Perturbed-parameter Simulations of the MJO with CAM5

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Motivation and Approach

- Modelers would like to understand how their climate models could better simulate an MJO
  - CAM5 is noticeably worse than CAM4 which was quite good (Lawrence et al. 2007). Why?
- We systematically explore the dependencies of CAM5's MJO simulation on uncertain parameters, with a "perturbed-parameter ensemble" technique
  - To what extent do the parameters control the interactions of the parameterized processes and influence the MJO?
  - Are better MJOs within tuning ranges? Or are new parameterizations needed?
- We wish to more fully explore the range of model MJO behaviors as a function of parameters

Perturbed Parameter Simulations

"Climate":
- CAM5.1 @ 2° resolution
- 5-year "AMIP" simulations (i.e. prescribed SSTs for 1998-03)
- Two ensembles:
  - Perturbed each of 22 parameters in CAM's physical parameterizations: ONE-AT-A-TIME
  - Simultaneously perturb 22 parameters using Latin Hypercube Sampling (LHS) (# of simulations = 1100)
- These simulations were performed for another project → Only hourly (total) precipitation is available for our analysis

Parameters Varied

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value Range</th>
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</thead>
<tbody>
<tr>
<td>dmpdz</td>
<td>0.5 – 1.0</td>
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<tr>
<td>c0_ocn</td>
<td>0.2 – 0.5</td>
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<tr>
<td>tau</td>
<td>0.6 – 1.0</td>
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<td>conv_ke</td>
<td>0.5 – 1.0</td>
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<td>zmconv</td>
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</tbody>
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Deep convection parameters matter

Future Work

- More diagnostics from longer simulations for selected runs
- Would an improved simulation result if we just change the parameters that are important, rather than all 22 simultaneously?
- Would we get a different impression from coupled-ocean atmosphere modeling?
- Comparison with hindcasts results (not shown today):
  - Differences: c0_ocn is unimportant for precip in hindcasts 
  - Similarity: shorter tau is a better solution

Acknowledgements

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