



**NOAA
Environmental
Software
Infrastructure and
Interoperability
Program**

NE S II

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NESII

Outline

- [NESII Overview](#)
- NESII Associated Projects
 - Earth System Curator
 - Earth System Modeling Framework
 - National Unified Operational Prediction Capability
 - DoD Battlespace Environments Institute
 - NASA Modeling Analysis and Prediction Program
 - Workflow Initiatives
 - NOAA Global Interoperability Program



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Overview of NESII

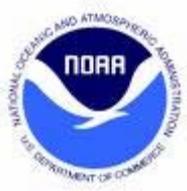
- New group at NOAA Earth System Research Laboratory in Boulder (as of Nov 1, 2009)
- Group was formerly the *Earth System Modeling Infrastructure* section at the National Center for Atmospheric Research
- Focuses on development of software infrastructure for Earth system modeling
- Includes key portions of the Earth System Modeling Framework and Earth System Curator projects
- Partners and customers are from research and operational centers, weather and climate, across NOAA, NSF, DoD, NASA and other organizations



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Earth System Curator

Background

- Collaborators include NCAR, GFDL, LLNL Program for Climate Model Diagnosis and Intercomparison, EU METAFOR project, University of Michigan, Georgia Tech, ...
- Curator project was sponsored by NSF from 2005-2008, extended through 2010 with NASA funds, new funding from NSF (Curator CoG) for 2010-2014

Activities

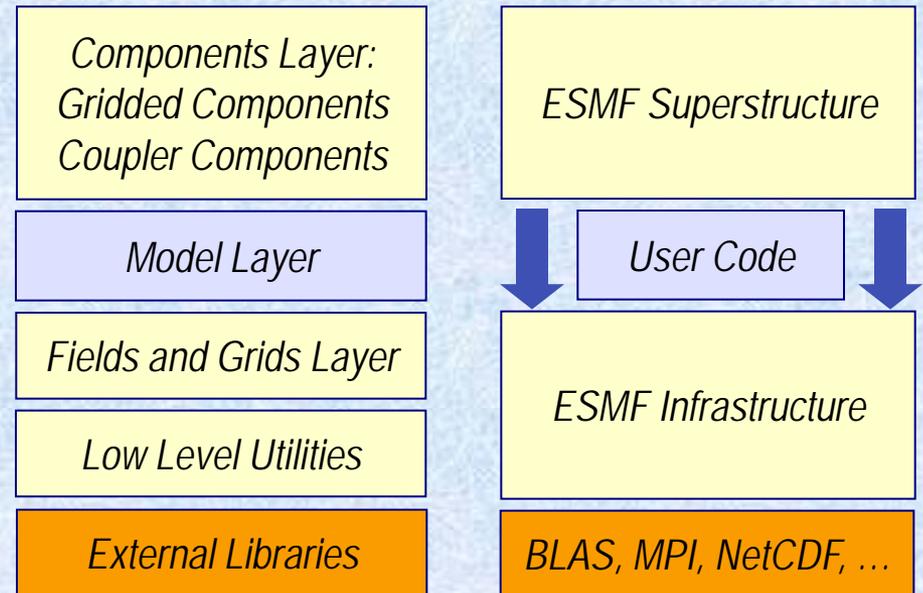
- Working with METAFOR, LLNL and others to implement user interfaces in the DOE Earth System Grid portal to connect CMIP5 simulations to detailed model and experiment descriptions
- Working with the ESMF team, the Naval Research Laboratory and others to encode metadata in applications, using COAMPS and CCSM as early examples
- Starting 2010, develop workspaces to support collaborative development and analysis, with integrated governance



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Earth System Modeling Framework

1. ESMF provides an environment for assembling geophysical components into applications.
2. ESMF provides a toolkit that components use to
 - i. increase interoperability
 - ii. improve performance portability
 - iii. reuse common utility code



Current activity areas include incorporation of ESMF into the new release of the Community Climate System Model (CCSM4), and work with operational numerical weather prediction centers on the next generation multi-model ensemble (NUOPC)



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National Unified Operation Prediction Capability (NUOPC)

- Consortium of Air Force, Navy, and NOAA modelers who are developing a multi-model ensemble for numerical weather prediction
- Interoperable components built on common standards and framework (ESMF)
- Funded through National Weather Service and Department of Defense, runs from 2010-2015, about \$1.5M/yr for infrastructure maintenance and development
- Still in final stages of negotiation



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Other application projects and programs

- Battlespace Environments Institute (BEI) – large DoD project with Army, Air Force and Navy (2005-2011)
 - Developing coupled models for operational and research purposes using ESMF
 - Mostly regional models: coastal, wave and watershed modeling, some space weather modeling
- NASA Modeling Analysis and Prediction Program (2005-2010)
 - Construction of the GEOS-5 atmospheric general circulation model and associated components
 - Many (30+) ESMF components



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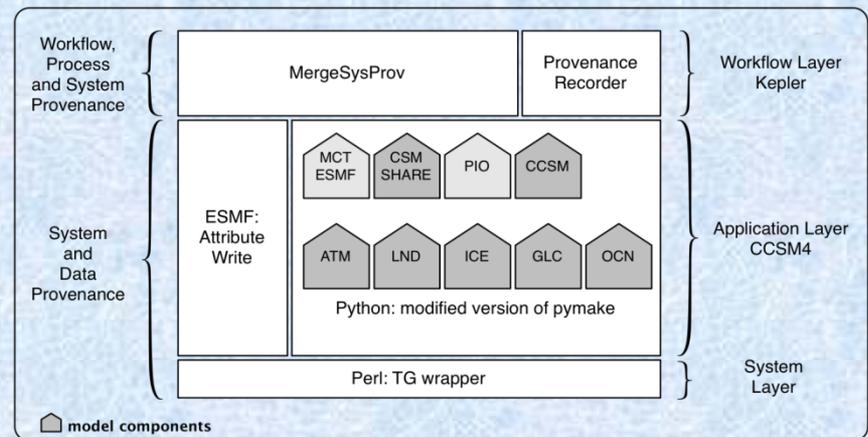
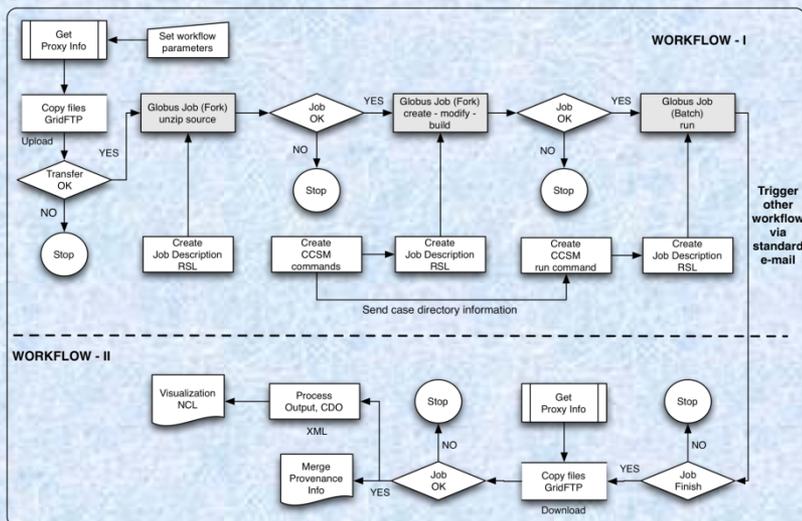
Climate Model Workflows

- Project initiated by Ufuk Turuncoglu, visitor from Istanbul Technical University, 2008-2009
- New award with NSF TeraGrid funding, partner with NCAR VETS and Purdue University: 2 years, about \$150K per year
- Create easy to use work environments for running complex models like CCSM4
- Automatically document parameter changes and other aspects of model runs
- Hide interactions with complicated computing technologies
- Archive, reproduce and share experiments

Workflow projects

- Complex workflow is captured and made reproducible using Kepler workflow software
- Ease of use and access increased by using (optional) ESMF web service component mode
- Multi-level provenance collection using scripts and ESMF Attributes
- CCSM prototype completed; now working on a WRF-ROMS coupling

CCSM two-stage execution workflow



Multiple levels of metadata generation and collection



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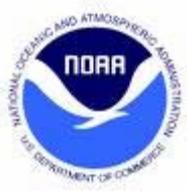
NOAA Global Interoperability Program

Goals

- Unified view of software infrastructure across functions (e.g. frameworks, data services, metadata), weather and climate domains, and agencies
- Create new paths of interaction among research and operational groups
- Advance strategies for model co-development and community evaluation of model elements
- Improve accessibility and usability of federal modeling systems

Specs

- Focus on multi-model ensembles for climate research and prediction
- Initiated FY09 by NOAA ESRL, funded through NOAA Climate Program Office
- \$3M/year for development, projects funded involve Earth System Grid, ESMF, gridspec and the netCDF team, atmospheric dynamics and physics summer schools



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Development progression

- Develop ESMF software and pools of interoperable components with standard interfaces
- Optionally cap ESMF components with web service protocols and loose coupling interfaces (e.g. OpenMI)
- Collaboratively develop and adapt metadata schemata to document component contents
- Implement the schemata in ESMF utilities so models can store, read and write structured metadata
- Build links between metadata outputs and data portals, so that model and simulation descriptions can be accessed via web interfaces
- Integrate commodity governance into science gateways to support distributed development and analysis
- Collectively create a variety of automated workflows using metadata, models, data services, and combinations of tight and loose coupling techniques