January 11, 2022 Theory Working Group Call

Attendees: Abby Lewis, Gerbrand Koren, Andrew Allyn, Noel Juvigny-Khenafou, Caleb Robbins, Christy Rollinson, Daijing Li, Cole Brookson, Jody Peters, Elyssa Collins
Regrets: Jonathan Tonkin, Glenda Wardle, Jaime Ashander

Agenda:
1. Actions Items from Dec 14 call
    a. Add comments to section 1 and Figure 1
    b. Any additional comments to section 2 also welcome
    c. Brainstorm any other roadmap items
    d. Abby added a table to the bottom of the manuscript for co-author contributions. Fill in your contributions so Abby knows who to tap for different tasks coming up
    e. Continue to find examples
        i. Any other specific types of articles needed for the lit review?
            1. Papers that provide example of specific contributions that we talk about in the paper. E.g., hypotheses in section 2. If you find paper that talks about the limit of predictability or tries to understand the uncertainty to limit predictability
            2. Would like co-author contributions to add lit citations to the manuscript
2. Notes from Jan 11 Call
    a. Manuscript making good progress. Appreciate seeing the edits come in. Will take Abby a bit to go through the edits
    b. "Where do I fit in?" - terms in manuscript such as "basic, applied, theoretical". Want to think about how someone reading it in the beginning will be looking to see where they fit in.
        i. Want readers to make a bridge to where they are and how they can contribute to this new space
        ii. Paper currently frames forecasting as collection of stats methods as general approach to doing science that unites people across science
        iii. Currently sounds like basic and applied are separate
        iv. How can readers position themselves in forecasting?
        v. A lot of dichotomies are set up. The relationship between the dichotomies isn't clear. And it is rarely binary. When there are too many dichotomies without a clear relationship between them.
        vi. Thinking of mechanistic models as formalized hypotheses, whereas empirical models (black box) useful for prediction and potentially for applied ecology. But grappling with what value do black box have to theoretical ecology. Some part of this can be addressed by rephrasing and being more explicit with how dichotomies connect/

1. When writing - go back to the central theme "theory". Orient everything around theory and show how things connect to theory

vii. Machine learning algorithm - not advancing a theory because not able to control or test what is going on. But can be used to develop mechanism models later down the road. Identify useful drivers. Says something about the relationship between the drivers and the form of the relationship. But different way to contribute to theory. As compared to taking a hypothesis and testing it

viii. Box 1 - do we need a definition of mechanistic and empirical models?
  1. Yes would be helpful
  2. How do we want to talk about mechanistic models in this paper? What definition serves our purpose best?
     a. A numerical representation of an ecological process
     b. A mathematical representation of theory/hypothesis
     c. Can we say that mechanistic models have parameters and predictors (compared to empirical which is AI which only has predictors).
        i. But also would count an ARIMA model that doesn't say how drivers influence but does have parameters
        ii. Want to be careful about this because ML has hyperparameters that you tune
     d. Something about specifying the form of the relationship between predictors and their response (e.g. x increases y)
     e. "phenomenological" may be a useful term to help relate empirical model approaches
     f. Mathematical model and statistical model - what is a non-mathematical model that is a statistical model?
        i. Something qualitative - not making numerical predictions, but are making up or down relationship
     g. From Christy: I think how we're talking about "mechanistic" is a "causal" model — we're (hypothesizing) that X *causes* y, even if it's really correlative. And empirical would then really be more correlative
        i. This is nice because it is the way people are thinking about hypothesis testing outside of forecasting
     h. Put "causal" in the definition
     i. Mechanistic model is a mathematical relationship that represents a causal relationship
     j. Empirical model - approach that identifies
        i. Need to be careful about terminology because some models don't have

- k. There may be some examples that fall in between the two definitions and that is okay. Don't have to catch everything. Can have empirical model coincide with a mechanistic model. Here are 3 examples that we are classifying as mechanistic models (give citations) and here are 3 examples that we are classifying as empirical (give citations). We are generally following this approach, but acknowledge that there are some things that fall in between.
- l. Deterministic model - no variation in the results.
    - i. Can have mechanistic models that can give you one answer. Talk about throughout the manuscrit the inclusion of uncertainty.
    - ii. Don't think deterministic needs to be included in the discussion.
    - iii. Think this discussion doesn't fit with mechanistic and empirical, but fits well with the discussion of null model - could include if null model is purely stochastic .
    - iv. Keep thinking about deterministic
    - v. From Caleb: I think I like 'mechanistic' - it implies there's some phenomenon for which we are hypothesizing mechanisms that comprise the behavior of that phenomenon, and the model is the formal relationship of that explanation/understanding.
3. Null model definitions
    - a. Currently lumps many definitions into one.
    - b. This comes in the manuscript to show how people have used comparison to null models to show forecast skill.
    - c. Null model does rely on some data/observations
4. Distinction between forecast horizon and forecast lead time
    - a. Definitions and examples
    - b. Abby thinks she is stuck on this because it is not the main point. But any lit review on how predictability changes have used forecast horizons, so need to be able to relate the two.
5. Box 1 - goal is to define terminology that people new to forecasting are not familiar with. What terms do people need to know to understand for the focus of this paper. It does not need to be a lit review or all encompassing. **Focus on the terms are central to the story we are telling in this paper. As people read through the text look at it from this perspective.**

      6. "Overfitting" should be more clearly defined (but perhaps not in the table)
      7. Looking at Fig 1 - most terms are in the box. But "decision support" is not in the table. Make sure it is defined in the text and may

c. Tasks for next call
    i. Abby will organize thoughts after this call and will send out
    ii. Edits to second section would be helpful
    iii. Talked through the Roadmap on last call - need more fleshing out. Add comments to this section thinking about:
      1. What steps are needed individually and as a community to advance ecoforecasting
    iv. Abby will work on framing/explanation
    v. Goal is to get a draft of the intro (will see how that meshes with the start of the semester)