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

Data Integrity WG
October 23, 2018
Peter Tango and Scott Phillips, USGS on behalf of STAR
Outline

• River flow into the Bay during 2018
• Initial monitoring results of Bay conditions
• Potential impacts compared to other high-flow years
• Implications for nutrient and sediment management
2018 River Flow: A Very Unusual Summer

- Above normal since May
- Monthly records: Aug and Sept
- Multiple storms
- WY: Oct-Sept

https://md.water.usgs.gov/waterdata/chesinflow/
Susquehanna Highlights During Summer 2018.

• Greatest July river flows on record

• 375,000 cfs - Highest flow at Conowingo Dam since Tropical Storm Lee

• Several flows above 200,000 cfs (Florence)

• The volume of debris was the largest in 20 years

• Normal flows about 10,000 cfs

USGS & Exelon data,
2018: Above normal for the Water Year.

- Only 2\textsuperscript{nd} year above normal in over a decade
- Last was 2011
- Negative impacts on Bay

10/16/2018  https://md.water.usgs.gov/waterdata/chesinflow/
Potential Bay Impacts

- Greater pollutant loads:
  - Poorer water clarity
  - Loss of SAV
  - Lower dissolved oxygen

- High amounts of fresh water
  - Oyster morality
  - Migration of crabs and fin fish

- Monitoring providing early results
Outline

• River flow into the Bay during 2018

• Initial monitoring results of Bay conditions
  • STAR: Multiple-agency monitoring effort
    • Clarity
    • SAV
    • Hypoxia
    • Fresh water and fisheries

• Potential impacts compared to other high-flow years

• Summary and implications
2018 Sediment plumes per peak discharge event
– as seen by satellite
USGS 01578310 Susquehanna River at Conowingo, MD / NASA Terra Satellite

Note: satellite view only available in cloud-free conditions

Source: Ron Vogel
NOAA 2018
SAV: Poor Water Clarity in Upper Bay but Grasses Still Present in the Susquehanna Flats

Turbidity 8-10-2018 out in the channel

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

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

Photos by Brooke Landry, MD DNR
Summer MD Hypoxia: Variable Conditions

- June: above average
- July: Below average
  - Due to winds
- August: near average

![Graph showing percentage of water in Maryland's Mainstem Chesapeake Bay below 2 mg/l Oxygen from 1985 to 2018.](image)
## 2018 Hypoxia – May to October (VIMS)

<table>
<thead>
<tr>
<th>Year</th>
<th>Maximum Daily HV [km$^3$]</th>
<th>Total Annual HV [km$^3$ days]</th>
<th>Duration [days]</th>
<th>Summer Average [km$^3$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>7.1</td>
<td>557</td>
<td>107</td>
<td>4.4</td>
</tr>
<tr>
<td>2015</td>
<td>8.4</td>
<td>468</td>
<td>94</td>
<td>3.7</td>
</tr>
<tr>
<td>2016</td>
<td>8.5</td>
<td>511</td>
<td>98</td>
<td>4.0</td>
</tr>
<tr>
<td>2017</td>
<td>10.4</td>
<td>630</td>
<td>92</td>
<td>5.1</td>
</tr>
</tbody>
</table>

http://www.vims.edu/research/topics/dead_zones/forecasts/cbay/hypoxic-volume/index.php
Duration: It depends on your threshold volume definition for when hypoxia exists in the bay

Chesapeake Bay Mainstem Bay
Annual Hypoxic Volume Duration (Days)

- Bever et al. 2013 (2 cu km threshold hypoxia)
  Estimated regression line only
- Zhou et al. 2014 (0.85 cu km threshold hypoxia)

About a 20 day difference

Hyphoxic Volume Duration (Days)

Year


Chesapeake Bay Hypoxia
Summer 2012
Freshwater flow impacts

• Mortality of some oysters (-)
  • Less disease down bay (+)?
• Crabs migrating south
• Fin fish moving to stay in salinity ranges
• Fewer jellyfish in the northern bay

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

• River flow into the Bay during 2018
• Initial monitoring results of Bay conditions
• Potential impacts compared to other high-flow years
  • Loads
  • SAV
  • Oysters (+ and -)
• Summary and implications
High Flows Deliver More Nutrients and Sediment

- High Flow years: 2011; 2003 & 2004
- Greater nutrient and sediment loads
- Usually lower DO
- May be near average in 2018
  - July wind events
  - More BMPs in place
Potential Loss of SAV

- 2011 High Flows
- Declines in SAV for two years
- SAV beds larger so may be more resilient
- More BMPs in place
- Less overall loss?
Living Resource Effects in High Flows: Historical inference for oysters and benthos

- Oysters 2011:
  - High mortality in the upper Bay
  - Excellent baywide survival

- Baywide benthos 2011
  - Showed little impact from the storms.

(M. Naylor MD DNR 2011 results)

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

(R. Llanso VERSAR Inc.)
Summary and Implications

• More climate and flow variability
  • N, P and S loads from storms need to be mitigated

• More emphasis on water-quality practices to address storm events
  • Urban storm water
  • Runoff from ag lands

• Monitoring to explain watershed and estuary response
  • Assess changes from high flows vs. management practices
  • Resilience of SAV and living resources

• Many thanks to field and lab teams for the long hours and storm chasing!