**Table S1** Model selection results for soil moisture, air temperature, and vapor pressure deficit. Soil moisture was used in a bivariate regression against *β*, while air temperature and vapor pressure deficit were used in bivariate regressions against *χ*\*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Soil moisture** | | **Air temperature** | | **VPD** | |
| Day | AICc | RMSE | AICc | RMSE | AICc | RMSE |
| 1 | 1305.20 | 0.7932 | -916.29 | 0.0720 | -912.46 | 0.0723 |
| 2 | 1302.81 | 0.7911 | -919.86 | 0.0718 | -911.14 | 0.0724 |
| 3 | **1302.43** | **0.7908** | -918.48 | 0.0719 | -910.05 | 0.0724 |
| 4 | 1303.01 | 0.7913 | **-920.36** | **0.0720** | **-923.78** | **0.0716** |
| 5 | 1304.50 | 0.7927 | -914.45 | 0.0722 | -911.33 | 0.0723 |
| 6 | 1305.26 | 0.7935 | -913.66 | 0.0722 | -911.44 | 0.0723 |
| 7 | 1306.05 | 0.7942 | -912.83 | 0.0723 | -911.00 | 0.0723 |
| 8 | 1306.87 | 0.7949 | -911.43 | 0.0724 | -910.67 | 0.0723 |
| 9 | 1308.13 | 0.7961 | -910.95 | 0.0725 | -910.04 | 0.0724 |
| 10 | 1309.73 | 0.7976 | -910.64 | 0.0725 | -909.74 | 0.0724 |
| 15 | 1315.24 | 0.8033 | -911.24 | 0.0724 | -909.23 | 0.0725 |
| 20 | 1321.00 | 0.8090 | -911.50 | 0.0724 | -910.57 | 0.0724 |
| 30 | 1325.83 | 0.8140 | -911.10 | 0.0724 | -913.18 | 0.0722 |
| 60 | 1326.94 | 0.8162 | -911.17 | 0.0724 | -915.90 | 0.0720 |
| 90 | 1327.01 | 0.8164 | -911.06 | 0.0725 | -916.73 | 0.0720 |

\*Timescale that conferred lowest AICc value is indicated in bold.

**Table S2** Structural equation model results investigating direct and indirect drivers of leaf nitrogen content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Predictor | Coefficient | SE | Z-score | P-value |
| *N*area | |  |  |  |  |
|  | *β* | -0.002 | 0.001 | -1.947 | **0.051** |
|  | *χ* | -0.393 | 0.577 | -0.681 | 0.496 |
|  | Soil N | 0.003 | 0.002 | 1.405 | 0.160 |
|  | PFT | -1.463 | 0.112 | -13.026 | **<0.001** |
| *β* | |  |  |  |  |
|  | Soil moisture | -13.022 | 13.321 | -0.978 | 0.328 |
|  | Soil N | -0.416 | 0.152 | -2.728 | **0.006** |
|  | PFT | -5.890 | 6.852 | -0.860 | 0.390 |
| *χ* | |  |  |  |  |
|  | VPD | -0.149 | 0.060 | -2.470 | **0.013** |
|  | Temperature | 0.001 | 0.006 | 0.092 | 0.927 |
|  | *β* | 0.001 | <0.001 | 13.737 | **<0.001** |
|  | PFT | -0.081 | 0.009 | -9.297 | **<0.001** |
| VPD | |  |  |  |  |
|  | Temperature | -0.059 | 0.004 | -15.762 | **<0.001** |
| Soil N | |  |  |  |  |
|  | Soil moisture | 48.755 | 3.608 | 13.512 | **<0.001** |

**Figure S1**

**Chart

Description automatically generated**

**Fig. S1** Correlation matrix indicating comparisons between all measured edaphic variables from composite soil samples. Colored boxes and numbers indicate the magnitude and direction of Pearson’s correlation coefficient.

**Figure S2**

Chart

Description automatically generated

**Fig. S2** Model selection results exploring relevant timescales for soil moisture (left panel), air temperature (middle panel), and vapor pressure deficit (right panel). The x-axis indicates the number of days before each site visit and the y-axis notes the corrected Akaike Information Criterion value. The timescale with the lowest AICc value, and therefore most relevant timescale to include in statistical models, is noted as a red point.