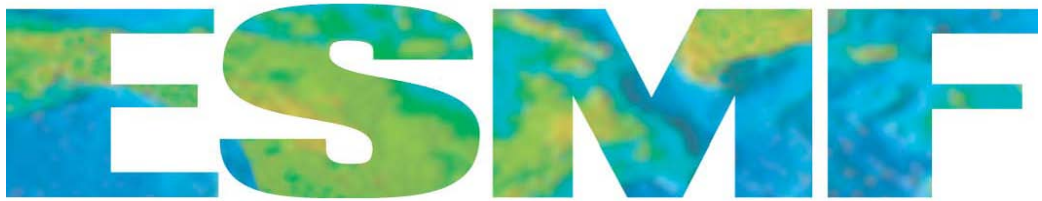


NOAA Chemical Modeling Workshop

Cecelia DeLuca / NCAR

October10, 2007

Outline

- Motivation
- About ESMF
- Development Status
- Recent Achievements & Challenges Ahead

Motivation

- National investment in computing and model development in the geophysical sciences is both *limited* and *dispersed*.
- **Therefore**, it behooves us to *leverage* this investment with a common modeling framework and shared software development.

What is ESMF?

- ESMF turns weather and climate models into collections of components (atmosphere, ocean, radiation, etc.)
- ESMF provides coupling tools to connect components
- ESMF offers common utilities that components use for services such as time management, configuration, and message logging

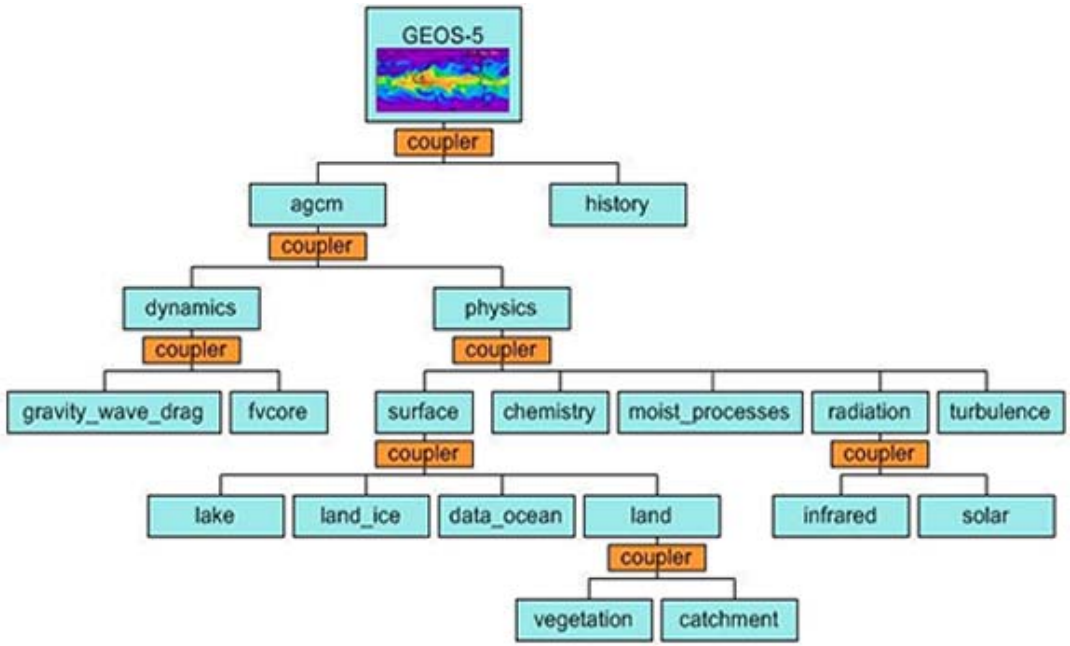
About the ESMF project …

- Now in its fifth year
- 58 ESMF components and growing - a critical mass within the modeling community
- Used in NOAA GFS, HYCOM-CICE, GEOS-5, COAMPS-NCOM, and other applications
- Multi-agency sponsorship and governance, many diverse partners (NSF, NASA, DoD, NOAA, university)

For more information - http://www.esmf.ucar.edu

ESMF Architecture

- Hierarchical, component based architecture
- Enables
  - Swapping components between applications
  - Coupling diverse components



Standard component interface for geophysical components and couplers:

call ESMF_GridCompRun (component, importState, exportState, clock, phase, blockingFlag, rc)

Each component has an Initialize, Run, and Finalize method with the standard interface.

ESMF Development Status (last public release, 2.2.2r)

- Serial or parallel execution
- Components can run concurrently or sequentially
- Single executable support, some support for multiple executables
- Support for model ensembles
- Logically rectangular, unstructured and multi-patch grids can be represented in index space and regridded using a general sparse matrix multiply. Users must supply their own interpolation weight matrices (in beta for FY07).
- Utilities such as time manager, message logger, and resource file manager are usable and adding features
- Fortran interfaces and complete documentation, increasing number of C interfaces
- Distributed with Reference Manual, Users Guide, ~2500 tests and examples

Upcoming releases

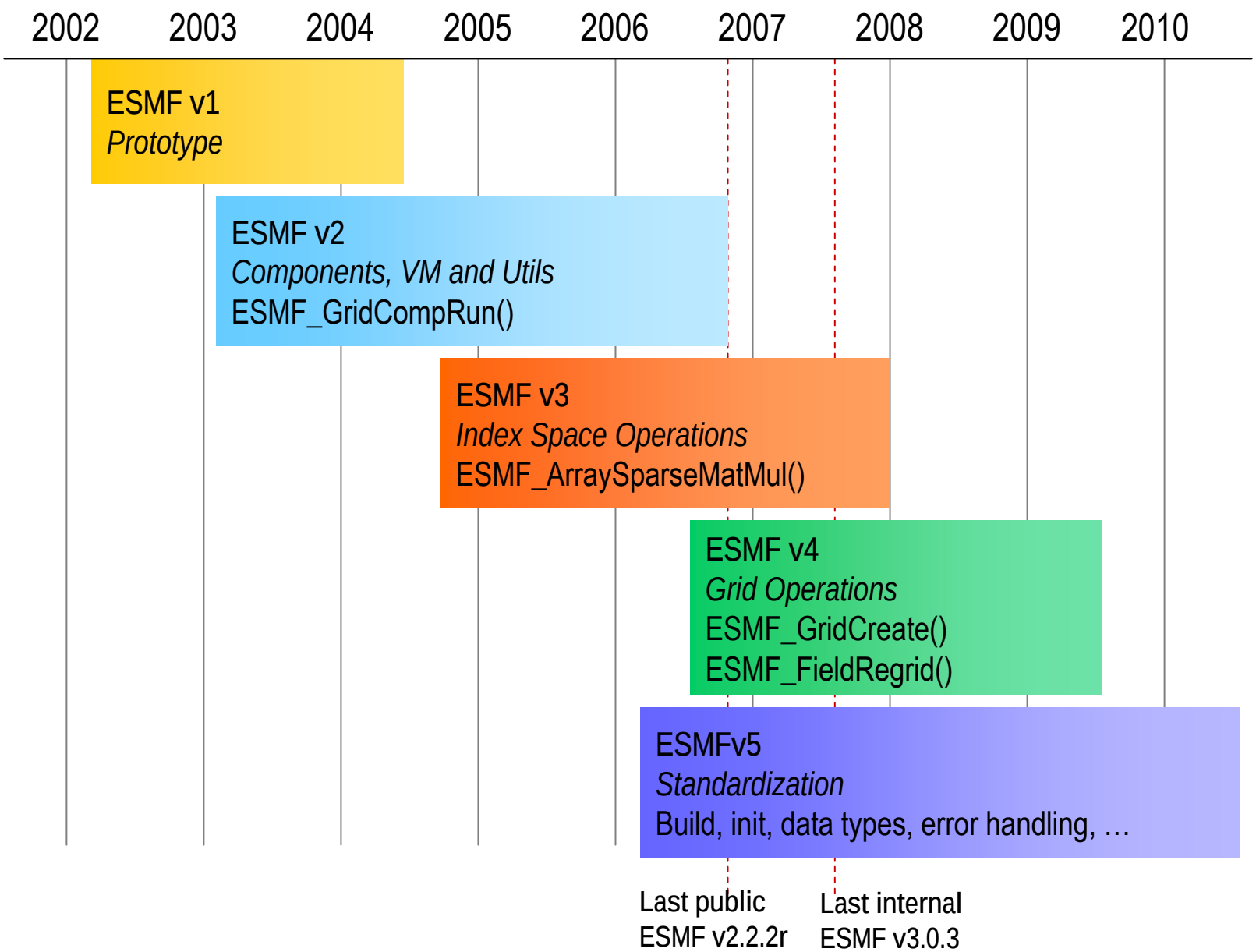
ESMF 3.1.0r, public release

- Scheduled late winter 2008
- Representation of logically rectangular, curvilinear, and multi-patch grids in production mode
- Optimized, scalable index space regridding and communications in production mode

ESMF 3.1.1, beta release

- Scheduled late winter 2008
- Very general parallel interpolation weight generation package (underlying grid representation is 3D, unstructured)

ESMF Release Plan



ESMF Platform Support

The following platforms are regression tested nightly and fully supported in ESMF v3.0.3:

- IBM AIX
- SGI IRIX64
- SGI Altix
- Cray X1
- Linux Intel
- Linux PGI
- Linux NAG
- Linux Absoft
- Linux Lahey
- Mac OS X with xlf
- Mac OS X with absoft
- Mac OS X with NAG

User contributed support (not regression tested)

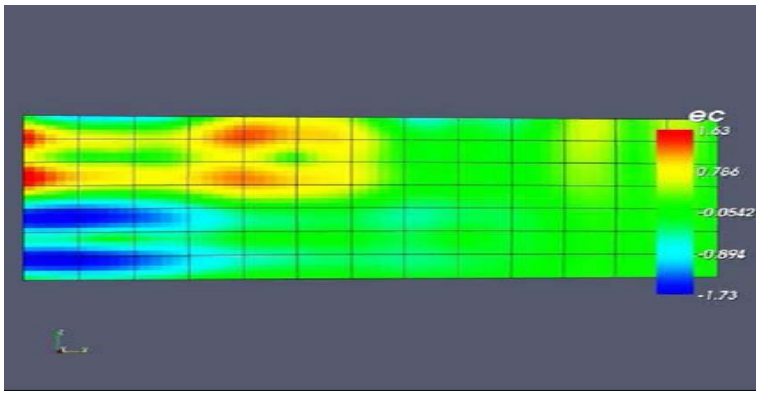
- g95
- Cygwin

Recent Achievements and Activities

- Successfully passed Community Climate System Model (CCSM) Stage 1 Plan showing < 5% overhead in time to solution on a range of platforms, memory use comparable to native infrastructure.
- Development of a component catalog within the NCAR/DOE Earth System Grid/Community Data Portal
  - Browse, search, and download datasets, components, and models
  - Sanity-check type compatibility checks (same calendar, platform, framework, …)
- ESMF Interoperability and Integration Initiative (ESMF-I3) started May 2007 to further the transition from collections of component to integrated systems.
  - Clearer compliance definition
  - Introduction of metadata to increase automation
- New ESMF award from NOAA: NOAA ESMF-based Modeling Architecture.
- New ESMF supplement from DoD: $1.5M over three years for the Battlespace Environments Institute.

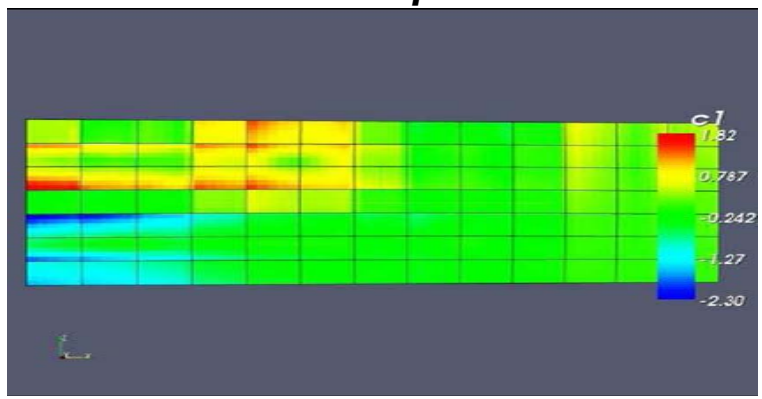
Analytic Wind Stress Interpolation Using Patch Recovery

Exact curl

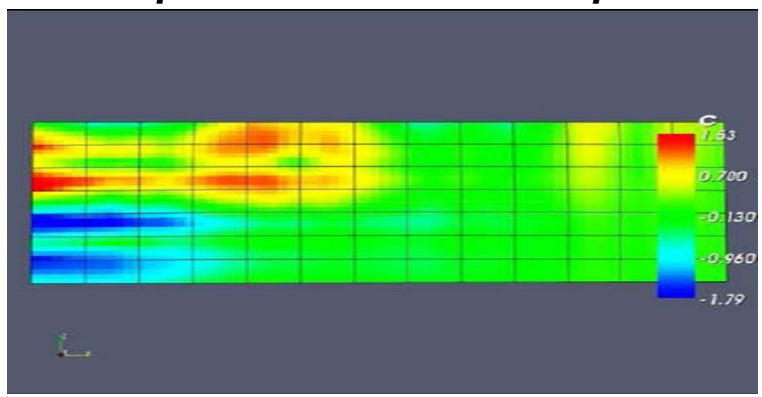


Work conducted by David Neckels/ESMF in collaboration with Bill Large of the ocean modeling section at NCAR.

Curl of bilinear interpolant



Curl of patch-recovered interpolant



ESMF Organizational Summary

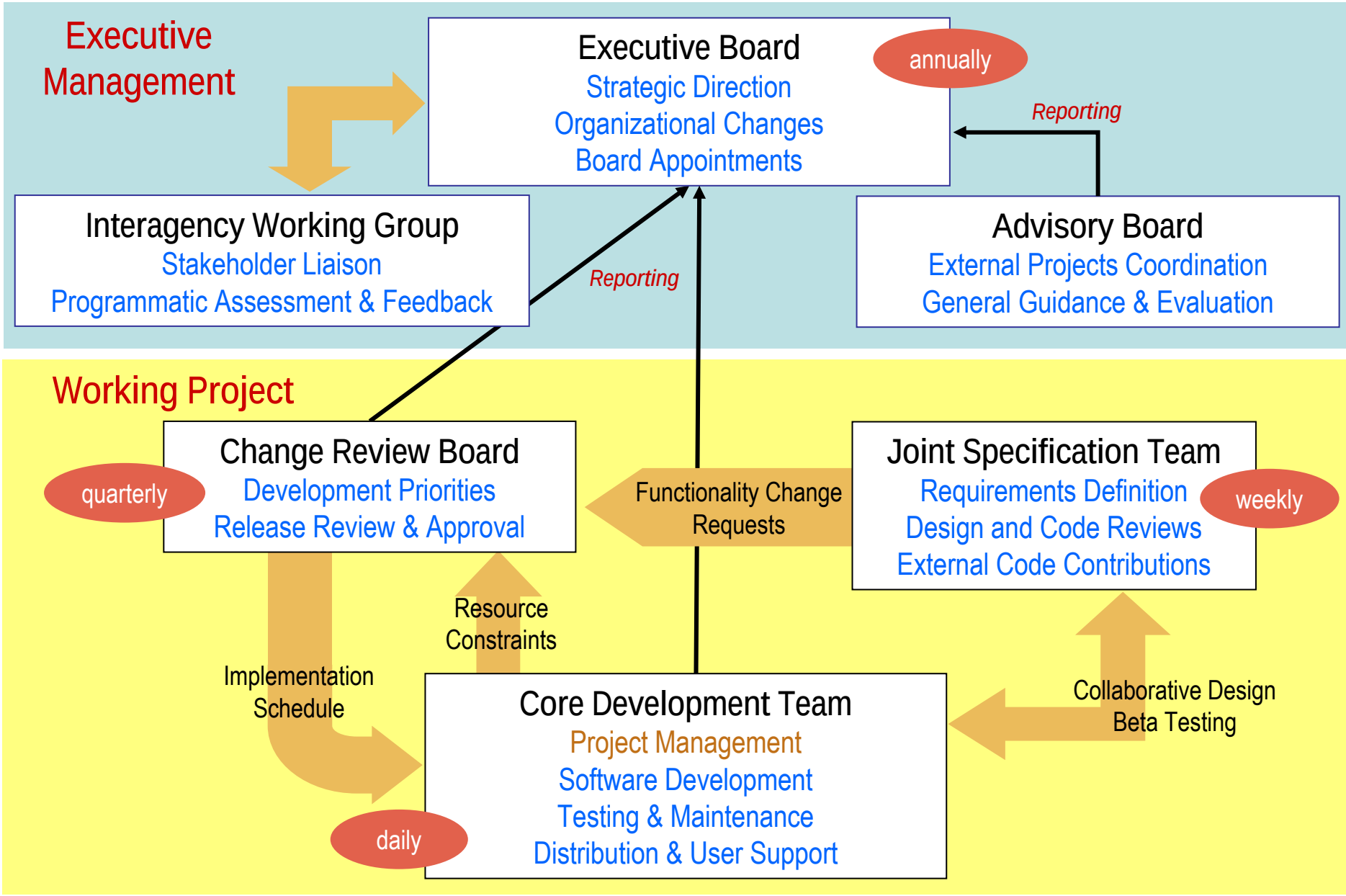
Working Project: Day-to-Day Operation

- Core Team – team responsible for ESMF software implementation and user support (now ~12 people)
- Change Review Board (CRB) – multi-agency board that meets quarterly via telecon to set development priorities
- Joint Specification Team (JST) – ESMF users who participate in weekly telecons that cover design reviews, code reviews, and other technical topics

Executive Management

- Executive Board – body that sets high-level direction and controls the structure of the ESMF organization
- Advisory Board – offers general guidance to the Executive Board
- Interagency Working Group (IAWG) – group of program managers that provides programmatic direction and advocacy

ESMF Governance



Key Challenges and Strategies

- Ensuring software quality, capability, and performance for operational and research customers
  - Development priorities set by customers
  - Exhaustive nightly regression testing
  - Responsive customer support
- Working towards the goals of easier model construction, use, and exchange
  - Constantly communicating with customers
  - Not getting sidetracked by computer science fads and fanciness