



## **Dynamics of the Taiga-Permafrost Coupled system in Siberia under climate change**

Ningning Zhang (1,3) and Tetsuzo Yasunari (2,4)

(1) Institute of Atmospheric Physics, LASG, China (zhangningning@lasg.iap.ac.cn), (3) Graduate School of Environmental Studies, Nagoya University, Japan, (2) Hydrospheric Atmospheric Research Center, Nagoya University, Japan, (4) Study consortium for Earth-Life Interactive System (SELIS) of Nagoya University, Japan

Taiga, also known as boreal forest, plays important roles in global and regional water–energy–carbon (WEC) cycles and in the climate system. Recent in situ observations have suggested that larch dominated taiga and the permafrost behaves as a coupled eco-climate system across a broad boreal zone of Siberia. However, neither field-based observations nor modelling experiments have clarified the synthesized dynamics of this system. Here, using a new dynamic vegetation model (DVM) coupled with a permafrost model, we reveal the interactive processes between taiga and permafrost. The model demonstrates that under the present climate condition in eastern Siberia, larch trees to maintain permafrost by controlling its seasonal melting of permafrost, which in turn maintains taiga by providing sufficient water to the larch trees. The experiment without permafrost processes showed that larch decrease its biomass and is replaced by a dominance of pine and other species that tolerate drier hydro-climatic conditions. Forest fires also play a role in preserving the taiga larch forest. Climate warming sensitivity experiments involving increased air temperature show that this coupled system cannot be maintained under warming of about 2°C or more. Under this condition, sub-boreal forests (dark conifer and other deciduous species) are alternatively dominated, decoupled from the permafrost processes. This study thus suggests that the future global warming could drastically alter the taiga–permafrost coupled system in Siberia, with associated changes of WEC processes and feedback to climate.