December 16, 2020 Theory Working Group Call

Attendees: Christy Rollinson, Abby Lewis, Amanda Gallinat, Jody Peters, Alex Young, Mike Dietze, Hassan Moustahfid

Agenda:

1. Poll to find a time for recurring calls next Jan-May. Ignore the dates and focus on the day and time options that generally fit your schedule

2. Draft Outline of Theory group manuscript
    a. This is based upon previous TG meetings and in particular the Forecasting Hypotheses document
    b. Update from Slack discussion of the 3 questions
        i. Felt Slack conversation was nice to have to supplement in between face to face meetings
        ii. Question 1: How does predictability relate to spatio-temporal variability
            1. Getting stuck by needing a definition of predictability. Predictability relative to a null model or just forecast performance
            2. If thinking about a figure where it is most predictable when space/time scale aligns with the process scale. Only true when relative to the null model. But if relative to the null model there issues when thinking about resilience and early warning indicators.
            3. Alex - Alix Contosta talked about losing resilience. Cut down huge watersheds and saw what came back and how the water use came back to normal. If we do the same experiments again would you see the same results? Are we losing resilience?
            4. Expect more resilient systems to be more predictable because expect more autocorrelation where system comes back.
            5. Mike disagrees that you have to relativize your forecast to the null model.
            6. Hypothesis as laid out is not what Abby predicts. Things are more predictable on shorter time scales. Predictability decreases the further out
            7. Figure with spatial scale on one axis and process scale on other axis. May not align because it is most predictable at a short scale
            8. Difference between predicting state of something vs predicting change. When you predict the state of something, persistence factors in. if you are predicting when something changes or the magnitude of change is different than predicting the magnitude (e.g., magnitude of carbon in soil vs. when that C might change)
            9. Rather than argue the semantics of predictability definition. Focus on what is important for predictability. Uncertainty in forecast is an

important component of predictability. Care about 2 things. Rate of the uncertainty increases and the point where you do know better than the null. Things with a longer forecast limit are more predictable. Things where uncertainty increases more slowly in time/space are more predictable.

10. Alex caught on - resiliency and potential for shifts in the system. If a null forecast is developed on previous knowledge of the system, but the system is changing that it will be hard to forecast. If a system undergoes a big shift that is outside the historic range our understanding of predictability will be very wrong.
11. A metric Abby is using looking at predictability in a meta-analysis paper is R-squared of relationship of predictions and observations. This is convenient because it is unitless and can be compared across studies. A transformation from root mean square error?
12. Similar to analyses of paleo-ecological multi-models. There are magnitudes of differences in state, but interested in looking at the changes rather than the magnitudes.
13. Finding with soil microbe forecasts. When bias corrected have decent correlation, but there is a huge bias. Probably because everyone measures soil bacteria differently. So have a hard time predicting soil microbe communities because everyone measures them differently.
14. On Slack there was movement to combine question 1 and 2.

iii. Question 2: What factors limit predictability across scales

1. Hassan is struggling with question 2 about what factors. He would look for a list of factors that limit predictability. Will we actually list factors?
    a. This has driven the discussion about combining questions 1 and 2. Would be good to continue to discuss combining the 2 questions. Examples will help.
2. Are we asking fundamental ecological questions? They are ecological questions, but are they fundamental?
    a. The examples will be helpful here.
    b. Original manuscript outline was thinking about ecological examples first. How would predictability, uncertainty, etc vary across biological organization, space, time. But want to go even more fundamental to think about the things that are transferable across systems, biological organization, space/time. Use forecasts to get at what is truly fundamental across systems.
3. Create a road map for forecasting. What we can do differently from Mike's previous paper or the Petchey paper is to give ecological examples or focus on how people can use forecasts to understand ecological systems better

4. Road map for how to try to understand the patterns we see across forecasts. See the big picture of the pattern across things instead of lots of case studies.

iv. Question 3: When does predictability in one context imply transferability to other contexts

1. Summary of Question 3 from the Slack discussion:
    a. Transformed into what limits transferability across systems.
    b. Thinking about how drivers, etc to how transferable a model is.
    c. Christy was trying to avoid “it depends”
    d. Processes are generally the least transferable, but it might have to do with what analogs are available for the systems available. If you have great initial conditions for one system but don't exist for another system.
    e. Link between data availability and theory in transferability
    f. Mike proposing that transferability of predictability is related to which uncertainties are dominating. Make different predictions about transferability depending on what uncertainty is limiting.
    g. Do we expect the inherent uncertainties within a system to be transferable across space and time?
    h. Do I think environmental sensitivities or internal stabilities or the key dominant parameters to stay the same
    i. Comes back to defining predictability - predictability of the state or predictability of the stability, etc
        i. Quoting what Christy said in the Zoom chat: are we trying to predict the state — e.g. there are 500 kg/m3 of soil carbon, where I hypothesize that initial conditions will have greater influence — or are we trying to predict how much/when/why soil carbon will *change*, which I think is a slightly different question and would rely more on drivers, processes, and parameters
    j. Continue over Slack before next meeting
    k. Nice to have examples - if you do have driver uncertainty dominating what kind of system would you expect?
        i. What does it look like when ___ change?
            1. you expect uncertainty in IC to dominate
            2. You expect uncertainty in Drivers to dominate
            3. … parameter uncertainty
            4. … process uncertainty
            5. Random effect uncertainty

ii. Helpful to the manuscript audience to have clear examples of what that looks like.

3. Tick Example
    a. When we get to the last section about which uncertainty dominates in the first, second, or last third of the forecast (t=0 to forecast horizon/extent) look at both the Tick example and the Phenology example
    b. Ticks for NEON we think are collected every 3-6 weeks.
    c. Phylogenetic scale - maybe draw on phylogenetic relationship. But for the scale of the forecast and what people are interested in are a species scale forecast. Vs compared to microbe forecast which is not at a species scale. Same for trophic scale
    d. Relevant time scale - wondering if info about the host population the year before would be useful? May also depend on tick life stage success.
    e. Want to forecast different life stages? Yes. Different life stages represent different levels of risk.
    f. Of Mice and Mast Paper - classic paper Mike recommends reading
        i. Think that there is a 2 year predictability.
    g. Spatial scale - beyond site host range that are spreading the ticks. If the site is a good representation of the host population. Site is what we have. Small mammal populations tend to stay put. 100 of yards max. A lot of the transport between sites is driven by deer, but they don't affect the population dynamics because immigration/emigration term is small. But if you are talking source/sink dynamics that is where deer matter.
    h. Scales of local dynamics are small. But other things in terms of climatic impacts will have a couple of dominant scales related to weather. Don't have data to test macroclimate, but do have data to test microsites.
    i. Have data to look at masting and 2 year predictability.

4. Next call:
    a. Priority to continue to discuss Hypotheses - definition of predictability, merging 1&2
    b. Prioritize last question on ticks and phenology - Start with them first on the Agenda.

5. Forecasting Vocab Terms
    a. Abby is working to compile the terms for a box for Anna Sjodin and Gretchen Stokes manuscript.
    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
    c. Didn't get to this in the Dec call. Leave on the Agenda for Jan.