論文内容の要旨

A Study on the Influence of the Indian Ocean Dipole Mode on the Snow Cover of the Tibetan Plateau in the Early Winter

（インド洋のダイポールモードがチベット高原の初冬の降雪に及ぼす影響の研究）

袁　潮霞

Using the snow cover data derived from the satellite observations, the interannual variation of EWTPSC (early winter Tibetan Plateau snow cover) is investigated. It is shown that the IOD (Indian Ocean Dipole Mode) has a positive correlation with the EWTPSC, when the influence of ENSO (El Niño/Southern Oscillation) is removed.

In the early winter of the pure positive IOD years with no co-occurrences of El Niño, the diabatic heating anomaly related to the IOD excites dominant baroclinic responses in the tropics. The cyclonic anomaly over the Arabian Peninsula and the anticyclonic anomaly over the Bay of Bengal in the lower troposphere induce northward flow from the tropical Indian Ocean to India. This increases the moisture supply to India. Since both baroclinic and barotropic components of the basic-state zonal wind over the Arabian Peninsula increase dramatically in early winter, it becomes favorable for the energy conversion from the baroclinic mode to the barotropic mode. The resulting barotropic mode over the Arabian Peninsula propagates poleward, and induces a barotropic cyclonic anomaly north of India. This enables the moisture that has been already advected to India to be further transported cyclonically to the Tibetan Plateau. The convergence of moisture over the plateau increases the possibility of precipitation and snow cover, and explains the positive correlation between IOD and EWTPSC.

The atmospheric response to the IOD-related diabatic heating anomaly is seasonally dependent. Contrast to the early winter, the barotropic and baroclinic components of the basic-state zonal wind are weak over the Arabian Peninsula in autumn. This is not favorable for the generation of barotropic mode and teleconnection. Therefore, the teleconnection from the Arabian Peninsula to the north of India is not present and no significant correlation between IOD and the Tibetan Plateau snow cover is found in autumn, even though the IOD-related diabatic heating anomaly in autumn is similar to that in early winter.

The FrAM (Frontier Atmospheric General Circulation Model) is used to reproduce the observed circulation anomaly related to the IOD in early winter to confirm the positive correlation between IOD and EWTPSC. The sensitivity experiment P-IOD (N-IOD) is forced by the SSTA (sea surface temperature anomaly) only within the tropical Indian Ocean of pure positive (negative) IOD years. Results show that the P-IOD well reproduces the dominant baroclinic atmospheric responses in the tropics and the poleward propagating barotropic mode from the Arabian

Peninsula to the north of India in early winter. Also, extra moisture supply from the northern Indian Ocean to the Tibetan Plateau is well simulated, confirming the positive influence of IOD on the EWTPSC. The observed seasonality of atmospheric responses to the IOD-related diabatic heating anomaly is also simulated; no teleconnection from the Arabian Peninsula to the north of India is present in autumn of the P-IOD. The N-IOD also simulates the dominant baroclinic responses in the tropics and the poleward teleconnection to the mid-high latitudes. Due to the northeastward shift of the simulated diabatic heating anomaly in the N-IOD as implied by the OLR (outgoing longwave radiation) anomaly, the resultant teleconnection in the N-IOD is shifted northeastward to that in the P-IOD. Nevertheless, the FrAM is able to simulate the circulation anomaly related to the IOD and the increase of moisture supply to the Tibetan Plateau in early winter, confirming the positive correlation between IOD and EWTPSC.