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Varied representation of the West Pacific pattern in multiple dynamical seasonal predictions of APCC-MME

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West Pacific (WP) teleconnection pattern is one of the well-known primary modes of boreal winter low-frequency variability (LFV) resolved in 500 hPa geopotential height and its phase and amplitude strongly influence regional weather conditions including temperature and rainfall extremes [Baxter and Nigam, 2015; Hsu and Wallace, 1985; Linkin and Nigam, 2008; Mo and Livezey, 1986; Thompson and Wallace, 1998; Wallace and Gutzler, 1981]. This study primary aims to evaluate individual 11 GCMs seasonal hindcasts employed as members of multi-model ensemble (MME) produced in APEC Climate Center (APCC) in representing WP. For the extensive and comprehensive evaluation, this study applied seven verification metrics in three scopes: (a) temporal representation of observed indices, (b) spatial mode separation in the Northern Hemisphere (NH), and (c) regional mode isolated in the preset longitudinal domain. Verification results display quite large inter-model spread. Some models mimic observed index variability while others display large bias of index variability compared to climatology. Basic north-south dipole pattern is mostly well reproduced in both rotated and unrotated loading modes. However, each individual seasonal forecast model exhibits slightly different behavior (e.g. amplification/weakening, zonal and meridional shift, downstream extension and so forth) in representing spatial structure of WP. When taking all 7 metrics into account, one Europe (CMCC) model, one Oceania (POAMA) model and two North America (NASA and NCEP) models are classified as relatively good performers while PNU is classified as a matchless poor performer out of 11. Least WP representing skill of PNU is sort of consistent with the largest bias of NH total variability.
This study further tries to examine winter mean biases of individual models and figure out how mean bias is linked to WP representation in model world. Model bias of winter climatology is investigated focusing on six large scale phenomena: East Asian winter monsoon (EAWM), Atlantic dipole, Pacific/Atlantic jets and Pacific/Atlantic Hadley circulations. Changes in structure and amplitude of them are diagnosed in terms of root mean square error, pattern correlation, intensity bias, zonal displacement and/or downstream extension. There is consistent strengthening/downstream extension of Atlantic jet and absence of southern divergence cell of Atlantic Hadley in most seasonal prediction models. It is demonstrated that WP representation has something to do with bias of Atlantic winter climatology (Atlantic dipole and Atlantic jet) from scatter plot and regression analysis. This implies the importance of realistic simulation of winter climatology further upstream for better WP representation. A fundamental conclusion of this study is that the representation of primary WP features varies among individual models of APCC-MME and it is significantly dependent on the deficiencies of some winter mean climatological patterns.