**Supplementary Information**

**Soil moisture sensors across the study sites**

|  |  |  |  |
| --- | --- | --- | --- |
| Site | Years | Sensor number | Sensor location |
| CA-DL1 | 2004-2019 | N=2 | horizontal; one in a wet location and one in a dry location at -10 cm depth |
| US-Atq | 2010-2019 | N=1 | horizontal -10 cm depth |
| US-Ivo | 2014-2019 | N=4 | horizontal at -5 cm depth |
| US-Bes | 2006-2010  2012-2019 | N= 2 | diagonally inserted at 0-10cm |
| US-Che | 2003-2004  2013-2016 | N=2 | horizontal -8cm and -16cm depth |
| RU-Sam | 2009-2010  2013-2017 | N=5 | horizontal at -5, -14, in rim ,  -5, -12, -15 cm in the center of ice-wedge polygon |
| US-ICt | 2008-2019 | N=2 | horizontal at -2.5 cm |
| US-ICh | 2008-2019 | N=2 | horizontal at -2.5 cm |
| GL-ZaH | 2000-2004  2005- | N=2 | vertical 0-6 cm  horizontal: -5cm, -10 cm |
| CA-TVC |  | N=1 | horizontal -20cm |

The average soil moisture indicated in Table 1 in the main manuscript includes all the sensors available at the sites; the number of sensors and the soil depths in each of the sites are listed for each site (CA-DL1: N=2 (in a wet location and a dry location, both at -10 cm depth); US-Atq: N=4 (2010-2013, at -5 (2),-15, and -30 cm depth), N=12 (2014-2019 at -5 (5),-15 (4), and -30 cm (3) depth); US-Ivo: N= 12 (4 at -5 cm depth, 4 at -15 cm depth, and 4 and -30 cm depth); US-Bes: N= 5 (2 diagonally inserted at 0-10 cm, 1 diagonally inserted at -20-30 cm, 2 vertically inserted at 0-30 cm depth); US-Che: N=2 (-8cm and -16cm depth); RU-Sam: N=11 (4 in slopes at -5, -14, -23, -33 depth, and 7 in rims at -5, -12, -15, -22, -26,- 34, and -37 cm depth); US-ICt: N=2 (at -2.5 cm depth); DK-ZaH: N=2 (2000-2004 vertical 0-6 cm and from 2005 onward are at two depths horizontal: -5cm, -10 cm depth) CA-TVC: N=1 ( inserted horizontally at -20cm depth).

**Supplementary Figures**

A picture containing diagram

Description automatically generated

**Supplementary Fig. 1** Relationships between the monthly cumulative net ecosystem exchange (NEE), gross primary productivity (GPP), ecosystem respiration (ER) and growing degree days (GDD), for the month of June, July, and August, for the 11 sites (the regression lines are separate for each site); in the figure legend the sites are grouped into two main categories based on the dominant vegetation (as described in the Methods section).

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