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## Do CMIP5 emergent constraints on the large scale atmospheric circulation work to constrain CMIP6 projections?

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Accurate future projections of the climate system are hindered by a number of sources of uncertainty: forcing uncertainty, internal variability and model structural uncertainty. An “Emergent constraint” is a technique that has been devised to reduce projection uncertainties arising from the model structural component. It consists of a statistical relationship (across a model ensemble) between a model’s representation of some aspect of the present day climate and its future projected climate change. This relationship can then be used to imply the future projected change, given the observed value of that present-day aspect. However, in order for the emergent constraint to be considered robust it must: (a) be accompanied by a physical mechanism and (b) be robust to out-of-sample testing.

In prior Coupled Model Intercomparison Projects (CMIP), in particular CMIP5, a number of emergent constraints on the large scale atmospheric circulation were proposed, with implications for regional hydroclimate change. These include: (1) a relationship between a model’s climatological jet latitude and its future projected poleward shift in the Southern Hemisphere; (2) a relationship between a model’s future projected wintertime circulation and hydroclimate change over North America and its climatological representation of stationary waves in the North Pacific; and (3) a relationship between a model’s future projected precipitation change over California and its representation of the relationship between ENSO and California precipitation. Constraints (2) and (3) actually imply opposite constraints on California precipitation changes for the real world, which speaks to the need for a deeper understanding of these emergent constraints and a comprehensive assessment of their robustness.

While the CMIP6 archive does not represent a true “out-of-sample” test of CMIP5 emergent constraints, it does provide us with a new dataset composed of new and/or more advanced models in which to assess their robustness. This presentation will review the proposed emergent

constraints on the large-scale atmospheric circulation and assess whether or not they are robust across both the CMIP5 and CMIP6 ensembles. Their potential for constraining regional hydroclimate projections will also be discussed.