

Large-scale increase in seasonal CO₂ exchange by northern terrestrial ecosystems since 1960

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As part of the measurement program of the International Geophysical Year (IGY), airborne observations of CO₂ concentration were conducted over the North Pacific and Arctic Oceans during 1958-61. Samples were collected at 700 and 500 mb (approx. 3 and 6 km altitude) and provide good spatial and seasonal coverage, particularly at 500 mb. With the HIAPER Pole-to-Pole Observations (HIPPO) campaign sampling similar regions of the northern troposphere during 2009-11, direct comparison of the two datasets provides a measure of the change in the seasonal cycle of CO₂ between the 1950s-60s and the 2000s. We will show that the seasonal amplitude at 500 mb has increased by 40-60% at latitudes north of 45°N, while amplitude changes south of 45°N are smaller than 25%. This pattern is similar to long-term ground-based CO₂ measurements at Barrow and Mauna Loa. The atmospheric observations demonstrate that large-scale changes in the seasonal flux of CO₂ from northern ecosystems have occurred over the last 50 years. We will investigate the changes in net ecosystem production (NEP) required to produce the observed growth in CO₂ amplitude, discuss mechanisms for the changes in NEP, and examine whether such changes are captured by the terrestrial models participating in the IPCC CMIP5.