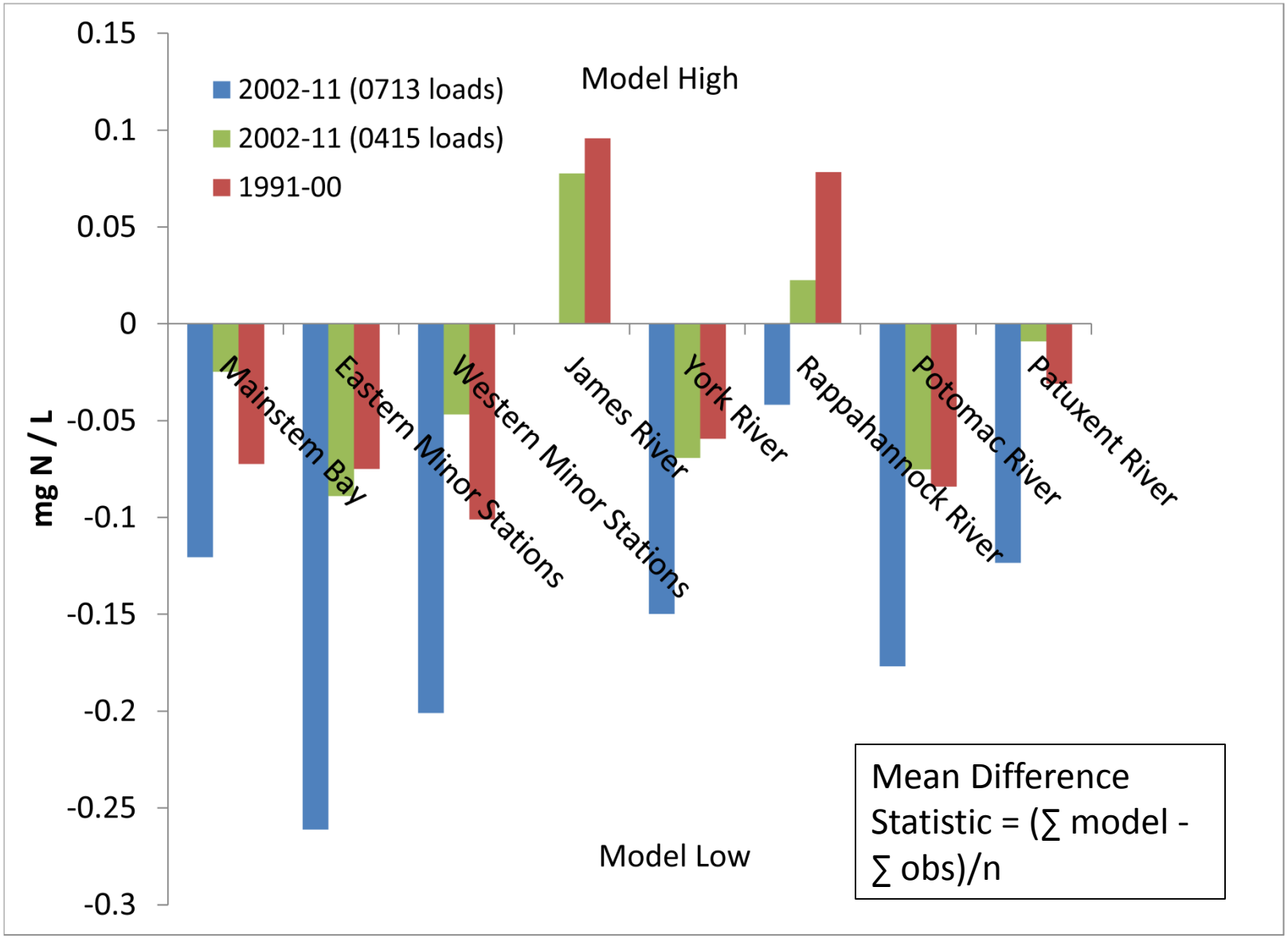
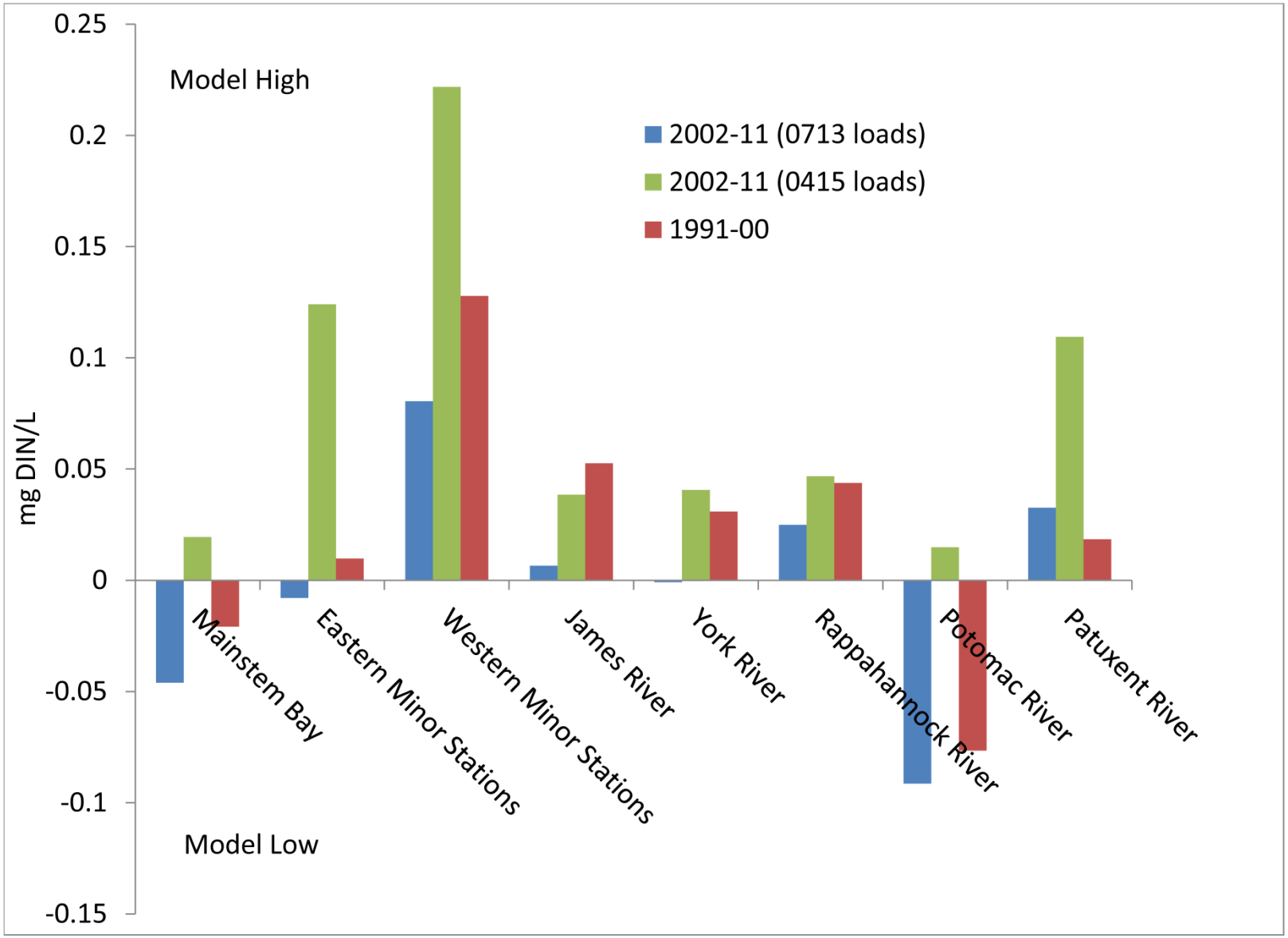
2002 – 2011 Simulation

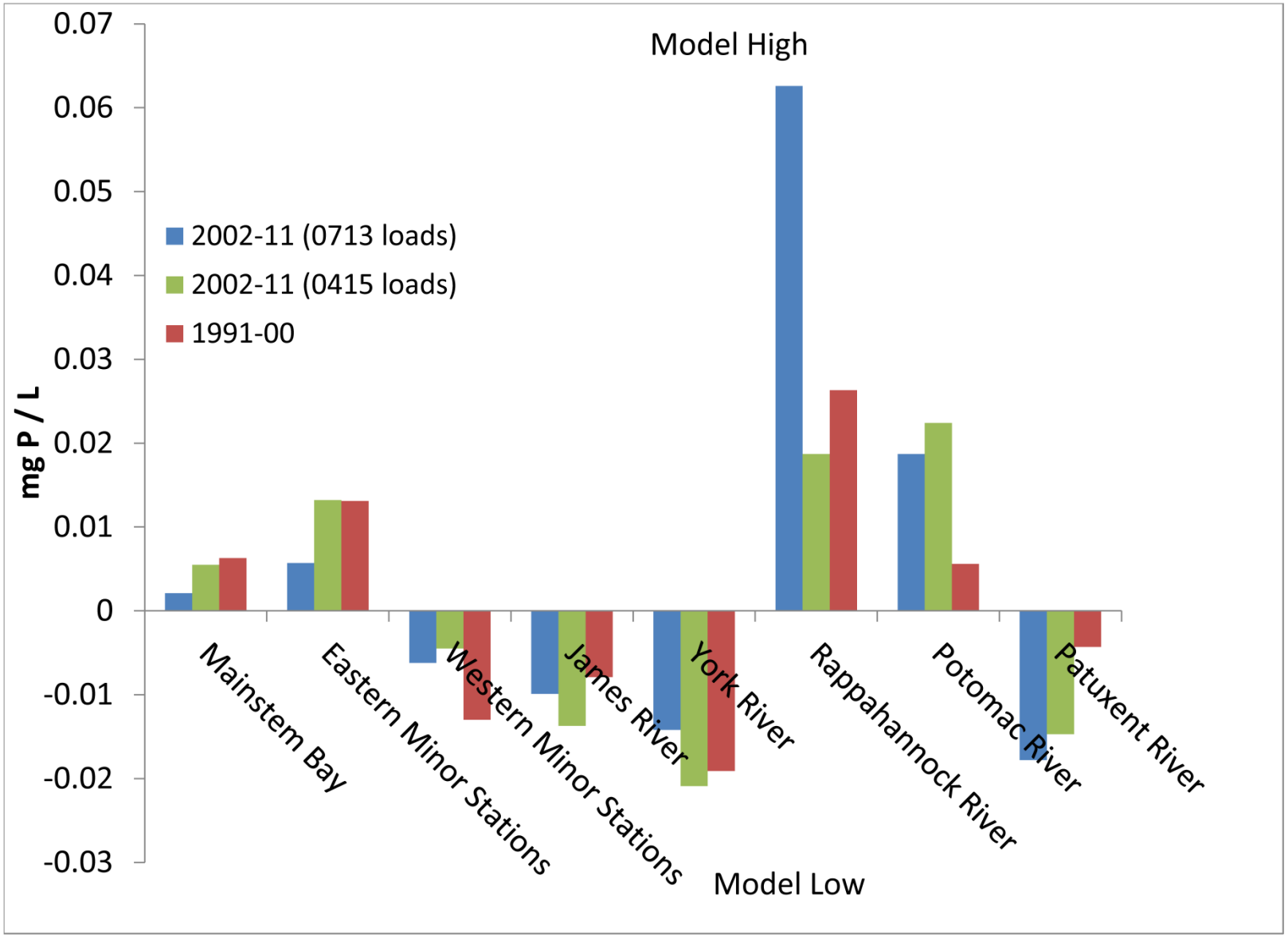
- This is a new base simulation for activities through to the 2017 re-evaluation. The previous base was 1991 - 2000
  - Move to recent land uses, loads, data.
  - Phase 6 Watershed Model
  - Incorporate bulk of shallow-water data.
  - Provide boundary conditions for multiple model project.

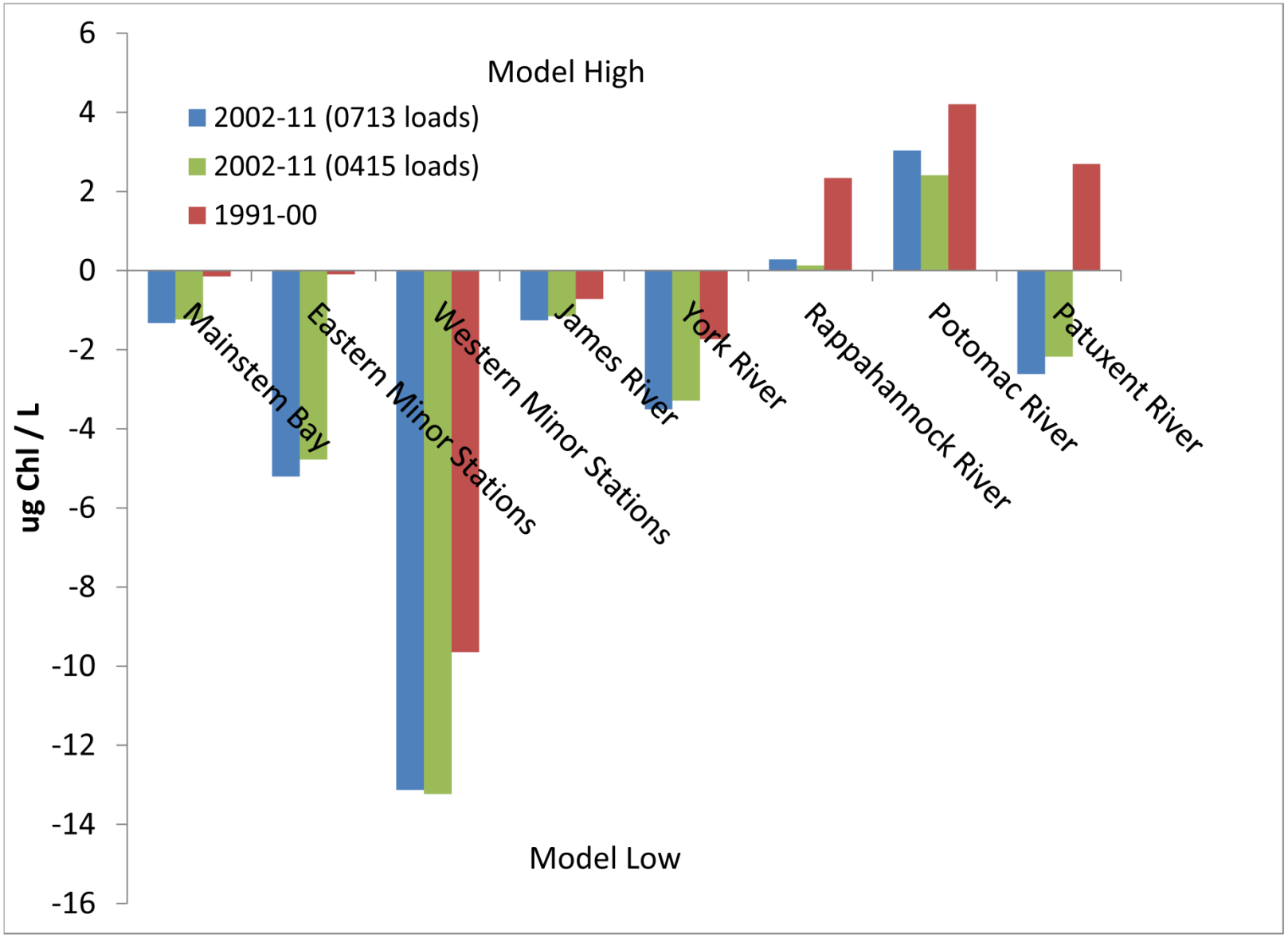
Background

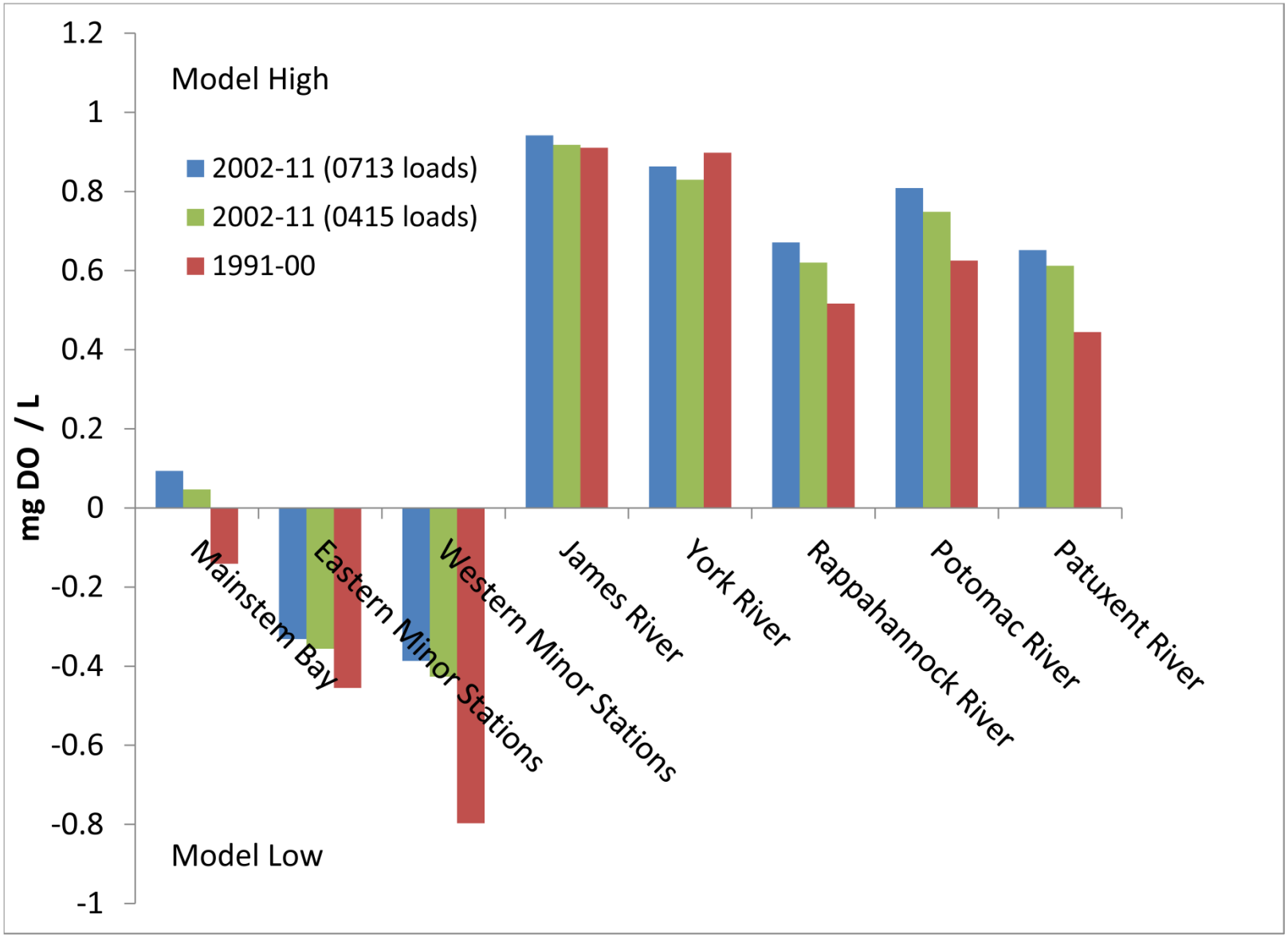
- Watershed Model Loads – Initial Phase 6 loads provided by CBP July 2013.
- Hydrodynamics – Prepared by CBP circa July 2013.
- Initial DO simulations were not as good as previously (e.g. 1991-2000 Phase 5.3.2 WSM).
- Less computed anoxia was apparently linked to a deficit in watershed nitrogen loads.
- We received the latest Phase 6 loads April 17.


0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
mg N / L
2002-11 (0713 loads)
2002-11 (0415 loads)
1991-00
Model High
Model Low
Mainstem Bay
Eastern Minor Stations
Western Minor Stations
James River
York River
Rappahannock River
Potomac River
Patuxent River
Mean Difference Statistic = (∑ model - ∑ obs)/n


0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
mg DIN/L
Model High
Model Low
2002-11 (0713 loads)
2002-11 (0415 loads)
1991-00
Mainstem Bay
Eastern Minor Stations
Western Minor Stations
James River
York River
Rappahannock River
Potomac River
Patuxent River

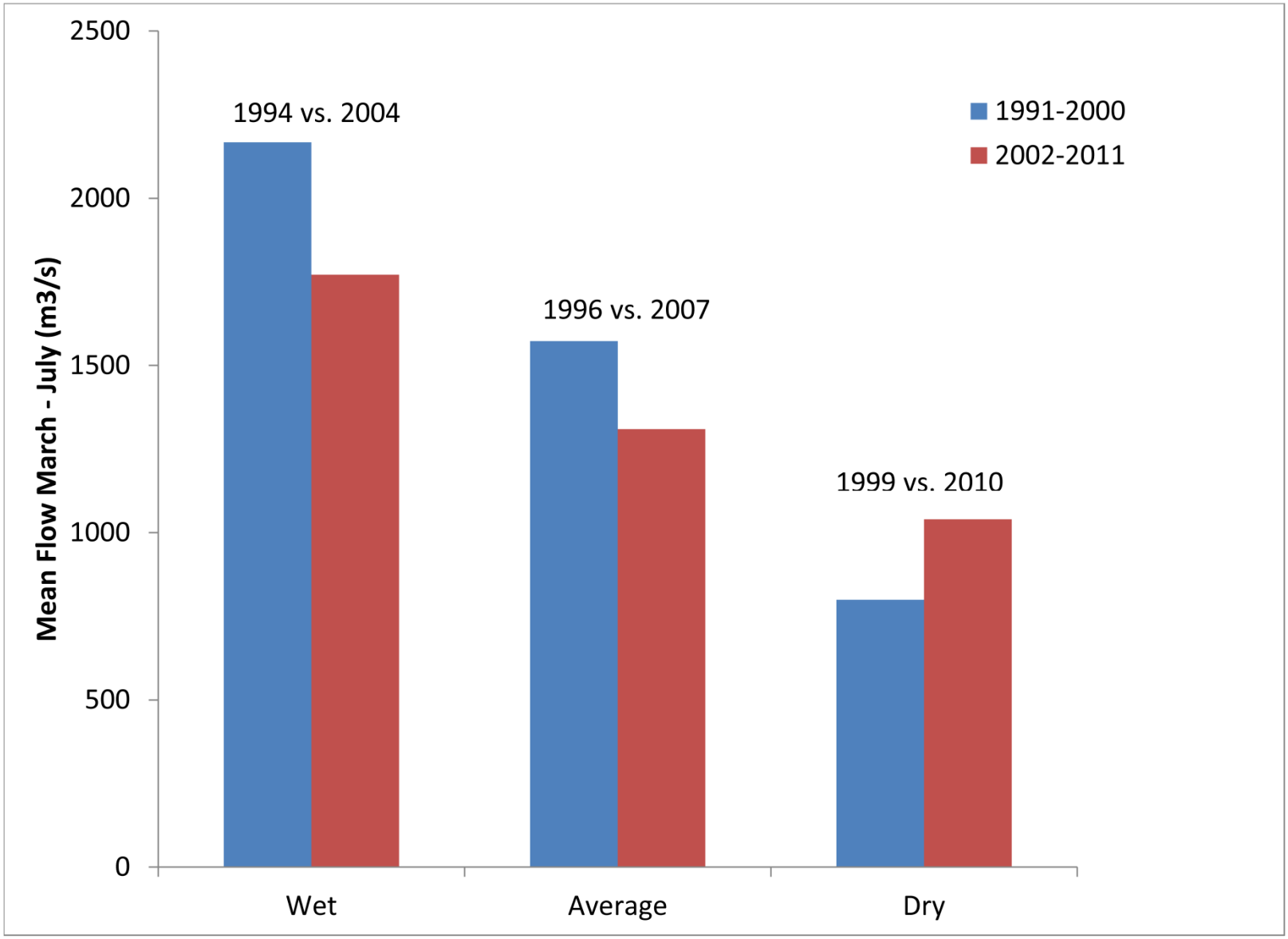

Model High
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
mg P / L
2002-11 (0713 loads)
2002-11 (0415 loads)
1991-00
Mainstem Bay
Eastern Minor Stations
Western Minor Stations
James River
York River
Rappahannock River
Potomac River
Patuxent River
Model Low

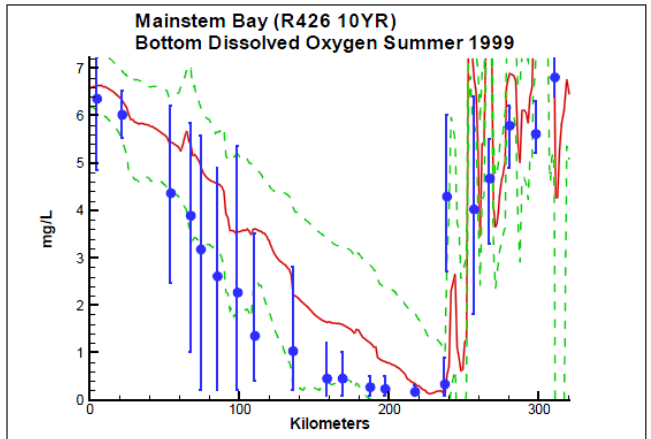

Model High
2002-11 (0713 loads)
2002-11 (0415 loads)
1991-00
ug Chl / L
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
Model Low
Mainstem Bay
Eastern Minor Stations
Western Minor Stations
James River
York River
Rappahannock River
Potomac River
Patuxent River

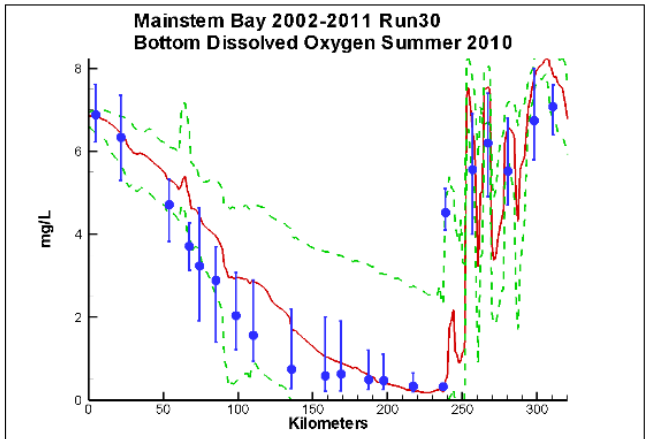

1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
mg DO / L
Model High
Model Low
2002-11 (0713 loads)
2002-11 (0415 loads)
1991-00
Mainstem Bay
Eastern Minor Stations
Western Minor Stations
James River
York River
Rappahannock River
Potomac River
Patuxent River

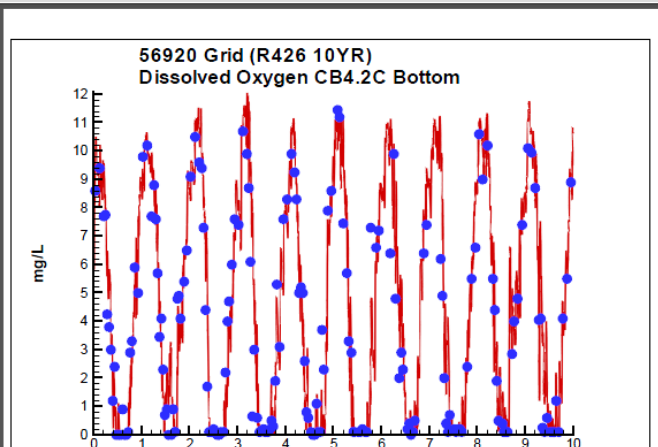
Background

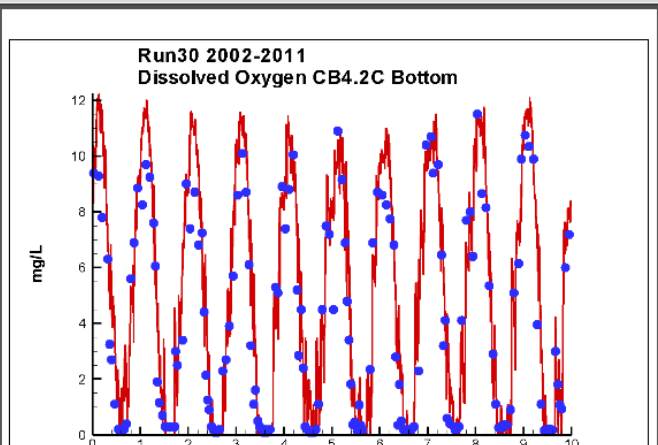
- Since the inception of the modeling program, we have examined hypoxia in characteristic wet, dry, and average years.
- The observed hypoxic volume increases as we progress from dry to average to wet hydrology.
- Model performance improves as we progress from dry to average to wet hydrology. We do better in wet years.
- How you define wet, dry, and average is a bit arbitrary.
- Here, we look at average Susquehanna flow March - July. Capture spring flow and loads, initial set-up of hypoxia.

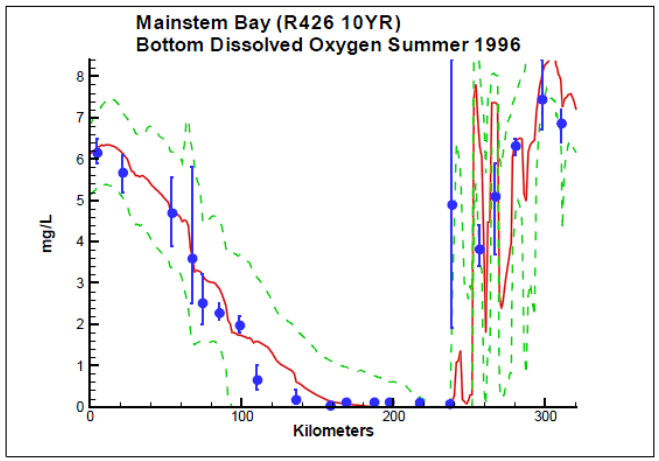

2500
2000
1500
1000
500
0
Mean Flow March - July (m3/s)
1994 vs. 2004
1996 vs. 2007
1999 vs. 2010
1991-2000
2002-2011
Wet
Average
Dry

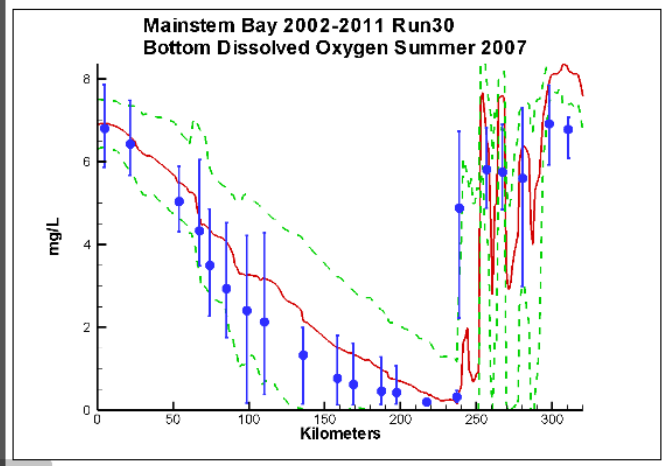

Mainstem Bay (R426 10YR)
Bottom Dissolved Oxygen Summer 1999
mg/L
Kilometers

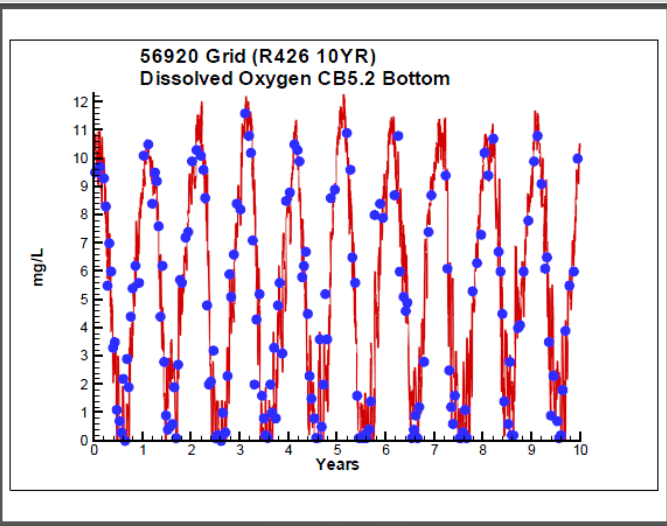

Mainstem Bay 2002-2011 Run30
Bottom Dissolved Oxygen Summer 2010
mg/L
Kilometers

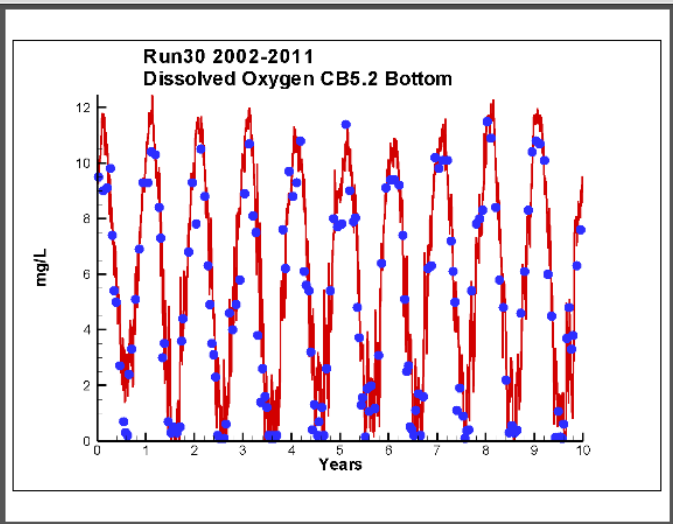

56920 Grid (R426 10YR)
Dissolved Oxygen CB4.2C Bottom
mg/L
Years

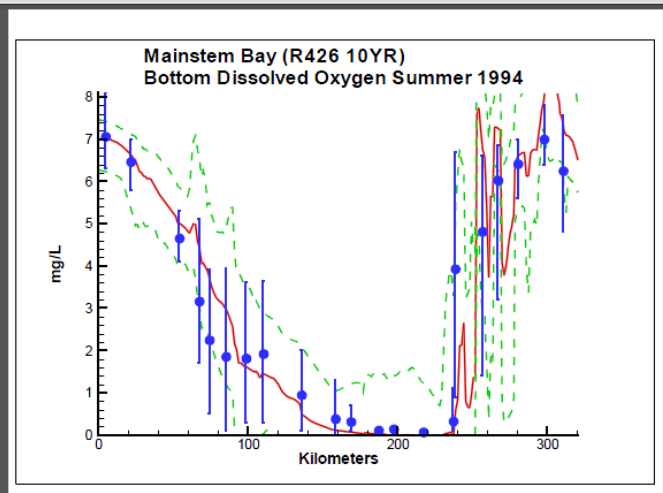

Run30 2002-2011
Dissolved Oxygen CB4.2C Bottom
mg/L
Years

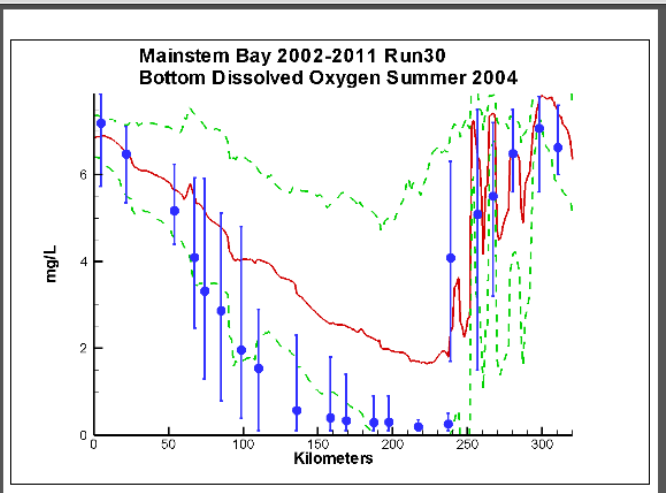

Mainstem Bay (R426 10YR)
Bottom Dissolved Oxygen Summer 1996
mg/L
Kilometers

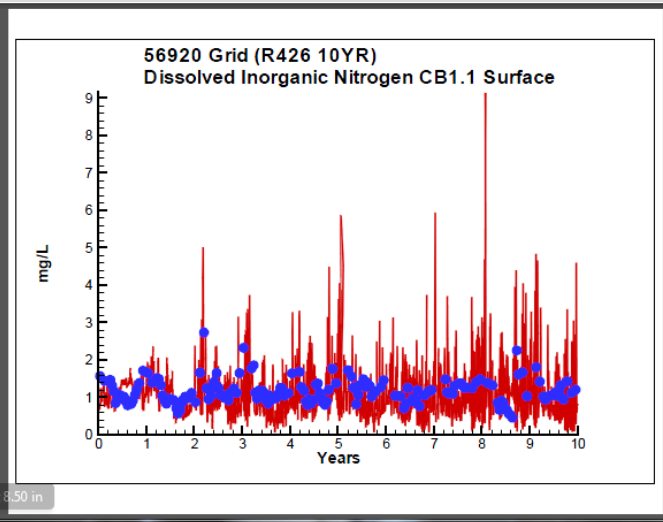

Mainstem Bay 2002-2011 Run30
Bottom Dissolved Oxygen Summer 2007
mg/L
Kilometers

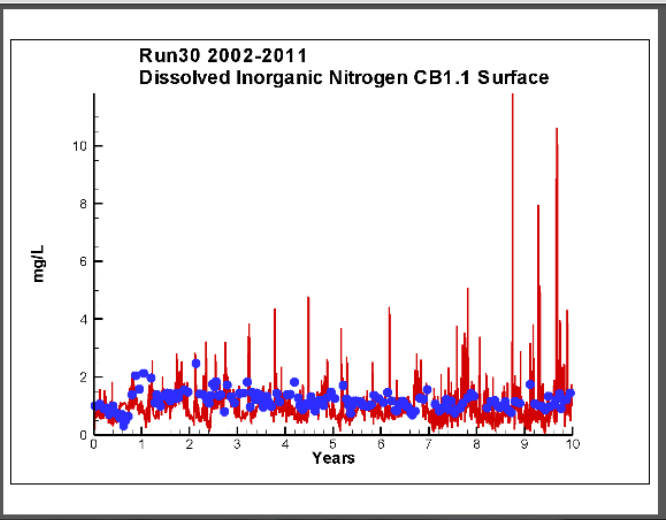

56920 Grid (R426 10YR)
Dissolved Oxygen CB5.2 Bottom
mg/L
Years


Run30 2002-2011
Dissolved Oxygen CB5.2 Bottom
mg/L
Years


Mainstem Bay (R426 10YR)
Bottom Dissolved Oxygen Summer 1994
mg/L
Kilometers


Mainstem Bay 2002-2011 Run30
Bottom Dissolved Oxygen Summer 2004
mg/L
Kilometers


56920 Grid (R426 10YR)
Dissolved Inorganic Nitrogen CB1.1 Surface
mg/L
Years


Run30 2002-2011
Dissolved Inorganic Nitrogen CB1.1 Surface
mg/L
Years

Summary

- Inspection indicates the model performance with present Phase 6 loads is comparable to performance with Phase 5.3.2.
- Summary statistics support the notion that present performance is comparable to previous performance.
- However, at present hypoxia during our “wet” year is poorly represented. This is contrary to all previous experience.
- Do the hydrodynamics from July 2013 need to be re-run? These are based on Phase 6 flows from July 2013.

Where Do We Go from Here?

- Our next steps are up to the group.
- Do we accept the Phase 6 results as “good enough” and move our efforts back to 2002-2011?
- Provide results to shallow-water teams?
- Implement G2/G3 state variables for 2002-2011?
- Work on our own shallow-water improvements?
- I think we need to do some more investigation. Are the results for 2004 a characteristic of Phase 6? Or is there something unusual about 2004?
- Do some swapping of hydrodynamics, loads from previous 1985-2005 simulation based on Phase 5.3.2 loads and flows.