2018 Chesapeake Bay Hypoxic Volume Report
October 22, 2018

Hypoxia Background

Hypoxia is characterized by dissolved oxygen concentrations in the water that are too low for aquatic organisms such as fish and blue crabs. Here, hypoxia is taken to mean dissolved oxygen concentration less than 2 mg/L. The Chesapeake Bay experiences hypoxic conditions every year, with the severity of hypoxia varying from year to year, depending on nutrient and freshwater inputs, wind, and temperature. Multiple metrics are used to relate the severity of hypoxia between different years:

- Maximum Daily Hypoxic Volume (km^3): The maximum volume of Chesapeake Bay water experiencing hypoxic conditions on any given day[a]
- Average Summer Hypoxic Volume (km^3): The average volume of hypoxic water from June through September
- Hypoxic Duration (days): The number of days in a given year between the first and last day of hypoxic conditions exceeding 2 km^3 in volume
- Total Annual Hypoxic Volume (km^3 days): The total amount of hypoxia in the Bay for a given year, calculated by summing the hypoxic volume on each day

2018 Hypoxia Analysis

The Virginia Institute of Marine Science, together with Anchor QEA and collaborators at UMCES, operates a real-time three-dimensional hypoxia forecast model that predicts daily dissolved oxygen concentrations throughout the Bay (www.vims.edu/hypoxia). The metrics listed above were estimated for 2018 from this forecast model. For reference, the same statistics have also been generated for earlier years (2014–2017; **Table 1**). These estimates are based on complex computer models that continue to be improved; therefore, past estimates may be updated as improvements are made to the model formulations.

The total amount of hypoxia in 2018 was estimated to be similar to 2017, but the seasonal patterns in hypoxia were very different. Hypoxia was estimated to start earlier and last longer in 2018 than in recent years.

Springtime inflows from the Susquehanna River were high in 2018, resulting in the prediction that 2018 would have an above average amount of hypoxia.[b] However, wind speed and direction also play a large role in the severity of hypoxia during the summer. During 2018, the total annual hypoxic volume was similar to 2014 and 2017 through mid-July, but larger than in 2015 and 2016 (**Figure 1**). Strong winds in the second half of July reduced the amount of hypoxia to near zero.[c] Hypoxia increased rapidly again in early August and peaked at a higher value in early September than in previous years. Strong winds in September again mixed the Bay water and resulted in a large reduction in the volume of hypoxic water. Overall, the total amount of hypoxia in 2018 was estimated to be similar to 2017, but the seasonal patterns in hypoxia were very different; hypoxia was estimated to start earlier and last longer in 2018 than

[a] 1 km^3 equals about 400,000 Olympic-sized swimming pools of water
[b] 2018 springtime forecast: https://scavia.seas.umich.edu/wp-content/uploads/2018/06/2018-Chesapeake-Bay-forecast_Final.pdf
[c] Very little hypoxia was also estimated from cruise-based data. See https://news.maryland.gov/dnr/2018/08/10/late-july-2018-hypoxia-report/

in recent years (**Table 1**). The lack of hypoxia in late July was very atypical of historical dissolved oxygen conditions.

Table 1. Severity of hypoxia estimated by the forecast model. (For more detailed information, see www.vims.edu/hypoxia.)

Year	Maximum Daily Hypoxic Volume (km^3)	Average Summer Hypoxic Volume (km^3)	Hypoxic Duration (days)	Total Annual Hypoxic Volume (summed over each day; km^3 days)
2014	7.1	4.4	107	557
2015	8.4	3.7	94	468
2016	8.5	4	98	511
2017	10.4	5.1	92	630
2018	10.8	4.6	141	622

Figure 1. Hypoxic volumes for 2014 through 2018 and wind speed for 2018