Software Development and Management Processes in the NOAA Environmental Software Infrastructure and Interoperability (NESII) Group

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Earth system modeling has undergone major changes due to the increasing power and availability of high performance computing resources. Making use of these resources has required paradigm shifts in both technical and management strategies.

The NOAA Environment Software Infrastructure and Interoperability (NESII) Group is working to help the Earth system modeling community realize the transition to the modern world of scientific computing. The aim of the NESII group is to build software to support interoperable modeling components, provide advanced utilities that many models can use, enable models to be self-describing, create workflows to automate the modeling process from beginning to end, and build workspaces that encourage collaborative, distributed development of models and data analysis. Each of these goals requires the concentrated effort of a distributed team, and a shift from traditional forms of project management.

The development style of the various NESII projects is largely influenced by the values of the open-source software movement and the need for community-driven development and ownership. This results in a strong commitment to supporting a diverse customer base and a globally distributed development environment. Formal processes have been adopted which allow customers to set priorities, and routine collaboration and public reviews allow customers, developers, and managers to monitor the implementation of new features effectively. To the extent possible, documentation and metrics are stored and displayed publicly, which helps to foster involvement across the community.

The NESII group is supported by a diverse customer base, which includes modeling groups from universities, the Navy, NCAR and other major U.S. research centers, the National Weather Service, the Department of Defense, and NASA.
Some of the individual NESII efforts include:
- The Earth System Modeling Framework (ESMF), a software architecture for composing complex, coupled modeling systems which includes data structures and utilities for developing individual models
- The National Unified Operational Prediction Capability (NUOPC), a layer that introduces conventions and templates for using ESMF and defines a "common model architecture" for interoperability

- The Earth System CoG (CoG), a project that examines organizational characteristics of community software projects and introduces a novel collaboration environment that combines project hosting and networks, metadata and data services, and support for distributed governance
- Open Climate GIS (OCGIS), a Python package designed for geospatial manipulation, subsetting, and computation of climate datasets stored in local NetCDF files or files served through THREDDS data servers, and ClimateTranslator, a GUI that is based on OpenClimateGIS
- The ESMF Python interface (ESMPy), a Python interface to the ESMF high performance regridding utility
- Cupid - a software development and user training environment for ESMF-based models
- Earth System Documentation (ES-Doc), an international effort to develop metadata services for a set of climate modeling and related projects
- Hydro-Climate Modeling, a distributed, service-based modeling system that incorporates both high performance computing and local, PC-based computing resources