**Supplementary Table S1**

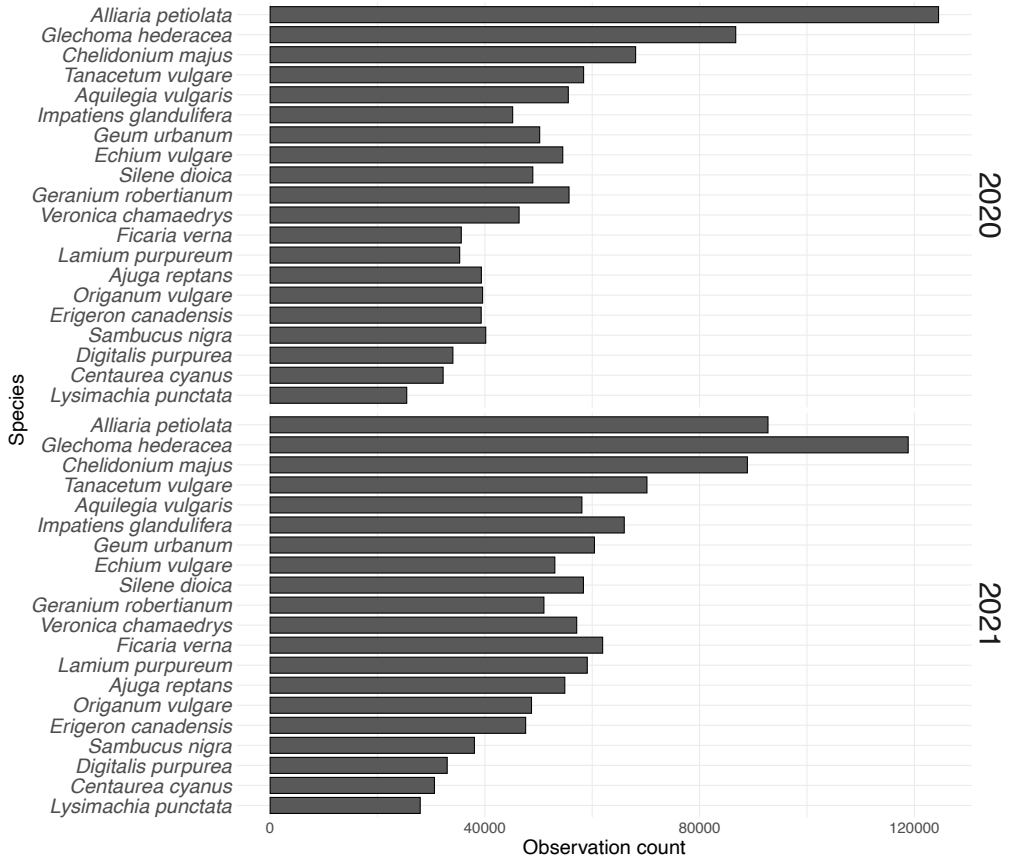
Observation overview and descriptive statistics of the observed peak of observations across all grid cells where a peak of observations for the species could be determined. The difference in medians between both years was tested using a paired two-sided Wilcox Rank sum test. The median absolute deviation (MAD) reflects the variability of the observed values.

| Species name and author | Total observations | | Median peak observation day ± MAD | | Median shift | | RMSE SVM | | Rsquared SVM | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2020 | 2021 | 2020 | 2021 | Δ MAD | p-value | 2020 | 2021 | 2020 | 2021 |
| *Ficaria verna* Huds. | 35605 | 61940 | 96 ± 5.93 | 104 ± 10.38 | 8 | <0.001 | 6.73 | 6.96 | 0.51 | 0.62 |
| *Lamium purpureum* L. | 35309 | 59074 | 100 ± 10.38 | 113 ± 8.90 | 13 | <0.001 | 10.87 | 8.80 | 0.44 | 0.44 |
| *Glechoma hederacea* L. | 86729 | 118853 | 115 ± 8.90 | 125± 10.38 | 10 | <0.001 | 6.08 | 8.61 | 0.74 | 0.57 |
| *Alliaria petiolata* M.Bieb. (Cavara & Grande) | 124511 | 92738 | 116 ± 8.15 | 130 ± 10.38 | 14 | <0.001 | 4.45 | 7.60 | 0.81 | 0.66 |
| *Ajuga reptans L.* | 39348 | 54890 | 120 ± 8.90 | 137 ± 7.41 | 17 | <0.001 | 4.89 | 7.26 | 0.74 | 0.63 |
| *Chelidonium majus* L. | 68080 | 88900 | 126 ± 11.12 | 138 ± 8.90 | 12 | <0.001 | 10.13 | 11.28 | 0.56 | 0.42 |
| *Silene dioica* (L.) Clairv. | 48930 | 58358 | 135 ± 13.34 | 147 ± 7.41 | 12 | <0.001 | 12.56 | 8.69 | 0.37 | 0.36 |
| *Veronica chamaedrys* L. | 46378 | 57108 | 137 ± 10.38 | 146 ± 5.93 | 9 | <0.001 | 6.96 | 6.25 | 0.71 | 0.59 |
| *Aquilegia vulgaris* L. | 55540 | 58075 | 140 ± 10.38 | 152 ± 4.45 | 12 | <0.001 | 5.92 | 4.07 | 0.76 | 0.71 |
| *Geranium robertianum* L. | 55679 | 51000 | 141 ± 16.31 | 151 ± 7.41 | 10 | <0.001 | 11.20 | 11.61 | 0.55 | 0.43 |
| *Sambucus nigra* L. | 40161 | 38054 | 146 ± 13.34 | 163 ± 7.41 | 17 | <0.001 | 12.32 | 15.10 | 0.31 | 0.24 |
| *Geum urbanum* L. | 50210 | 60413 | 153 ± 10.38 | 159 ± 7.41 | 6 | <0.001 | 11.48 | 10.09 | 0.33 | 0.12 |
| *Digitalis purpurea* L. | 34042 | 32983 | 163 ± 14.83 | 172 ± 8.90 | 9 | <0.001 | 7.14 | 7.55 | 0.71 | 0.55 |
| *Lysimachia punctata* L. | 25447 | 27956 | 174 ± 8.90 | 176 ± 5.93 | 2 | <0.001 | 6.45 | 5.21 | 0.57 | 0.59 |
| *Centaurea cyanus* L. | 32223 | 30608 | 174± 9.64 | 175 ± 10.38 | 1 | n.s. | 8.57 | 7.98 | 0.39 | 0.36 |
| *Echium vulgare* L. | 54508 | 53033 | 174 ± 7.41 | 179 ± 7.41 | 5 | <0.001 | 8.28 | 9.09 | 0.30 | 0.31 |
| *Erigeron canadensis* L. | 39318 | 47596 | 191 ± 10.38 | 197 ± 14.83 | 6 | <0.001 | 11.91 | 16.48 | 0.27 | 0.14 |
| *Origanum vulgare* L. | 39576 | 48687 | 200 ± 5.93 | 205 ± 8.90 | 5 | <0.001 | 6.29 | 7.34 | 0.30 | 0.23 |
| *Tanacetum vulgare* L. | 58392 | 70189 | 214 ± 10.38 | 216 ± 8.90 | 2 | <0.01 | 10.75 | 10.70 | 0.24 | 0.37 |
| *Impatiens glandulifera* Royle | 45179 | 65964 | 233 ± 11.86 | 234 ± 7.41 | 1 | <0.001 | 10.24 | 9.37 | 0.20 | 0.13 |

**Supplementary Table S2**

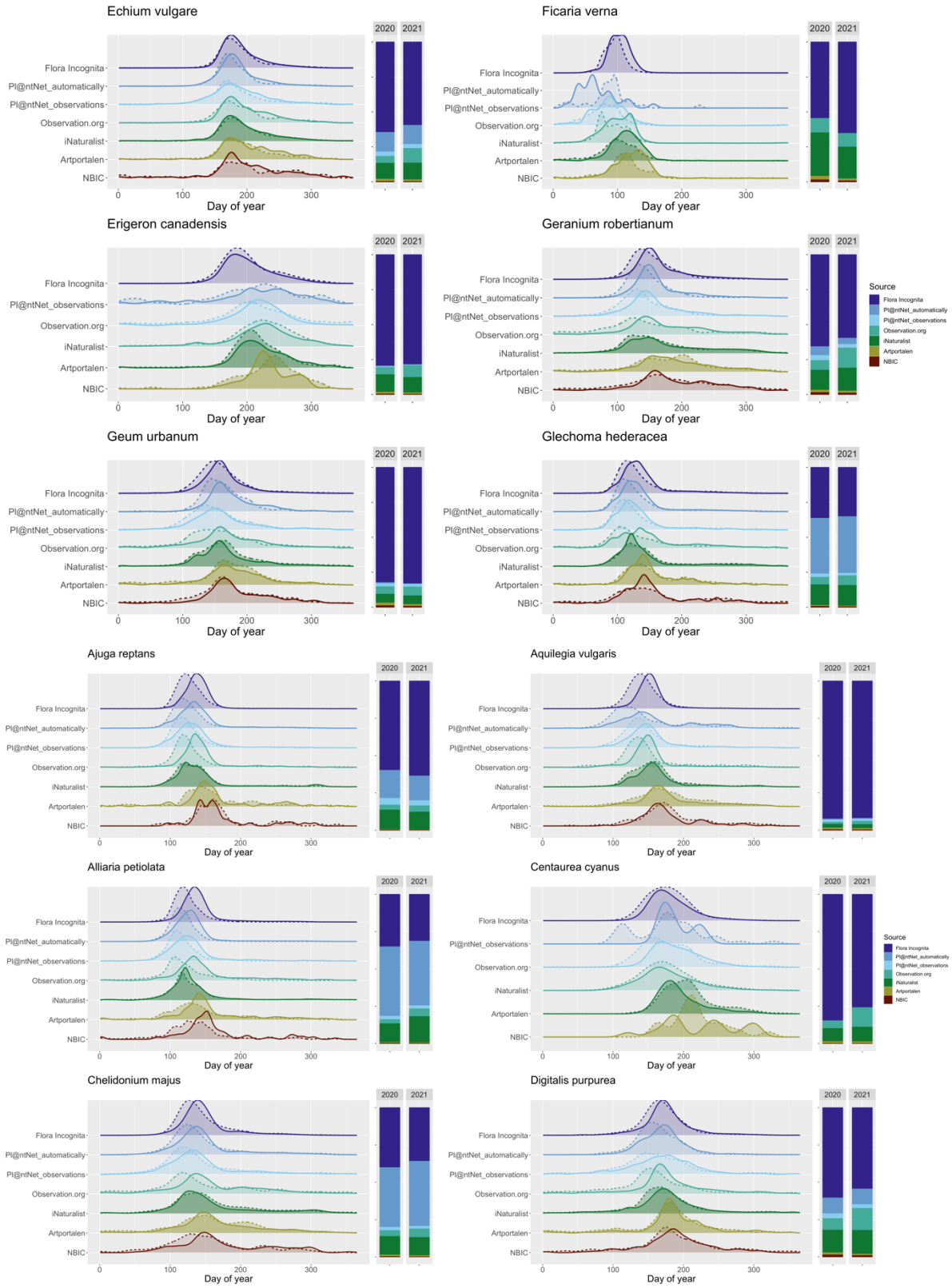
Overview of the shift in mean date of observation per species in response to 1000 m elevation and per degree latitude and longitude in the observed years. The presented values are coefficients derived from a multiple linear regression model for the originally observed (true) values per species. The adjusted $R^2$ is shown in the last columns and the p-values of the coefficients and significant values are marked with asterisks, where *: p<=0.05, **: p<=0.01, ***: p<=0.001, and ns: not significant. P-values were corrected for multiple testing according to the Bonferroni-Holm method. The median day of year (DOY) across all observed grid cells is shown for each species and in both years for reference.

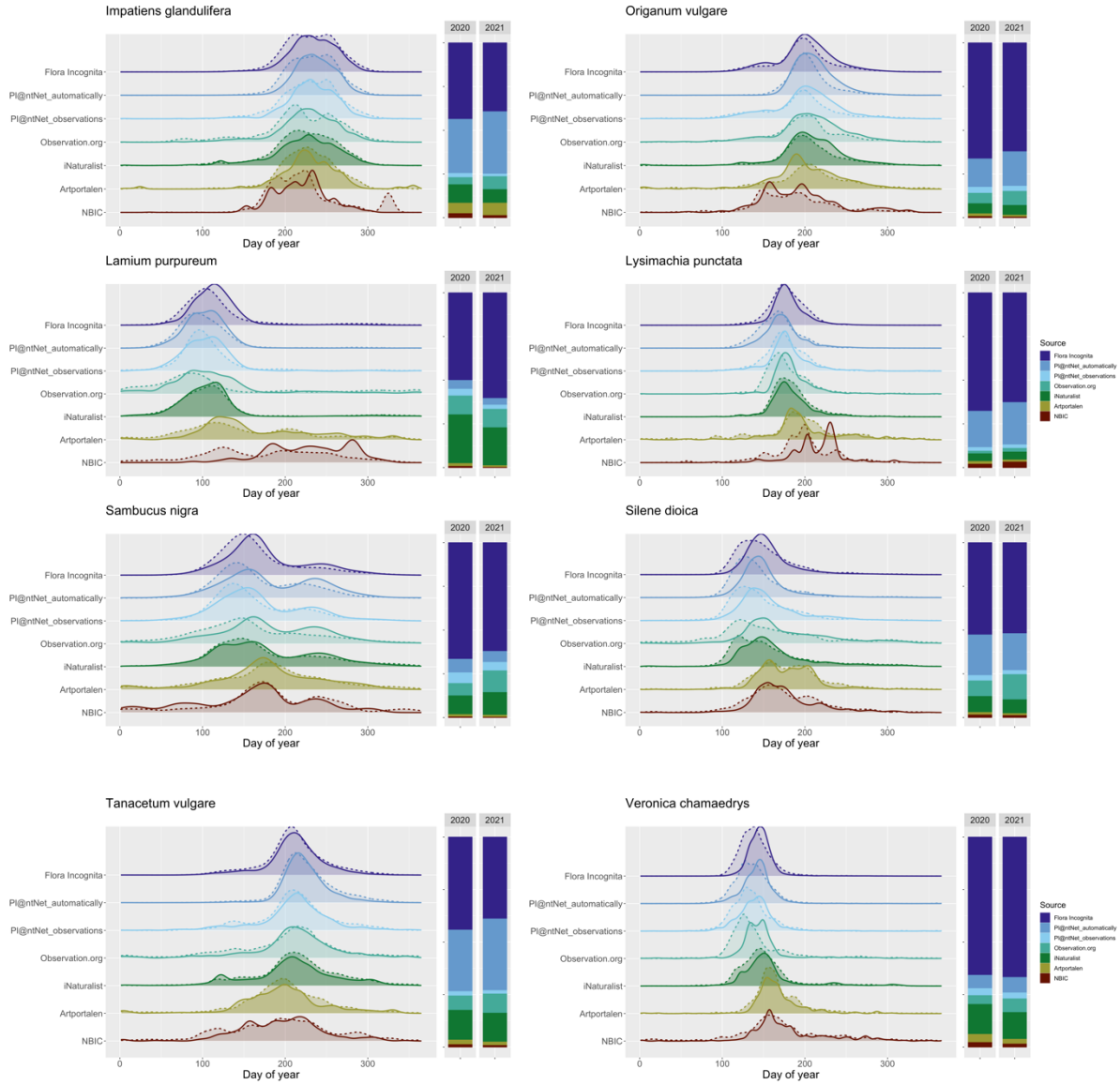
| | Flowering | Grid cells | | Median DOY | | Elevation | | Latitude | | Longitude | | Adj. $R^2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **time** | **2020** | **2021** | **2020** | **2021** | **2020** | **2021** | **2020** | **2021** | **2020** | **2021** | **2020** | **2021** |
| *Ficaria verna* | spring | 234 | 299 | 96 | 104 | 20.28*** | 15.59*** | 1.98*** | 2.15*** | 0.56*** | 0.89*** | 0.52 | 0.62 |
| *Lamium purpureum* | spring | 202 | 274 | 100 | 113 | 33.80*** | 15.25*** | 4.18*** | 2.98*** | 0.77* | 1.06*** | 0.42 | 0.50 |
| *Glechoma hederacea* | spring | 447 | 499 | 115 | 125 | 6.69*** | 7.50*** | 2.48*** | 2.25*** | 0.44*** | 0.49*** | 0.74 | 0.55 |
| *Alliaria petiolata* | spring | 477 | 455 | 116 | 130 | 9.71*** | 11.46*** | 2.08*** | 2.61*** | 0.65*** | 0.48*** | 0.81 | 0.66 |
| *Ajuga repta*ns | spring | 265 | 292 | 120 | 137 | 13.26*** | 18.34*** | 2.84*** | 3.40*** | 0.11ns | -0.44*** | 0.74 | 0.64 |
| *Chelidonium majus* | spring | 424 | 462 | 126 | 138 | 9.36*** | 13.64*** | 2.54*** | 2.56*** | 0.28* | -0.11ns | 0.57 | 0.42 |
| *Silene dioica* | spring | 320 | 327 | 135 | 147 | 20.35*** | 14.77*** | 2.22*** | 1.77*** | 0.70*** | 0.08ns | 0.39 | 0.35 |
| *Veronica chamaedrys* | spring | 324 | 338 | 137 | 146 | 22.56*** | 16.45*** | 2.98*** | 2.36*** | 0.20ns | -0.11ns | 0.72 | 0.59 |
| *Geranium robertianum* | spring | 318 | 279 | 140 | 151 | 30.16*** | 28.25*** | 3.21*** | 3.13*** | 1.22*** | 0.77*** | 0.57 | 0.44 |
| *Aquilegia vulgaris* | spring | 256 | 251 | 140 | 152 | 24.23*** | 17.51*** | 2.75*** | 1.60*** | 0.79*** | -0.10ns | 0.77 | 0.71 |
| *Geum urbanum* | spring | 268 | 274 | 153 | 159 | 15.84*** | 5.89ns | 2.28*** | 1.12*** | 0.45ns | 0.51** | 0.33 | 0.17 |
| *Sambucus nigra* | spring | 283 | 260 | 146 | 163 | 14.83*** | 14.92** | 2.88*** | 2.52*** | 1.05ns | 1.15*** | 0.30 | 0.25 |
| *Digitalis purpurea* | spring | 223 | 205 | 163 | 172 | 49.92*** | 42.69*** | 2.82*** | 1.82*** | 1.32*** | 0.18ns | 0.70 | 0.52 |
| *Centaurea cyanus* | summer | 210 | 192 | 174 | 175 | 32.94*** | 31.90*** | 3.65*** | 3.17*** | -0.79* | -1.35*** | 0.41 | 0.37 |
| *Lysimachia punctata* | summer | 223 | 229 | 174 | 176 | 19.54*** | 19.82*** | 1.86*** | 1.70*** | 0.37* | -0.51*** | 0.57 | 0.57 |
| *Echium vulgare* | summer | 349 | 352 | 174 | 179 | 10.63*** | 13.89*** | 1.78*** | 1.88*** | -0.07ns | -0.17ns | 0.32 | 0.32 |
| *Erigeron canadensis* | summer | 225 | 233 | 191 | 197 | 10.78*** | 8.73 ns | 2.75*** | 2.00*** | -0.18ns | 0.85** | 0.30 | 0.19 |
| *Origanum vulgare* | summer | 267 | 307 | 200 | 205 | 11.79*** | 4.23* | 0.64*** | -0.75*** | 0.07ns | -0.27ns | 0.30 | 0.27 |
| *Tanacetum vulgare* | summer | 369 | 398 | 214 | 216 | 8.62** | 6.37* | -0.89*** | -1.05*** | -0.11ns | -0.52*** | 0.24 | 0.36 |
| *Impatiens glandulifera* | summer | 322 | 357 | 233 | 234 | -5.17* | -2.80ns | -1.34*** | -0.94*** | 0.53*** | 0.55*** | 0.19 | 0.15 |




**Supplementary Figure S1**

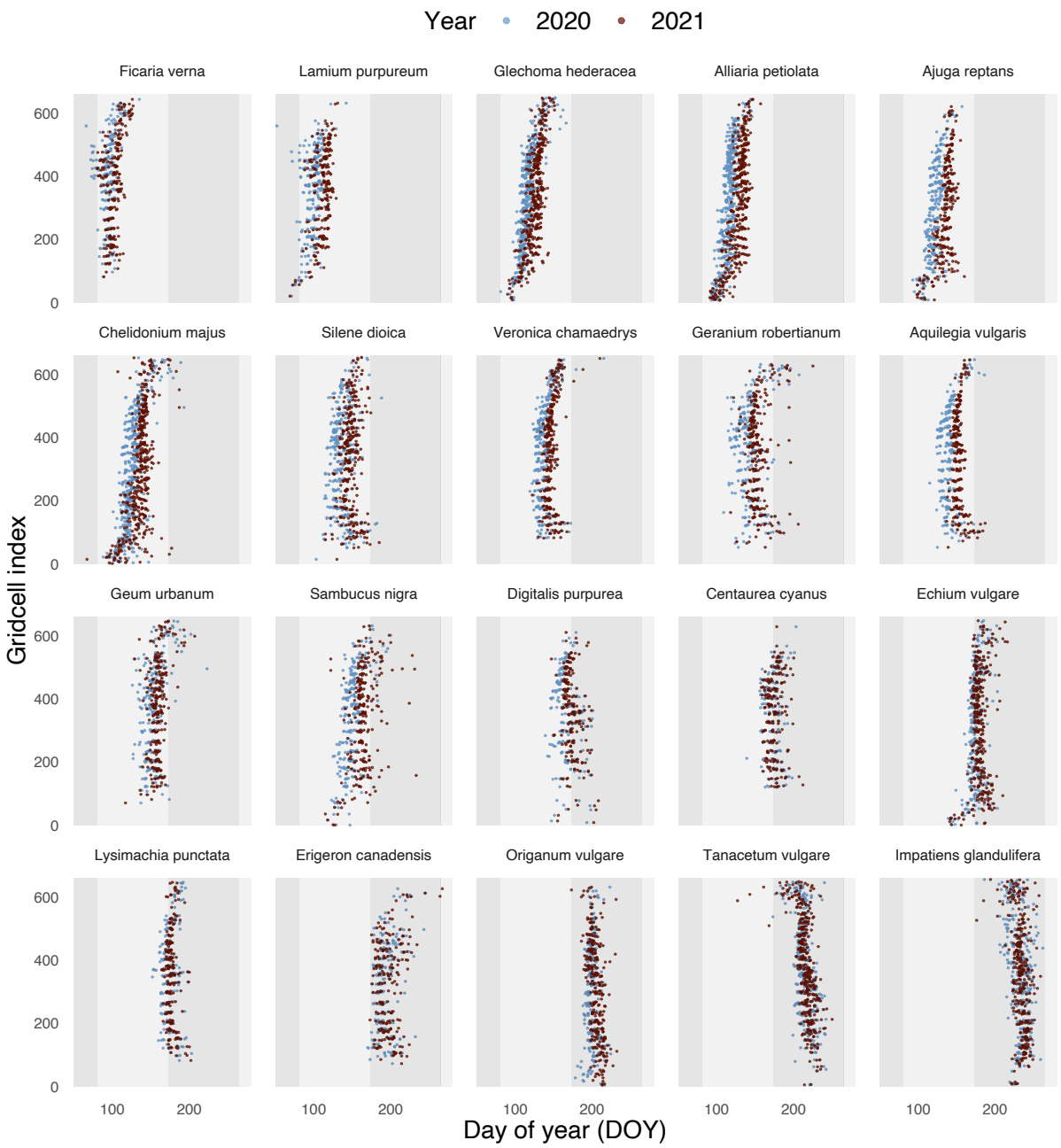
Number of collected observations per species and year.


Echium vulgare
Ficaria verna
Erigeron canadensis
Geranium robertianum
Geum urbanum
Glechoma hederacea
Ajuga reptans
Aquilegia vulgaris
Alliaria petiolata
Centaurea cyanus
Chelidonium majus
Digitalis purpurea
Flora Incognita
Pl@ntNet_automatically
Pl@ntNet_observations
Observation.org
iNaturalist
Artportalen
NBIC
2020
2021
0
100
200
300
Day of year
Source



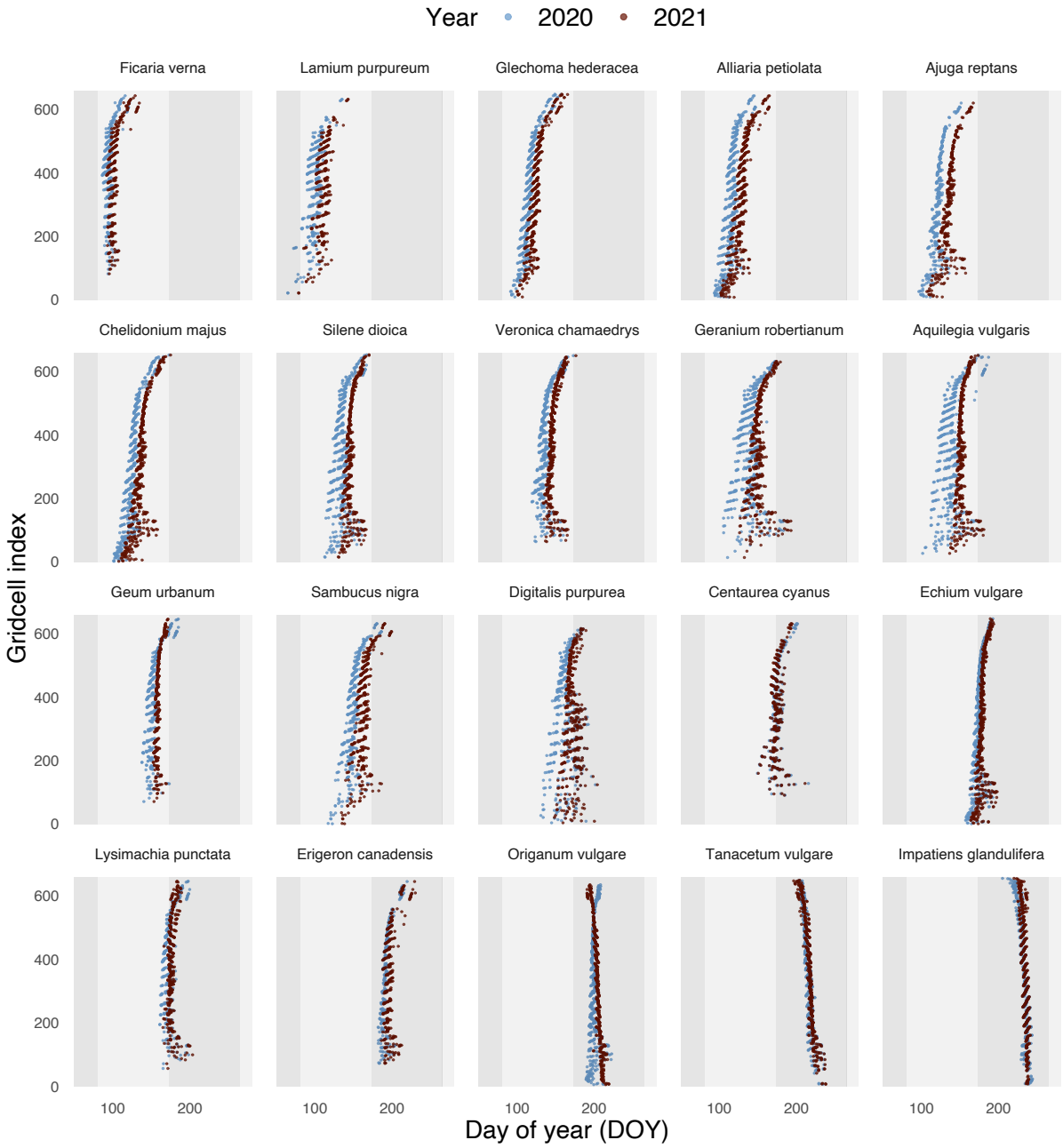

**Supplementary Figure S2**

Observation density curves across species and data sources. The left panels indicate the relative observation frequency throughout the year with color-coded observation sources. The two barplots on right part of the plot present the relative contribution of each source in both years to the overall number of observations.



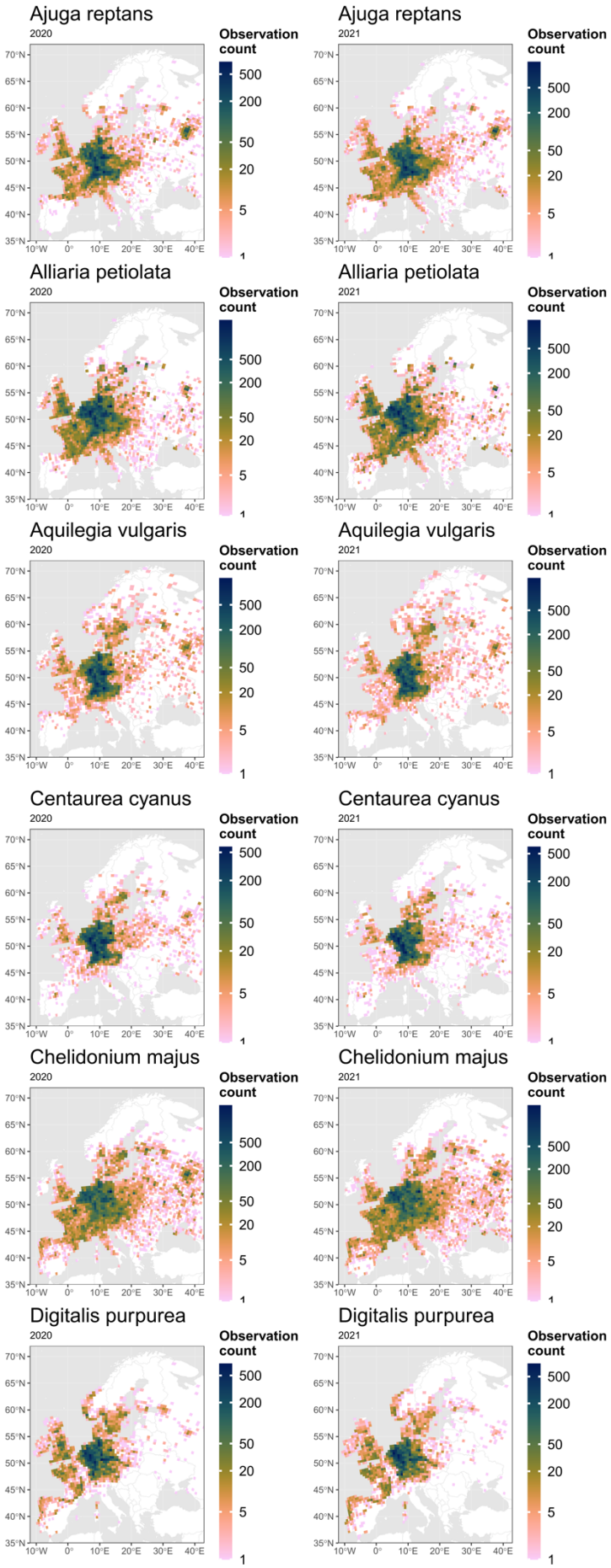

**Supplementary Figure S3a**

Differences in originally observed median observation (MOD) dates between 2020 (blue) and 2021 (brown) for all observed species across all gridcells where MOD could be estimated. Note that the order of the gridcells roughly corresponds to a raster pattern beginning in the south-west of Europe to the north-east. As a consequence, the gridcells with lower index numbers represent gridcells in the south while higher index numbers represent gridcells in the north. The different grey levels in the background of each panel indicate the 4 seasons in the year. Please refer to Supplementary Figure S5 for MOD in exact spatiotemporal context.

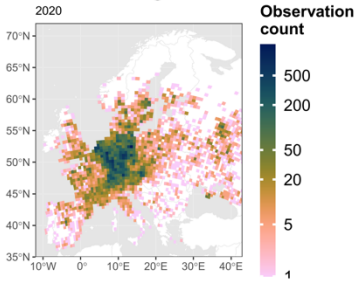



**Supplementary Figure S3b**

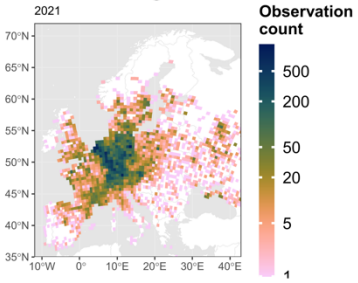
Differences in interpolated median observation (MOD) dates between 2020 (blue) and 2021 (brown) for all observed species across all gridcells where MOD could be estimated. Note that the order of the gridcells roughly corresponds to a raster pattern beginning in the south-west of Europe to the north-east. As a consequence, the gridcells with lower index numbers represent gridcells in the south while higher index numbers represent gridcells in the north. The different grey levels in the background of each panel indicate the 4 seasons in the year. Please refer to Supplementary Figure S5 for MOD in exact spatiotemporal context.


Ajuga reptans
2020
Observation count
500
200
50
20
5
1
70°N
65°N
60°N
55°N
50°N
45°N
40°N
35°N
10°W
0°
10°E
20°E
30°E
40°E
Ajuga reptans
2021
Observation count
Alliaria petiolata
2020
Observation count
Alliaria petiolata
2021
Observation count
Aquilegia vulgaris
2020
Observation count
Aquilegia vulgaris
2021
Observation count
Centaurea cyanus
2020
Observation count
Centaurea cyanus
2021
Observation count
Chelidonium majus
2020
Observation count
Chelidonium majus
2021
Observation count
Digitalis purpurea
2020
Observation count
Digitalis purpurea
2021
Observation count

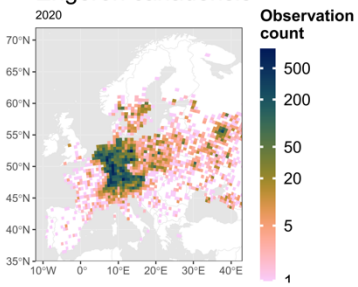
Echium vulgare



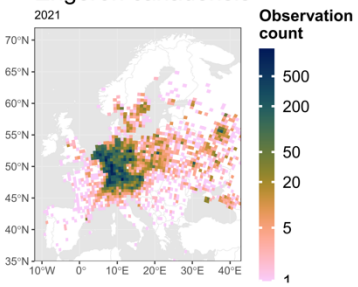

Echium vulgare



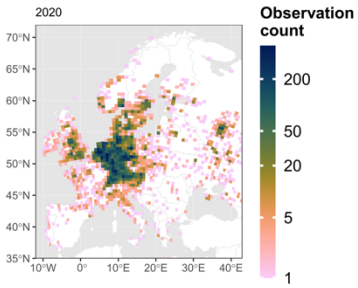

Erigeron canadensis



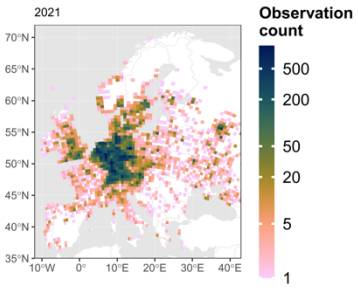

Erigeron canadensis



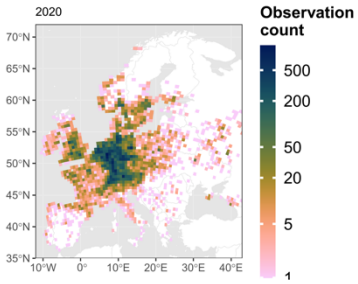

Ficaria verna



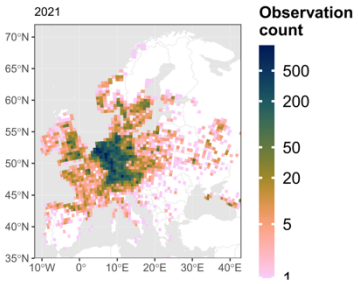

Ficaria verna



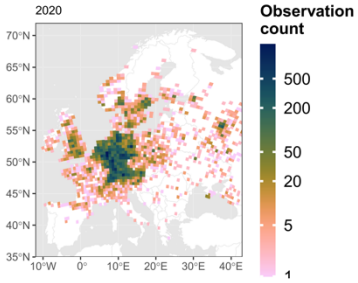

Geranium robertianum



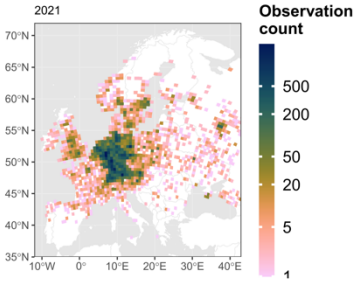

Geranium robertianum



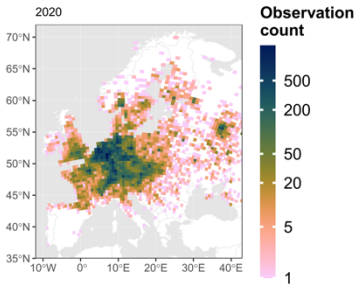

Geum urbanum



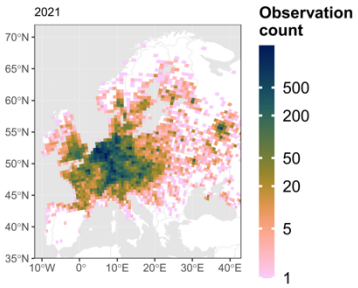

Geum urbanum

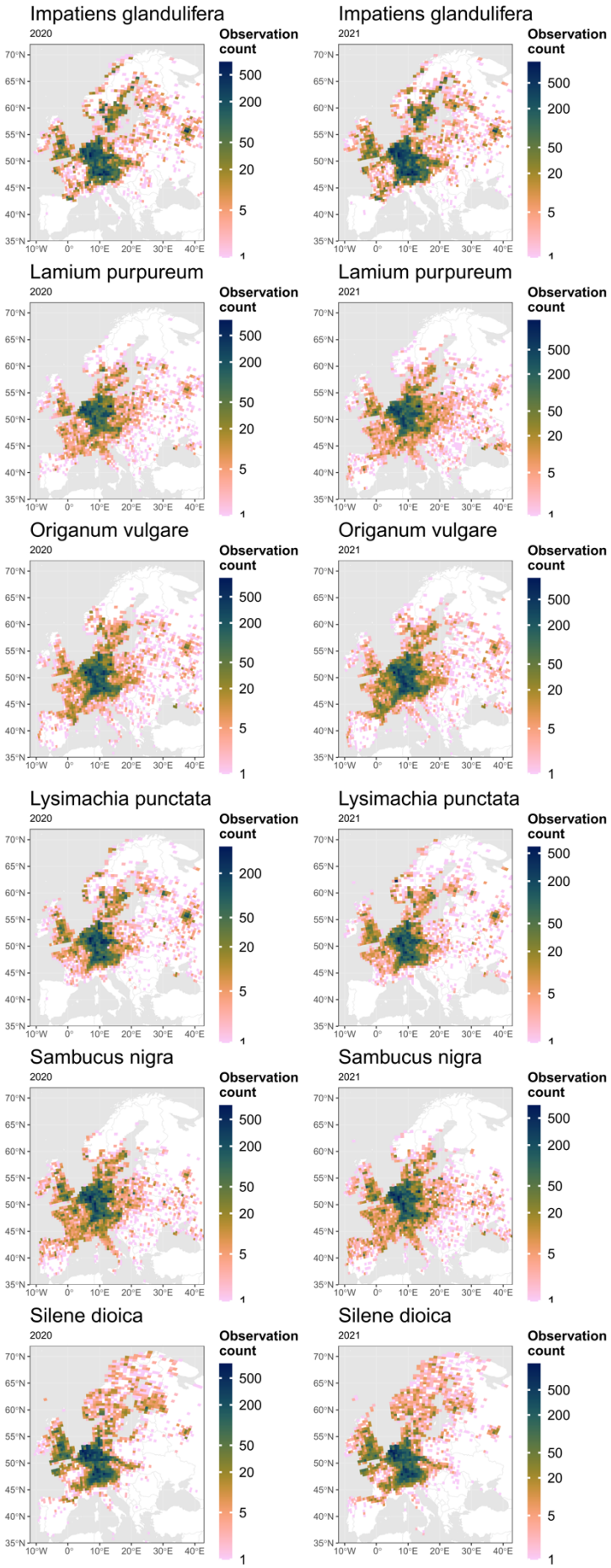


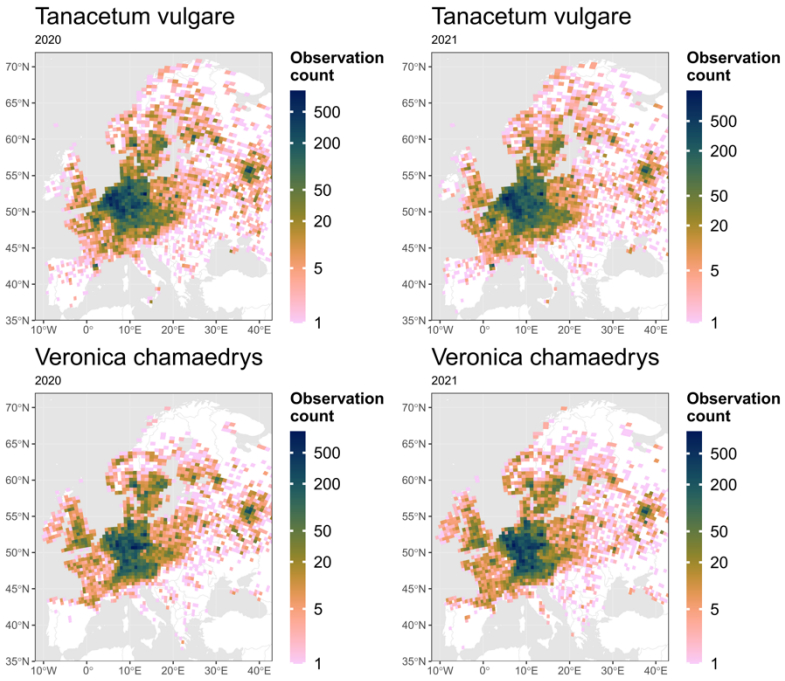

Glechoma hederacea




Glechoma hederacea

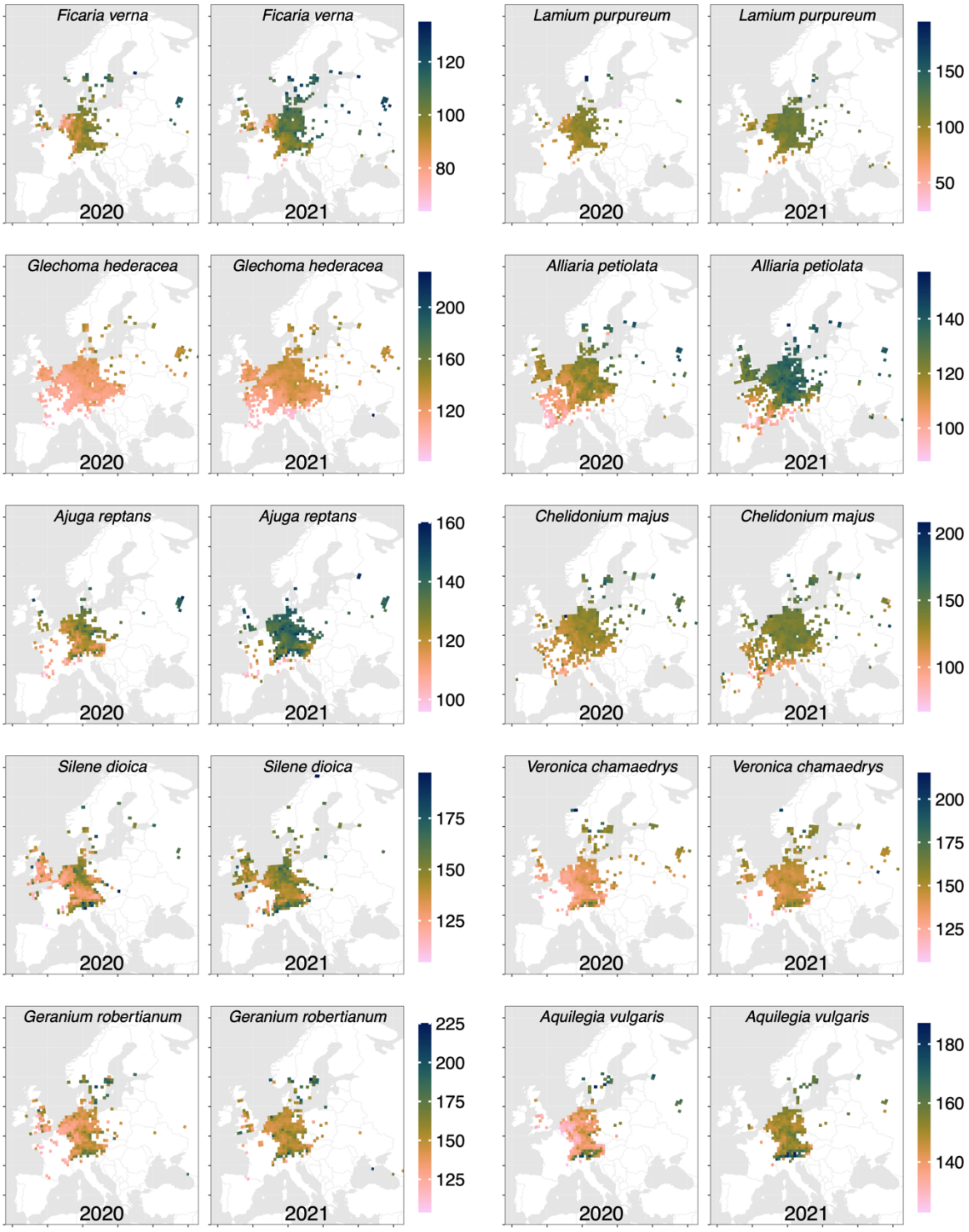



Impatiens glandulifera
2020
Observation count
500
200
50
20
5
1
70°N
65°N
60°N
55°N
50°N
45°N
40°N
35°N
10°W
0°
10°E
20°E
30°E
40°E
Impatiens glandulifera
2021
Observation count
500
200
50
20
5
1
Lamium purpureum
2020
Observation count
500
200
50
20
5
1
Lamium purpureum
2021
Observation count
500
200
50
20
5
1
Origanum vulgare
2020
Observation count
500
200
50
20
5
1
Origanum vulgare
2021
Observation count
500
200
50
20
5
1
Lysimachia punctata
2020
Observation count
200
50
20
5
1
Lysimachia punctata
2021
Observation count
500
200
50
20
5
1
Sambucus nigra
2020
Observation count
500
200
50
20
5
1
Sambucus nigra
2021
Observation count
500
200
50
20
5
1
Silene dioica
2020
Observation count
500
200
50
20
5
1
Silene dioica
2021
Observation count
500
200
50
20
5
1



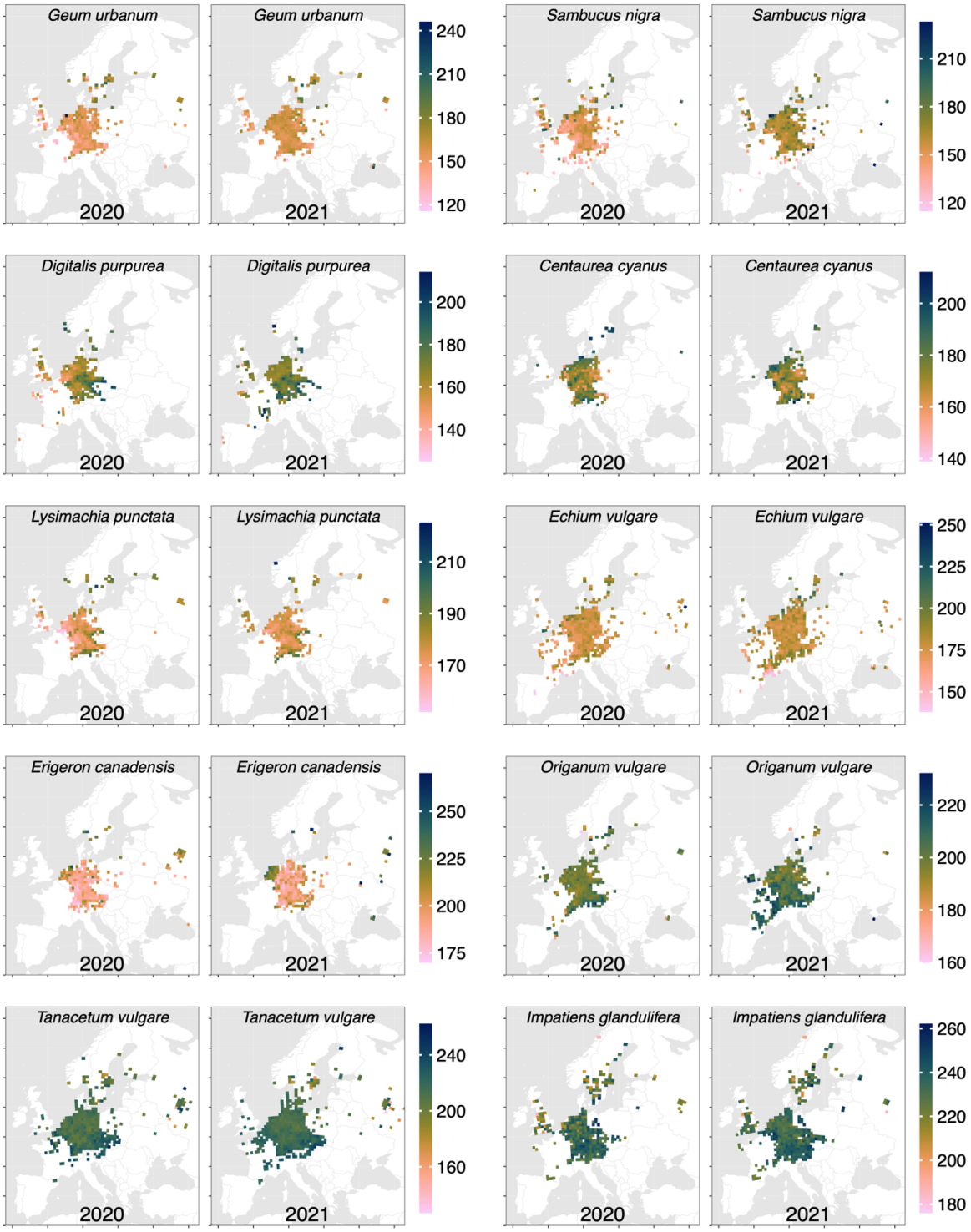

**Supplementary Figure S4**

Overview of observation count per gridcell for all considered species and years in comparison. Note that the color coding is on a log-scale.

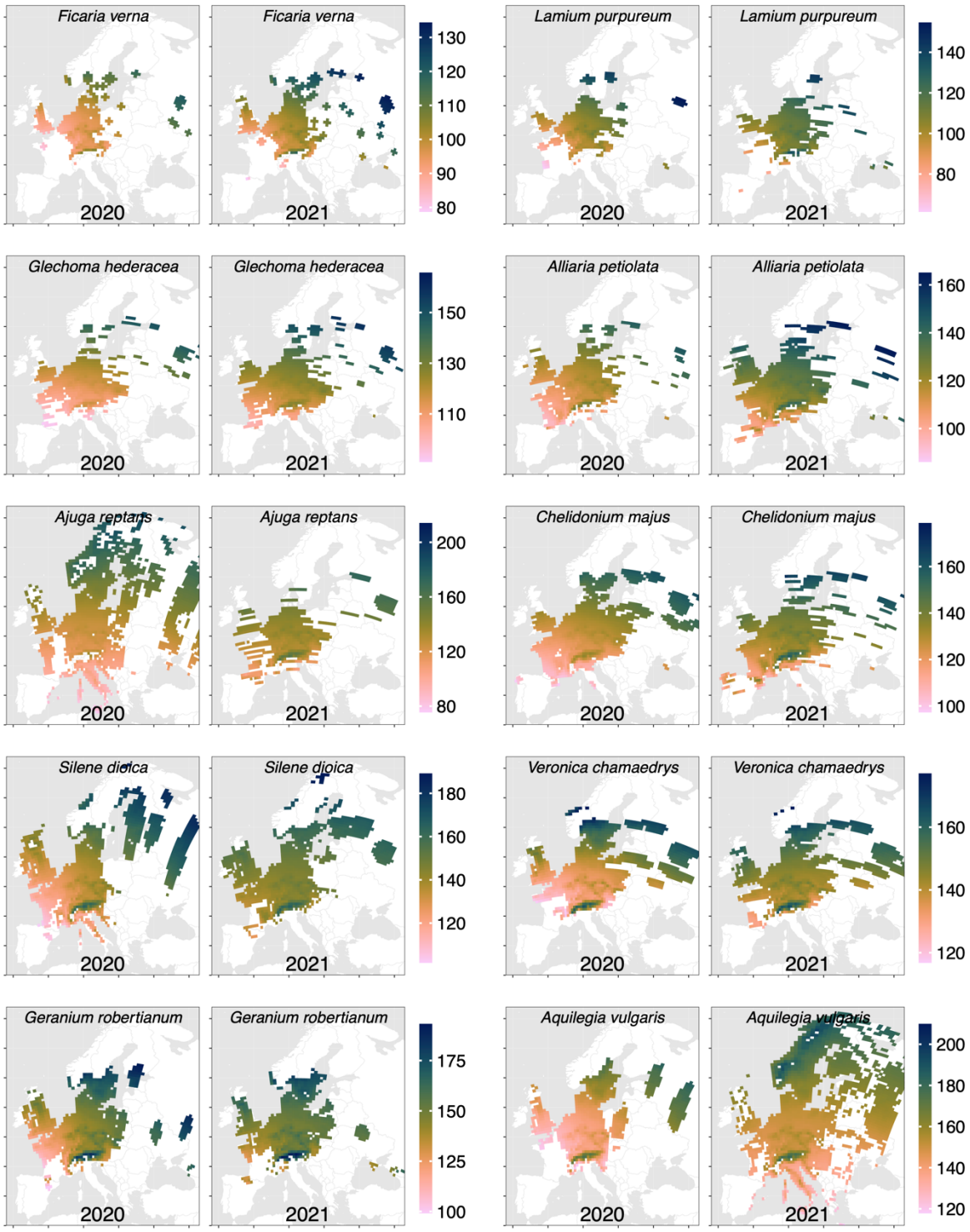



**Supplementary Figure S5a**

Median date of observation (MOD) per grid cell for the ten earlier flowering species for both years in comparison. Note that the scales are unique for each species, comprising the total range of observed values across both years. Therefore, colors are only comparable within species.

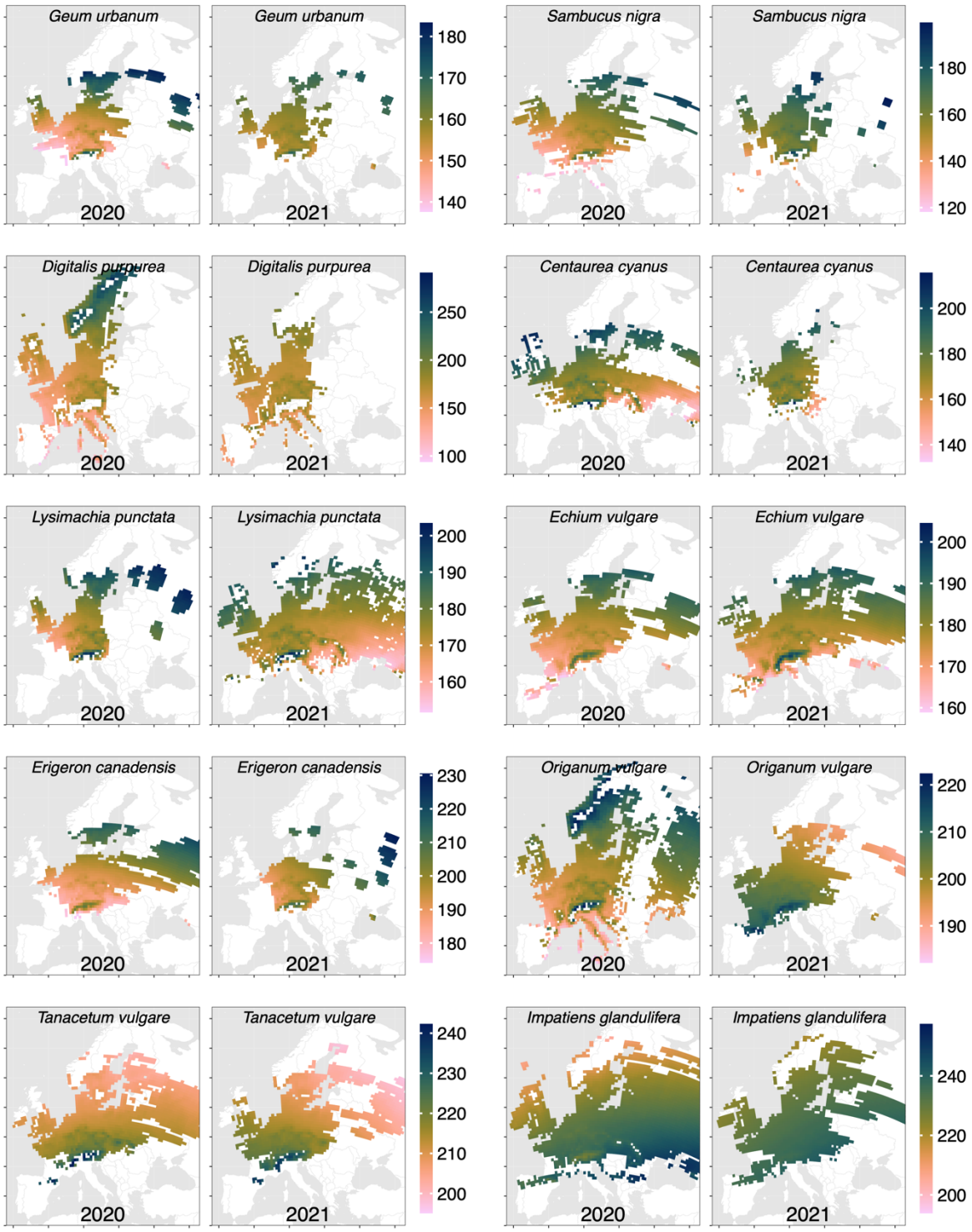



**Supplementary Figure S5b**
Median observation date (MOD) per grid cell for the ten later flowering species for both years in comparison. Note that the scales are unique for each species, comprising the total range of observed values across both years. Therefore, colors are only comparable within species.




**Supplementary Figure S6a**

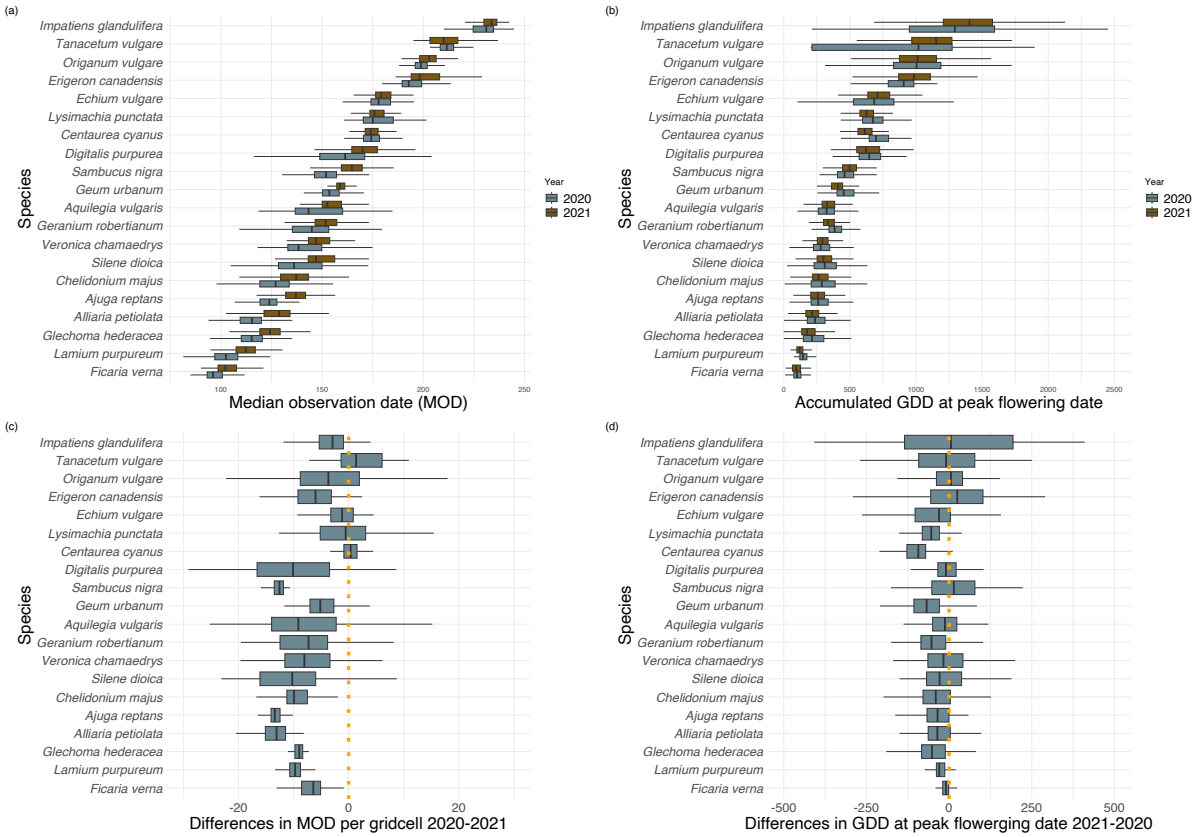
Interpolated median observation date (MOD) per grid cell for the ten earlier flowering species for both years in comparison. Note that the scales are unique for each species, comprising the total range of observed values across both years. Therefore, colors are only comparable within species.




**Supplementary Figure S6b**

Interpolated median date (MOD) per grid cell for the ten later flowering species for both years in comparison. Note that the scales are unique for each species, comprising the total range of observed values across both years. Therefore, colors are only comparable within species.


**Supplementary Figure S7**
Change of median observation date (MOD) in 2021 relative to 2020 based on the observed values for grid cells with observations from both years.




**Supplementary Figure S8**

The boxplots represent the distribution of species observations in all gridcells. (a) represents the temporal distribution of median observation dates (MOD) for all observed species in both observed years. (b) shows the accumulated temperature above the baseline of 5°C (GDD) in each gridcell at the time when peak flowering of this species was observed. (c) shows the distribution of differences for MOD between the years for all observed species. (d) shows the distribution of differences between the years for accumulated temperature (GDD) per gridcell for all observed species.