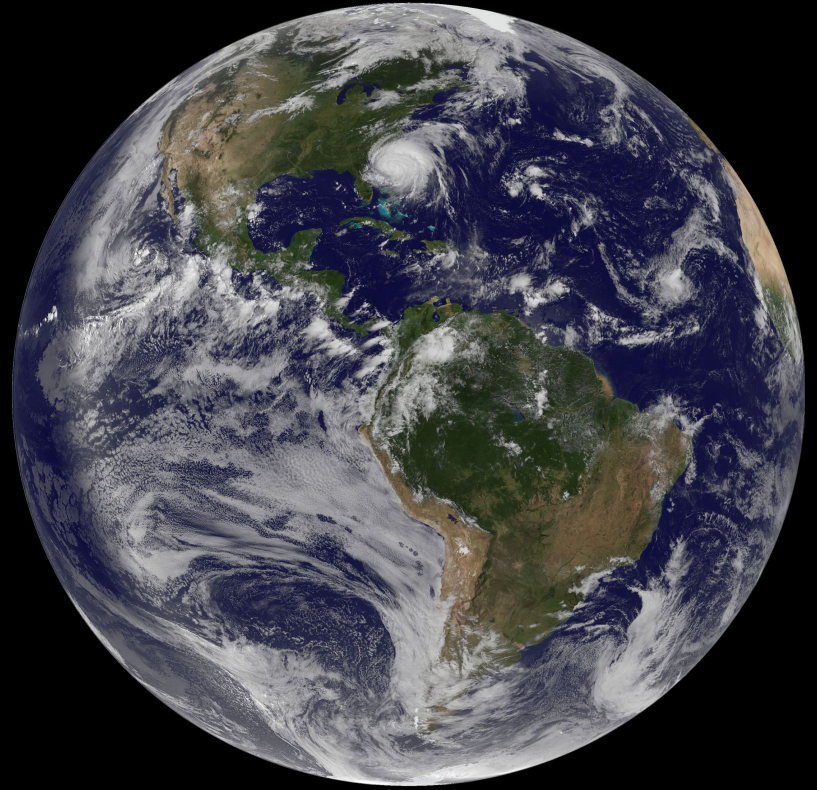


ESMF Update

Ann Tsay

September 9, 2025



ESMF Overview

The **Earth System Modeling Framework (ESMF)** is a **high performance parallel software infrastructure** used in coupled Earth science applications.

Offering:

- Standardization of models data representation
- Regridding Methods for different use cases
- Flexibility of coupling implementation
 - NUOPC-based
 - Direct coupling
 - C API
- Optimization Improvement
- Accelerator Device Management (GPU)



Remap/Regrid Methods

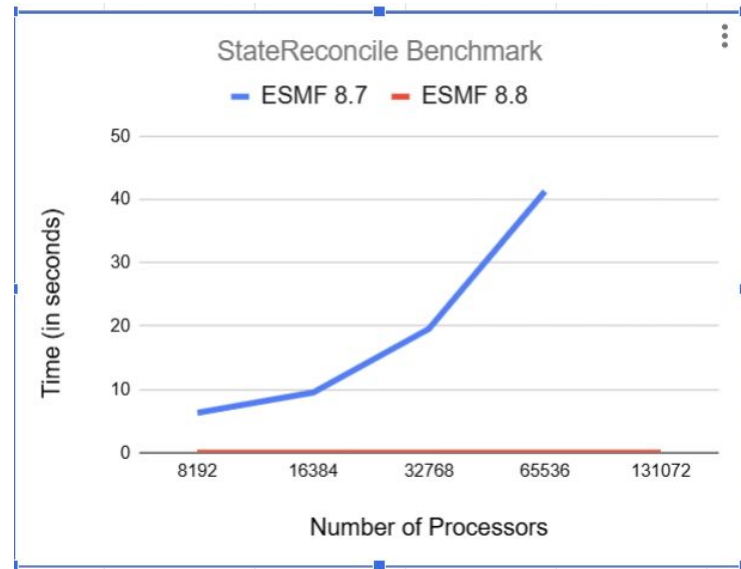
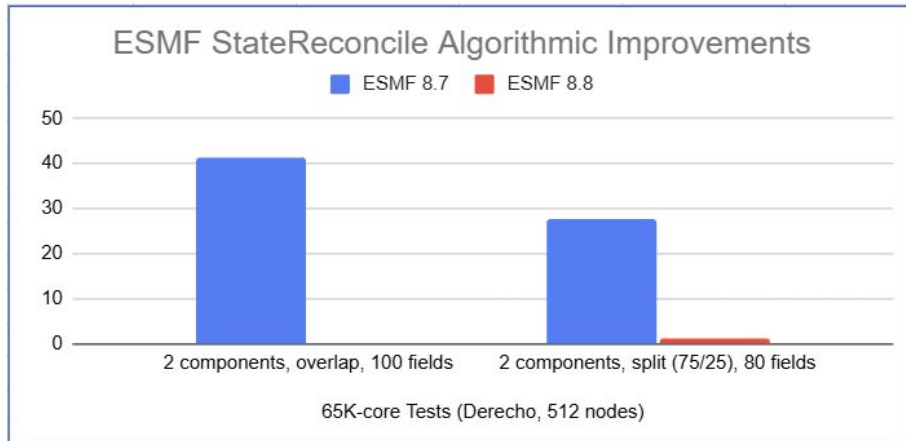
Name	Pros	Cons	Typical Uses
Bilinear	Smooth	Non-conservative	Interpolation of state variables (e.g. temp.)
Patch	Very smooth including derivatives	Values can go outside src range, Non-conservative	Interpolation of state variables where you want them to be very smooth (e.g. wind stress)
Conserve	Preserves integral over an area for values between src and dst	Can be blocky with a coarser src than dst	Interpolation of fluxes or other quantities in cases where you need the total amount to be preserved
Conserve 2nd	Preserves integral over an area for values between src and dst	Values can go outside src range	Interpolation of fluxes or other quantities in cases where you need the total amount to be preserved, but want a smoother result than the above
Nearest SToD	Exactly copies existing values, dst point doesn't need to be within src grid	Not smooth, Non-conservative	Interpolation of values that you don't want blended (e.g. land type), extrapolation
Nearest DToS	Preserves sum of values between src and dst, dst point doesn't need to be within src grid	Not smooth, Non-conservative	Discharging river run off into a body of water

Flexibility of Coupling Implementation

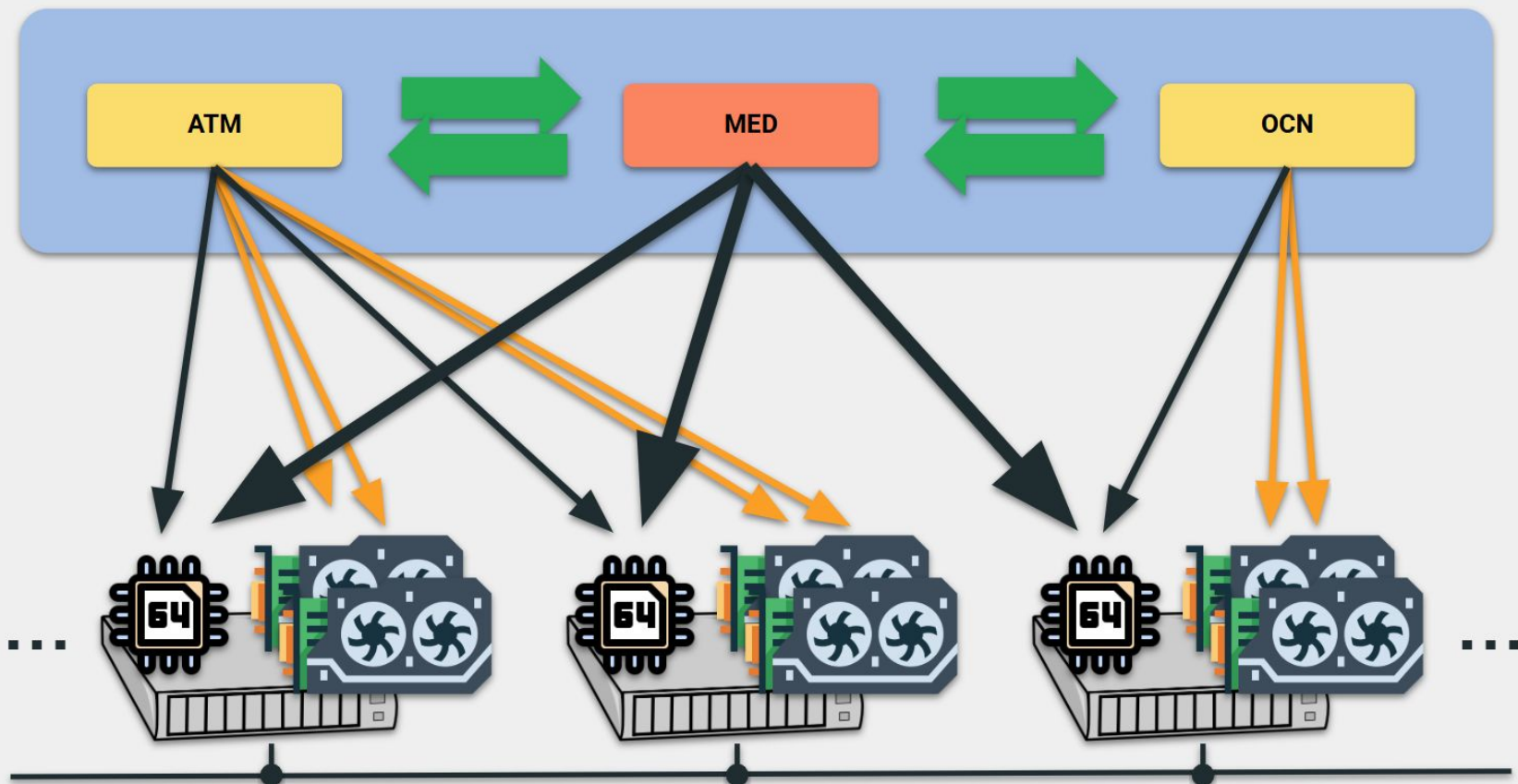
- **NUOPC Coupling**
 - Minimize internal model modifications for coupling with other coupled systems.
 - Demonstrated coupling of different language models
 - C
 - Fortran
 - Python
 - Julia
 - Enhance C API targeting AI/ML models and other new languages
- **Close Coupling via reference sharing (provided by NUOPC)**
 - i.e. no copying needed - to improve performance
 - UFS for CHEM coupling
- **Functional Coupling Approach (without NUOPC)**
 - One component can call the other function from another component directly.
 - Attachable method that you can call from another component (e.g. NASA GEOS)

ESMF Optimization - "State Reconcile"

Version 8.8.0 : Performance Optimization:
state_reconcile function improvement



Device Resource Management (including GPU)



Future Roadmap

Always ready to answer community questions via esmf_support@ucar.edu or Github Discussion board.



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**Gerhard
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**Ann
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The ESMF Core Team is primarily housed within NCAR's CGD Lab, Boulder, Colorado.

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