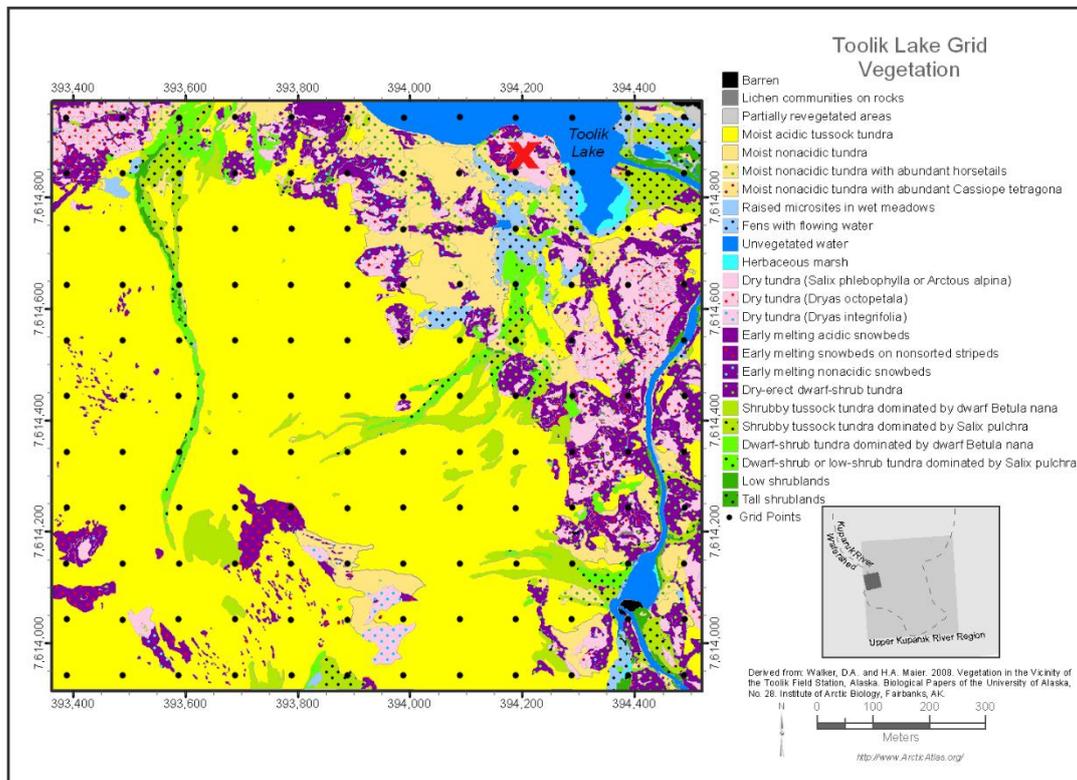
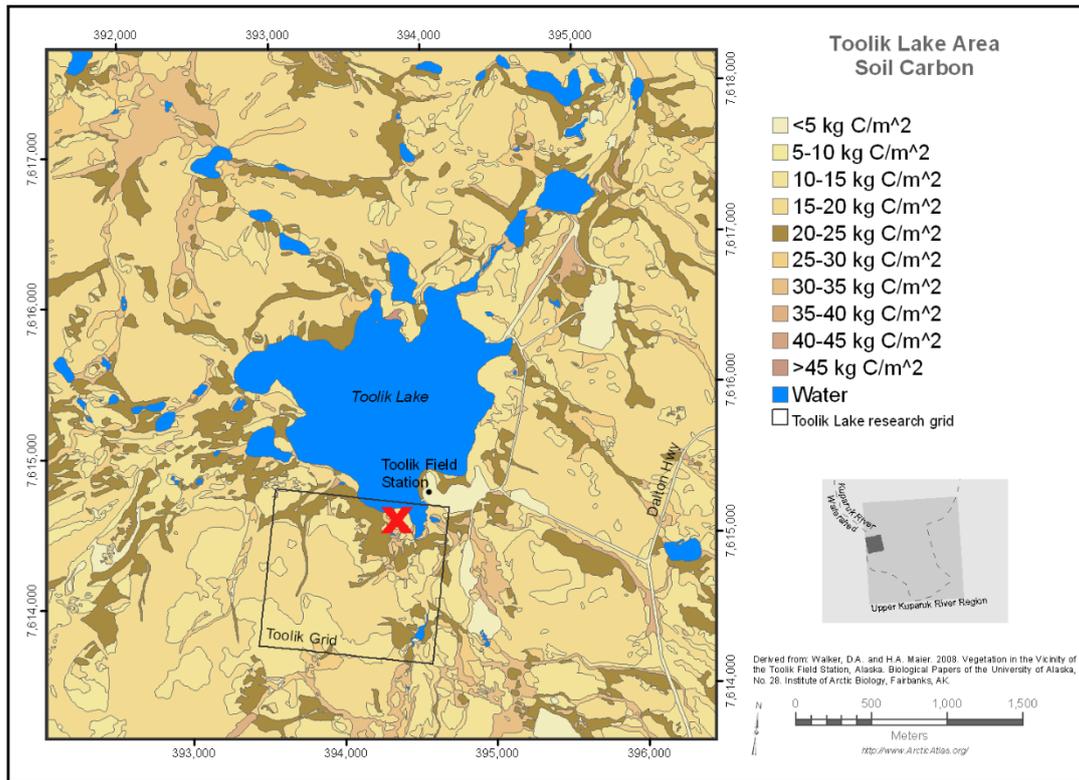


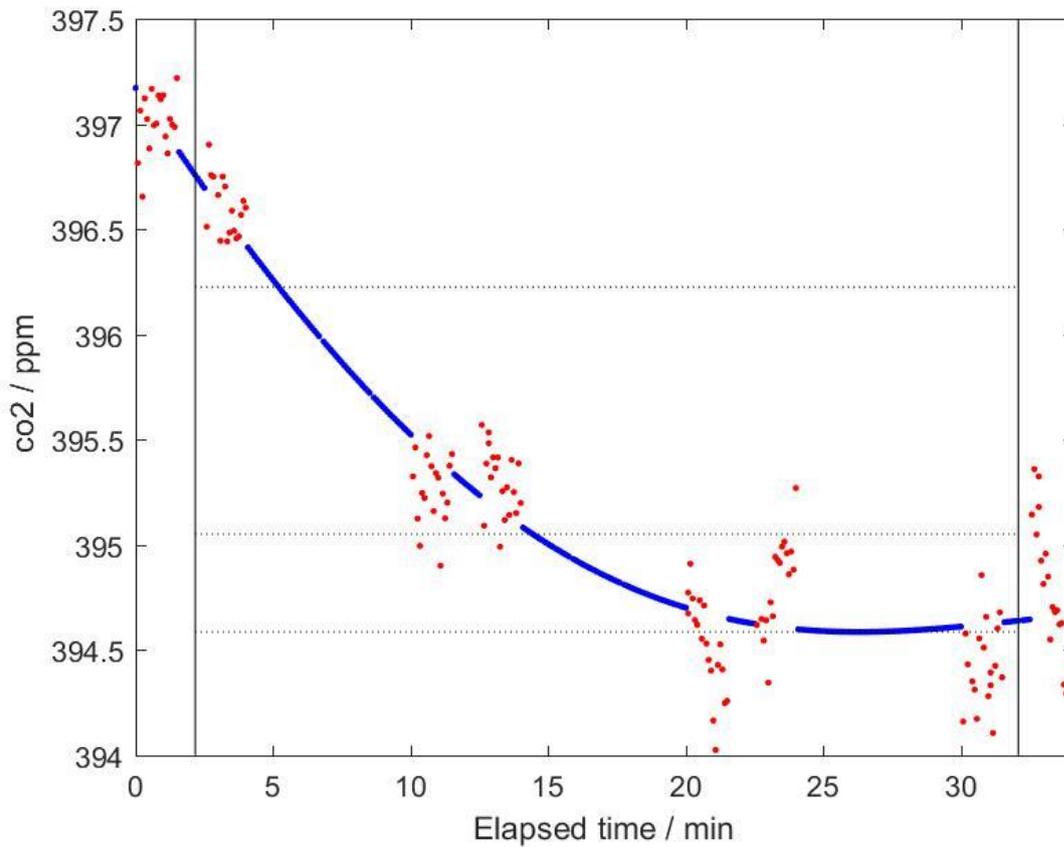
Supplemental Information for Howard et al. *Environmental controls on ecosystem-scale cold season methane and carbon dioxide fluxes in an Arctic tundra ecosystem.*



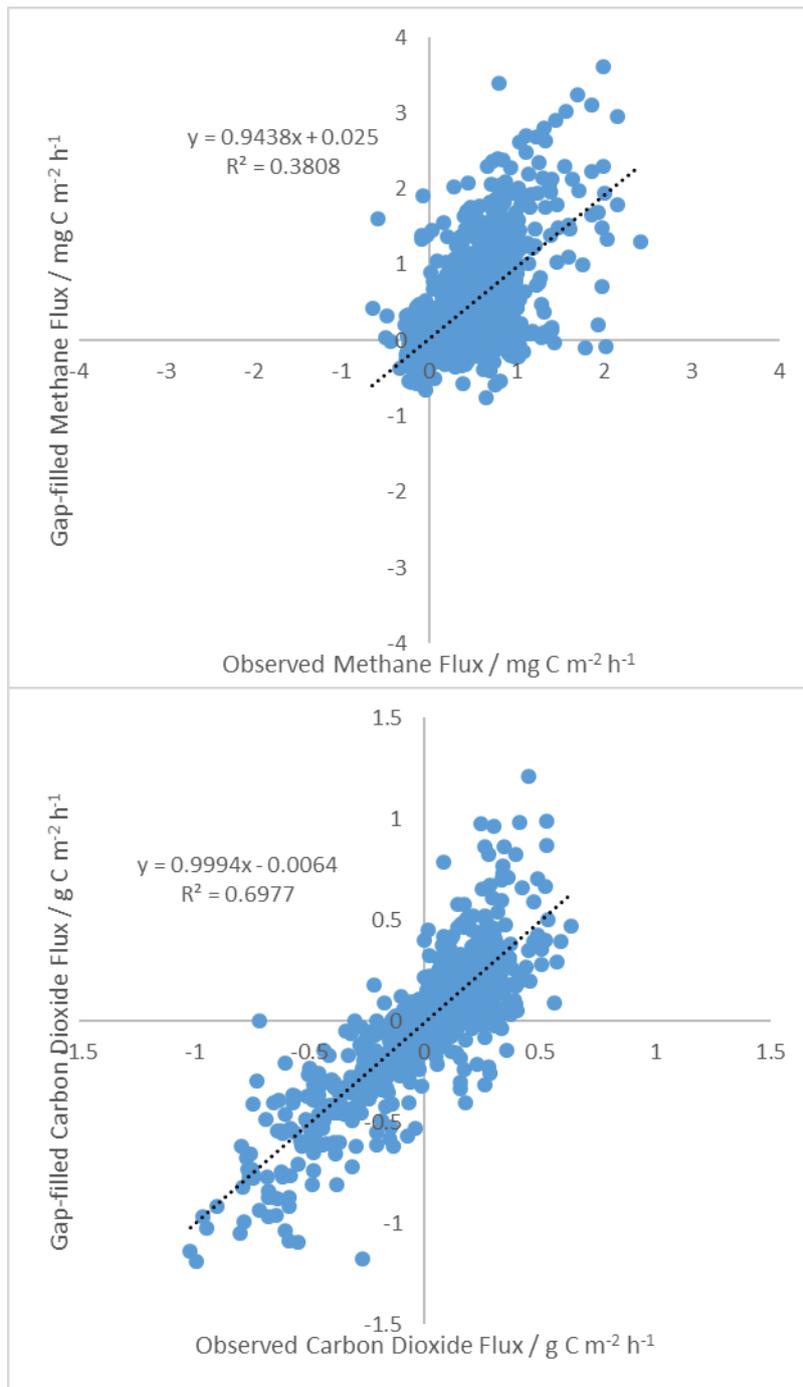
**Fig S1:** Vegetation map showing major communities in the vicinity of the flux tower. Red 'X' shows the approximate location of the flux tower. Reproduced with permission from Donald A. (Skip) Walker of University of Alaska Fairbanks.



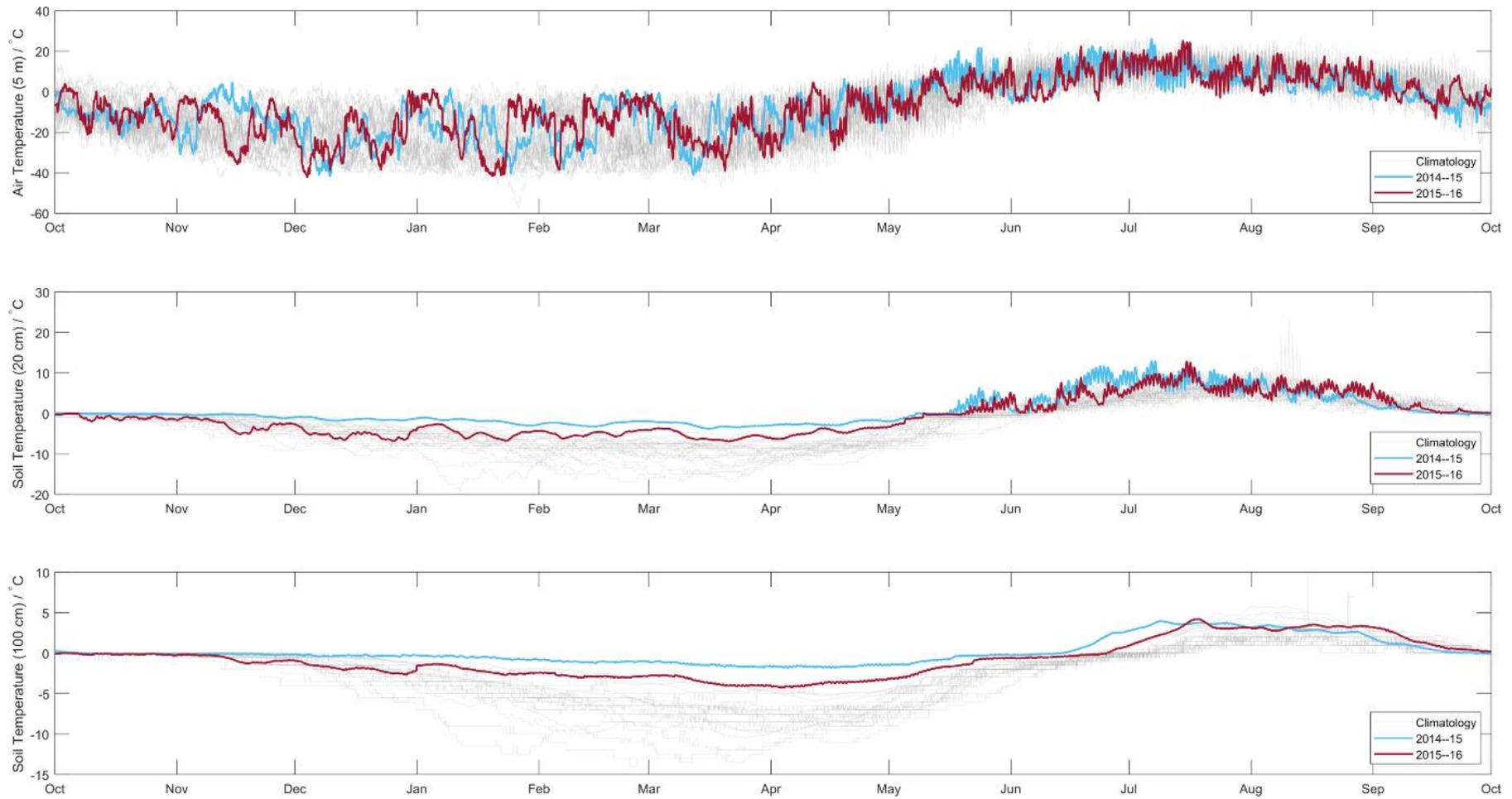
**Fig S2:** Soil carbon content map for the region around the flux tower. Red 'X' shows the approximate location of the flux tower. Inset square ("Toolik Grid") shows extent of map in Fig. S1. Reproduced with permission from Donald A. (Skip) Walker of University of Alaska Fairbanks.



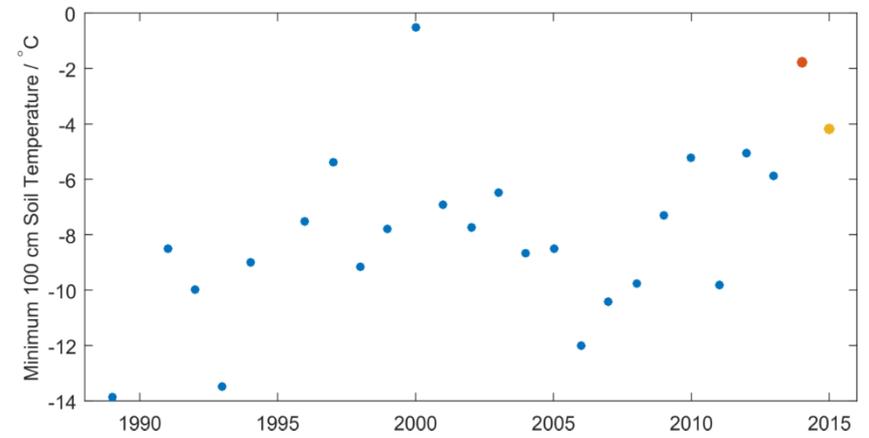
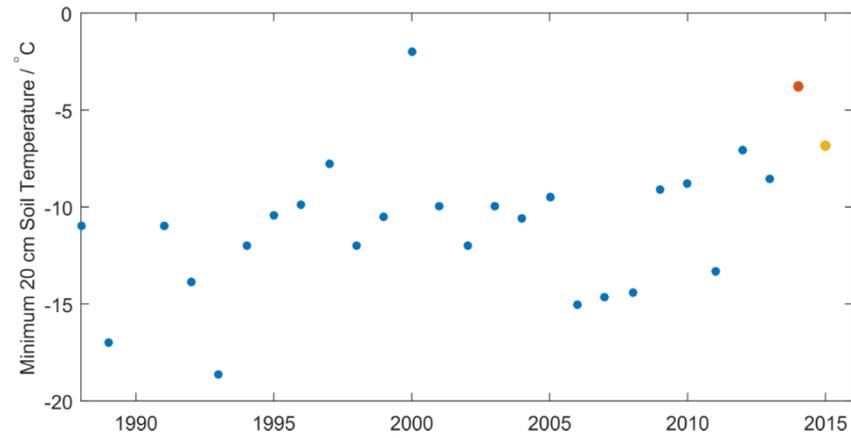
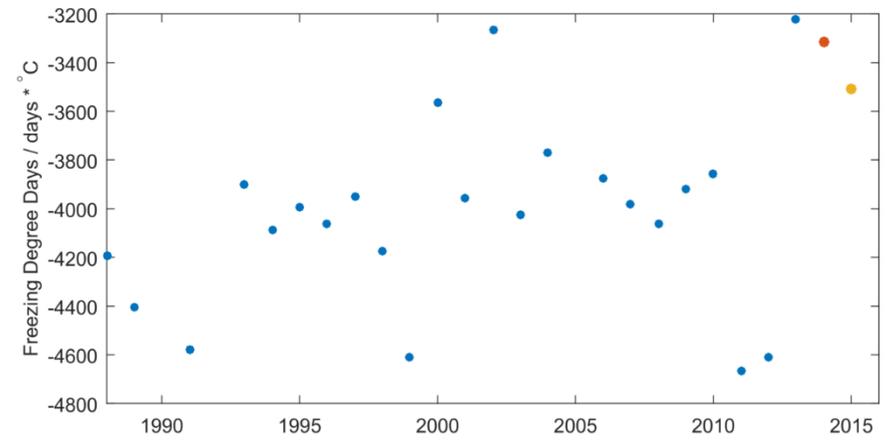
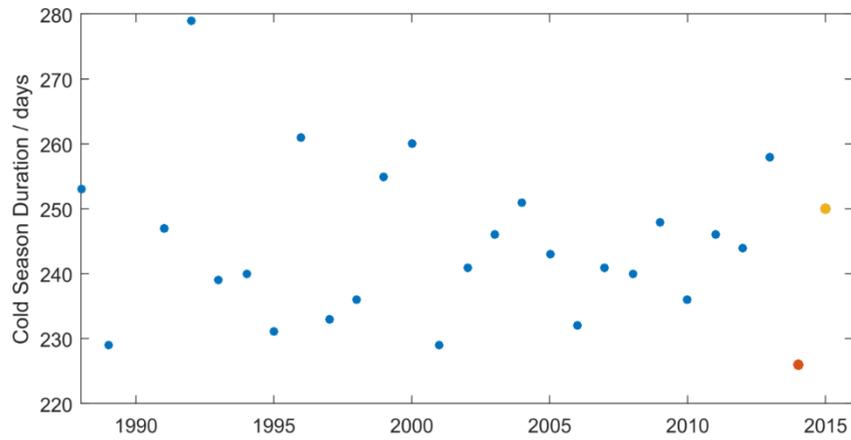
**Fig S3:** Example of the gap-filling algorithm used to complete concentration data within each averaging period. Red dots represent all measured values used to construct the 4<sup>th</sup>-order polynomial (blue dots). Black vertical lines give the averaging period (30 minutes) – note that red dots outside this averaging period were used to construct the 4<sup>th</sup>-order polynomial but not included in the average. Lower and upper black dotted horizontal lines show the 10<sup>th</sup> and 90<sup>th</sup> percentiles of all values (red and blue dots) within the averaging period. Central black dotted horizontal line shows the truncated mean (10<sup>th</sup>–90<sup>th</sup> percentile) that is used as the final value for calculating fluxes.



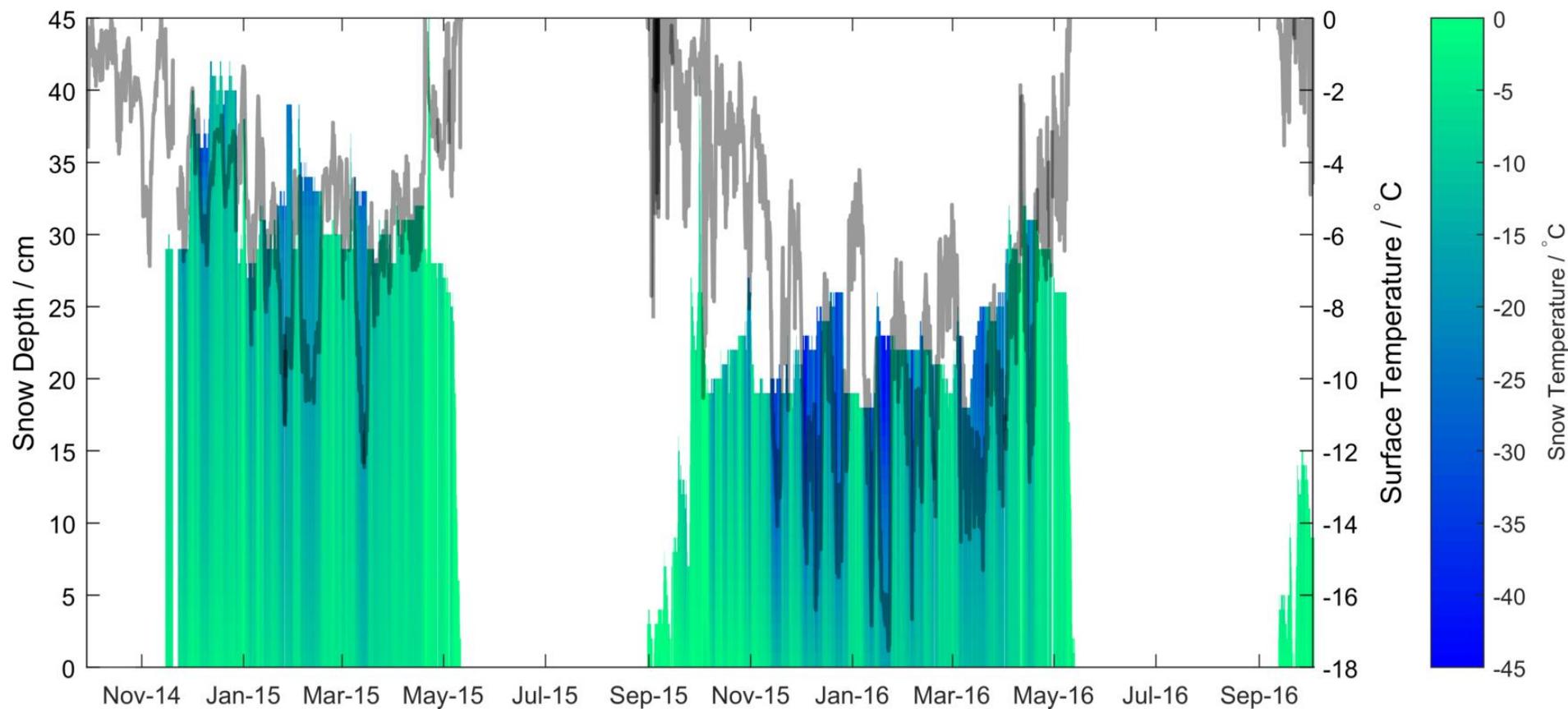
**Fig S4:** Validation sets showing the efficacy of the gap-filling process. Before gap-filling, 10% of known values were randomly selected and kept aside as the validation set. These are here compared to values estimated by the gap-filling process, with simple linear regression included.



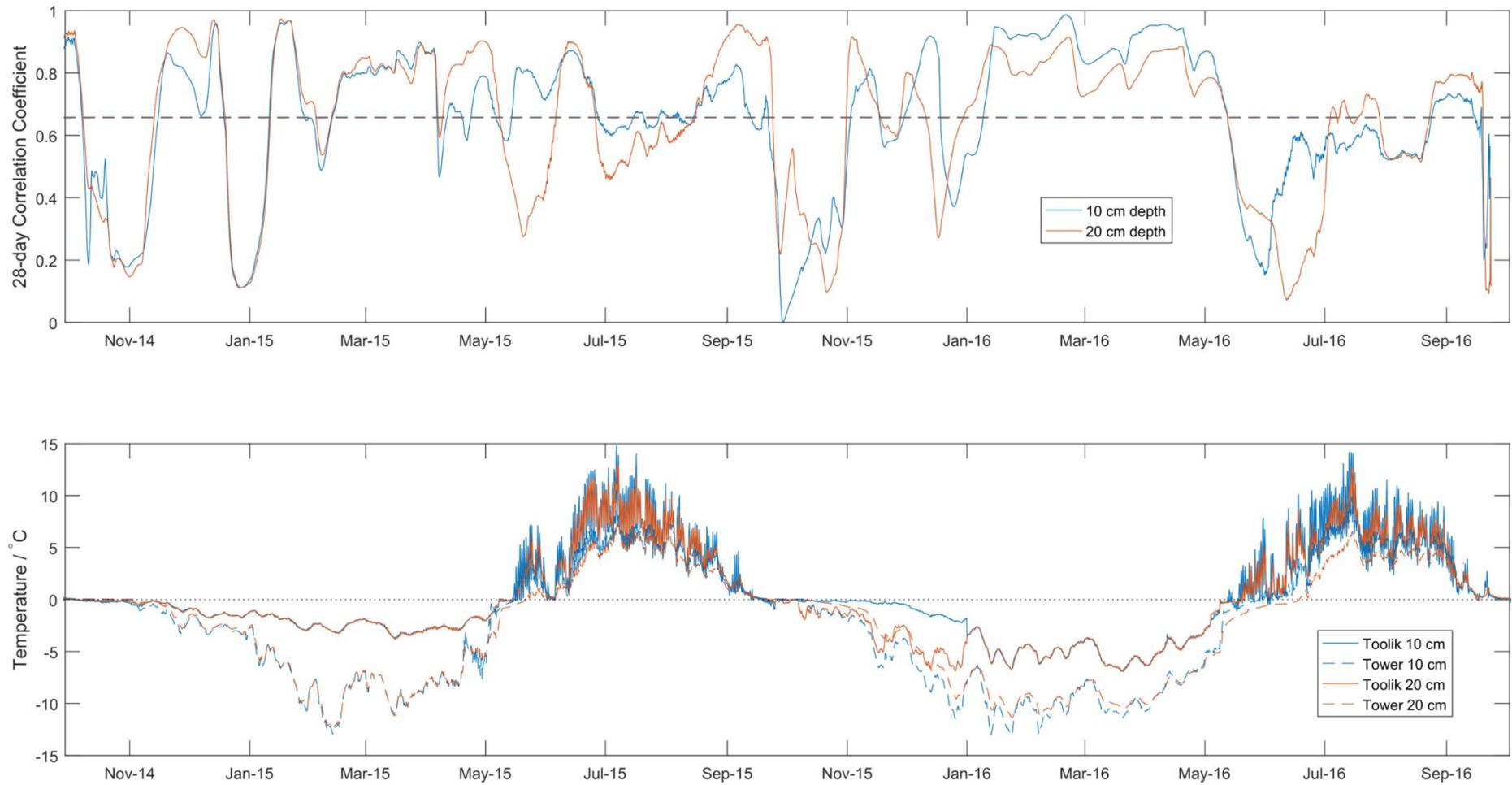
**Fig S5:** Air (5 m) and select soil temperatures as measured at the Toolik Field Station. Grey lines give all values measured between 1988—Oct. 2014. Blue and red lines give values for Year 1 and Year 2 as defined in the text, respectively.



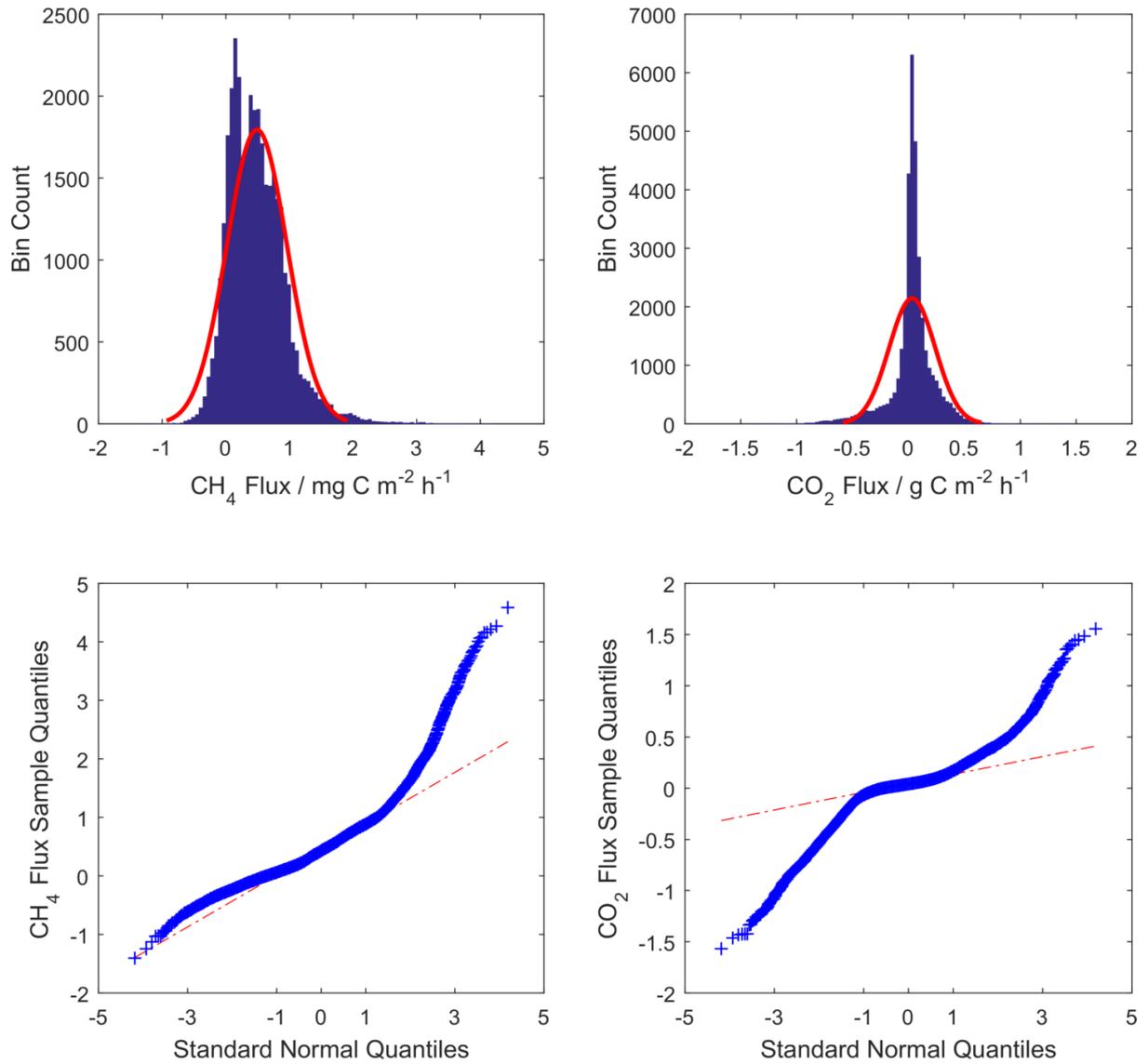
**Fig S6:** Upper left: cold season durations (calculated using 28-day average 5 m air temperature – see text), along with total freezing degree days for cold seasons as so defined (upper right). Lower panels show the minimum recorded temperature during the cold season as so defined at depths of 20 cm (lower left) and 100 cm (lower right). All data are taken from Toolik Field Station – red dots are for the 2014–15 cold season, yellow for the 2015–16 cold season, blue dots for all other years.



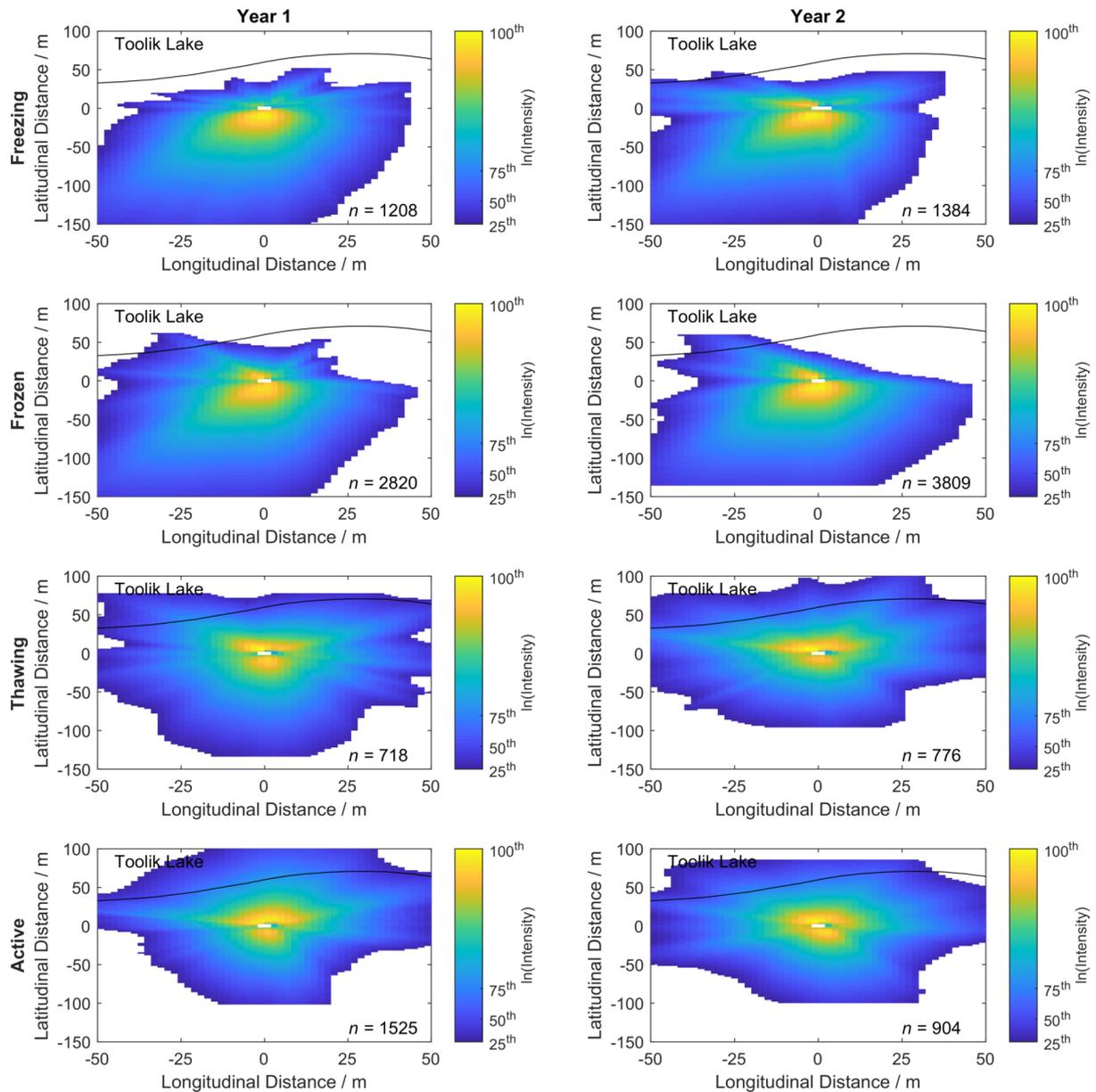
**Fig S7:** Snow depth (coloured shading, left axis), coloured by temperature as measured by the snow tower. Note that snow depth measurements only began in November 2014 and so values are missing prior to this date. Grey line shows the surface temperature (right axis), as measured at the base of the snow tower.



**Fig S8:** Upper: correlation coefficients between soil temperatures as measured at Toolik Field Station (average of both soil profiles) and close to the flux tower (average of both soil profiles), at 10 cm and 20 cm depth. Lower: Actual temperatures measured at 10 cm and 20 cm at Toolik Field Station and close to the flux tower.



**Fig S9:** Histograms (upper panels) and quantile plots (lower panels) for all observed methane fluxes (left panels) and carbon dioxide fluxes (right panels).



**Fig S10:** Climatological 2-d footprint analyses as determined using the method given by Kljun et al. (2015) for Year 1 (left panels) and Year 2 (right panels). Labels on the left-hand side give the seasons (as defined in the text) for which the footprints were constructed. Colours represent footprint intensity (unitless) on a logarithmic scale to highlight those values closest to the tower. Values on the colour bars give the percentiles of values shown.