# Nonlinear forced change implies nonergodicity and vice-versa: The case of ENSO teleconnections

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We study the forced response of the teleconnection between the El Niño–Southern Oscillation (ENSO) and global precipitation in general and the Indian summer monsoon (IM) in particular in the Max Planck Institute Grand Ensemble. The forced response of the teleconnection is defined as the time-dependence of a correlation coefficient evaluated over the ensemble. The ensemble-wise variability is taken either wrt. spatial averages or dominant spatial modes in the sense of Maximal Covariance Analysis or Canonical Correlation Analysis or EOF analysis. We find that the strengthening of the ENSO-IM teleconnection is robustly featured in view of all four teleconnection representations, and both in the historical period and under the RCP8.5 forcing scenario. We also find that this forced change is typically nonlinear by formally rejecting the hypothesis that ergodicity holds, i.e., that expected values of temporal correlation coefficients with respect to the ensemble equal the ensemble-wise correlation coefficient itself. We also provide global maps of the degree of nonlinearity of the forced change of the teleconnection between local precipitation and ENSO.

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