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Examples of Best-Practices for Reusability and Reproducibility in a Multi-sector, Multi-scale Modeling Framework

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Abstract:

Numerical frameworks built to conduct multi-sector, multi-scale, and multi-model integrated experiments have historically overlooked the importance of maintaining reusability and reproducibility in modelling, which are fundamental to creating robust software, persistent datasets, and processes that are broadly usable by the scientific community. The Integrated Multi-sector, Multi-scale Modeling (IM3) research team has constructed a modeling system that includes both open-source and proprietary tools. This system facilitates a collaboration framework through which contributors can plan projects, document and capture model and data provenance, promote data sharing across institutions, facilitate best practices and tools for code and data repositories, utilize computational resources ranging from desktops to remote HPC, facilitate data DOI minting, and disseminate the resulting products on the web. We demonstrate the IM3 capabilities by walking through the development of one of the integrated models in the IM3 ecosystem: Demeter. Demeter was developed as an open-source Python package that was built to disaggregate projections of future land allocation generated by an integrated assessment model. Demeter is publicly available via GitHub (<https://github.com/IMMM-SFA/demeter>) and is being used by multiple research teams to explore the impacts and implications of land use and land cover change at various scales. This demonstration highlights the by-design process of planning, developing, executing, and sharing to construct reusable software, and reproducible and persistent data and processes in a complex multi-sector, multi-scale modeling ecosystem.

Keywords:

integrated modeling; framework; system; multi-model; multi-scale