2020 Hypoxia Forecast

Modeling Workgroup Quarterly Call
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Chesapeake Bay hypoxia forecasting model

**Driver:**
- Jan-May average Susquehanna TN load

**Model output:**
- Average subpynocline [DO] as a function of distance from TN source
  
**Calibration target:**
- Mean July hypoxic volume (HV) ([DO] < 2 mg/L)

Hypoxic length = sum of all segments with [DO] < 2 mg/L

Hypoxic length → hypoxic volume through empirical V-L relationship

V-L relationship

Scavia et al. 2006
Calibration exercises

1. HV metrics:
   Average July (km$^3$), Average Summer (km$^3$),
   Total Annual (km$^3$ * days)

2. HV estimates

3. Load sources:
   Sus, Pot, Sus+Pot, Sus+Pot+PS, All 9 RIM rivers,
   All 9 RIM rivers + PS

4. Load time frames:
   Oct-May (all possible combinations)
   Oct-Jun (all possible combinations)
Chesapeake Bay hypoxia forecasting model

Driver:
Jan-May average Susquehanna TN load

Calibration target:
Mean July hypoxic volume (HV) ([DO] < 2 mg/L)

Model output:
Average subpycnocline [DO] as a function of distance from TN source

Hypoxic length = sum of all segments with [DO] < 2 mg/L

Hypoxic length → hypoxic volume through empirical V-L relationship
Chesapeake Bay hypoxia forecasting model

Driver:

- Jan-May average Susquehanna TN load
- All 9 RIM rivers + PS TN load

Model output:

Average subpycnocline [DO] as a function of distance from TN source

Hypoxic length = sum of all segments with [DO] < 2 mg/L

Calibration target:

Mean July hypoxic volume (HV)
Total Annual HV ([DO] < 2 mg/L)

Hypoxic length → hypoxic volume through empirical V-L relationship

V-L relationship

Scavia et al. 2006

- Hypoxic length = \sum \text{segments with } [\text{DO}] < 2 \text{ mg/L}
- Hypoxic length → hypoxic volume through empirical V-L relationship
Blind forecasts and 2020 forecast

Average July HV

Total Annual HV
Potential future improvements

- Develop method to update forecast over the summer, potentially as a function of weather
- Estimate bioavailable portion of the TN load
- Assign different weights to loads from different months
- Assign load sources to different locations along the model's spatial domain
- Revise Length-Volume relationship
Estimated HV decrease:
-17% (95% CI: -12%/-26%)
Estimated HV decrease: -29% (95% CI: -20%/-45%)
HV metrics and estimation methods

Average Summer HV

Total Annual HV

Bever et al., 2013; Murphy et al., 2011; Zhou et al., 2014
Results – Best performing models

<table>
<thead>
<tr>
<th>HV metric</th>
<th>Load Sources</th>
<th>Load Period</th>
<th>NSE</th>
<th>r2</th>
<th>RMSE</th>
<th>MAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Summer</td>
<td>9 RIMs + PS</td>
<td>Jan-Jun</td>
<td>0.40</td>
<td>0.52</td>
<td>1.11</td>
<td>0.88</td>
</tr>
<tr>
<td>Tot Annual</td>
<td>9 RIMs + PS</td>
<td>Jan-Jun</td>
<td>0.50</td>
<td>0.61</td>
<td>135</td>
<td>106</td>
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