Maintain Healthy Watersheds GIT Meeting
June 13, 2022
11am-1pm
Meeting Materials

Announcements and Updates R*enee Thompson, USGS*

The Diversity Workgroup is hosting CsTREAM Intern Bianca Martinez Penn. She has taken on a project that will create resource materials to provide background and guidance that guide Chesapeake Bay Program Goal Implementation Teams and Workgroups in taking steps to increase diversity, equity, inclusion, and justice through work in different sectors of Bay restoration and conservation. She will be working with our GIT to help build our DEIJ materials. If you have any articles, research papers, or useful materials that relate DEIJ needs to healthy waters and watersheds please send them to Bianca (bbbianca33@gmail.com).

We are pleased to announce the latest data release from the CBP Land Use/Land Cover Data Project. This release builds upon the first high-resolution LULC data from 2013/14, published in 2016. The new products from this release include:

- New land use/land cover data representing the 2017/18 timeframe
- Updates to the original 2013/14 data that was released in 2017
- The first-ever Chesapeake Bay LULC Change data, showing how the landscape has transformed between 2013/14 and 2017/18.

More information:

- The data and documentation for this project can be found here.
- Our press release announcing this milestone can be found here.

We have a new director at the Bay Program! Dr. Kandis Boyd has been named as the new Director of EPA's Chesapeake Bay Program. Dr. Boyd has nearly 30 years of experience leading, teaching, advising and mentoring students and early career enthusiasts in environmental and atmospheric science. Her skillset as a strategic thinker, change agent, and leader includes designing, developing, and managing cutting edge initiatives to advance STEAM - science, technology, engineering, arts, and math. The press release can be found here.

Monitoring Very-High Resolution Land Use/Land Cover Change, Sarah McDonald, USGS

Sarah gave a presentation on the updated 2013-14 High-Resolution Land Cover and Land Use Data Project, which provides new land use and land cover data captured in 2017-18 and include a new data product that describes the changes in land use and land cover throughout the Chesapeake Bay watershed from 2013-14 to 2017-18. The new 2017-18 dataset includes a more detailed land use/land cover classification with enhanced technical and scientific information that was not previously available for the 2013-14 data products. To complement these updated and new datasets, change data is being offered for the very first time. (Supports Actions 1.2, 1.4 and 5.1).

Sarah gave some background on what is land use, land cover, and land use/land cover.

- Land Use: describes how people use and manage the land (agriculture, timber harvest, etc.)
- Land Cover: describes the physical features of the ground (low vegetation, water, etc.).
- Land use/Land Cover: Land Use with Land Cover classes preserved
    - Land cover (LC)- Herbaceous
    - Land use (LU)- Cropland
    - Land use/land cover (LU/LC)- Cropland Herbaceous

University of Vermont's Spatial Analysis Lab and Chesapeake Conservancy Conservation Innovation Center (CIC) were partners in developing this data. University of Vermont mapped 12 Land Cover (LC) classes, and CIC mapped 54 LULC classes.

54 classes are a lot to look at on a map. To make it easier to visualize there is an 18 generalized classification.

Sarah showed how the data look in example of Garrett County, MD. She noted that because the data is mapped at such a fine scale you can get a really good idea on what is happening on the landscape.

The change part of the project was then talked about. Land Cover Change represents transitions between the 12 mapped Land Cover classes (Tree Canopy to Low Vegetation, Low Vegetation to Structures, etc.)

Land watershed Use/Land Cover (LULC) Change represents transitions between the 54 mapped LULC classes (Forest to Harvested Forest, Cropland to Structures, etc.)

Sarah showed an example of LU/LC change in Buckingham, Virginia. In just the land cover change data it shows tree canopy to barren and low vegetation, while in the land use change data it gives more context, and it shows forest to harvested forest. The key driver to LULC Change is Land Cover Change. All mapped Land Cover Transitions are converted to LU/LC Transitions. This gives the most complete story. A land use might change, but the cover did not. In these cases, tax parcels and Land Cover Change are used to signal areas of Land Use change that did not have a change in land cover.

There are some cases in which the land cover stays the same, but the land uses differ. Sarah showed an example from Fredrick, MD where new homes were built on previous cropland. The grass around the homes stayed classified as low vegetation, but the use changed as it went from cropland to turf grass, giving a more complete story to the news homes and what is happening to the land.

Sarah talked about major changes in LU/LC transitions throughout the watershed during the 2013/14 – 2017/18 window. The categories of the most changes were timber harvesting, development, agriculture, and forest. The main take away was that development area has expanded, while agriculture and forest area has been reduced. She gave some of nuances to this data and noted that mapping some land use/land cover can be difficult as we may not know the "end state" of that land.

Sarah moved on to explain the 18-Class Change Matrix for the CBW, which gives all the nuances that are being mapped in the raster data so even if you are not maybe a geospatial expert, you can still get this tabular data and really understand the trends of what is going on at the watershed scale, state scale, or county level scale. The matrix breaks down the 18 General Classification and shows what the land use was in 2013/14 and what it changed to in 2017/18. Sarah then broke down some of nuances of the matrix. For example, a change in forest to tree canopy over turf grass does not contribute to loss of tree canopy, but rather implies development in forested areas as well as new trees in developed areas. This is a forest heavy data set; wetlands were mapped but the roll up us not focused on them.

The 2021/22 LU/LC data will hopefully be coming in 2024. The 2013/14 and 2017/18 data will be remapped using the new rules and classifications. The 2021/22 will help provide some of that "end state" data.

Discussion on the LU/LC data

Renee Thompson asked about how can we improve the communication and visualization of the matrix. It is easy to understand when someone walks you through it, but a challenge when you do it on your own.

Sarah offered to look at any feedback to make the matrix better. She gave here email (smcdonald@chesapeakebay.net). She noted that there is a write up on all the definitions on the conservancy website to help give more context. The matrix itself is also somewhat guided by the colors for each general land use/land cover: light yellow is developed classes, green is natural classes, gold is agricultural classes, light blue is wetland classes, and dark blue is water.

Kristen Saunders then asked about the plans for this data. Is it just being put out into the world for people to figure out or are there any plans to do analysis on the data (especially in those geographic areas where we are seeing major change happening)?

There are a couple examples of analysis projects that are in the works. County level tree canopy fact sheets are being created with this data which hints at the trends of tree canopy in a specific county. Peter Claggett and Sarah are turning in interpretive papers on this data for the watershed. The Maryland Forest Technical study is also using this data.

Any county in the watershed can download a matrix and understand what is happening in their county. The map viewer housed on the Chesapeake Conservancy website for those who just want to poke around the data.

Iris Allen brough up that The State of the Forest 2.0 project is taking off, and it will be using this data and telling the story of the forests in the watershed.

In the chat Jeff Learner asked: are we summarizing rolled up losses in natural habitat (i.e. forests and wetlands) vs. gains in impervious cover (development, etc.)?

Renee noted that Jeff's question would be a good place to move forward as it will be answered in the next part of the conversation.

Sarah went on to talk about Land Use Methods and Metrics (LUMM) Outcome, which falls under the HWGIT. Through the Chesapeake Bay Watershed Agreement, the Chesapeake Bay Program has committed to:

1. Measure rate of farmland, forest and wetland conversion, and the extent and rate of change in impervious surface coverage.
2. Quantify the potential impacts of land conversion to water quality, healthy watersheds and communities.
3. Launch a public awareness campaign to share this information with citizens, local governments, elected officials and stakeholders.

The GIS team will be using the 1-Meter LU/LC and Change data to meet the LUMM Outcome. The 1-meter resolution LU/LC and LU/LC change data can be summarized by different geographies to meet the LUMM Outcome:

- Impervious Cover (all impervious surfaces)
- Tree Cover (the canopy area for all standing trees)
- Forest Cover (our definition of "forests" as a subset of all tree cover)
- Natural Cover (tree cover, young/early-stage forests, and wetlands)
- Developed Tree Canopy (tree canopy over turf grass or impervious surfaces

The above data will be summarized at the county, NHDv2 Catchment, and Watershed scales. Sarah noted that they are open to comments on whether some metrics should be visualized as acres of change as opposed to percentage change.

Sarah then ran through maps with the above data summarized at the county scale to give members an idea on where the data stands and what changes have happened of the 2013/14 to 2017/18 period. Sarah noted that MD and DE measure change in five-year time periods while all other states measure in four years. To make sure that the data is uniform on the maps Sarah took the total acres of change for each state and converted it to an annual rate of change in acres per year and then finally converted to a percentage. Sarah pointed out some trends on the maps and gave some context.

LUMM Discussion

Renee noted that the maps are great in terms of satisfying our requirements with the status and trends workgroup as they satisfy the LUMM outcome language. She could see the HWGIT putting together a white paper where each of the maps that represent a specific indicator are described, and a summarization of the various scales. The white paper could be sent out with the documentation to our members in advance of them approving anything. We could also put together a simple viewer for folks to interact with the data and allow them to get familiar with the metrics.

Scott Phillip asked how did the GIS team produce the numerical breaks for the categories of change? When looking at the percent of annual rate of forest change by county map most of the counties have no change. Scott noted that there should be three categories with some sort of coding that indicates

what changed, coding indicating what is static, and then some sort of coding of showing increase. Making the maps pop could help tell the story.

ACTION: There will be more conversation on these indicators. Please engage with any content with regards to the updates LUMM.

MD Healthy Watershed Assessment, *Nancy Roth Tetra Tech*

The Chesapeake Healthy Watersheds Assessment provided a set of metrics characterizing multiple aspects of watershed health, in broad categories of landscape condition, hydrology, geomorphology, habitat, biological condition, and water quality. Geospatial analyses leverage data from Chesapeake Bay high-resolution land use / land cover and other regional data sources. Recent updates for a Maryland Healthy Watersheds Assessment pilot include integration of new data for land use / land cover, flow alteration, and streambank sediment, along with several state-specific metrics and a refined definition of riparian areas. Predictive power of candidate metrics is being tested using Maryland Biological Stream Survey bioassessment data as response variables. The assessment framework, metrics, and geodatabase created in this state-specific refinement are intended to be useful for a variety of management applications, primarily to support strategies to protect and maintain the health of Maryland's Tier II waters. (Supports Actions 1.2, 1.4 and 5.1)

Nany opened her presentation with reminding folks about the HWGIT goal and outcome.

- Goal: Sustain state identified healthy waters and watersheds recognized for their high quality and/or high ecological value
- Outcome: 100 percent of state-identified healthy waters and watersheds remain healthy.

Nancy moved on to talk about how the EPA defines a healthy watershed. It is one in which natural land cover supports: Dynamic hydrologic and geomorphic processes within their natural range of variation, habitat of sufficient size and connectivity to support native aquatic and riparian species, and physical and chemical water quality conditions able to support healthy biological communities. The idea behind this definition is that there is a lot of money to fix degrading places, but there also need to be a focus on ensuring healthy watersheds stay intact.

Through GIT funding the MDHWA was created. It is based off the Chesapeake Healthy Watershed Assessment and will be used to support the protection of Tier II high quality waters ins MD. Each state identifies their own healthy watersheds. In Maryland they define their healthy watersheds as "streams and their catchments are designated Tier II when their biological characteristics are significantly better than minimum water quality standards".

Nancy went on to talk about the condition metrics for that are in the CHWA:

- Landscape Conditions
- Hydrology
- Geomorphology
- Water quality
- Habitat
- Biological Conditions

Each condition metric has sub-indices that help define the metric.

Vulnerability metrics are also in the CHWA:

- Land use change
- Wildfire
- Water use
- Climate change

These metrics help signal change, if one starts to show signs of change it can signal to mangers that an area needs attention.

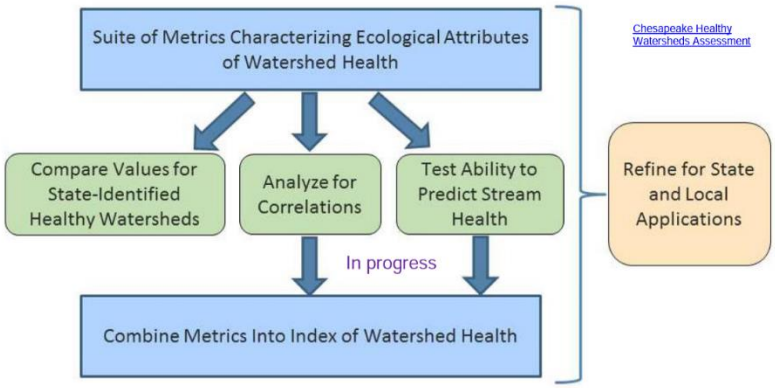
The MDHWA will refine and customize the CHWA for application to Maryland. The MD assessment will evaluate statistical relationships between landscape indicators and on-the-ground diagnostic measures of stream conditions. The MDHWA will provide new tool to support management of healthy watersheds (Tier II waters) The MDHWA focuses on only on MD, but the develop approach can be replicated in other jurisdictions using state, local, or regional data.

The MDHWA is at the scale of NHDPlus version 2 catchments. There are about 83,000 catchments in the watershed, and about 14,000 catchments in the state of MD. Nancy then showed a schematic of how Tetra Tech proceeded with the creation of the MDHWA.

Next some examples of the data that are used in the MDHWA were presented. Some of the data includes:

- Chesapeake Bay Program 2017-2018 1-m resolution land use
- USGS Floodplain and Channel Evaluation Tool (FACET)
- USGS stream temperature and brook trout occupancy

Metric selection for the MDHWA were decided by partners and project advisory team. Candidate watershed health metrics were put into five categories, biology was kept out of the categories as it will be used as the response variable. Selection of state and regional data is important to make the assessment the most useful to MD. The criteria for selecting candidate metrics include:



- consistency with other Bay Program efforts
- appropriate spatial scale and resolution to support developing catchment-scale metrics
- relevance to characterizing watershed health and vulnerability
- availability of data
- spatial coverage
- appropriate temporal period

Some data was suggested to be used as metrics, but it was not available at the catchment scale. This data will be included as an overlay to give more context. Some examples of that overlay data will include:

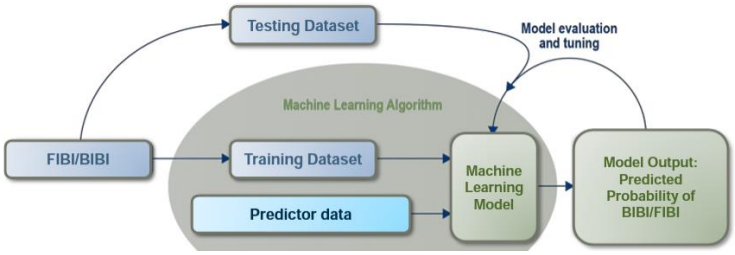
- Source water protection areas
- Coldwater protection areas
- Environmental justice indicators
- Specific locations of protected lands

The selected metrics are very wide in range to tell the best story:

- Active and Abandoned Mines
- Streambank Erosion, Streambank Change, and Sediment Flux
- Forest Habitat
- MBSS Stronghold Watersheds
- Maryland Biodiversity Conservation Network (BioNet)
- Recent and Projected Future Land Change
- Flow Alteration
- Conductivity
- Stream Impairments
- USGS SPARROW
- Maryland Fire Priority Areas

Nancy then ran through some example health metric maps and vulnerability maps to show how the metrics play out in the state.

Another part of this project is testing predictive power of the metrics. The Tetra Tech team built a random forest model to assess which watershed condition metrics were the best predictor of stream conditions. The response variable was collected from the MD Biological Stream survey which monitors non-tidal stream communities –both benthic macroinvertebrate and fish Indices of Biotic Integrity (IBI). Nancy showed a schematic of how the data is used to generate a random forest:



The data gets run through the machine learning model which runs through many iterations (the random forest) looking at how the predictor data can classify sites. It then produces an output of predicted probability of good BIBI of FIBI. Once the model goes through the training data and predictor data it can run the testing datasets to see what they predict. After the random forest is run precision is then looked at to see how well the model is doing.

Tetra Tech is now at the point where they are getting the last of the metrics tuned up and into the model. Nancy went over what they have at this time. The overall accuracy of the Fish Indices of Biotic Integrity model (FIBI) at this point is around 66% which may change as more data is added. The model does a good job of predicating where the “good” sites are located. The model does a decent job of predicting “poor” sites. Where things start to get tricky is predicting the “fair” sites, it is harder to pin down sites in the middle. This is consistent with other predictive models.

The overall accuracy for the benthic macroinvertebrate Indices of Biotic Integrity (BIBI) at this point is around 62% which may change as more data is added. The BIBI model better predicts where the “poor” sites better than the “good” sites, however the good sites are still predicated relatively well. The BIBI model runs into the same issue with the “fair” sites as the FIBI.

Nancy then went on to talk about applying the Healthy Watershed Assessments for MD and beyond. The HWA can be used to support management decision making, particularly for maintaining the health of

watersheds. It can help assess current conditions, track conditions overtime, provide early warning signals, and identify residency.

Discussion on the MDHWA

Renee took a moment to remind folks that this was a GIT funding project. MD came to the goal team a couple years ago to see if there was a way to develop a healthy watershed assessment with Maryland specific data. This project was a pilot to see how we might be able to customize assessments. With the conclusion of this project the code will be available for other jurisdictions to plug in their own data and run the models again. We are working on the best next steps on how to go about how to the back end information out.

Steve Epting asked about filtering the MBSS data used for the response variable. e.g., using only recently collected data that represent bio conditions 'today'

Nancy responded by explaining that she was not 100% sure on the exact years they were using but that they matched the MBSS data to the land cover data to look at the conditions contemporaneously.

Protected Lands Indicator Update - Jake Leizear, Chesapeake Conservancy

An accurate Chesapeake Bay watershed protected lands geospatial dataset is essential for tracking progress toward multiple Chesapeake Bay Watershed Agreement goals, including the land protection goal itself. It is also crucial for ensuring state and local governments and non-governmental organizations have accurate annual land protection data on which to base projections included in Bay TMDL Watershed Implementation Plans. The Protected Lands Indicator is in the process of being updated and revamped to be on an automation cycle that allows for up to date land conservation indicator progress and mapping and visualization when new datasets are released. (Supports Actions 1.3, 2.2 and 5.1)

Jake opened with the previous way the update was done. The indicator was previously only updated biannually, where multiple sources of data on protected lands from states in the watershed, NGOs, federal sources, individual sources, etc. were gathered. That data was then integrated into one final dataset Integrate into one finalized dataset, based on a schema decided by the Protected Areas Database of the United States. This way took a lot of manual work and time as someone would have to collect, process, and quality control all the data.

A pilot project was needed to better understand how to automate the process of assimilation (getting the state data in the right format) and calculating acres of land. Through the Chesapeake Bay Trust the pilot was funded. Maryland was used for the pilot project as it has the most variety and depth of data sets. With help of USGS and NPS funds the project was then expanded to the whole watershed. The project is expected to wrap up at the end of June.

Each state has their own protected lands data sets. Each dataset is different, and states have different dataset formats. All the data has to be collected, put into the PADUS schema, given back to PADUS, and then that PADUS data can be used to update the protected lands indicator.

The Chesapeake Protected Indicator team has work with over 50 partners across the bay jurisdictions to present the project, compile data, identify missing data, and get input on interim product. All 7 jurisdictions have been involved in this project. The CBP, CCP, and USGS are all working together to roll out the dataset.
The team is currently in the review stage. They are reviewing state polygons as compiled and transformed. Next step is to reach out to partners for data confirmation. Then finally the team will update indicator documentation and websites on Chesapeake Progress Communication and roll out.
Some preliminary review of the data has found some gaps. These gaps are not indicative of protected lands loss, but rather datasets changing or not being represented.
With an automated process, the review and analysis can happen much faster. Running the data through python code allows for updates to happen when new data is submitted, rather than biannually.

Protected Lands Indicator Update Discussion
In the chat Jeff wrote: Is the National Conservation Easement Database connected here? I can't recall how its connected to PADUS. How about NRCS data on easements?

Renee answered his question and said that as of 2018 they are all in one. The way PADUS data is organized and structured it has fee and easement designations separated within it.

Renee noted that we collect the data straight from the source and don't just use what is available through PADUS, that way it is the most up to date and we are including all the protected land. PADUS is supposed to be updated every 2 years. With this new automated system, we are able to be more responsive to new data.

Pennsylvania Unassessed Waters Initiative - Jennifer Orr-Greene, Eastern Policy Director, Trout Unlimited.
Ms. Orr-Greene shared experiences working with the Pennsylvania Fish and Boat Commission, and Department of Environmental Protection, to upgrade waterways to High Quality and Exceptional Value status. (Supports Actions 1.1, 1.4 and 4.1)

Jennifer opened with the fact that using Trout populations are one method to achieve higher stream protections and antidegradation standards under the Clean Water Act. This presentation is focused on PA, but Trout Unlimited has been doing this work in other states.

Jennifer then moved on to talk about the PA Wild Trout Stream Designations, which are Clean Water Act classifications that are in PA code:

- Wild Trout = Cold Water Fishes (CWF); evidence of natural reproduction (young fish)
- Class A= High Quality – Cold Water Fishes (HQ-CWF); species and biomass
- Wilderness Trout Streams = Exceptional Value (EV); species and landscape factors
- Wetlands contiguous to all wild trout waters = EV

She also noted that NY, MD, WV, VA have similar links to Clean Water Act protections using fisheries communities.

The designations are important as they can equal more stringent discharge limits, give stream banks riparian buffer requirements (150 feet each side of stream), and enhanced BMPs. High quality and exceptional value also give priority in restoration/protection and funding opportunities.
Trout are canaries in the coal mine of streams, they alert managers of changes happening. For example, if impervious area gets beyond 5% in a watershed a decline of the native brook trout can be seen.

Trout Unlimited has a tool called the Eastern Brook Trout Portfolio that can help identify strategic conservation opportunities and evaluate potential projects within the range of Eastern brook trout. It is a landscape tool that integrates spatial data to evaluate population metrics, temperature, habitat connectivity, and fisheries communities. The tool also allows for risk-based decision making, including decisions around climate change.

Some of the ways Trout Unlimited collects data is through stream surveys via electro fishing. Trout Unlimited has surveyed over 1500 streams since 2011, they have found wild trout populations average of 40% of the time, and Class A 3-5% of the time.

Jenifer went on to talk about getting streams a higher designation also known as the Use Designation Upgrade process. For PA it looks like:
Trout Unlimited is doing an assessment and stream survey to determine what streams should have higher designation (HQ/EV). They send those streams to the Pa. Fish and Boat Commission (PFBC) where they do their review and if they accept the streams as HQ/EV the PFBC brings that information to the Pa. Department of Environmental Protection (PADEP). PA DEP does a review and decides if the streams the PFBC have accepted as HW/EV get at higher Clean Water Act designation.

How it should work after Class A listing by PFBC: PADEP will list streams as HQ on its Existing Use list; this ensures immediate protection until formal rulemaking. Formal rulemaking will upgrade the stream to Designated Use.

An "existing use" is defined in 25 Pa. Code 93.1 as "Those uses actually attained in the water body on or after Nov. 28, 1975, whether or not they are included in the water quality standards." The same definition appears in the federal regulations at 40 CFR 131.3(e). An "existing use" is different than a "designated use." A "designated use" is defined in 93.1 as those uses specified in 93.9a-93.9z for each waterbody or segment whether or not the use is being attained. Designated uses are regulations promulgated by the Environmental Quality Board (EQB) through the rulemaking process.

Trout Unlimited has to be very vigilant with this process as the existing use category is fuzzy even for regulatory agencies. You must keep on top of it to make sure that things are implemented correctly. Some of the ways to do that is through visualization of the streams via maps. Showing regulatory agencies and policy makers what streams have trout that are protected and streams that have trout and are not protected can be helpful as the provide more context.

Trout unlimited also does public education and engagement, which gets more people to care about this issue and advocate for trout.

Jennifer concluded with pros and cons of doing this work to get streams higher designations:
Pros:

- Surveys are quick (1.5 hours/site)
- Assessment costs much less than restoration costs per mile ($156.25)
- Enhanced protections also include riparian areas and wetlands (in Pa.) 341 stream miles = 12,400 acres buffers, 19,102 acres wetlands
- Approach can be used in most Bay watershed jurisdictions

(These numbers are based off a single project but give you an idea of the pros)
Cons

- Regulatory process of changing uses is slow (assessment to CWA designation in PA is about 5-8 years)
- How do we protect existing uses between Pa. Fish and Boat Commission listing and Pa. DEP CWA use change?
- Recreational stakeholders do not always appreciate the importance of initial designation by Pa. Fish and Boat Commission in CWA protections

Pennsylvania Unassessed Waters Initiative Discussion
Kristen noted that this information is a terrific way to connect with the Fisheriess GIT.
Jeff noted that the key point is that this is another tool in the toolbox to protect healthy waters. Using stream designation as a tool is something that could be used across the watershed.
Jen responded to those comments that she is willing to help continue this conversation and work with others to share this work.
The STAC Rising Temps Workshop really fits into this work and is something that the Bay Program has started to take on.