CESD Cyberinfrastructure Working Groups

Environmental System Science (ESS) PI Meeting
Bolger Center, Potomac, Maryland, USA
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Model–Data Integration

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Model–Data Integration Scope

- Model–data comparison
- Uncertainty quantification (UQ) & data assimilation (DA)
- Management of model results and observational data
- Geospatial and remote sensing data analysis
- Data analytics methods and techniques, e.g.,
  - Data mining
  - Neural networks
  - Genetic algorithms
  - Other machine learning techniques
  - Visual analytics
- Model–data fusion
Short-Term Goals (2016–2018)

- Encourage archiving and versioning of publications, data, models, and software tools
  - Document best practices jointly with other Working Groups
  - Versioning for synthesized & combined data sets (e.g., FLUXNET2015)
  - Digital Object Identifiers (DOIs) for pubs, data, models, and tools

- Identify available scientific workflows, UQ frameworks, and model–data tools (e.g., ESGF, UV-CDAT, PEcAn, ILAMB)
  - What workflows are people using and when does one assign a DOI?
  - Develop a user survey to capture initial information

- Initiate subgroup on geospatial analysis and remote sensing
  - Google Earth Engine and similar useful tools are rapidly evolving
  - Identify tools and resources for geospatial data analytics
  - Individual community projects have pockets of expertise (e.g., ARM)

- Advocate for open and standard data formats & conventions
  - Engage in groups to develop standards and educate users
  - Deploy tools/APIs to transform observational data into model formats
  - Foster API consistency across multi-agency/federated data centers
Short-Term Goals (2016–2018) (continued)

• Support community activities to make observational data quickly and easily available for model evaluation (e.g., ILAMB)
  – Sponsor working groups focused on individual data sets and corresponding model metrics
  – Make AmeriFlux, NGEE Arctic, NGEE Tropics, SPRUCE, FACE, and similar data sets rapidly available to modelers by creating benchmarks

• Organize disparate uncertainty quantification (UQ) activities to foster collaboration and establish best practices
  – Standardize methods and approaches
  – Create workflows for common modeling frameworks
Progress Since 2016

- Geospatial analysis and remote sensing
  - 2017 whitepaper: *Geospatial Science to Inform Land Surface Models* (Mishra, Serbin, Wainwright, Kumar, Huang, and Chen)
- Model–data comparison and benchmarking
  - International Land Model Benchmarking (ILAMB) Workshop and Tools (described by Hoffman later)
- Archiving of publications, data, models, & software tools and open data standards & conventions
  - Data management plan plus software productivity and sustainability requirements for CESD projects
  - Work with new ESS-DIVE
  - Draw on work of ESIP, ISMC, CSDMS, EarthCube
- Uncertainty quantification (UQ) & data assimilation (DA)
  - Akuna-CLM, DART-PFLOTRAN, PEcAn
- Scientific workflows and model & data analysis tools
  - Jupyter notebooks
- Community outreach
  - AGU Fall Meeting sessions on “Computational Methods and Tools for Model–Data Integration” and “Big Data in the Geosciences” and “ML”
Path Forward

• Community survey on workflows and model–data integration tools being conducted
  – Please take this survey by the end of the ESS PI Meeting: https://goo.gl/forms/BdLCDpq1IZckhKPI3

• Preliminary results with 27 responses:
  - 56% Python
  - 33% MATLAB
  - 30% R
  - 30% Visit
  - 22% NCL
  - 19% C/C++
  - 11% IDL
  - 7% FORTAN
  - 48% Jupyter notebooks
  - 44% ILAMB
  - 15% PEcAn
  - 15% Akuna