Carbon has been accumulating in northern high latitude terrestrial ecosystems for thousands of years, but as the climate warms, the large pool of carbon is at risk of being thawed, decomposed, and transferred to the atmosphere. Despite the potential importance of changes in northern carbon cycling for global climate, both the sign and magnitude of the current and future carbon balance of the Arctic remain highly uncertain. To address this uncertainty, I will present ecosystem carbon cycling results from a warming and drying experiment in a sub-arctic tundra landscape, and then I will focus on carbon cycling in the Arctic during the period of greatest uncertainty, the nongrowing season (NGS; fall, winter, spring). Using a new synthesis of NGS CO2 fluxes that span northern high latitude terrestrial ecosystems, I examine the drivers of NGS respiration, estimate current NGS CO2 emissions for the northern permafrost region, and project NGS CO2 emissions under two future climate scenarios--Representative Concentration Pathways (RCP) 4.5 and 8.5. While climate change may shift the Arctic from a carbon sink to a source, the magnitude of this response will be highly dependent on future climate change mitigation efforts.