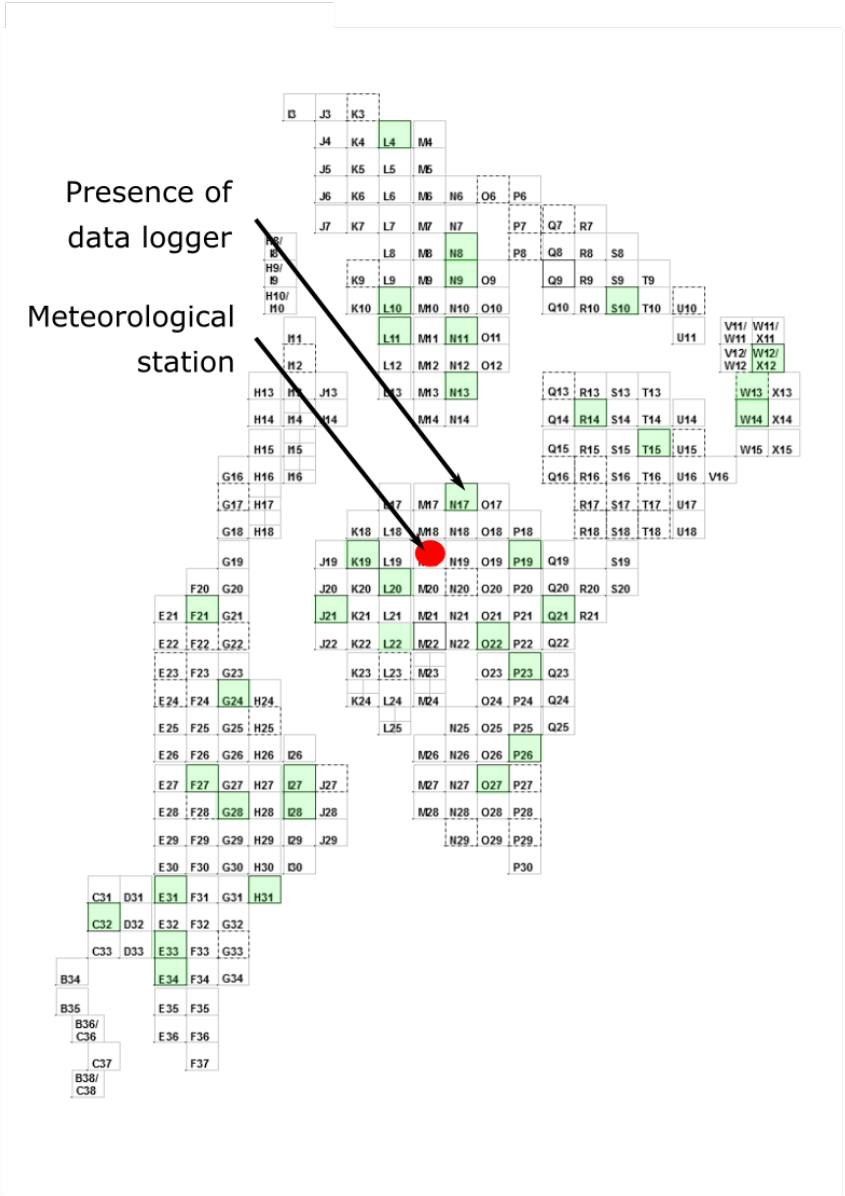
Appendix S2: Temperature modeling

A. Temperature and humidity data logger distribution

Spatial distribution of temperature and humidity data logger and position of the meteorological station in BEF China Site A



B. Variables

Description of the variables used to predict air temprature at the plot level.

Variables	Name	Usage	Units
Logger daily minimum temperature	T.min	Response	Celsius
Logger daily average temperature	T.mean	Response	Celsius
Logger daily maximum temperature	T.max	Response	Celsius
Station daily minimum temperature	T.station.min	Explanatory	Celsius
Station daily minimum temperature	T.station.mean	Explanatory	Celsius
Station daily minimum temperature	T.station.max	Explanatory	Celsius
Daily solar radiation	Radiation	Explanatory	W/qm
Rainfall	Rain	Explanatory	mm
Latitudinal position	X	Explanatory	No unit
Longitudinal position	Y	Explanatory	No unit
Gaussian radial basis vectors	B1 - B12	Explanatory	No unit
Date	date	Explanatory	dd.mm.yyyy hh:mm
Altitude	Alt	Explanatory	m
Eastness	East	Explanatory	Celsius
Northness	North	Explanatory	Celsius
Slope	Slope	Explanatory	Celsius
Plot profile curvature	Curve.Pr	Explanatory	%
Plot plan curvature	Curve.Pl	Explanatory	%
Annual solar radiation	Solar.radiation	Explanatory	W/qm
Tree Species Richness	Sp.Rich	Explanatory	No unit
Forest vertical stratification	ENL	Explanatory	No unit

C. Model structure

Structure of the model used to predict air temperature.

$$\begin{aligned} min.T \sim (X + Y + date)^2 \\ +poly(T.station.min, 3) + poly(T.station.mean, 3) + poly(T.station.max, 3) \\ +Solar * Radiation + Rainfall + Rainfall.week \\ +ENL + Spe.Rich \\ +Alt + East + North + Slope + Curve.Pr + Curve.Pl \\ +B1 + B2 + B3 + B4 + B5 + B6 + B7 + B8 + B9 + B10 + B11 + B12 \end{aligned} \tag{1}$$

$$\begin{aligned} mean.T \sim (X + Y + date)^2 \\ +poly(T.station.min, 3) + poly(T.station.mean, 3) + poly(T.station.max, 3) \\ +Solar * Radiation + Rainfall + Rainfall.week \\ +ENL + Spe.Rich \\ +Alt + East + North + Slope + Curve.Pr + Curve.Pl \\ +B1 + B2 + B3 + B4 + B5 + B6 + B7 + B8 + B9 + B10 + B11 + B12 \end{aligned} \tag{2}$$

$$
\begin{aligned}
max.T \sim (X + Y + date)^2 \\
+poly(T.station.min, 3) + poly(T.station.mean, 3) + poly(T.station.max, 3) \\
+Solar * Radiation + Rainfall + Rainfall.week \\
+ENL + Spe.Rich \\
+Alt + East + North + Slope + Curve.Pr + Curve.Pl \\
+B1 + B2 + B3 + B4 + B5 + B6 + B7 + B8 + B9 + B10 + B11 + B12
\end{aligned}
\tag{3}
$$

D. Model fit

Model fit output of each response variable.

Minimum temperature

```
Call:
lm(formula = min.T ~ X_DD + poly(mean.T.station, degree = 3) +
    poly(min.T.station, degree = 3) + poly(max.T.station, degree = 3) +
    ENL + East + Slope + Curve.Pr + Rain.day + Rain.week + B1 +
    B4 + B5 + B7 + B8 + B9 + B10 + B11 + B12, data = df.comp2.mod)

Residuals:
     Min       1Q   Median       3Q      Max
-3.07162 -0.75806  0.04286  0.75880  2.45860

Coefficients:
                                   Estimate Std. Error t value Pr(>|t|)
(Intercept)                        1.283e+05  3.684e+04   3.481 0.000513 ***
X_DD                              -1.088e+03  3.124e+02  -3.481 0.000514 ***
poly(mean.T.station, degree = 3)1 -4.309e+02  3.512e+01 -12.269  < 2e-16 ***
poly(mean.T.station, degree = 3)2  1.578e+02  1.562e+01  10.108  < 2e-16 ***
poly(mean.T.station, degree = 3)3  1.744e+00  5.514e+00   0.316 0.751776
poly(min.T.station, degree = 3)1   3.895e+02  2.158e+01  18.048  < 2e-16 ***
poly(min.T.station, degree = 3)2  -1.153e+02  9.136e+00 -12.624  < 2e-16 ***
poly(min.T.station, degree = 3)3   2.222e+00  3.991e+00   0.557 0.577733
poly(max.T.station, degree = 3)1   1.561e+02  1.494e+01  10.452  < 2e-16 ***
poly(max.T.station, degree = 3)2  -7.778e+01  7.647e+00 -10.172  < 2e-16 ***
poly(max.T.station, degree = 3)3   8.440e+00  3.512e+00   2.403 0.016386 *
ENL                                9.234e-03  1.165e-03   7.926 4.36e-15 ***
East                              -1.711e-01  8.767e-02  -1.951 0.051208 .
Slope                             -2.317e-02  8.658e-03  -2.677 0.007515 **
Curve.Pr                          -3.246e-03  9.069e-04  -3.579 0.000356 ***
Rain.day                          -1.006e-01  8.358e-03 -12.033  < 2e-16 ***
Rain.week                         -6.798e-02  3.920e-03 -17.341  < 2e-16 ***
B1                                 3.001e+00  1.706e+00   1.759 0.078740 .
B4                                -4.969e+00  1.635e+00  -3.039 0.002416 **
B5                                 7.599e+00  1.578e+00   4.814 1.63e-06 ***
B7                                 1.194e+01  3.418e+00   3.492 0.000493 ***
B8                                -1.210e+01  2.034e+00  -5.948 3.38e-09 ***
B9                                 1.294e+01  2.045e+00   6.328 3.26e-10 ***
```

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B10                              -1.030e+01  4.591e+00  -2.245 0.024941 *
B11                               1.631e+01  3.432e+00   4.751 2.21e-06 ***
B12                              -9.278e+00  2.230e+00  -4.160 3.36e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.9883 on 1511 degrees of freedom
  (232 observations deleted due to missingness)
Multiple R-squared:  0.8833,    Adjusted R-squared:  0.8813
F-statistic: 457.3 on 25 and 1511 DF,  p-value: < 2.2e-16
```

Average temperature

```
Call:
lm(formula = mean.T ~ X_DD + date + poly(mean.T.station, degree = 3) +
    poly(min.T.station, degree = 3) + poly(max.T.station, degree = 3) +
    Solar.radiation + Radiation + ENL + Sp.Rich + Alt + North +
    Slope + Curve.Pr + Curve.Pl + Rain.day + Rain.week + B1 +
    B2 + B3 + B4 + B5 + B6 + B7 + B8 + B9 + B10 + B11 + B12,
    data = df.comp2.mod)

Residuals:
    Min      1Q  Median      3Q     Max
-3.2275 -0.6104 -0.0125  0.5653  3.2355

Coefficients:
                                   Estimate Std. Error t value Pr(>|t|)
(Intercept)                        1.973e+05  5.839e+04   3.379 0.000747 ***
X_DD                              -1.677e+03  4.952e+02  -3.386 0.000728 ***
date                               2.820e-02  2.958e-03   9.533  < 2e-16 ***
poly(mean.T.station, degree = 3)1 -4.432e+01  3.269e+01  -1.356 0.175356
poly(mean.T.station, degree = 3)2  6.870e+01  1.534e+01   4.478 8.10e-06 ***
poly(mean.T.station, degree = 3)3 -2.283e+01  4.994e+00  -4.572 5.24e-06 ***
poly(min.T.station, degree = 3)1   8.654e+01  1.984e+01   4.363 1.37e-05 ***
poly(min.T.station, degree = 3)2  -5.637e+01  9.049e+00  -6.229 6.07e-10 ***
poly(min.T.station, degree = 3)3   1.998e+01  3.690e+00   5.415 7.11e-08 ***
poly(max.T.station, degree = 3)1   7.204e+01  1.413e+01   5.098 3.86e-07 ***
poly(max.T.station, degree = 3)2  -4.363e+01  7.576e+00  -5.759 1.02e-08 ***
poly(max.T.station, degree = 3)3   1.352e+01  3.129e+00   4.322 1.65e-05 ***
Solar.radiation                   -1.681e-05  2.673e-06  -6.288 4.20e-10 ***
Radiation                          5.556e-04  2.815e-05  19.736  < 2e-16 ***
ENL                               -2.099e-02  1.480e-03 -14.181  < 2e-16 ***
Sp.Rich                           -2.372e-02  7.208e-03  -3.291 0.001023 **
Alt                                3.373e-02  6.170e-03   5.466 5.39e-08 ***
North                             -4.303e+00  6.038e-01  -7.127 1.59e-12 ***
Slope                             -1.013e-01  2.008e-02  -5.046 5.06e-07 ***
Curve.Pr                           9.134e-03  1.350e-03   6.764 1.91e-11 ***
Curve.Pl                           6.286e-03  1.421e-03   4.425 1.03e-05 ***
Rain.day                          -1.142e-01  7.552e-03 -15.117  < 2e-16 ***
Rain.week                         -5.896e-02  3.699e-03 -15.940  < 2e-16 ***
B1                                -7.099e+01  4.995e+00 -14.212  < 2e-16 ***
B2                                 2.340e+01  2.285e+00  10.240  < 2e-16 ***
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B3                                -3.943e+01  4.178e+00  -9.438  < 2e-16 ***
B4                                 4.069e+01  2.434e+00  16.716  < 2e-16 ***
B5                                -5.834e+01  3.737e+00 -15.612  < 2e-16 ***
B6                                 1.583e+01  2.988e+00   5.297 1.36e-07 ***
B7                                -9.252e+01  6.319e+00 -14.642  < 2e-16 ***
B8                                 5.345e+01  3.705e+00  14.427  < 2e-16 ***
B9                                -6.078e+01  4.586e+00 -13.253  < 2e-16 ***
B10                                2.737e+01  5.692e+00   4.809 1.67e-06 ***
B11                               -6.597e+01  6.047e+00 -10.909  < 2e-16 ***
B12                                1.885e+01  3.752e+00   5.024 5.67e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8796 on 1502 degrees of freedom
  (232 observations deleted due to missingness)
Multiple R-squared:  0.9143,    Adjusted R-squared:  0.9124
F-statistic: 471.5 on 34 and 1502 DF,  p-value: < 2.2e-16
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Maximum temperature

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Call:
lm(formula = max.T ~ Y_DD + date + poly(mean.T.station, degree = 3) +
    poly(min.T.station, degree = 3) + poly(max.T.station, degree = 3) +
    Solar.radiation + Radiation + ENL + Sp.Rich + Alt + North +
    Curve.Pr + Curve.Pl + Rain.day + Rain.week + B1 + B2 + B3 +
    B4 + B5 + B6 + B7 + B8 + B9 + B10 + B11 + B12, data = df.comp2.mod)

Residuals:
    Min      1Q  Median      3Q     Max
-7.2717 -1.1448 -0.0354  1.1209  6.3630

Coefficients:
                                    Estimate Std. Error t value Pr(>|t|)
(Intercept)                       -1.031e+05  5.531e+04  -1.864  0.06256 .
Y_DD                               3.488e+03  1.899e+03   1.837  0.06645 .
date                               9.851e-02  6.316e-03  15.598  < 2e-16 ***
poly(mean.T.station, degree = 3)1 -1.154e+02  6.980e+01  -1.654  0.09833 .
poly(mean.T.station, degree = 3)2  6.833e+00  3.276e+01   0.209  0.83479
poly(mean.T.station, degree = 3)3 -7.794e+01  1.066e+01  -7.309 4.35e-13 ***
poly(min.T.station, degree = 3)1   5.100e+01  4.235e+01   1.204  0.22872
poly(min.T.station, degree = 3)2   6.042e+00  1.932e+01   0.313  0.75452
poly(min.T.station, degree = 3)3   6.303e+01  7.879e+00   8.000 2.46e-15 ***
poly(max.T.station, degree = 3)1   2.174e+02  3.017e+01   7.206 9.08e-13 ***
poly(max.T.station, degree = 3)2  -3.558e+01  1.618e+01  -2.200  0.02797 *
poly(max.T.station, degree = 3)3   3.403e+01  6.681e+00   5.094 3.96e-07 ***
Solar.radiation                   -1.989e-05  3.090e-06  -6.437 1.63e-10 ***
Radiation                          1.505e-03  6.011e-05  25.035  < 2e-16 ***
ENL                               -1.180e-01  2.766e-03 -42.656  < 2e-16 ***
Sp.Rich                           -5.137e-02  1.634e-02  -3.143  0.00170 **
Alt                                3.165e-02  1.173e-02   2.699  0.00704 **
North                             -6.390e+00  7.255e-01  -8.808  < 2e-16 ***
Curve.Pr                           4.041e-02  2.958e-03  13.659  < 2e-16 ***
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```
Curve.Pl                          1.757e-02  2.924e-03   6.010 2.32e-09 ***
Rain.day                         -1.492e-01  1.613e-02  -9.254  < 2e-16 ***
Rain.week                        -7.077e-02  7.898e-03  -8.960  < 2e-16 ***
B1                               -2.250e+02  1.078e+01 -20.865  < 2e-16 ***
B2                                6.613e+01  3.865e+00  17.113  < 2e-16 ***
B3                               -1.278e+02  9.322e+00 -13.705  < 2e-16 ***
B4                                1.354e+02  7.032e+00  19.251  < 2e-16 ***
B5                               -1.960e+02  7.642e+00 -25.642  < 2e-16 ***
B6                                4.253e+01  6.425e+00   6.619 5.02e-11 ***
B7                               -3.138e+02  1.275e+01 -24.600  < 2e-16 ***
B8                                1.852e+02  7.700e+00  24.047  < 2e-16 ***
B9                               -2.249e+02  9.658e+00 -23.284  < 2e-16 ***
B10                               6.914e+01  1.631e+01   4.239 2.38e-05 ***
B11                              -2.324e+02  1.141e+01 -20.358  < 2e-16 ***
B12                               5.648e+01  1.007e+01   5.611 2.39e-08 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.878 on 1503 degrees of freedom
  (232 observations deleted due to missingness)
Multiple R-squared:  0.8818,    Adjusted R-squared:  0.8792
F-statistic: 339.7 on 33 and 1503 DF,  p-value: < 2.2e-16
```