James River Study 2013

Katherine C. Filippino
Margie R. Mulholland
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Sampling sites - 2012

Tidal fresh – monthly nutrients, chl \(a\), PN/PC, N & C uptakes

Mesohaline & Laf. Headwaters – weekly nutrients, chl \(a\), PN/PC, pigments, N and C uptakes
Sampling sites – 2012 & 2013

Whole river = nutrient pulsing and DATAFLOW cruises

WHRO and CP = Stormwater sites

NYCC and AC = YSI and Daily sampling sites
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Continuous monitoring (CONMON)

- YSI’s at AC (headwaters) and NYCC (mouth)
- Collecting Temp., salinity, depth, fluorescence, pH, turbidity from March – October
- Sites for weekly sampling (AC – 2012) and daily sampling (AC & NYCC – 2013)
- 2 additional sites proposed in James River in 2014 - HRSD
Nutrient pulse studies

- Combined fixed site monitoring (AC & NYCC) and whole river surface mapping and monitoring before and after rain events
- Nutrients collected 30 minutes and hourly after rain event up to 24 hours at AC & NYCC with ISCOs
- Nutrients collected at 10 surface stations 1 day before and 1 day after rain events along whole river, DATAFLOW in use
Precipitation – 2012 & 2013 comparisons

Luxembourg pump station, near AC

2012 - Monthly Totals

2013 - Monthly totals

Taussig Blvd. pump station, near NYCC

2012 - Monthly Totals

2013 - Monthly totals
Chl $a$ & Temp - 2012 & 2013
Chl $a$ vs temp. – 2012 & 2013

**AC 2012**
Corrected chl $a$
$$y = 4.33 \ e^{0.06x}$$

**NYCC 2012**
Corrected chl $a$
$$y = 0.014 \ e^{0.35x}$$

**AC 2013**
Corrected chl $a$
$$y = 8.75 \ e^{0.05x}$$

**NYCC 2013**
Corrected chl $a$
$$y = 0.533 \ e^{0.16x}$$

- 10% chl > 50 $\mu$g/L, of that, 85% > 25°C
- 72% chl > 15 $\mu$g/L, of that 65% > 25°C
- 5% chl > 50 $\mu$g/L, of that, 99% > 25°C
- 72% chl > 15 $\mu$g/L, of that 65% > 25°C
AC – Daily sampling 2013

Removing the DON pool, N pool is dominated by urea and NH₄.

N pool dominated by DON.

* not corrected chl a
Removing the DON pool, N pool is dominated by urea and NH₄.
Winds from the South

NOAA/NOS/CO-OPS
Winds at 8638595, South Craney Island VA
From 2013/06/06 00:00 GMT to 2013/06/10 23:59 GMT

Winds at 8638595, South Craney Island VA
From 2013/06/06 00:00 GMT to 2013/06/10 23:59 GMT

Winds from the South

Precipitation (in.)

N & P (µmol L⁻¹)

Chl a (µg L⁻¹)

Mouth

Headwaters

6/6/13
6/7/13
6/8/13
6/9/13
6/10/13

PO4
Urea
NH4
NO3+NO2
Chl a
Vertical profiles – storm event

Before storm 6/6/13 (1100 – 1220) – well mixed water column

After storm 6/8/13 (1720 – 1845) – stratified water column, particularly in headwaters and mainstem

* Interpretation could also be skewed since profiles were taken at mid-day and early evening
Vertical profiles – Chl $a$ variability

- Of the total vertical profiles conducted in 2013 during nutrient pulse cruises, 73% had chl $a$ maximums either at the surface ($< 0.5$ m) or sub-surface ($0.5 – 1.0$ m) layers.
- Temporal (diel variability, timing between storm events) and spatial (mouth vs headwaters) variability important.
- Indicates a strong need to assess chl $a$ with depth in order to gain a representative estimate of its related effects on designated uses.
Diel variability

- Chl $a$ and biomass data convoluted with tide, stratification, light, and vertical migration
- Stratified water column at low tide – surface chl $a$ higher in evening compared to morning
- Mixed water column at flood and ebb tides – surface chl $a$ higher in mid-morning compared to evening
- Bulk N (TDN & DON) trends with tide
- DIN trends with biomass
Analyses to date: Rainfall – nutrient – chl a relationship

• Wind and rain events likely add nutrients and stimulates Chl production

• Although nutrients can be modulated by tide, only bulk nitrogen (TDN & DON) and P have significant relationship with depth

• DIN concentrations and affects on Chl a are regulated by biology and introduction of nutrients through rain, run-off, and mixing. BUT effects confounded by diel light cycle and tidal mixing/forcing. Timing may be important
AC-Rain events 2013

- 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 NH$_4^+$
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-Rain events 2013

- Large rain event > 1.3 in. in 6 hours
- 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-Rain events 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
Analyses to date: Rainfall – nutrient – chl a relationship

• Rain event frequency & duration appear to initiate blooms once temps. are greater than 24°C
• 2012 – Whole river and CONMON sampling, captured large-scale nutrient concentrations, but difficult to relate to precipitation events
• 2013 – Effects of rainfall on in situ nutrient concentrations and chl a are highly variable because of interactive effects between magnitude of inputs, tidal forcing, and biology
Analyses to date: Data gaps

• 2014 – Relate diel changes in the vertical distribution of chl a to surface chl a concentrations made – Diel variability can be greater than seasonal and/or annual variability
  – Attainable criteria during what part of the solar or tidal cycle? At what depth?

• 2014 – Direct assessment of atmospheric deposition (wet only) component not yet quantified; sediment advective flux in response to wind