



*Supplement of*

**ABCFlux v2: Arctic–boreal CO<sub>2</sub> and CH<sub>4</sub> monthly flux observations and ancillary information across terrestrial and freshwater ecosystems**

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## **S1. Description of the ESA CCI, BAWLD and biome classes and datasets used in figures**

For figures 4, 5, 7, 8 and 9, we used the classes “Boreal forest”, “Tundra”, “Wetland”, “Lentic”, and “Lotic” which were formed utilizing the column “bawld\_class” for terrestrial (Wetland=bog, fen, marsh, permafrost bog, and wet tundra, Tundra=dry and moist tundra, Boreal forest=Boreal forest) and waterbody\_type for lentic and lotic.

For figure 6, we used the terrestrial BAWLD (column “bawld\_class”) wetland classes (bog, fen, marsh, permafrost bog, and wet tundra) for calculating the proportion of flux data in the dataset for each class. We also calculated their aerial extents in the gridded product (Olefeldt et al., 2021b). Boreal forest class in column “bawld\_class” was split to classes deciduous broadleaf forest, evergreen needleleaf forest, deciduous needleleaf forest and mixed forest based on ESA CCI column “land\_cover\_ecosystem”; aerial extents of these classes within the original BAWLD boreal forest domain were calculated based on ESA CCI gridded data (ESA CCI 2016). The dry and moist tundra classes in column “bawld\_class” were split to shrub, graminoid and barren classes based on column “land\_cover\_ecosystem”; aerial extents of these classes in the gridded ESA CCI product within the original dry tundra class in BAWLD product were also calculated. Sparse vegetation types were found in boreal forests and dry tundra class in the BAWLD gridded product and their aerial extents in both biomes were calculated and then summed together. For the aquatic classes, we regrouped lotic and lentic classes by their size (Large lentic=Large Lake; Midsize lentic=Midsize Glacial Lake, Midsize Peatland Lake, Midsize Yedoma Lake; Small lentic=Small Glacial Lake, Small Peatland Lake, Small Yedoma Lake; Large lotic=Large river; Small lotic=Small Organic-Rich River, Small Organic-Poor River) and calculated their aerial extents.

**Table S1. The number of site-months in ABCFlux v2 for each individual flux variable.**

| <b>Flux column</b>                | <b>Number of site-months</b> |
|-----------------------------------|------------------------------|
| nee                               | 14,913                       |
| gpp                               | 11,623                       |
| reco                              | 13,017                       |
| co2_flux                          | 3,770                        |
| ch4_flux_total                    | 8,094                        |
| ch4_flux_diffusion                | 3,560                        |
| co2_flux_ebullition               | 33                           |
| ch4_flux_ebullition               | 474                          |
| co2_flux_storage                  | 3                            |
| ch4_flux_storage                  | 367                          |
| nee_seasonal                      | 27                           |
| ch4_flux_total_seasonal           | 179                          |
| ch4_flux_diffusion_seasonal       | 4                            |
| ch4_flux_ebullition_seasonal      | 19                           |
| water_co2                         | 7,923                        |
| water_ch4                         | 7,745                        |
| <b>Total Fluxes</b>               | 56,139                       |
| <b>Total concentration values</b> | 15,668                       |

**Table S2. The 1st and 99th percentiles of terrestrial flux variables separated by measurement methods (EC= eddy covariance, Non-EC= manual and automatic chambers and snow pack diffusion) used to identify outlier measurements.**

| Month | Biome  | Flux method | 1st nee  | 99th nee | 1st gpp | 99th gpp | 1st reco | 99th reco | 1st CH <sub>4</sub> | 99th CH <sub>4</sub> |
|-------|--------|-------------|----------|----------|---------|----------|----------|-----------|---------------------|----------------------|
| 1     | Boreal | EC          | -13.007  | 50.131   | 0.000   | 68.664   | -19.618  | 51.634    | -0.040              | 5.599                |
| 2     | Boreal | EC          | -12.817  | 42.354   | 0.001   | 59.237   | -10.343  | 42.103    | -0.826              | 3.979                |
| 3     | Boreal | EC          | -44.080  | 39.233   | 0.219   | 67.651   | -7.305   | 65.854    | -0.130              | 3.320                |
| 4     | Boreal | EC          | -85.205  | 36.783   | 1.724   | 99.452   | -1.746   | 140.242   | -0.077              | 2.490                |
| 5     | Boreal | EC          | -108.804 | 48.295   | 8.333   | 231.916  | 3.296    | 249.231   | -0.153              | 4.942                |
| 6     | Boreal | EC          | -160.174 | 36.586   | 16.534  | 314.340  | 12.362   | 360.195   | -0.204              | 2.761                |
| 7     | Boreal | EC          | -138.957 | 38.031   | 22.589  | 366.238  | 24.167   | 398.710   | -0.185              | 4.041                |
| 8     | Boreal | EC          | -99.772  | 66.841   | 17.773  | 331.058  | 20.292   | 311.961   | -0.201              | 4.359                |
| 9     | Boreal | EC          | -45.720  | 86.208   | 11.374  | 257.750  | 6.529    | 197.074   | -0.184              | 2.360                |
| 10    | Boreal | EC          | -12.087  | 86.766   | 1.262   | 160.611  | -0.992   | 88.286    | -0.115              | 2.372                |
| 11    | Boreal | EC          | -0.805   | 81.776   | 0.292   | 95.468   | -17.586  | 35.166    | -0.078              | 4.213                |
| 12    | Boreal | EC          | -11.880  | 62.902   | 0.007   | 74.486   | -14.161  | 38.070    | -0.044              | 5.291                |
| 1     | Tundra | EC          | -23.280  | 39.765   | 0.000   | 50.422   | -24.024  | 48.183    | -0.134              | 0.856                |
| 2     | Tundra | EC          | -28.065  | 34.041   | 0.000   | 40.317   | -16.837  | 41.167    | -0.125              | 0.539                |
| 3     | Tundra | EC          | -26.299  | 33.138   | 0.000   | 45.050   | -23.175  | 36.740    | -0.135              | 0.494                |
| 4     | Tundra | EC          | -25.386  | 34.025   | 0.000   | 47.901   | -11.355  | 46.164    | -0.096              | 0.564                |
| 5     | Tundra | EC          | -38.250  | 30.536   | 1.059   | 76.125   | -8.633   | 106.578   | -0.057              | 1.109                |
| 6     | Tundra | EC          | -95.447  | 31.338   | 3.393   | 119.604  | -0.040   | 186.357   | -0.135              | 2.736                |
| 7     | Tundra | EC          | -120.362 | -2.450   | 3.451   | 140.281  | 19.598   | 226.331   | -0.090              | 4.181                |
| 8     | Tundra | EC          | -72.763  | 14.205   | 7.108   | 123.961  | 10.956   | 155.444   | -0.003              | 4.048                |
| 9     | Tundra | EC          | -21.758  | 33.556   | 3.017   | 75.252   | -1.959   | 61.033    | 0.003               | 2.550                |
| 10    | Tundra | EC          | -13.271  | 42.063   | 0.354   | 60.809   | -9.346   | 25.889    | -0.065              | 1.149                |
| 11    | Tundra | EC          | -12.782  | 39.046   | 0.168   | 37.806   | -13.594  | 15.096    | -0.144              | 0.572                |
| 12    | Tundra | EC          | -21.244  | 39.304   | 0.000   | 39.167   | -18.752  | 19.320    | -0.134              | 0.614                |
| 1     | Boreal | Non-EC      | 0.913    | 8.149    | 3.515   | 8.164    | 0.000    | 0.000     | -0.030              | 1.337                |
| 2     | Boreal | Non-EC      | 0.015    | 15.936   | 1.183   | 16.327   | 0.000    | 0.000     | -0.026              | 4.026                |
| 3     | Boreal | Non-EC      | 0.320    | 19.406   | 1.416   | 19.310   | 0.000    | 0.000     | -0.041              | 1.157                |
| 4     | Boreal | Non-EC      | -33.851  | 21.189   | -0.146  | 26.236   | 0.000    | 55.314    | -0.163              | 1.169                |
| 5     | Boreal | Non-EC      | -63.068  | 37.251   | 0.981   | 177.796  | 2.598    | 507.675   | -0.106              | 8.510                |
| 6     | Boreal | Non-EC      | -176.048 | 93.987   | 1.615   | 250.548  | 3.525    | 670.628   | -0.180              | 6.591                |
| 7     | Boreal | Non-EC      | -361.110 | 173.791  | 1.281   | 366.409  | 13.849   | 793.996   | -0.191              | 11.537               |
| 8     | Boreal | Non-EC      | -424.430 | 79.618   | 1.038   | 168.134  | 21.858   | 819.444   | -0.172              | 9.504                |

|    |        |        |          |         |        |         |         |         |        |        |
|----|--------|--------|----------|---------|--------|---------|---------|---------|--------|--------|
| 9  | Boreal | Non-EC | -259.839 | 61.962  | 0.317  | 136.952 | -27.942 | 445.003 | -0.266 | 6.190  |
| 10 | Boreal | Non-EC | -9.606   | 25.935  | 0.556  | 39.045  | 0.000   | 31.389  | -0.075 | 4.357  |
| 11 | Boreal | Non-EC | -0.080   | 13.290  | 0.754  | 10.182  | -0.036  | 0.653   | -0.106 | 4.463  |
| 12 | Boreal | Non-EC | 0.020    | 19.408  | 2.237  | 8.285   | 0.000   | 0.000   | -0.069 | 1.254  |
| 1  | Tundra | Non-EC | 0.107    | 23.231  | 4.906  | 4.906   |         |         | 0.001  | 0.557  |
| 2  | Tundra | Non-EC | -0.083   | 10.373  |        |         |         |         | 0.003  | 0.892  |
| 3  | Tundra | Non-EC | 0.000    | 12.816  | 8.716  | 10.676  |         |         | -0.846 | 0.291  |
| 4  | Tundra | Non-EC | -0.023   | 29.433  | -3.076 | 28.918  | 3.748   | 36.016  | -1.826 | 0.466  |
| 5  | Tundra | Non-EC | -9.080   | 49.132  | 1.504  | 130.650 | 7.145   | 92.611  | -1.513 | 1.534  |
| 6  | Tundra | Non-EC | -77.834  | 109.158 | 1.247  | 425.724 | -0.676  | 219.060 | -0.137 | 11.808 |
| 7  | Tundra | Non-EC | -175.583 | 117.286 | 5.840  | 628.680 | 0.000   | 402.490 | -0.716 | 28.216 |
| 8  | Tundra | Non-EC | -146.325 | 92.193  | 4.068  | 293.761 | 0.000   | 318.983 | -0.632 | 42.387 |
| 9  | Tundra | Non-EC | -95.418  | 67.054  | 4.273  | 529.057 | -7.269  | 196.348 | -0.050 | 36.320 |
| 10 | Tundra | Non-EC | 1.351    | 76.742  | 1.291  | 71.069  | -2.318  | 4.864   | -0.004 | 4.290  |
| 11 | Tundra | Non-EC | 1.051    | 19.168  | 4.629  | 6.678   | 2.621   | 2.621   | 0.008  | 1.559  |
| 12 | Tundra | Non-EC | 0.116    | 13.061  | 8.292  | 8.292   |         |         | -0.002 | 1.190  |

**Table S3. The start and end dates (month-year) of data collection and number of site-months for all eddy covariance flux data in ABCFlux v2 separated by gases.**

Footprint\_Partitioned refers to datasets where fluxes have been isolated to different ecosystems within the footprint and thus there are multiple datasets across the different ecosystems for a single site.

| <b>site_reference</b>                                                                    | <b>Start CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CO<sub>2</sub> site-<br/>months</b> | <b>Start CH<sub>4</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CH<sub>4</sub> data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CH<sub>4</sub> site-<br/>months</b> | <b>Footprint_<br/>Partitioned</b> |
|------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|-----------------------------------|
| Abisko Stordalen birch<br>forest_tower                                                   | May-21                                                               | Oct-23                                                             | 30                                                   |                                                                      |                                                                |                                                      |                                   |
| Adventdalen_SJ-<br>Adv_tower                                                             | Jan-12                                                               | Dec-15                                                             | 48                                                   |                                                                      |                                                                |                                                      |                                   |
| Alberta - Western Peatland<br>- LaBiche River,Black<br>Spruce,Larch Fen_CA-<br>WP1_tower | Sep-03                                                               | Sep-09                                                             | 73                                                   |                                                                      |                                                                |                                                      |                                   |
| Alberta - Western Peatland<br>- Poor Fen (Sphagnum<br>moss)_CA-WP2_tower                 | May-04                                                               | Dec-06                                                             | 32                                                   |                                                                      |                                                                |                                                      |                                   |
| Alberta - Western Peatland<br>- Rich Fen (Carex)_CA-<br>WP3_tower                        | May-04                                                               | Dec-06                                                             | 32                                                   |                                                                      |                                                                |                                                      |                                   |
| Anaktuvuk River Moderate<br>Burn_US-An2_tower                                            | Jun-08                                                               | Aug-23                                                             | 47                                                   |                                                                      |                                                                |                                                      |                                   |
| Anaktuvuk River Severe<br>Burn_US-An1_tower                                              | Jun-08                                                               | Aug-23                                                             | 47                                                   |                                                                      |                                                                |                                                      |                                   |
| Anaktuvuk River<br>Unburned_US-An3_tower                                                 | Jun-08                                                               | Aug-23                                                             | 47                                                   |                                                                      |                                                                |                                                      |                                   |
| Andoya_NO-And_tower                                                                      | Jul-08                                                               | Nov-14                                                             | 77                                                   |                                                                      |                                                                |                                                      |                                   |
| ARM-NSA-Barrow_US-<br>A10_tower                                                          | Nov-11                                                               | Dec-20                                                             | 109                                                  | Feb-14                                                               | Oct-19                                                         | 58                                                   |                                   |
| ARM-NSA-Oliktok_US-<br>A03_tower                                                         | Sep-14                                                               | Jun-21                                                             | 80                                                   | Jan-18                                                               | Jan-18                                                         | 1                                                    |                                   |
| Atqasuk_US-Atq_tower                                                                     | Jan-03                                                               | Nov-22                                                             | 173                                                  | Sep-13                                                               | Nov-22                                                         | 93                                                   |                                   |
| Attawapiskat River<br>Bog_CA-ARB_tower                                                   | May-11                                                               | Dec-15                                                             | 56                                                   |                                                                      |                                                                |                                                      |                                   |
| Attawapiskat River<br>Fen_CA-ARF_tower                                                   | Apr-11                                                               | Dec-15                                                             | 57                                                   |                                                                      |                                                                |                                                      |                                   |
| Barrow_Medium<br>lake_tower                                                              | Jun-11                                                               | Aug-11                                                             | Seasonal flux                                        |                                                                      |                                                                |                                                      |                                   |
| Barrow_Old lake_tower                                                                    | Jun-11                                                               | Aug-11                                                             | Seasonal flux                                        |                                                                      |                                                                |                                                      |                                   |
| Barrow_Young lake_tower                                                                  | Jun-11                                                               | Aug-11                                                             | Seasonal flux                                        |                                                                      |                                                                |                                                      |                                   |

| <b>site_reference</b>                                 | <b>Start CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CO<sub>2</sub> site-<br/>months</b> | <b>Start CH<sub>4</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CH<sub>4</sub> data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CH<sub>4</sub> site-<br/>months</b> | <b>Footprint_<br/>Partitioned</b> |
|-------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|-----------------------------------|
| Barrow-BEO_US-<br>Beo_tower                           | Jan-13                                                               | Nov-22                                                             | 92                                                   | Oct-13                                                               | Nov-22                                                         | 82                                                   |                                   |
| Barrow-BES_US-<br>Bes_tower                           | Jul-05                                                               | Nov-22                                                             | 104                                                  | Aug-13                                                               | Nov-22                                                         | 74                                                   |                                   |
| Barrow-CMDL_US-<br>Brw_tower                          | Sep-13                                                               | Dec-22                                                             | 107                                                  | Sep-13                                                               | Dec-22                                                         | 96                                                   |                                   |
| Bayelva, Spitsbergen_SJ-<br>Blv_tower                 | Jan-08                                                               | Dec-15                                                             | 28                                                   |                                                                      |                                                                |                                                      |                                   |
| Bernard Lake_tower                                    | Jul-22                                                               | Jan-24                                                             | 19                                                   | Jul-22                                                               | Jan-24                                                         | 19                                                   |                                   |
| Bernard spruce-moss<br>valley_tower                   | Nov-18                                                               | Jan-24                                                             | 63                                                   | Jul-21                                                               | Jan-24                                                         | 29                                                   |                                   |
| Bibai bog_JP-Bby_tower                                | Jan-15                                                               | Feb-21                                                             | 74                                                   | Jan-15                                                               | Feb-21                                                         | 74                                                   |                                   |
| Bonanza Creek Black<br>Spruce_US-BZS_tower            | Jun-10                                                               | Dec-21                                                             | 115                                                  | May-15                                                               | Sep-16                                                         | 11                                                   |                                   |
| Bonanza Creek Old<br>Thermokarst Bog_US-<br>BZo_tower | Apr-18                                                               | Dec-21                                                             | 45                                                   |                                                                      |                                                                |                                                      |                                   |
| Bonanza Creek Rich<br>Fen_US-BZF_tower                | May-11                                                               | Dec-21                                                             | 116                                                  | May-14                                                               | Oct-16                                                         | 16                                                   |                                   |
| Bonanza Creek<br>Thermokarst Bog_US-<br>BZB_tower     | Jan-11                                                               | Dec-21                                                             | 120                                                  | May-14                                                               | Oct-16                                                         | 18                                                   |                                   |
| Bouleau peatland_CA-<br>BOU_tower                     | Jun-18                                                               | Oct-20                                                             | 29                                                   | Jun-18                                                               | Oct-20                                                         | 13                                                   |                                   |
| Cambridge Bay -<br>Mesic_CB-mesic_tower               | May-22                                                               | Sep-22                                                             | 5                                                    |                                                                      |                                                                |                                                      |                                   |
| Cape Bounty_CA-<br>CB_tower                           | Jun-08                                                               | Jul-18                                                             | 12                                                   |                                                                      |                                                                |                                                      |                                   |
| Cascaden Ridge Fire<br>Scar_US-Fcr_tower              | Jan-11                                                               | Dec-14                                                             | 48                                                   |                                                                      |                                                                |                                                      |                                   |
| Central Marsh_US-<br>Cms_tower                        | Jan-99                                                               | Aug-05                                                             | 80                                                   | Jun-99                                                               | Aug-00                                                         | 5                                                    |                                   |
| Cherskii disturbed<br>forest_RU-<br>Eusk_cher2_tower  | Mar-13                                                               | Nov-15                                                             | 31                                                   |                                                                      |                                                                |                                                      |                                   |
| Cherskii ecotone_RU-                                  | Jan-12                                                               | Dec-15                                                             | 36                                                   |                                                                      |                                                                |                                                      |                                   |

| <b>site_reference</b>                                         | <b>Start CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CO<sub>2</sub> site-<br/>months</b> | <b>Start CH<sub>4</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CH<sub>4</sub> data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CH<sub>4</sub> site-<br/>months</b> | <b>Footprint_<br/>Partitioned</b> |
|---------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|-----------------------------------|
| Eusk_cher1_tower                                              |                                                                      |                                                                    |                                                      |                                                                      |                                                                |                                                      |                                   |
| Cherskii reference_RU-<br>Ch2_tower                           | Jul-13                                                               | Dec-21                                                             | 102                                                  | Jul-13                                                               | Dec-21                                                         | 102                                                  |                                   |
| Cherskii_RU-Che_tower                                         | Aug-02                                                               | Dec-21                                                             | 134                                                  | Jul-13                                                               | Dec-21                                                         | 102                                                  |                                   |
| Churchill Fen 3_CA-<br>CF3_tower                              | Sep-22                                                               | Dec-24                                                             | 28                                                   | Sep-22                                                               | Dec-24                                                         | 28                                                   |                                   |
| Churchill Fen Site 2_CA-<br>CF2_tower                         |                                                                      |                                                                    |                                                      | Jul-08                                                               | Nov-11                                                         | 18                                                   |                                   |
| Churchill Fen Site 1_CA-<br>CF1_tower                         | Jan-07                                                               | Dec-08                                                             | 24                                                   |                                                                      |                                                                |                                                      |                                   |
| Council Alaska<br>Tundra_US-CAK_tower                         | Sep-24                                                               | Sep-24                                                             | 1                                                    | Sep-24                                                               | Sep-24                                                         | 1                                                    |                                   |
| Council, Alaska_US-<br>KOC_tower                              | Jul-14                                                               | Aug-23                                                             | 26                                                   |                                                                      |                                                                |                                                      |                                   |
| Daring Lake_CA-<br>DL1_tower                                  | May-04                                                               | Aug-15                                                             | 54                                                   |                                                                      |                                                                |                                                      |                                   |
| Daring Lake_CA-<br>DL3_tower                                  | May-10                                                               | Aug-15                                                             | 24                                                   |                                                                      |                                                                |                                                      |                                   |
| Daring Lake_CA-<br>DL4_tower                                  | May-10                                                               | Aug-15                                                             | 21                                                   |                                                                      |                                                                |                                                      |                                   |
| Daring Lake_tower                                             | May-06                                                               | Aug-06                                                             | 4                                                    |                                                                      |                                                                |                                                      |                                   |
| Degero_SE-Deg_tower                                           | Jan-01                                                               | Dec-23                                                             | 276                                                  | Jan-14                                                               | Dec-18                                                         | 50                                                   |                                   |
| Delta Junction evergreen<br>conifer forest_US-<br>Bn2_tower   | Apr-02                                                               | Apr-04                                                             | 3                                                    |                                                                      |                                                                |                                                      |                                   |
| Delta Junction deciduous<br>broadleaf forest_US-<br>Bn1_tower | Apr-02                                                               | Apr-04                                                             | 3                                                    |                                                                      |                                                                |                                                      |                                   |
| Disko_GL-Dsk_tower                                            | Dec-12                                                               | Dec-23                                                             | 107                                                  |                                                                      |                                                                |                                                      |                                   |
| Eastmain Reservoir_tower                                      | Jan-08                                                               | Sep-12                                                             | 45                                                   |                                                                      |                                                                |                                                      |                                   |
| Eight Mile Lake_US-<br>EML_tower                              | May-08                                                               | Mar-24                                                             | 188                                                  | Jul-15                                                               | Mar-24                                                         | 67                                                   |                                   |

| <b>site_reference</b>                                                                        | <b>Start CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CO<sub>2</sub> site-<br/>months</b> | <b>Start CH<sub>4</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CH<sub>4</sub> data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CH<sub>4</sub> site-<br/>months</b> | <b>Footprint_<br/>Partitioned</b> |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|-----------------------------------|
| Elgeei forest station_RU-Ege_tower                                                           | Jan-10                                                               | Dec-18                                                             | 108                                                  |                                                                      |                                                                |                                                      |                                   |
| Faejemyr_SE-Faj_tower                                                                        | Jul-05                                                               | Dec-09                                                             | 53                                                   |                                                                      |                                                                |                                                      |                                   |
| Finse west_NO-Fns_tower                                                                      | Jan-19                                                               | Dec-21                                                             | 36                                                   |                                                                      |                                                                |                                                      |                                   |
| Fish Island_FI-NWT_tower                                                                     | Jul-17                                                               | Aug-17                                                             | 2                                                    | Jul-17                                                               | Aug-17                                                         | 2                                                    |                                   |
| Flakaliden_SE-Fla_tower                                                                      | Jun-96                                                               | Dec-09                                                             | 103                                                  |                                                                      |                                                                |                                                      |                                   |
| Flux Observations of Carbon from an Airborne Laboratory (FOCAL) Campaign Site 1_US-Fo1_tower | Jul-13                                                               | Sep-24                                                             | 9                                                    | Jul-13                                                               | Sep-24                                                         | 9                                                    |                                   |
| Flux Observations of Carbon from an Airborne Laboratory (FOCAL) Campaign Site 2_US-Fo2_tower | Jun-23                                                               | Sep-24                                                             | 9                                                    | Jun-23                                                               | Sep-24                                                         | 9                                                    |                                   |
| Fyodorovskoye_RU-Fyo_tower                                                                   | May-98                                                               | Dec-20                                                             | 272                                                  |                                                                      |                                                                |                                                      |                                   |
| Fyodorovskoye2_RU-Fy2_tower                                                                  | May-15                                                               | Dec-20                                                             | 68                                                   | Jun-15                                                               | Dec-18                                                         | 43                                                   |                                   |
| Gunnarsholt_IS-Gun_tower                                                                     | Jul-96                                                               | Dec-98                                                             | 22                                                   |                                                                      |                                                                |                                                      |                                   |
| Hakasia 10 yr_RU-Ha3_tower                                                                   | Apr-04                                                               | Nov-04                                                             | 8                                                    |                                                                      |                                                                |                                                      |                                   |
| Hakasia 5yr_RU-Ha2_tower                                                                     | Jul-02                                                               | Jul-03                                                             | 9                                                    |                                                                      |                                                                |                                                      |                                   |
| Hakasia Steppe_RU-Ha1_tower                                                                  | Jul-02                                                               | Dec-04                                                             | 30                                                   |                                                                      |                                                                |                                                      |                                   |
| Halmyran_SE-Hmr_tower                                                                        | Apr-20                                                               | Dec-22                                                             | 33                                                   | Apr-20                                                               | Dec-22                                                         | 33                                                   |                                   |
| Halsingfors mire_SE-HfM_tower                                                                | Apr-20                                                               | Dec-22                                                             | 33                                                   | Jun-20                                                               | Dec-22                                                         | 31                                                   |                                   |
| Happy Valley Wet Sedge Tundra_US-HVs_tower                                                   | May-95                                                               | Sep-95                                                             | 5                                                    |                                                                      |                                                                |                                                      |                                   |
| Happy Valley_US-HVa_tower                                                                    | Jun-94                                                               | Sep-95                                                             | 7                                                    | Jun-95                                                               | Aug-95                                                         | 3                                                    |                                   |

| <b>site_reference</b>                                         | <b>Start CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CO<sub>2</sub> site-<br/>months</b> | <b>Start CH<sub>4</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CH<sub>4</sub> data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CH<sub>4</sub> site-<br/>months</b> | <b>Footprint_<br/>Partitioned</b> |
|---------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|-----------------------------------|
| Havikpak Creek_CA-<br>HPC_tower                               | Apr-13                                                               | Sep-22                                                             | 114                                                  | Jan-18                                                               | Sep-22                                                         | 57                                                   |                                   |
| HJP02 Jack Pine_CA-<br>HJP02_tower                            | Jan-04                                                               | Dec-05                                                             | 24                                                   |                                                                      |                                                                |                                                      |                                   |
| HJP75 Jack Pine_CA-<br>HJP75_tower                            | Apr-04                                                               | Dec-05                                                             | 21                                                   |                                                                      |                                                                |                                                      |                                   |
| HJP94 Jack Pine_CA-<br>HJP94_tower                            | Jan-04                                                               | Dec-05                                                             | 24                                                   |                                                                      |                                                                |                                                      |                                   |
| Hustai grassland_MN-<br>Hst_tower                             | Jan-15                                                               | Dec-20                                                             | 72                                                   |                                                                      |                                                                |                                                      |                                   |
| Hyltemossa_SE-<br>Htm_tower                                   | Jan-15                                                               | Dec-20                                                             | 71                                                   |                                                                      |                                                                |                                                      |                                   |
| Hyttiala_FI-Hyy_tower                                         | Jul-96                                                               | Dec-23                                                             | 330                                                  | Jan-12                                                               | Dec-16                                                         | 21                                                   |                                   |
| Igarka_RU-Iga_tower                                           | Jun-16                                                               | Aug-23                                                             | 26                                                   |                                                                      |                                                                |                                                      |                                   |
| Illisarvik_IL-NWT_tower                                       | Jul-16                                                               | Aug-16                                                             | Seasonal flux                                        | Jul-16                                                               | Aug-16                                                         | Seasonal flux                                        |                                   |
| Imnavait Creek Watershed<br>Heath Tundra_US-<br>ICh_tower     | Sep-07                                                               | Dec-21                                                             | 172                                                  |                                                                      |                                                                |                                                      |                                   |
| Imnavait Creek Watershed<br>Tussock Tundra_US-<br>ICt_tower   | Jul-07                                                               | Dec-21                                                             | 174                                                  |                                                                      |                                                                |                                                      |                                   |
| Imnavait Creek Watershed<br>Wet Sedge Tundra_US-<br>ICs_tower | Sep-07                                                               | Dec-21                                                             | 160                                                  | Jun-14                                                               | Nov-21                                                         | 22                                                   |                                   |
| Iqaluit Tundra_CA-<br>IQ1_tower                               | May-22                                                               | Oct-23                                                             | 11                                                   |                                                                      |                                                                |                                                      |                                   |
| Iqaluit_CA-Iqa_tower                                          | Jul-08                                                               | Jul-08                                                             | 1                                                    |                                                                      |                                                                |                                                      |                                   |
| Iskoras_NO-Isk_tower                                          | Apr-19                                                               | Feb-22                                                             | 35                                                   | Apr-19                                                               | Feb-22                                                         | 31                                                   |                                   |
| Iskoras_NO-Isk-fen_tower                                      | Apr-19                                                               | Feb-22                                                             | 35                                                   | Apr-19                                                               | Feb-22                                                         | 31                                                   | Yes                               |
| Iskoras_NO-Isk-<br>palsa_tower                                | Apr-19                                                               | Feb-22                                                             | 35                                                   | Apr-19                                                               | Feb-22                                                         | 31                                                   | Yes                               |
| Iskoras_NO-Isk-<br>pond_tower                                 | Apr-19                                                               | Feb-22                                                             | 35                                                   | Apr-19                                                               | Feb-22                                                         | 31                                                   | Yes                               |
| Ivotuk_US-Ivo_tower                                           | Oct-03                                                               | Nov-18                                                             | 119                                                  | Jul-13                                                               | Jul-18                                                         | 49                                                   |                                   |

| site_reference                                               | Start CO <sub>2</sub> data collection (Month-Year) | End CO <sub>2</sub> data collection (Month-Year) | Number of CO <sub>2</sub> site-months | Start CH <sub>4</sub> data collection (Month-Year) | End CH <sub>4</sub> data collection (Month-Year) | Number of CH <sub>4</sub> site-months | Footprint_Partitioned |
|--------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------|---------------------------------------|----------------------------------------------------|--------------------------------------------------|---------------------------------------|-----------------------|
| Kaamanen_FI-Kaa_tower                                        | Jan-97                                             | Dec-08                                           | 143                                   |                                                    |                                                  |                                       |                       |
| Kalevansuo_FI-Kns_tower                                      | Sep-04                                             | Apr-09                                           | 56                                    |                                                    |                                                  |                                       |                       |
| Kenttarova_FI-Ken_tower                                      | Jan-12                                             | Dec-23                                           | 84                                    |                                                    |                                                  |                                       |                       |
| Kherlenbayan Ulaan_MN-Kbu_tower                              | Jan-03                                             | Dec-08                                           | 72                                    |                                                    |                                                  |                                       |                       |
| Kitinen_tower                                                | Jun-18                                             | Sep-18                                           | 4                                     | Jun-18                                             | Sep-18                                           | 4                                     |                       |
| Knottasen_SE-Kno_tower                                       | Jan-06                                             | Dec-17                                           | 139                                   |                                                    |                                                  |                                       |                       |
| Kuivajaervi_FI-Kvr_tower                                     | Aug-10                                             | Mar-22                                           | 113                                   | Sep-12                                             | Sep-15                                           | 31                                    |                       |
| Kymijoki_tower                                               | Jun-09                                             | Jul-09                                           | 2                                     |                                                    |                                                  |                                       |                       |
| Kytalyk, Russia_RU-Cok_tower                                 | May-03                                             | Sep-21                                           | 80                                    | Jul-08                                             | Aug-21                                           | 21                                    |                       |
| Lac Le Caron peatland, an ombrotrophic bog_CA-LLC_tower      | Jan-08                                             | Sep-12                                           | 45                                    |                                                    |                                                  |                                       |                       |
| Lake Hazen, Ellesmere Island_CA-LHazen1-semidesert_tower     | Jun-09                                             | Sep-12                                           | 9                                     |                                                    |                                                  |                                       |                       |
| Lake Hazen, Ellesmere Island_CA-LHazen2-meadow wetland_tower | Jun-11                                             | Sep-12                                           | 6                                     |                                                    |                                                  |                                       |                       |
| Lettosuo_FI-Let_tower                                        | Sep-09                                             | Dec-24                                           | 183                                   |                                                    |                                                  |                                       |                       |
| Lily Lake Fen_US-KPL_tower                                   | Apr-21                                             | Oct-23                                           | 31                                    | Mar-21                                             | Oct-23                                           | 20                                    |                       |
| Ljusdal_HY_tower                                             | Aug-19                                             | Oct-22                                           | 23                                    |                                                    |                                                  |                                       |                       |
| Ljusdal_SLM_tower                                            | Jun-20                                             | Dec-22                                           | 25                                    |                                                    |                                                  |                                       |                       |
| Lompolojankka_FI-Lom_tower                                   | Jan-06                                             | Dec-12                                           | 72                                    | Jan-06                                             | Dec-10                                           | 60                                    |                       |
| Lutose_CA-LUT_tower                                          | Jun-21                                             | Oct-23                                           | 29                                    |                                                    |                                                  |                                       |                       |

| site_reference                                                                                 | Start CO <sub>2</sub><br>data<br>collection<br>(Month-Year) | End CO <sub>2</sub><br>data<br>collection<br>(Month-Year) | Number of<br>CO <sub>2</sub> site-<br>months | Start CH <sub>4</sub><br>data<br>collection<br>(Month-Year) | End CH <sub>4</sub> data<br>collection<br>(Month-Year) | Number of<br>CH <sub>4</sub> site-<br>months | Footprint_<br>Partitioned |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------|---------------------------|
| Manitoba - Northern Old<br>Black Spruce (former<br>BOREAS Northern Study<br>Area)_CA-Man_tower | Apr-94                                                      | Dec-08                                                    | 149                                          |                                                             |                                                        |                                              |                           |
| Merasjaervi_tower                                                                              | Jun-05                                                      | Oct-05                                                    | 5                                            |                                                             |                                                        |                                              |                           |
| Mittimatalik (Pond Inlet)<br>Tundra_CA-Mtk_tower                                               | Aug-24                                                      | Nov-24                                                    | 4                                            | Aug-24                                                      | Sep-24                                                 | 2                                            |                           |
| Mukhrino field station,<br>Khanty-Mansiysk,<br>Russia_RU-Muh_tower                             | May-15                                                      | Sep-22                                                    | 11                                           |                                                             |                                                        |                                              |                           |
| Mukhrino_Mukhrino_RHC_<br>tower                                                                | May-15                                                      | Aug-15                                                    | 4                                            |                                                             |                                                        |                                              |                           |
| Nalaikh grassland_MN-<br>Nkh_tower                                                             | Jan-15                                                      | Dec-20                                                    | 72                                           |                                                             |                                                        |                                              |                           |
| Nelegel_RU-Nel_tower                                                                           | Jun-00                                                      | Aug-06                                                    | 30                                           |                                                             |                                                        |                                              |                           |
| Neleger Burnt Forest_RU-<br>NeB_tower                                                          | Jan-99                                                      | Dec-00                                                    | 24                                           |                                                             |                                                        |                                              |                           |
| Neleger Cutover_RU-<br>NeC_tower                                                               | Jan-01                                                      | Dec-06                                                    | 72                                           |                                                             |                                                        |                                              |                           |
| Neleger larch forest_RU-<br>NeF_tower                                                          | Jan-00                                                      | Dec-06                                                    | 84                                           |                                                             |                                                        |                                              |                           |
| NEON Barrow<br>Environmental Observatory<br>(BARR)_US-xBA_tower                                | Jun-19                                                      | Oct-22                                                    | 37                                           |                                                             |                                                        |                                              |                           |
| NEON Caribou Creek -<br>Poker Flats Watershed<br>(BONA)_US-xBN_tower                           | Nov-17                                                      | Nov-22                                                    | 56                                           |                                                             |                                                        |                                              |                           |
| NEON Delta Junction<br>(DEJU)_US-xDJ_tower                                                     | Oct-17                                                      | Nov-22                                                    | 54                                           |                                                             |                                                        |                                              |                           |
| NEON Healy (HEAL)_US-<br>xHE_tower                                                             | Jan-18                                                      | Nov-22                                                    | 48                                           |                                                             |                                                        |                                              |                           |
| NGEE Arctic Barrow_US-<br>NGB_tower                                                            | Sep-12                                                      | Dec-19                                                    | 88                                           | Jun-13                                                      | Aug-23                                                 | 35                                           |                           |
| NGEE Arctic Council_US-<br>NGC_tower                                                           | Aug-17                                                      | Dec-19                                                    | 29                                           | Jul-17                                                      | Jul-23                                                 | 24                                           |                           |
| North Star Yedoma_US-<br>NSY_tower                                                             | May-21                                                      | Apr-23                                                    | 24                                           | May-21                                                      | Apr-23                                                 | 24                                           |                           |

| site_reference                                                                                 | Start CO <sub>2</sub><br>data<br>collection<br>(Month-Year) | End CO <sub>2</sub><br>data<br>collection<br>(Month-Year) | Number of<br>CO <sub>2</sub> site-<br>months | Start CH <sub>4</sub><br>data<br>collection<br>(Month-Year) | End CH <sub>4</sub> data<br>collection<br>(Month-Year) | Number of<br>CH <sub>4</sub> site-<br>months | Footprint_<br>Partitioned |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------|---------------------------|
| Norunda_SE-Nor_tower                                                                           | Jan-99                                                      | Dec-23                                                    | 180                                          |                                                             |                                                        |                                              |                           |
| Nuuk Fen_GL-NuF_tower                                                                          | Jun-08                                                      | Sep-22                                                    | 49                                           |                                                             |                                                        |                                              |                           |
| Ontario - Groundhog River,<br>Boreal Mixedwood<br>Forest_CA-Gro_tower                          | Aug-03                                                      | Dec-13                                                    | 125                                          |                                                             |                                                        |                                              |                           |
| Pallasjaervi_tower                                                                             | Jul-13                                                      | Oct-13                                                    | 4                                            |                                                             |                                                        |                                              |                           |
| Pitsalu_tower                                                                                  | Oct-22                                                      | Oct-23                                                    | 13                                           | Oct-22                                                      | Oct-23                                                 | 13                                           |                           |
| Plotnikovo field station,<br>Tomsk, Rusia_RU-<br>Plt_tower                                     | May-22                                                      | Oct-22                                                    | 6                                            |                                                             |                                                        |                                              |                           |
| Poker Flat Research<br>Range Black Spruce<br>Forest_US-Prr_tower                               | Jan-11                                                      | Dec-22                                                    | 144                                          |                                                             |                                                        |                                              |                           |
| Poker Flat Research<br>Range: Succession from<br>fire scar to deciduous<br>forest_US-Rpf_tower | Sep-08                                                      | Dec-22                                                    | 172                                          |                                                             |                                                        |                                              |                           |
| Pond Inlet_CA-Pin_tower                                                                        | Jul-08                                                      | Jul-08                                                    | 1                                            |                                                             |                                                        |                                              |                           |
| Quebec - 1975 Harvested<br>Black Spruce_CA-<br>Qc2_tower                                       | Jan-08                                                      | Dec-10                                                    | 36                                           |                                                             |                                                        |                                              |                           |
| Quebec - Eastern Boreal,<br>Mature Black Spruce_CA-<br>Qfo_tower                               | Sep-03                                                      | Dec-10                                                    | 88                                           |                                                             |                                                        |                                              |                           |
| Ranskalankorpi_FI-Ran<br>forestry treatment_tower                                              | Oct-19                                                      | Jul-23                                                    | 46                                           |                                                             |                                                        |                                              | Yes                       |
| Ranskalankorpi_FI-<br>Ran_tower                                                                | Oct-19                                                      | Jul-23                                                    | 46                                           |                                                             |                                                        |                                              | Yes                       |
| Resolute Bay Polar<br>Desert_CA-RSB_tower                                                      | Aug-24                                                      | Sep-24                                                    | 2                                            | Sep-24                                                      | Sep-24                                                 | 1                                            |                           |
| Romaine-2<br>reservoir_raft+shore_tower                                                        | Jul-18                                                      | Jan-24                                                    | 67                                           | Jul-18                                                      | Jan-24                                                 | 64                                           |                           |

| <b>site_reference</b>                                                             | <b>Start CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CO<sub>2</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CO<sub>2</sub> site-<br/>months</b> | <b>Start CH<sub>4</sub><br/>data<br/>collection<br/>(Month-Year)</b> | <b>End CH<sub>4</sub> data<br/>collection<br/>(Month-Year)</b> | <b>Number of<br/>CH<sub>4</sub> site-<br/>months</b> | <b>Footprint_<br/>Partitioned</b> |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|-----------------------------------|
| Rosinedal-3_SE-<br>Ros_tower                                                      | Aug-14                                                               | Dec-20                                                             | 77                                                   |                                                                      |                                                                |                                                      |                                   |
| Rylekaerene_tower                                                                 | Jun-08                                                               | Oct-09                                                             | 11                                                   | Jun-08                                                               | Oct-09                                                         | 11                                                   |                                   |
| Sag River_US-Sag_tower                                                            | Jun-96                                                               | Aug-96                                                             | 3                                                    | Jun-96                                                               | Aug-96                                                         | 3                                                    |                                   |
| Salmisuo_FI-Salm_tower                                                            | Jan-06                                                               | Dec-07                                                             | 24                                                   |                                                                      |                                                                |                                                      |                                   |
| Sammaltunturi fell_FI-<br>SamFell_tower                                           | Jan-12                                                               | Dec-12                                                             | 12                                                   |                                                                      |                                                                |                                                      |                                   |
| Samoylov Island_Merged<br>polygonal pond_tower                                    | Jul-19                                                               | Sep-19                                                             | Seasonal flux                                        |                                                                      |                                                                |                                                      |                                   |
| Samoylov Island_RU-Sam<br>(closed)_tower                                          | Sep-10                                                               | Aug-17                                                             | 31                                                   |                                                                      |                                                                |                                                      |                                   |
| Samoylov Island_RU-Sam<br>(open)_tower                                            | Aug-09                                                               | Sep-17                                                             | 66                                                   |                                                                      |                                                                |                                                      |                                   |
| Samoylov Island_RU-<br>Sam_tower                                                  | Jan-02                                                               | Dec-14                                                             | 106                                                  |                                                                      |                                                                |                                                      |                                   |
| Saskatchewan - Western<br>Boreal, forest burned in<br>1977_CA-SF1_tower           | Aug-03                                                               | Dec-06                                                             | 41                                                   |                                                                      |                                                                |                                                      |                                   |
| Saskatchewan - Western<br>Boreal, forest burned in<br>1989_CA-SF2_tower           | Jul-01                                                               | Dec-05                                                             | 48                                                   |                                                                      |                                                                |                                                      |                                   |
| Saskatchewan - Western<br>Boreal, forest burned in<br>1998_CA-SF3_tower           | May-01                                                               | Sep-06                                                             | 59                                                   |                                                                      |                                                                |                                                      |                                   |
| Saskatchewan - Western<br>Boreal, Jack Pine<br>harvested in 1975_CA-<br>SJ3_tower | Dec-03                                                               | Dec-06                                                             | 37                                                   |                                                                      |                                                                |                                                      |                                   |
| Saskatchewan - Western<br>Boreal, Jack Pine<br>harvested in 2002_CA-<br>SJ2_tower | Jan-04                                                               | Dec-07                                                             | 48                                                   |                                                                      |                                                                |                                                      |                                   |
| Saskatchewan - Western<br>Boreal, Mature Aspen_CA-<br>Oas_tower                   | May-96                                                               | Dec-10                                                             | 176                                                  |                                                                      |                                                                |                                                      |                                   |

| site_reference                                                        | Start CO <sub>2</sub><br>data<br>collection<br>(Month-Year) | End CO <sub>2</sub><br>data<br>collection<br>(Month-Year) | Number of<br>CO <sub>2</sub> site-<br>months | Start CH <sub>4</sub><br>data<br>collection<br>(Month-Year) | End CH <sub>4</sub> data<br>collection<br>(Month-Year) | Number of<br>CH <sub>4</sub> site-<br>months | Footprint_<br>Partitioned |
|-----------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------|---------------------------|
| Saskatchewan - Western<br>Boreal, Mature Black<br>Spruce_CA-Obs_tower | May-99                                                      | Dec-10                                                    | 140                                          |                                                             |                                                        |                                              |                           |
| Saskatchewan - Western<br>Boreal, Mature Jack<br>Pine_CA-Ojp_tower    | Jan-00                                                      | Dec-10                                                    | 132                                          |                                                             |                                                        |                                              |                           |
| Scotty Creek Bog_CA-<br>SCB_tower                                     | Jan-14                                                      | Sep-22                                                    | 105                                          | May-14                                                      | Sep-22                                                 | 94                                           |                           |
| Scotty Creek<br>Landscape_CA-<br>SCC_tower                            | Jan-13                                                      | Dec-22                                                    | 108                                          | May-13                                                      | Dec-22                                                 | 104                                          |                           |
| Seida_RU-Vrk_tower                                                    | Jan-08                                                      | Dec-08                                                    | 12                                           | Jun-08                                                      | Sep-08                                                 | 4                                            |                           |
| Siikaneva_FI-Sii_tower                                                | Jan-05                                                      | Dec-23                                                    | 225                                          | Feb-08                                                      | Dec-20                                                 | 134                                          |                           |
| Siikaneva2_FI-Si2_tower                                               | Jan-12                                                      | Dec-16                                                    | 60                                           | Apr-12                                                      | Sep-16                                                 | 36                                           |                           |
| Skogaryd_Lake<br>Erssjoen_tower                                       |                                                             |                                                           |                                              | Apr-13                                                      | Dec-13                                                 | 7                                            |                           |
| Skyttorp 1_SE-Sk1_tower                                               | Jan-05                                                      | Dec-08                                                    | 48                                           |                                                             |                                                        |                                              |                           |
| Skyttorp 2_SE-Sk2_tower                                               | Jan-04                                                      | Jul-05                                                    | 12                                           |                                                             |                                                        |                                              |                           |
| Smith Creek_CA-<br>SMC_tower                                          | Jul-17                                                      | Sep-22                                                    | 63                                           | Jul-17                                                      | Sep-22                                                 | 63                                           |                           |
| Sodankyla_FI-Sod_tower                                                | Jan-01                                                      | Dec-14                                                    | 168                                          |                                                             |                                                        |                                              |                           |
| Southern Khentei<br>Taiga_MN-Skt_tower                                | Jan-03                                                      | Dec-06                                                    | 48                                           |                                                             |                                                        |                                              |                           |
| Steen River_CA-<br>STR_tower                                          | Jun-20                                                      | Jun-23                                                    | 37                                           |                                                             |                                                        |                                              |                           |
| Stordalen Fen_Lake<br>Villasjoen_SE-St1_tower                         |                                                             |                                                           |                                              | Jun-12                                                      | Aug-19                                                 | 42                                           | Yes                       |
| Stordalen Fen_SE-<br>St1_tower                                        | Jun-12                                                      | Sep-19                                                    | 81                                           | Jun-12                                                      | Aug-19                                                 | 73                                           | Yes                       |
| Stordalen Palsa Bog_SE-<br>Sto_tower                                  | Jan-14                                                      | Aug-23                                                    | 104                                          | Jan-14                                                      | Dec-19                                                 | 48                                           |                           |
| Stordalen_Harrsjoen_Lake<br>Harrsjoen_L1_tower                        | Jun-09                                                      | Sep-09                                                    | 4                                            |                                                             |                                                        |                                              |                           |
| Stordalen,<br>Sweden_Stordalen_tower                                  |                                                             |                                                           |                                              | May-96                                                      | Jul-96                                                 | 3                                            |                           |

| <b>site_reference</b>                  | <b>Start CO<sub>2</sub> data collection (Month-Year)</b> | <b>End CO<sub>2</sub> data collection (Month-Year)</b> | <b>Number of CO<sub>2</sub> site-months</b> | <b>Start CH<sub>4</sub> data collection (Month-Year)</b> | <b>End CH<sub>4</sub> data collection (Month-Year)</b> | <b>Number of CH<sub>4</sub> site-months</b> | <b>Footprint_Partitioned</b> |
|----------------------------------------|----------------------------------------------------------|--------------------------------------------------------|---------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|---------------------------------------------|------------------------------|
| Stortjarn_SE-Srj_tower                 | Apr-20                                                   | Dec-22                                                 | 33                                          | Apr-20                                                   | Dec-22                                                 | 31                                          |                              |
| Svartberget_SE-Svb_tower               | Jan-14                                                   | Dec-23                                                 | 108                                         |                                                          |                                                        |                                             |                              |
| Taemnaren_tower                        | Sep-10                                                   | Sep-12                                                 | 18                                          | Sep-10                                                   | Sep-12                                                 | 18                                          |                              |
| Tervalamminsuo_Dry_tower               | Jul-12                                                   | Dec-22                                                 | 126                                         |                                                          |                                                        |                                             |                              |
| Tervalamminsuo_Wet_tower               | Jul-12                                                   | Dec-22                                                 | 126                                         |                                                          |                                                        |                                             |                              |
| Tiksi_RU-Tks_tower                     | Jul-10                                                   | Dec-14                                                 | 54                                          |                                                          |                                                        |                                             |                              |
| Tombstone_slavin_CA-TWOSL_tower        | Jan-20                                                   | Nov-22                                                 | 35                                          |                                                          |                                                        |                                             |                              |
| Toolik Lake_US-TOL_tower               | Jun-10                                                   | Aug-15                                                 | 18                                          | Jun-10                                                   | Aug-15                                                 | 18                                          |                              |
| Trail Valley Creek_Big Bear Lake_tower | Feb-23                                                   | Sep-23                                                 | 8                                           | Mar-23                                                   | Aug-23                                                 | 6                                           |                              |
| Trail Valley Creek_CA-TVC_tower        | Jan-13                                                   | Sep-22                                                 | 117                                         | Jan-13                                                   | Sep-22                                                 | 117                                         |                              |
| Tura_RU-Tur_tower                      | Jan-04                                                   | Aug-23                                                 | 33                                          |                                                          |                                                        |                                             |                              |
| UCI-1850 burn site_CA-NS1_tower        | Jun-02                                                   | Sep-05                                                 | 40                                          |                                                          |                                                        |                                             |                              |
| UCI-1930 burn site_CA-NS2_tower        | Aug-01                                                   | Sep-05                                                 | 50                                          |                                                          |                                                        |                                             |                              |
| UCI-1964 burn site wet_CA-NS4_tower    | Jan-03                                                   | Sep-05                                                 | 33                                          |                                                          |                                                        |                                             |                              |
| UCI-1964 burn site_CA-NS3_tower        | Aug-01                                                   | Sep-05                                                 | 50                                          |                                                          |                                                        |                                             |                              |
| UCI-1981 burn site_CA-NS5_tower        | Aug-01                                                   | Sep-05                                                 | 50                                          |                                                          |                                                        |                                             |                              |
| UCI-1989 burn site_CA-NS6_tower        | Oct-01                                                   | Sep-05                                                 | 48                                          |                                                          |                                                        |                                             |                              |
| UCI-1998 burn site_CA-NS7_tower        | May-02                                                   | Sep-05                                                 | 41                                          |                                                          |                                                        |                                             |                              |
| Udleg practice forest_MN-Udg_tower     | Jan-10                                                   | Dec-12                                                 | 36                                          |                                                          |                                                        |                                             |                              |
| Umiujaq_tower                          | Jun-17                                                   | Apr-20                                                 | 35                                          |                                                          |                                                        |                                             |                              |

| <b>site_reference</b>                        | <b>Start CO<sub>2</sub> data collection (Month-Year)</b> | <b>End CO<sub>2</sub> data collection (Month-Year)</b> | <b>Number of CO<sub>2</sub> site-months</b> | <b>Start CH<sub>4</sub> data collection (Month-Year)</b> | <b>End CH<sub>4</sub> data collection (Month-Year)</b> | <b>Number of CH<sub>4</sub> site-months</b> | <b>Footprint_Partitioned</b> |
|----------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|---------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|---------------------------------------------|------------------------------|
| University of Alaska, Fairbanks_US-Uaf_tower | Jan-03                                                   | Dec-23                                                 | 252                                         | Apr-11                                                   | Nov-23                                                 | 95                                          |                              |
| Vaenajavesi_tower                            | Jan-16                                                   | Jan-17                                                 | 13                                          |                                                          |                                                        |                                             |                              |
| Valkea-Kotinen_tower                         | Apr-03                                                   | Jun-09                                                 | 52                                          |                                                          |                                                        |                                             |                              |
| Varrio_FI-Var_tower                          | Jan-12                                                   | Dec-23                                                 | 144                                         |                                                          |                                                        |                                             |                              |
| Wolf_creek_Buckbrush_CA-A-WCBB_tower         | Jan-15                                                   | Dec-22                                                 | 96                                          |                                                          |                                                        |                                             |                              |
| Wolf_creek_forest_CA-WCF_tower               | Jan-17                                                   | Nov-22                                                 | 71                                          |                                                          |                                                        |                                             |                              |
| Wolf_creek_SparseShrub_CA-WCPLT_tower        | Jan-15                                                   | Dec-22                                                 | 96                                          |                                                          |                                                        |                                             |                              |
| Wolf_creek_upper_forest_CA-WCUF_tower        | Jan-20                                                   | Nov-22                                                 | 35                                          |                                                          |                                                        |                                             |                              |
| Yakutsk Spasskaya Pad larch_RU-SkP_tower     | Jul-00                                                   | Sep-14                                                 | 132                                         |                                                          |                                                        |                                             |                              |
| Yakutsk Spasskaya Pad Pine_RU-Sk2_tower      | Jan-04                                                   | Dec-08                                                 | 48                                          |                                                          |                                                        |                                             |                              |
| YKD (burned)_US-YK1_tower                    | Oct-20                                                   | Dec-22                                                 | 27                                          | Oct-20                                                   | Dec-22                                                 | 27                                          |                              |
| YKD (unburned)_US-YK2_tower                  | Jul-19                                                   | Dec-22                                                 | 42                                          | Jul-19                                                   | Dec-22                                                 | 42                                          |                              |
| Zackenberg Fen_GL-ZaF_tower                  | May-08                                                   | Sep-22                                                 | 80                                          |                                                          |                                                        |                                             |                              |
| Zackenberg Heath_GL-ZaH_tower                | Jun-97                                                   | Sep-22                                                 | 88                                          |                                                          |                                                        |                                             |                              |
| Zotino_RU-Zot_tower                          | Mar-02                                                   | Sep-04                                                 | 23                                          |                                                          |                                                        |                                             |                              |
| Zotino; Central Siberia_RU-Zfw 1_tower       | Apr-99                                                   | Apr-00                                                 | 3                                           |                                                          |                                                        |                                             |                              |
| Zotino; Central Siberia_RU-Zfw 2_tower       | Apr-99                                                   | Jul-00                                                 | 3                                           |                                                          |                                                        |                                             |                              |
| ZOTTO Bog_RU-Zo1_tower                       | May-13                                                   | Jun-16                                                 | 11                                          |                                                          |                                                        |                                             |                              |
| ZOTTO Forest_RU-Zo2_tower                    | Apr-13                                                   | Jun-17                                                 | 15                                          |                                                          |                                                        |                                             |                              |

**Table S4. The distribution of site-months and sites for the whole dataset as well as separately for the terrestrial and aquatic ecosystems, and CO<sub>2</sub> and CH<sub>4</sub> flux and concentration datasets across Arctic-boreal countries.** Country-level areal estimates from Wikipedia ([https://en.wikipedia.org/wiki/List\\_of\\_countries\\_and\\_dependencies\\_by\\_area](https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_area)). We also included some data from Japan, Mongolia, and the UK but their country-level cover is not shown

|              | Area                    | Overall dataset  |            |            |                                        | Terrestrial      |            |            |                                        | Aquatic          |            |            |                                        | CO <sub>2</sub>  |            | CH <sub>4</sub>  |            |
|--------------|-------------------------|------------------|------------|------------|----------------------------------------|------------------|------------|------------|----------------------------------------|------------------|------------|------------|----------------------------------------|------------------|------------|------------------|------------|
|              | Million km <sup>2</sup> | % of site-months | % of sites | # of sites | # of sites per million km <sup>2</sup> | % of site-months | % of sites | # of sites | # of sites per million km <sup>2</sup> | % of site-months | % of sites | # of sites | # of sites per million km <sup>2</sup> | % of site-months | % of sites | % of site-months | % of sites |
| Alaska (USA) | 1.718                   | 24.3             | 18.2       | 186        | 108.3                                  | 23.4             | 30.3       | 102        | 59.4                                   | 25.9             | 12.8       | 91         | 53.0                                   | 22.1             | 16.7       | 20.6             | 19.8       |
| Sweden       | 0.450                   | 201.0            | 23.3       | 239        | 530.8                                  | 14.7             | 9.5        | 32         | 71.1                                   | 32.5             | 29.6       | 211        | 468.6                                  | 18.3             | 24.9       | 21.4             | 9.1        |
| Canada       | 9.985                   | 19.2             | 14.1       | 144        | 14.4                                   | 20.3             | 25.8       | 87         | 8.7                                    | 17.6             | 8.6        | 61         | 6.1                                    | 20.8             | 12.3       | 17.4             | 13.5       |
| Finland      | 0.338                   | 17.4             | 24.4       | 250        | 739.3                                  | 20.5             | 7.4        | 25         | 73.9                                   | 11.5             | 31.6       | 225        | 665.4                                  | 19.1             | 28.0       | 20.3             | 36.4       |
| Russia       | 17.098                  | 11.2             | 14.3       | 146        | 8.5                                    | 11.9             | 14.8       | 50         | 2.9                                    | 9.9              | 14.7       | 105        | 6.1                                    | 12.0             | 13.1       | 10.1             | 15.8       |
| Norway       | 0.386                   | 3.0              | 2.3        | 24         | 62.1                                   | 3.8              | 5.0        | 17         | 44.0                                   | 1.3              | 1.1        | 8          | 20.7                                   | 2.8              | 1.9        | 5.9              | 2.3        |
| Greenland    | 2.166                   | 2.2              | 2.1        | 21         | 9.7                                    | 2.9              | 3.9        | 13         | 6.0                                    | 1.1              | 1.1        | 8          | 3.7                                    | 2.5              | 1.5        | 2.3              | 2.3        |
| Mongolia     | 1.564                   | 1.0              | 0.5        | 5          | 3.2                                    | 1.6              | 1.5        | 5          | 3.2                                    |                  |            |            | 0.0                                    | 1.5              | 0.6        |                  |            |
| Estonia      | 0.045                   | 0.3              | 0.3        | 3          | 66.2                                   | 0.4              | 0.9        | 3          | 66.2                                   |                  |            |            | 0.0                                    | 0.4              | 0.3        | 0.9              | 0.3        |

here.

**Table S5. Monthly median NEE (g C m<sup>-2</sup> month<sup>-1</sup>) across key boreal terrestrial ecosystems, with 25th–75th quantiles in parentheses.**

| Month | Deciduous<br>Broadleaf<br>Forest | Evergreen<br>Needleleaf<br>Forest | Deciduous<br>Needleleaf<br>Forest | Mixed Forest              | Bog                      | Fen                       |
|-------|----------------------------------|-----------------------------------|-----------------------------------|---------------------------|--------------------------|---------------------------|
| 1     | 13.2<br>(11 to 18)               | 12.5<br>(6.6 to 20.7)             | 13.7<br>(10.6 to 16.2)            | 11.4<br>(4.1 to 15)       | 7.2<br>(4.3 to 11.8)     | 4.5<br>(2.9 to 7.3)       |
| 2     | 12.8<br>(9.4 to 16)              | 10.1<br>(5.1 to 16.5)             | 15.9<br>(8.8 to 20)               | 4.2<br>(2.1 to 12.3)      | 5.9<br>(2.9 to 8.7)      | 3.7<br>(2.2 to 6.1)       |
| 3     | 17.2<br>(12 to 20.4)             | 8.7<br>(3.1 to 14.5)              | 12.6<br>(7.4 to 14)               | 1.0<br>(0.5 to 3)         | 5.0<br>(1.9 to 8)        | 3.7<br>(1.6 to 6.8)       |
| 4     | 16<br>(8.8 to 33.3)              | -3.1<br>(-22.6 to 8.6)            | 9.0<br>(-3.8 to 10.9)             | 2.5<br>(-1.5 to 5.3)      | 1.1<br>(-0.9 to 6.5)     | 4.4<br>(2.2 to 6.3)       |
| 5     | 2.3<br>(-18.7 to 28.8)           | -32.7<br>(-54.9 to -17.1)         | -2.0<br>(-8.8 to 6.1)             | -20.0<br>(-30.2 to -9.4)  | -7.7<br>(-18.5 to -2.3)  | -0.8<br>(-7.5 to 5.6)     |
| 6     | -44.5<br>(-122.8 to -23.5)       | -48.4<br>(-69.6 to -30.5)         | -58.2<br>(-87.9 to -28.3)         | -51.9<br>(-73.8 to -39.4) | -18.5<br>(-32.7 to -6.2) | -25.3<br>(-39.1 to -14.9) |
| 7     | -65.5<br>(-110.2 to -21.4)       | -31.5<br>(-55.2 to -14.6)         | -41.1<br>(-59.5 to -27.4)         | -48.8<br>(-63.9 to -38.4) | -22<br>(-46.6 to -8.6)   | -40.8<br>(-74.3 to -27.6) |
| 8     | -25.9<br>(-78.3 to 0.6)          | -7.6<br>(-28.2 to 10.3)           | -19.9<br>(-30.7 to -11.4)         | -25.8<br>(-39.3 to -12.7) | -13.6<br>(-23.4 to -6.5) | -20.1<br>(-35.5 to -12.1) |
| 9     | 16.6<br>(-0.8 to 24.3)           | 10.0<br>(-6.4 to 26.5)            | 15.0<br>(8.7 to 24.4)             | 7.3<br>(-3.5 to 17.9)     | -2.8<br>(-6.6 to 2.6)    | 4.4<br>(-3.1 to 11.7)     |
| 10    | 30.8<br>(22 to 52.7)             | 19.4<br>(11.7 to 34.5)            | 20.5<br>(14.5 to 26.1)            | 18.3<br>(12.2 to 25.1)    | 8.7<br>(2.3 to 16.8)     | 9.9<br>(7.2 to 15.7)      |
| 11    | 25.4<br>(16.5 to 30.9)           | 19.8<br>(12 to 30.2)              | 17.3<br>(15.9 to 24.2)            | 17.9<br>(11.4 to 20.7)    | 10.3<br>(6.8 to 15)      | 7.5<br>(4.8 to 10.4)      |
| 12    | 14.9<br>(10 to 20.4)             | 15.4<br>(7.6 to 25.7)             | 17<br>(10.5 to 18.6)              | 12.8<br>(7.5 to 20.8)     | 9.5<br>(6.3 to 13.9)     | 5.7<br>(3.7 to 9)         |

**Table S6. Monthly median NEE (g C m<sup>-2</sup> month<sup>-1</sup>) across key tundra terrestrial ecosystems, with 25th–75th quantiles in parentheses.**

| Month | Permafrost Bog           | Wet Tundra               | Shrub                   | Graminoid                 | Sparse Vegetation        | Barren                  |
|-------|--------------------------|--------------------------|-------------------------|---------------------------|--------------------------|-------------------------|
| 1     | 4.5<br>(2.8 to 6.5)      | 4.1<br>(1 to 9.9)        | 5.8<br>(3.1 to 8.4)     | 5.0<br>(1.6 to 15.6)      | 1.5<br>(1.2 to 5.6)      |                         |
| 2     | 4.3<br>(1.8 to 5.6)      | 3.4<br>(0.5 to 7.5)      | 4.8<br>(2 to 8.1)       | 1.9<br>(-0.1 to 10.8)     | 1.5<br>(-0.2 to 7.4)     |                         |
| 3     | 2.6<br>(1 to 5.2)        | 2.9<br>(0.6 to 7.1)      | 3.6<br>(1 to 8.5)       | 2.4<br>(0.3 to 7.5)       | 1.0<br>(0.2 to 4.5)      |                         |
| 4     | 1.7<br>(-1.2 to 5)       | 1.5<br>(0.3 to 6.4)      | 3.1<br>(1 to 7.7)       | 1.9<br>(0.6 to 4.2)       | 0.5<br>(0.2 to 1.1)      |                         |
| 5     | -4.6<br>(-25.4 to 1.4)   | 3.7<br>(0.6 to 9.2)      | 3.9<br>(0.8 to 8.9)     | 0.2<br>(-6.6 to 3.5)      | 12.0<br>(8.8 to 15)      |                         |
| 6     | -14.9<br>(-31.7 to -4.1) | -10.2<br>(-28.1 to 3.7)  | -11.9<br>(-27.7 to 5.7) | -13.5<br>(-40.8 to 1.4)   | -4.2<br>(-19.2 to 6.6)   |                         |
| 7     | -27.7<br>(-56.9 to -7.2) | -41.8<br>(-63.7 to -21)  | -17.4<br>(-46.8 to 4)   | -28.7<br>(-57.2 to -10.7) | -15.4<br>(-31.7 to -0.9) | 7.3<br>(-29.4 to 61.3)  |
| 8     | -20.1<br>(-41 to -4.8)   | -19.8<br>(-36.7 to -7.6) | -7.3<br>(-26.1 to -0.4) | -17.6<br>(-33.9 to -4.1)  | -5.8<br>(-13.7 to 0.1)   | -1.0<br>(-3.8 to -0.2)  |
| 9     | 1.7<br>(-8.9 to 17.2)    | 10.6<br>(0.2 to 19.1)    | 12.0<br>(6.4 to 17.9)   | 9.7<br>(3.8 to 16.8)      | 12.7<br>(10.7 to 18.2)   | -7.6<br>(-14.5 to -7.2) |
| 10    | 8.8<br>(5.1 to 11.7)     | 9.9<br>(4.8 to 15.8)     | 11.5<br>(8.6 to 15.3)   | 9.8<br>(6.2 to 21.4)      | 12.9<br>(8.7 to 14.6)    |                         |
| 11    | 6.1<br>(3.4 to 7.7)      | 7.6<br>(4.3 to 12.4)     | 8.8<br>(5.6 to 11.7)    | 9.2<br>(3 to 19.6)        | 10.3<br>(7.3 to 13.5)    |                         |
| 12    | 4.9<br>(2.6 to 6.8)      | 6.2<br>(2.5 to 10.4)     | 7.4<br>(3.3 to 10)      | 5.6<br>(2.8 to 23.9)      | 4.7<br>(2.3 to 9.2)      |                         |

**Table S7. Monthly median NEE ( $\text{g C m}^{-2} \text{ month}^{-1}$ ) across key aquatic ecosystems, with 25th–75th quantiles in parentheses.**

| Month | Large Lentic          | Midsized Lentic        | Small Lentic           | Large Lotic             | Small Lotic             |
|-------|-----------------------|------------------------|------------------------|-------------------------|-------------------------|
| 1     | 2.1<br>(-0.7 to 3.4)  | 2.1<br>(1.5 to 5.1)    | 25.3<br>(25 to 26.1)   | 74.7<br>(35.3 to 170.4) |                         |
| 2     | 3.3<br>(2.2 to 5.7)   | 1.2<br>(0.2 to 2.7)    | 22<br>(15.8 to 23.1)   |                         |                         |
| 3     | 3.5<br>(1.2 to 7.9)   | 2.2<br>(0.9 to 3.5)    | 21.8<br>(10.8 to 22)   |                         | 29.8<br>(9.5 to 67.5)   |
| 4     | 6.6<br>(4.0 to 9.4)   | 5.2<br>(2.5 to 11.8)   | 12.1<br>(6.1 to 21.4)  |                         | 51.0<br>(25.8 to 115.8) |
| 5     | 14.5<br>(9.1 to 32.2) | 36.1<br>(15.1 to 60.7) | 18.8<br>(5.8 to 57.7)  | 22.8<br>(16.9 to 63.3)  | 58.0<br>(26.5 to 126.2) |
| 6     | 9.6<br>(4.8 to 14.9)  | 10.3<br>(4.2 to 19.5)  | 11.7<br>(4.7 to 30.7)  | 52.1<br>(13.1 to 152.3) | 78.4<br>(35.6 to 195.6) |
| 7     | 6.1<br>(0.4 to 14.0)  | 3.9<br>(0.8 to 9.3)    | 6.7<br>(2 to 18)       | 30.7<br>(10.6 to 75.6)  | 50.5<br>(17.4 to 159.3) |
| 8     | 8.3<br>(2.7 to 14.5)  | 6.3<br>(1.0 to 16.1)   | 11.3<br>(3.2 to 27)    | 58.0<br>(28.6 to 86.3)  | 67.4<br>(29.8 to 180.1) |
| 9     | 14.5<br>(9.4 to 21.2) | 13.1<br>(4.7 to 30.1)  | 22.1<br>(5.4 to 58.3)  | 95.9<br>(35.4 to 154.1) | 63.2<br>(25.5 to 164.6) |
| 10    | 8.9<br>(5.1 to 13.2)  | 14.6<br>(5.0 to 23.1)  | 20.6<br>(6.5 to 37.1)  | 20.1<br>(9.8 to 30.4)   | 42.3<br>(20.9 to 77.8)  |
| 11    | 10.1<br>(2.0 to 14.1) | 8.1<br>(3.6 to 11.5)   | 13.1<br>(10.8 to 19.1) |                         | 34.0<br>(10 to 75.6)    |
| 12    | 0.5<br>(-1 to 4.5)    | 2.6<br>(0.9 to 5.0)    | 21.6<br>(7.4 to 24.6)  |                         | 0<br>(0 to 20.2)        |

**Table S8. Monthly median CH<sub>4</sub> flux (mg C m<sup>-2</sup> month<sup>-1</sup>) across key boreal terrestrial ecosystems, with 25th–75th quantiles in parentheses.**

| Month | Deciduous<br>Broadleaf Forest  | Evergreen<br>Needleleaf Forest | Deciduous<br>Needleleaf Forest | Mixed Forest                | Bog                         | Fen                         |
|-------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|-----------------------------|-----------------------------|
| 1     |                                | 65.63<br>(-17.35 to 231.16)    |                                | -1.69<br>(-6.43 to 0.21)    | 325.1<br>(29.9 to 513.6)    | 216.1<br>(117.4 to 310.6)   |
| 2     | 1961.25<br>(979.03 to 2943.47) | -9.26<br>(-30.51 to 207.67)    |                                | -1.2<br>(-7.6 to 2)         | 91.9<br>(25.5 to 465.8)     | 182<br>(85.7 to 245)        |
| 3     | 358.26<br>(82.71 to 629.79)    | 35.58(-9.38 to 153.14)         |                                | 0.52<br>(0.1 to 1.87)       | 73.7<br>(9.9 to 224.7)      | 197.5<br>(126.8 to 255)     |
| 4     |                                | 67.99<br>(-14.42 to 194.2)     | -13.98<br>(-20.89 to -9.01)    | 0<br>(-4.79 to 0.38)        | 106.5<br>(26.2 to 291.2)    | 328.2<br>(157.4 to 421.9)   |
| 5     | 157.71<br>(-4.62 to 1067.12)   | 37.38<br>(-26.38 to 302.54)    | 0.17<br>(0.14 to 1.29)         | 6.68 (-2.74 to 29.47)       | 587.7<br>(127.4 to 1238.9)  | 586.9<br>(205.1 to 907.6)   |
| 6     | -12.73<br>(-18.4 to 456.35)    | 0.67<br>(-22.15 to 284.75)     | 4.46<br>(4.45 to 4.47)         | 2.35<br>(-4.74 to 21.56)    | 839.6<br>(155 to 1813.2)    | 892.3<br>(448.8 to 1724)    |
| 7     | -32.63<br>(-45.26 to -27.11)   | -40.87<br>(-77.48 to -10.07)   | 1.19<br>(-0.9 to 3.27)         | -21.24<br>(-58.9 to -3.46)  | 1037.9<br>(190.8 to 2459.3) | 1719.8<br>(505.5 to 3336.5) |
| 8     | 0.25<br>(-31.95 to 154.38)     | -5.21<br>(-47.98 to 222.19)    | 2.55<br>(2.18 to 3.22)         | 0.55<br>(-12.65 to 102.81)  | 1463.5<br>(320 to 2802.5)   | 2059.9<br>(960.6 to 3147.8) |
| 9     | -35.09<br>(-62.36 to -23.57)   | 0.91<br>(-77.58 to 147.41)     | -0.37<br>(-3.49 to 2.74)       | -2.38<br>(-13.87 to 46.54)  | 761.4<br>(190 to 1719.2)    | 1482.3<br>(776 to 2292)     |
| 10    | 61.98<br>(61.98 to 61.98)      | -24.52<br>(-55.36 to 292.5)    |                                | 38.26<br>(-10.45 to 100.91) | 425.2<br>(178.9 to 796.6)   | 718.8<br>(471.4 to 927.5)   |
| 11    |                                | -1.43                          |                                | 32.62                       | 211.7                       | 405.4                       |

|    |  |                            |  |                          |                          |                           |
|----|--|----------------------------|--|--------------------------|--------------------------|---------------------------|
|    |  | (-46.01 to 241.15)         |  | (-3.6 to 264.34)         | (91.6 to 530.7)          | (297.9 to 525.1)          |
| 12 |  | 29.69<br>(-20.15 to 252.9) |  | -2.08<br>(-7.51 to 1.88) | 366.9<br>(52.8 to 505.6) | 309.5<br>(213.1 to 406.8) |

**Table S9. Monthly median CH<sub>4</sub> flux (mg C m<sup>-2</sup> month<sup>-1</sup>) across key tundra terrestrial ecosystems, with 25th–75th quantiles in parentheses.**

| Month | Permafrost Bog           | Wet Tundra                  | Shrub                       | Graminoid                    | Sparse                      | Barren                    |
|-------|--------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|---------------------------|
| 1     | 15.7<br>(5.1 to 57.3)    | 122.9<br>(45 to 302)        | 9.6<br>(9.6 to 9.6)         | 68.05<br>(-1.05 to 143.86)   | -1.81<br>(-6.75 to -0.7)    |                           |
| 2     | 12.9<br>(0.7 to 48.8)    | 103.4<br>(49.8 to 236.9)    | 8.67<br>(8.67 to 8.67)      | 135.22<br>(17.46 to 2458.96) | -0.45<br>(-2.1 to -0.22)    |                           |
| 3     | 14<br>(0.4 to 23.6)      | 86.6<br>(18.7 to 189.4)     | -2.49<br>(-3.48 to 0.15)    | 33.72<br>(7.15 to 50.77)     | -1.2<br>(-1.82 to 0)        | -249<br>(-249 to -249)    |
| 4     | 4.7<br>(0 to 11.8)       | 22.2<br>(1.5 to 138.4)      | -4.04<br>(-20.46 to -0.8)   | 43.27<br>(1.35 to 88.9)      | 0.07<br>(-0.7 to 0.35)      | -2219<br>(-2582 to -1856) |
| 5     | 8.4<br>(0 to 80.5)       | 111.9<br>(29.2 to 317.3)    | -19.26<br>(-58.37 to 20.85) | 281.7<br>(163.62 to 354.86)  | -1.85<br>(-10.2 to 0.03)    | 290<br>(-415 to 995)      |
| 6     | 30.4<br>(1.2 to 265.7)   | 376.3<br>(146 to 1023.6)    | -16.18<br>(-53.48 to -1.18) | 7.17 (0 to 79.54)            | -1.89<br>(-8.34 to 4.05)    |                           |
| 7     | 142.2<br>(2.2 to 980.2)  | 1008.2<br>(380.9 to 2518.1) | -31.96<br>(-69.14 to -7.94) | 2.89 (-9.2 to 145.47)        | -19.56<br>(-47.47 to -1.92) | 9.56<br>(-1.33 to 26.49)  |
| 8     | 158.1<br>(2.1 to 1579.5) | 947<br>(424 to 1825.3)      | -24.39<br>(-46.71 to -8.17) | 8.93 (-4.83 to 375.68)       | -8.9<br>(-24.35 to 5.87)    |                           |
| 9     | 27.8<br>(0.2 to 308.9)   | 452.9<br>(266.8 to 895.4)   | -33<br>(-79.35 to -1.44)    | 193.17 (9.04 to 746.65)      | -10<br>(-28.96 to -5.3)     |                           |
| 10    | 9.5<br>(-0.3 to 89.2)    | 368.2<br>(205.4 to 619.9)   | -17.71<br>(-34.16 to -5.17) | 105.58<br>(8.37 to 136.11)   | -17.2<br>(-27.73 to -4.58)  |                           |
| 11    | 26.8<br>(5.6 to 210.4)   | 245.8<br>(143.4 to 367.5)   | -23.93 (-38.3 to -9.36)     | 52.96 (12.61 to 259.32)      | -11.4 (-19.5 to -2.55)      |                           |

|    |                      |                           |                            |                          |                         |  |
|----|----------------------|---------------------------|----------------------------|--------------------------|-------------------------|--|
| 12 | 26.9<br>(9 to 175.3) | 165.8<br>(106.5 to 353.1) | -11.84<br>(-24.66 to 5.68) | 83.47<br>(-1 to 1434.63) | -3.9<br>(-14.9 to -0.6) |  |
|----|----------------------|---------------------------|----------------------------|--------------------------|-------------------------|--|

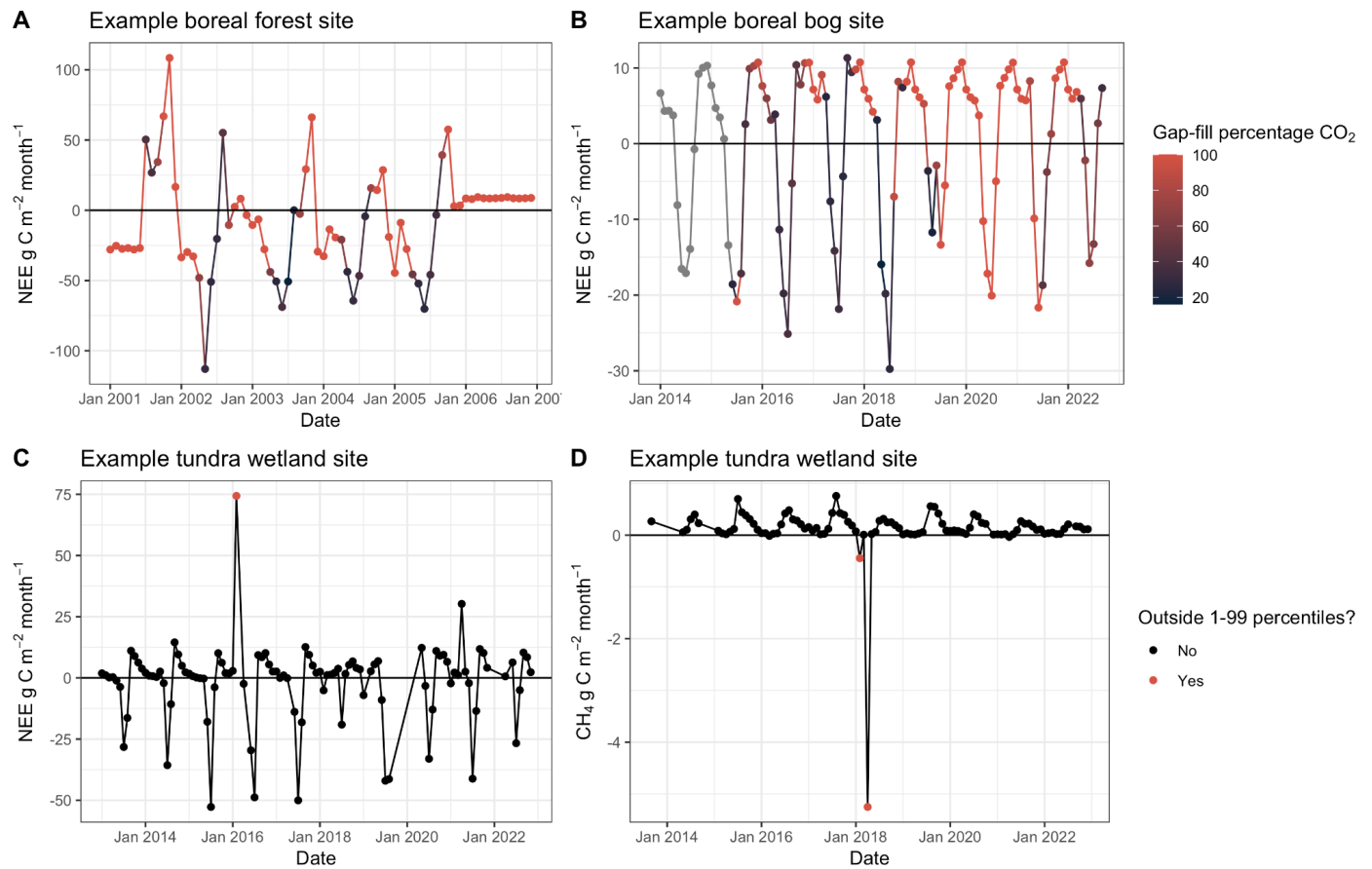
**Table S10. Monthly median total, ebullitive, and diffusive CH<sub>4</sub> flux (g C m<sup>-2</sup> month<sup>-1</sup>) across key aquatic ecosystems, with 25th–75th quantiles in parentheses.** Total flux estimates came from eddy covariance sites or sites where both ebullitive and diffusive fluxes were measured. Ebullitive fluxes are not presented for December–February, as the number of available measurements (<6) was insufficient for estimates.

| Month | Flux pathway | Small Lentic              | Midsized Lentic         | Large Lentic             | Small Lotic                  | Large Lotic              |
|-------|--------------|---------------------------|-------------------------|--------------------------|------------------------------|--------------------------|
| 1     | total        | 222.1<br>(210 to 227)     | -2.3<br>(-26.5 to -1.8) | 78.8<br>(47.6 to 127.8)  |                              |                          |
| 1     | diffusion    |                           | 67.8<br>(57.9 to 77.7)  |                          | 898.4<br>(688.5 to 1186.2)   | 458<br>(212.2 to 1119.8) |
| 2     | total        | 162.7<br>(154.7 to 169.1) | 2.1<br>(0 to 6.7)       | 54.2<br>(25.6 to 119.2)  |                              |                          |
| 2     | diffusion    |                           | 122.8<br>(81.7 to 164)  |                          | 983.5<br>(983.5 to 983.5)    |                          |
| 3     | total        | 206.1<br>(106.9 to 221)   | 2.6<br>(-0.9 to 4)      | 125.1<br>(64.8 to 161.6) | 2228.5<br>(2228.5 to 2228.5) |                          |
| 3     | ebullition   |                           |                         |                          | 0<br>(0 to 0)                |                          |
| 3     | diffusion    |                           | 236<br>(146.1 to 357.5) |                          | 14.2<br>(3.7 to 97.4)        |                          |
| 4     | total        | 271.8<br>(76 to 446.1)    | 4.9<br>(2.3 to 13.6)    | 89<br>(26 to 158.3)      |                              |                          |
| 4     | ebullition   | 22.1<br>(14 to 114.6)     |                         |                          |                              |                          |

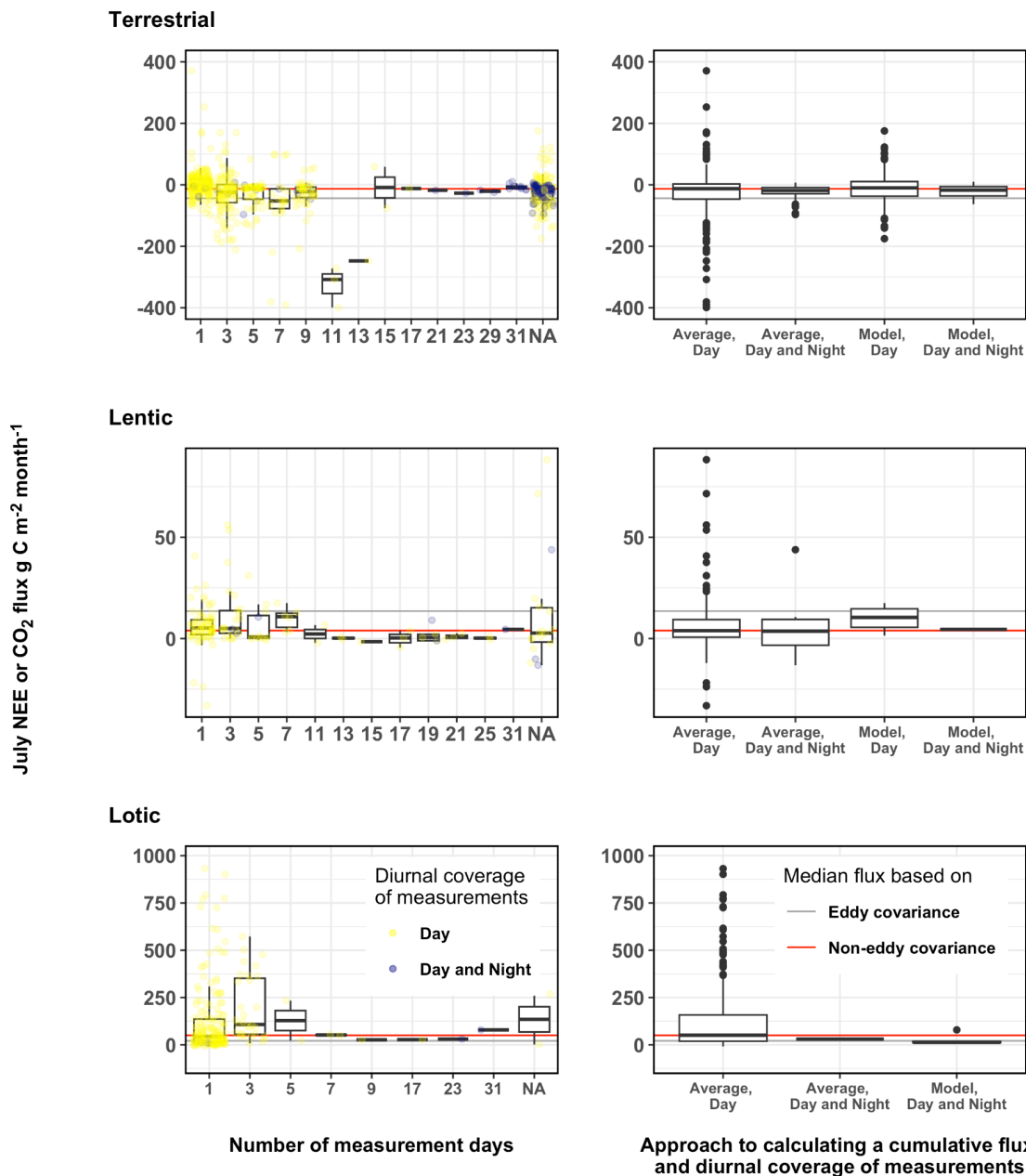
|   |            |                            |                              |                          |                               |                          |
|---|------------|----------------------------|------------------------------|--------------------------|-------------------------------|--------------------------|
| 4 | diffusion  | 49.8<br>(38.4 to 172.2)    | 1378.7<br>(1378.7 to 1378.7) | 5<br>(4 to 6)            | 43.3<br>(0 to 296.9)          |                          |
| 5 | total      | 587.9<br>(265.9 to 886.1)  | 121.8<br>(36.8 to 1358.4)    | 51.6<br>(22.7 to 156.5)  | 6685.4<br>(5861.3 to 7509.5)  |                          |
| 5 | ebullition | 629.9<br>(233.6 to 1070)   | 38<br>(26.7 to 65.8)         | 4.2<br>(4.2 to 4.2)      | 510.7<br>(359.8 to 661.6)     |                          |
| 5 | diffusion  | 106.9<br>(26.1 to 756)     | 19.1<br>(5.3 to 86.7)        | 10.8<br>(2.5 to 49.6)    | 60.2<br>(3.5 to 388.9)        | 81.8<br>(11.2 to 280.2)  |
| 6 | total      | 432.2<br>(153.7 to 1173.6) | 400<br>(155.4 to 590)        | 25.5<br>(18.7 to 314)    | 1123.2<br>(603.6 to 7413.3)   |                          |
| 6 | ebullition | 166.8<br>(39.4 to 519.9)   | 104.5<br>(3.5 to 474.8)      | 11.4<br>(6.1 to 16.8)    | 0<br>(0 to 112.3)             |                          |
| 6 | diffusion  | 142<br>(40.8 to 548.8)     | 27.1<br>(12.1 to 81.2)       | 6.5<br>(5.4 to 15.7)     | 220.9<br>(12.4 to 1700)       | 94.8<br>(29.4 to 1057.5) |
| 7 | total      | 670.4<br>(263.3 to 1274.4) | 776.1<br>(244.4 to 1405.2)   | 141.2<br>(25.2 to 435.3) | 15814.9<br>(210.9 to 43241.8) |                          |
| 7 | ebullition | 362.4<br>(102 to 843.9)    | 373.4<br>(27.1 to 1327.8)    | 7.3<br>(5.1 to 9.4)      | 14985.9<br>(317 to 41742.4)   |                          |
| 7 | diffusion  | 287.5<br>(105.7 to 674.9)  | 221.5<br>(60.5 to 548)       | 20<br>(4.4 to 82.3)      | 40.7<br>(1.8 to 228.4)        | 9.9<br>(2.6 to 45)       |

|    |            |                           |                           |                           |                              |                          |
|----|------------|---------------------------|---------------------------|---------------------------|------------------------------|--------------------------|
| 8  | total      | 850.2<br>(343 to 1224.9)  | 890<br>(357.1 to 1684.8)  | 271.7<br>(93.8 to 474.5)  | 5408.7<br>(1561.9 to 7476.8) |                          |
| 8  | ebullition | 331.4<br>(156.9 to 742.6) | 932<br>(10.2 to 1899)     | 26.3<br>(18.8 to 33.8)    | 613.6<br>(537.7 to 6673)     |                          |
| 8  | diffusion  | 290<br>(100 to 1370)      | 67.8<br>(29.7 to 265.3)   | 21.3<br>(10.1 to 80)      | 129.4<br>(4.7 to 769.7)      | 134<br>(16.9 to 1087.4)  |
| 9  | total      | 458.8<br>(257.9 to 780.9) | 404.8<br>(119.4 to 623.6) | 191.3<br>(179.2 to 322.7) | 100<br>(100 to 100)          |                          |
| 9  | ebullition | 208.5<br>(71.6 to 418.9)  | 281.7<br>(5.6 to 697)     |                           |                              |                          |
| 9  | diffusion  | 475 (103.8 to 2379.8)     | 160.2 (52.6 to 518.1)     | 30<br>(30 to 140)         | 212.3<br>(17.3 to 674.1)     | 283.1<br>(20.2 to 855.3) |
| 10 | total      | 184.2<br>(127.5 to 446.7) | 198<br>(36.4 to 235)      | 323.4<br>(159.2 to 338.2) |                              |                          |
| 10 | ebullition | 71.8<br>(63.7 to 84.4)    | 48.4<br>(20.2 to 83.6)    | 10.4<br>(10.4 to 10.4)    |                              |                          |
| 10 | diffusion  | 64.2<br>(22.3 to 317.2)   | 17.5<br>(8.6 to 41.8)     | 6<br>(3.3 to 15.3)        | 38.7<br>(4.7 to 273.4)       | 4.5<br>(1.6 to 392.7)    |
| 11 | total      | 180.7<br>(93.4 to 323.8)  | 1.8<br>(-46.4 to 4.5)     | 238.8<br>(207.8 to 289.3) |                              |                          |
| 11 | ebullition | 23.4<br>(23.4 to 23.4)    |                           |                           |                              |                          |

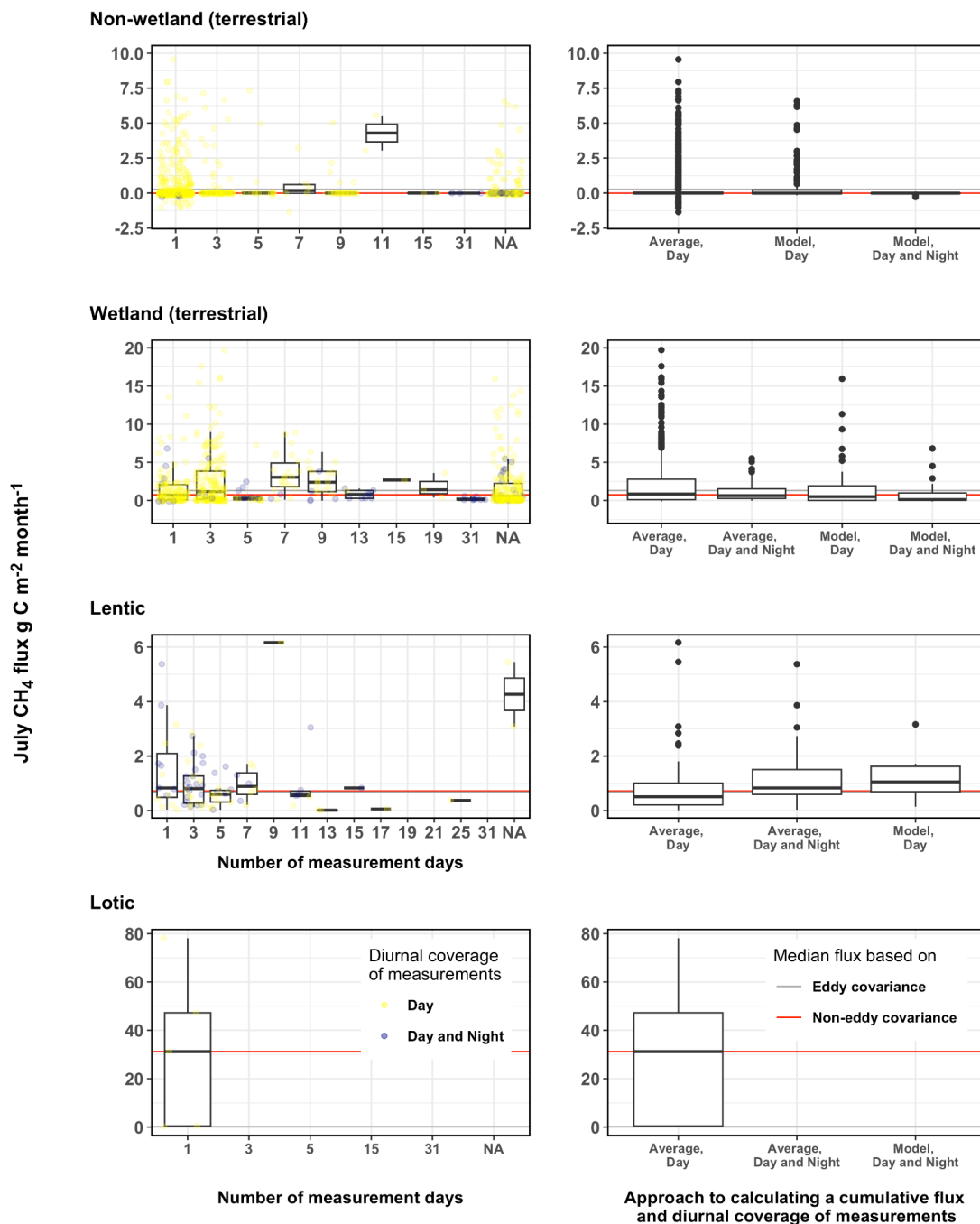
|    |           |                         |                       |                       |                      |  |
|----|-----------|-------------------------|-----------------------|-----------------------|----------------------|--|
| 11 | diffusion | 77.8<br>(21.5 to 600)   | 7<br>(5 to 17.8)      | 9.5<br>(9.2 to 9.8)   | 22.1<br>(3 to 206.2) |  |
| 12 | total     | 231.1<br>(180.8 to 260) | -2.5<br>(-5.8 to 2.2) | 268<br>(194 to 680.3) |                      |  |
| 12 | diffusion | 13.3<br>(13.3 to 13.3)  | 126<br>(6 to 247.9)   | 6.5<br>(4.8 to 8.2)   | 0.3<br>(-0.3 to 8.4) |  |



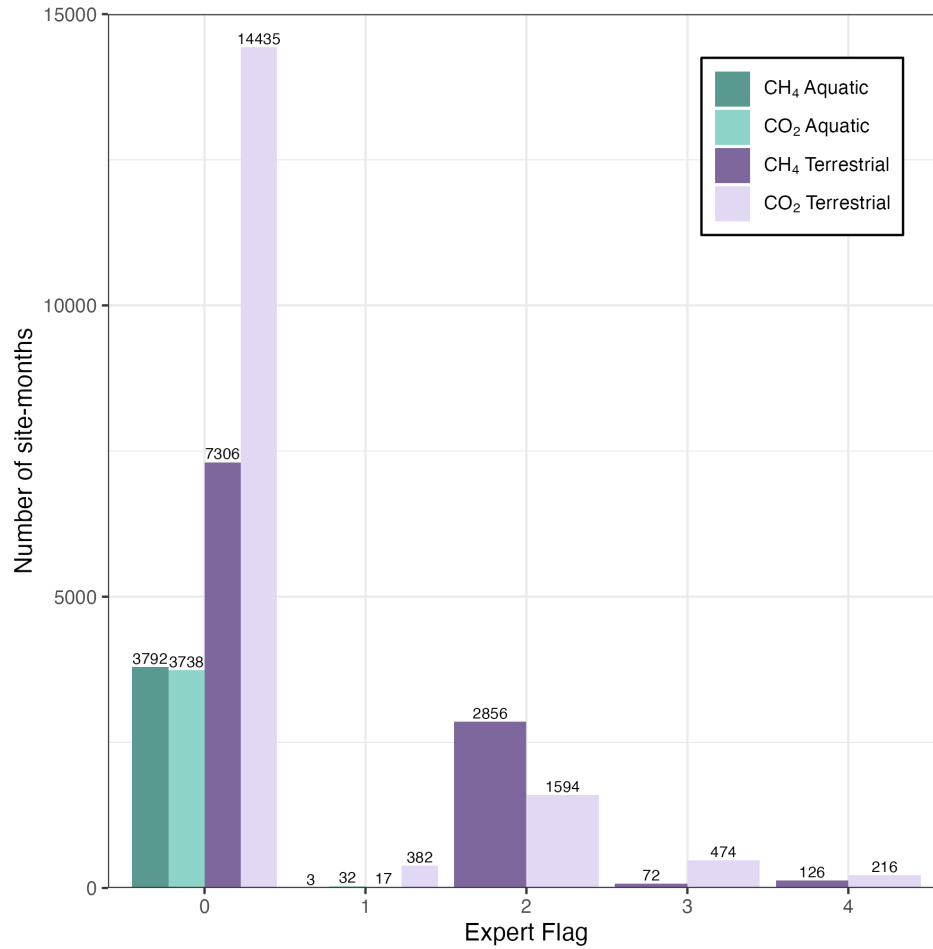
**Figure S1. Example of situations encountered in data cleaning** A) site time series with “flat lines” based on entirely gap-filled data, B) heavy gap-filling across most winters and some years (grey points and lines indicate no gap-fill percentage was available), fluxes flagged as outside the 1-99th percentiles and visually identified as outliers that were removed for C) NEE and D)  $\text{CH}_4$ .



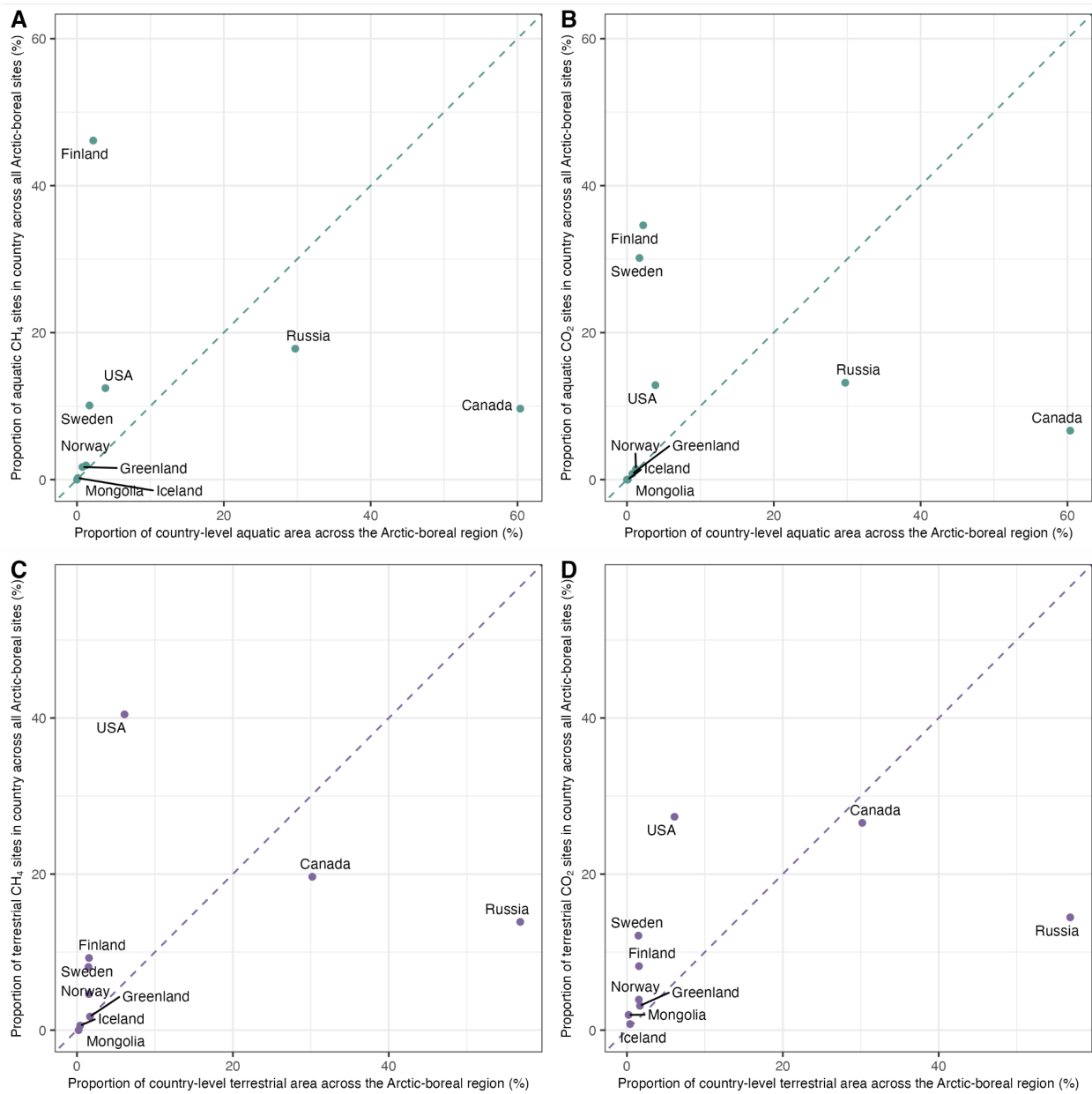
**Figure S2. The relationship between chamber-based net CO<sub>2</sub> flux for July and the number of measurement days, diurnal coverage, and the method used to calculate cumulative fluxes across key ecosystems.** "Terrestrial" refers only to treeless ecosystems. When information on diurnal coverage was unavailable, we assumed daytime-only measurements for this visualization. Similarly, in the absence of details on the aggregation approach, we assumed a simple average was used—that is, the mean measured flux multiplied by the number of days, rather than modeled using light and temperature response functions.



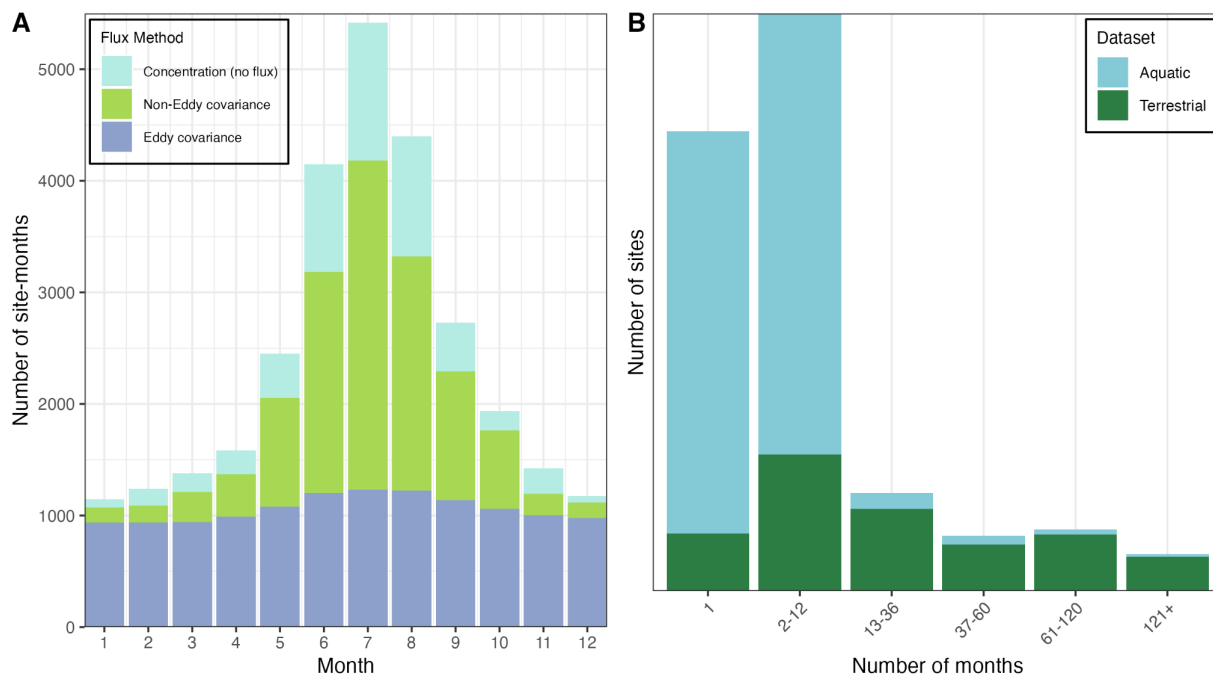
**Figure S3. The relationship between chamber-based net CH<sub>4</sub> flux for July and the number of measurement days, diurnal coverage, and the method used to calculate cumulative fluxes across key ecosystems.** When information on diurnal coverage was unavailable, we assumed daytime-only measurements for this visualization. Similarly, in the absence of details on the aggregation approach, we assumed a simple average was used—that is, the mean measured flux multiplied by the number of days, rather than modeled using environmental response functions.



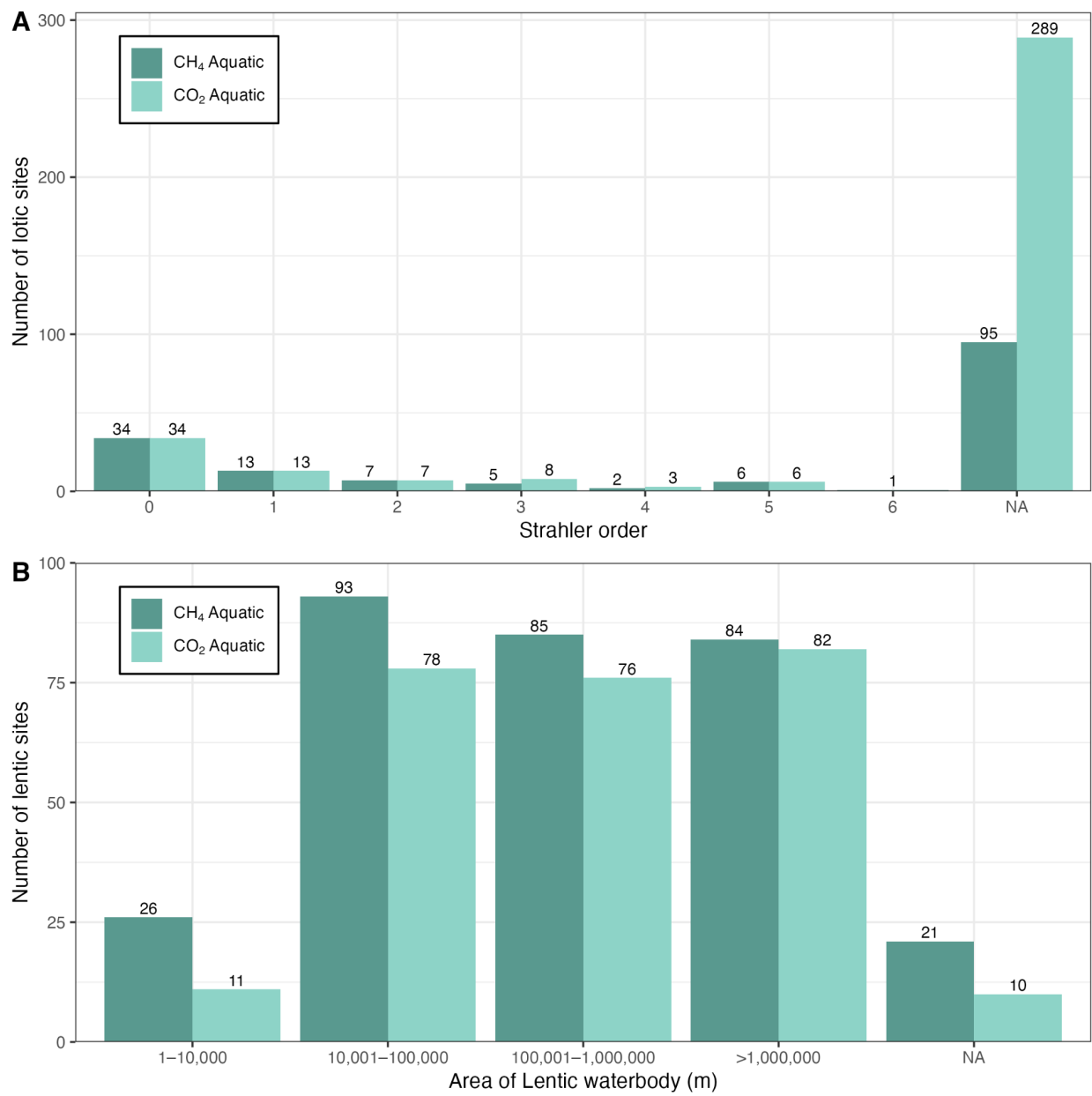
**Figure S4.** The number of site-months flagged with the 4 different expert flags across CO<sub>2</sub> fluxes (NEE, GPP, Reco) and CH<sub>4</sub> fluxes (flag 0 = data was not flagged). For CO<sub>2</sub>, the flags considered fluxes outside the 1st and 99th percentiles for terrestrial, and outside the 99th percentile for aquatic data (flag 1). For CH<sub>4</sub>, flag 1 points to terrestrial sites with fluxes higher than 30 g C m<sup>-2</sup> month<sup>-1</sup>, and to lentic sites with higher CH<sub>4</sub> diffusion fluxes. Flags 2 to 4 refer to both gas species and only terrestrial sites. Monthly fluxes based on sporadic non-eddy covariance measurements were marked with flag 2, eddy covariance data with long periods of entirely gap-filled data with flag 3, and sites that do not represent typical conditions across the Arctic-boreal region with flag 4 (Table 4).



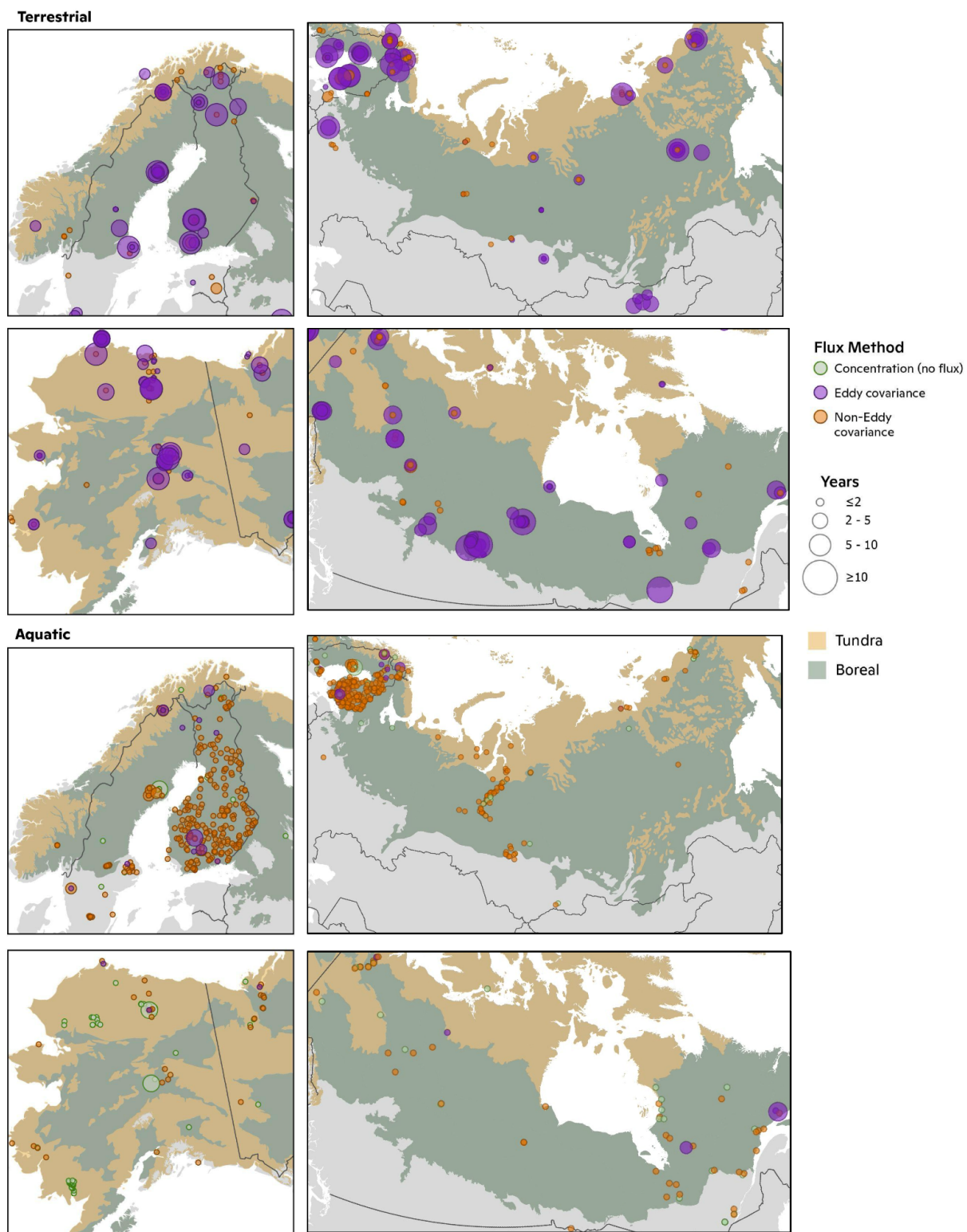
**Figure S5. Proportion of sites in each country across all Arctic-boreal sites relative to the proportion of total area (terrestrial or aquatic) occupied by countries in the ABCFlux v2 study region for A) aquatic  $\text{CH}_4$  fluxes and concentration data, B) aquatic  $\text{CO}_2$  fluxes and concentration data, C) terrestrial  $\text{CH}_4$  fluxes and concentration data, D) terrestrial  $\text{CO}_2$  fluxes and concentration data. Area estimates from BAWLD land cover product were used (terrestrial area includes rocklands, boreal forest, dry tundra, and all wetland classes; aquatic area includes all lentic and lotic classes).**



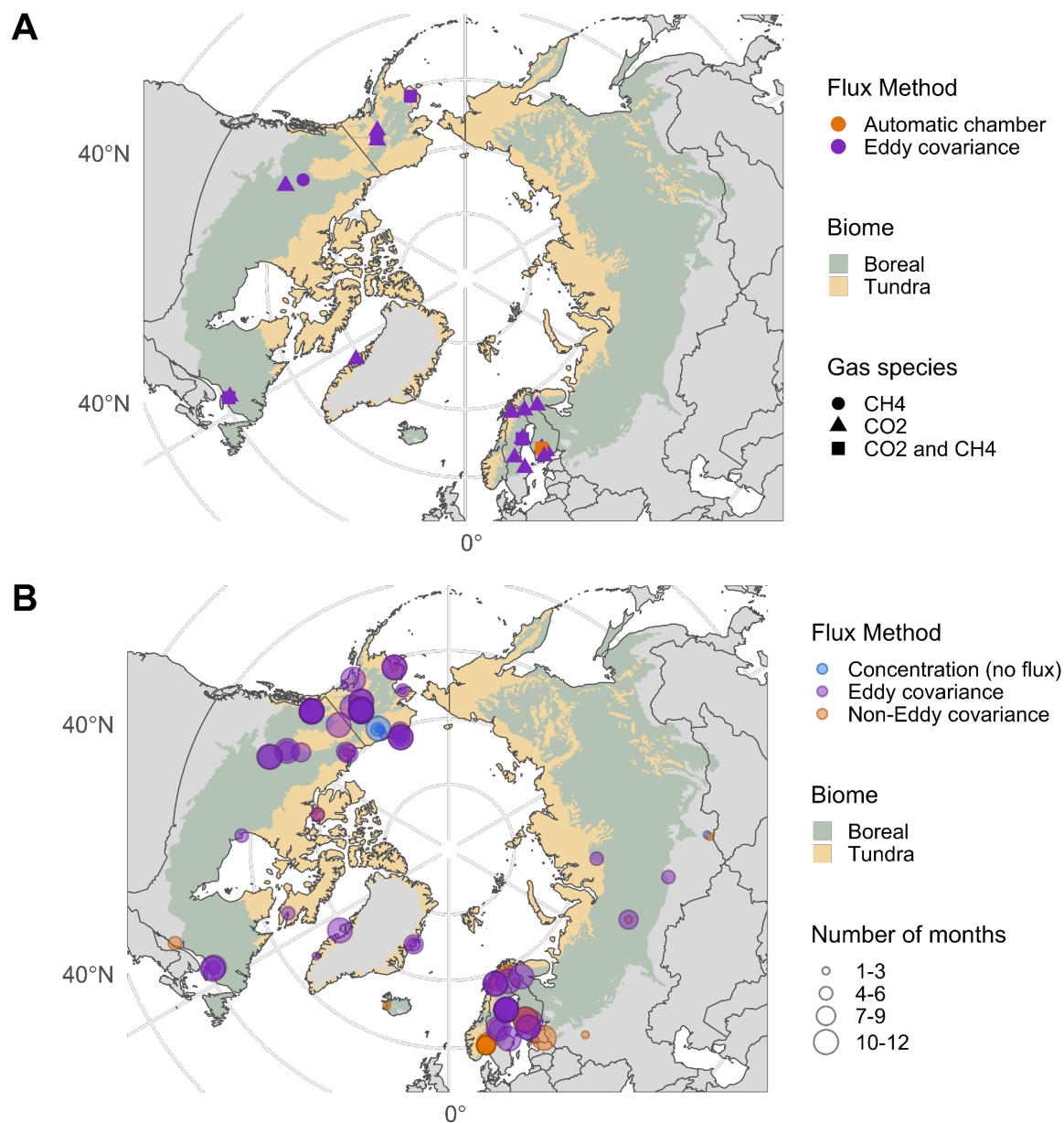
**Figure S6. A) The number of observations by measurement method distributed across months. B) The number of sites by the number of total site-month observations for each site separated by aquatic and terrestrial datasets.**



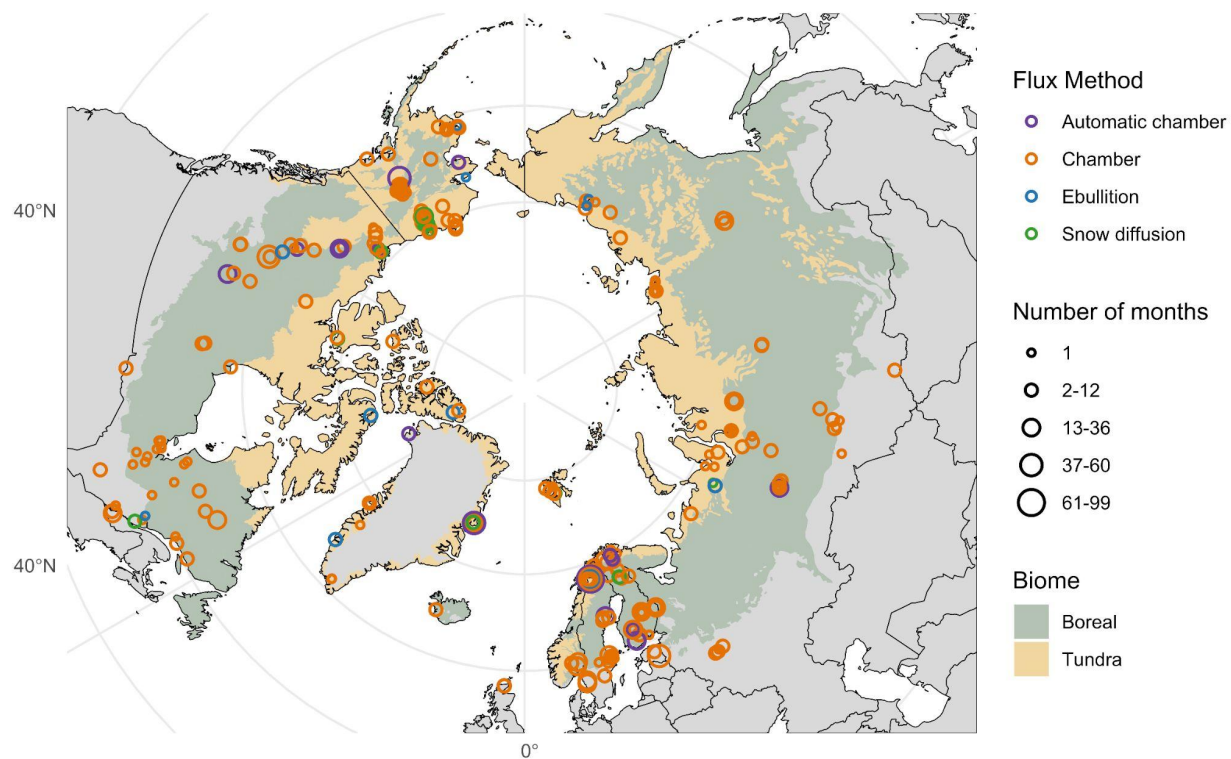
**Figure S7. Number of unique lotic sites for each Strahler order for CO<sub>2</sub> and CH<sub>4</sub>**



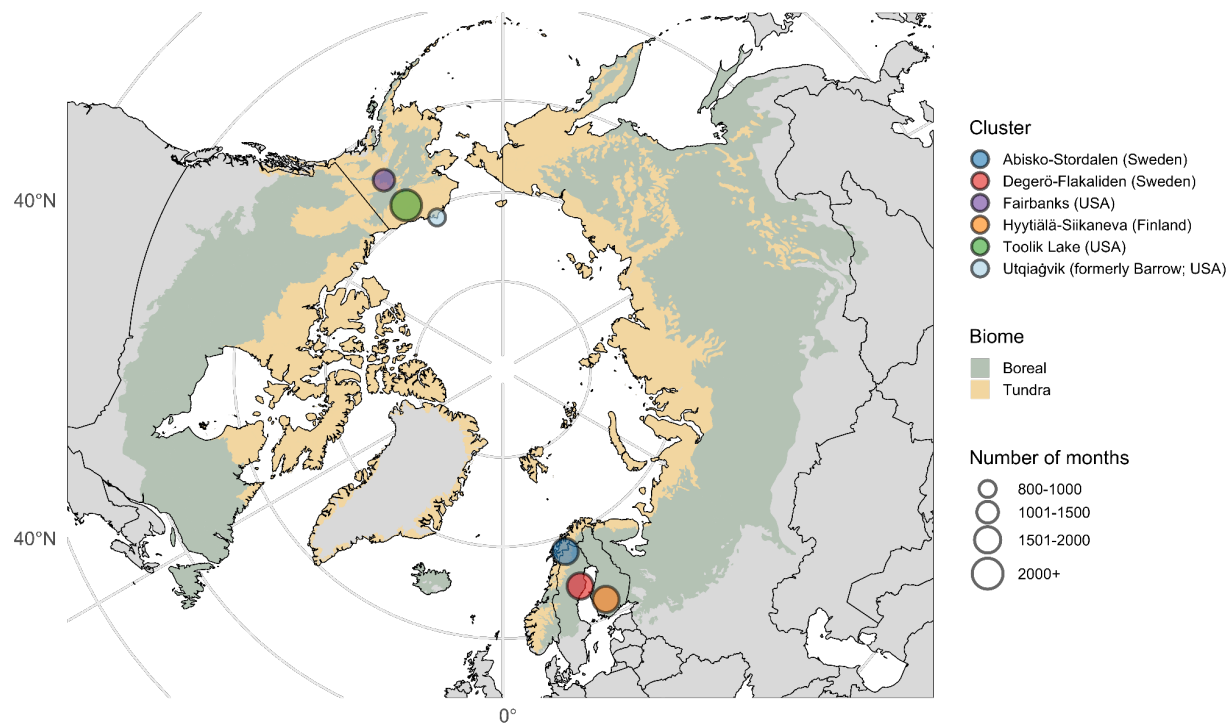
**Figure S8. Zoomed-in maps of regional flux sites.**



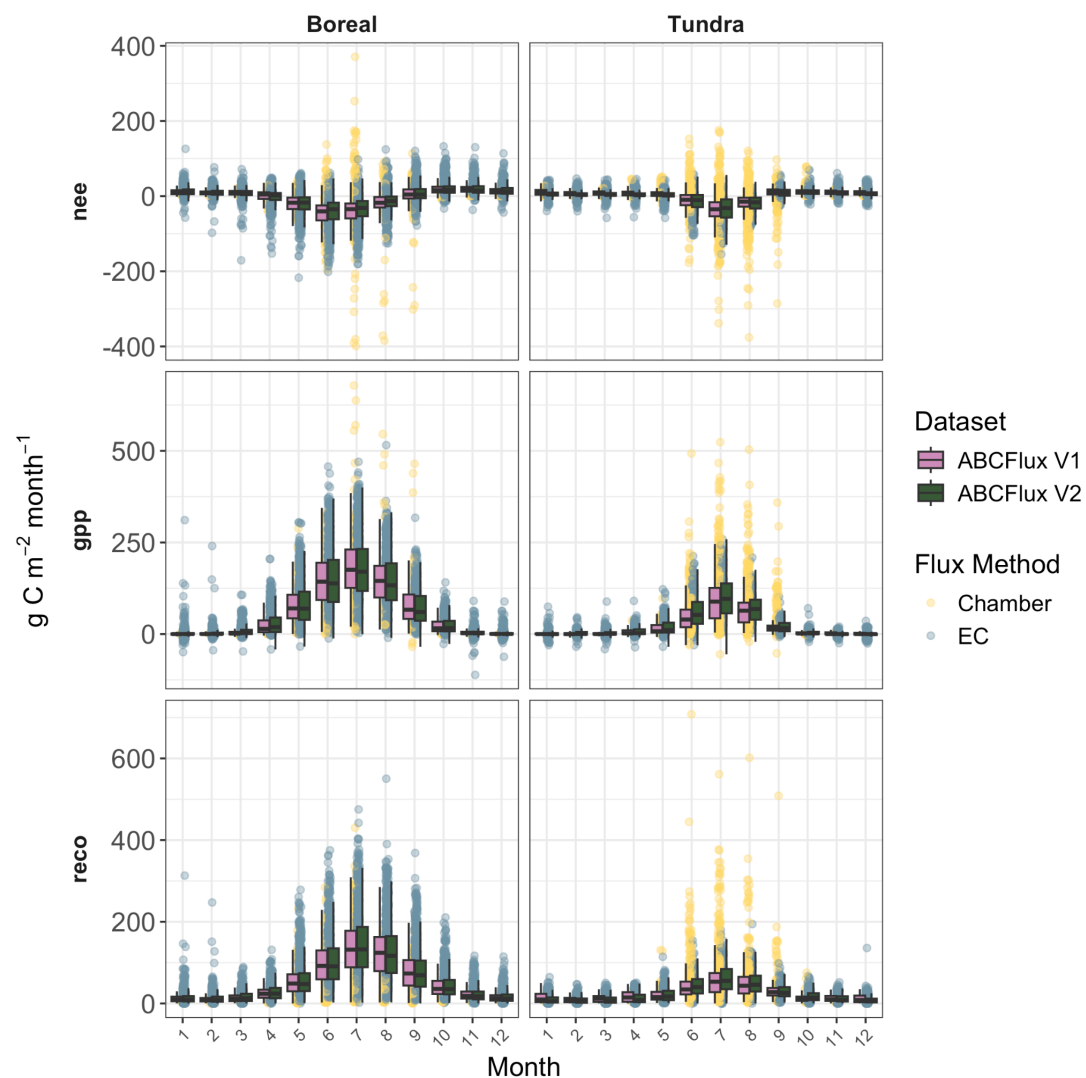
**Figure S9. Eddy covariance and automated chamber sites that provided (a) a full year of data (12 months of data, excluding months that are 100% gap-filled) and (b) some monthly data for year 2022 (representing the situation for sites actively sharing data).**



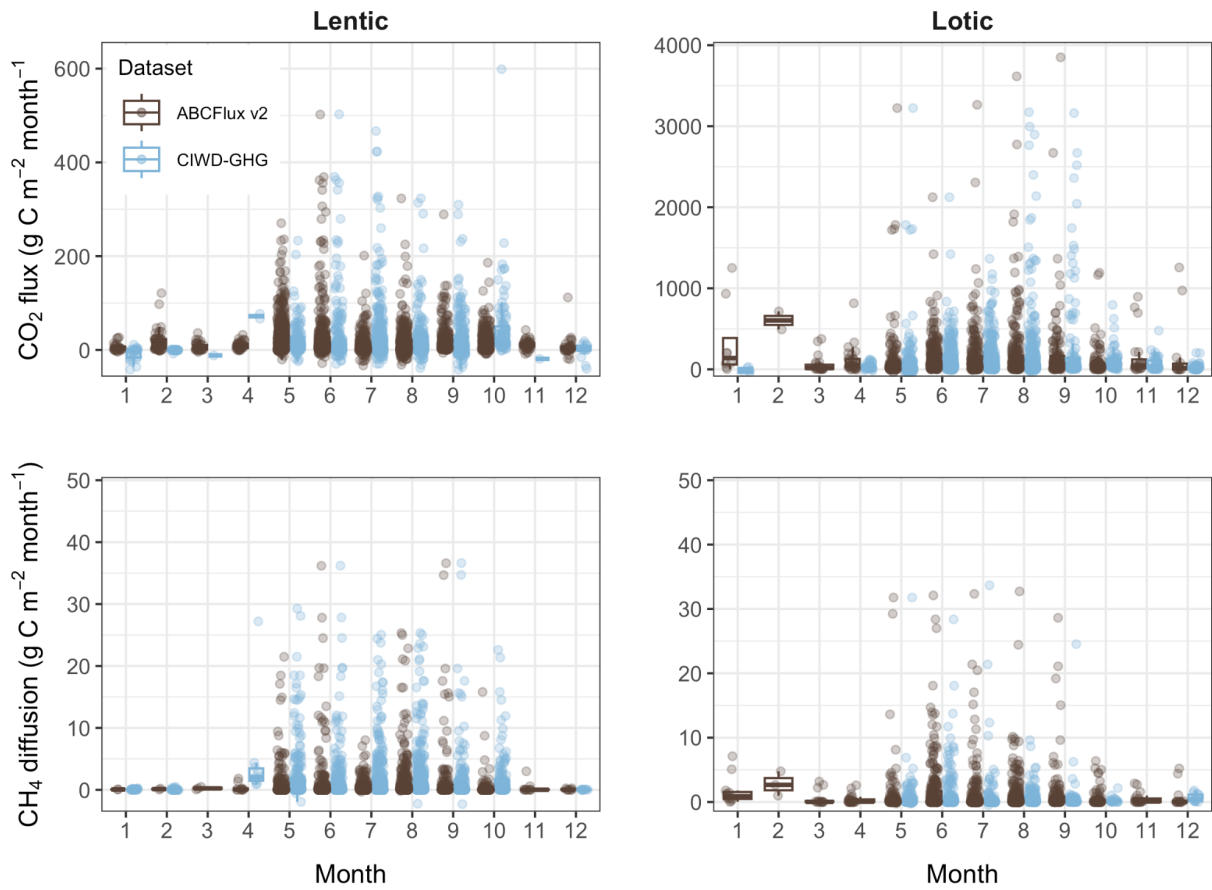
**Figure S10. Site-months of non-eddy covariance based measurement sites.**



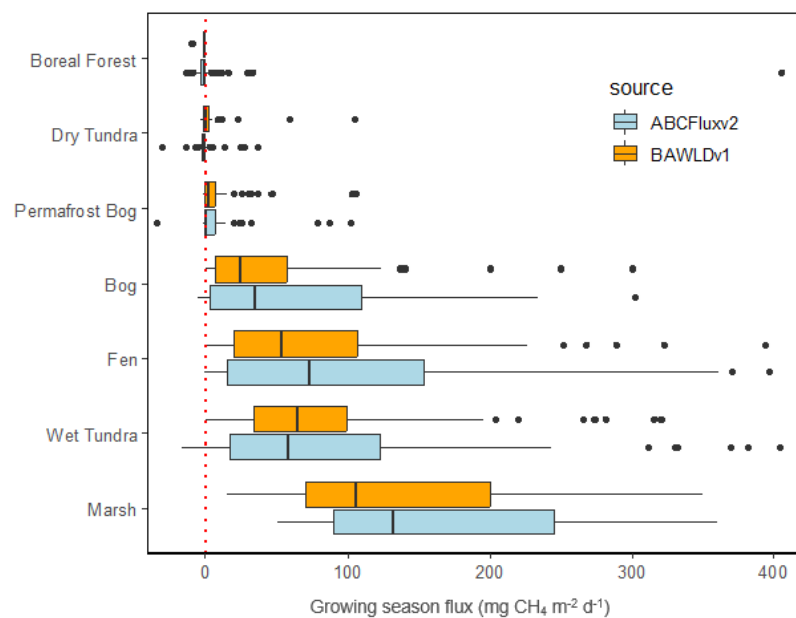
**Figure S11. Cluster sites identified by more than 800 site-months within 30km radius.**



**Figure S12. Comparison of monthly terrestrial CO<sub>2</sub> flux magnitudes in ABCFluxv1 vs. v2. GPP was presented as a negative flux in ABCFlux v1 but was converted to positive for the purpose of this comparison.**



**Figure S13. Comparison of monthly cumulative carbon fluxes (CO<sub>2</sub> and diffusive CH<sub>4</sub> flux) for aquatic ecosystems between this study (ABCFlux v2, grey) and Song et al. (2024; CIWD-GHG, blue).**



**Figure S14. Comparison of terrestrial CH<sub>4</sub> fluxes in ABCFlux v2 vs BAWLD-CH<sub>4</sub> v1.** Fluxes from ABCFlux v2 represent the average fluxes between June and August.