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LONG-TERM OBSERVATIONS AND SYNTHESIS FOR EVALUATING CARBON DIOXIDE FLUXES OVER ALASKA

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Micrometeorological measurement, such as eddy covariance, is a powerful tool to understand terrestrial carbon, energy, and water fluxes in the Arctic under rapid environmental changes. Currently, number of eddy covariance towers has been growing and records of fluxes at some sites cover more than decade. In this study, we report the decade of a flux record (Ueyama et al., 2014a) and synthesize the eddy covariance data from 21 sites in Alaska for evaluating spatio-temporal variabilities of the fluxes (Ueyama et al., 2013a, b, 2014b).

CO_2 balance of a black spruce forest in interior Alaska changed from sink to source from 2003 to 2011. Gross primary productivity (GPP) and ecosystem respiration (RE) increased in autumn due to autumn warming. The greater increase in RE than GPP was the major reason of the shift of the carbon balance.

Growing season CO_2 fluxes among the 21 sites showed tundra and boreal forests in Alaska acted as a growing season CO_2 sink except one tundra site and disturbed sites. Spatial variation in the CO_2 fluxes was explained by growing season length, growing degree days, and satellite-derived leaf area index. The CO_2 fluxes were upscaled using satellite-derived green index, land surface temperature, landcover, and fire information with a machine learning technique: support vector regression. The upscaled fluxes showed that respective continental GPP and RE were 369 ± 22 and 362 ± 12 Tg C yr^{-1} during 2000 and 2011, indicating Alaska acting a CO_2 neutral. The upscaled CO_2 balance was consistent with a top-down model: CarbonTracker.

Long-term observations and multi-site synthesis are essential to understand current CO_2 balance and their environmental responses for stand, regional, and continental scales in the Arctic.

Ueyama et al., 2013a: Ecological Applications, 23, 1798–1816.
Ueyama et al., 2013b: Journal of Geophysical Research: Biogeosciences, 118, 1-16.
Ueyama et al., 2014a: Global Change Biology, 20, 1161-1173.
Ueyama et al., 2014b: Journal of Geophysical Research: Biogeosciences, 119, doi:10.1002/2014JG002717.