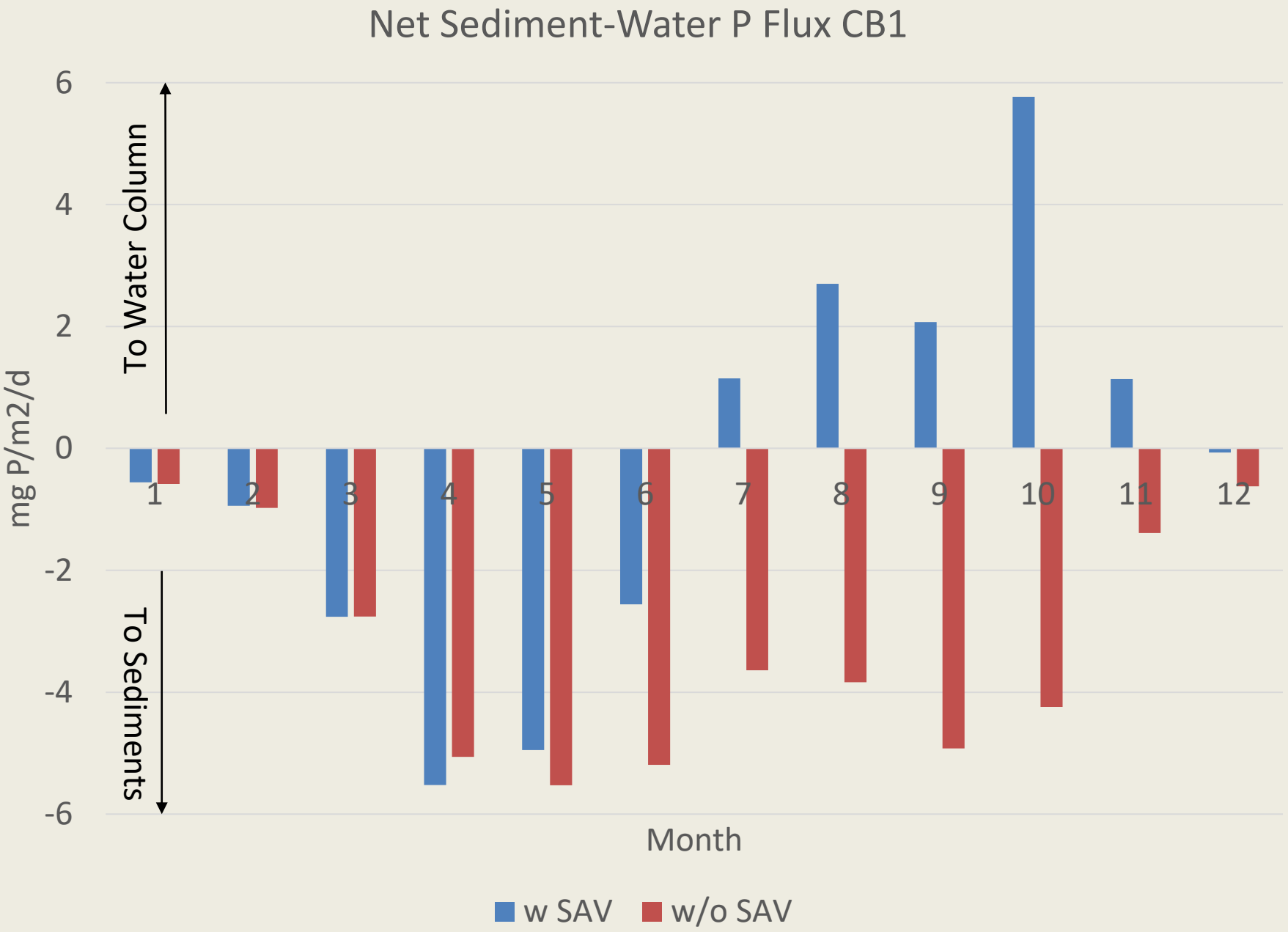


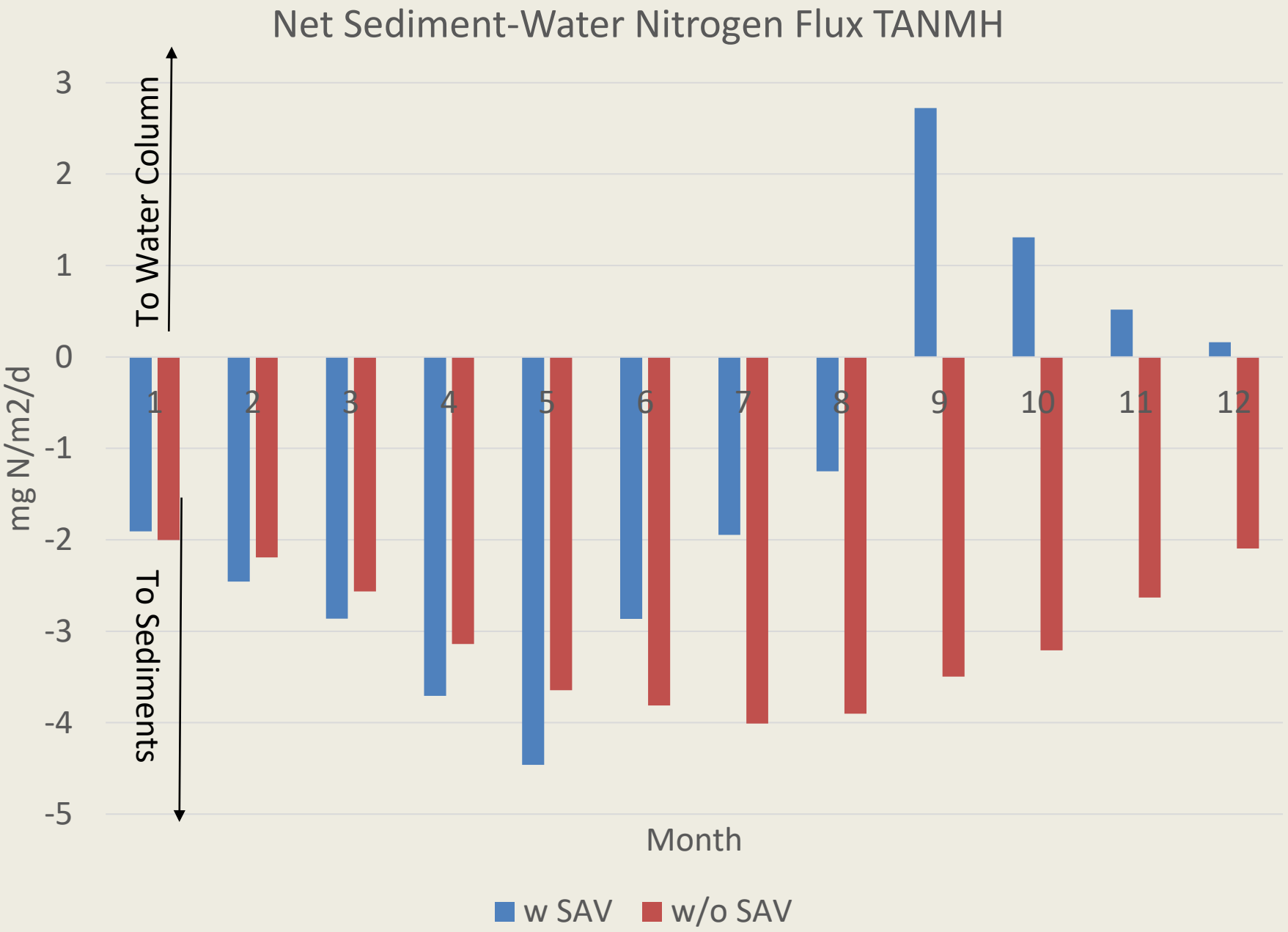
We quantify and can report out the additional fluxes but it is difficult to isolate the influence of SAV.

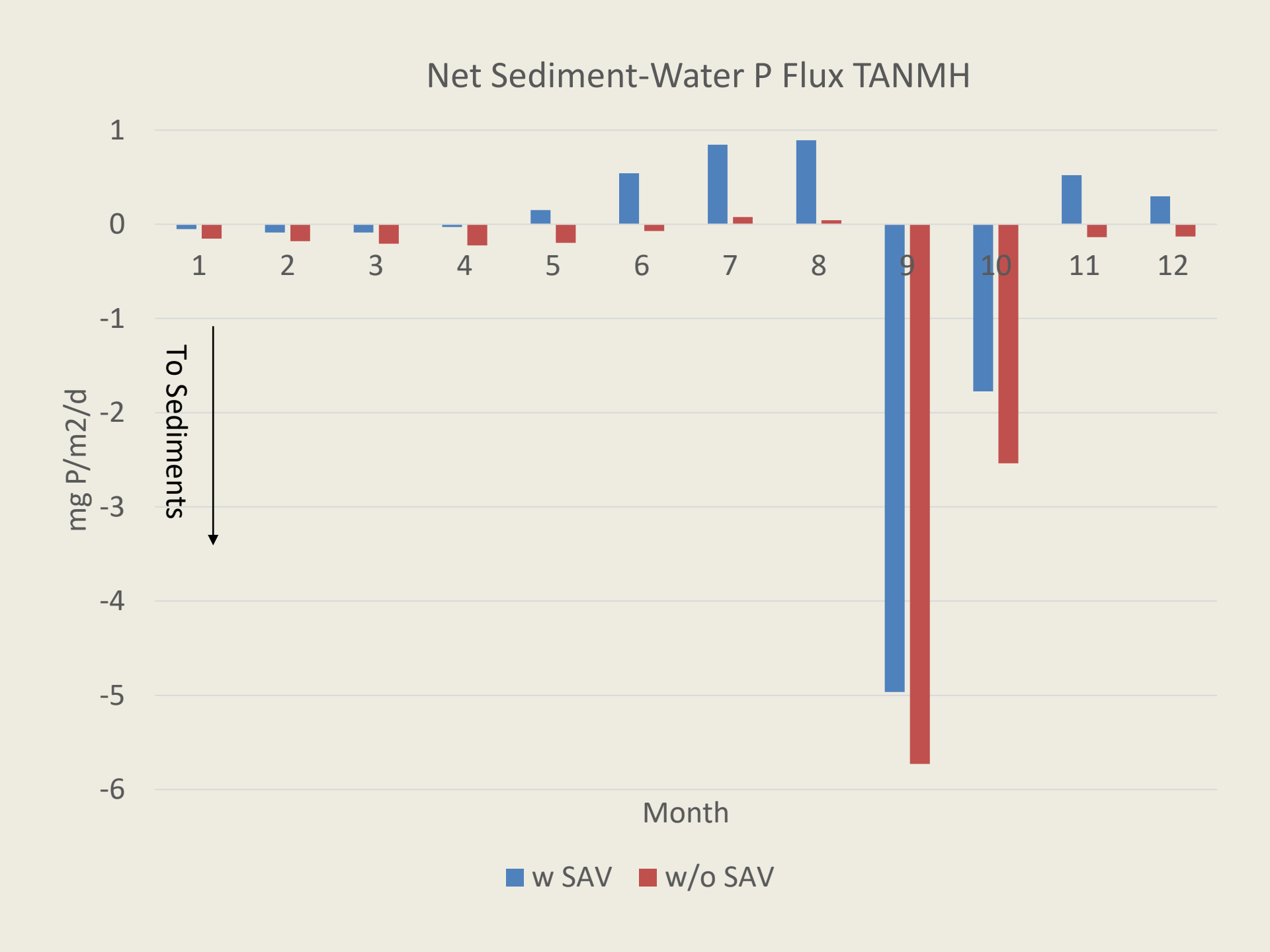

Nitrogen TANMH
4
2
0
-2
-4
-6
-8
-10
-12
mg N/sq m/d
To Water
To Sediments
BENNH4
BENNO3
DENIT
PNFWS
SAV
NET
w SAV
no SAV

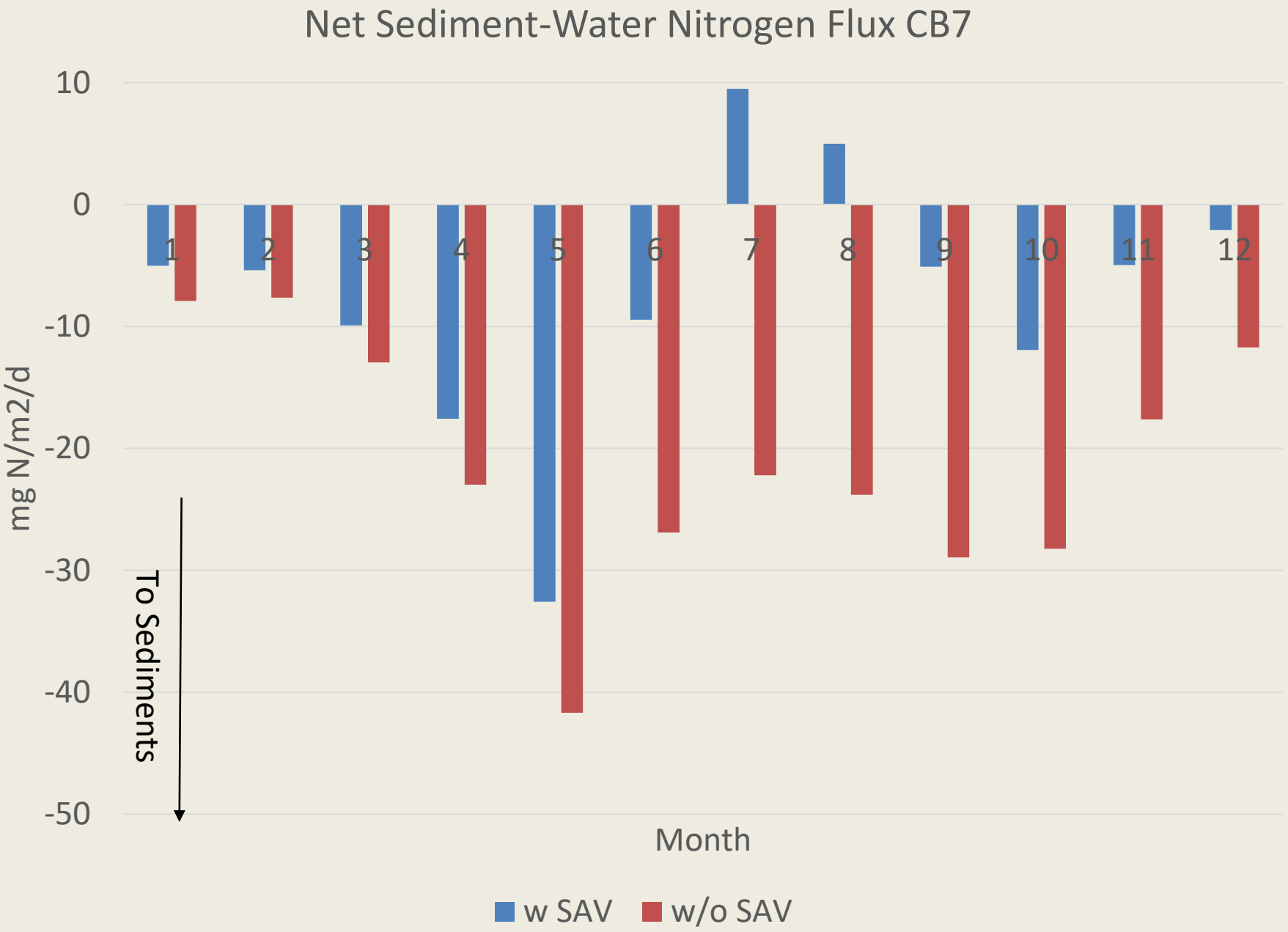

Phosphorus TANMH
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
mg P/sq m/day
To Water
To Sediments
BENPO4
PIPFWS
PPFWS
SAV
NET
w SAV
no SAV

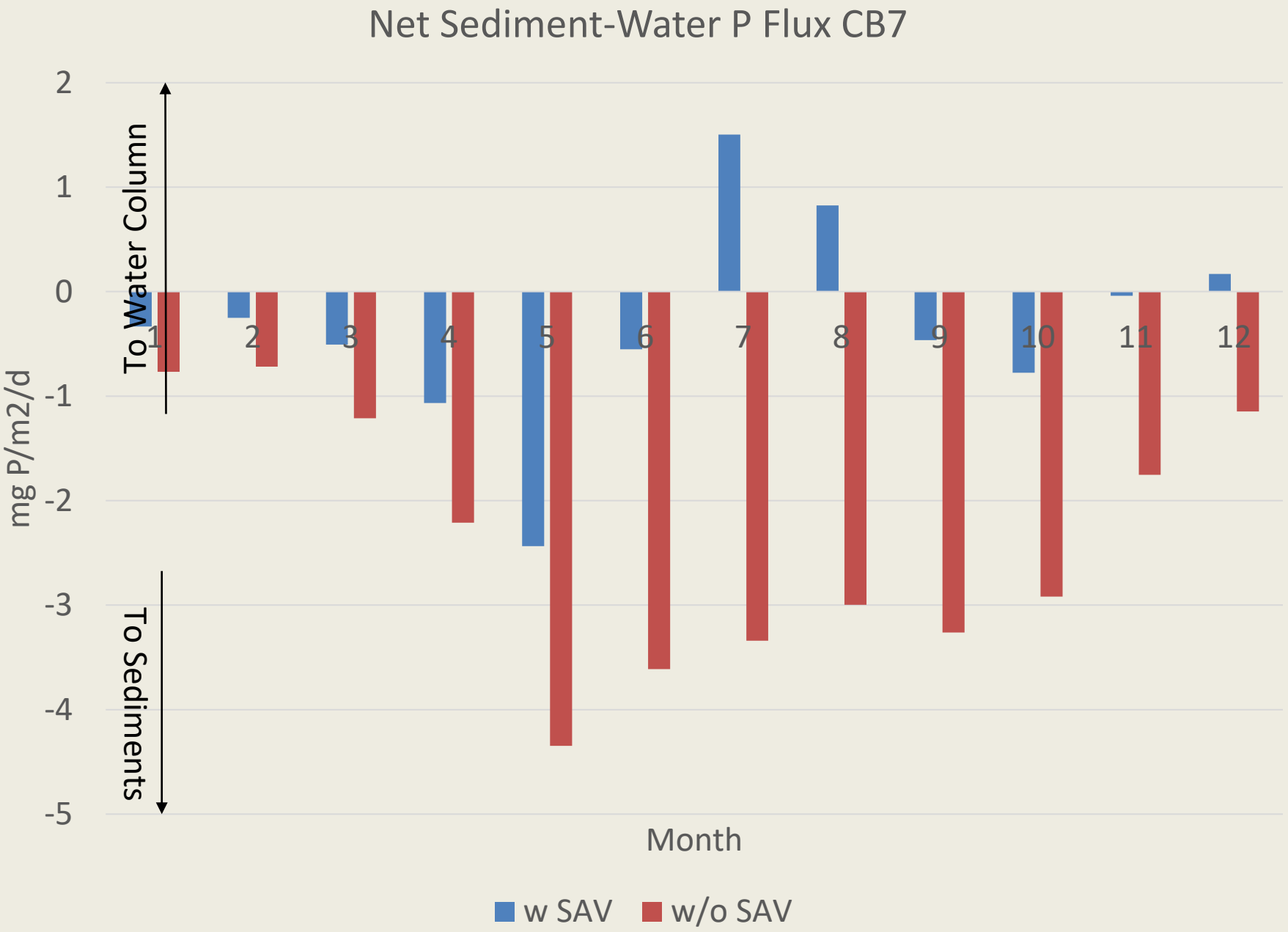

Net Sediment-Water Nitrogen Flux CB1
Month
1
2
3
4
5
6
7
8
9
10
11
12
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
mg N/m2/d
To Sediments
w SAV
w/o SAV


Net Sediment-Water P Flux CB1
6
4
2
0
-2
-4
-6
mg P/m2/d
To Water Column
To Sediments
1
2
3
4
5
6
7
8
9
10
11
12
Month
w SAV
w/o SAV


Net Sediment-Water Nitrogen Flux TANMH
To Water Column
To Sediments
mg N/m2/d
3
2
1
0
-1
-2
-3
-4
-5
1
2
3
4
5
6
7
8
9
10
11
12
Month
w SAV
w/o SAV


Net Sediment-Water P Flux TANMH
1
0
-1
-2
-3
-4
-5
-6
mg P/m2/d
To Sediments
1
2
3
4
5
6
7
8
9
10
11
12
Month
w SAV
w/o SAV


Net Sediment-Water Nitrogen Flux CB7
10
0
-10
-20
-30
-40
-50
mg N/m2/d
To Sediments
1
2
3
4
5
6
7
8
9
10
11
12
Month
w SAV
w/o SAV


Net Sediment-Water P Flux CB7
2
1
0
-1
-2
-3
-4
-5
mg P/m2/d
To Water Column
To Sediments
1
2
3
4
5
6
7
8
9
10
11
12
Month
w SAV
w/o SAV

Conclusion to Date

- SAV diminishes sediment nutrient retention.
- In some instances (months, locations), SAV can reverse direction of sediment-water nutrient fluxes.
- Sediments are still a net sink of nutrients.

How to Examine DO?

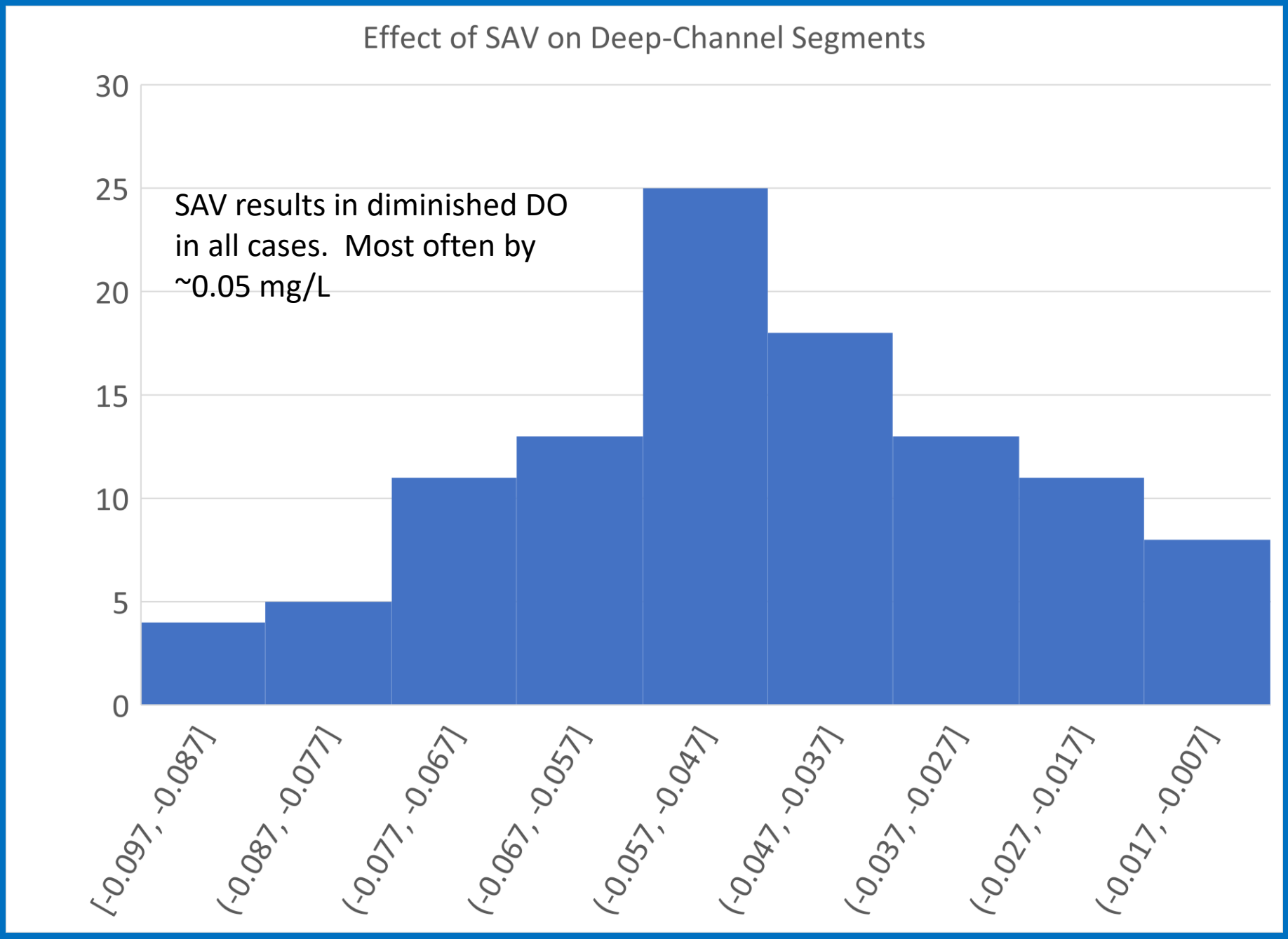
Consider three years, 1993 – 1995.

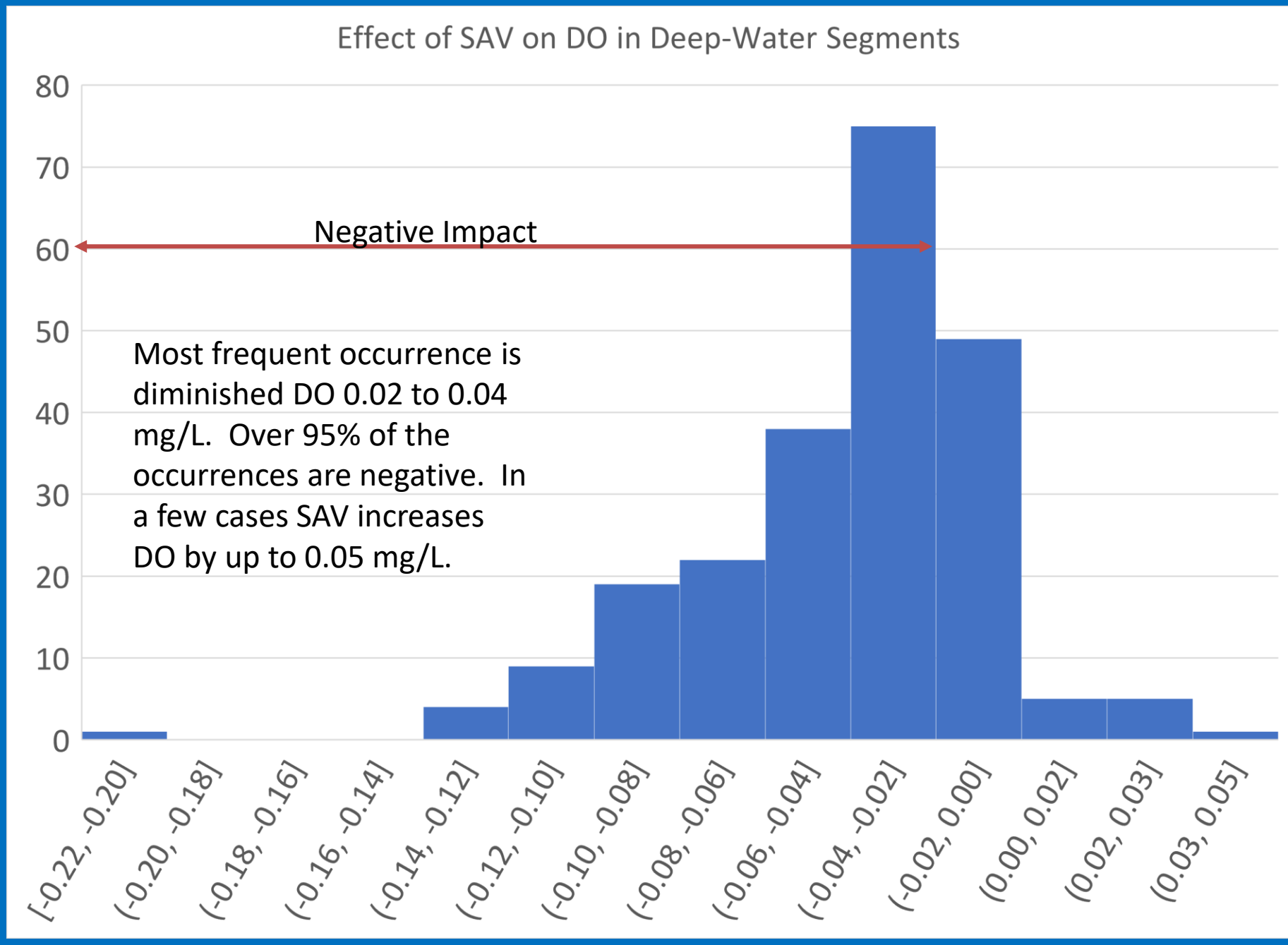
Consider four months, June – September.

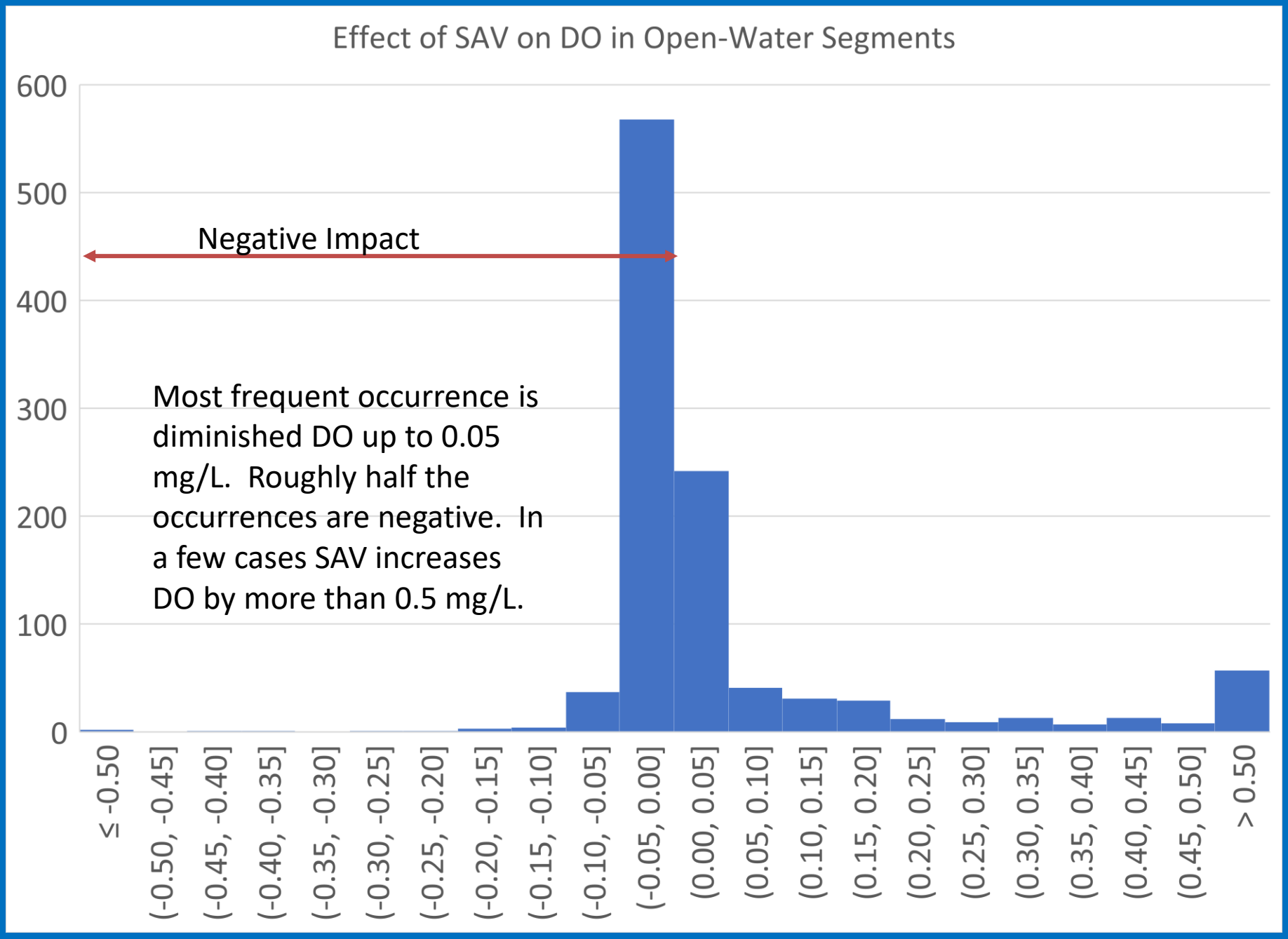
Take monthly averages for Deep Channel (DW), Deep Water (DW), and Open Water (OW) segments.

Each Year-Month-Segment average is an “occurrence.”

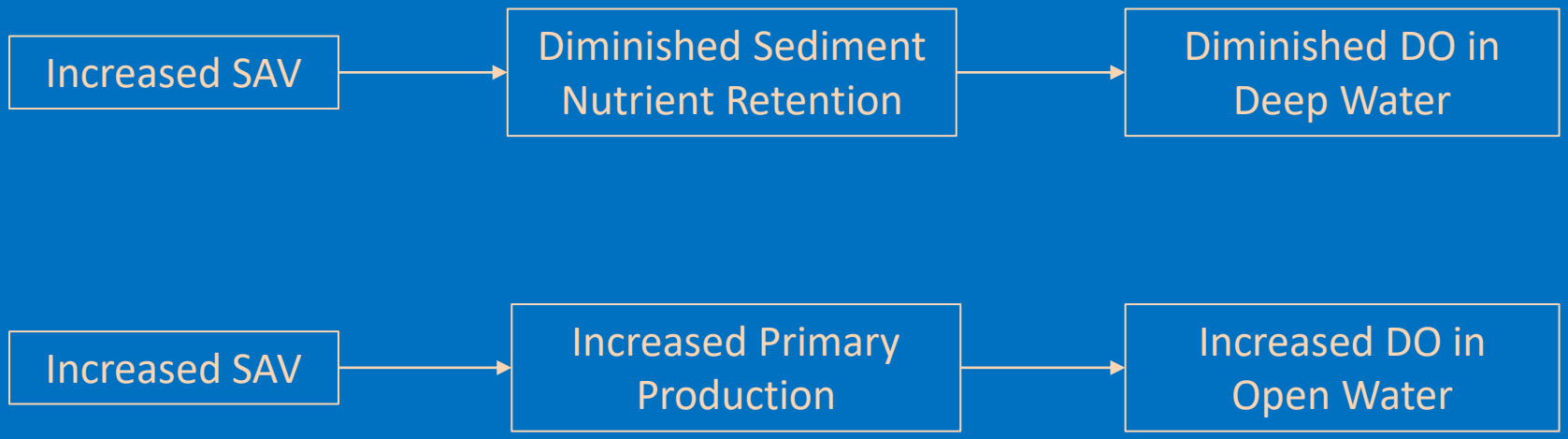
We get from 108 (DC) to 1080 (OW) occurrences.


Effect of SAV on Deep-Channel Segments
SAV results in diminished DO in all cases. Most often by ~0.05 mg/L
30
25
20
15
10
5
0
[-0.097, -0.087]
(-0.087, -0.077]
(-0.077, -0.067]
(-0.067, -0.057]
(-0.057, -0.047]
(-0.047, -0.037]
(-0.037, -0.027]
(-0.027, -0.017]
(-0.017, -0.007]


Effect of SAV on DO in Deep-Water Segments
80
70
60
50
40
30
20
10
0
Negative Impact
Most frequent occurrence is diminished DO 0.02 to 0.04 mg/L. Over 95% of the occurrences are negative. In a few cases SAV increases DO by up to 0.05 mg/L.
[-0.22, -0.20]
(-0.20, -0.18]
(-0.18, -0.16]
(-0.16, -0.14]
(-0.14, -0.12]
(-0.12, -0.10]
(-0.10, -0.08]
(-0.08, -0.06]
(-0.06, -0.04]
(-0.04, -0.02]
(-0.02, 0.00]
(0.00, 0.02]
(0.02, 0.03]
(0.03, 0.05]


Effect of SAV on DO in Open-Water Segments
600
500
400
300
200
100
0
Negative Impact
Most frequent occurrence is diminished DO up to 0.05 mg/L. Roughly half the occurrences are negative. In a few cases SAV increases DO by more than 0.5 mg/L.
≤ -0.50
(-0.50, -0.45]
(-0.45, -0.40]
(-0.40, -0.35]
(-0.35, -0.30]
(-0.30, -0.25]
(-0.25, -0.20]
(-0.20, -0.15]
(-0.15, -0.10]
(-0.10, -0.05]
(-0.05, 0.00]
(0.00, 0.05]
(0.05, 0.10]
(0.10, 0.15]
(0.15, 0.20]
(0.20, 0.25]
(0.25, 0.30]
(0.30, 0.35]
(0.35, 0.40]
(0.40, 0.45]
(0.45, 0.50]
> 0.50

Conceptual Models



Next Steps

- Try to systematize/understand why segments behave as they do.
- Quantify SAV effect on nutrient fluxes. Compare to other nutrient sources/sinks.
- Move analysis to WIP loads and SAV distribution.
- Write up results.