# Multi-Scale Synthesis and Terrestrial Biospheric Model Intercomparison Project (MsTMIP)

## MsTMIP Team:

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Deborah Huntzinger (Science PI)</td>
<td>University of Michigan</td>
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<td>Anna Michalak (PI)</td>
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<td>Kevin Schaefer</td>
<td>NSDC, Univ. of Colorado</td>
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<td>Andrew Jacobson</td>
<td>NOAA, Univ. of Colorado</td>
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<td>Mac Post; Robert Cook; Yaxing Wei</td>
<td>Oak Ridge National Lab</td>
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## Collaborators

- Peter Thornton
- Forrest Hoffman
- Rama Nemani
- Weile Wang
- Josh Fisher
- Philippe Ciais
- Nicolas Viovy
- Philippe Peylin
What is driving the variability seen in the model estimates?

Terrestrial Biospheric Modeling Inputs
- **Consistent boundary conditions**
  - Soil properties
  - Vegetation type
  - Land management
  - Elevation
- **Consistent forcing data**
  - Daily weather
  - $\text{CO}_2$ concentration pathways
  - N-deposition history
  - Land-use/land cover changes
- **Common implementation protocol**
  - Spin-up procedures
  - Ensemble generation
  - Factorial model experiments

Model Outputs
- Standard units, space/time resolution
- netCDF/CF-1 format

Inverse Model Outputs
- Standard units, space/time resolution
- netCDF/CF-1 format

Model Simulations
- Site, Regional Global

Observations and Measurements
- **Global**
  - Atmospheric $\text{CO}_2$ measurements
  - Satellite observations
  - Global weather models
- **Regional**
  - Regional weather models
  - Continental $\text{CO}_2$ measurements
  - Forest inventories
  - Agricultural production statistics
- **Site**
  - Intensive field campaigns
  - Eddy covariance fluxes
  - Local survey data

Analysis: Diagnostic benchmarks, fingerprint analysis, prediction inter-comparison
MsTMIP Overview

• Three scales of estimation
  – Global (0.5° by 0.5°)
  – Regional (North America) (0.25° by 0.25°)
  – Site level – with regional meteorology

• Consistent driver data

• Formal protocol

• Model evaluation framework built off of C-LAMP (now iLAMB)

• Model team support (mini-grants)
### Baseline Simulations

<table>
<thead>
<tr>
<th>Domain</th>
<th>Simulation Name</th>
<th>Simulation Period</th>
<th>Climate Forcing</th>
<th>Land-Use &amp; Disturbance History</th>
<th>Atmospheric CO$_2$</th>
<th>Nitrogen Deposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global (0.5° x 0.5°)</td>
<td>BG1</td>
<td>1901-2008</td>
<td>CRU+NCEP</td>
<td>Time-varying</td>
<td>Time-varying</td>
<td>Time-varying</td>
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<tr>
<td>North America</td>
<td>BR1</td>
<td>1980-2008</td>
<td>NARR$^1$</td>
<td>Time-varying</td>
<td>Time-varying</td>
<td>Time-varying</td>
</tr>
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Provide a model’s best attempt at representing the spatial and temporal distribution of land-atmosphere carbon flux as influenced by:

**Climate, land-use / disturbance, and nutrient deposition**
## Sensitivity Simulations

<table>
<thead>
<tr>
<th>Domain</th>
<th>Simulation Name</th>
<th>Simulation Period</th>
<th>Climate Forcing</th>
<th>Land-Use &amp; Disturbance History</th>
<th>Atmospheric CO₂</th>
<th>Nitrogen Deposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global (0.5° by 0.5°)</td>
<td>SG1</td>
<td></td>
<td></td>
<td>Constant</td>
<td>Constant</td>
<td>Constant</td>
</tr>
<tr>
<td></td>
<td>SG2</td>
<td>1901-2008</td>
<td>CRU+NCEP</td>
<td>Time-Varying</td>
<td>Constant</td>
<td>Constant</td>
</tr>
<tr>
<td></td>
<td>SG3</td>
<td></td>
<td></td>
<td>Time-Varying</td>
<td>Time-Varying</td>
<td>Constant</td>
</tr>
<tr>
<td>North America (0.25° by 0.25°)</td>
<td>SR1</td>
<td></td>
<td></td>
<td>Constant</td>
<td>Constant</td>
<td>Constant</td>
</tr>
<tr>
<td></td>
<td>SR2</td>
<td>1980-2008</td>
<td>NARR¹</td>
<td>Time-Varying</td>
<td>Constant</td>
<td>Constant</td>
</tr>
<tr>
<td></td>
<td>SR3</td>
<td></td>
<td></td>
<td>Time-Varying</td>
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</tr>
</tbody>
</table>

Help to **partition** observed NEE among processes such as climate variability, CO₂ fertilization, nitrogen limitation, current land management, and the recovery from historical land use and disturbance.