# Ecosystem carbon cycle in Brøgger Peninsula, Svalbard: a 20-year study

Takayuki Nakatsubo[1]
[1]*Hiroshima University*

The recent warming trend, which is widely observed in Arctic regions, is likely to profoundly influence ecosystem carbon pools by changing the rate of carbon flows. Quantitative assessments of carbon pools and flows are necessary to predict the impact of climate change on Arctic ecosystems. Since 1994, we have conducted a project to clarify the pattern of ecosystem carbon cycle and the factors controlling the cycle in the Brøgger Peninsula, Svalbard.

As the first step, we examined major carbon pools and flows along a primary successinal gradient within the glacier foreland of Austre Brøggerbreen (East Brøgger Glacier) in Ny-Ålesund. Vegetation cover and soil carbon pools tended to increase with the progress of succession though development of vegetation cover and accumulation of soil carbon appeared to be very slow. However, a non-negligible amount of organic carbon, including ancient organic carbon, is distributed in soils of the latter stages of succession (Yoshitake et al. 2011). Photosynthesis of vascular plants, especially that of polar willow (*Salix polaris*), was the major pathway of carbon fixation. Although cryptogams (mosses and lichens) contributed the major proportion of phytomass in the latter stages, their net primary production was much smaller than that of the vascular plant because of water limitation (Nakatsubo et al. 2005). Using observations of carbon cycle processes, we constructed a simple ecological process-based model to assess how the che carbon balance will be altered by ongoing climate change. Model analysis indicated that rising temperature did not always have positive effects on carbon sequestration because of enhanced respiration in the later part of the growing season under low light condition (Uchida et al. 2016).

Moss tundra that accumulates a thick peat layer is another important type of vegetation in this area. In order to know the current carbon cycle of moss tundra, we estimated carbon accumulation rates, $CO_2$ and $CH_4$ fluxes, and dissolved organic carbon (DOC) flow at moss tundra in the northern part of the Brøgger Peninsula (Stuphallet; 78°57'N, 11°39-40'E). The area was covered with a thick peat layer dominated by various moss species. Apparent rates of carbon accumulation was estimated based on the $^{14}C$ age and amount of peat in the active layer. The calibrated age of peat from the bottom of the active layer (20-30 cm) ranged from 81 to 701 cal yr BP. Based on the total carbon (4.5-9.2 kg C $m^{-2}$), we estimated the apparent rate of carbon accumulation in the active layer as 9.0-19.2 g C $m^{-2}$ $yr^{-1}$, which is similar to or greater than the net ecosystem production or net primary production reported for other vegetation types in this area (Nakatsubo et al. 2015). This suggest that moss tundra plays an imporatnat role in carbon sequestration in this area.

In the future study, we need to conduct a larger scale assessment of ecosystem carbon cycle by the remote sensing technique in order to know the overall response of ecosystem carbon cycle to climate change in this area. In addition, considering the variation in the climatic condition within Svalbard, comparative studies along climatic gradient would be an effective approach for evaluating the consequences of climate change.

**References**

Nakatsubo, T., Bekku, Y. S., Uchida, M., Muraoka, H., Kume, A., Ohtsuka, T., Masuzawa, T., Kanda, H. and Koizumi, H. Ecosystem development and carbon cycle on a glacier foreland in the high Arctic, Ny-Ålesund, Svalbard. Journal of Plant Research 118, 173-179, 2005.

Nakatsubo, T., Uchida, M., Sasaki, A., Kondo, M., Yoshitake, S. and Kanda, H. Carbon accumulation rate of peatland in the High Arctic, Svalbard: Implications for carbon sequestration. Polar Science 9, 267-275, 2015.

Uchida, M., Muraoka, H. and Nakatsubo, T. Sensitivity analysis of ecosystem $CO_2$ exchange to climate change in a High Arctic tundra using an ecological process-based model. Polar Biology, 39, 251-265, 2016.

Yoshitake, S., Uchida, M., Ohtsuka, T., Kanda, H., Koizumi, H. and Nakatsubo, T. Vegetation development and carbon storage on a glacier foreland in the High Arctic, Ny-Ålesund, Svalbard. Polar Science 5, 391-397, 2011.