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Influence of spatial coherence of temperature anomalies on the supposed breakdown of the warmer spring – larger carbon uptake mechanism in northern high latitudes

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Land vegetation growth in the northern high latitudes (north of 50˚N) is strongly temperature limited, thus anomalously warm years are expected to result in an increased drawdown of Carbon Dioxide (CO_2) and vice versa. Piao et al (2017) concluded in an analysis of climate and CO_2 data from Point Barrow, Alaska that there was a weakening response of northern high latitude spring carbon uptake to temperature anomalies over the last 40 years. They proposed that this is due to a weakening control of temperature on productivity. We have analysed northern high latitude climate and remote sensing vegetation indices, as well as atmospheric CO_2 data at Point Barrow, with atmospheric transport analyses of the footprint seen at Barrow. Our results show no large-scale significant change in the spring NDVI-temperature relationship inside the footprint of Barrow, and across the high northern latitudes as a whole. This casts doubt on the assertion that the changing relationship between CO_2 uptake and temperature is driven by a change in vegetation response to temperature. We thus tested several alternative mechanisms that could explain the apparent weakening, including a change in interannual variability of atmospheric transport (i.e. the footprint seen by Barrow) and the spatial agreement of temperature anomalies. We find that the heterogeneity of temperature anomalies increased over time, whereas there is no significant change in interannual variation in the footprint seen by Barrow. These results offer an additional explanation for the apparent decrease in spring temperature sensitivity of northern high latitude CO_2 uptake.