C20C - Climate of the 20th Century: Interannual modes of variability of Southern Hemisphere atmospheric circulation in C20C AGCMs

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The seasonal mean atmospheric circulation is affected by processes with time scales from less than seasonal to interannual or longer. It is therefore useful to conceptualise the seasonal mean as consisting of intraseasonal and slowly-varying (longer than a season) components. Based on this model, an Analysis of Variance method has been developed to separate the interannual variability of the seasonal mean into terms related to these components. This requires at least monthly mean data. In the case of ensembles of model realisations, the slow component can be further thought of as consisting of components related to slowly-varying internal dynamics and external forcings. Coherent patterns, or modes, of variability of each component are then estimated by eigenvalue decomposition of the corresponding covariance matrix. In a recently published paper (Grainger et al., 2011), the method was applied to monthly mean Southern Hemisphere (SH) 500hPa geopotential height from five atmospheric general circulation models (AGCMs) in the Climate of the 20th Century (C20C) project. Their interannual modes of variability are estimated for SH summer and winter for 1951-2000 and compared with those estimated by reanalysis data. In both seasons, the modes of variability of the intraseasonal and slow components estimated by the reanalysis data are qualitatively well reproduced by the C20C AGCMs, with few clear differences between the five models. In the C20C AGCMs, the Southern Annular Mode is by far the dominant mode of SH slowly varying internal component. Two modes of the slow-externally forced component are related to the atmospheric response to the El Niño-Southern Oscillation, and a third mode is attributed to the atmospheric response to trends in external forcings. In future work, the metholodogy developed here will be applied to new C20C model datasets, and to ensembles of coupled general circulation model realisations, e.g. the CMIP3 and CMIP5 datasets. Grainger, S. et al., 2011. Modes of variability of Southern Hemisphere atmospheric circulation estimated by AGCMs. Climate Dynamics, 36:473-490.