March 8, 2022 Theory Working Group Call

Theory Notes from the February 8, 2022 Call HERE

Attendees: Caleb Robbins, Christy Rollinson, Jody Peters, Gerbrand Koren, Andrew Allyn, Cole Brookson, Elyssa Colins, Steph Brodie, Amanda Gallinat, Abby Lewis, Glenda Wardle, Jaime Ashander, Noel Juvigny-Khenafou, Mike Dietze
Regrets: Jono Tonkin, Nick Record

Quick links:

1. Manuscript Text HERE.
2. Spreadsheet to compile literature on forecasting papers that shed light on theory topics from the manuscript and non-forecasting papers on theory/ecology that are key for the manuscript

Agenda:

1. Key points of discussion from coauthor review:
    a. Introduction - reframing or reoutline
        i. Mike - suggests re-outlining. Thinks that it jumps around and takes for granted things that were explained later on.
        ii. Think there are possible side proposals of new outlines and then moving text into that outline should be easier.
        iii. Want to agree on the progression and the argument we are trying to make
        iv. Proposed flow of ideas - could look at version from a few months agao
            1. Original idea: Ecoforecast developed as an emerging field, forecasts produced widely and used in a wide variety of contexts. But forecasts are not being used for theory development, despite calls in theory to be more predictive. One thing that is limiting that progress is a framework for how forecasts apply to theory.
            2. Don't frame it as a repurposing. Many paper showing link between theory and predictability and forecasting. But fair to say the current generation of forecasts are living up to applications goal rather than the theory goal. Forecasts haven't fundamentally changed the way the community is doing theory.
            3. Don't want us to fall into the false dichotomy of applied vs not-applied
            4. Want to articulate the commonalities and the gaps that this paper can help solve.
            5. Last point in Pt1 of Abstract " While forecasting has typically been conceptualized as a decision-support tool, ecological forecasting

is well poised to advance ecological theory.“ - Want to think about the Introduction to keep this thread going.

6. After Intro (see outline in manuscript) - dive into Scientific Method. Bring in the hypothesis testing from Section 2. Avoid the argument in the intro or bring the full argument up to the Intro
7. Make sure the intro leads to the paragraph at the end of the intro about what we will be talking about - focusing on 2 goals - how forecast can advance theory and how forecasts can answer questions about predictability.
8. Want to make sure the intro funnels us down to the above 2 themes
    a. to get to that funnelling that michael just mentioned you could just take the first 2 sentences of each paragraph of the intro. If it reads on its own giving all the main ideas that we want to convey then it should work.
9. Glenda: Do we have the same theory in mind when we suggest all the advance that will happen?
    a. E.g., theory about invasions lead to many hypotheses. But what about the how. Want to say “the theory of” and say something at the end of that
    b. How is this advance going to take place? It is there in our intent, but not in the words everywhere.
    c. Imagining how to tell people how they will do theory different than they have been doing.
    d. Andrew: Proposal - what assumed/explicit theory you are trying to understand - in forecast context you are making a prediction/forecast to some out of data sample and testing your understanding when you created your model.
    e. Temp influences species distribution is an assumption, then you fit model and fit species response to temp curve, then you test it and it is significantly different from 0. There is a track that pitches that will advance theory
    f. But forecasts hold true to out of data sample to test the theory which is going beyond the stats inference side
    g. Steph: Point of forecasting and why we need it is that our world is changing. Could have some sentences that if we want to advance the theory then need to think about the drivers for species responses. This can give guidance for how theory should advance.
    h. Glenda: Change is the right framing that will help us put the explanation on this. We don’t expect things to stay as they were. They way that species will respond to temp will shift or is it on a different spectrum of temperatures.

Shifting baselines - if your world is on shifting baselines then want to be able to predict what is coming.

i. Amanda: define ecological forecasting in intro and make an attempt at defining ecological theory - pull out patterns and truths that operate at different systems. And we need a way to test if what we think is true is a true pattern and do we see the same thing across systems.
j. Theory definition: Acknowledge that we aren't giving one universal theory, but theory applies across space and time and through forecasting we are developing an understanding systems that allows us to understand across space and time. We are creating a large set of quantitative models that explain ecosystem processes and mechanistic models that explain how ecosystems are working
k. Mike - think we are looking for overarching patterns and rules. Right now have a large collection of case studies because we are at the infancy of this synthesis, but that isn't the goal of the synthesis.
    i. Eye opening to see how ecology has gotten mired in theory free work and subdisciplinary theory (theory within narrow silos about how very specific things work), but less attempts to put it all together and understand the overarching patterns
    ii. Goal - show that ecology is more than a collection of case studies.
    iii. Mike added text to the Transferability section that gets at where he thinks we could be going. E.g., imagine we have k different models for k different species within a clade and you want to predict species k+1 within that clade. The transferability question - can we predict the important covariate data is, can we put informative priors, and if we have across species level covariate info (phylogenetic, functional trait) can you narrow down all these choices? You can more info about the new species, you could predict the out of sample species to build a legitimate predictive model. Does that show that we understand the patterns of how processes work in ecosystems. If we can do that within a narrow clade, how far up can we take that? At what point is there shared information?

iv. Glenda: Life history - life span vs change in environment. Think there are underlying processes. We want to synthesize. We want to give audience inspiration. Don't go theory free. Want to get multiple communities thinking. There is theory about life history, there is theory about evolution, about biomechanics, stoichiometry, macroecology. These provide touchpoints to thinking more broadly. Where can we use all of those things ina forecasting context to make our discipline predictive? And which theory wins? They can't all be right. But we can use forecasts to test that.

v. In intro/abstract - want to hook people from disparate communities that are developing their own theories to ground someone who only thinks about life history theory and why it matters to them.

vi. Given the current need and ecosystem changes, we can't explain things in the hindcasting, we need to be able to make predictions.

vii. In writing/introduction want to be explicit about why a broad understanding is needed - solve the major challenges (resource management, etc). Why finding common patterns across species is needed - how can that solve a grand challenge. It is key to understanding what is happening in a changing world.

1. Want to be careful where we put this. Maybe come back to this in the conclusions - fi we can address these challenges it will improve our about ability to make predictions. If we know what is predictable then we can make management decisions and assess risk.
2. Transferability - we are chronically data limited. Local scale data collection

l. Zoom notes:

m. Glenda: From intro this is key motivation for me "In addition to accelerating our ability to refine existing ecological theories, forecasting has the potential to enable the development of novel theories about the predictability of ecological variables"

n. Steph: FYI - I did add a sentence to the new intro outline where we could touch on the concept of why we need to do this (i.e. shifting baselines and non-stationarity).
o. +1Glenda
p. Christy: +1 separating and mirroring forecasting —> theory and theory —> application; I think making sure to provide space and not try to tackle all the connected issues at once is generally what has been a challenge with this paper and so many voices involved
q. @Christy - non-stationarity is a similar thing to forecasting in that it subtends many fields of ecology. did you get much engagement from dyed in the wool disciplinary folks on your Frontiers paper on it?
r. I have to jump off in a couple minute but glad to be re-engaged and will jump in on next round of comments Abby
s.
t.
u.
v.

b. Box 1
    i. Overfitting - Gerbrand think that define overfitting in the text rather than in the table
    ii. Forecast lead time vs Forecast horizon
        1. Lead time - multiple forecasts at the same date at multiple distances from that date, while horizon are predictions made on the same date for different amounts of time in the future
    iii. Forecast skill
        1. A little tricky because there are lots of different way to talk about forecast skill
    iv. Look at what the key words are used in multiple sections. Could think about the ones that are used in headers
    v. Forecast lead time is only in forecast lead time. So may not be as big of a through line thing, so may make more sense to put definition in that section
    vi. Focus on terms that are less familiar to the community or where we want to be very precise because there are multiple definitions in the community. Overfitting is ubiquitously known. But lead time is not something everyone is thinking about so we make it clear
    vii. Predictability and lead time definitions in the box need to be updated. Predictability - use the definition later on in the paper
    viii. Lead time - use AMS definition

   c. Predictability conceptual figure
   d. The bulk of the effort will be resolving the comments over the next 2 weeks. Will shift co-author review up a few days on the schedule below so Abby has time to look through comments before our April 5 meeting.

2. Timeline (DUE April 15th)
   a. March 8 Meeting
   b. March 8–21 ASL resolve edits, write cover letter
   c. March 21–April 3 Final feedback on final MS
      i. Sign off on whether you are okay with submitting or would like to see another version
   d. April 5 Meeting
   e. April 5–15 ASL resolve comments, ping people as necessary
      i. 2–3 volunteers to do a final read through of MS and cover letter
   f. April 15 ASL submit

3. Remaining Tasks

Other Items Previously Discussed that Jody is leaving in for reference

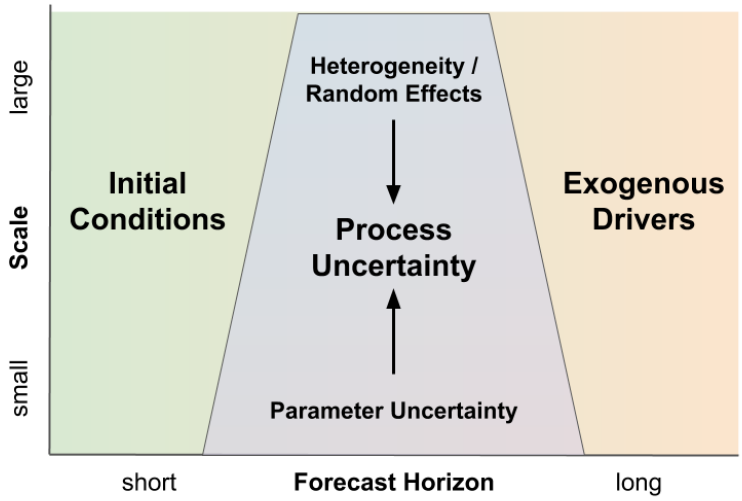
1. Original Authorship Guidelines Reminder
   a. See updates above in point 2

2. Old 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. Materials from previous calls: Google doc for Q1 notes, Slides
      ii. Ecology question 2: What can we learn about ecological theory through the transferability of forecasts?
         1. Materials from previous calls: Google doc for Q2 notes, Slides
   b. Next steps

3. 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

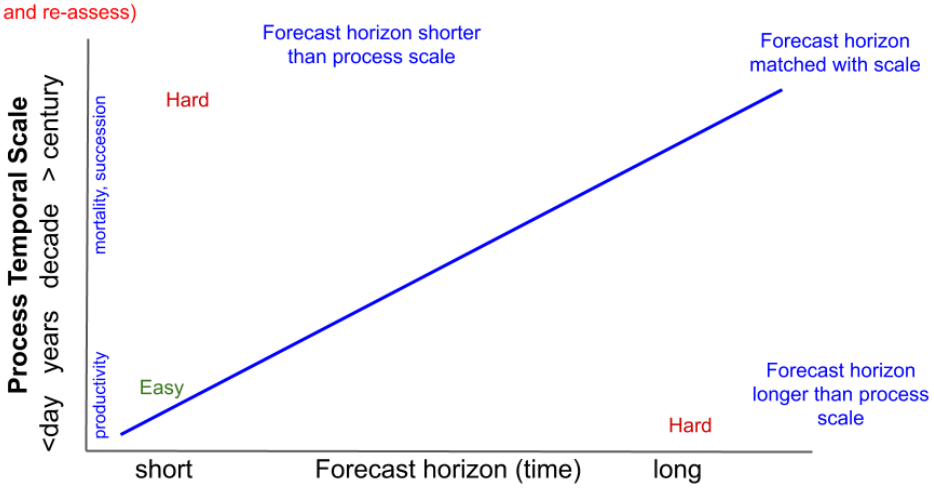
Old Material Referring to the Common Framework slides for reference especially for thinking about the RCN Forecasting Challenge examples:

a. Slide 8

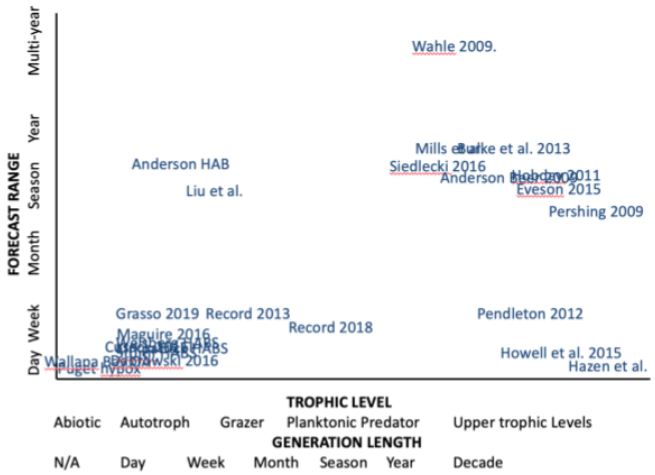


b. Slide 9

Rollinson Note: Are temporal scaling issues in forest modeling are separate from levels of organization or not. Can the temporal scale be independent of the forecast horizon? (I did this before seeing the Adler pre-print; will read and re-assess)



c. Slide 10



This is from a literature review I've been working on for marine ecological forecasts. Just from my notes-- I've just eyeballed the positions on this graph. Placing it here as food for thought. -Nick

d. Uncertainty components in forecasts

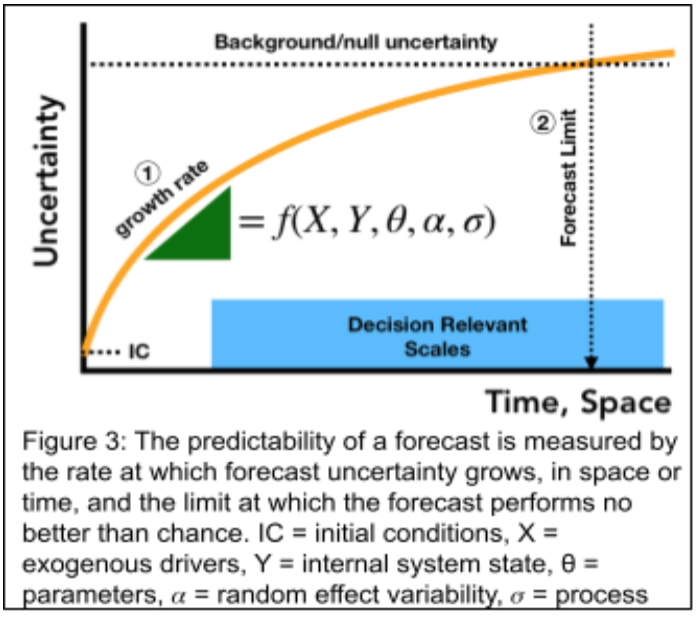


Figure 3: The predictability of a forecast is measured by the rate at which forecast uncertainty grows, in space or time, and the limit at which the forecast performs no better than chance. IC = initial conditions, X = exogenous drivers, Y = internal system state, θ = parameters, α = random effect variability, σ = process error.