

## September 22 2020 Joint Methods & CI Working Group Call

Attendees: Helen Scott, Whitney Woelmer, Abby Lewis, Rob Kooper, Jake Zwart, Quinn Thomas, Bruce Wilson, Debjani Sihi, Leah Johnson, Mike Dietze, Alexey Shiklomanov, Carl Boettiger, Ben Toh

Agenda/Notes:

1. Updates on EFI Task Views
  - a. Use [Task View 1 on Reproducible Workflows](#) as a guide
  - b. Uncertainty Quantification & Propagation, Modeling & Stats
    - i. Updates from Abby, Ben, Ash
      1. Notes from the Call:
      2. How much do we need to make sure the Task Views are usable for the NEON Challenge? While the Task Views are not specific to the Challenge, we want to make sure to mention the tools we are using for the Challenge in the Task Views.
      3. Abby, Ben, and Ash divided the Task View into sections based on the type of models highlighted.
      4. Each section is in various forms of completion and they are open to having more comments/suggestions on each section
      5. Aiming for 1 page per section. Because of the short length the plan is to link to many resources. If anyone knows of resources that can be added, feel free to add them to the document
      6. It would be good to have people involved with NEON Challenge CI to help incorporate the tools in to the Task Views
        - a. The Task View 1 could include a small update for the CI
      7. Currently there is text about the Uncertainty part of the Forecasting Standards included in this Task View for the different models, so if someone is using one of the models and there are points of confusion about the metadata standards then this Task View could provide clarification.
        - a. How to best integrate the Forecast Standard Document and this Task View is a question. The Forecasting Standard document is dense.
        - b. Whichever Task View we have a section on Metadata can link to the Standards. Task View 1 has Metadata which links to the repo which then links to the Standards so that is good.
        - c. For this Task View we want to be consistent with the description of Uncertainty with what is in the Forecasting Standard, but this does not need to be a repeat of what is in the Standard

8. Think about reformatting this Task View to show the topic and the associated tools. Annotate the tools that are useful. Don't need to write a whole paragraph about the tools
9. If things can be pulled out into bullet points then it will be easier for people to process
10. Add text and details that can be useful for understanding key differences and merits of the tools. If you go to the websites for each of the tools you get the overview, but you don't always see what aspect of each tool is most useful.
  - a. e.g., JAGS, STAN, etc comparison
  - b. Which tools will handle spatial problems, which ones will struggle when you have huge giant covariance matrices, which ones do not work well with missing data/latent variables
11. Inspiration for Task Views are Cran Task Views - they are not lessons. Only accessible if you have some initial knowledge. If you know what you are looking for in a broad sense. There is a lot out there. We can't exhaustively teach people, but we can say here are the tools to use if you are looking to do time series, Bayes, etc.
12. Focus on what tools are available to the community and a little bit about strengths or weaknesses. If there is a topic that has an exhaustive list of resources focus on what people are most commonly using
13. Aspire to have the structure be: here are the characteristics of the ideal statistical model tool and then go through 4-5 common ones and identify the extent to what they can or cannot do
14. Earth system model vs regression model example. Could brainstorm a decision tree with someone starting with a general problem (e.g., predict in a single lake, predict beetles across US, predict flood in this region) - then provide a bunch of general modeling types and provide list of options the person can use (e.g., regression stats, earth system model, etc) and what sort of tools are available to incorporate uncertainty in those types of models
  - a. From Rob's experience he uses the tools he is most familiar with. So it is good to provide a list of what we recommend is best, but people will most likely fall back to what they are most comfortable with.
  - b. Describe a handful of tools in more detail and then provide a longer list of useful tools.
  - c. When you have different classes of problems, there will be different sets of resources

- i. JAGS - small problems to establish conjugate relationships. STAN works better in a different situation.
  - ii. If working with Earth System model, then MCMC
  - iii. If working with Bayes - there are a lot of stand-alone tools that work with different program languages.
  - iv. STAN/JAGS can be worked with by itself, as well as working in R and Python. NIMBLE is implemented in R, there isn't a Python option of NIMBLE.
- d. Small examples can be useful. Small snippet of code to get people started. Not sure if we want to add this to the Task View, but for example could provide a link to JAGS learning materials.
- e. Don't want to duplicate resources that are already available
- f. Education team has the task to make lessons for these resources that are not available. Currently the team is assessing what is available and looking where there are gaps to fill.
- g. The Task View text has a good start on Stats side of things.
- h. Suggest rethinking the deterministic and agent based models. What are the big picture statistical challenge of working with process based models? What are the resources for calibration, uncertainty, and prediction?
  - i. What is the aim of the deterministic and agent based model section?
    - 1. If you are using process based models, what are the tools available to you for calibration, uncertainty, and prediction.
    - 2. When you have big complicated models, here are the class of tools to deal with those models statistically.
    - 3. Split into empirical and process-based models.
      - a. Machine learning is a complex empirical example, regression is a simple example
      - b. Deterministic - executables. How to do when models are simple - how to do when it is an ODE or PDE.

4. How to link statistical tools with numerical solvers
  - a. There aren't very many off the shelf tools.
  - b. Leah has package for doing Bayes for different equation models
  - c. Simple can be done in STAN
  - d. If you want to do inference or match data with individual based model, then all bets are off. You have to derive your own likelihood and implement yourself or use established tools as emulators to do inference and calibration but it is still not done well or easy.
    - i. Mention that this is a place to go. But if people are interested in using these models, then it is not a place to add it into a workflow
  - ii. Bin of differential approaches for deterministic models
  - iii. Bin of executables that you treat as black box that you call
  - iv. Not listed yet - stochastic models of some form. Stochastic population or cellular model - individual/agent based models.
  - v. Emulators would be a good subsection to add
- i. Other big ticket items that still need to be included.
  - i. Data Assimilation Tools
    1. Currently DA is split between the different modeling techniques because it looks different depending on the modeling technique
    2. But there are general purpose tools for doing Data Assimilation (e.g., DART, EMPIRE, OpenDA)
      - a. These tools wrestle with how to handle this when data gets very large. Implement software algorithm that works for large data
      - b. These are distinct from tools for calibration

3. Have a separate Data Assimilation section and an Uncertainty section separate for each Model?
    - ii. What are the Uncertainty Quantification tools?
  15. What is straightforward and has good tutorials vs what is the bleeding edge where there aren't tools
  16. Abby, Ben, Ash to tag people from this call who can provide a brain dump for the tools that they have thought a lot about
  17. There may be tools/resources available that we don't know about yet which is fine. There is a form that people can provide suggestions for new tools for the Task View and the Task Views are living documents that can be updated as needed moving forward.
- c. Data Ingest, Cleaning, Management
- i. Matt H., Jake Zwart, Chris Jones, Bruce
  - ii. Any progress on this in the last month?
    1. Nothing so far
  - iii. Don't have a leader for this Task View yet. Jake is not available to take the lead on this Task View, but he is willing to help provide input
  - iv. Hold off on this one while we work on the other two Task Views
- d. Visualization/Decision Support Tools, User Interface
- i. Abby, Ben happy to help, Chris happy to co-lead with people more familiar with R Shiny and tableau.
  - ii. The Social Science group looked over this and made suggestions in their August call. Their two big suggestions were to 1) think about visualization separate from decision support tools and 2) use case examples (static vs interactive, spatial visualization, time series, etc)
    1. Notes from the Social Science call [here](#)
    2. From the two CI/Methods and Social Science polls, we might be able to have the groups meet on Tues, Oct 20 with CI/Methods meeting by themselves from 12-12:30, joint CI/Social call from 12:30-1:30pm, and then Social Science only from 1:30-2 (or some kind of iteration on that - maybe 45 minutes for each and 30 minutes joint?)
  - iii. Whitney is interested in helping to work on this Task View.
    1. It will be good to have input from this group and the Social Science group
  - iv. The Social Science group did not feel like they had much experience with the CI side of the Visualization/Decision Support tools. So who implements Decision Support Tools? Can Melissa or Kira suggest folks to reach out to? Who are the social scientists who implement Decision Support Tools? Jody can reach out to Kira/Melissa to check in about this
  - v. A little background about where the Task Views came from - there were 12 topics that are main components of ecological forecasting that were

brainstormed during the 2019 EFI Meeting. These 12 topics were lumped into the 4 Task View Themes

- vi. The Task Views are worked on by CI and Methods because they are at the interface of CI/Methods because it is about tools.
  - vii. This Task View could coincide with visualizations for the Challenges
  - viii. Whitney and Jody will connect to reach out to people in the Methods, CI, and Social Science groups.
  - e. We want to keep moving forward with the Task Views, but we don't need to work on all 3 at the same time
2. Another opportunity to consider: Katie in Mike's lab developed the start to an RShiny app that provides forecasting outputs for 3 different forecasts.
- a. The goal is to develop the App further so it can read outputs in EFI standard and visualize the forecasts. Want to use what Katie has done as a jumping off point
  - b. Quinn has been working with Katie on this: <https://shiny.ecoforecast.org>
    - i. Single R markdown format that can take in a repo. Can pull from a repo, it goes into the CI and it shows on the Shiny server
    - ii. The framework is set up. Want to port things together. The forward facing and where it goes and the format is set up. The next step is the App development.
    - iii. Have 3 similar forecast prototypes from Katie's work that can be developed for the shiny.ecoforecast.org app
    - iv. Can't provide a generic decision support tool for all applicants, but can provide the base starting point that is then customized for each different forecast
    - v. Idea for Phase 2 of the Challenge - what about having a visualization challenge where people aren't making forecasts, but are making output
    - vi. Another idea is to have a show and tell at EFI meeting or flash talks where you show your visualization. The data under the hood is all the same, but the visualization can be different.
      - 1. The one challenge for this is scoring - how to score visualizations. Sort this out for a competition - how do you rate it? What are the criteria? Needs to be more than this is pretty/aesthetically pleasing. Need to be able to get information out of the visualizations.
  - c. Need to merge the forecast\_viz\_app with the neon4cast-shiny
3. Forecasting Workflow Updates
- a. Google doc outlining major tasks
  - b. Updates on GitHub phen-null repo or Beetle repo
  - c. Didn't get to this on today's call. Leave as a placeholder for the October call