**Supplemental Table 2.** *L. dalmatica* correlations table of covariates used in the final model. See Table 1 for covariates’ full names. The Pearson correlation coefficient, r, is shown for each combination of covariates with |r| close to 0 showing low correlation and an increasing degree of correlation with higher values.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | tmax\_sm | dem | luc | td | ndvi\_m | clyppt\_15 | ppt\_wt | ahm |
| tmax\_sm | 1 | -0.686 | 0.386 | 0.619 | -0.280 | 0.594 | -0.713 | 0.793 |
| dem |  | 1 | -0.427 | -0.755 | 0.041 | -0.586 | 0.511 | -0.497 |
| luc |  |  | 1 | 0.386 | -0.230 | 0.482 | -0.392 | 0.329 |
| td |  |  |  | 1 | -0.351 | 0.647 | -0.545 | 0.571 |
| ndvi\_m |  |  |  |  | 1 | -0.449 | 0.333 | -0.517 |
| clyppt\_15 |  |  |  |  |  | 1 | -0.645 | 0.569 |
| ppt\_wt |  |  |  |  |  |  | 1 | -0.745 |
| ahm |  |  |  |  |  |  |  | 1 |

**Supplemental Table 3.** *L. vulgaris* correlations table of covariates used in the final model. See Table 1 for covariates’ full names. The Pearson correlation coefficient, r, is shown for each combination of covariates with |r| close to 0 showing low correlation and an increasing degree of correlation with higher values.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | tmax\_at | luc | ndvi\_m | ppt\_wt | clyppt\_15 | dd18\_sm | slope |
| tmax\_at | 1 | 0.364 | -0.243 | -0.679 | 0.531 | 0.882 | -0.566 |
| luc |  | 1 | -0.230 | -0.392 | 0.482 | 0.383 | -0.408 |
| ndvi\_m |  |  | 1 | 0.333 | -0.449 | -0.276 | 0.373 |
| ppt\_wt |  |  |  | 1 | -0.645 | -0.543 | 0.602 |
| clyppt\_15 |  |  |  |  | 1 | 0.478 | -0.586 |
| dd18\_sm |  |  |  |  |  | 1 | -0.501 |
| slope |  |  |  |  |  |  | 1 |

**Supplemental Table 4.** Hybrid *Linaria* correlations table of covariates used in the final model. See Table 1 for covariates’ full names. The Pearson correlation coefficient, r, is shown for each combination of covariates with |r| close to 0 showing low correlation and an increasing degree of correlation with higher values.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | nffd\_sm | eosn\_sd | ppt\_sm | slope |
| nffd\_sm | 1 | -0.057 | -0.135 | -0.480 |
| eosn\_sd |  | 1 | 0.169 | 0.241 |
| ppt\_sm |  |  | 1 | 0.172 |
| slope |  |  |  | 1 |

**Supplemental Table 5.** Summary of *L. dalmatica* model selection using AICc. See Table 1 for covariates’ full names. Models are shown in order of decreasing number of parameters. The final model with moderate complexity is made bold. The AUC value is calculated from a single run, i.e. without ten-fold cross validation, so the value for model rank 1 (0.773) does not equal that in Table 1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Covariates | MaxEnt settings\* | No. of covariates | No. of parameters | AICc | ΔAICc | AUC | Model rank |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQTH, β=1 | 8 | 79 | 27229.7 | -66.9 | 0.779 | 9 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQTH, β=1.5 | 8 | 63 | 27263.2 | -33.4 | 0.773 | 8 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQH, β=2 | 8 | 58 | 27322.0 | 25.4 | 0.776 | 6 |
| **tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm** | **LQTH, β=2** | **8** | **56** | **27296.6** | **0.0** | **0.773** | **1** |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQPH, β=2 | 8 | 52 | 27304.9 | 8.3 | 0.767 | 3 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQTH, β=2.5 | 8 | 51 | 27329.5 | 32.9 | 0.772 | 7 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQPTH, β=2 | 8 | 51 | 27284.9 | -11.8 | 0.763 | 4 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt | LQTH, β=2 | 7 | 49 | 27279.8 | -16.8 | 0.774 | 5 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15 | LQTH, β=2 | 6 | 49 | 27289.4 | -7.2 | 0.783 | 2 |
| tmax\_sm, dem, luc, td, ndvi\_m | LQTH, β=2 | 5 | 45 | 27424.1 | 127.5 | 0.757 | 10 |
| tmax\_sm, dem, luc, td | LQTH, β=2 | 4 | 35 | 27483.5 | 186.8 | 0.746 | 11 |

MaxEnt settings are linear (L), quadratic (Q), product (P), threshold (T), and hinge (H) features; β is the regularization multiplier.

**Supplemental Table 6.** Summary of *L. dalmatica* model selection using AICc. See Table 1 for covariates’ full names. Models are shown in order of decreasing number of parameters. The final model with moderate complexity is made bold. The AUC value is calculated from a single run, i.e. without ten-fold cross validation, so the value for model rank 1 (0.773) does not equal that in Table 1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Covariates | MaxEnt settings\* | No. of covariates | No. of parameters | AICc | ΔAICc | AUC | Model rank |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQTH, β=1 | 8 | 79 | 27229.7 | -66.9 | 0.779 | 9 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQTH, β=1.5 | 8 | 63 | 27263.2 | -33.4 | 0.773 | 8 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQH, β=2 | 8 | 58 | 27322.0 | 25.4 | 0.776 | 6 |
| **tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm** | **LQTH, β=2** | **8** | **56** | **27296.6** | **0.0** | **0.773** | **1** |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQPH, β=2 | 8 | 52 | 27304.9 | 8.3 | 0.767 | 3 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQTH, β=2.5 | 8 | 51 | 27329.5 | 32.9 | 0.772 | 7 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt, ahm | LQPTH, β=2 | 8 | 51 | 27284.9 | -11.8 | 0.763 | 4 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15, ppt\_wt | LQTH, β=2 | 7 | 49 | 27279.8 | -16.8 | 0.774 | 5 |
| tmax\_sm, dem, luc, td, ndvi\_m, clyppt\_15 | LQTH, β=2 | 6 | 49 | 27289.4 | -7.2 | 0.783 | 2 |
| tmax\_sm, dem, luc, td, ndvi\_m | LQTH, β=2 | 5 | 45 | 27424.1 | 127.5 | 0.757 | 10 |
| tmax\_sm, dem, luc, td | LQTH, β=2 | 4 | 35 | 27483.5 | 186.8 | 0.746 | 11 |

MaxEnt settings are linear (L), quadratic (Q), product (P), threshold (T), and hinge (H) features; β is the regularization multiplier.

**Supplemental Table 7.** Summary of hybrid *Linaria* model selection using AICc. See Table 1 for covariates’ full names. Models are shown in order of decreasing number of parameters. The final model with moderate complexity is shown in bold.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Covariates | MaxEnt settings | No. covariates | Parameters | AICc | ΔAICc | AUC | Model rank |
| nffd\_sm, eosn\_sd, ppt\_sm, slope | LQH, β=1 | 4 | 20 | 904.9 | 52.0 | 0.899 | 7 |
| nffd\_sm, eosn\_sd, ppt\_sm, slope | LQPH, β=1.5 | 4 | 19 | 896.8 | 43.9 | 0.895 | 6 |
| nffd\_sm, eosn\_sd, ppt\_sm, slope | LQPTH, β=1.5 | 4 | 16 | 860.4 | 7.5 | 0.904 | 2 |
| **nffd\_sm, eosn\_sd, ppt\_sm, slope** | **LQH, β=1.5** | **4** | **15** | **852.9** | **0.0** | **0.895** | **1** |
| nffd\_sm, eosn\_sd, ppt\_sm, slope | LQH, β=2 | 4 | 13 | 843.6 | 9.3 | 0.892 | 3 |
| nffd\_sm, eosn\_sd, ppt\_sm, slope | LQH, β=2.5 | 4 | 11 | 837.0 | -15.9 | 0.889 | 5 |
| nffd\_sm, eosn\_sd, ppt\_sm | LQH, β=1.5 | 3 | 9 | 838.3 | -14.6 | 0.873 | 4 |

MaxEnt settings are linear (L), quadratic (Q), product (P), threshold (T), and hinge (H) features; β is the regularization multiplier.