Agricultural Modeling Team (AMT)
Meeting Minutes

February 10th, 2023
09:00 AM – 10:15 AM
Meeting Materials

Summary of Actions and Decisions

Decision: The AMT approved the January meeting minutes.

Action: VOTING MEMBERS - please fill out this survey to prioritize discussion topics and decisional items that the Ag Modeling Team will address. The AMT leadership will compile the results of this survey to develop a workplan for the group. (Note: this workplan will be a living document and is subject to change as the group progresses).

Meeting Minutes

Statement of purpose: *The purpose of this meeting is to improve the understanding of the AMT on CAST inputs and loads. After this final dedicated learning session, the group will shift towards decision making for the Phase 7 model.*

Announcements:

- At the direction of the MB a Fertilizer Expert Group has been formally created. They will be meeting March 6th 01:00-03:00. We encourage participation from AMT Members.
- **Decision:** The AMT approved the January meeting minutes.

Introduction – 09:00-09:10 [10 min (Tom Butler, EPA)]

Tom provided a recap of our discussions on nutrient application in CAST.

Nutrient applications: Animal Populations – 09:10-10:10 [60 min (30 min presentation 30 min discussion) (Tom Butler, EPA)]

CAST utilizes manure nutrients from multiple types of livestock. The group examined the effects of increasing the number of Animal Units from different livestock groups to CAST and the algorithm that CAST uses to process manure nutrients.

Discussion
Alisha Mulkey: What do you mean by stored nitrogen? Can you elaborate on that?
Tom Butler: Manure that is collected and stored in barnyards to eventually be applied.
Chris Brosch (in chat): So dry manure is as excreted?
Tom Butler: Manure is excreted with moisture. Dry manure is removing the moisture content after excretion.

Chris Brosch (in chat): It looks like 3.4%N at 0% moisture (mostly dairy there).
Tim Larson (in chat): Virginia has a poultry litter transit program that moves a lot of manure across county lines.
Eric Rosenbaum (in chat): For the beef & dairy options -- does this assume pasture acres will remain the same or does it factor land use changes for this increase?
Jess Rigelman: The number of animals does not directly affect the amount of pasture land. The pasture and hay land is determined by crops (crops/hay/pasture/etc.) in the ag census, not animal counts.
Robert Shoemaker (in chat): On crops, why isn't fertilizer load dropping when manure increases?
Tom Butler: If you increase the animal units, you have to apply the manure somewhere, whether it be pasture, hay or crop based on the crop need. Not necessarily using total sales of fertilizer in 2025, we don't have that information. We apply fertilizer to meet the same proportion that was applied in 2016.
Robert Shoemaker: In reality, if we're using more manure than we're using less fertilizer on a farm by farm basis.
Tom Butler: Right, there's a conflict between what we can do with the data on the scale we have it versus what is actually happening on a farm by farm basis.
Eric Rosenbaum (in chat): If most producers have a nutrient management plan the reduction of fertilizer would happen through the planning process
Chris Brosch (in chat): Have you tested a year that does not require projecting fertilizer from a measured year? Holding that ratio is going to make it hard to judge the mechanics as designed.
Tom Butler: We didn't do this analysis for 2016, but we can do that and see what it would look like.
Chris Brosch: To Robert's point, in the NM world, we expect the fertilizer to come down so working in these parameters, it would not behave the way we designed it to behave. The years we run this model without real fertilizer data, we don't have a better estimate of what the data should be. So we can't judge how much is going to get sold and therefore how much the model will try to apply. Will skew the results into territory that is unrealistic.
Gary Shenk: If we used 2016 to run this scenario, where there was a fertilizer bucket, and added a bunch of animals, then that's not a realistic scenario because the amount of fertilizer sold in 2016 was reacting to the actual amount of animals on the ground. So we ran future scenarios instead, 2025 no action, specifically because it allows the fertilizer to adjust. The rule is that the total application target would remain the same in the future, the fertilizer should be adjusting at this point because there is not a bucket. What we've found is because of these fertilizer only applications, fertilizer is not allowed to reduce as much as you would think, to Robert's point. Both county and farm scale, we think fertilizer would reduce because of more manure being available, but the model is not allowing that to happen because of these fertilizer only application rules.
Chris Brosch: I don't think we should show it this way.
Gary Shenk: Let's talk about different ways to do this offline. Just trying to show sensitivity scenarios.
Ruth Cassilly: So you're saying that in the real world if a farmer has more manure, there are no non-manure eligible crops, they are going to put manure on a crop that is designated to only receive fertilizer?
Chris Brosch: The premise is ridiculous. We're simulating at a county level, not a farm level. Farmers are not going to buy a bunch of animals and collect their manure the same year they purchased fertilizer. It will stay in the bag until they need it. Doesn't feel realistic.

Dave Montali: For these counties, is the constraint lands that can't receive manure? like grain without manure?
Tom Butler: This is a combination of those things. Elements of crop types themselves, land uses, and fertilizer. We can examine each of the crop types offline if needed.
Olivia Devereux: It is done by each individual crop hay or pasture type - multiple applications depending on the crop. States were thinking about which type of nutrient would be applied during which application and since there are multiple applications for crops they are specified with different nutrient types and it makes it far more complex and difficult to predict the loads. It varies by county.
Eric Rosenbaum (in chat): Also thinking about the influence of planning - would phosphorus indexing allow the manure allocations as modeled?
Tom Butler: This is all N shown here, but P acts similarly. If you're using manure at one point and then inorganic fertilizer at another point, there is the potential for overlap where you're inadvertently applying P based on the timing. That's something more state specific.
Eric Rosenbaum: In PA, most pastures are in proximity to surface water. Before we'd be able to increase our grazing deposition of manure our P index would limit our animal densities on pasture. We wouldn't be able to apply or have that many more animals on pasture to equal some of the deposition loads you're showing here in this scenario. Under our current framework for regulation, we couldn't get to what the model is predicting.
Chris Brosch (in chat): @eric, those mechanics are not modeled. We guesstimated that role of inorganic fertilizer with this % that is guaranteed to not be manure. Animal density in PA NM is not easy to match this modeling.
Tom Butler: Okay we can find a better way to investigate this offline.
Chris Brosch (in chat): Row Crop land use is represented here? As opposed to Pasture or Hay?
Tom Butler: Yes, this is just row crop.
Dave Montali: Is the strong influence of layers related to the nitrogen content of layer manure?
Tom Butler: This is showing animal units. Layers have a much larger impact on the potential for applying nitrogen, though there is variation in all of them.
Dave Montali: Per animal unit, the ratio of N to dry manure is higher for poultry and that's one reason why you get more N when you add more N units? Correct?
Tom Butler: Yes, in this case layers seem to have a much higher impact. The Poultry litter subcommittee came up with these rates.
Dave Montali: There are increase on crop in some places. In those places, if you showed the pasture and hay for places that don't have as much influence on crop, those values will be much higher. This is because of the complicated way we apply this stuff and the land uses available in those counties.
Tom Butler: You're probably hinting at application curves. I'd agree that those would impact this and would see differences based on the current land uses you have when you're adding in animal units.
Dave Montali: If you had 100,000 animal units in two counties and crop went up a little bit in one and much more in the other, I think if you looked at other ag land uses in those counties, you would see the difference. It would have a bigger influence on hay or pasture because you have to put the manure down somewhere.
Alisha Mulkey (in chat): Dave, there are significantly more pasture acres in Frederick, MD than Kent, MD.
Tom Butler: Right, that could be a way to break this down more.
Chris Brosch: This visualization (last slide) gives me anxiety because of what Dave and Alisha mentioned. Doesn't account for the fact that different animal types have different N contents.

When you dry these manures to 0%, it might not be clear here how that impacts the application rate. Also don't know why we're simulating turkeys when it's almost irrelevant in the model based on the number of lbs in the watershed - need to simulate broilers. Lastly, talking about the number of million of lbs N - need to account for lbs per acre were applied before the increase in animals. When you're talking about croplands separate from pasture and hay, each county has a different ratio of those land uses and the interconnectedness of pasture to animals directly deposit manure is not represented here. This slide does not illustrate anything other than the ratio of N in different animal types.
Robert Shoemaker (in chat): Perhaps graph is misleading but majority of beef manure is deposited on pasture not crops.
Tom Butler: I'll reach out to look at different ways to show this. Moving forward I'd like to get some input from some folks about how best to show the impact of this in an easy to understand way.
Chris Brosch (in chat): @ Robert, that's another reason dark blue falls below the other animal types on a chart like this. In addition to the %N/Ton.
Cassie Davis: Can you incorporate a reference to what section of the model documentation you are referring to in your presentations?
Tom Butler: Sure.
Chris Brosch: Can you please clarify the second statement on your last slide?
Tom Butler: Just a generalization trying to note that it's a complex issue and there aren't single effects to adding animal units in the model. There are multiple factors and effects from doing so.
Lisa Duriancik (in chat): It definitely should be revisited with the group. Thanks. And thank you to those who raised great questions today.
Tim Larson: Are you modeling other manure sinks such as lagoons, on-site storage, methane plants? Not all of it ends up on fields.
Tom Butler: That is part of our no action. There are manure treatment technologies in the model in general but we excluded them in this scenario to try and highlight the baseline.
Gary Shenk: When we first ran these scenarios we looked at total increase in application and the scenarios were unstable. There is much more stable application if we look at hay pasture and crop. There is still a lot of variability over different counties when adding the same amount of animal units but it's a lot less than the graphic showing only crop application. We still need to understand why we're seeing these differences.
Chris Brosch: Why do we see so much more data towards the left of the graph?
Gary Shenk: The one to the right are counties that have a lot of application, very ag intensive counties. There are just a lot more counties in the watershed that don't have as much agriculture.
Chris Brosch: Would it be fair to say counties that have lower density of animals compared to the amount of crops they're trying to grow would respond by accepting more manure application to the county and would show up towards the left of the graph?
Gary Shenk: Yes, correct. They all reduce inputs of fertilizer but they don't all reduce it by the same amount. This is a future scenario so we assume the total application goal for all sources remains the same. If we put more manure on, should be reducing that fertilizer 1:1 if we can.
Dave Montali: There is no difference in mineralization rate by location, right?
Jess Rigelman: No there is not.
Lisa Duriancik (in chat): Gary - so I understand, when you say "more applications" that is more based on your assumptions and rulesets and land use/crop? And based on N not P? not survey or manure management plan review? Thx!

Tom Butler: Applications are what we put down for N based on the rules, but we did not put in the BMPs. This is just Nitrogen. Applications of the placement on the crop.
Gary Shenk: Correct. Just to be clear, this is all sources (fertilizer, manure, biosolids, fixation, and, for pasture, direct deposit of manure).
Robert Shoemaker: Grain is produced and then exported outside the watershed which is an export of nutrients. Manure is nutrients recycled in the watershed. What is the significance of When it comes to recycled vs imported nutrients? Does the model work as a mass balance?
Tom Butler: When we're talking about the uptake and removal, we do account for crop uptake and those removal rates. We have the ability to update those if needed. We also have a manure transport BMP that reflects manure moving around the watershed and between counties.
Olivia Devereux (in chat): CAST is not intended to be a crop growth model. It is intended to be used to predict the effect of BMPs in an average hydrological year to inform large-scale planning.
Chris Brosch (in chat): My question is about P based plans. Have we ever modeled NM in a P based way?
Olivia Devereux: No we have not. Nutrient applications are on N based plans. But the NM expert panel separate N and P into two separate BMPs, so you could get credit for P core NM without having a N core NM.
Chris Brosch (in chat): Does uptake change through time or is it constant?
Jess Rigelman: It is constant. We model it by land use so change would be the change in crops.
Chris Brosch: Seems like an opportunity for this group to explore.
Gary Shenk: My understanding is that the uptake per yield unit doesn't change but that the yield units change with the ag census.
Jess Rigelman: That is true for 8 crops.
Tim Larson (in chat): So the effect of feed appears in the manure production numbers
Olivia Devereux (in chat): @Tim, yes, and in BMPs such as dairy precision feeding.
Tim Larson (in chat): Nice presentation Tom and team, thanks! There are good land use change models, some spatially explicit.

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Closing – 10:10-10:15 (5 minutes)

Adjourn – 10:15

Up Next: AMT Meeting on March 10th, 2023 from 09:00 - 11:00 AM: First topic of discussion for decision item (based on prioritization survey results).

Participants

Jackie Pickford, CRC/Staffer
Tom Butler, EPA/Coordinator
Zach Easton, VT/Chair
Tim Larson - VA DCR
Cassie Davis, NYS DEC
Olivia Devereux, Devereux Consulting
Alex Soroka, USGS
Kristen Bisom, WV Conservation Agency
Candiss Williams, NRCS
Scott Heidel, PA DEP

Alisha Mulkey, MDAg
Emily Dekar - Upper Susquehanna Coalition, NY
Karl Blankenship, Bay Journal
Jeff Sweeney, EPA
Dave Montali, Tetra Tech, WV
Curt Dell, USDA-ARS, University Park, PA
Ruth Cassilly, UMD CBPO
Elizabeth Hoffman, MDA
Suchith Ravi, UMCES/CBPO
Jessica Rigelman, J7
Patrick Thompson, EnergyWorks Group
Lisa Duriancik, NRCS
Gary Shenk USGS@CBPO
Robert Shoemaker, VA DCR
Eric Rosenbaum, Rosetree Consulting & PA4R
Nutrient Stewardship
Seth Mullins, VA DCR
Chris Brosch, DDA
Clare Gooch, DNREC
Tad Williams, VA DCR
Tamie Veith, USDA
15403912102
Clint Gill, DE
Thomas Dooney

**Common Acronyms
AgWG - Agriculture Workgroup
AMT - Agricultural Modeling Team (Phase 7)
BMP - Best Management Practice
CAST - Chesapeake Assessment Scenario Tool (user interface for the CBP Watershed Model)
CBP - Chesapeake Bay Program
CBPO - Chesapeake Bay Program Office (houses EPA, federal partners, and various contractors and grantees working towards CBP goals)
CBW - Chesapeake Bay Watershed
CRC- Chesapeake Research Consortium
EPA - [United States] Environmental Protection Agency
MB - Management Board
NM - Nutrient Management
N - Nitrogen
P - Phosphorus
PSC – Principals' Advisory Committee (CBP)
STAC - Scientific & Technical Advisory Committee
TMDL - Total Maximum Daily Load
WQGIT - Water Quality Goal Implementation Team