NC Nutrient Criteria Development Plan – Scientific Advisory Council (SAC)

10/30/2019

Attendees

SAC members in attendance:

Jesse Jarvis

Hans Paerl

Lauren Petter

Judy Kenworthy

Marcelo Ardon

Astrid Schnetzer

Nathan Hall

James Bowen

Michael O'Driscoll

Martin Lebo

Fritz Rohde

Racheal Dittman

NCDEQ staff in attendance:

Brian Wrenn

Connie Brower

Nora Deamer

Susan Meadows

Bridget Flaherty

Heather Jennings

Elizabeth Fensin

Christopher Ventaloro

Jim Hawhee

Leigh Stevenson

Jeff Manning

SAC meeting facilitator

Lauren Daniel

Criteria Implementation Committee members in attendance:

Andy McDaniel

Anne Coan

Meeting materials can be found on the Division of Water Resources Nutrient Criteria Development Plan Scientific Advisory Council webpage. Click here for a direct link.

Meeting notes

All questions, comments and answers are paraphrased

1) **Convene** (Lauren Daniel)
   a) Desired outcomes for this meeting:
      i) Shared understanding of the Nutrient Criteria Development Plan.
      ii) Shared understanding and approval of the SAC charter.
      iii) Shared understanding of the APNEP Phase I report.
      iv) Shared understanding of the existing conditions in the Chowan River/Albemarle Sound.
   b) Welcome new SAC members
   c) February 2019 SAC meeting minutes are available for review. June meeting minutes are being prepared.
   d) Review of SAC ground rules:
      i) Begin/end on time
      ii) Listen
      iii) Disagree respectfully
      iv) All participate
      v) SAC can invite guests to speak
      vi) Members should project their voices when speaking (meetings are recorded)
   e) Travel reimbursement forms are available for mileage
   f) Conflicts of interest:
      i) Members are required to sign a conflict of interest form. This is just simple statement of whether the member has any conflicts of interest. It is required to maintain transparency and will not disqualify anyone from being able to participate.
      ii) Members should review the NCDP ethics statement.
2) **High Rock Lake Chlorophyll-a recommendation document update** (James Bowen)
   a) Continuing work to conclude the document. Following the outline that we produced last summer.
   b) During the 2-day SAC meeting in December of 2018 we came to consensus on the chlorophyll-a recommendation and agreed on the following process for creation of the final recommendation document:
      i) James B. would manage the construction of the document; All SAC members would contribute to the document; The document would consist of 5 chapters and would aim to be around 30-pages in length; Each SAC member would be assigned to sections including:
         (1) Literature search
         (2) Existing conditions
         (3) Proposed criteria
         (4) Suggested framework for developing criteria for other NC lakes & reservoirs
   c) As of October 29, 2019, most of the document is finished and a PDF of the document is available as a draft for review and editing.
   d) Deadline for the final document is the end of 2019. This still seems reasonable.

e) Questions/comments:
   i) Martin L.: What is the process for providing feedback?
      (1) James B.: I will maintain the document and comments should be submitted using track changes. We should work toward editing the document as a group. Need to decide as a group where edits need to be made. I will schedule a phone call with SAC members after Thanksgiving to coordinate further.

3) **Nutrient Criteria Development Plan (NCDP) version 2.0** (Brian Wrenn)
   a) See slides here.
   b) Background:
      i) Nutrient criteria development started in 2001. There have been various iterations over the years though no real traction was gained until EPA began pressing for numeric nutrient criteria for total nitrogen and total phosphorous.
      ii) The NC Forum on Nutrient Over Enrichment was held in 2012 and the first version of the Nutrient Criteria Development Plan was developed in 2014.
         (1) 2014 NCDP did not mention the Criteria Implementation Committee (CIC), did not clearly define the expected roles of the SAC and has outdated timelines.
      iii) Version 2 of the NCDP has been developed this year (2019)
         (1) Updated language to represent progress to date, revised the role of the SAC, officially recognized the CIC, paired the Chowan River with Albemarle Sound, and updates milestones with reasonable dates.
   c) NCDP version 2 goals:
      i) Link nutrient criteria with designated uses in such as aquatic life protection, recreation, water supply, etc.)
      ii) Evaluate causal & response variables (nutrient, chlorophyll-a, pH, dissolved oxygen, etc.)
      iii) Express numerically or in narrative form with a numeric translator (concentration, mass loadings)
   d) Roles of SAC and CIC
      i) SAC provides advice on the development of scientifically defensible nutrient criteria.
      ii) CIC comments on the social and fiscal impacts of potential criteria, provides information to inform fiscal notes which tie in the beginning of the rulemaking process.
   e) Details of the NCDP
      i) Develop nutrient criteria for three water body types (lakes/reservoirs, rivers and streams, and estuaries).
      ii) Specific water bodies provide a starting place and include: High Rock Lake (lake/reservoir), Central Cape Fear (river/stream), and the Chowan River/Albemarle Sound (estuary).
   f) Chowan River/Albemarle sound
      i) Much of the preliminary work has been done as part of the Albemarle Pamlico National Estuary Program (APNEP)
      ii) APNEP has released a Phase I report (Jim Hawhee will present on this later today) that identifies and prioritizes potential criteria parameters, data gaps, and research needs.
      iii) DWR and the NCDP SAC will pick up evaluation efforts and development of final criteria. This will be Phase II.

(1) Plan to follow EPA's Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Marine Waters.

iv) DWR data gaps
(1) Some data is lacking for this system. It is difficult to monitor due to it being a large area.
(2) Some existing information includes:
(a) Water quality data from USGS, NARS-NCA
(b) Aquatic life data including SAV and DO sensitive fish from DMF, USGS, NARS-NCA
(c) Nutrient bioassays from Nathan Hall and UNC-IMS
(d) Cyanotoxins from DWR, Astrid Schnetzer, and NCSU
(e) The need for a clarity optical model has been discussed but a model has not been developed.

g) Comments/questions:
i) Judd K.: Has there been any consideration of salinity? Effects and nutrient criteria can react with changes in salinity.
ii) Brian W.: Are you referring to changing salt wedge related to sea water rise? (Yes) It is something to consider. DWR is looking at how sea level rise will impact coastal management.
iii) Hans P.: Salinity is important for determining occurrence of cyanotoxin blooms as well. More extreme weather events will also likely impact the frequency/severity of these events.
iv) Marcelo A.: (Regarding the charter duties) The revised NCDP does not clarify whether the SAC is charged with developing criteria documents. Also don't see a difference between this and the first version.
(1) Brian W.: The new NCDP reflects a shift in the process away from the SAC developing criteria to the DWR taking on that role. DWR will now do the criteria development with assistance from the SAC. The SAC can contribute in various ways (white papers, minority reports, etc.).

4) **SAC Charter review** (Brian Wrenn)
i) See charter here.
ii) Charter provides:
(1) Guidance for staff.
(2) Better describes the duties of the SAC (advisory role, information source, utilization of expertise).
(3) Outlines the decision-making process (SAC consensus, minority report option, established chair & vice-chair to facilitate consensus).
(4) Discusses implementation, duration and frequency components of criteria.
iii) Does the SAC agree to adopt it this charter?
(1) SAC agrees to adopt the charter.

5) **APNEP Phase I report review** (Jim Hawhee)
a) See slides here.
b) The Phase I report has been sent to SAC members and includes:
i) Executive summary, meeting minutes, overview of supporting materials, priorities for future research, and appendices.

c) Initial goal was to recommend nutrient criteria. Workgroup didn't accomplish that but did develop a list of research priorities.
d) Summary of report:
    i) Nine meetings held between 2014 and 2016
    ii) Group considered pH, DO, clarity, TN & TP, phytoplankton and cyanotoxins, chlorophyll-a, and turbidity.
    iii) Supporting projects included:
        (1) Remote sensing evaluation (NASA). Compared chlorophyll-a to remote sensing data as a means of evaluating blooms. Did not find a strong relationship although there may still be use for this technology int the future.
        (2) Literature survey (Tetra Tech). Helped to establish which areas of the sound respond to TN & TP.
        (3) Law & policy review (Sea Grant). Focused efforts on law and policy related to nutrient regulation.
        (4) Literature compilation (Tetra Tech). Identified and sorted around 1,000 references.
        (5) USGS Albemarle Sound initiatives.
        (6) DWR supplementary data analysis.
        (7) Criteria development case studies.
    iv) Factfinding occurred in early 2016 and members generated criteria proposals which were then evaluated by the greater group (late 2016). Where limitations were identified, research needs were proposed/ranked.
    v) Priority research areas included:
        (1) Algal toxin surveys (some are currently underway)
        (2) Clarity optical model (not underway. TSS data being collected for calibration)
        (3) Summarization of historical data (DWR has done a preliminary evaluation)
        (4) Nutrient bioassays (grant proposals have been submitted. No funding yet)
        (5) Historical SAV coverage (APNEP efforts complete. Evaluation of potential habitat not underway)
        (6) Correlations between oxygen-sensitive fish species, habitat utility and seasonality. (existing NOAA resources, requires further evaluation).
e) Next step → SAC version 2.0
    i) The SAC picks up where the APNEP workgroup left off. Potential areas for discussion include:
        (1) Application and implementation of a clarity water quality standard.
        (2) Chlorophyll-a seasonal average.
        (3) Nitrogen and phosphorous criteria.
        (4) Bioconfirmation approach toward nutrient criteria.
f) Comments/questions:
    i) Martin L.: Would clarity be used to derive a chlorophyll-a standard that applies to the water column?
    ii) Hans P.: How has the nutrient load changed in the system over time? There's disagreement about this. Blooms frequent in the 1970's & 1980's. They went away but are back again. Is

this due to nutrients or other factors? Important to set nutrient thresholds but important to understand the other contributing factors to make management successful.

iii) Jim H.: We have some information that will allow for determination of changes in load for parts of the sound but not for others.
iv) James B.: What are the pros and cons of including the Chowan River as part of this? Aren't there blooms in the river?
v) Hans P.: We are dealing with a nutrient continuum. Blooms are occurring throughout the sound.
vi) James B.: Are there concerns in the sound beyond the blooms?
vii) Hans P.: Clarity in open systems is a concern. Most blue-green algae can survive in the low salinity waters found in the sound.
viii) Martin L.: The sound is really an extension of the river. It ends up being very nearly fresh water at certain times of the year.
ix) Marcelo A.: Long-term trends show that the Albemarle Sound is getting saltier. I have a graduate student working on this now.
x) Jim H.: We're seeing a lot of blooms. Want to make sure we consider criteria that are appropriate to address the issue. Need to consider the downstream uses as well.
xi) Judd K.: There are very few monitoring stations in the sound. Was there any discussion about this during the APNEP process?
xii) Jim H.: I don't recall there being any substantial discussion of this. N-Step funding might be helpful for this?
xiii) Hans P.: Problem is that the sound is very large and is difficult to get out on. This is compounded by the state not having the resources to devote to monitoring.
xiv) Brian W.: We are hoping to provide the universe of available data to the SAC during the December 2019 meeting. We also had a conversation with EPA about pairing remote sensing with field data (for ground-truthing) to get estimates of chlorophyll-a in the sound. This would require funding for staff and access to satellite data. Working on an N-Steps proposal now. This will, hopefully, either provide sampling assistance from EPA or provide us funding for more sampling.
xv) Hans P.: Data is lacking for the intermediate areas of the sound. Should establish more monitoring stations in these areas.
xvi) Judd K.: Doesn't appear to be enough monitoring stations and data to be able to figure out what is going on in the system. Can establish a standard, but without increased monitoring will that address the issues?
    (1) Jim H.: With a standard established the water body will be assessed for impairment every two years as part of the 303(d) Impaired Waters program.
    (2) Mike O.: Another thing to consider is the lack in flow data for this system. May be possible to make use of flood stage data.

6) **Criteria development schedule and process** (Brian Wrenn, Connie Brower, Chris Ventaloro)
    a) See slides here.
    b) Overview of surface water Water Quality Standards (WQS)
        i) Types of WQS:

(1) Drinking water standards
    (a) Regulatory authority is the federal Safe Drinking Water Act
    (b) Applies to finished drinking water
    (c) State regulation through the DWR Public Water Supply Section
(2) Surface water standards
    (a) Regulatory authority is the federal Clean Water Act
    (b) Applies to variety of designated uses (protection of aquatic life & wildlife, recreation, water & fish consumption, tec.)
    (c) State regulation through the DWR Planning Section
(3) Groundwater standards
    (a) Regulatory authority is the North Carolina Administrative Code (15A NCAC 02L)
    (b) No federal requirement
    (c) Applies to protection of groundwater as a source of drinking water
    (d) State regulation through the DWR Planning Section

ii) Substances are regulated differently by each of these programs because each program has specific goals it is seeking to attain.
    (1) Ex: Selenium WQS is 5 ug/L in surface water, 50 ug/L in drinking water, and 20 ug/L in groundwater

iii) The federal Clean Water Act of 1972 requires states to develop & routinely update WQS for surface waters. WQS are state regulation or rules that serve to protect the waters of the state from the detriment effects of pollution. WQS describe the desired conditions (goals) for waters and the requisites for attaining those conditions.

iv) WQS are established based on best available scientific information and do not consider fiscal impacts.

v) Classifications are established in rule (15A NCAC 02B) and define the desired conditions (designated uses or best uses) and the numeric & narrative criteria to attain those conditions. Classifications include:
    (1) Freshwater: Class C, Class B, Class WS (I-V)
    (2) Saltwater: Class SC, Class SB, Class SA
    (3) Supplemental: HQW, ORW, NSW, Trout

vi) Designated uses include:
    (1) Class C & SC: aquatic life & wildlife, secondary recreation, fish tissue consumption
    (2) Class B & SB: primary recreation
    (3) Class SA: special requirements for shellfish harvesting areas
    (4) Class NSW: special requirements for nutrient sensitive waters
    (5) Class ORW: special requirement for areas of exceptional water quality

vii) Water bodies may have multiple classifications. Class C (freshwater) & SC (saltwater) provide a basic level of protection to all waters. Additional classifications add to these protections.

viii) Nutrient standards provide protection from the physical, chemical and biological impacts resulting from high nitrogen and phosphorous concentrations. Development is challenging!

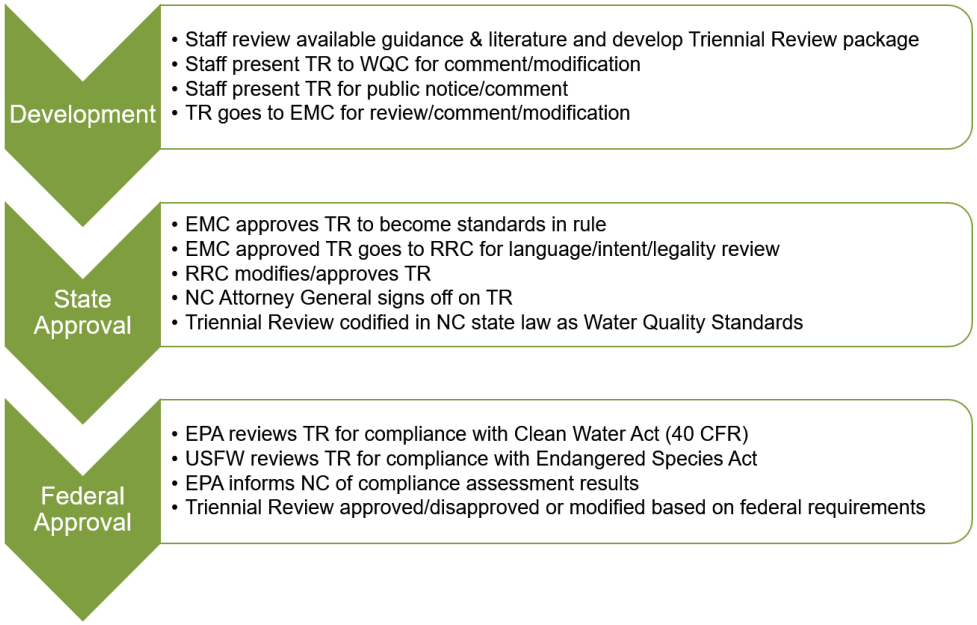
(1) N & P do not directly impact uses (ex: they do not cause physical harm to aquatic life), however,
(2) They may result in complex ecosystem changes that do impact uses.
(3) To address this need to:
    (a) Establish relationships between causal (N & P) and response (DO, chlorophyll-a, etc.) variables,
    (b) Determine the most sensitive uses in the ecosystem, and
    (c) Develop numeric and/or narrative criteria based on these relationships to sensitive uses.

ix) Considerations for nutrient standards
(1) How do nutrients impact aquatic life?
    (a) Altered phytoplankton composition, human and aquatic life health effects from exposure to cyanotoxins, habitat alteration, altered chemistry (pH, DO), etc.
(2) Species sensitivities?
    (a) Submerged aquatic vegetation (SAV), threatened & endangered species, aquatic-dependent wildlife, etc.
(3) Human health impacts?
    (a) Cyanotoxin exposure to recreators, accumulation of cyanotoxins in fish tissue, etc.
(4) Aesthetic impacts?
    (a) Discolored water, bad odors, bad taste in fish tissue, etc.

x) Possible nutrient specific endpoints & indicator
(1) Physical
    (a) DO, pH, turbidity, light penetration
(2) Chemical
    (a) Algal toxins
(3) Biological
    (a) Healthy SAV
    (b) Relationship of chlorophyll-a concentrations to N & P concentrations
    (c) Balanced phytoplankton biomass
    (d) Balance aquatic flora and fauna communities

xi) Development & adoption of WQS
(1) Clean water act requires states to review WQS every three years (triennial review). This is a continuous process. Completion of one triennial review leads to the beginning of the next triennial review.
(2) DWR staff are responsible for reviewing any EPA National Recommended Water Quality Criteria that have been published since the previous triennial review and reviewing existing WQS to see if new scientific information is available that would modify the standard.
(3) DWR staff then begin the rulemaking process (per the NC Administrative Procedures Act). This process involves staff proposing new criteria and changes to the NC Environmental Management Commission (and associated Committees) for adoption into State rule. As part of this process staff publish a public notice via the NC Register,

engage stakeholders, and conducting Public Hearings. Upon adoption by the EMC the triennial review (and associated rules changes) must also be approved by the NC Rules Review Commission, published by the NC Office of Administrative Hearings, and be signed by the NC Attorney Generals Office. After this the triennial review is submitted to the EPA to be reviewed for compliance with the Clean Water Act. A simplified summary of this process can be seen in the chart below.



xii) Comments/questions:

7) **Existing condition of the Chowan River and Albemarle Sound** (Nora Deamer)
   a) See slides here.
   b) The slides provide a number of charts, maps and tables detailing the existing conditions in the Chowan River and Albemarle Sound. Additional comments follow.
   c) Virginia makes up about 76% of the Chowan River basin.
   d) The current basin plan for this area is being finished now. Some findings include:
      i) Algal blooms began to reappear in 2015
      ii) The Chowan/Albemarle Action Plan requires a 20% reduction in nitrogen and a 30% reduction in phosphorous to comply with the current chlorophyll-a standard of 40 ug/L.
      iii) We don't yet know why the blooms are occurring in this system again. Land use has not changed significantly, there is only one major discharger and there are few animal operations permits.
      iv) Most of the previously existing dischargers are now non-dischargers (switch to land application).
      v) There have been no big changes to agriculture in the area, though we suspect there are more poultry operations. We are not allowed to permit these operations and so we don't know for sure how many are out there.

vi) Considering forestry operations as a possible contributor. Timber harvesting has increased and there has been a loss of mature forest. Forests now consist mostly of shrubs.
   (1) Judd K.: What is the timber harvest inspection like? Is an inspection done after every harvest?
   (2) Anne C.: NC Forest Service does these inspections. Harvesting is to comply with established best management practices.
   (3) Hans P.: have the harvest areas changed? Harvesting occurring at the rivers edge could lead to water quality impacts and could increase nutrient loading.
   (4) Nora D.: Not sure. The report says that loos of timber forest can result in increased flows. A lot of swamp forest logging is occurring as well.

vii) There are few 303(d) impairments in the Chowan River basin. These include Cricket Swamp (DO) and the Wiccacon River (benthic impairment). Some previous impairments have been removed from the list.

viii) There are nine ambient monitoring stations spread throughout the system. Two (Chowan River) are in Virginia and seven (Chowan River & Albemarle Sound) are in NC.

ix) There are no flow gauges in the Chowan River. There is a gauge in the Nottoway River (Virginia), the Blackwater River (Virginia) and Potecasi Creek (NC).

x) Increased concentrations of ammonia and phosphorous are being observed, however there is no clear indication of sources (see slides 17 & 18).

xi) Increases in TKN are also observed (see slides 19 & 20)
   (1) Astrid S.: How often was the sampling for this done?
   (2) Nora D.: About monthly over a twelve-month period.

xii) There are some data gaps. Working on getting data from the Virginia stations.

xiii) DWR modeling group is also working on developing ammonia and nitrate loading estimates.

xiv) See the remaining presentation slides for further observations. Some points of interest include:
   (1) Nottoway River (Virginia) showing steady phosphorous levels, nitrogen reduction and a decrease in flow.
   (2) Blackwater River (Virginia) shows decrease in nitrate, TKN, total N, and P.
   (3) Stations D0010000, D6250000, D8356200, D8950000, and D949000 show increasing N and decreasing to stable P. Data suggest that chlorophyll-a at these locations is increasing though this needs further evaluation. The downstream portion of the Albemarle Sound is showing the greatest increase in chlorophyll-a.
   (4) 303(d) Impairments in the Albemarle Sound include:
      (a) Assessment unit (AU) #30c2a (pH, copper)
      (b) AU #26 (dioxin)
      (c) AU #30b (copper)
      (d) AU #30c1 (copper; inconclusive for pH & chlorophyll-a)
      (e) AU #30c2b (copper)
   (5) Trends for individual sampling stations in the Albemarle Sound. In generally we see increasing pH moving from the Chowan River through the Albemarle Sound.
      (a) M390000C = increasing pH

(b) M610000N = increasing pH
(c) M610000C = increasing pH
(d) M610000S = increasing pH
(e) D999500N = increasing pH (slight)

e) Comments/questions:
   i) Hans P.: Important to know if the phytoplankton species are changing, particularly those species that are nitrogen fixing as these could be a source of N.
   ii) Elizabeth F.: Problem is that the only regular data we have for phytoplankton composition is from an area that is strongly flushed. It is not representative of the system.
   iii) Hans P.: It would be good to get data on this. This system has shown a consistent trend towards eutrophication.
   iv) Nathan H.: I have looked at the cyanobacterial fraction of nitrogen fixing species and there is an increase. Looked at the mouth of the Chowan River and in the central part of the Albemarle Sound. The potential for nitrogen fixation is there but we don't know if it is occurring. Haven't seen high rates of this so far.
   v) Brian W.: DWR has some phytoplankton data that may help with this.
   vi) Leigh S.: I have a slide of how much data is available (back to 1991). Not sure of the quality of some of that data, though.
   vii) Hans P.: There is probably older data from WRRI that can be used. Upstream shows increasing TKN. This suggests that the source of nitrogen is external to the system. TKN could also be due to an increase in biomass.

8) **Cyanobacteria HABs in the Chowan River and Albemarle Sound** (Leigh Stevenson)
   a) Overview
      i) Blooms have been reported annually (mostly in the Chowan) since 2015. In 2019 blooms occurred in all rivers and creeks and widespread impacts were observed (pets/humans, aquatic life, recreation, local economy). Often to get to bloom sites to sample in time. There is an increase is visual documentation and of blooms occurring in canals.
   b) Characteristics
      i) Blooms are occurring along the shoreline and in canals. They are dynamic (mobile) and hard to track. Microcystin being detected more frequently and at levels above the EPA recreational guidelines. *Aphanizomenon*, *Microcystis* and *Dolichospermum* are the predominant species.
      ii) Reports of blooms are occurring earlier in the season and the season is lasting longer (through October).
   c) Episodic data
      i) 2018, mid-June → high chlorophyll-a, no microcystin.
      ii) 2018, August → first microcystin hit. Concentration was higher than the WHO recreation guideline of 10 ug/L.
      iii) 2019 → high cyanobacteria densities, high microcystin concentrations (some in canals, some in mainstem). Highest concentration measured was 620 ug/L.
   d) Routine sampling

i) Routine sampling done from 1993 through the present. These are composite samples taken at 2x the photic zone. Algal community and density evaluated. Mid-channel stations probably don't capture bloom events since they seem to occur mostly near shore and in canals.

e) Near-shore sampling
   i) Recently added a near-shore ambient monitoring station at an area where blooms have been occurring. Goals are to capture routine data for a "bloom prone" area and to compare sampling methodologies (composite vs. surface grab). No significant bloom events captured by routine monitoring so far. Hope to gather a full year of data.

f) Remote sensing
   i) Satellite imagery available weekly (Cyanobacteria Assessment Network (CYAN)). Data is available from 2012 to present. Using this data as a screening tool right now. Pixel values can be converted to cyanotoxin cell density (cells/mL) and chlorophyll-a concentration (ug/L).
   ii) Inherent limits include interference near shoreline, resolution limit of about 300 x 300 m, and lack of tidal specific algorithms (developed for freshwater).

g) Comments/questions:
   i) Judd K.: referring to satellite image of bloom in the Currituck Sound, is that data representative of what has been going on in the Currituck Sound?
   ii) Leigh S.: The signal is typical but we do not have any sampling data or bloom reports from that area.
   iii) Elizabeth F.: One samples was received, but it didn't appear to be a problem bloom.
   iv) Nathan H.: Harold Marshal published a paper showing what Elizabeth mentioned. There was no scum and the species found were thin and sparse. *Cylindrospermopsin* and *Psuedoanabaena* are typical of this.
   v) Elizabeth F.: In the Albemarle we saw microcystins earlier this year than we did last year.
   vi) Han P.: Should consider long-term changes in temperature as opposed to just season changes. Wind data would also be useful here. In China we have seen increases in wind speed over time.
   vii) Mike O.: Is anyone using drones for observation of blooms?
   viii) Hans P.: Some difficulty with that. FAA requires line-of-sight operation. We're talking with some private companies now.

9) **Cyanotoxins in water fish and clams** (Astrid Schnetzer)
   a) Astrid provides an update on her projects
   b) Study began in the Chowan River in 2016 and went through 2018. The objective was to identify what toxins are present and where they were occurring. Monthly testing was done at seven locations using SPATTS (dissolved toxin), grabs and photic zone sampling. Obtained grants from WRRI and working with DWR and citizens.
   c) Found that four to five toxins were present at low levels year-round. We may be missing peak blooms. Consistent low-level exposure to multiple toxins may impact aquatic life.

d) Food web study initiated. Sein, gill net and clam bed sampling conducted between May and October and a weekly to monthly frequency. Clams showed low levels of toxins and fish had low level positives in stomach and muscle tissue.
e) Comments/questions:
    i) Mike O.: Does resuspension occur following storms.
    ii) Astrid S.: Yes it may occur.
    iii) Hans P.: It would be useful to keep doing measurement into the winter especially in the tributaries.
    iv) Astrid S.: Have been trying to do this in the lab. Costly to continue sampling.
    v) Hans P.: Are you also doing storage experiments?
    vi) Astrid S.: Yes.
    vii) Hans P.: In China we found higher concentrations in the winter long after the blooms were over.
    viii) Astrid S.: Have been seeing this in the lab work we are doing. Suspect that toxins leak out of cells as they deteriorate.

10) Closing

a) Brian W.: Meeting materials have been posted on the NCDP SAC webpage. Next SAC meeting will be on December 11 at the NC State CMAST facility in Morehead City.