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Role of the Indian Ocean on the wintertime low-frequency atmospheric variability in the Northern Hemisphere

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The link between the pronounced warming of the sea surface temperatures (SSTs) of the Indian Ocean since the 1950s and the observed low frequency trend of the Arctic Oscillation (AO) is investigated using two 20-yr simulations performed with the Météo-France ARPEGE 4.3 atmospheric global circulation model. In both experiments, the model is forced by repeated observed monthly varying SSTs climatology computed for over 1950-2001, except for the Indian Ocean where in the first (second) simulation the 1950-1976 (1977-2001) mean state is applied. Contrasting the two ensemble means shows that the model Northern Hemisphere pressure response to the Indian Ocean warming projects on the AO observed trend over the past decades. The latter is characterized by a deepening of the subpolar lows and a concomitant strengthening of the subtropical highs. In the model, the Indian Ocean warming intensifies the local convection and upward motions. The associated upper level divergence is compensated by reinforced subsidence on the Indonesian archipelago, thus altering the local Hadley cell, and then modifying the subtropical jet and the Rossby waves activity on the western Pacific sector. The change in the Pacific meridional cell leads downstream to a wave train towards the Atlantic along the jet wave guide. This alters the activity of the storms in both the North Pacific and the North Atlantic, as is shown to have a positive feedback on the anomalous mean flow. These results collectively suggest that the warming trend in the Indian Ocean plays an important role in the high latitudes atmospheric circulation of Northern Hemisphere, and could explain part of the observed large scale pressure trend.