Closing Thoughts from EESM PI Meeting—Jennie Rice, presented 8/9/24

Steering Committee co-chair for Urban and Methods in Model Integration, etc.

- Modeling the complexities of interacting human and natural systems across scales was a common challenge in several sessions I attended or co-chaired, including Urban (co-chair), Energy, Water, and Land Transitions, and Methods in Model Integration, etc. (co-chair) and I believe it is an important theme for this meeting as whole.

- The scale crossing challenge is not just about spatial or temporal upscaling or downscaling. It has different process-related manifestations:

    - multiscale individual processes,
    - individual processes interacting across scales, and
    - modeling common phenomena at different scales to understand the importance of modeling complexity for different science questions.
    - In addition, in MSD and in the E3SM GCAM coupling, for example, we layer on multiple sectors, increasing the dimensionality and complexity of modeling across scales.

- Note also that process scales intersect with spatial and temporal scales in complex ways. A single supply chain, for example, may have multiscale individual processes (e.g., crop transport is local to global and seasonal), as well as individual processes interacting across scales (e.g., food demand and biomass demands interact through regional and global crop prices; but food demands are driven by population and regional tastes whereas biomass demands are a function of regional energy system needs and price competition with other fuels.

- UC and model diagnostics are critical for all modeling but are especially important and also especially challenging for complex multiscale multi-model chains with large dimensionality. We are on the frontier of innovation at DOE for this challenge.

- This brings me to the importance of decision/societal relevance. Not only because this is the mission but also because framing UC/UQ challenges in the context of the relevant decisions can reduce their dimensionality. Not everything matters to everyone all the time. Decision-focused framing of UC/UQ provides bounds that help us identify the consequential dynamics and key uncertainties.

- This in turn makes me think about the urban IFLs and their research on urban adaptation. I believe collaboration with these projects is critical across EESM and I am excited to see the strong connections with the IFLs in the early career projects and would like to see IFL participation in future meetings like this.

- I believe we are also seeing that MSD research at the urban scale, along with the urban IFLs, the ECR projects, and urban system enhancements within E3SM, are providing foundational insights into urban systems as well as highlighting the societal relevance of EESM research.

- And finally, in several sessions I observed a common theme of a desire for more CoP type opportunities across EESM, including sharing best practices for open source modeling and reproducibility, tools, and models on particular topics such as emulation, and upscaling and downscaling/ crossing scales, as well as approaches to stakeholder engagement. Which of course all ties back to the topics of model complexity, UCUQ, and societal relevance.