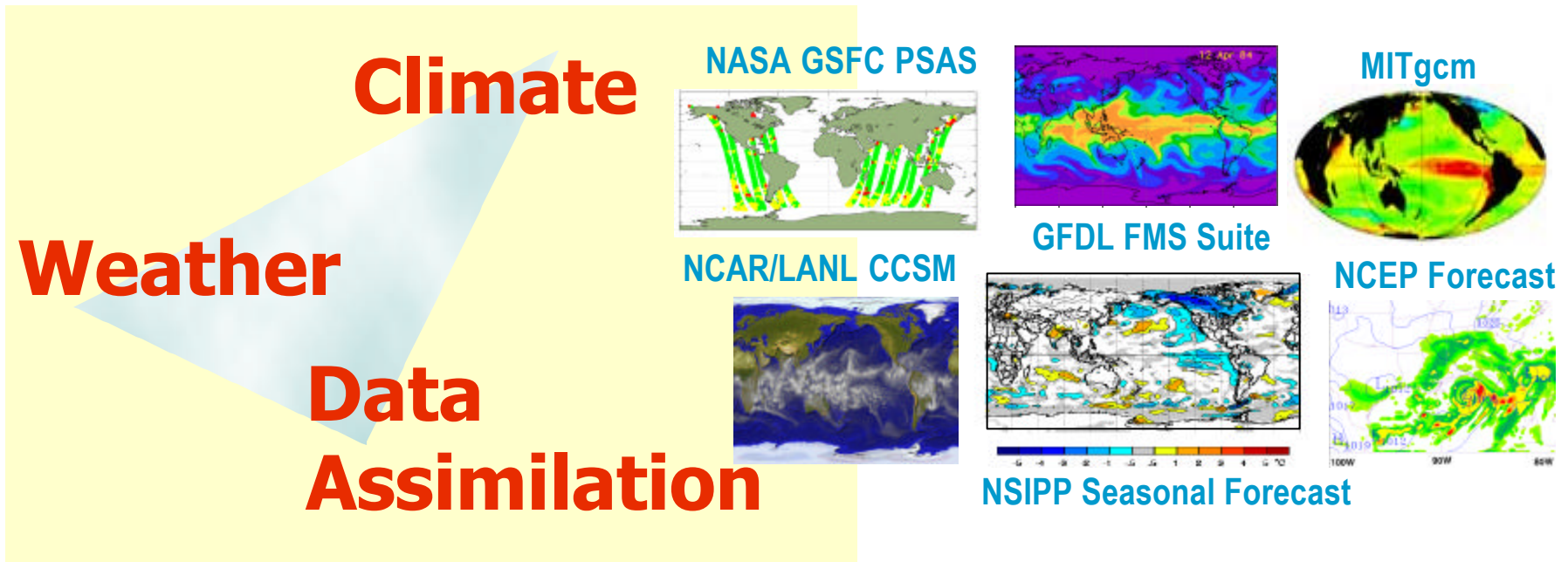


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Architecture of the Earth System Modeling Framework



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ESMF Project Description

GOALS: To increase software reuse, interoperability, ease of use and performance portability in climate, weather, and data assimilation applications

PRODUCTS:

- Core framework: Software for coupling geophysical components and utilities for building components
- Applications: Deployment of the ESMF in 15 of the nation’s leading climate and weather models, assembly of 8 new science-motivated applications

METRICS:

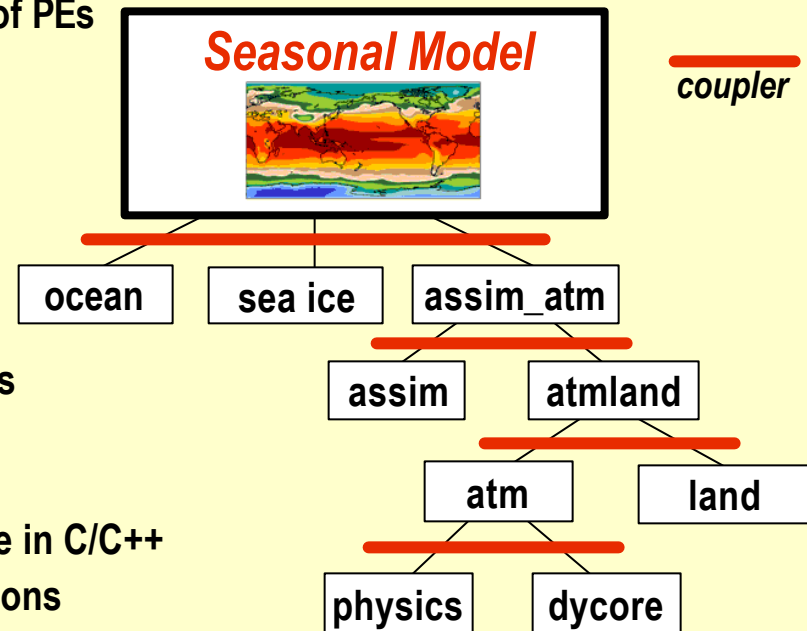
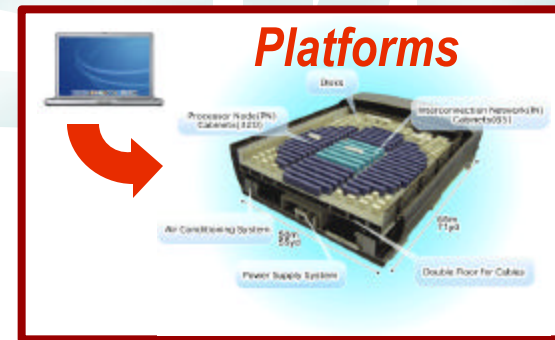
Reuse	Interoperability	Ease of Adoption	Performance
15 applications use ESMF component coupling services and 3+ utilities	8 new applications comprised of never-before coupled components	2 codes adopt ESMF with less than 2% SLOC changed, or within 120 FTE-hours	No more than 10% overhead in time to solution, no degradation in scaling

RESOURCES and TIMELINE: \$10.1M over 3 years



Computational Characteristics of Weather/Climate

- Applications solve time-dependent PDEs
- Mix of global transforms and local communications
- Load balancing for diurnal cycle, event (e.g. storm) tracking
- Applications typically require 10s of GFLOPS, 100s of PEs – but can go to 10s of TFLOPS, 1000s of PEs
- Required Unix/Linux platforms span laptop to Earth Simulator
- Multi-component applications, combined data/task parallelism
- Component hierarchies, ensembles, exchanges and multiple contexts
- Data and grid transformations between components
- Applications may be SPMD/MPMD, concurrent/sequential, combinations
- Most applications are implemented in Fortran, some in C/C++
- Parallelization via MPI, OpenMP, shmem, combinations
- Large applications (typically 100,000+ SLOC)



ESMF Class Structure

