



## Which Teleconnections are Robust to Internal Atmospheric Variability?

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Assuming that the atmosphere's response to the observed external forcing can be reliably estimated by Atmosphere General Circulation Models (AGCM), it is here tested whether teleconnections seen in observations hold if the atmosphere is allowed to "re-run" many times with this kind of forcing. In this view, each AGCM run – here from AMIP and ERA-20CM – is one unique realization of the atmosphere and the probabilistic nature of the response can be mimicked by considering the conjunction of runs (ensemble).

Using the correlation coefficient ( $r$ ) to describe the strength and sign of the teleconnections, a simple statistical test is proposed to obtain a confidence interval for variations in  $r$  that are caused by internal [atmospheric] variability. The utility of this test is then shown through applying it to a wide range of teleconnections seen in the observational record.

Teleconnections to the extratropics are generally not robust to perturbation through internal variability, particularly if they are drawn from short sub-periods of the twentieth century. In this case, albeit the results from individual model runs exhibit nonstationarities similar to those seen in observations, the CI including the effects of internal variability is approximately constant in time. Hence, it is argued that many of the "short-term" teleconnections seen in observations just arose, because the unique realization of internal variability in the real atmosphere was favourable for its development. This implies 1) that modulation by climate oscillations operating on lower-frequencies (e.g. the PDO and AMO) is not needed to explain the nonstationarities seen in observations and 2) that empirical relationships drawn from the deterministic observational record not hold if applied in the future, meaning that statistical forecasting schemes based on these rules are unreliable.