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The CLIVAR C20C Project: Which components of the Asian-Australian monsoon circulation variations are forced and reproducible?

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A multi-model set of atmospheric simulations forced by historical sea surface temperature (SST) or SSTs plus Greenhouse gases and aerosol forcing agents for the period of 1950-1999 is studied to identify and understand which components of the Asian-Australian monsoon (A-AM) variability are forced and reproducible. The analysis focuses on the summertime monsoon circulations, comparing model results against the observations. The priority of different components of the A-AM circulations in terms of reproducibility is evaluated. Among the subsystems of the wide A-AM, the South Asian monsoon and the Australian monsoon circulations are better reproduced than the others, indicating they are forced and well modeled. The primary driving mechanism comes from the tropical Pacific. The western North Pacific monsoon circulation is also forced and well modeled except with a slightly lower reproducibility due to its delayed response to the eastern tropical Pacific forcing. The simultaneous driving comes from the western Pacific surrounding the maritime continent region. The Indian monsoon circulation has a moderate reproducibility, partly due to its weakened connection to June-July-August SSTs in the equatorial eastern Pacific in recent decades. Among the A-AM subsystems, the East Asian summer monsoon has the lowest reproducibility and is poorly modeled. This is mainly due to the failure of specifying historical SST in capturing the zonal land-sea thermal contrast change across the East Asia. The prescribed tropical Indian Ocean SST changes partly reproduce the meridional wind change over East Asia in several models. For all the A-AM subsystem circulation indices, generally the MME is always the best except for the Indian monsoon and East Asian monsoon circulation indices.