

July 12, 2022 Theory Working Group Call

Attendees: Abby Lewis, Christy Rollinson, Caleb Robbins, Bilgecan Sen, Amanda Gallinat, Noel Juvigny-Khanafou, Mike Dietze, Jody Peters

Regrets: Glenda Wardle, Shubhi Sharma, Andrew Allyn, Steph Brodie, Cole Brookson, Jono Tonkin, Jaime Ashander

Agenda:

1. Celebrate the Methods in Ecology & Evolution manuscript when Abby is on the call :-)
 - a. Revisions went in by June 25. Manuscript was accepted!!

2. [EFI Strategic Plan](#) - Mike or Christy to discuss
 - a. Steering Committee (SC) wants to share the Strategic Plan and is sharing it with each of the working groups to make sure the groups are aware that it exists and provide more communication between working groups and the SC
 - b. Came out of the 1st year with the Steering Committee. The SC plotted out activities based on difficulty and interest. Came up with quick wins (easy and important), major projects (hard and important), fill ins (easy but not as important), and luxuries (hard and not as important)
 - c. Activities fall within 5 themes
 - i. Transform the science
 - ii. Improve decision making
 - iii. Create collaborative community
 - iv. Increase Diversity, Equity, and Inclusion
 - v. Improve Governance and Sustainability
 - d. Major Projects - lays out the SC vision
 - i. Tier 1 and Tier 2 with Tier 1 being of higher priority
 - ii. MSI Student Mentoring - want to connect to minority serving institutions to make connections and develop a mentoring program
 - iii. JEDI Database - working to develop a database to
 - iv. Distributed leadership - don't want to be reliant on the same individuals. Want to expand the number of people participating in a number of small roles
 - v. External Advisory - want to pull together senior leadership, program officers, presidents of NGOs, etc to provide input to SC and leadership with input on growth
 - vi. Engaging with Agencies - EFI has a strong track record of engaging with agencies by responding to requests for input. Working to push individuals within EFI that are part of government agencies to lead those discussions. 2 top priorities from conversations with agencies is CI and engaging with stakeholders.
 - vii. Cyberinfrastructure - CI is a bottleneck to the growth of ecoforecasting. Much of the work here is focused around the RCN Forecasting Challenge

- viii. Long term sustainability
- ix. Undergrad training modules
 - x. Research Outreach
 - xi. Partner Outreach
 - xii. Social Science
- xiii. Boundary - EFI helping those who are trained to create forecasts and those who use forecasts find each other
- xiv. All the Major projects have a similar timeline and subtasks for each activity
- xv. If anyone is interested in any of the projects - let the SC know so you can get involved.
- xvi. The major projects are for EFI at large (not necessarily focused on any particular working groups). The working groups are the most active part of our membership so the SC wanted to make sure to convey their vision. Some of the Projects map on directly (DEI working group, CI working group). But none of the major projects maps on to Theory. Perhaps - research outreach in terms of the MEE paper reaching out to people who aren't thinking about forecasting
- xvii. Theory is part of the goal to transform the science

3. Results from poll to gauge interests and availabilities - see the results on pg 6
 - a. Had 14 respondents
 - b. Group was most interested in co-authorship and learning new ideas through discussion
 - c. Most people were excited about the testing hypotheses from the MEE manuscript using the NEON Challenge output followed by enthusiasm (many "most excited" and "really like" responses) to reanalyze existing long term experiments from a forecasting perspective
 - d. The Phenology Challenge has a manuscript that is far along to analyze the spring forecasts. Quinn is working on a manuscript to give a description of what the forecasting challenge is and the lessons learned. There isn't a paper yet that compares across forecasts
 - e. How many forecasts are available from the NEON Challenge?
 - i. 54 teams contributed to the challenges
 - ii. Depending on how you count the forecasts there are 1500 or 2 million
 - iii. Model data pairings pairwise there are over 2 million comparisons. They are not equally distributed. Phenology has the most submission. Beetle had the least participation.
 - iv. Comparative gets harder if you are looking within some of the themes
 - v. If looking at total number of forecasts produced there are plenty of power
 - vi. Aquatic and terrestrial have in between number of forecasts. They were sub-daily forecasts submitted so that inflates the number of comparisons. Phenology was the only one in Round 1 with daily forecasts.

- vii. When diving into the existing forecasts think we will find things we wish people had done that they hadn't.
- viii. The timing is good for both analyses using the NEON Challenge and providing input on the Challenge Design for Round 3. For Round 3 next year, we want to have a push to have more forecasts submitted/teams registered. We had a big push for Round 1. We took a step back to work on the Cyberinfrastructure for Round 2 (although Round 2 is running and people are submitting forecasts - just not at the same volume as in Round 1)
- ix. Design changes for the Challenge will take place this fall. So we want to flesh that out this fall (Sept-Nov 2022).
- x. Do people have to submit their full models with these? Can we retroactively run the forecasts at the time steps and to run them at LTER to look at transferability?
 - 1. Right now they are black box. But that is something that has come up early on in Theory when talking about Standards.
 - 2. 3 tiers - archive the forecast, archive the model, and archive the workflow with docker containers
 - 3. If we want to do multi-model analyses, it will be important to provide a mechanism for teams to submit their workflows, not just the executable.
- xi. What hypotheses would we want to test from the MEE?
 - 1. Factors that determine the transferability of models
 - 2. Relative predictability over forecast horizon and how the slope declines over that variable
 - 3. Hypothesis about aggregating - are there different scales of aggregation. Looking at 1 site, multiple sites. NEON has individual phenology, have plot level phenology, and multiple plots within region.
 - a. For Challenge we are asking for predictions at ecosystem level from phenocams
 - 4. Temporal and spatial scale - aquatic and terrestrial output could be analyzed this way.
 - a. Terrestrial - have diurnal cycle and seasonal cycle. If being good at one make you good at the other? Can work from ½ hour to annual/interannual.
 - 5. If we have the same people submitting forecasts in multiple years, could look at interannual differences.
 - 6. But if want to look at interannual variability, look at other option for reanalyzing long term time series data listed in the poll (option e listed below).
 - 7. Temporal aggregation - can you look at different scales for the aquatic challenge and compare that to something in the terrestrial

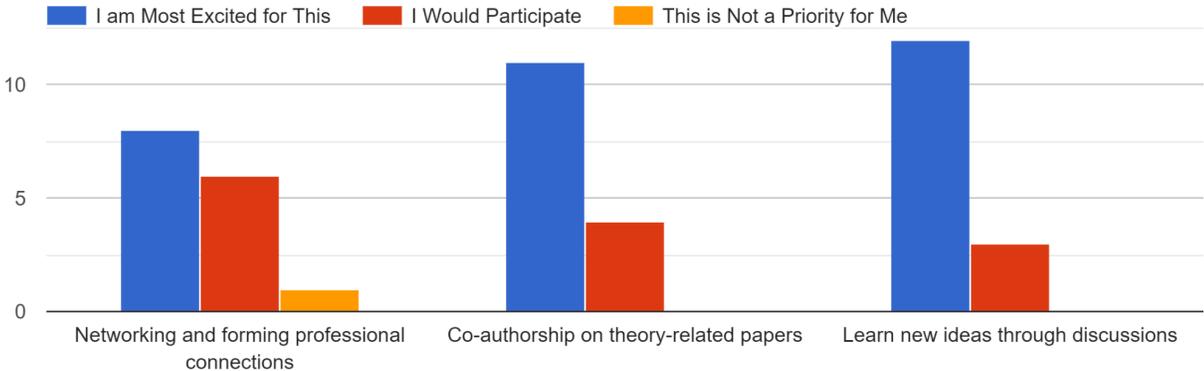
- challenge. Would want to discuss what the pattern would look like with this group before looking at the data.
8. Aquatics - DO and Temp would expect to be driven heavily by the forecasting. Expect this to be true at the Terrestrial sites as well.
 9. In year 3 could do better to make sure there is a pairing between the Terrestrial and Aquatic sites to be close
 10. In paper - pushed to come up with expectation ahead of time. We have this opportunity to focus on/document/archive for Round 3 and then look at it after the Round. Would force us to think through the logistics.
 11. Quinn and Mike have looked at uncertainty partitioning with FLARE (aquatics) and Terrestrial forecasts from different sites
 12. Lead time figures would be interesting as a starting place. Have done them for the phenology
 13. Think there is more observation uncertainty for eddie flux compared to sensors in streams and lakes
 14. Key results from Phenology
 - a. CRPS (skill) vs measure of lead time compared across types of models
 - i. Show that uncertainty increases with time. But level off at different places at different rates depending on model
 - b. Also looked at CRPS (skill) vs day of year - showed consistent pattern regardless of modeling approach for when uncertainty is peaking vs when it goes down. Expect this to be different for other systems (but maybe not radically different)
 15. The most uncertainty for phenology is at the start of greenup. Might expect terrestrial forecasts to be less spiky, but think will be most uncertainty in transition periods.
 16. Think will see a phenological pattern in all the systems
 17. Would expect stream sites will be temp driven, while lake sites might have more impact of algal bloom input on dissolved oxygen while surface temp will be similar to atmospheric temp
 18. Harder with ticks because sampling is monthly or coarser
 - a. From John Foster's dissertation it is all phenology related to when the life stages are peaking
 - b. Could do temporal aggregation - look at annual average between sites vs monthly. At the annual scale would expect it would average out
- xii. One thing we will need for this project and to have recommendation for the 3rd year of the Challenge will need to have a Champion - don't need to know everything, but need someone willing to wrangle the group.

- 1. All the data is available. If you can get the arrows package you can download the data easily. It is well organized.
- 2. Mike can help people get familiar with the data
- 3. Amanda can not take the lead over the next year. Christy can help support but can't lead. Same for Noel
- 4. There is a lot of interest in this project - but need to have Champion. Champion doesn't mean you have to do all the writing, but more to outline the paper and pester people to fill in
- 5. From the poll think there may be some untapped capacity to lead projects or lead by committee
- 6. Check with Shubhi to see if this is of interest and check the poll again to see who expressed interest in helping as part of a small group.
- 7. Abby will reach out to those who expressed interest
- 8. Don't want to scoop analyses/papers from any of the Challenge Design teams - Quinn/Mike/Jody can reach out to the Design teams to check about this

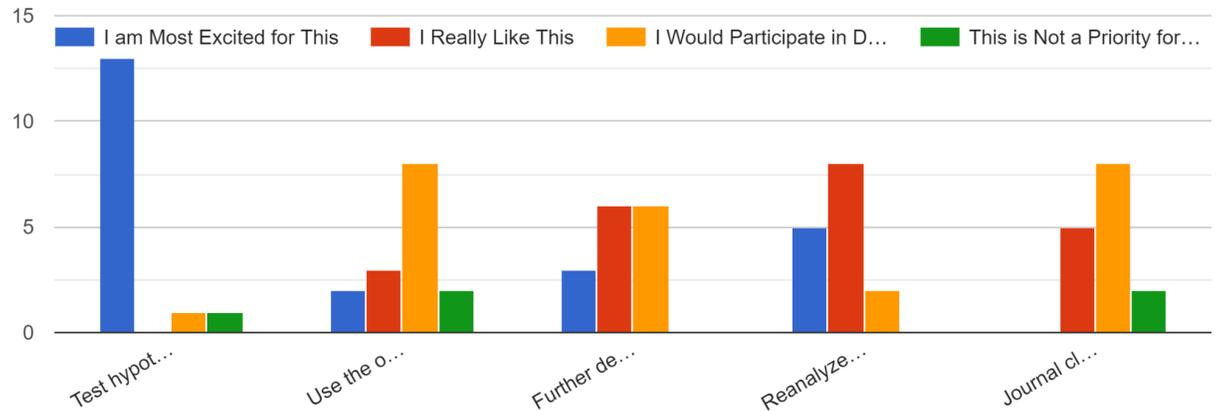
4. Co-chair

- a. Shubhi Sharma and Christy Rollinson both expressed interest!

Rank your personal goals for participating in the Theory Working Group?



The following are Activities listed during recent Theory Calls. Rank what you are most interested in.



- b. Option1: Test hypotheses from the MEE manuscript about transferability of forecasts and limits to predictability using existing forecast submitted to the NEON Challenge
 - c. Option 2: Use the opportunities for theory development from the MEE manuscript to help design model experiments for Round 3 of the NEON Challenge
 - d. Option 3: Further develop toy models started through the MEE manuscript writing process to provide direction for analyzing messy/real data
 - e. Option 4: Reanalyze existing long term experiments from a forecasting perspective.
 - f. Option 5: Journal club - dive into and discuss papers that cover existing theory
5. What hypotheses from the manuscript could be explored within one or across the [NEON Forecasting Challenge themes](#) or with forecasts listed on the [EFI forecasting profiles webpage](#) or from the EFI community
 - a. Hypothesis 1: The rate of decline in predictability over increasing forecast horizons differs across variables and scales
 - b. Hypothesis 2: Predictability increases with biological and ecological aggregation
6. Reanalyzing long term experiments with a forecasting view
7. Jody is leaving this in as a reminder of ideas suggested - Recap from icebreaker from the April call about ideas from the group about what to work on next
 - a. Test some of the hypotheses put forth in the manuscript

- b. Several versions of figure 1 that lays out forecasting - produce something in a non-manuscript format, but through EFI that lays out underlying theory of forecasting and expand and provide through EFI (not necessarily through traditional manuscripts). Graphical abstract of what forecasting is about
- c. Test transferability
- d. Work on/test the toy model that Abby and Elyssa started a while ago
- e. Use existing experiments to reanalyze with a forecasting approach. Start to understand how to do science differently. Put into practice the idea of how forecasting can change what we are currently doing. Especially some of these experiments that have been done across multiple sites
- f. Journal club - dive into and discuss papers that cover existing theory. (student group has had fun and productive discussions on complexity and simplicity - could possibly have cross-over call)
- g. Opportunity for synthesis and to learn from each other. Thinking about different scales of ecological organization and where predictability scales across that. Synthesis across domains (marine, terrestrial, freshwater). Think about different end users - resource managers, ag management, water management. Sounds like some of the ideas in the very first manuscript outline-- comparing predictability across levels of biological organization, geography, life history, etc
- h. Model validation/model selection using large datasets or past datasets.
Transferability
- i. Use manuscript as starting point to put things into practice to show benefit of forecasts. Like having the manuscript to motivate to read new papers and organize thoughts more than just discussing a topic.
- j. Working on the uncertainty component of the manuscript - is uncertainty the key part of forecasting or required? Can work to explain the different sources and show how to do it and visualize.
- k. Something else that came up on June 7 call - toy models have come up as the group has been meeting - this is something the group could come back to think about how to analyze messy real data
 - i. Elyssa had given a reminder of the toy model she had created for the manuscript so could be good to go back to.