令和二年度　環境科学院　修士論文内容の要旨

Historical change of winter Tibetan Plateau snow cover and its controlling factors
(チベット高原における冬季積雪被覆の歴史的変化とその決定要因)

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Subseasonal to seasonal (S2S) climate prediction, especially for extreme precipitation, is one of the great challenges. Tibetan Plateau (TP) is geomorphologically the largest and highest high land region. The anomalies of the Tibetan Plateau snow cover (TPSC) are formed in the winter and can persist through the summer. Recent researches indicated spring land surface temperature of TP associated with snow anomaly is possibly a new aspect to improve climate prediction over East Asia at the S2S time scale. Therefore, the objective of this study is to investigate the controlling factors leading to high/low winter TPSC. The snow observation in TP, however, is limited by space or time. Hence, the output of two 100-member ensemble simulations is mainly used in this study. In high TPSC year, a positive-AO (Arctic Oscillation)-like circulation pattern is dominant over the Eurasian continent. More importantly, the historical simulations (HIST) reveal that high/low TPSC is in relation to El Niño/La Niña events.

The impact of AO and ENSO on TPSC is quantified. In both observation and HIST, positive TPSC anomalies preferably appear when the AO index is positive and higher, and vice versa for negative TPSC anomalies. Moreover, the joint impact of AO and ENSO is investigated. When positive AO collaborates with El Niño, higher positive TPSC appears; similarly, lower negative TPSC anomalies occur when negative AO collaborates with La Niña. This is because ENSO provides more humidity and induces more storm activities around TP that alter TPSC, while AO intensifies subtropical jet and water vapor transport toward TP, resulting in a beneficial condition to more snowfall in TP. Finally, a comparison of the thermodynamical relationship for precipitation and air temperature is investigated for HIST and non-warming simulations (NAT). Historical global warming has decreased the snow-to-rain ratio over TP. Nonetheless, increased precipitation compensates for it. As a result, the impact of global warming on TPSC is negligible. A recent decline of TPSC is, however, shown in the observation. The circulation leading to high TPSC is robust regardless of the recent

decline. Hence, the recent decline of TPSC is likely attributed to other processes, such as light-absorbing aerosols.