Upscaling of high-latitude CO_2 fluxes in NE Siberia based on a satellite data-driven model

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Arctic ecosystems are characterized by pronounced gradients in ecosystem properties at various spatial scales. Even over short distances, systematic differences in e.g. vegetation community structure or water table depth can create mosaics of micro-sites where each unit displays an individual exchange pattern of carbon and energy with the atmosphere. To analyze the effect of high-resolution modeling on Arctic regional carbon budgets, we present CO_2 flux budgets that have been simulated based on a satellite-data driven model at high (0.1deg) resolution for a regional domain of 6 × 44 degrees in Northeast Siberia.

The model has been calibrated using eddy-covariance flux datasets from five sites within the region. Validation against independent datasets as well as comparison against MODIS reference flux fields demonstrates the good performance of this parsimonious modeling framework under the given conditions. On the other hand, comparison against helicopter-based flux transects over the Lena river delta indicate that the setup of the model domain would even need to be further refined to capture the observed spatial variability in flux rates. A direct comparison of model runs based on a model version trained on the regional flux sites against a version using North American observations sites representing similar biomes resulted in systematic differences between both versions, highlighting the importance of local reference datasets for model calibration. Moreover, the pronounced fine-scale variability and regional gradients due to vegetation and climate patterns partly creates strong deviations from coarser scale reference products, suggesting that aggregation errors can alter CO_2 budget simulations over the Arctic significantly.

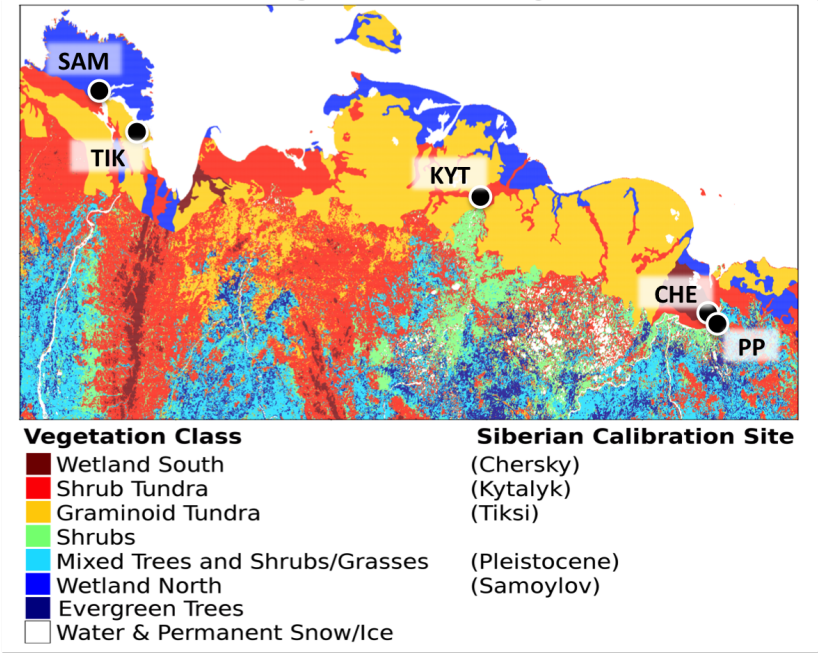

Figure 1: Vegetation map