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DYNAMICS OF THE ARCTIC OSCILLATION AS A DOMINANT INTERNAL VARIABILITY AND A POSSIBLE LINK TO THE WARMIG HIATUS

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Global warming hiatus is now a great concern in the climate prediction study. The warming hiatus is explained by cooling of the tropical eastern Pacific showing La-Nina type SST anomaly induced by stronger trade wind. The appearance of the La-Nina type SST pattern is closely connected to the negative PDO (Pacific Decadal Oscillation) which is in turn connected to the negative Arctic Oscillation (AO) in the atmosphere. The warming hiatus is now widely recognized as a result of the internal variability of the Atmosphere-Ocean coupled system, despite such an internal variability has long been considered as the secondary importance for the anthropogenic global warming scenario by the previous IPCC reports. Suppose that the internal variability of the PDO is the cause of the warming hiatus, the most dominant internal variability of the atmosphere, such as AO, must be connected to the warming hiatus.

In this study, the AO is investigated theoretically in the framework of a linear baroclinic model (LBM) of the primitive equation on the global atmosphere. In our previous study, we showed that the AO is not a statistical artifact of the EOF analysis, but a dynamical intrinsic mode named as a standing AO mode. There are two phases of positive AO and negative AO for the standing solution. Moreover, we investigated the theoretical life-cycle of baroclinic instability waves (i.e., storm tracks) using the LBM in the non-zonal basic states for positive and negative AO indices. It is found that the positive feedback between the storm tracks and the AO is confirmed even for the theoretical life-cycle of the baroclinic waves. The standing AO mode, energized by the baroclinic waves, becomes resonant for any quasi-stationary decadal forcing such as PDO, which now is directed to the negative AO index, causing warm Arctic and cold mid-latitudes. The dynamics of the AO index (AOI) is further investigated by newly derived AOI equation, which describes the cause of the decadal variability of the AOI. It is found that the variability of the AOI is controlled by the internal linear dynamics rather than the external forcing such as PDO. The result implies that the AO might control the decadal fluctuation not by passively but by actively through the coupling with the PDO.