Modeler’s Meeting

November 20, 2015

Present: Olivier Jolliet, Karin Veltman, Bill Salas, Larry Chase, Joyce Cooper, Greg Thoma, Marty Matlock, Peter Vadas, Richard Gaillard, Matt Ruark, Carolyn Betz, Curtis Jones, Cesar Izaurralde, Al Rotz

Agenda Item 1: New York Farm paper

Since the last meeting, all of the simulations have been completed. Karin will send another version of the paper before Thanksgiving and then it will be ready for submission.

Agenda Item 2: LCA/Model integration

The LCA teams needs the final list of BMPs, so they can find out what variables will change and then continue with the work. Greg explained that we have a continuation of information flow: experimental scale, then into process models and then inflow to LCA, then high level of information of GHG across all. This continuum of information flow may be useful to all.

Joyce: we need a complete unit process so we can know what is missing. Examples: we would have a definition for crop production, manure treatment, milk production and barn management. Joyce took the big Excel worksheet and saw how the data might be divided up and then compartmentalized to define unit processes. Also show where data or model output fits within the flow.

We are still refining the BMP list. The scenarios will be 200 cow herd and 1,000 cow herd size (milking cows). NY farm is 2,400 herd size with 1,096 milking cows. Should we can start with the NY farm and use that instead of the 1,000? Just for this case study it makes sense to model 1,096, but as we move forward, we should use a more standard unit of 1,000 milking cows. We are going to be creating simulated farms from scratch in the future. Bill suggested we’ll need to show how we scaled the infrastructure when the change is made. Al Rotz asked for clarification on the number of cows – milking vs. dry etc. Actually, there are 1,261 milking cows on the NY farm.

Feed Management BMPs

Michel Wattiaux and Matias Aguerre have suggested five feed management scenarios. Greg asked how to change high feed efficiency; Larry was able to describe how this can be done. He also described how genetics can be worked into this from the literature. Larry can find out what makes a difference first and then go back to the NY farm herd and then use their rations. Greg asked about how to change a model. The NY farm uses three different rations. Larry could run the models with the genetic factors and then present the results to the group. Need methane emissions, then the N and P in manure. Bill wants to characterize feed changes and will let DNDC track the N and P through the farm. IFSM can also be adjusted. It is flexible once Larry narrows it down. We might want Wattiaux’ input.

Manure processing and storage BMPs

Small farms don’t have digesters so they will focus on composting. Larger farms have a wider variety of options. Greg asked if the models have the ability to model liquid-solid separation. Manure-DNDC has the ability to do this but may be difficult to do subsequent treatment. IFSM can run all of the BMP scenarios. Ying is also interested in seeing about extraction of nitrogen for fertilizer use. Al says a lot more work is being done on P extraction, not N. APEX can do manure separation based on P, but they will have to investigate further. Bill asked questions about the liquid separation. Olivier needs to get more information from Ying.

Scenario 1 has been run by DNDC was run for six-month storage. IFSM was run for less than six months. Al said he has run all four scenarios for the NY farm. These haven’t been published yet, but has a manuscript submitted. Each scenario has different emissions results. APEX can also run the scenarios.

Crops and Soils BMPs

There are a lot of issues in this group of BMPs, such is just changing the soil type. Matt reviewed the four items in the list. Changing the crops or rotations will change other things as well. Greg said that BMPs cannot be looked at in isolation. We need to think about this from another angle which means they should be looked at combination of BMPs in suites. Looking at them one at a time is a good way to start, but it’s not realistic from the actual operations level. When one thing is changed, it affects the whole system. Once we get going, these relationships will become more evident. DayCent doesn’t do ammonia. Matt suggested working with Bill Jokela to get some data. Twin Birch farm incorporates manure on the same day, so in that case, this BMP has already been run. DNDC can run these four scenarios.

Future Climate Scenarios

Marty thinks we are only going to run the high and low intensity changes and one in the middle for all 13 regions. Right now we are running climate scenarios based on each region. Rob sent a file that describes the process used. Olivier asked Curtis Jones to take the lead with the climate modelers. The models take into consideration climate and effect on yield. Cesar said they can run APEX with the climate data. They are just focusing on the field, not the other components of the operation. Marty says we are interested in the impacts on the functional unit, not the cow itself. For IFSM, air temperature affects milk quality and production. Joyce asked if the type of operations would change based on climate change? The low, medium and high scenarios should cover pretty much everything and bookend the scenarios. Curtis needs to report back to the group about the climate change scenarios at the next meeting, December 10 at noon Central Time.

Topic 3: **Experimental data and validation** - Richard Gaillard

Richard reviewed the data that have been generated at WICST and rotations that are used there. We have data from 2010 and 2011 for soil temperature, NO2, CH3, CO2 and a few others. In 2014 and 2015 there are data for soil water, NO2 etc. for the corn and alfalfa rotations. He is going to put those data sets together. He wants everyone to run those situations to validate their models. Need to discuss validation and calibration and statistics criteria. Richard uses a linear regression and T test for yields. Marty asked for articulation of the statistics. Richard walked the group through the spreadsheets he had sent out. He worked through the data request process before he could start. WICST data are from 1993 till present. Tabs at the bottom contain data as well that are needed. He will complete this spreadsheet and send it to the group today. 2010-11 data is from every few days for the season; 2014-15 isn’t as intensively measured but he needs to get more information from Sarah about why the data were collected when they were collected. There are weather files that go with the WICST data.

Bill said we need to have a conversation about calibration and how this will be done. He described how the calibration would be done for DNDC. Curtis described how he would do this for APEX. Peter said that everyone needs to calibrate for crops and soil moisture. Models are being calibrated for events. He isn’t sure that the measured data can be used in the same way. Calibrating for the event means using only when the data were collected. We can interpolate in between events, but the models could be used instead. For the LCA we need gas emissions for the whole year, not just events.

Olivier asked the LCA team if they are running for just the NY farm or for all of the measurement sites. Greg and Joyce think we need to modularize the LCA. This will allow for greater flexibility. Joyce says we want to create an LCA so a framework exists so that a model will be able to place all the inputs and outputs. If we understand what’s going in and what’s going out, we can place it in the model. For example, if DayCent and IFSM are different in the flow, you can see how it helps the overall results. You can have a dataset with only the experimental results. Then you can have a dataset with the modeling results. That way you can swap out modeling and measurement results.

The LCA is always going to model the entire system, but the components of the system might be based on different models or monitored data. We must understand the whole farm. You can do these in groups of feed production, barn management etc. as said before. Olivier is trying to force-fit different models. Will the calibration allow for the different model results to exist together? Joyce is trying to understand how we can allow the different models to co-exist. Olivier said they are trying to keep the different model results separate. IFSM keeps track of other data, like tractor emission. IFSM will be a benchmark. Greg says the key thing is that the models have been harmonized and that each one represents their own thing. He doesn’t recommend we input the experimental data into the LCI when we run the BMPs. Joyce asked if we could use the experimental data in the LCA but keep this separate from the model runs. We need to start with the modeling data. Joyce has the experimental data and wants see how it fits in and can be used.

Olivier suggested we come back to this issue later since the call was getting long. Richard will send out the gas emission experimental data today. Then the modelers can set up their simulations. Don’t wait till the next call to get going. Please contact Richard or Peter as soon as possible to make sure that everyone knows what they are doing and all is going well. We hope we will be able to have a discussion on Dec. 10 about the results, so send results by Dec. 8th to Richard.

Peter needs to get approval from his USDA office before the paper is submitted by Karin. Olivier suggested he use the next draft to get his approvals.

Estimating Global Warming Potential (GWP) of Dairy Production Systems

Scenarios for Evaluation

* Scenarios are divided into 2 general farm sizes (200 and 1,000 cow herds)
* Baseline scenario is identified for each farm size which is the basis for comparison for changes in farm management

**200 cow herd**

**Feed Management**

*Contact: Michel Wattiaux, Matias Aguerre*

*Five feed management scenarios (coupled with a specific crop rotations)*

1. Baseline
2. High NDFD
3. High forage + high NDFD
4. High FE
5. High Fat

**Manure Processing & Storage**

*Contact: Becky Larson, Horacio Aguirre-Villegas, Doug Reinemann*

*Standard practice: manure collection with skid steer*

1. Baseline practice = solid manure, no processing and no storage basin (daily haul)
2. BMP = composting

**Crops & Soils**

*Contact: Matt Ruark and Becky Larson*

*Assume application based on P removal rates of the crops in rotation, with additional N purchased*

*(Note: need sufficient detail on each major dairy feed: alfalfa, corn, corn silage, soybean to feed model inputs. This includes info on rotations and level of nutrient application)*

1. Manure application

* Baseline = daily haul unprocessed manure
* BMP = daily haul composted manure (2x per year)

1. Tillage

* Baseline = chisel plow
* BMP = all no-till

1. Manure application

* Baseline = all surface
* BMP = all manure injected or incorporated same day of application

1. Soil type
   * Baseline – well-drained, highly productive
   * Alternate practice – poorly drain soil low production soil

**Future climate scenarios**

1. Baseline – current climate
2. Alternative - evaluate comparison to future climate for 13 climate regions

**1,000 cow herd**

**Feed Management**

*Contact: Michel Wattiaux, Matias Aguerre*

*Five feed management scenarios (coupled with a specific crop rotations)*

1. Baseline
2. High NDFD
3. High forage + high NDFD
4. High FE
5. High Fat

**Manure Processing & Storage**

*Contact: Becky Larson, Horacio Aguirre-Villegas, Doug Reinemann*

*Standard practice: manure collection with skid steer*

1. Baseline = liquid manure, no processing and 6 month storage basin
2. BMP = liquid-solid separation (screw press) and storage basin
3. BMP = anaerobic digestion, liquid-solid separation and storage basin
4. BMP = storage basin covered (lower cost cover – this does not include the cover with methane collection as that will be similar to the digestion scenario)

**Crops & Soils**

*Contact: Matt Ruark and Becky Larson*

*Assume application based on P removal rates of the crops in rotation, with additional N purchased*

*(Note: need sufficient detail on each major dairy feed: alfalfa, corn, corn silage, soybean to feed model inputs. This includes info on rotations and level of nutrient application)*

1. Manure application

* Current = 50% in fall and 50% in spring manure (pre-plant)
* BMP = Spring with 25% of annual manure applied in-season

1. Tillage

* Current practice = chisel plow
* BMP = all no-till

1. Manure application

* Current practices = all surface
* BMP = all manure injected or incorporated same day of application

1. Soil type
   * Baseline – well-drained, highly productive
   * Alternate practice – poorly drain soil low production soil

**Future climate scenarios**

1. Baseline – current climate
2. Alternative - evaluate comparison to future climate for 13 climate regions