# Effect of using CCI land cover on ISBA Leaf Area index (LAI) simulations over Europe

In order to better understand the downstream impacts of changes in land cover, we analysed the differences in leaf area index (LAI) climatology between the new land cover derived from the Climate Change Initiative (CCI) and the old land cover (ECOCLIMAP-SG and ECOCLIMAP-II, respectively). As shown in Figure S1, significant LAI variations, frequently surpassing 1 m² m⁻² and occasionally exceeding 2 m² m⁻² in certain regions of Spain and France, demonstrate the substantial sensitivity of the modelled vegetation state to land cover inputs. These LAI differences are consistent with transitions in land cover classes. For instance, a transition from bare soil or rocks in ECOCLIMAP-II to crops or deciduous forests in ECOCLIMAP-SG results in a larger simulated LAI. Decreases in LAI are also observed in urban areas, as larger cities are better represented in ECOCLIMAP-SG.
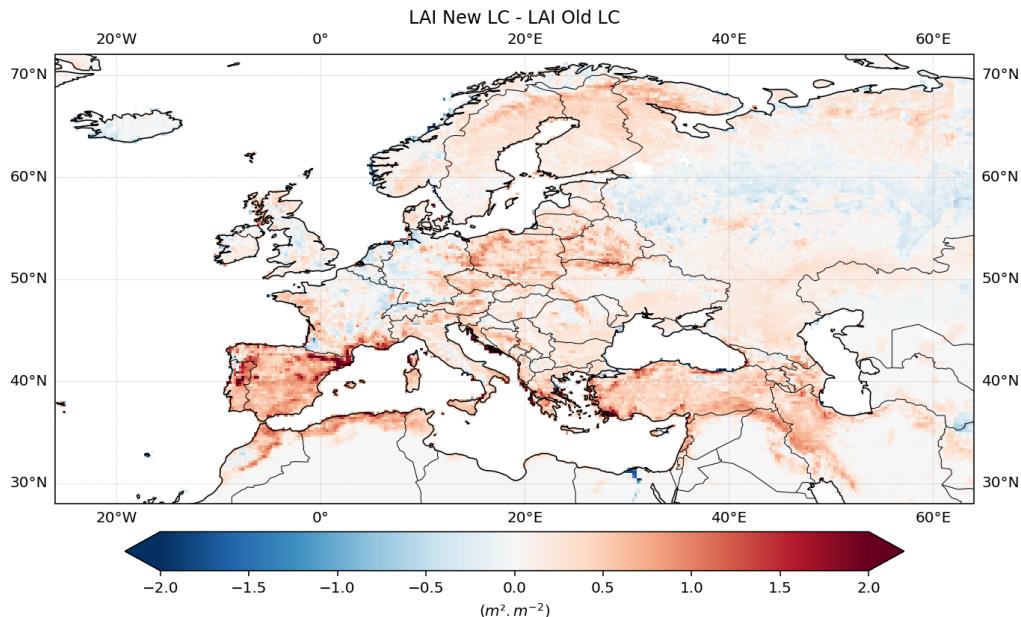
**Figure S1** – Mean LAI differences between ISBA simulations using CCI land cover vs. pre-existing LC ("New LC" and "Old LC",respectively), from 2019 to 2022.

# Assessment of ISBA LST simulations

**Table S1**: Same as Table 1 LST results, except for snow-free conditions only.

| Model | vs. CCI variable | *R* | RMSD | ubRMSD | Mean bias | Number |
|---|---|---|---|---|---|---|
| ERA5 | Daytime LST | 0.95 | 4.8 | 4.4 | -1.8 | 17,028,884 |
| ISBA Old LC | (K) | 0.95 | 6.1 | 4.8 | -3.7 | 18,470,996 |
| ISBA New LC | | 0.95 | 6.2 | 4.9 | -3.8 | 18,475,517 |
| ERA5 | Nighttime LST | 0.95 | 2.9 | 2.3 | 1.7 | 20,000,058 |
| ISBA Old LC | (K) | 0.93 | 2.9 | 2.8 | 0.9 | 21,266,313 |
| ISBA New LC | | 0.93 | 2.9 | 2.8 | 0.9 | 21,296,545 |

**Table S2**: Same as Table 1 LST results, except for the DJF season only.

| Model | vs. CCI variable | *R* | RMSD | ubRMSD | Mean bias | Number |
|---|---|---|---|---|---|---|
| ERA5 | Daytime LST | 0.96 | 3.7 | 3.6 | - 0.2 | 889,017 |
| ISBA Old LC | (K) | 0.94 | 4.9 | 4.5 | -1.9 | 1,081,712 |
| ISBA New LC | | 0.94 | 4.9 | 4.6 | -1.8 | 1,081,706 |
| ERA5 | Nighttime LST | 0.93 | 3.2 | 3.0 | 1.3 | 3,474,492 |
| ISBA Old LC | (K) | 0.88 | 3.9 | 3.9 | 0.4 | 3,805,975 |
| ISBA New LC | | 0.89 | 3.8 | 3.8 | 0.6 | 3,805,923 |

Note: DJF stands for December-January-February

**Table S3**: Same as Table 1 LST results, except for the DJF season and snow-free conditions only.

| Model | vs. CCI variable | *R* | RMSD | ubRMSD | Mean bias | Number |
|---|---|---|---|---|---|---|
| ERA5 | Daytime LST | 0.95 | 3.7 | 3.7 | -0.2 | 646,537 |
| ISBA Old LC | (K) | 0.93 | 5.1 | 4.6 | -2.3 | 819,387 |
| ISBA New LC | | 0.93 | 5.1 | 4.7 | -2.2 | 823,023 |
| ERA5 | Nighttime LST | 0.85 | 2.8 | 2.4 | 1.4 | 1,993,240 |
| ISBA Old LC | (K) | 0.70 | 3.0 | 3.0 | 0.6 | 2,238,276 |
| ISBA New LC | | 0.71 | 3.0 | 2.9 | 0.7 | 2,250,248 |

Note: DJF stands for December-January-February