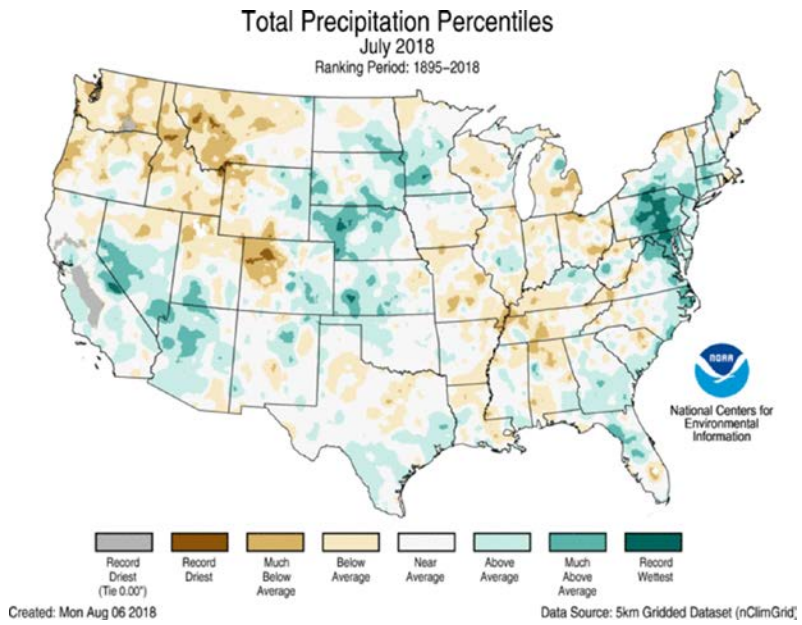
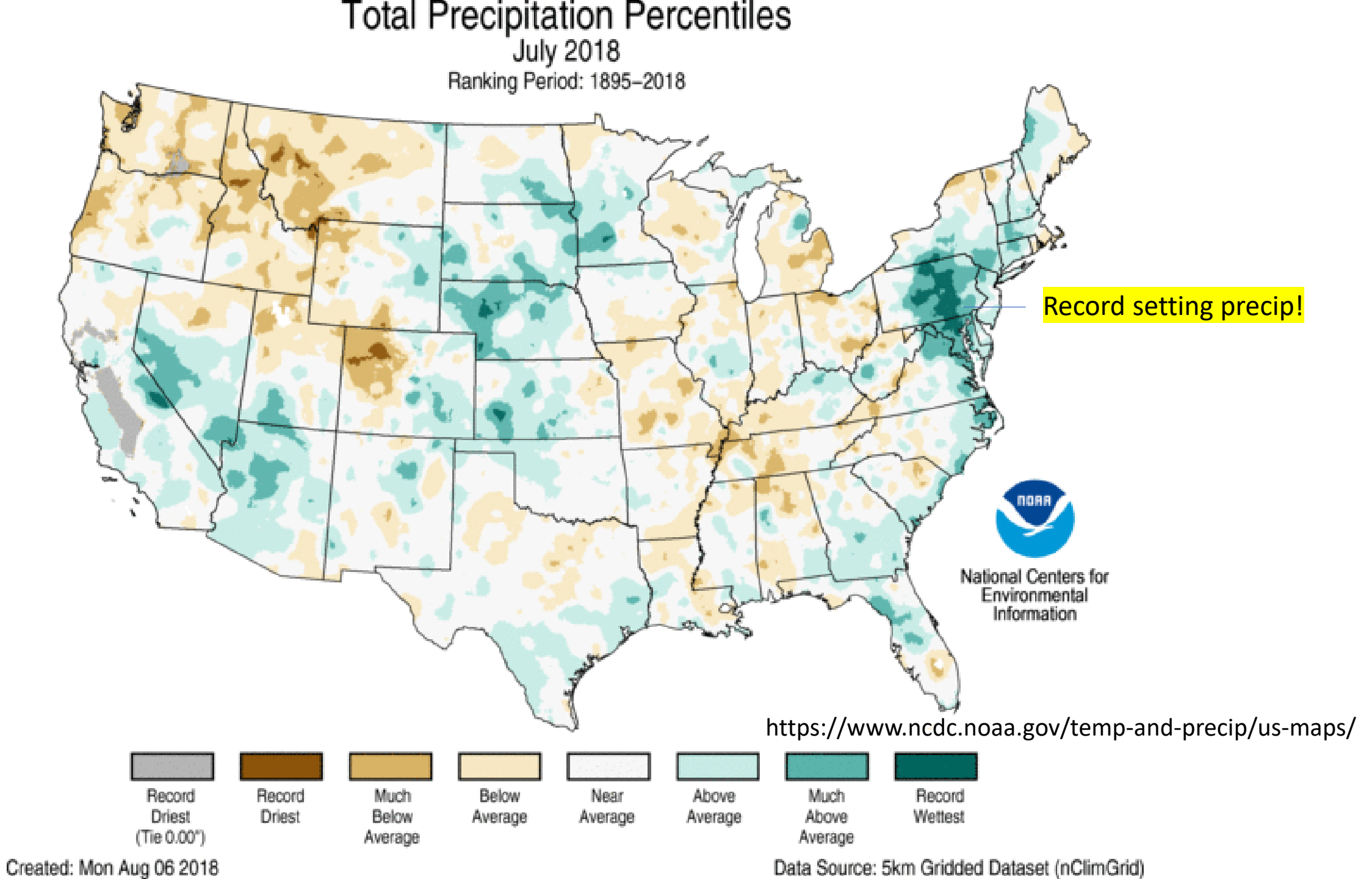
# Summer Storms 2018: Chesapeake Bay watershed conditions and early monitoring results

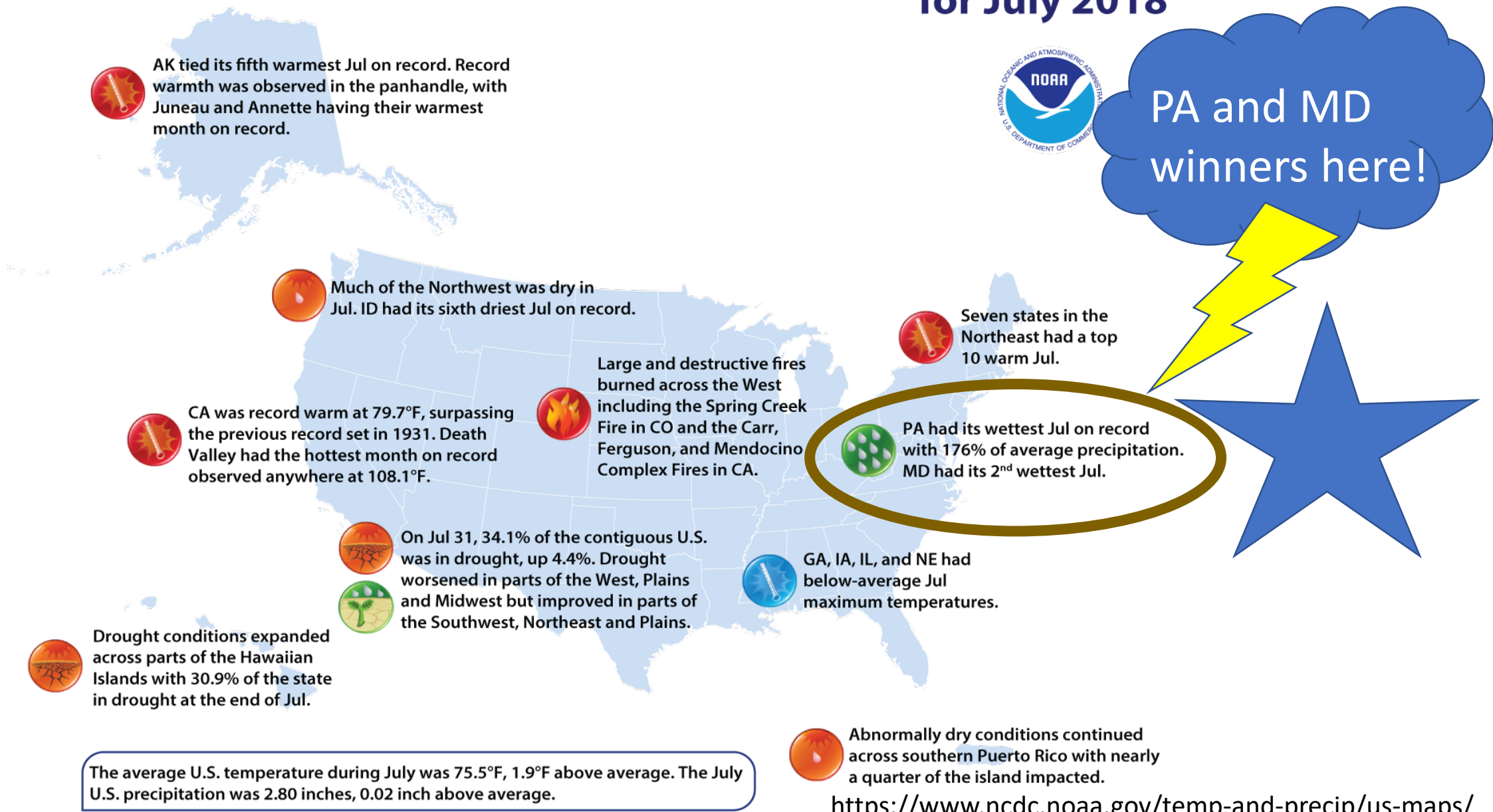



STAR August 2018

CBP Community Collaboration


Total Precipitation Percentiles
July 2018
Ranking Period: 1895–2018
Record setting precip!
National Centers for Environmental Information
https://www.ncdc.noaa.gov/temp-and-precip/us-maps/
Record Driest (Tie 0.00")
Record Driest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Wettest
Created: Mon Aug 06 2018
Data Source: 5km Gridded Dataset (nClimGrid)

# U.S. Selected Significant Climate Anomalies and Events for July 2018



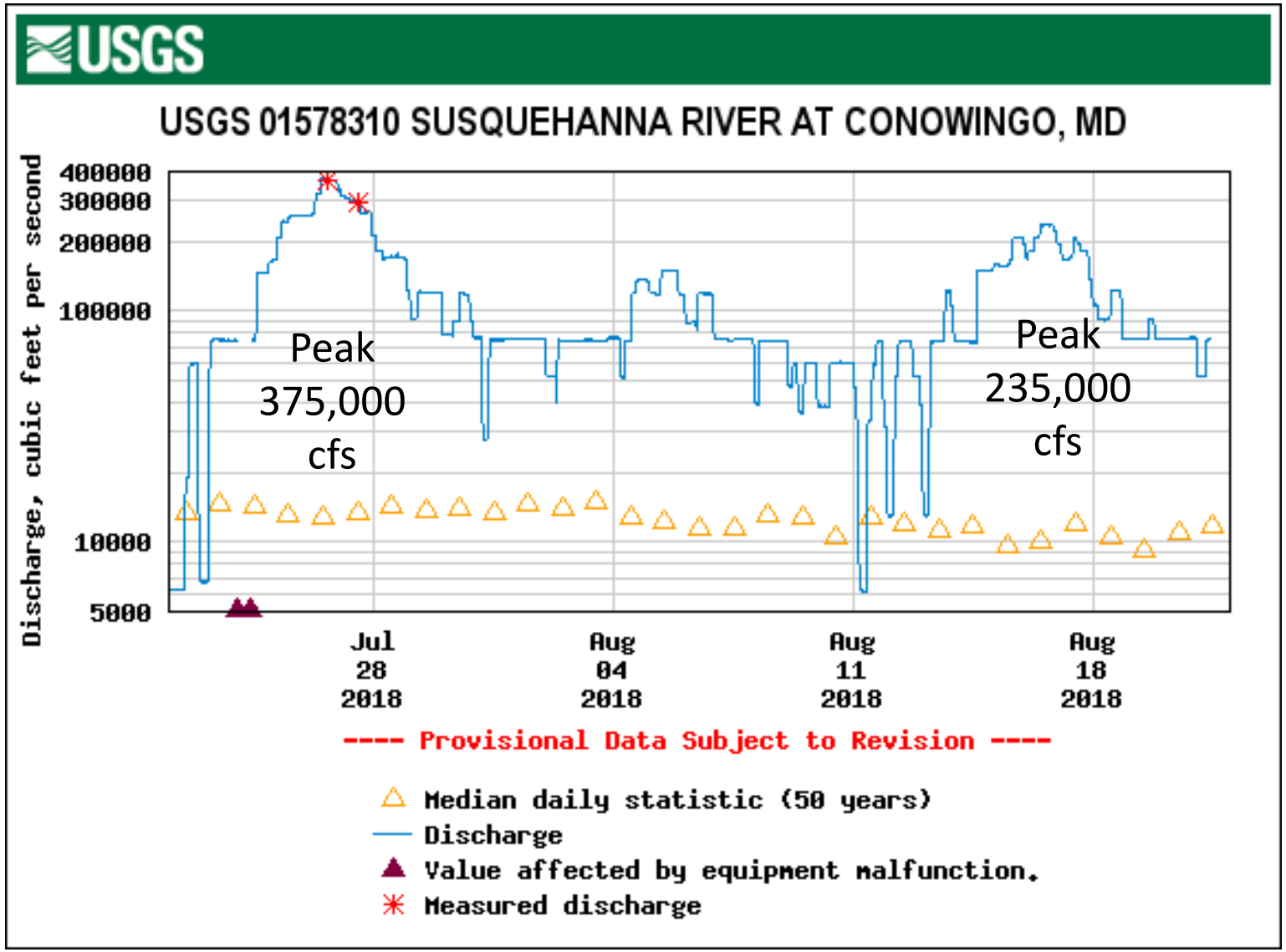

PA and MD winners here!

The average U.S. temperature during July was 75.5°F, 1.9°F above average. The July U.S. precipitation was 2.80 inches, 0.02 inch above average.

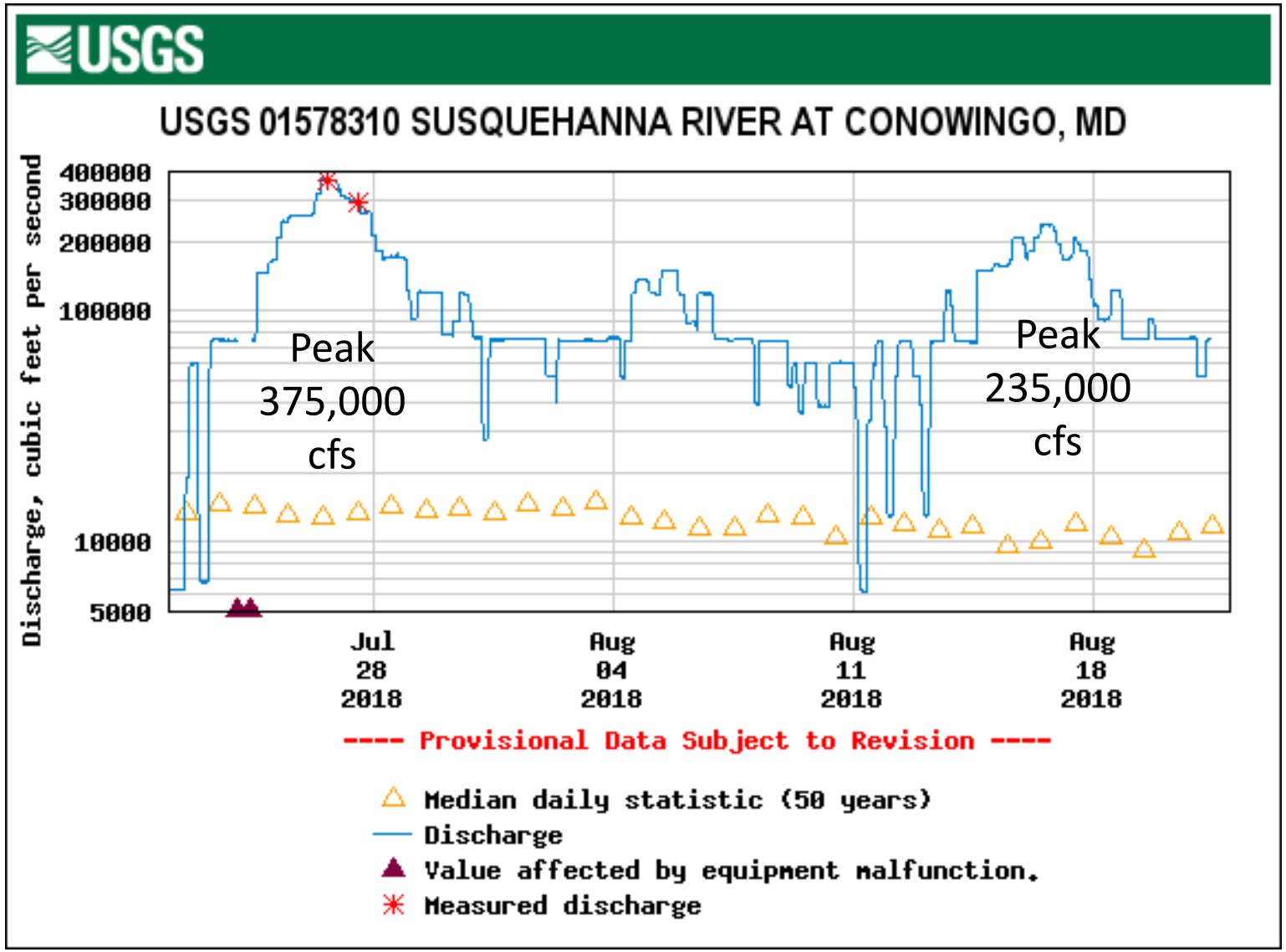
https://www.ncdc.noaa.gov/temp-and-precip/us-maps/

Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: http://www.ncdc.noaa.gov/sotc

# Lower Susquehanna River:
# High flow conditions reached in July and August 2018 at Conowingo Dam



# Lower Susquehanna River:
# High flow conditions reached in July and August 2018 at Conowingo Dam



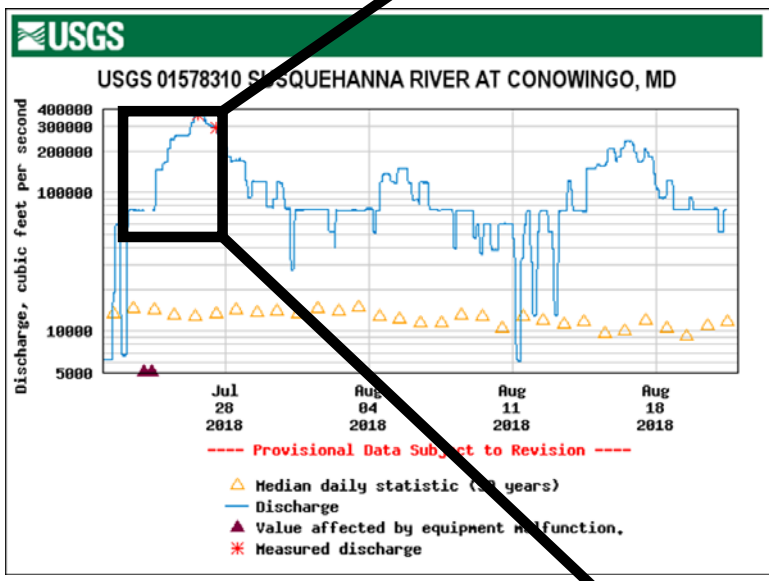

Maximum flows for comparison:

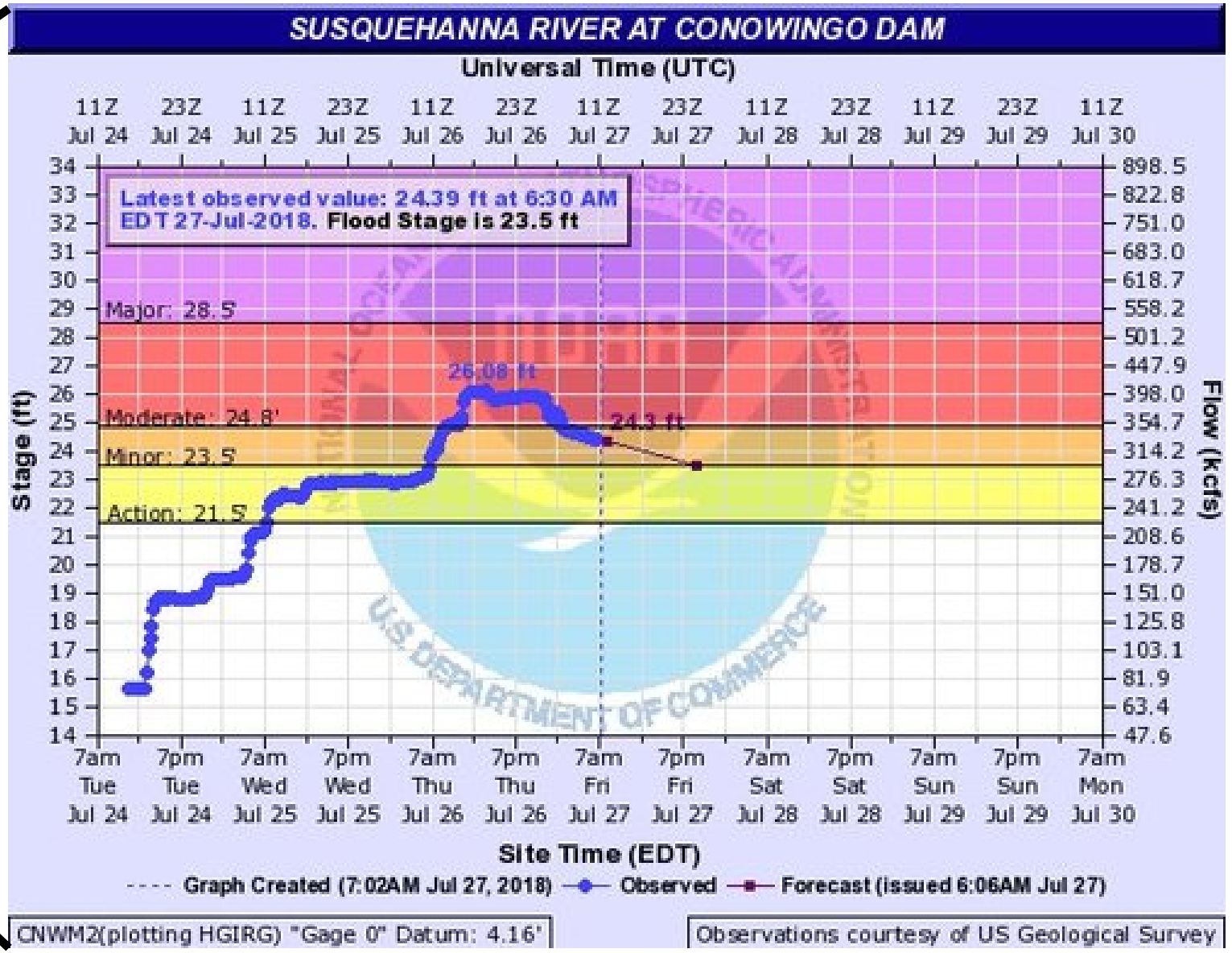
H. Agnes: 1.13M cfs

Jan 1996: ~900,000 cfs

TS Lee 2011: ~775,000 cfs

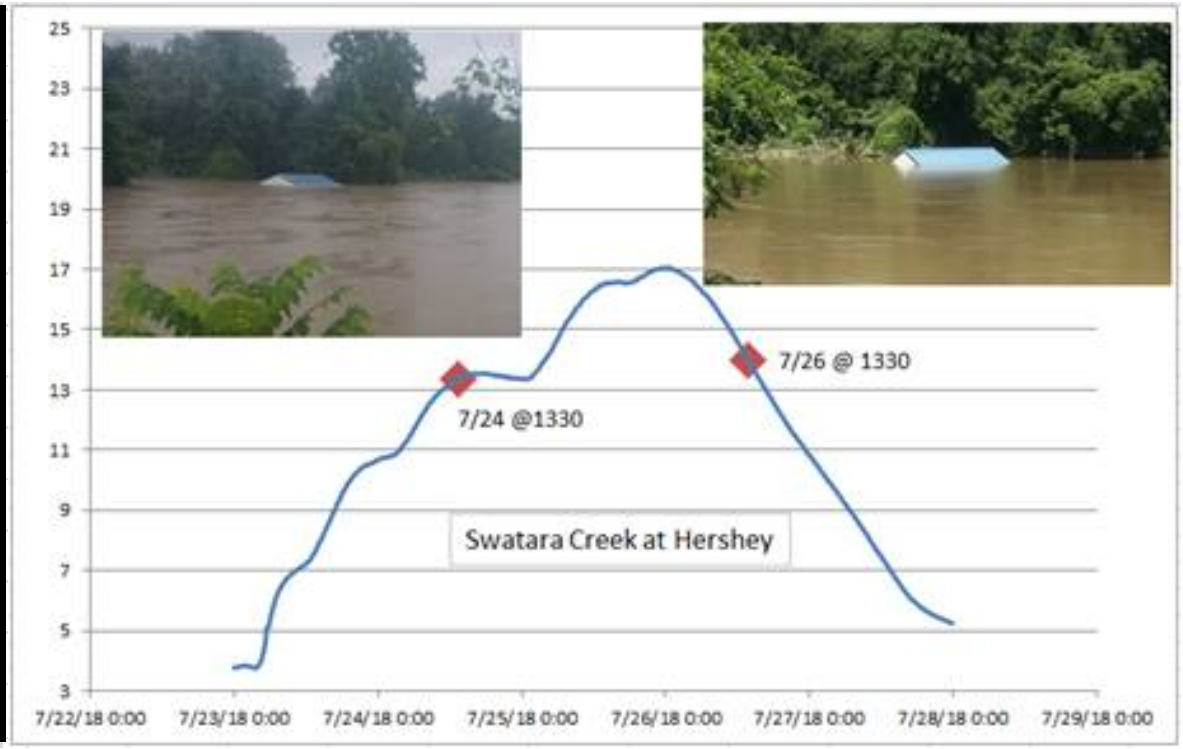
# Moderate Flood Stage achieved July 26th, 2018



# Storm sampling in the watershed – July 2018

| | Tues | Wed | Thur | Fri | Sat | Sun | Mon | Total |
|---|---|---|---|---|---|---|---|---|
| Towanda | | | 1 | 1 | | | | 2 |
| Wilkes B | | | 1 | 1 | | | | 2 |
| Danville | | | 1 | 1 | | | | 2 |
| Lewisburg | | | 1 | 1 | | | | 2 |
| Penns | | 1 | 1 | | | | | 2 |
| Mahantango | | | 1 | 1 | | | | 2 |
| Shermans | | 1 | 1 | | | | | 2 |
| Conodoguinet | | 1 | 1 | | | | | 2 |
| Swatara | 1 | | 1 | | | | | 2 |
| West Conewago | 1 | | 1 | | | | | 2 |
| Marietta | | | | 1 | | | 1 | 2 |
| Newport | | | 1 | | | | | 1 |
| Bald Eagle | | | | 1 | | | | 1 |




Storm sampling across the Susquehanna River Nontidal Water Quality Monitoring Network

Courtesy of K. McGonigal, SRBC

# July 2018.

- **Susquehanna River flows** - It was an unusually wet July in the Susquehanna watershed, with *the greatest July river flows on record for that watershed*.

- **375,000 cfs** - This was *the highest flow at Conowingo Dam since Tropical Storm Lee in 2011*.

- **Total river flow to the bay** - USGS estimates that in 2018, rivers contributed *the second greatest July freshwater flows to Chesapeake Bay on record*. (First place – July 1972 with Hurricane Agnes)

USGS report, photo MD DNR

# July 2018. Total river flow to the bay

- Normal July streamflow entering the Bay is between 25,000 and 44,100 cubic feet per second. (These are the 25th and 75th percentiles, respectively, of all July values in the 81 year record).

- Average July streamflow to the bay is 38,800 cfs.

- The estimated monthly mean streamflow entering Chesapeake Bay for July 2018 was 100,000 cubic feet per second (cfs)

Susquehanna Flats, August 2018. Photo D. Nemazie, UMCES

# Related issues during the storm flows - sewage.

**NY plant released 35M gallons of untreated waste into Susquehanna**

August 17, 2018 timesleader Local, News 70

By Ed Lewis - elewis@timesleader.com

- USGS computed that the dilution rate of this release was estimated at 1:156,000. (M. Langland)
- At 100,000 cfs, 35M gallons is about 0.05% of 1 day of flow at Conowingo.
- 35M gallons is about 0.002% of the bay volume.

# Related issues during the storm flows - sewage.

**NY plant released 35M gallons of untreated waste into Susquehanna**

August 17, 2018 timesleader Local, News 70

By Ed Lewis - elewis@timesleader.com

- USGS computed that the dilution rate of this release was estimated at 1:156,000. (M. Langland)
- At 100,000 cfs, 35M gallons is about 0.05% of 1 day of flow at Conowingo.
- 35M gallons is about 0.002% of the bay volume.

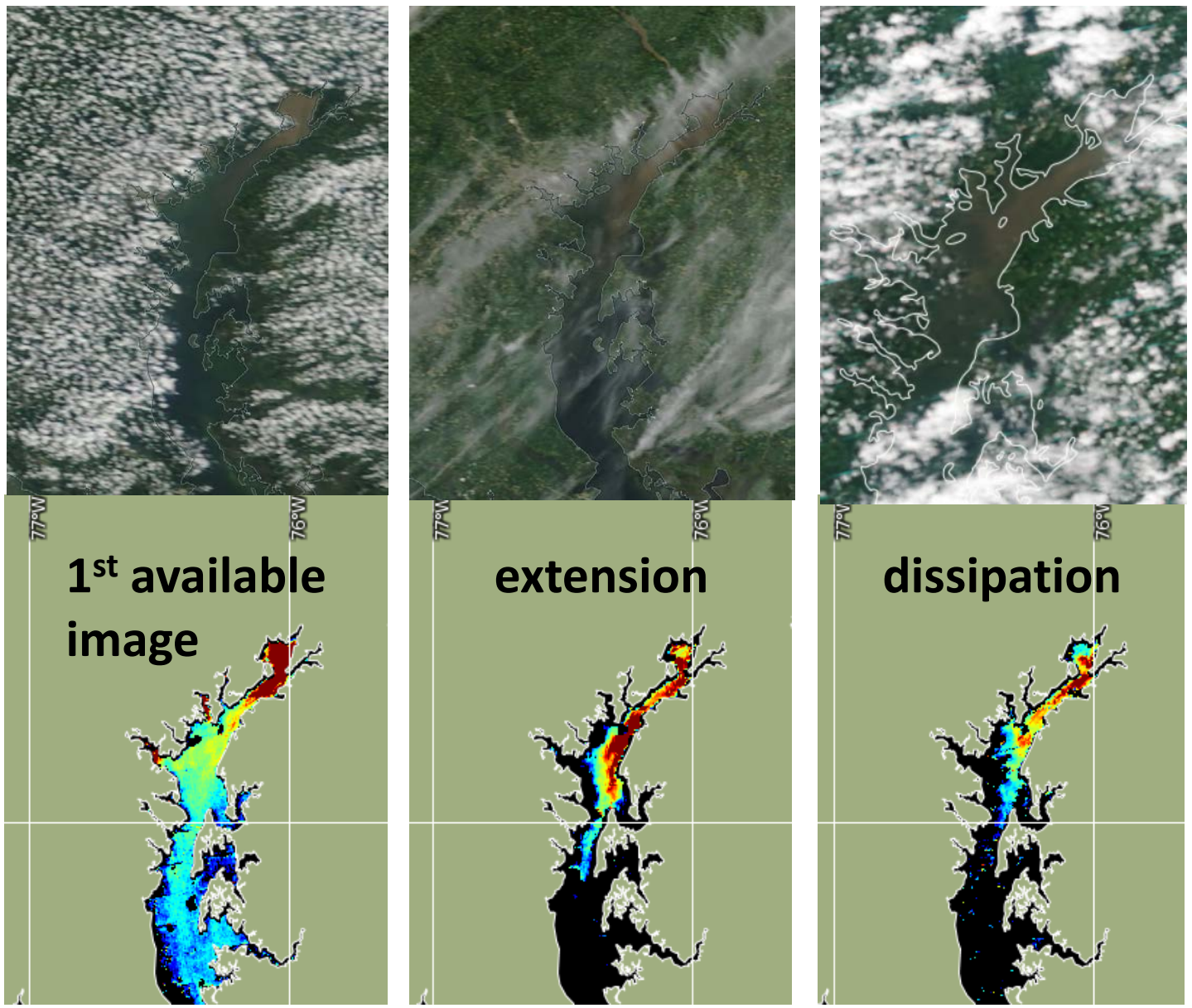

Baltimore Harbor – Balt Sun photo

Meanwhile,
down on the bay…

# NOAA Satellites Track the Sediment Plume

**Satellite image**

**Total Suspended Matter Concentration from satellite (mg/L)**




R. Vogel

Susquehanna Flats, August 2018. Photo D. Nemazie, UMCES

# On the Bay… States continued biweekly WQ monitoring cruises July and August.

- MD DNR adjusted the timing of its 2nd August cruise to the third week of August instead of 4th week to better align with nearterm effects of storm flows on the bay.
- Additional samples were collected for nutrient, sediment and related parameters with support from USEPA.
- UMCES conducted additional survey work on the upper Bay.

# Latest news from the upper Bay.

- Brooke Landry (MD DNR) visited the SAV bed on the Susquehanna Flats on Friday, Aug. 10.
    - Interior of the SAV beds look good.
    - Water clarity was excellent.
    - Periphery of the beds showed some impact of the July high flow event, but overall bed integrity was sound and resilient.

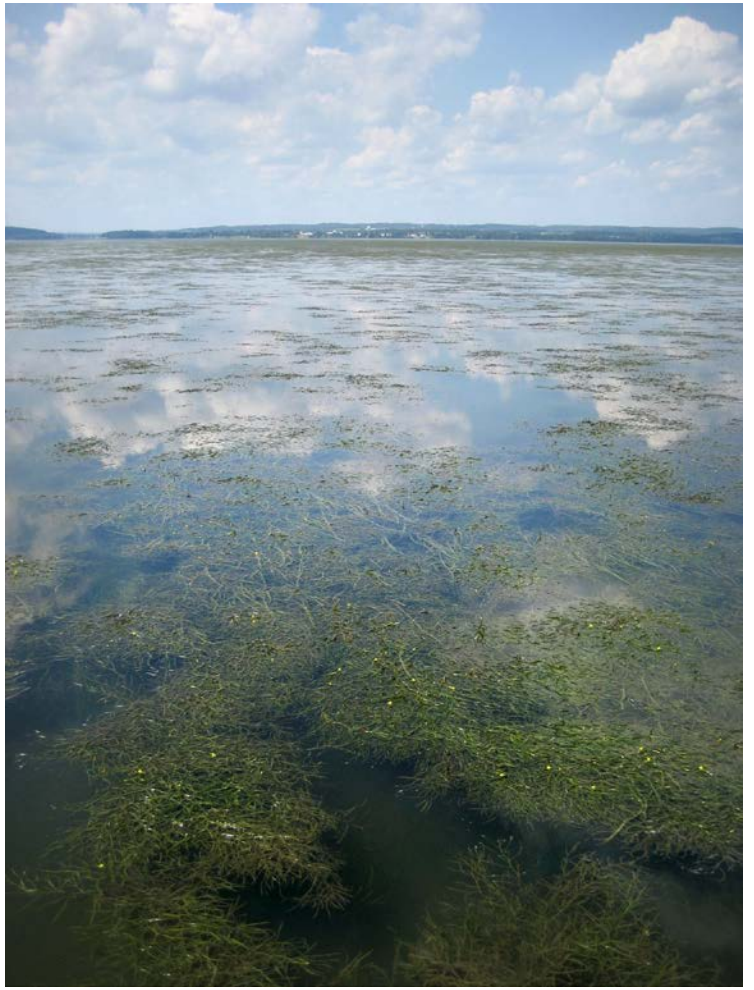


Photo Phys.org – not from this week

# Honorable mention – citizen collaboration on launch site use by VADEQ

- Special thanks to Donn Hall

RiverCreek Properties LLC

President - RiverCreek HOA

46 Ironwood Road

Fredericksburg, AA 22405

Located between Muddy Creek and mainstem Rappahannock in VA.

# Next steps

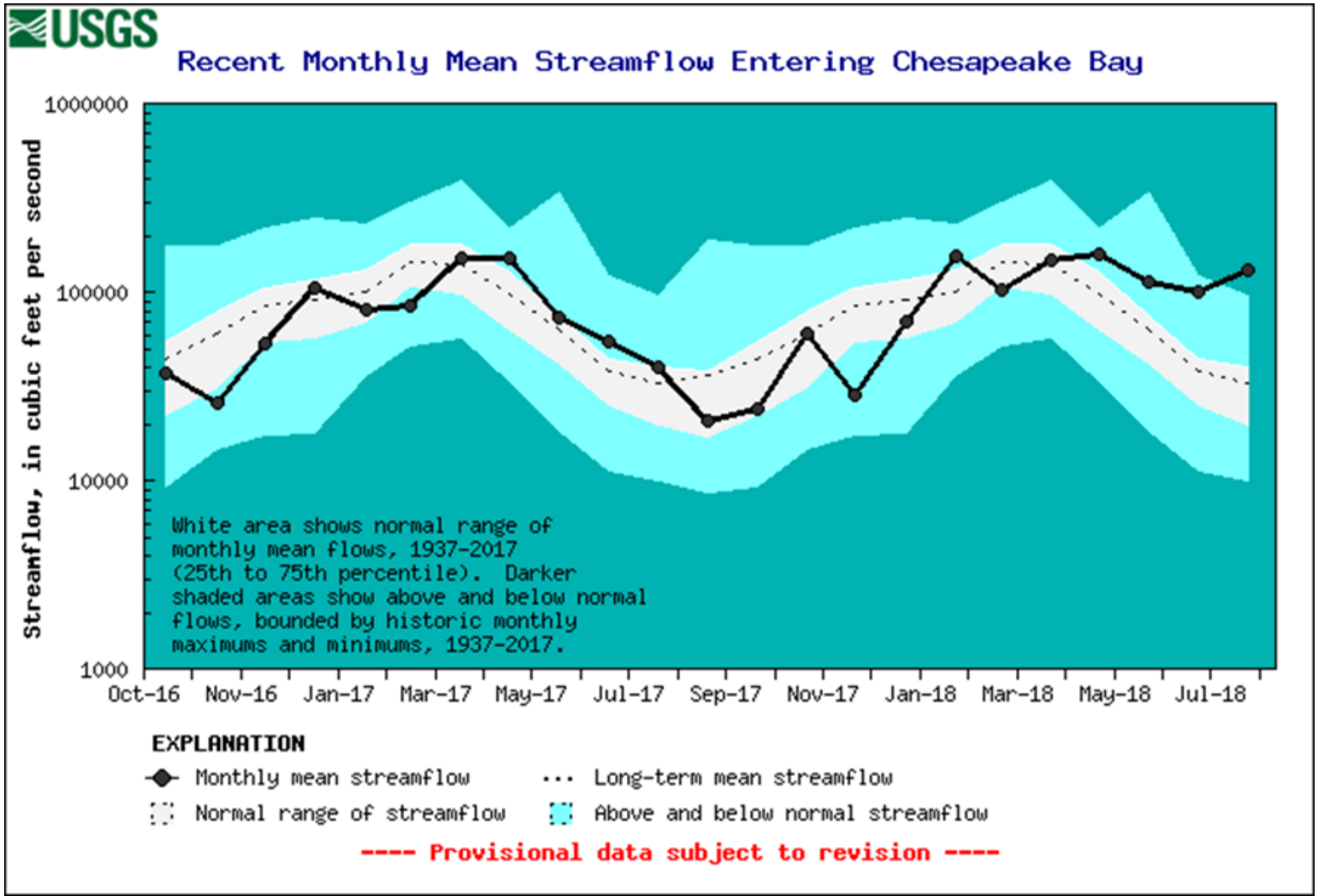
- Laboratory processing of samples will take months.
- We will continue updates of the story into the fall and early winter as sample results become available.

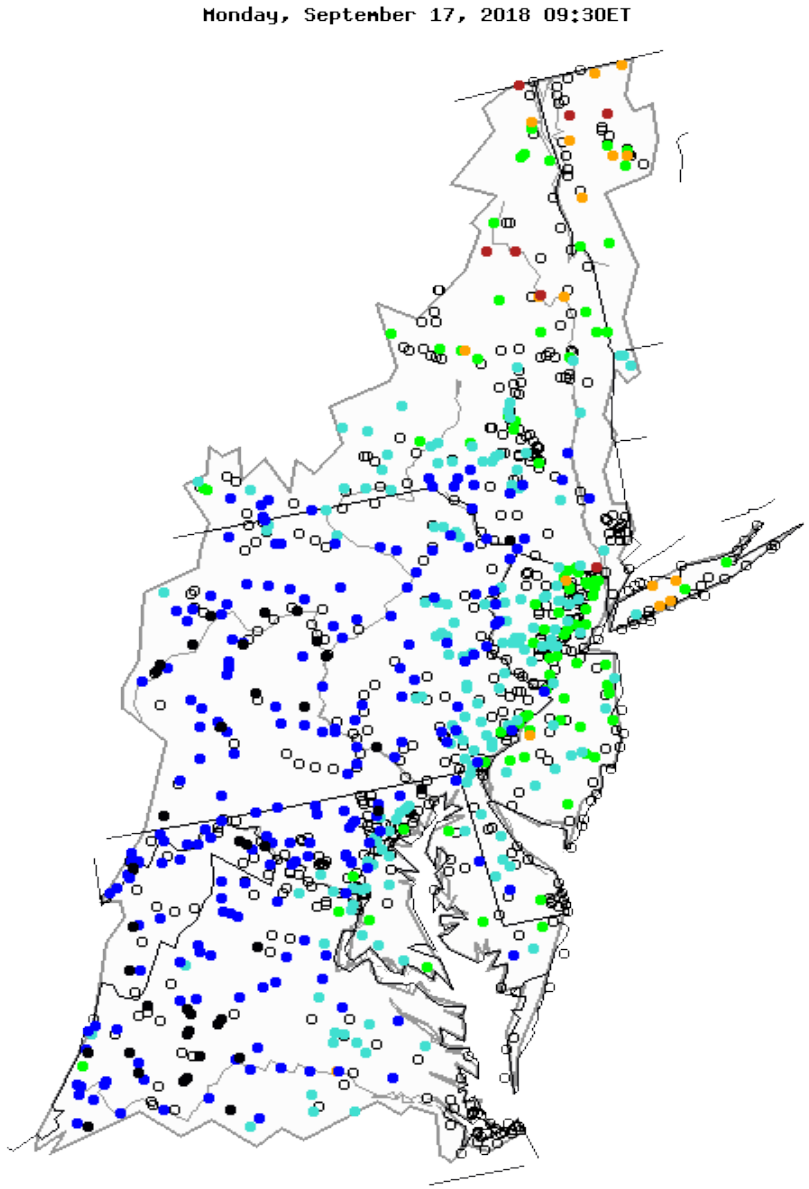
- Many thanks to field and lab teams for the long hours and stormflow chasing efforts across the watershed!

# 2018 Wet Year Watershed & Bay conditions

- Continued… September 27, 2018.

Chart: Monthly river flow into the Chesapeake Bay. The monthly flows have been above normal since May and set a record for August 2018. https://chesapeake.usgs.gov/sciencesummary-rainwaterflow.html



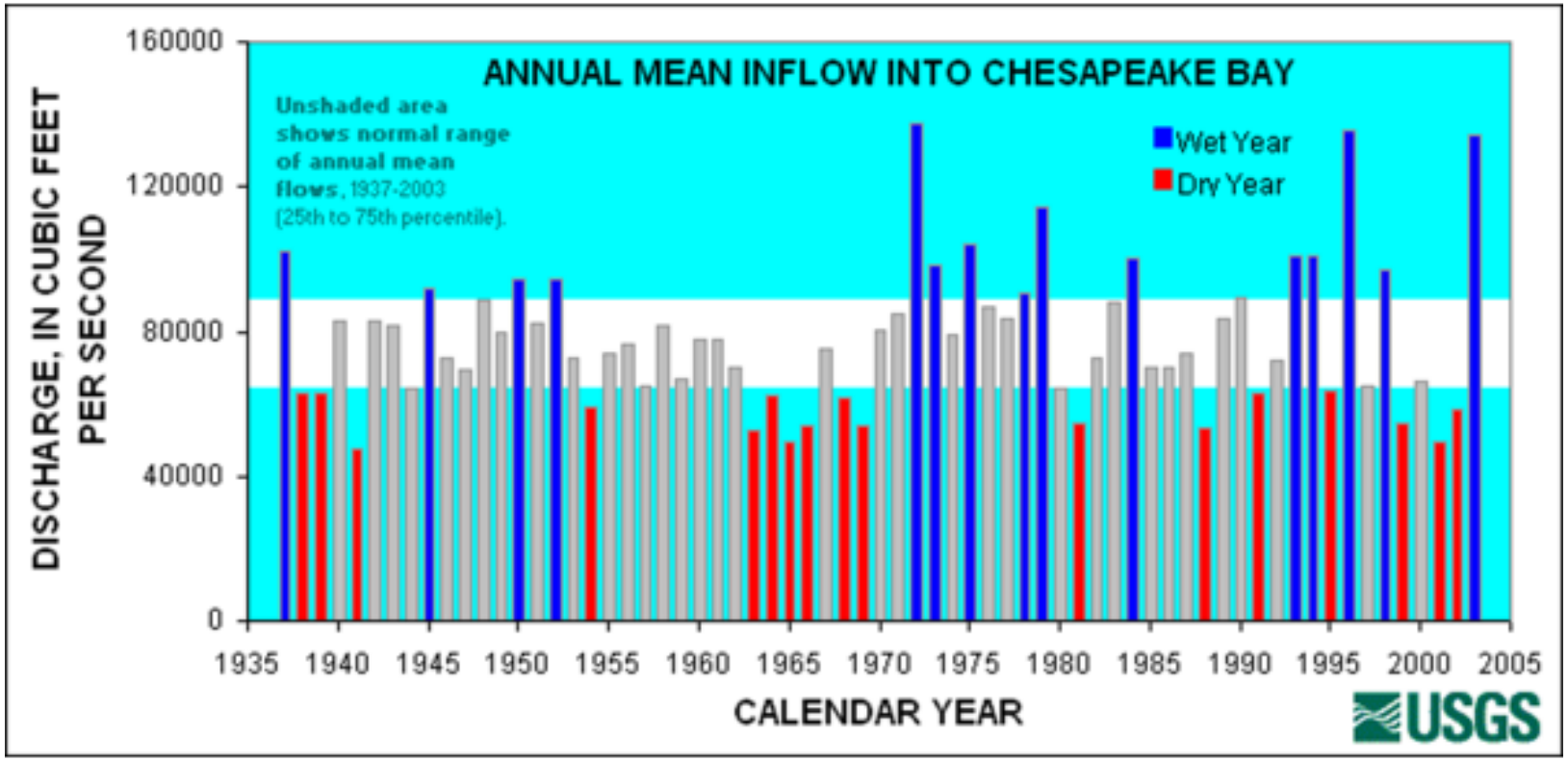



Map of real-time river flows. Sites with black symbols are record highs. Sites with blue shades are well above normal. Sites with green have normal flow levels.

Source: USGS Water Watch

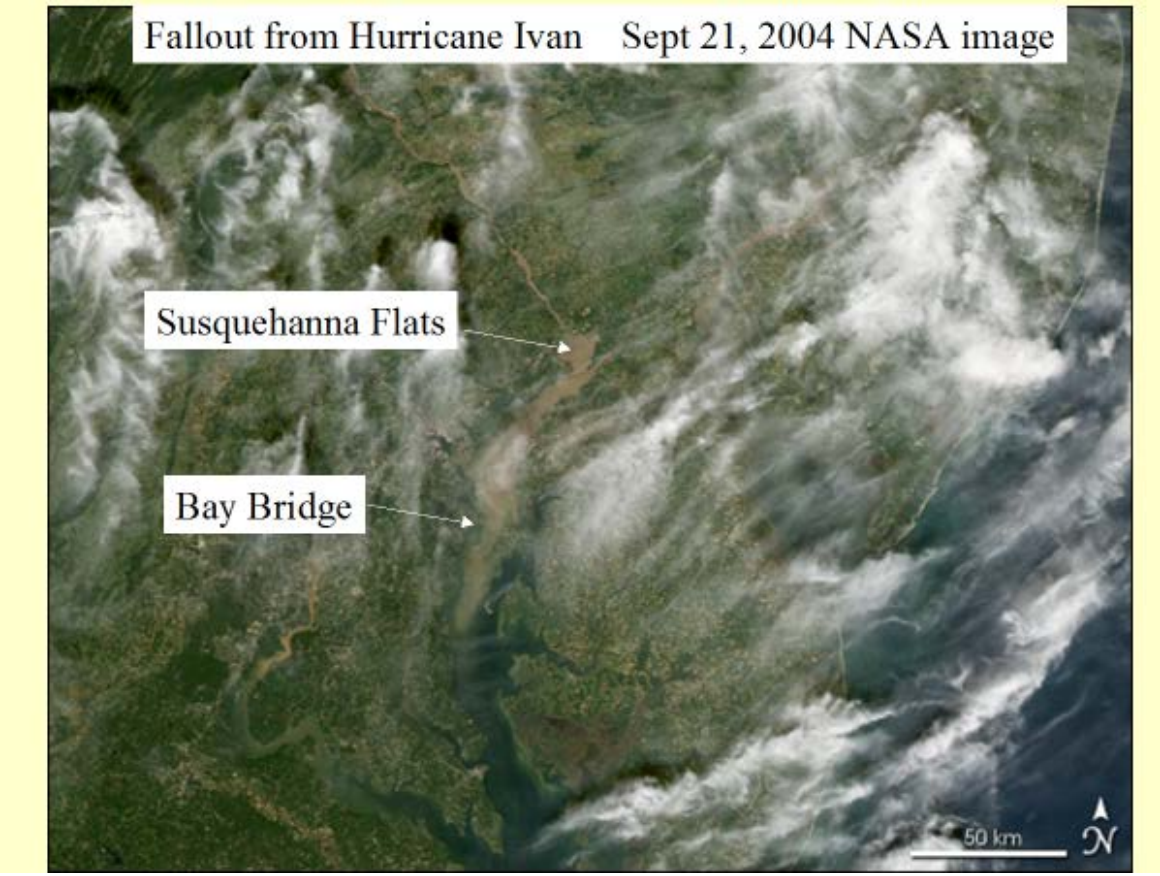
FLASHBACK –

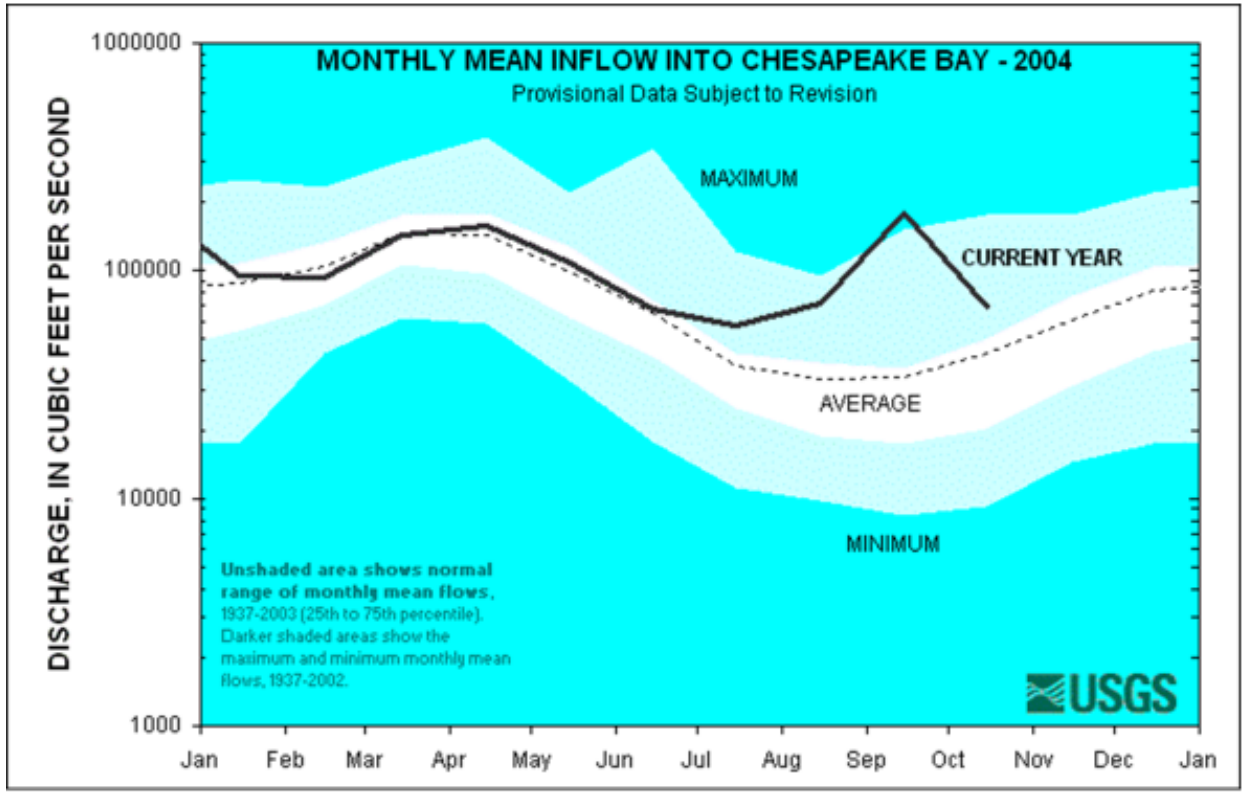
2003, 2004. Hurricanes Isabel, Ivan. Lessons on salinity effects to the bay.



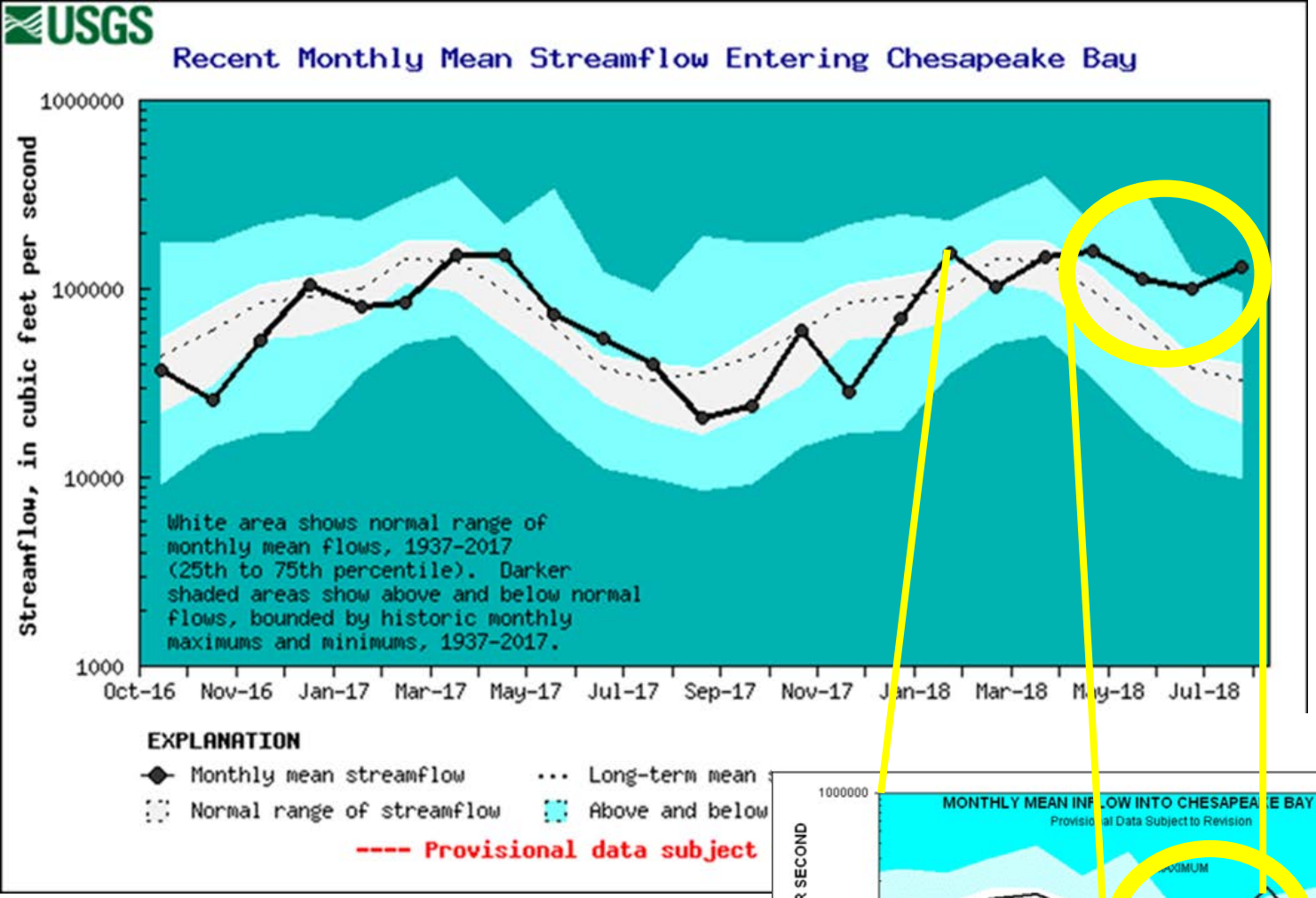

2003 was among the top 3 wettest years since 1937

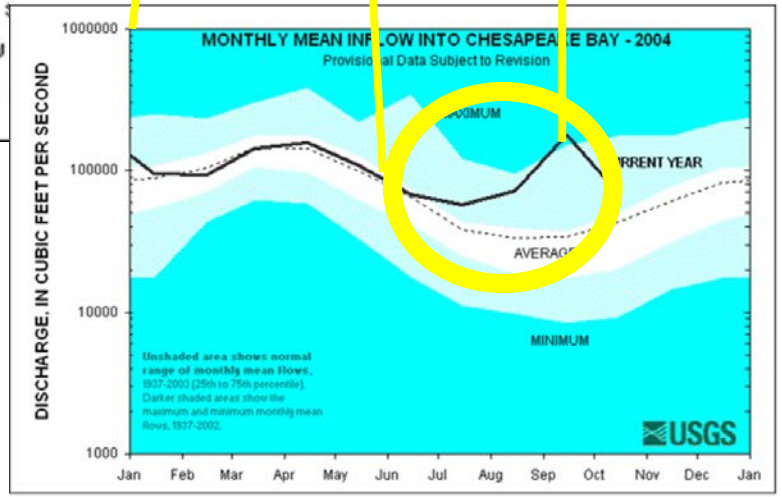
# FLASHBACK – 2003, 2004. Hurricanes Isabel, Ivan



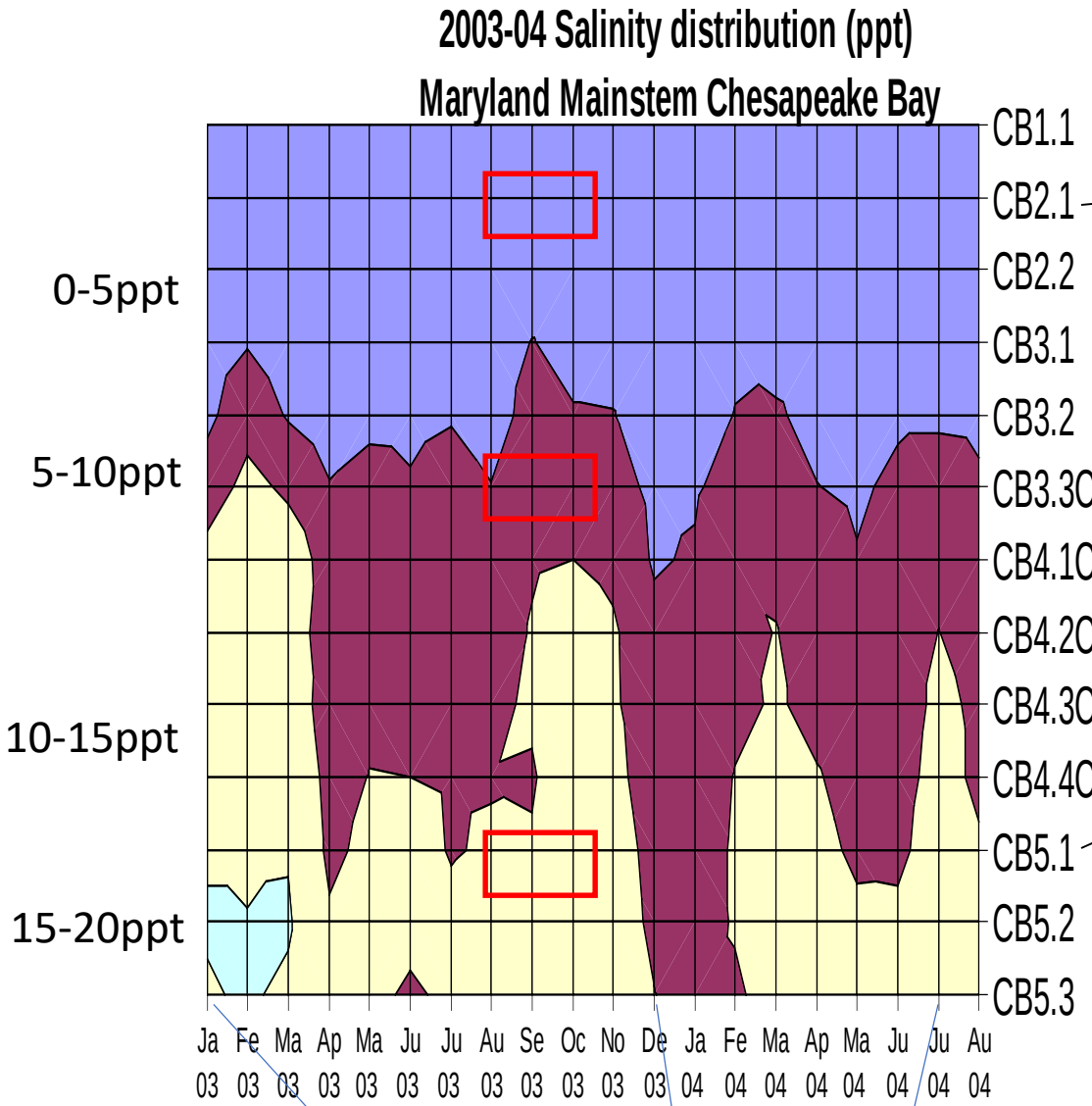



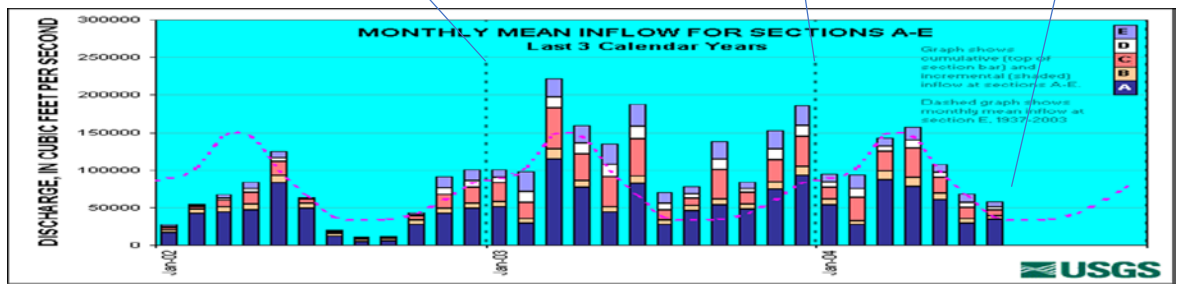

2004 was also record setting

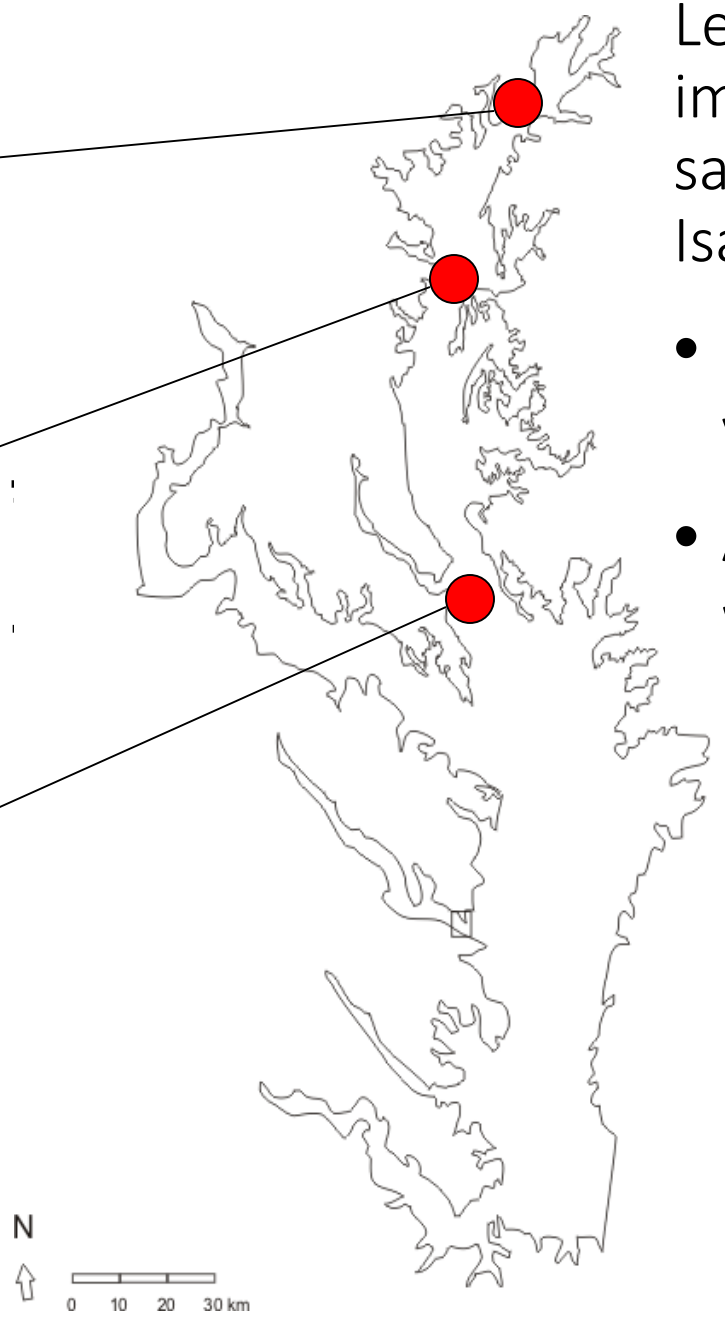



2004 very similar in flow pattern to the bay in 2018



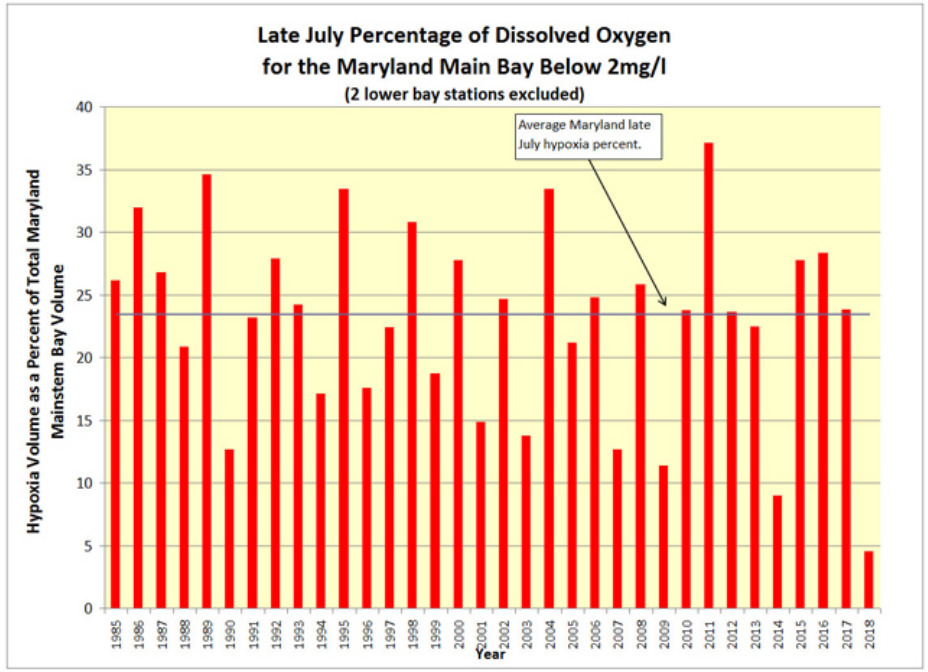



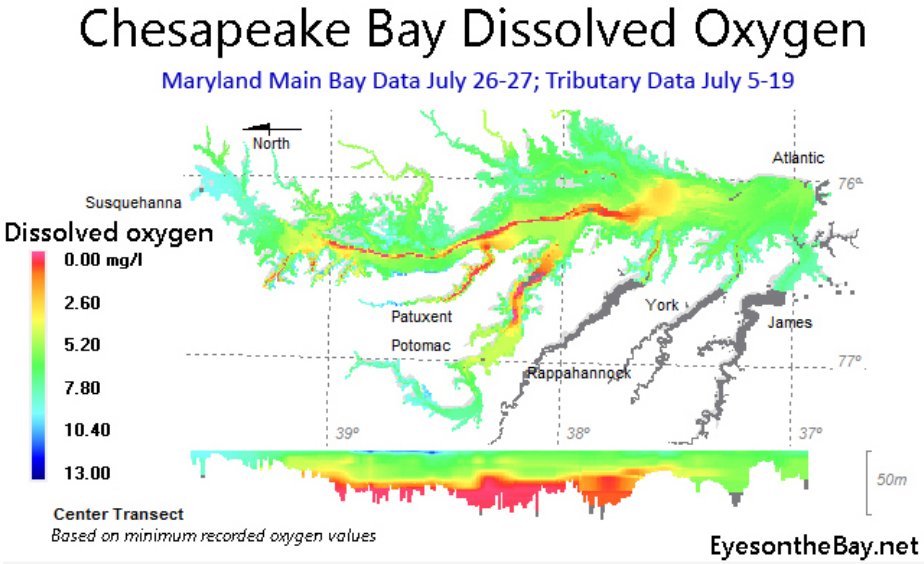

# Lessons: Flow impacts on salinity with H. Isabel

- 2003 wet year effects
- Also south wind effects

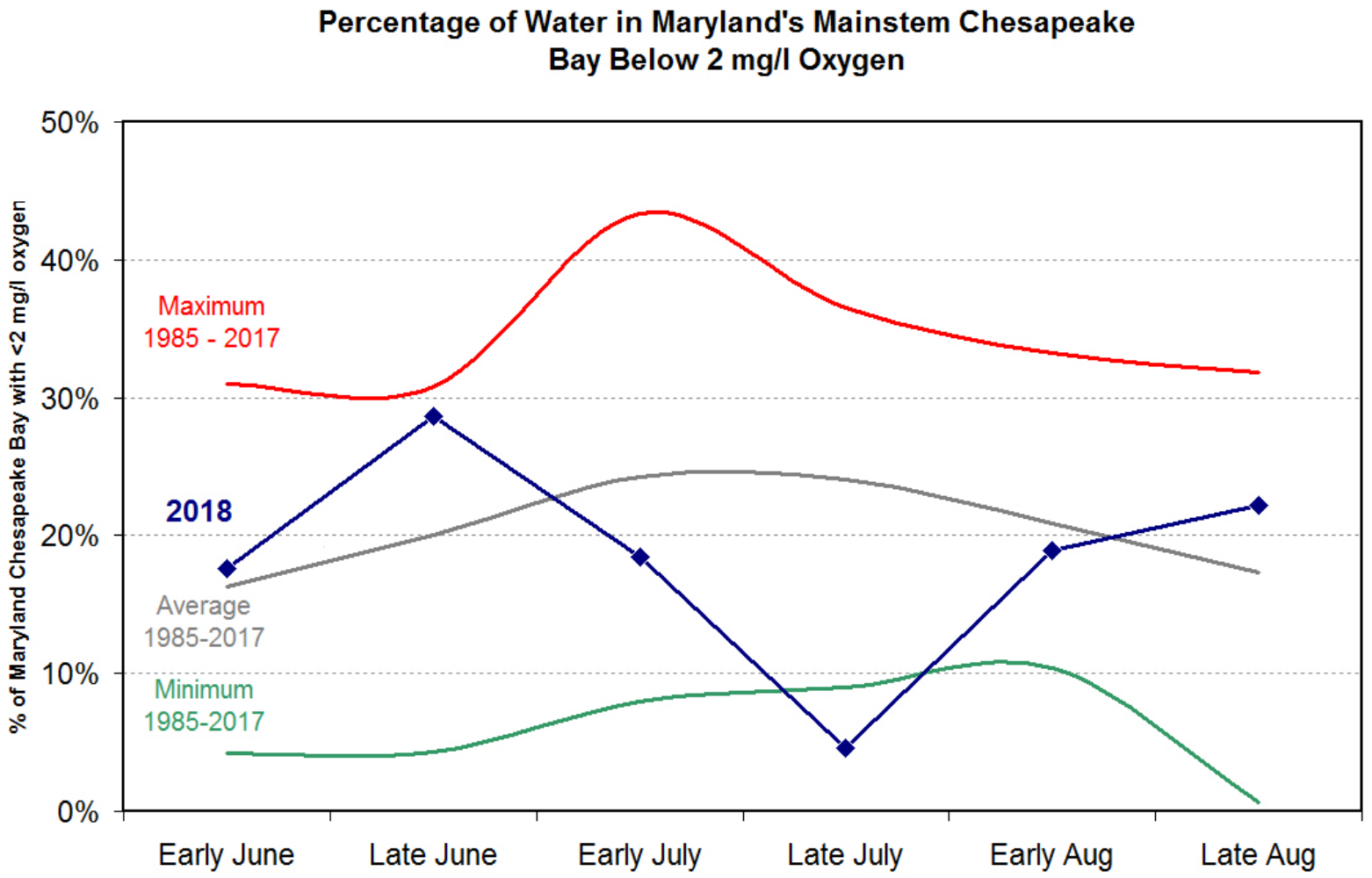
# HYPOXIA 2018

MD DNR: “Late July hypoxia was constrained to the deepest parts of the main bay channel at depths of 65 feet or greater”



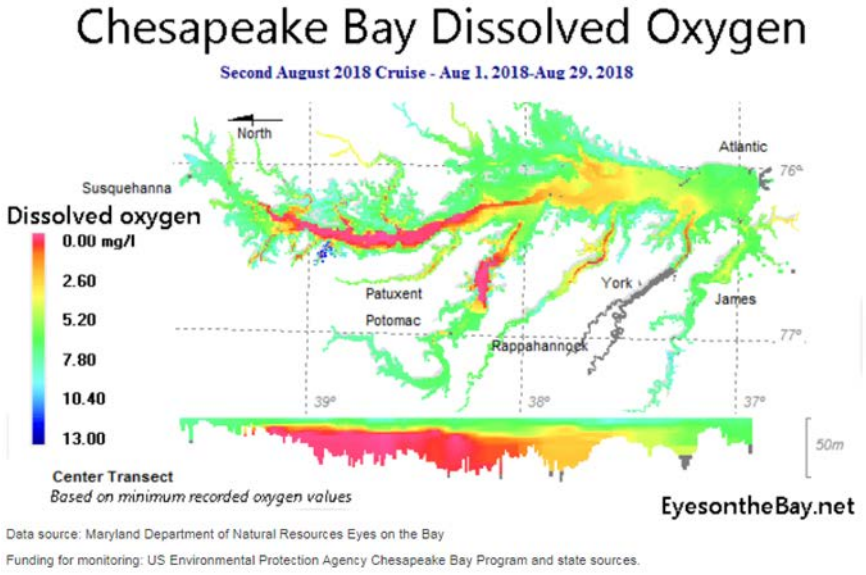
# Annual MD Hypoxia looking below average.

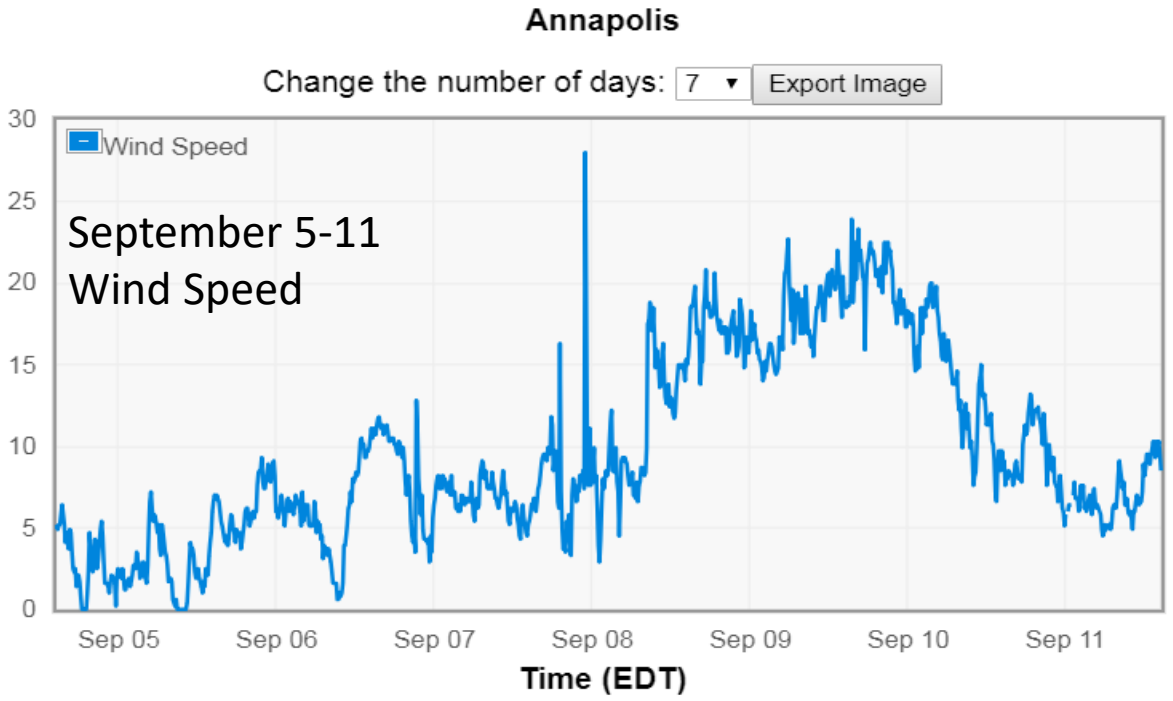


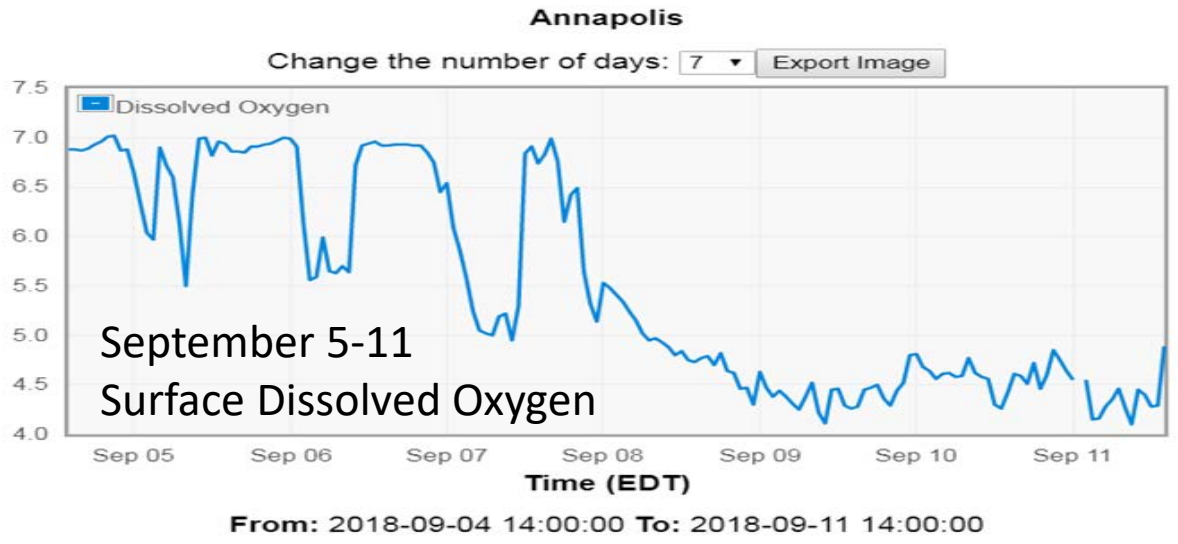

M. Trice. MD DNR

# Early September Water Column Mixing

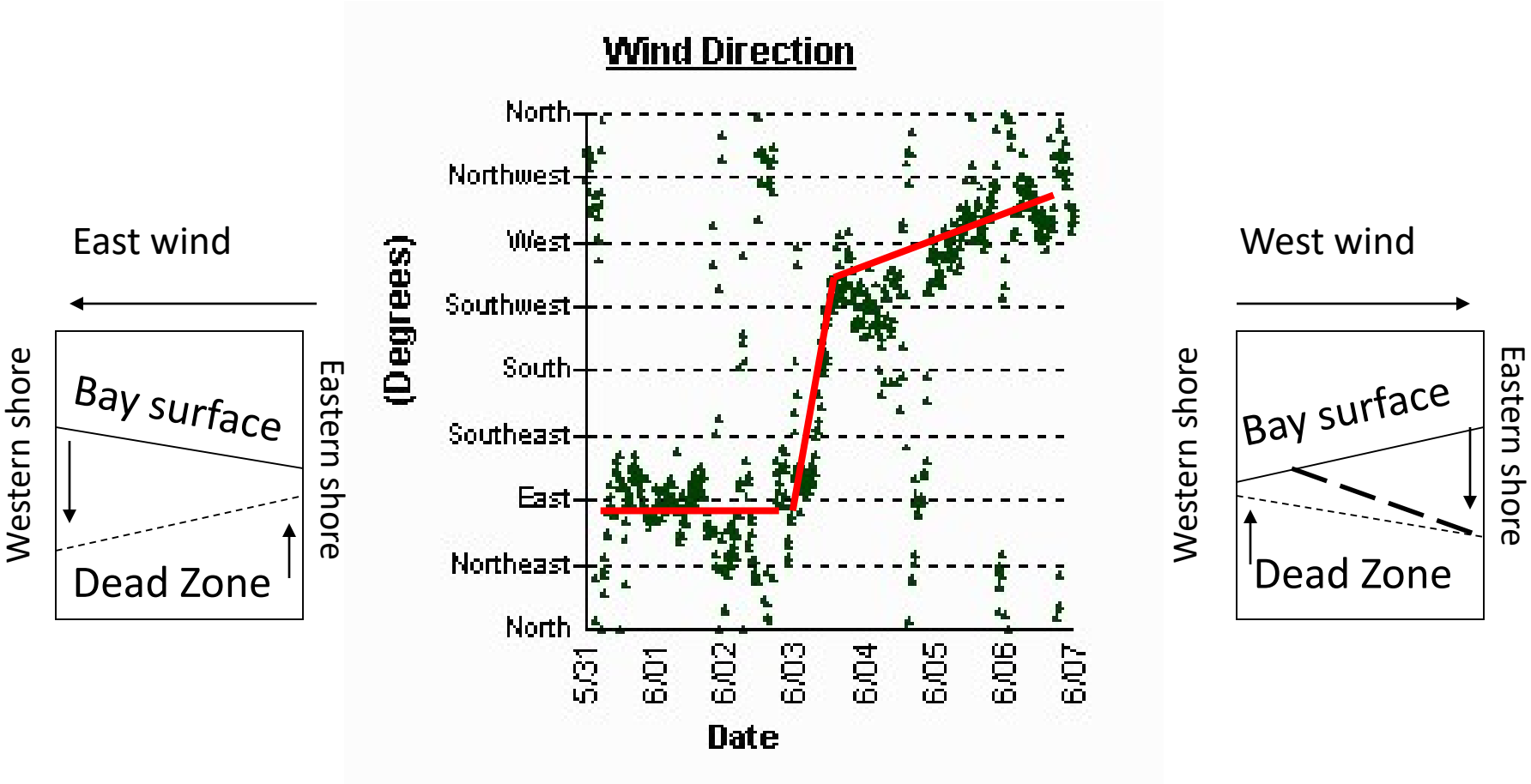
Late August – well established dead zone
Associated with strong stratification.



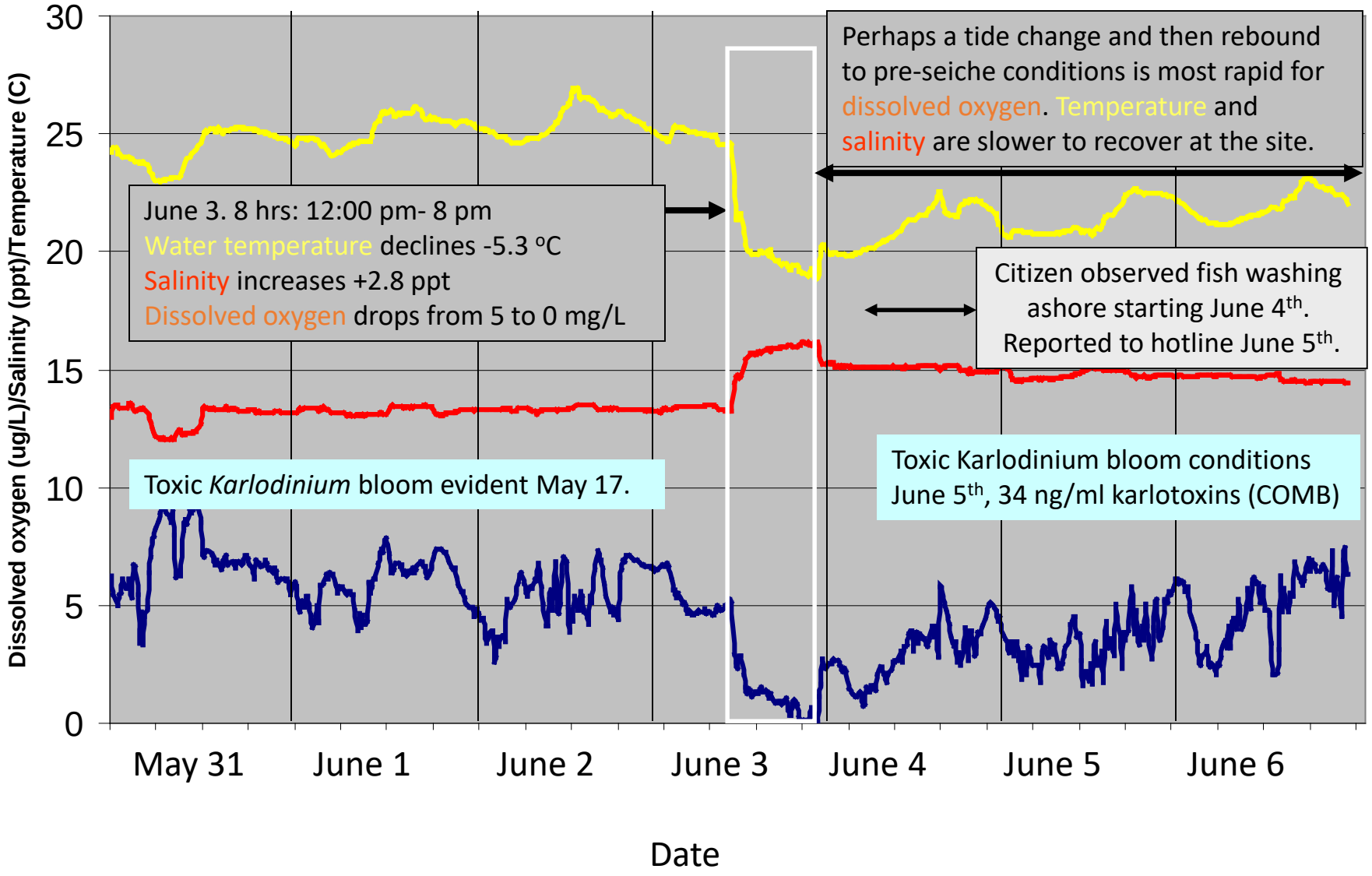
Synthesis: Climate influence on Bay water quality and Living Resources.




Sandy Point State Park.
Winds from 5/31 through 6/2/2006 were dominantly easterly. During 6/3, winds shifted 180 degrees to westerly conditions and remained in a west-northwest tendency through 6/6. A similar pattern of wind record is recorded at the University of Maryland Horn Point Laboratory, Cambridge, MD.

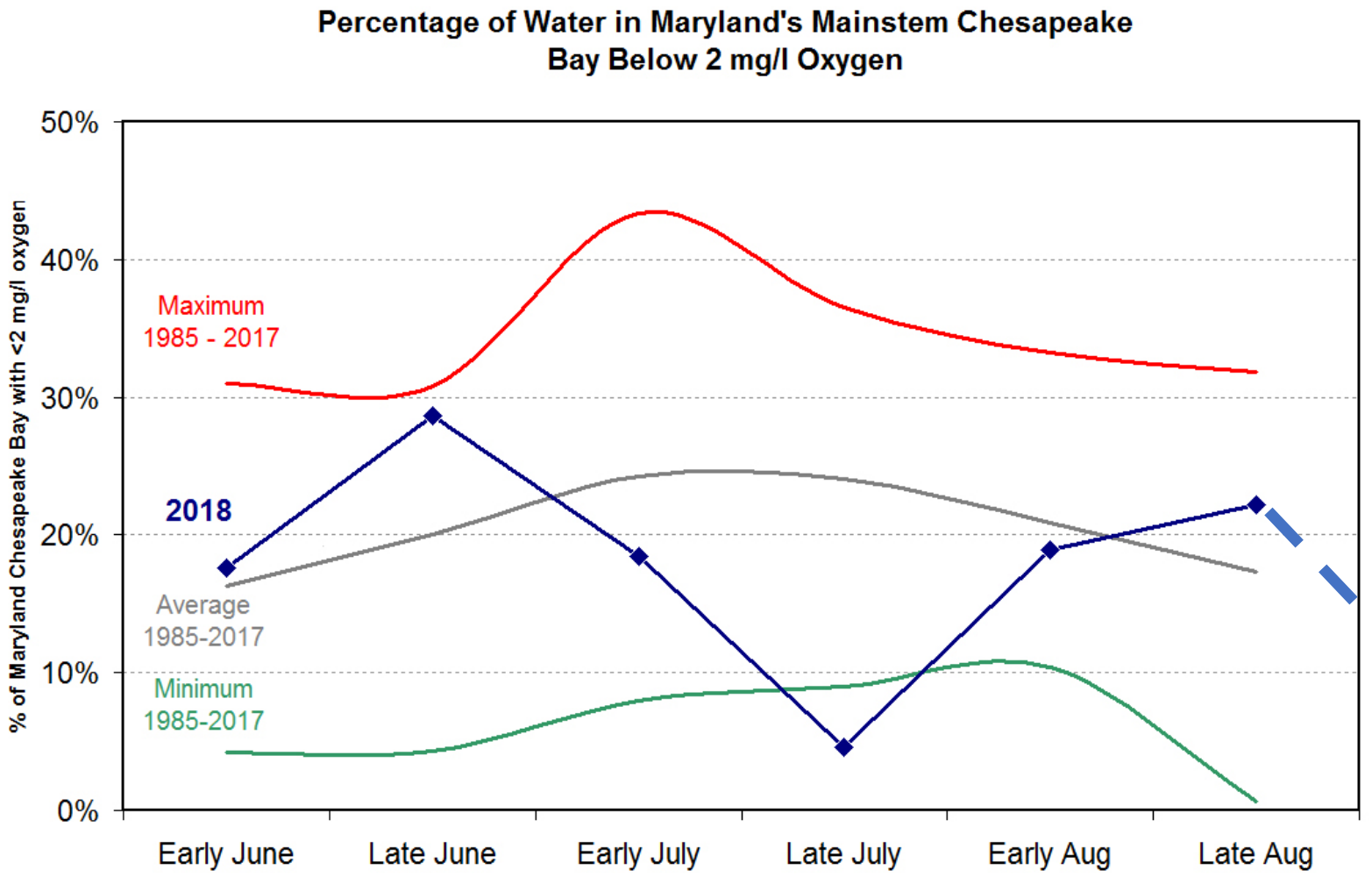
SIMILAR WIND EVENT HISTORY 2006

**Changes in the Water Quality signal: Synopsis of a Fish Kill. June 5, 2006. Thousands of fish dead in lower Potomac River**




Piney Point Continuous Monitoring data for dissolved oxygen (mg $O_2$/L), salinity (ppt) and water temperature (oC), May 31-June 6, 2006.

# Annual MD Hypoxia looking below average.



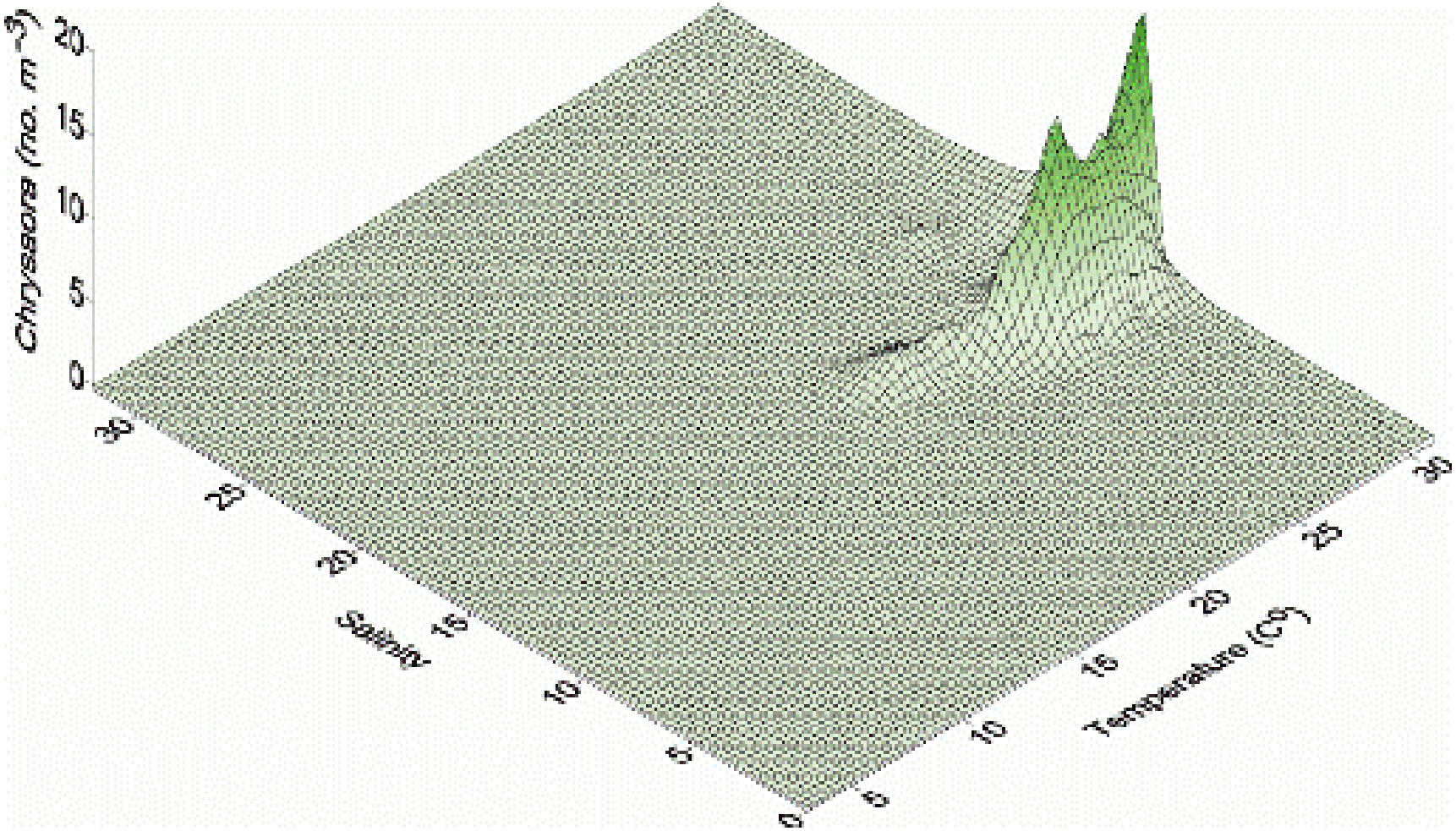

Expecting September to show lower DO due to extensive storm mixing

M. Trice. MD DNR

# Other habitat shifts: Jellyfish distributions

# LIVING RESOURCE IMPACTS: NOAA Jellyfish Habitat Model:

Concentrations of *Chrysaora* were found within a relatively narrow, well-defined range of temperature and salinity (26-30° C and 10-16 PSU).

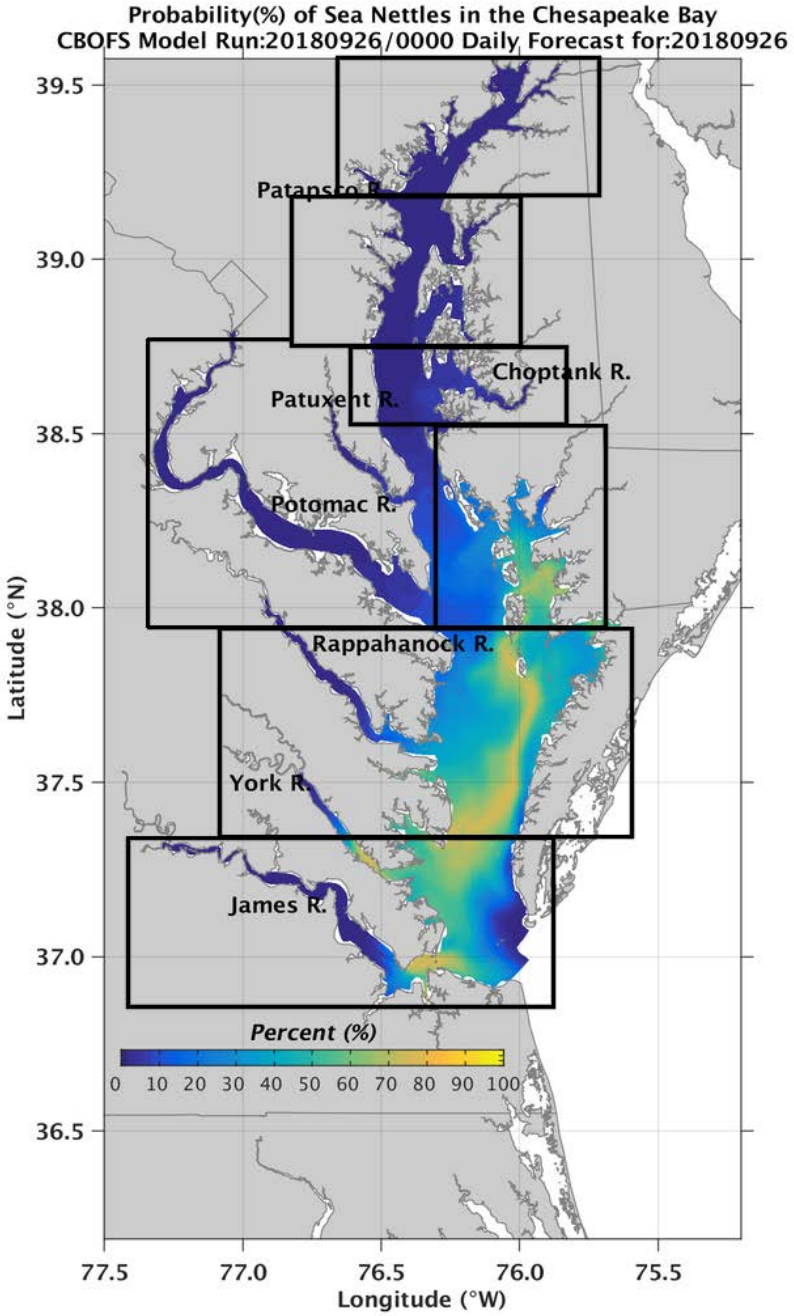



Sea Nettles (NOAA webpage image)

https://chesapeakebay.noaa.gov/products/habitat-model-for-sea-nettle-project

# LIVING RESOURCE IMPACTS

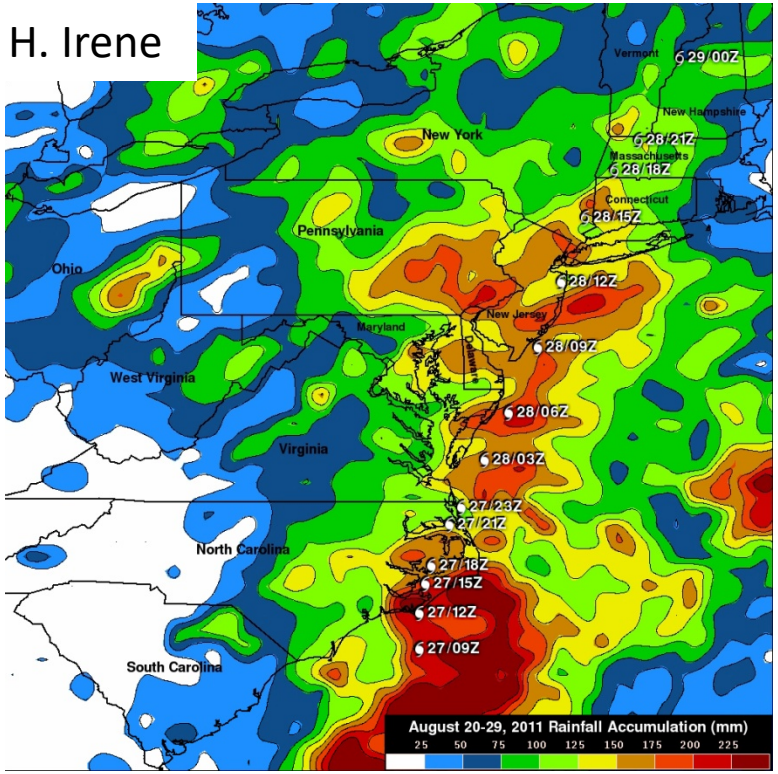
- **The greater amount of fresh water into the Bay will affect survival of some oysters and distributions fisheries and jellyfish**



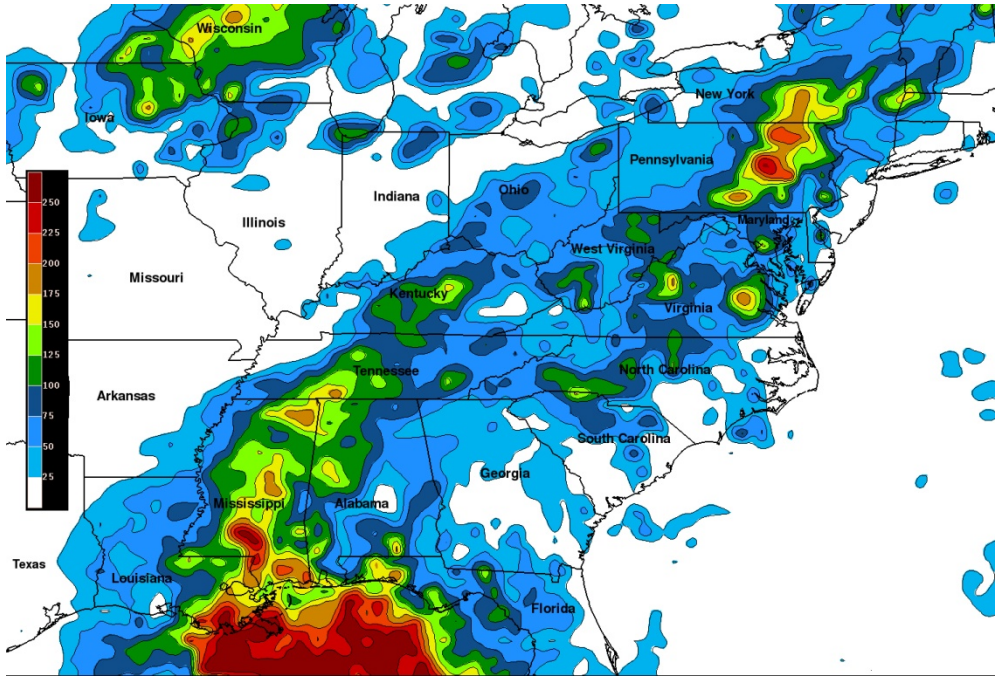

https://www.opc.ncep.noaa.gov/Loops/SeaNettles/prob/SeaNettles.shtml

# Hurricane Irene and Tropical Storm Lee delivered significant rainfall to the Bay region

H. Irene




TS Lee

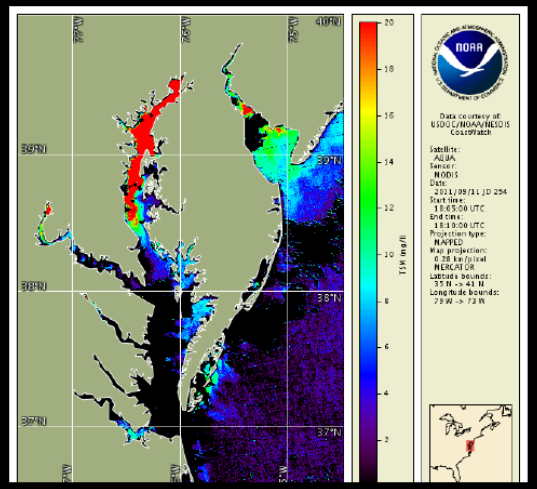



*www.nasa.gov 2011 hurricane archives pages*

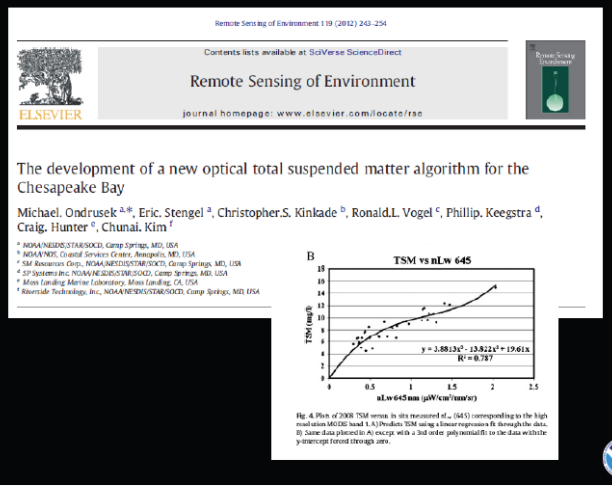
# Remote Sensing was used to effectively track Total Suspended Matter in Chesapeake Bay (M. Ford 2011 NOAA)

Total Suspended Matter (mg/l)

Lee Response – Ondrusek et al.



Lee Response – Ondrusek et al.



Remote Sensing of Environment 119 (2012) 243–254

Contents lists available at SciVerse ScienceDirect

Remote Sensing of Environment

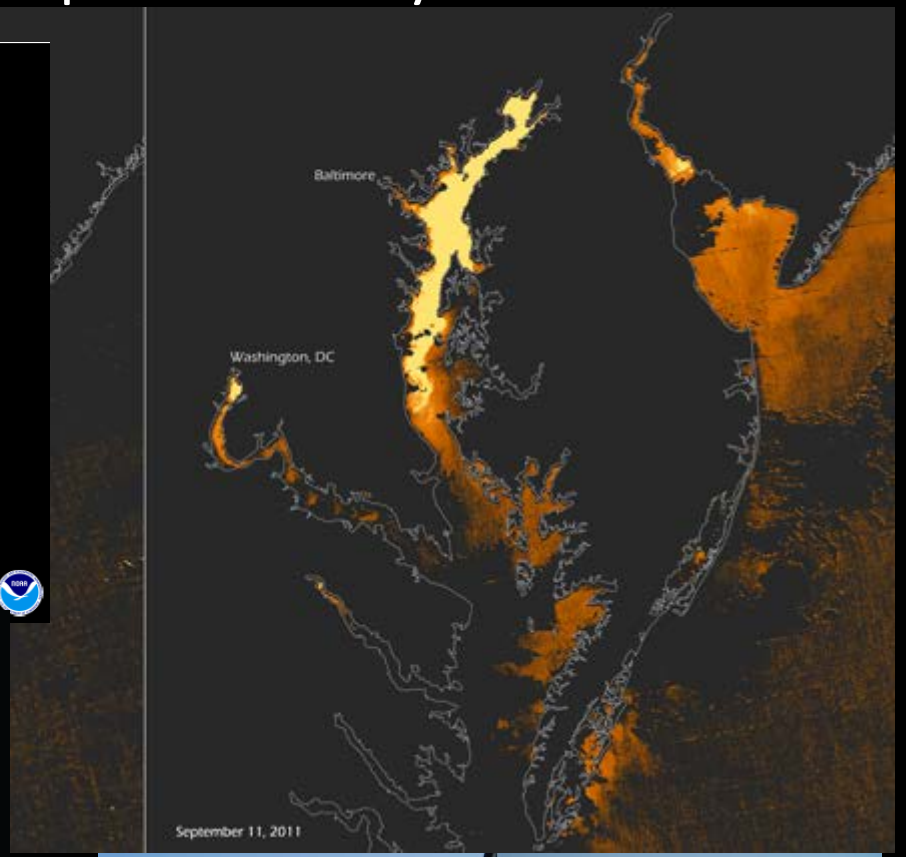
journal homepage: www.elsevier.com/locate/rse

ELSEVIER

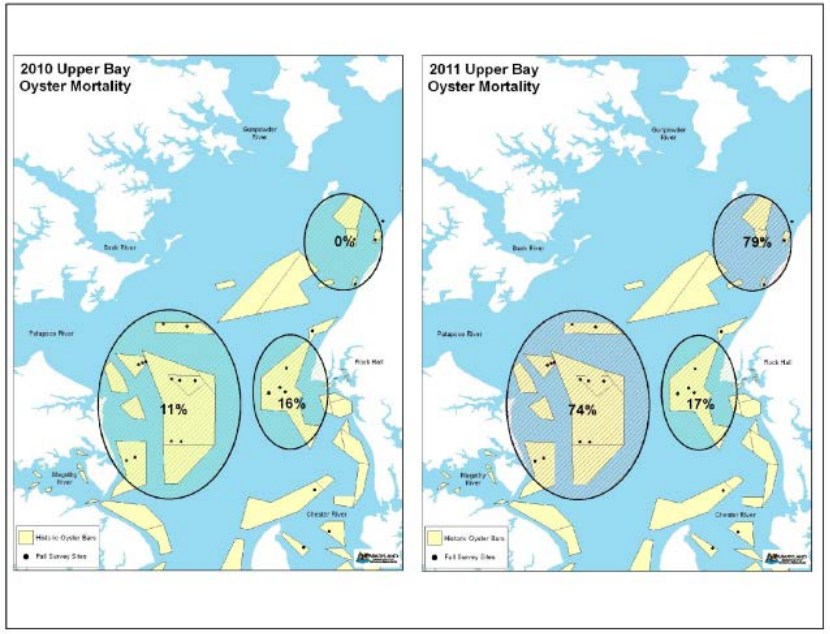
The development of a new optical total suspended matter algorithm for the Chesapeake Bay

Michael. Ondrusek [a,*], Eric. Stengel [a], Christopher.S. Kinkade [b], Ronald.L. Vogel [c], Phillip. Keegstra [d], Craig. Hunter [e], Chunai. Kim [f]




# Living Resource Effects 2011: Oysters experienced high mortality in the upper Bay but have excellent baywide survival




## Flow impact to Oysters

- Highest overall oyster survival rate since 1985 (92%)
- More than double the survival rate of 2002
- 44% increase in oyster biomass in one year
- Dermo and MSX at all-time lows

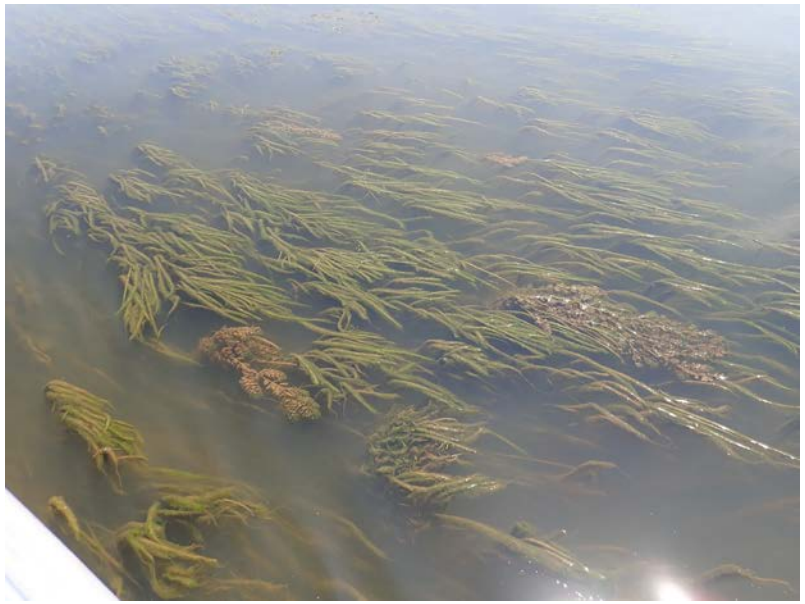
(M. Naylor MD DNR)

Bacteria: South River relationships to storms suggested 0.5 inches of rain often produced bacteria levels out of compliance instead of the often cited 1 inch of rain. (D. Mueller, SRF)

Baywide benthos assessment showed little impact from the storms.
(R. Llanso VERSAR Inc.)

# Back to this year, August 10, 2018. Upper bay post-big flows on the Susquehanna Flats. Looking impressive!

Turbidity 8-10-2018
out in the channel



Bay Grass 8-10-2018
Perimeter if beds with epiphytes

Bay Grass 8-10-2018
Clear water in the beds

Photos by Brooke Landry, MD DNR

# Conowingo Dam

- The volume of debris was the largest in 20 years, according to Exelon. In a statement, they say they normally remove 600 tons of trash from behind the dam in a year, but so far this summer, they've removed 1,800 tons.

- 9/26 – JJ Orth: Conowingo Dam is still wide open, closing only to about 70,000 cubic ft/sec and opening to about 100-120,000 cubic ft /sec.

# Summary

- Significant precipitation is still occurring
- High flows continue across the watershed
- Storm effects have influenced hypoxia dynamics
- Flow effects have impacted habitat conditions and distributions
- We see forecasted impacts to salt sensitive living resources while we also see resilience in light sensitive aquatic vegetation
- Data collection and analysis continues

Salinity distributions:
2002 Drought vs 2003, 2004 Wet

- Tidal Fresh – fairly stable
- Downbay – more substantive variation