July 15, 2019 Theory Working Group Call

Agenda

• Introductions / record attendance
• What are the short term goals for this working group -- what could be accomplished (or balls that could get rolling) this year and how do we get there?
• What are the longer term goals we are working toward
• Are there goals where a small amount of seed funding from EFI (<$5K) would help move us forward
• Leave with a plan for a next call (either exact date or data range to poll) and hopefully some discrete, assigned next steps.
• Links to EFI2019 Conference Notes
First Breakout Notes (LINK REMOVED)

Notes From the July 15 Call

Introductions/Attendance
Mike Dietze

Jamie Ashander - Postdoc at RFF; background in pop bio modeling, env change, effects of human decisions on pop'n forecasts;

John Foster - Grad student with Mike. Near term forecasting of tick born diseases. Goal is to forecast at NEON sites across country. Learn techniques/underlying theory of forecasting.

Amanda Gallinat - Postdoc at Utah State. Community assembly and phylogenetics with Will Pearse. Lots of opportunity for ecological forecasting in her fields. Interested in standards for forecasting and standards for reviewing papers, etc

Jody Peters - McLachlan lab manager / PalEON coordinator / EFI coordinator

Peter Adler - Utah State wildland resources, plant population/community ecologist looking at how IAV in weather drives pop'n; can we develop predictive skill? Through various proposals keep coming back to the question about whether we have general hypotheses about what forecasts are predictable?

Carl Boettinger - UC Berkeley, theoretical ecologists, understanding the limits of forecasting from a theoretical perspective, limits of uncertainties

Kevin Rose - RPI, aquatic ecologist, lake ecology and hydrodynamic models, spatial and temporal coherence and synchrony, limits to predictability; theory: limits of forecasting; also domain based theory to think about scaling patterns; what is the balance between general (forecasting itself) vs domain applications

Ritvik Sahajpal - Asst Research prof, U MD, geo plant crop monitoring ; operational crop yield forecasts using machine learning; interested in Bayes and Data Assimilation and attribution of yield fx of abiotic factors

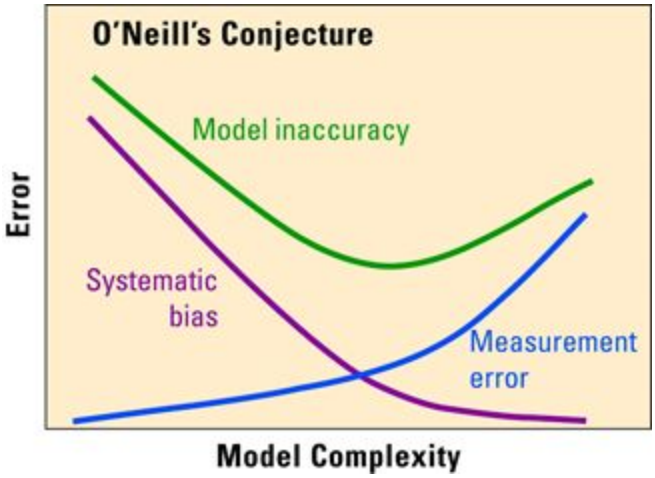
<u>What are the short term goals for this working group -- what could be accomplished (or balls that could get rolling) this year and how do we get there?</u>

- In terms of predictability - are there common patterns that make processes predictable and is this related to partitioning of uncertainty.
- One way to attack problem is to create archives of forecasts to compare the forecasts
- **How can we standardize forecasts in order to make comparisons across forecasts**
- What are the questions we want to ask and what are the covariates/metadata needed in order to test questions of predictability across ecology
- General idea: case study approach
- How do we get beyond the idea of case studies to come up with hypotheses?
- We can come up with general hypotheses like:
    - Phylogenetic constraints should affect predictability
    - Climatic effects should predictability
    - Traits should affect
    - But how do we get to something like “traits are more important or less important than phylogenetics to predictability”
- Peter: Evolution and compositional change alter the organisms that are being predicted. If you can hold the organisms as fixed, then may have a chance. But turnover and change of species leads to challenges. Perhaps working with the timescale will help. Short time scales may be easier to predict.
- If there are strong attractors then in the long term, then perhaps the transients will work themselves out.
- Thinking about how to standardize across forecasts is key. Compare forecasts in the same “currency”.
- Justifiable mechanism based on time scale to assess forecasts is attractable way to think about how to make comparisons.
- Algal bloom vs yield per acre of forest silviculture - what is the first thing to do to say these are comparable measurements. Time scale is key. But what else?

- What do we mean “this is more predictable than that”. Precise and wrong vs uncertain and correct.
- Need to have in place the standards before looking at the forecasts
- Ideas to think about: Distance between observation and prediction. Where does error relate to uncertainty. Compare to baseline model (e.g. persistence, climatology)
    - Points of synergy - Education group identified definitions and terminology as part of what they are tackling in short term goals. They were wanting to agree on definitions then getting to a place where to argue over semantics.
    - CI group is thinking about output standards
    - File format may not be important to think about. But do we want all the forecast output or just the synthesis? This will change how things are archived.
    - CI is thinking about a standard way to record what uncertainty are or aren’t recorded in a forecast. (e.g., dynamic model vs static model refed time series of inputs)
- Possible way forward: pick a small number of forecasts and think about how we would compare them
    - Actual forecasts or group of organisms. Maybe be asking different questions depending on scale of interest. All of ecology? Or organisms that are closely related? Intercomparison of organisms and processes. Population forecasts will have phylogeny be important. But what about ecosystem level process like Net ecosystem exchange? Could partition to species? Will need to deal with apples and oranges
    - Do easy comparison and harder comparison. E.g., Ticks and elk and then throw in ecosystem processes forecast
- Expect that how transferable are model structures will be easier to think about with organisms that are closely related. E.g., John’s work with ticks. He starts with one tick species and then sees how transferable the forecasting model is for other tick species.
- Ritvik: also interested in transferability in the context of crop yield: from same group to new location. Also across organisms.
    - Transferability across locations may be a more generalizable concept across different forecasts compared to transferability across different crops. Individual crops have different satellite signals so hard to be transferable
- Retaining ensembles or not?
    - Capital weather gang; panel plots of ensemble weather runs. For him, vary way to quantify uncertainty **for a lay person**
    - Check with social scientists to see if lay people understand ensembles

    - RCN - funded under NEON call. Setting up forecasting competitions that will leverage NEON data is one of the goals for the first RCN meeting within the next year.
        - Think about what Theory group input is to setting up the forecasting competitions. Do we want the RCN to focus on spatial transferability/predictability or transferability across systems?
        - Perhaps a subset look at NEON data catalogue to see what NEON variables are transferable?
    - Spatial transferability is very important
    - Across-forecast transferability is very different

- Some common themes from May: predictability, transferability, scale, identifiability
- What could we do with existing fx catalog? What can't we do because info is lacking?
- Peter: could start by compiling whether there's existing theory on EF
    - What in recent papers?
    - What's in the RCN and STC?
- What level of model **complexity** is needed to forecast, how does that change for different responses, systems, etc.
- From Kevin: O'Neill's 1986 on hierarchy - used in Monica Turner's landscape ecology book



- Use this as one way to frame comparisons
- What does complexity mean on X-axis? It is subjective, but Kevin thinks of it as # of parameters. Error is also subjective
- Measurement error ~ parameter error, input error
- Peter: some of these concepts are very general, not specifically ecological
- If we do a review of the forecasting theory - stats will be one part of it. Then there will be ecological specific theory as well.
- AGMIP -- existing outputs of multiple models
    - These and other MIPs could be mined to assess predictability
        - Projections don't have validation data
    -

What are the longer term goals we are working toward

- Large scale comparative analyses
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Are there goals where a small amount of seed funding from EFI (<$5K) would help move us forward

- Could be used to ID data from NEON and other sources and prep it for a common challenge

Plan for a next call (either exact date or data range to poll) and hopefully some discrete, assigned next steps.

- Next call - could sit and come back to the same agenda sooner
- Amanda: someone who knows a lot of case studies, would be helpful to comparing two forecasts that could be comparable (e.g. organismal) and then maybe look at a process forecast and think about transferability and predictability. Would be useful to thinking about where the interesting processes / questions are.
    - +1
    - Mike to pick 3-4 existing forecasts. Group think about transferability, complexity, etc
- Week of Aug 19 or 26? Kevin out Aug 19. JP poll those two weeks