**Appendix**

S2. Occurrence points for each region before and after using 50 km filtering and manual adjustment.

|  |  |  |  |
| --- | --- | --- | --- |
| Regions | Original number of occurrence points | Number of occurrence points after using 50 km filtering | Number of occurrence points after using 50 km filtering and manual adjustment |
| North America | 221 | 140 | 61 |
| Brazil | 125 | 86 | 40 |
| Europe and North Africa | 750 | 472 | 197 |
| Pakistan | 90 | 72 | 31 |
| Australia and Indonesia | 56 | 53 | 39 |

S3. Parameter settings selected during model calibration. Model performance was assessed based on statistical significance (partial ROC), omission rates, and model complexity (corrected Akaike information criterion; AICc).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | Mean AUC ratio | Partial ROC | Omission rate at 5% | AICc | Delta AICc | Parameters |
| **All regions** | | | | | | |
| M\_2\_F\_t\_set1 | 1.491 | 0 | 0.048 | 8219.844 | 0 | 44 |
| **North America** | | | | | | |
| M\_0.8\_F\_lqp\_set3 | 1.551 | 0 | 0.032 | 1185.31 | 0 | 8 |
| M\_0.6\_F\_lqp\_set3 | 1.559 | 0 | 0.032 | 1185.51 | 0.198 | 9 |
| M\_0.7\_F\_lqp\_set3 | 1.548 | 0 | 0.032 | 1186.91 | 1.600 | 9 |
| M\_0.7\_F\_qp\_set3 | 1.537 | 0 | 0.032 | 1186.92 | 1.618 | 9 |
| M\_0.9\_F\_qp\_set3 | 1.541 | 0 | 0.032 | 1187.29 | 1.980 | 8 |
| **Brazil** | | | | | | |
| M\_6\_F\_l\_set1 | 1.0004 | 0 | 0 | 758.72 | 0 | 4 |
| M\_6\_F\_lt\_set1 | 1.0004 | 0 | 0 | 758.72 | 0 | 4 |
| M\_6\_F\_lh\_set1 | 1.0004 | 0 | 0 | 758.72 | 0 | 4 |
| M\_6\_F\_l\_set2 | 1.0004 | 0 | 0 | 758.72 | 0.002 | 4 |
| M\_6\_F\_lt\_set2 | 1.0004 | 0 | 0 | 758.72 | 0.002 | 4 |
| M\_6\_F\_lh\_set2 | 1.0004 | 0 | 0 | 758.72 | 0.002 | 4 |
| M\_6\_F\_l\_set3 | 1.0002 | 0 | 0 | 759.94 | 1.218 | 4 |
| M\_6\_F\_lt\_set3 | 1.0002 | 0 | 0 | 759.94 | 1.218 | 4 |
| M\_6\_F\_lh\_set3 | 1.0002 | 0 | 0 | 759.94 | 1.218 | 4 |
| **Europe and North Africa** | | | | | | |
| M\_4\_F\_pth\_set3 | 1.428 | 0 | 0.040 | 3828.6370 | 0 | 7 |
| M\_4\_F\_ph\_set3 | 1.424 | 0 | 0.040 | 3828.6664 | 0.029 | 7 |
| **Pakistan** | | | | | | |
| M\_0.2\_F\_lp\_set2 | 1.217 | 0.04 | 0.137 | 474.52 | 0 | 5 |
| M\_0.1\_F\_l\_set3 | 1.235 | 0.048 | 0.103 | 476.11 | 1.587 | 5 |
| **Australia and Indonesia** | | | | | | |
| M\_0.2\_F\_lq\_set3 | 1.787 | 0 | 0 | 695.37 | 0 | 10 |

S4. Summary of predicted model changes and extrapolation risks expected for the future (2050) under the RCP 8.5 emissions scenario. The degree of agreement in changes of suitable areas and strict extrapolative zones is given by the number of GCMs that coincide in their predictions.



S5. Summary of variation coming from distinct sources in projections of models created with data from North America. Maps of variation coming from distinct sources correspond to variance in future projections only.



S6. Summary of variation coming from distinct sources in projections of models created with data from Europe and North Africa. Maps of variation coming from distinct sources correspond to variance in future projections only.



S7. Summary of variation coming from distinct sources in projections of models created with data from Australia and Indonesia. Maps of variation coming from distinct sources correspond to variance in future projections only.



S8. Calculating change in suitable areas (gain and loss) in percentage (%) across all regions and each one separately with and without extrapolation areas.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Numerical results (%) of changes in suitable areas with strict-extrapolation** | | | | | | | | | |
| Conditions | All regions | | North America | | Brazil | | Europe and North Africa | | Australia and Indonesia | |
| 4.5 | 8.5 | 4.5 | 8.5 | 4.5 | 8.5 | 4.5 | 8.5 | 4.5 | 8.5 |
| Not suitable | 15.55 | 12.61 | 14.05 | 9.62 | 1.08 | 1.65 | 42.16 | 38.52 | 46.6 | 44.19 |
| Gain 1 GCM | 5.86 | 4.86 | 4.38 | 5.17 | 1.54 | 1.01 | 2.83 | 3.41 | 4.08 | 3.51 |
| Gain 2 GCM | 3.95 | 3.47 | 2.43 | 2.27 | 0.84 | 0.72 | 1.6 | 2.45 | 2.04 | 2.15 |
| Gain 3 GCM | 2.62 | 2.61 | 1.34 | 1.64 | 0.48 | 0.41 | 1.07 | 1.59 | 1.48 | 1.67 |
| Gain 4 GCM | 2.26 | 2.27 | 1.19 | 1.24 | 0.32 | 0.3 | 1.1 | 0.92 | 1.25 | 1.2 |
| Gain 5 GCM | 1.91 | 1.96 | 1.05 | 1.01 | 0.2 | 0.24 | 0.66 | 0.7 | 1.08 | 1.16 |
| Gain 6 GCM | 1.65 | 1.76 | 0.98 | 0.96 | 0.16 | 0.19 | 0.65 | 0.53 | 1.1 | 1.37 |
| Gain 7 GCM | 1.63 | 1.72 | 0.97 | 0.98 | 0.11 | 0.11 | 0.51 | 0.55 | 1.14 | 1.34 |
| Gain 8 GCM | 1.58 | 1.91 | 1.05 | 1.09 | 0.1 | 0.09 | 0.5 | 0.65 | 1.16 | 1.3 |
| Gain 9 GCM | 1.43 | 2.02 | 1.53 | 1.24 | 0.06 | 0.09 | 0.57 | 0.52 | 1.17 | 1.24 |
| Gain 10 GCM | 1.81 | 2.34 | 2.43 | 1.78 | 0.04 | 0.07 | 0.66 | 0.84 | 1.96 | 1.26 |
| Gain 11 GCM | 2.65 | 5.36 | 1.77 | 6.16 | 0.02 | 0.05 | 1.97 | 3.58 | 1.44 | 4.11 |
| Loss in All GCMs | 0.13 | 0.32 | 0.01 | 0 | 0 | 0 | 0.07 | 0.13 | 0.1 | 0.27 |
| Loss in 10 GCM | 0.24 | 0.4 | 0.01 | 0.01 | 0 | 0 | 0.08 | 0.09 | 0.19 | 0.23 |
| Loss in 9 GCM | 0.42 | 0.53 | 0.02 | 0.02 | 0.01 | 0.01 | 0.08 | 0.1 | 0.22 | 0.21 |
| Loss in 8 GCM | 0.65 | 0.6 | 0.03 | 0.03 | 0.05 | 0.03 | 0.09 | 0.13 | 0.23 | 0.25 |
| Loss in 7 GCM | 0.68 | 0.69 | 0.06 | 0.06 | 0.14 | 0.07 | 0.16 | 0.12 | 0.26 | 0.28 |
| Loss in 6 GCM | 0.81 | 0.78 | 0.11 | 0.1 | 0.2 | 0.14 | 0.18 | 0.15 | 0.39 | 0.32 |
| Loss in 5 GCM | 1.01 | 0.9 | 0.21 | 0.17 | 0.17 | 0.2 | 0.24 | 0.16 | 0.47 | 0.37 |
| Loss in 4 GCM | 1.29 | 1.18 | 0.32 | 0.3 | 0.24 | 0.21 | 0.32 | 0.22 | 0.77 | 0.53 |
| Loss in 3 GCM | 1.98 | 1.45 | 0.71 | 0.45 | 0.44 | 0.34 | 0.43 | 0.29 | 0.94 | 1.21 |
| Loss in 2 GCM | 3 | 2.26 | 1.73 | 0.83 | 0.77 | 0.56 | 0.69 | 0.5 | 1.59 | 1.52 |
| Loss in 1 GCM | 6.38 | 4.05 | 5.19 | 1.76 | 1.82 | 1.23 | 1.77 | 0.98 | 4.8 | 2.98 |
| Stable | 40.52 | 43.96 | 58.42 | 63.08 | 91.23 | 92.26 | 41.61 | 42.84 | 25.55 | 27.35 |
|  | **Numerical results (%) of changes in suitable areas without strict-extrapolation** | | | | | | | | | |
| Not suitable | 30.73 | 28.79 | 30 | 28.01 | 72.92 | 73.32 | 62.76 | 62.53 | 73.47 | 74.15 |
| Gain 1 GCM | 4.99 | 5.29 | 6.12 | 5.08 | 2.12 | 1.67 | 2.52 | 1.81 | 1.97 | 1.24 |
| Gain 2 GCM | 3.04 | 2.93 | 2.56 | 2.37 | 1.27 | 1.16 | 1.11 | 1.18 | 0.79 | 0.69 |
| Gain 3 GCM | 2.17 | 2.34 | 1.55 | 1.95 | 0.7 | 0.69 | 0.77 | 0.86 | 0.46 | 0.43 |
| Gain 4 GCM | 1.85 | 1.97 | 1.3 | 1.94 | 0.48 | 0.46 | 0.59 | 0.54 | 0.32 | 0.3 |
| Gain 5 GCM | 1.65 | 1.54 | 1.32 | 1.31 | 0.34 | 0.39 | 0.57 | 0.47 | 0.26 | 0.28 |
| Gain 6 GCM | 1.19 | 1.2 | 1.31 | 1.19 | 0.28 | 0.33 | 0.44 | 0.41 | 0.2 | 0.2 |
| Gain 7 GCM | 0.97 | 1.12 | 1.29 | 1.38 | 0.21 | 0.23 | 0.41 | 0.33 | 0.2 | 0.21 |
| Gain 8 GCM | 0.97 | 1.06 | 1.19 | 1.28 | 0.21 | 0.2 | 0.32 | 0.38 | 0.13 | 0.17 |
| Gain 9 GCM | 0.95 | 1.04 | 1.05 | 1.43 | 0.19 | 0.2 | 0.36 | 0.49 | 0.13 | 0.14 |
| Gain 10 GCM | 1.03 | 1.26 | 1.01 | 1.8 | 0.27 | 0.21 | 0.43 | 0.84 | 0.13 | 0.13 |
| Gain 11 GCM | 1.11 | 2.12 | 0.58 | 1.56 | 0.49 | 0.64 | 1.05 | 1.47 | 0.1 | 0.2 |
| Loss in All GCMs | 0.16 | 0.39 | 0.26 | 0.51 | 0.81 | 0.88 | 0.36 | 0.43 | 0.19 | 0.28 |
| Loss in 10 GCM | 0.27 | 0.42 | 0.27 | 0.37 | 0.21 | 0.23 | 0.18 | 0.2 | 0.24 | 0.36 |
| Loss in 9 GCM | 0.39 | 0.54 | 0.23 | 0.26 | 0.17 | 0.15 | 0.2 | 0.2 | 0.27 | 0.33 |
| Loss in 8 GCM | 0.61 | 0.59 | 0.23 | 0.18 | 0.19 | 0.16 | 0.19 | 0.25 | 0.26 | 0.27 |
| Loss in 7 GCM | 0.69 | 0.71 | 0.33 | 0.3 | 0.23 | 0.2 | 0.26 | 0.2 | 0.25 | 0.27 |
| Loss in 6 GCM | 0.85 | 0.9 | 0.37 | 0.31 | 0.31 | 0.26 | 0.28 | 0.27 | 0.27 | 0.26 |
| Loss in 5 GCM | 1.07 | 0.96 | 0.48 | 0.35 | 0.3 | 0.32 | 0.3 | 0.3 | 0.33 | 0.32 |
| Loss in 4 GCM | 1.47 | 1.53 | 0.65 | 0.51 | 0.43 | 0.38 | 0.44 | 0.32 | 0.49 | 0.39 |
| Loss in 3 GCM | 2.31 | 1.89 | 1.07 | 1.35 | 0.7 | 0.57 | 0.6 | 0.46 | 0.6 | 0.58 |
| Loss in 2 GCM | 3.3 | 2.83 | 2.19 | 2 | 1.35 | 0.87 | 1.02 | 0.77 | 1 | 0.79 |
| Loss in 1 GCM | 6.71 | 5.29 | 6.26 | 3.73 | 3.57 | 1.91 | 2.85 | 1.75 | 2.65 | 1.4 |
| Stable | 31.52 | 33.29 | 38.39 | 40.82 | 12.23 | 14.55 | 21.99 | 23.53 | 15.3 | 16.61 |