Large Loss of CO$_2$ in Winter Observed Across the Northern Permafrost Region

**Problem:** Amplified winter warming in the Arctic is expected to enhance soil CO$_2$ emissions, but the amount of winter CO$_2$ loss and its impact on the annual carbon budget is highly uncertain.

**Finding:** Estimated winter CO$_2$ loss (1662 Tg C yr$^{-1}$) is larger than growing season CO$_2$ uptake (1032 Tg C yr$^{-1}$). Enhanced soil CO$_2$ loss from winter warming is degrading the northern carbon sink based on flux observations and SMAP L4-C estimates.

**Impact:** Reduced uncertainty regarding winter CO$_2$ emissions and their impact on the boreal-Arctic annual carbon budget.

Natali, Watts, Rogers, et al., 2019: Large loss of CO2 in winter observed across the northern permafrost region, *Nature Climate Change.*