Monitoring Objectives

- Assess magnitude, frequency and duration of algal blooms.
  - Compare to DEQ-CBP monthly fixed-station monitoring.
- Characterize environmental conditions favoring bloom development.
- Document associated water quality conditions (e.g., low DO, presence of toxins).

2013 Monitoring Activities

- Fixed-interval, fixed station
  - VCU: weekly tidal-fresh, May-Sept.
  - ODU: Lafayette River (June-July + events)
- Spatial Continuous (dataflow)
  - HRSD (JMSMH, JMSPH, LAFMH and ELIPH) weekly Feb-Oct.
  - VIMS (JMSOH) weekly Feb-Mar, monthly Apr-Sep.
- Temporal Continuous (automated)
  - VCU: JMS75 (year-round)
  - VIMS & HRSD: JMS17.96 (Feb-Nov), LAF (Mar-Oct; two sites).

Presentation of Results

- Tidal-fresh: Chl a and Microcystin (Paul)
- Lower James: dataflow, continuous and event sampling (Will & Margie)
- Phytoplankton communities (Todd)

Tidal Fresh - 2013 Hydrologic Conditions

FRT = Freshwater Replacement Time (with means for Jul-Aug)
Cyanobacteria & Microcystin

Tidal Fresh

Dataflow & Continuous Monitoring

2012 Dataflow Results
**2013 Spring Bloom**

**2013 Summer Bloom**

**Continuous Monitoring (JMS17.96)**

- 2012
- 2013

**Vertical CHLA depth profiles**

Differences in CHLA between surface and bottom relevant to assessing exposure to blooms.
- E.g. lesser exposure for benthic animals and possible avoidance by some pelagic organisms

**Vertical CHLA depth profiles**

- Suggests a need to include vertical profiles and volumetric assessment during blooms
- Diurnal patterns are likely and more study is recommended in 2014

**Lafayette River continuous, daily & event sampling**

- WHRO and CP = Stormwater sites
- LAF1.63 and LAF4.7 = YSI and Daily sampling sites

CHLA is uncorrected YSI result
Precipitation - 2012 & 2013 comparisons

Continuous Monitoring - bloom timing in 2012 vs. 2013

Chl a versus temperature

LAF4.7 Daily sampling 2013*

LAF4.7 - Small rain event (<0.5 in)

- TDN peaks at 1.5 h and 10 h after rain event
- No major change in Chl a, fluctuates with tide
- N pool dominated by urea and NH₄⁺
LAF4.7 - Medium rain event (>0.8 in)

- TDN peaks at 1.5 h and 12 h after rain event, then levels out
- High Chl a after rain event, coinciding with TDN decrease (6 h), then sharp decline as TDN stays elevated
- N pool dominated by NH$_4^+$ and urea, also see decrease with Chl a increase at 6 h

AC-Large rain event (>1.3 in)

- TDN lowest at 10 h then levels out
- High Chl a after first and second rain event
- Inorganic N and urea depleted in first 3 hours during initial Chl a increase, NH$_4^+$ and urea increase (recycled)

AC-Large rain event 2013

- Large rain event > 1 in. in 6 hours
- TDN lowest at 1.5 h then levels out
- Chl a trends with TDN
- N pool dominated by NH$_4^+$

* Take home message, all rain events not created equal

Summary – Lower James

- Blooms in 2013 initiated later than in previous years. Cooler water temperatures may have contributed to this as blooms are correlated with water temperature.
- While significant rainfall often precedes blooms, Chl a and dissolved N concentrations cannot be significantly related to these events — we probably don’t understand their complex relationship
- Vertical distribution of CHLA during blooms appears to be an important consideration for exposure and living resources effects.
- Next – phytoplankton community composition.

Phytoplankton Community Analysis

- Upper James:
  - VCU weekly samples: JMS75 & JMS99 (May-Sept)
  - VCU-DEQ longitudinal survey (July-Sept)
- Lower James:
  - HRSD weekly samples: JMSMH, JMSPH, ER & LAF (Feb-Oct)
  - ODU OEAS: daily sampling: Lafayette River (June-Aug)
  - ODU OEAS: 24hr study: Aug 9

Total samples: 497

2013 temporal overview
**2013 spatial overview**

- Upper tidal fresh
- Lower tidal fresh
- Oligohaline
- Mesohaline
- Polyhaline (and ER & Lafayette)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Upper James (Tidal Fresh &amp; Oligohaline)</th>
<th>Lower James (Mesohaline ER &amp; Lafayette)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Chl a µg/L</td>
<td>2.9</td>
<td>25.9</td>
</tr>
<tr>
<td>Max Chl a µg/L</td>
<td>7.6</td>
<td>285.9</td>
</tr>
<tr>
<td>Mean Phytoplankton</td>
<td>24.2</td>
<td>410.0</td>
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<tr>
<td>Max Phytoplankton</td>
<td>48.7</td>
<td>1,224.4</td>
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<tr>
<td>Mean Chl a µg/L</td>
<td>15.9</td>
<td>144.4</td>
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<tr>
<td>Max Chl a µg/L</td>
<td>33.5</td>
<td>288.1</td>
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<tr>
<td>Mean Algae</td>
<td>46.1</td>
<td>3,836.1</td>
</tr>
<tr>
<td>Max Algae</td>
<td>446</td>
<td>67,637.1</td>
</tr>
</tbody>
</table>

**Phytoplankton biomass and chlorophyll a**

- Upper James: increased biomass of several algal phyla, primarily diatoms

**Bloom intensity**

- *Heterocapsa triqueta* (mesohaline, February-April)
  - Max Chl a: 446 µg/L
  - Max density: 179,100 cells/ml (*336,800 cells/ml DEQ, Deep Creek 3/14)
  - Max chlorophyll µg/L: 1,815
- *Coschcidium polykrikoides* (August-September)
  - Initiation in upper Lafayette and possibly Warwick Rivers
  - Max Chl a: 295.9 µg/L
  - Max density: 22,250 cells/ml (*62,200 cells/ml VDH, mouth of Warwick River 8/20)
- *Akashiwo sanguinea* (July-August)
  - Upper Lafayette and mesohaline James
  - Max Chl a: 191.5 µg/L
  - Max density: 5,620 cells/ml

**Algal community composition: 2013**

- Algal community composition (1986-2012)

**Phytoplankton biomass and chlorophyll a**

- Dinoflagellate blooms in Lower James drive relationship between biomass and Chl a. (other phyla non sig.)

- Upper James: increased biomass of several algal phyla, primarily diatoms
Other HABs

- Dinoflagellates
  - *Alexandrium monilatum* Polyhaline and Elizabeth River
  - Karlodinium veneficum Lafayette River
  - *Prorocentrum minimum* Mesohaline James

- Cyanobacteria (tidal fresh)
  - *Microcystis aeruginosa*
    - max 2700 cells/ml (0.3-4.5% of biomass when present)
    - 2012: max 6900 cells/ml
    - *Anabaena circinalis*

- Raphidophytes
  - *Chattonella subsalsa*, *Heterosigma akashiwo*
    - Lafayette and Elizabeth Rivers

2013 algal community summary

- Upper James:
  - Reduced biomass from 2012 (ex. JMS75 values ~50% lower than last year)
  - Species composition similar to 2012 and long-term dataset (dominance by centric diatoms e.g., *Aulacoseira granulata*)
  - Low HAB abundance (cyanobacteria ~6%)

- Lower James:
  - Reduced biomass from 2012 (~50% lower) and 5-7 weeks later.
  - Composition similar to 2012, long-term monitoring station (LE5.5-W) not representative of bloom conditions for region.
  - High ChL-a-biomass associated with monospecific dinoflagellate blooms (*C. polykrikoides*, *H. triqueta*, et al.).
  - Increased number of major bloom species (>100µg/L Chl a), continued presence of HABs.