March 10, 2020 Theory Working Group Call

Attendees: Giorgio Vacchiano, Peter Adler, Amanda Gallinat, Jaime Ashander, Christy Rollinson, Jody Peters, Hassan Moustahfid

Agenda:

1. Manuscript updates and plans to move forward.
    a. Which sections have we identified people to work on? Which sections do we still need to identify people to help?
    b. The following are Goals for tasks for each section. Where are we at with this and where to people need help?
        i. get a rough outline for each subsection and
        ii. a bit more depth about major questions/hypotheses for each section (may need to be fleshed out with a lit review)
        iii. then think about how would we test them the questions/hypotheses using a forecasting approach
        iv. and finally, is there data or existing analyses that would provide low hanging fruit that we could do tests of the hypotheses now without having to write a new proposal?
        v. As folks dive into the literature/hypotheses for each section/category, use Figure 3 as a framework to see where existing questions of predictability in each section/category fits into the key concepts from the Figure (e.g., Uncertainty, Uncertainty partitioning, Scale, Complexity, Transferability)

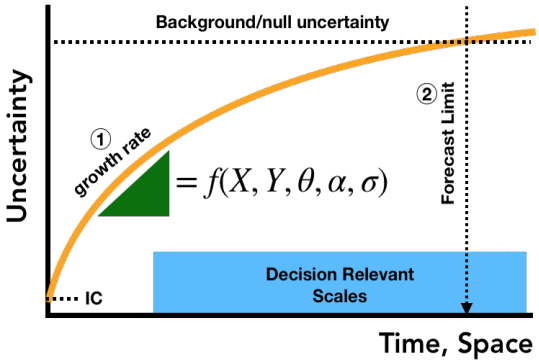


Figure 3: The predictability of a forecast is measured by the rate at which forecast uncertainty grows, in space or time, and the limit at which the forecast performs no better than chance. IC = initial conditions, X = exogenous drivers, Y = internal system state, θ = parameters, □ = random effect variability,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

Notes:

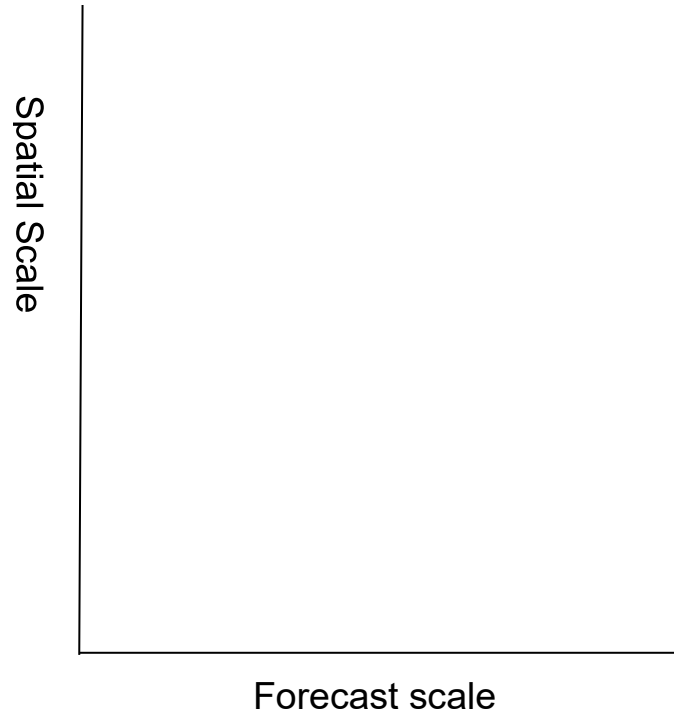
1. Intros - Giorgio joined today. He works on Forest Management
2. Will/Amanda re-cap of what they wrote in the Phylogenetic/Taxonomy section - what phylogentic trait/taxonomy can tell us about forecasts. Came up with non-trivial predictions. This is the state of the field, this is a non-trivial state of the field.
    a. Functional traits are the measurable variable that can be used for life history estimates

   b. In terms of scaling - phylogentic scaling matching spatial scaling and have predictions coming from that. Have others that of that more? Can we predict across a phylogeny and can that be the phylogeny section
   c. In phylogeny scale - start at a large scale vs traits at a smaller scale. Should that be more centralized and be the bulk vs the interactions that make it more difficult to predict or models to be transferrable
   d. Function traits example? Process based mechanistic vs functional traits split.
      i. Sandra Diaz - let functional be functional.
      ii. SLA - specific leaf area. How heavy vs light dense your leaf is
      iii. Anatomical of physiological trait vs light history
      iv. Any trait that measure ecological mechanism - we can model
      v. Another type of forecasting prediction could be for ecosystem services
   e. Predict ecosystem services and predict species are things Will has worked on, but for this paper not sure what the focus is for this paper.
   f. Interaction between where species occur and co-occur with each other. Can we predict where they are no and then where they will occur/co-occur in the future.
   g. Using functional traits can predict what clade of species will be found in different areas, but at the local scale, it is still hard to predict specific species.
   h. 1st paragraph - young clade harder to predict. Can make predictions across clades, but not at local scales. Phylogeny is less useful going into Anthropocene. Functional traits will be poor at predicting distribution

3. Phylo/Taxonomy section could be its own paper. If we include in paper to have it play well, the links between where we predict what is where and what we predict into the future, needs to be developed further.
   a. Think of applying to time as well. Link the space-time connection
   b. The spatial scaling is important to how transferable models are
   c. This came up during the EFI 2019 meeting. Forecasting across space as long as it is iterative and distribution
   d. Decide whether we want to limit forecasting to be forecasting over time or be conscious of considering forecasts over space and time. Maybe do both and then highlight
   e. Testing spatial forecasts

4. Christy - re-cap of how she tried to organize the spatial/temporal ideas added to the Google doc from lots of people and find the keys/themes.
   a. Christy thinks about forecasting over time and how that is affected by temporal and spatial scale
   b. Drivers predictability at scales. How to scale up or down. With poorly linked data it can be hard to scale
5. Cohesive concepts paper - prediction and/or/vs ecological forecasting. Making that distinction.
6. Importance of phylogeny or environments/time is an important contribution to the idea of forecasting.

7. From Christy's perspective, the mesoscale is hardest to forecast. But from Will/Amanda in Phylogeny mescoscale is the easiest to make predictions for.
8. Difference between mechanistic and phenomenological or eco-evolutionary
9. We're all coming at this from different areas of expertise. Ask for each system what combination. Try to make forecasts through time (could be short or long time intervals). Then could be focused on different spatial scales (one location vs large area/region).
    a. Forecast horizon on one axis and spatial scale on the other axis and then make notes that show where we think we can do a good job for each study system/organism
    b. Does this figure already exist? There are a lot of space/time plots.
    c. Will would add on to the degree of generality. With phylogeny the power is using info from one species and apply to another
    d. Biogeochemical model vs specific species
    e. Would a figure like this be a way to taking everything on the document and force it into a common framework.
    f. Phylogeny that has been modeled dynamically. Phylogentic diversity through time and how that affects ecosystem services. See Mark Cadotte's recent papers
10. Is there a generic way to describe that can connect state variables and parameters to the different categories listed in the Google doc?
    a. Initial conditions, exogenous variables that come up in the ecosystem models are not easily picked out in the phylogeny work. But Will thinks he could draw a graph with a positive correlation that could make the connection to those
    b. Want to compare and synthesize the ideas in the different languages
11. For moving forward - repeat this exercise for more of the categories we have. Flesh out more hypotheses.
    a. Use Peters figure idea: x-axis = time horizon, y-axis = spatial scale
    b. What drives uncertainty for each topic at the different scales
    c. Think about what kind of universal framework.
    d. Forecasting across time (not space, not phylogeny) then phylogeny is a term in the model. Want to have a structure that makes sense for the paper, not necessarily based on what each person on the call knows the best.
    e. What do we need to know about each of the fields to make this a cohesive paper?
    f. Put references on the Peter-graph as well
    g. Think about time/space graph horizon across different systems
    h. Peter will create a bunch of templates for this graph in Google slides and people can fill in for next call
    i. Jaime recommends Google drawings. Or there is a way to link a Google slide to a Google Doc
        i. OK! Go Insert > Drawing > New to do this, for example but I guess these drawings may have a more limited set of features than slides? Not sure. (You can click on the fig and hit Edit to see what's possible)



j.
k. For slide: highlight slide on side bar, click copy, then when you paste into doc you can paste as link to slide, which can then get updated as changes are made

12. Going back to the taxonomy forecasting, while it is typically at the long time scale, predictions about where invasive species will be are on a short time scale.
13.