July 19, 2021 Theory Working Group Call

Attendees: Abby Lewis, Cole Brookson, Steph Brodie, Andrew Allyn, Jaime Ashander, Glenda Wardle, John Foster, Dan McGlinn, Elyssa Collins, Jody Peters, Christy Rollinson

Agenda:

1. Authorship Guidelines Reminder
    a. If anyone has suggestions/edits to the guidelines, put it in Slack and we can discuss updates.

2. Draft Outline of Theory group manuscript
    a. Updates from:
        i. Ecology question 1: How does predictability relate to spatiotemporal variability? How do forecasts change over a forecast horizon
            1. Google doc for Q1 notes
            2. Discussion of Slides from the group that met after the June monthly call.
                a. Ecological example from Steph: case study in CA current system and distribution of swordfish. Top row is temporal decomposition of sea surface temp. Top left plot is daily sea surface temp. Then can decompose into 3 parts. B = monthly climatology. C= interannual variability. D = residual component left over. Main takeaway is the difference between top and bottom rows. Time in 2007 and Time in 2015 when there was a heat wave. In 2007 the whole domain was colder than average. In 2015 the whole domain was warmer than average. It isn't superfine features that are able to be forecasted. Purple = monthly climatology - seasonal cycle. Green = observed temp. Yellow line = low frequency, Blue line = high frequency.
                    i. Can predict in the middle zone the best. It fits with the hypotheses plots (blue and red)
                    ii. Take home is thinking about forecasting catchability - didn't test it on a forecast system. But if they did the forecast will predict 6 months out. If it is a good swordfish year then fishers can plan on that.
                    iii. Does it tell a fundamental principle about swordfish ecology. Tells about what migrating species respond to. When you find a fish in a specific location it is the sum of all the processes that lead it to that location. Can get to it at a broad scale means instead of needing to predict the bait fields.
                    iv. Tells about movement not internal reproduction

v. Cool example

b. For Toy Example: Peter wanted a model to illustrate what we are talking through. If going to use a model use a logistic model with stochasticity and play around with that. No one has taken time to work on that yet.

c. For Q1 need to think about hypotheses more before being able to come up with the example model. (see examples below in point 3.

ii. Ecology question 2: What can we learn about ecological theory through the transferability of forecasts?

1. Google doc for Q2 notes
2. Discussion of Slides from the group that met after the June monthly call.
    a. Framing this section by
    b. 1) defining transferability - transferability happens when forecasts are applied outside the system it was created - application can be done in lots of different ways such as location, temporal or spatial scale, or biological system
    c. 2) Why does transferability matter broadly in ecology - group is doing a lit review
    d. 3) What is the state of transferability in forecasting - group is doing a lit review. Lots of work has been done on this part of it (see the manuscript outline)
    e. Hypotheses!! See double arrowed slide
        i. If we know the ecological system (e.g., know it has high observation uncertainty) then can we use that to predict how transferable the forecast can be.
        ii. Can go the other way what does the forecast transferability tell us about the novelty of systems
        iii. Expect it will be hard to transfer forecasts to novel systems (but hard to define what makes a system novel or how novel a system is)
        iv. This area is most in development. If anyone has ideas go ahead and add them.
    f. When macroecology first started (Rosenzweig, Brown) showed where can take a species distribution model and it works everywhere, can be applied in lots of different systems. That transferability unveils things about the systems and what we know about biology.
    g. Other examples - allometric models. Metabolic theory of ecology (mass scales to metabolism example). Look at the deviance from what is not transferable and that is the interesting point. It falls nicely in the iterative forecasting cycle idea.

h. Have discussion between general theory and a particular model - you can imagine an accepted model that you are trying to parameterize in different systems where things might work differently. Will be an interesting point to unpack. Will get to the difference between what we are doing in this paper and what was discussed in the Hoolihan (discussed prediction and how it applies to metabolic theory and forecasts). So want to hone in on forecasts so this paper is different from Hoolihan.
i. Specifically want to focus on how uncertainty related to transferability in both directions.
j. When you create a forecast it will include uncertainty in forecasted drivers which you won't have in a general model. So knowing the uncertainty is critical in the forecasting process.
k. Is it not a forecast if you don't include uncertainty in a driver parameter? Are we talking about something really distinct from modeling? Want to point to what makes a forecast vs a general ecological model.
l. Uncertainty will be foreign for readers. So will want to be clear
m. Plant rule example from Glenda. Ecologists looking for generality which is another term for transferability. What is distinctive about this type of modeling as compared to
n. Transferability can't just be done by eye. It will come down by how it is supported. What is the statistical approach that will be used to say yes it has been transferred.
o. From Christy: I think for me the discussion about uncertainty always sparks to me that forecasting for a hypothesis framework is about more than getting the right answer — it's about more than just producing a number (which is what I associate with a prediction)
p. Forecast example: If the forecast has 20% chance of rain and it does or does not rain your answer is fine either way.
q. Want to talk about forecasting specifically unless we can come up with something about predictions that has not been said already for modeling. But think that it has been done for modeling more broadly. Want to think about how forecasting is useful beyond applied management
r. Need to lay out in the intro what is distinct about forecasting and the uncertainty sources.
s. Discussion of Figure 1 from Theory paper outline

        i. Trying to cross walk the terms that are used for forecasting that may or may not overlap with other modeling efforts
        ii. One of the goals of this figure is to use it as a visual glossary of the forecasting terms
        iii. Want this figure to familiarize a generalist ecology reader what we want to bring up in Q1 and Q2
3. See Abby's Google slide for a discussion of the Predictions for each Question
    a. Q2 hypotheses for What can we learn about ecological theory through transferability?
        i. Can we generalize the process model to apply to multiple systems?
        ii. Does a lack of transferability indicate ecological novelty?
            1. Would looking at relative sources of uncertainty in a non-transferrable model help you understand why it's NOT transferrable?

        iii. Do models (or ecological processes or parameters) with higher process/parameter uncertainty have lower transferability?
        iv. Lots of high measurement uncertainty are not expected to be transferable either
        v. It could be a feature of the model itself or parameters. Where error is multiplicative. E.g., lotka-volterra models where you model lots of species interactions. If they are all off just a little, because you have so many parameters
    b. Q1 hypotheses for What can we learn about ecological theory through predictability?
        i. Forecasting as hypothesis testing
        ii. What scale of interactions are important (Fine grain interactions vs coarse grain interactions)
        iii. From Steph's example we can learn about the role of processes in the forecast skill and also the scale of temp and spatial accuracy. Did you capture the process well. Different processes may dominate at different scales. One may be easier to get a handle on then others
        iv. Another example: Bond and McGill paper on species distribution models. Building models from different starting points. Throwing all environmental

variables at species distribution vs using covariates. Species are patchy. If you capture the patchiness you do pretty well. By comparing across forecasts you can see what process in most important

v. Abby's paper example - compared forecasts across papers for the following variables. Chlorophyll, Phytoplankton, Pollen, Evapotranspiration. Chlo and Phyto have similar patterns in predictability over horizon. Pollen and ET have lower performance to start with but does not decay as much over time compared to Chlo and Phyto. The more forecasts that are created, the more robust the patterns will be

b. Next steps
    i. Abby will work on the manuscript this month to synthesize comments and directions from this meeting. Plan is to flag people individually over the month. Will chat with Amanda for directions for the month. May have another set of interim meetings to keep pushing that forward.

3. Jody is leaving this point in for reference. We don't need to discuss this point on the call if there are no updates. Forecasting Vocab Terms
    a. Abby is working to compile the terms for a box for Anna Sjodin and Gretchen Stokes manuscript. Vocab Box
    b. From Nov call, the goals was to compare these terms with how they are used in the Forecast Standards to make sure they are consistent