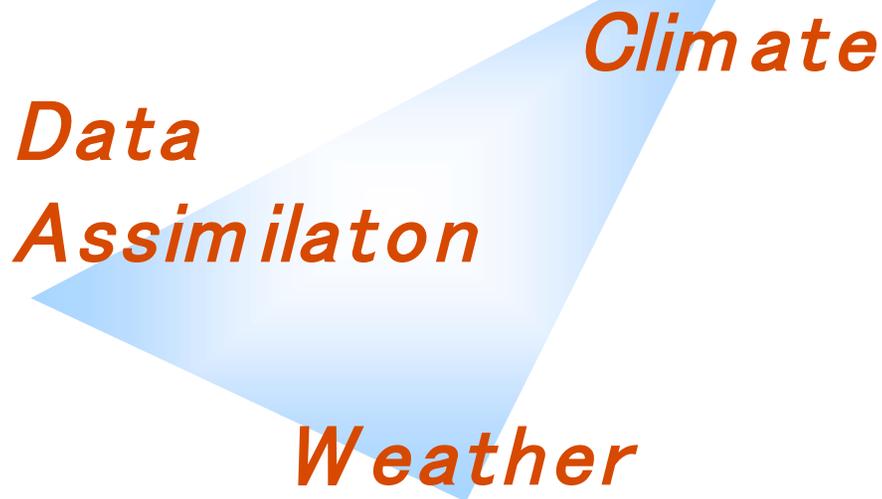




Building Community and Capability through Common Infrastructure: ESMF and the Earth System Curator



Cecelia DeLuca
cdeluca@ucar.edu

MAP Meeting
College Park, MD
March 7-9, 2007



Modeling Evolution



- Monolithic codes *to* modular, **coupled**, component-based codes
- Institutional development *to* collaborative, distributed development
- Disjoint workflows *to* linked workflows (model assembly, run, archival, ...)
- Models with few configuration options *to* modeling environments with many

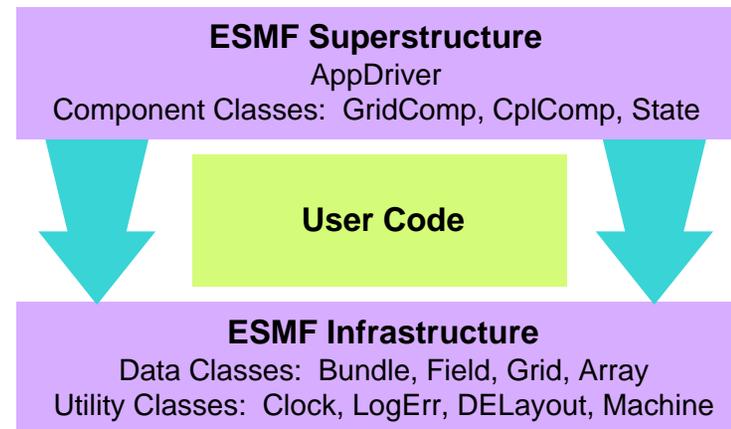
We envision a community where each modeling group locally develops its own software – but where **interface standards, common tools and component and data catalogs** are in place that enable the community to readily build, survey, obtain, combine and use a wide variety of modeling components and models.



Components and ESMF



- ESMF provides **component wrappers** with standard interfaces and standard drivers.
- ESMF provides data structures and **common utilities**, such as data communication, time management, configuration, and message logging



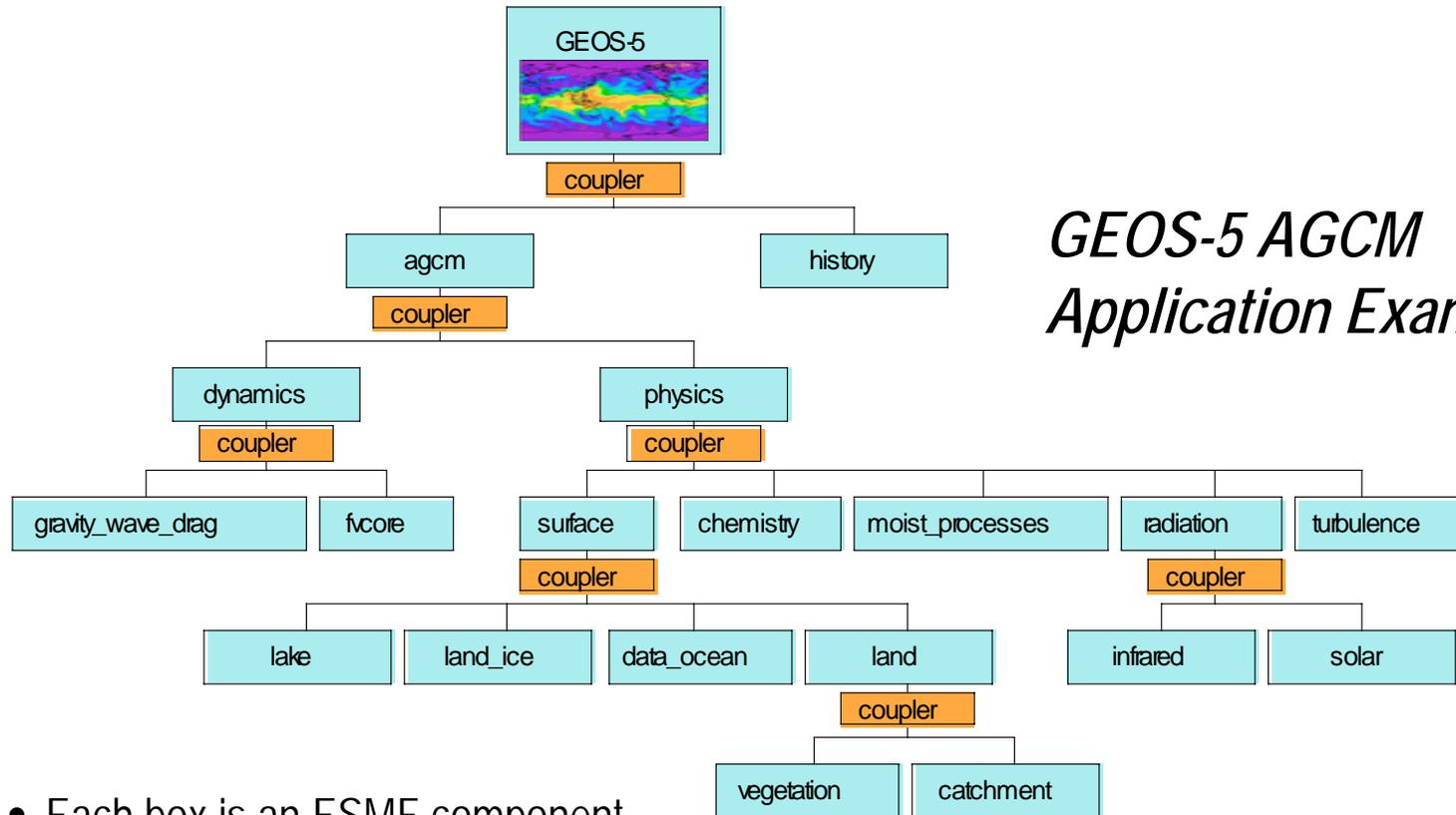
About the ESMF project ...

- Now in its fifth year
- Funded through multi-agency support, mainly NASA, NSF, DoD
- Component interfaces are currently used by NCEP, GEOS-5, MOM4, HYCOM, ADCIRC, other Department of Defense codes, CICE, WRF, others

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



ESMF Application Example



GEOS-5 AGCM Application Example

- Each box is an ESMF component
- Every component has a standard interface to encourage “swappability”:
subroutine `Comp_Run(comp, importState, exportState, clock, rc)`
- Hierarchical architecture enables the systematic assembly of many different systems



ESMF Releases



2002 2003 2004 2005 2006 2007 2008 2009 2010

ESMF v1
Prototype

ESMF v2
Components, VM and Utils
ESMF_GridCompRun()

ESMF v3
Index Space Operations
ESMF_ArraySparseMatMul()

ESMF v4
Grid Operations
ESMF_GridCreate()
ESMF_FieldRegrid()

ESMFv5
Standardization
Build, init, data types, error handling, ...

ESMF v2.2.2r ESMF v3.0.1



Earth System Curator



- NSF-funded (leads NCAR ESMF/ESG, GFDL, MIT, GA Tech), just starting second year
- Developing a set of tools that allows climate modelers to:
 - archive and query models, experiments, model components, and model output
 - test the technical compatibility of model components
 - assemble and run multi-component models
- Prerequisite is **metadata development** – Curator works closely with European groups and PCMDI to develop international conventions for model architecture, coupling specifications, and grids



Spanning the Gap Between Models and Datasets



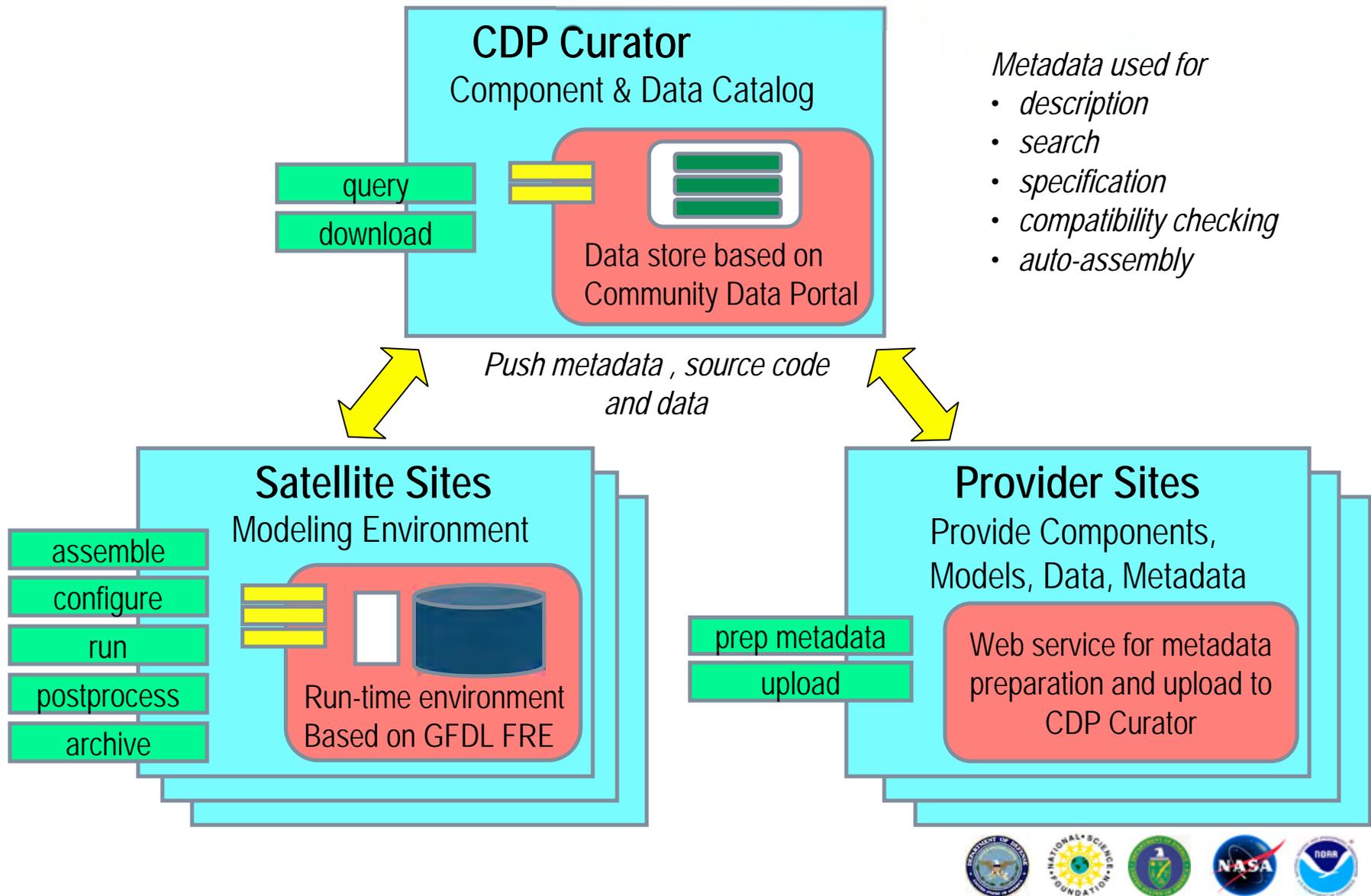
Curator Architecture



- The three pieces of the of the Curator architecture are:
 - **CDP Curator**, a catalog of models, components and data (based on existing NCAR/DOE *CDP/ESG BasePortal Technology*)
 - **Satellite sites** which house software for assembly and execution of modeling experiments (based on GFDL *FMS Runtime Environment*)
 - **Provider sites** that supply models and components to the CDP Curator via a web service interface
- Compatibility checking and automated assembly rely on *ESMF standard interfaces*
- For more information - <http://www.earthsystemcurator.org>



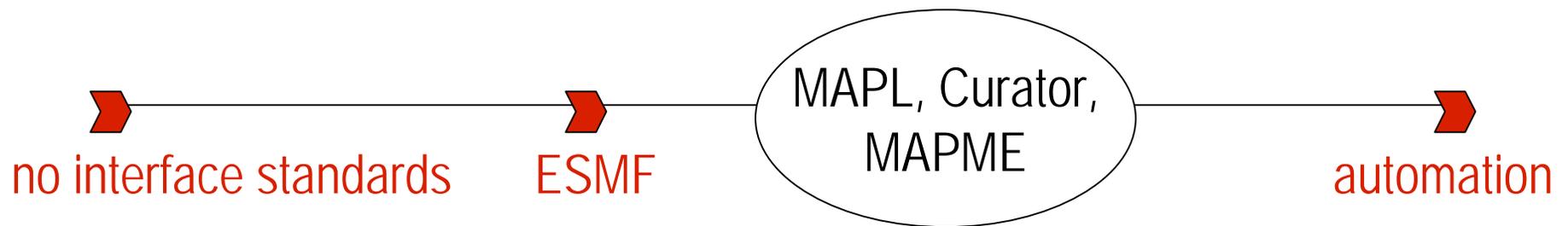
Curator Architecture



Infrastructure Challenges



How do we increase model interoperability throughout a broad community beyond what ESMF alone can do? And how do we define and measure success?



NEED: Broadly accepted conventions and metrics for modeling component interoperability

- What level of interoperability is desired, and what is required to achieve it - time and sequencing rules, metadata ... ? Balance with effort and intrusiveness?
- Would ESMF compliance standards and "certification" be useful or threatening to modelers (or both?)
- How deep does ESMF need to go to be useful (high level wrappers? physics/dycores? parameterizations?)
- What metrics best measure interoperability?

