Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-653-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: Simultaneous fully dynamic characterization of multiple input-output relationships in climate models" *by* Ben Kravitz et al.

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Received and published: 18 September 2016

In this paper, Kravitz and co-authors introduce the System Identification (SI) technique to probe the linear dynamical response of climate models to localized perturbations. They demonstrate that by perturbing the temperature of adjacent regions of the ocean with orthogonal noise and then filtering the global response by the the time series for each region, they can approximately reproduce the effect of a step change in temperature in one of those regions on the low cloud and surface latent heat flux fields.

While I found the approach intriguing, I feel that there are three key analysis steps missing from a publishable paper. First, since the study reported here involved three simulations using the SI procedure, it seems odd that only ensemble means, but no

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Discussion paper

ensemble variability was shown. The results were said to be robust across the three runs, but why not show the readers the variability? Why not perform a few more runs, so that some measure of statistical significance of the results could be shown, for example by stippling, in the figures?

Second, there's little discussion of the character of the differences between the step-change runs and the SI results. What's going on with the synoptical scale variability in latent heat flux found in the mid-latitude storm tracks in SI runs (figure 4, middle row, right column)? Are these natural modes of variability whose frequency happens to correspond to the frequencies excited over the Indian Ocean? Are these patterns also found in the response for many other regions. In this regard, it would be helpful to see the response patterns to the perturbation introduced in at least one other region besides the Indian Ocean, even without a corresponding step-change experiment. Are the remote responses corresponding to the perturbations in these regions similar to the ones from the Northwest Indian Ocean? If so, is there a filtering procedure that could potentially be used to screen them out?

Finally I believe it would be helpful if the authors could clarify the usefulness of the detection of purely linear responses to climate perturbations (subject to some accidental contamination with non-linear responses). Since the response to any observable forcing will include non-linear features, the authors should say a little more about the benefits and hazards of isolating the linear response using SI.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-653, 2016.