A Use Test Case for Multi-Component Regridding in ESMF

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What is ESMF?

The Earth System Modeling Framework (ESMF) is software for building and coupling weather, climate, and related models.

It has been used to componentize models such as the GEOS-5 climate model of NASA.
Description of the Problem

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- Implement Two-Way coupling.
- Implement Grid Class capabilities that are currently being developed.
Interpolation

- The interpolation is done using ESMF’s Sparse Matrix Multiply routine.
- This algorithm generates a sparse matrix from a list of weight values and uses this to transfer data from one matrix (grid) to another.

\[
\text{do } k=1,\text{NumWeights} \\
\quad \text{DestinationField( address(2,k) ) } = \text{Weights(k)} * \\
\quad \quad \text{SourceField( address(1,k) )} \\
\text{enddo}
\]

- The file used to read in the weights was generated using the SCRIP package of Los Alamos National Laboratories.
File I/O

- All file handling was done with netCDF

- Both grids are read in the initialization phase of the program

- Grids are read into gridded components and weights files are read into a coupler component

- The results of the interpolation are written to another netCDF file
Use Case Structure

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- Finalize
Visualization

- Given the netCDF format of all I/O files, the NCAR Command Language (NCL) was used for visualization.

One of the input fields for this use test case:

\[ \text{Field}(i, j) = 100 + 100 \times e^{\left(-2.25 \times (\cos^{-1}(\cos(\text{lat}) \times \cos(\text{lon})))^2\right)} \]
Test Configuration

Programming Language: mixed Fortran77 and Fortran90
Platform: Apple G5, Darwin/Absoft/LAM (Glass)
Platform: SGI IRIX64 (Tempest)
Platform: IBM Power5 (Bluevista)
Communications: MPI
Processors: 6 for each component
Results

The Raw and Relative error in the forward interpolation:

The Raw and Relative error in the backward interpolation:
Future Work

Implement **Function Pointers** for facile definition of the analytic interpolation fields

Continue implementation of new and developing **Grid Class** functionality
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References