AIRFRESH

LIFE19 ENV/FR/00086

# AIRFRESH

Air pollution removal by urban forests for a better human well-being

# Maps of Ecosystems Services provided by urban trees in Aix-en-Provence and Florence

Actions B2 & B3
Reporting Date: 01/12/2024

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| **Data Project** | |
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| **Data Beneficiary** | |
| Name Beneficiary | ACRI-ST |
| Contact person | Dr Pierre SICARD |
| Postal address | 260, route du Pin Montard - BP 234<br>06904 Sophia Antipolis cedex - France |
| E-mail | pierre.sicard@acri-st.fr |
| Project website | www.life-airfresh.eu |

## Table of Content

## Executive summary

Mediterranean cities are expected to be more strongly affected by climate change, including ozone ($O_3$) pollution, than most of the other regions of the world (Sicard et al., 2017). We have thus selected two front-runner cities Aix-en-Provence (France) and Florence (Italy) as pilot cities. In 2020-2024, LIFE AIRFRESH developed **new citywide geospatial tools** designed to i) detect, classify, and map individual trees and urban green spaces within private and public areas (Fig. 1); ii) map the benefits that urban trees generate (air pollution reduction); iii) map the 3-30-300 rule compliance; iv) map the areas prone to urban heat islands; and v) map the open areas available for re-naturing. **Due to the limitation (<50MB), all maps are available on request.**

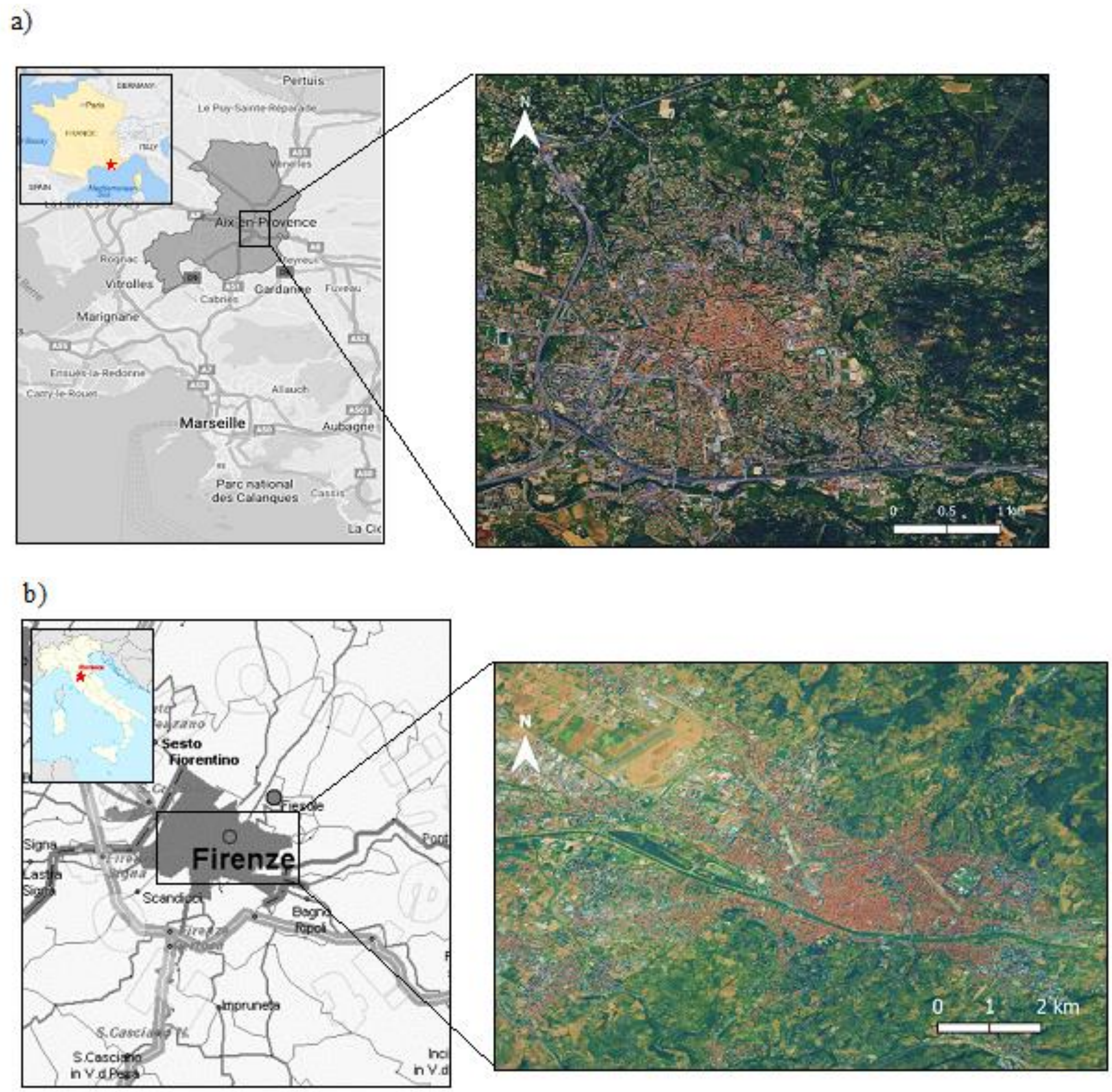



**Figure 1 -** Localization of the two study areas in both cities: Aix-en-Provence (a) and Florence (b). The study area, covered by the satellite image extends over 35 km² in Aix-en-Provence and 70km² in Florence.

## 1. Mapping of tree species at city scale

The municipal tree inventories include only public trees managed by the municipality which represent less than 15% of the total number of trees detected in both public and private areas over the study areas in Florence and Aix-en-Provence.

In Aix-en-Provence, **413,895 individual trees** as well as 5,438 herbaceous areas have been detected. The **vegetated areas** (trees and grass) cover **39.6%** of the study area (Fig. 2).

Our satellite-based approach allowed classifying **22 dominant tree species** and grassland with an **overall accuracy of 84%** (Sicard et al., 2023). The total canopy cover of most common tree species are: *Pinus spp*. (~ 487 ha), *Celtis australis* (~ 374 ha), *Platanus acerifolia* (~ 370 ha), *Acer spp*. (~ 265 ha), *Cupressus sempervirens* (~ 124 ha), *Sophora japonica* (~ 54 ha), *Fraxinus spp.* (~ 41 ha), *Cercis siliquastrum* (~ 14 ha), *Populus spp*. (~ 8 ha), and *Tilia* spp. (~ 7 ha). The grass (lawn/turf) covers about 152 ha (Fig. 3).

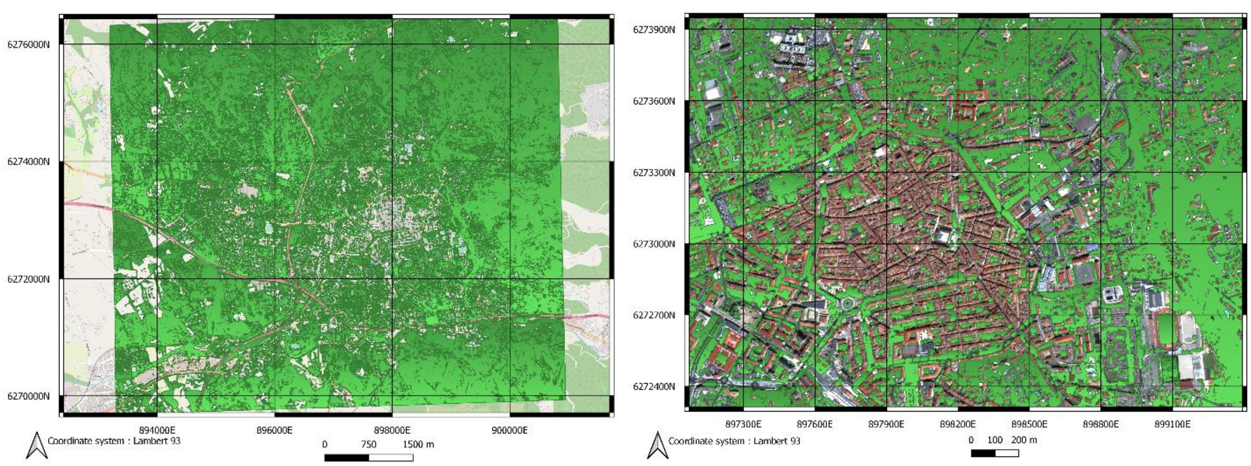



**Figure 2** - Green spaces coverage (tree canopy cover, and grass) over the study area in Aix-en-Provence: study area (left) and a zoom over the south-east part of the study area (right).

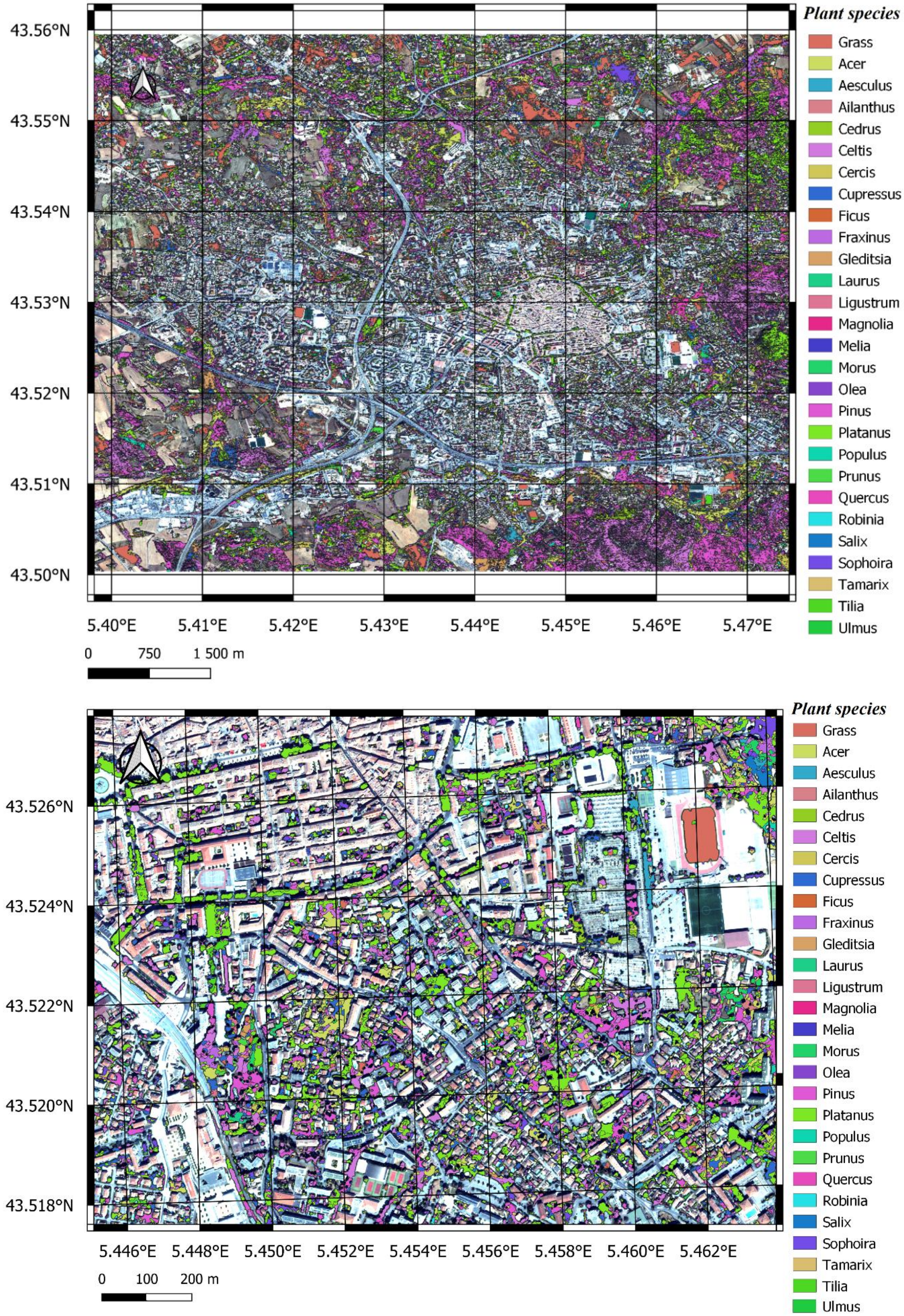



**Figure 3 –** Detection, delineation, and classification of urban tree canopies over the study area in Aix-en-Provence (top, 50km²) and a zoom over the south-east part of the study area (bottom).

In Florence, **549,416 individual trees** have been detected as well as 1,157 herbaceous areas have been detected. The **vegetated areas** (trees and grass) cover **30.1%** of the study area (Fig. 4).

Our satellite-based approach allowed classifying **20 dominant tree species** and grassland with an **overall accuracy of 83%** (Sicard et al., 2023). In Florence, the total canopy cover of most common tree species (Fig. 5) are: *Quercus* spp. (~ 728 ha), *Tilia europaea* (~ 492 ha), *Celtis australis* (~ 338 ha), *Pinus* spp. (~ 278 ha), *Cupressus sempervirens* (~ 176 ha), *Platanus acerifolia* (~ 90 ha), *Olea europaea* (~ 88 ha), and *Acer* spp. (~ 61 ha).


**Figure 4** - Green spaces coverage (tree canopy cover, and grass) over the study area in Florence: study area (left) and a zoom over the center part of the study area (right).

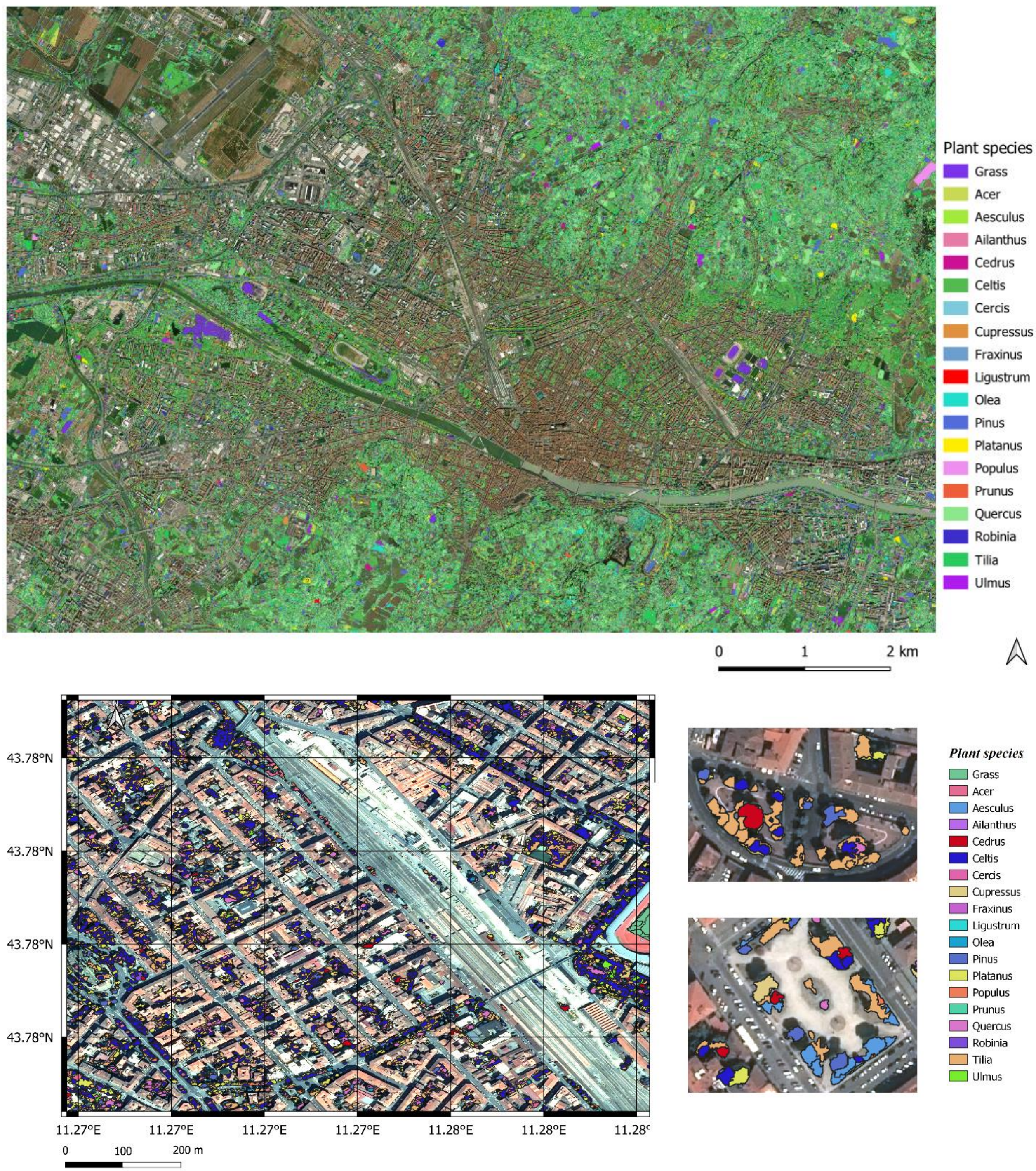



**Figure 5 -** Detection, delineation, and classification of urban tree canopies over the study area in Florence (top, 80km²), and a zoom over the city center (bottom).

The produced maps deliver spatially explicit representations of green spaces distribution in a cost-effective and objective way over a large spatial extent. The area covered and geo-located characteristics of urban green spaces as well as **open areas potentially available for re-naturing** are mapped in a GIS environment.

## 2. Air Pollution removal capacity of urban trees at city scale

In LIFE AIRFRESH, we developed an innovative single-tree model (FlorTree) to quantify and map the air pollutants removal capacity of about 400 plant species, e.g., $CO_2$, $O_3$, $PM_{10}$, $PM_{2.5}$, $NO_2$. Hourly meteorological data and surface air pollutants concentrations are obtained with WRF-CHIMERE model with a spatial resolution of <1km (Anav et al., 2024).

In Aix-en-Provence, the **413,960 adult trees** have eliminated in 2023: 225 tons $O_3$ (formation: 9 tons, removal: 234 tons), 41 tons $NO_2$ (6,600 cars[1]), 97 tons $PM_{10}$ (147,400 cars[1]), 16,560 tons $CO_2$ (10,400 cars[1]) and lawns/herbaceous have eliminated 423 tons $CO_2$ (about 2.6%). The 414,000 adult trees have eliminated 3.1% and 2.8% of the $NO_x$ and $CO_2$ local emissions and 36.7% of $PM_{10}$ emissions.

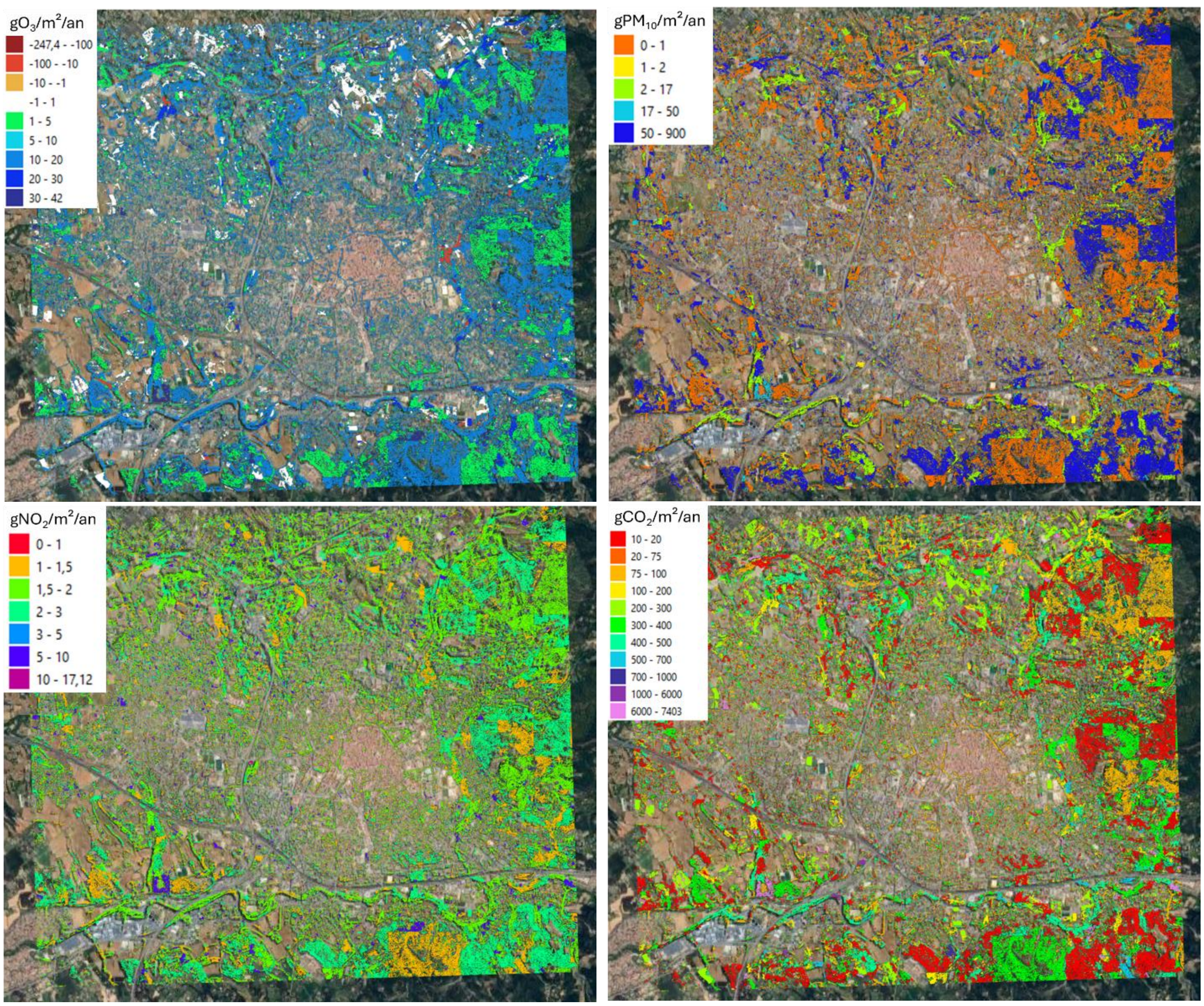



**Figure 6** – Spatial distribution of the removed ozone (top, left), $PM_{10}$ (top, right), $NO_2$ (bottom, left) and $CO_2$ (bottom, right) amount by individual trees (g per $m^2$ of leaf area per year) in Aix-en-Provence for the year 2023.

[1] *emissions of private cars registered in France which has driven an average of 12,200 km during the year with an average speed of 70 km/h.*

In **Florence**, the vegetated areas cover 30.3% of the studied area, and the **553,450 adult trees** have eliminated: 530 tons $O_3$ (formation: 22 tons, removal: 552 tons), 73 tons $NO_2$ (17,140 cars[1]), 185 tons $PM_{10}$ (281,550 cars[1]), 25,205 tons $CO_2$ (15,890 cars[1]).

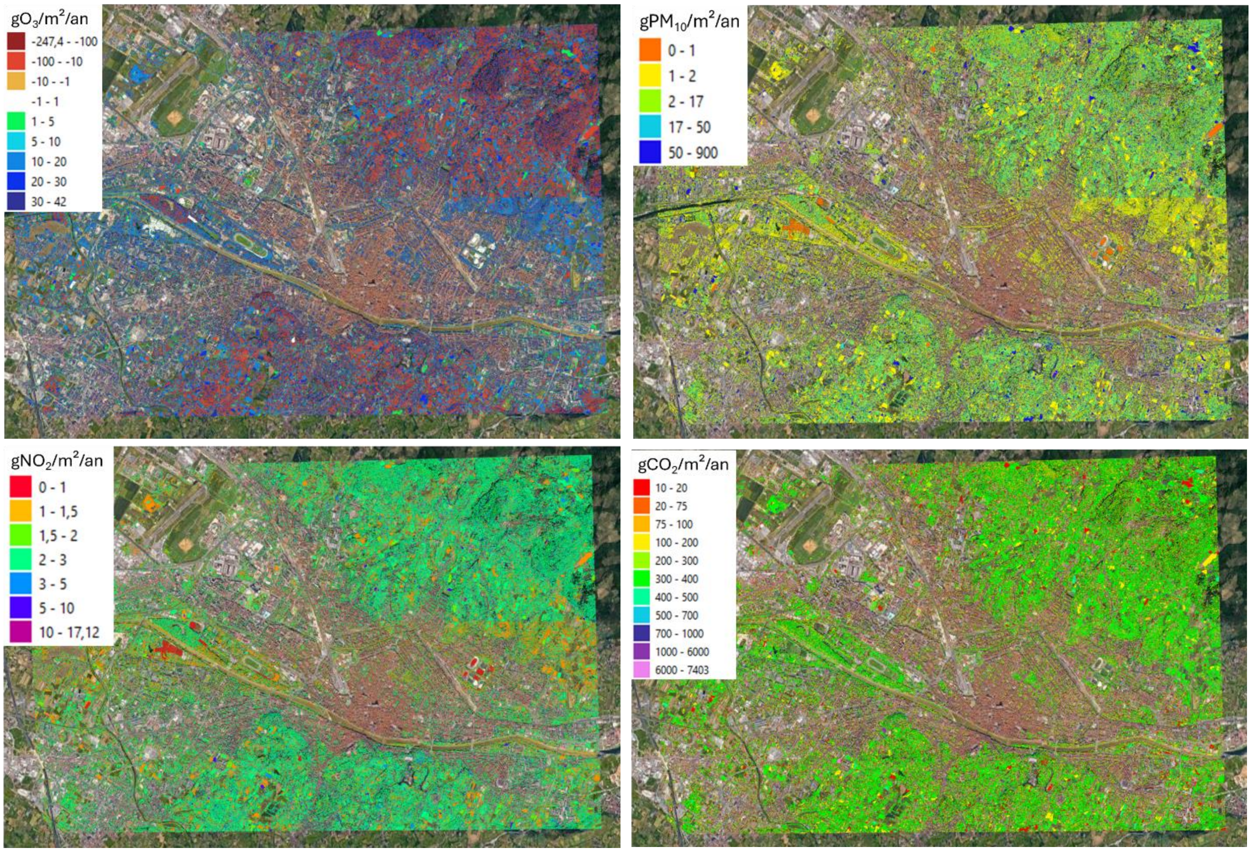
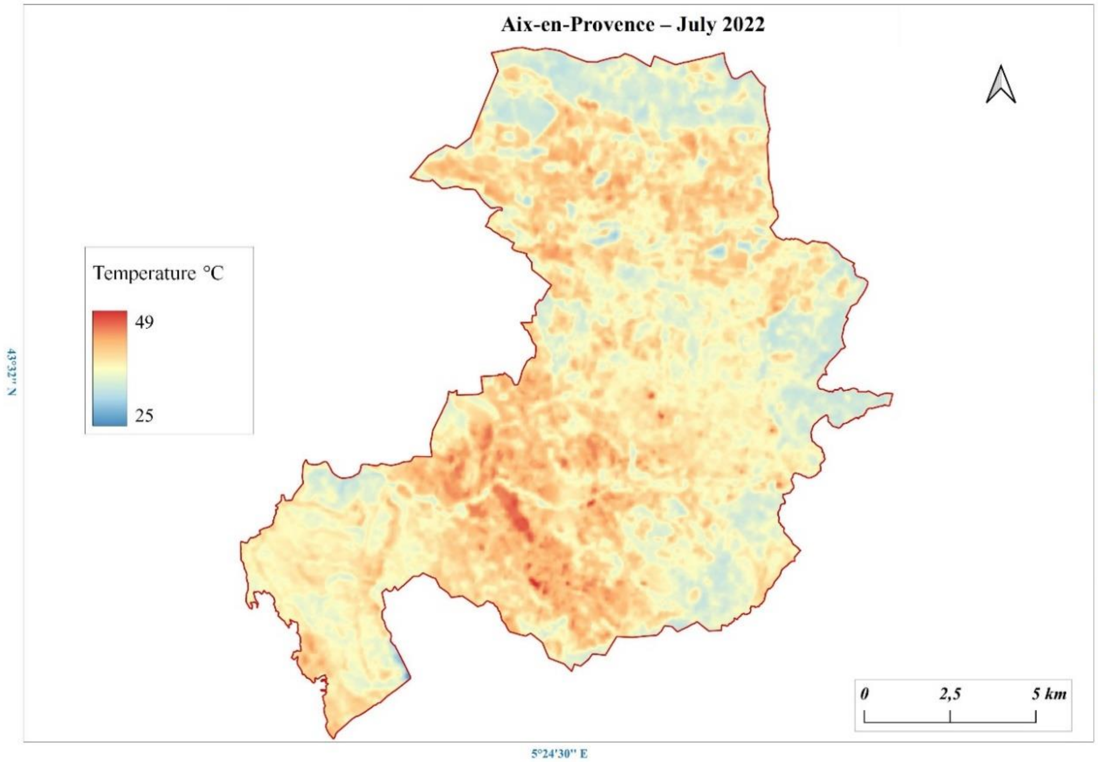



**Figure 7** – Spatial distribution of the removed ozone (top, left), $PM_{10}$ (top, right), $NO_2$ (bottom, left) and $CO_2$ (bottom, right) amount by individual trees (g per m² of leaf area per year) in Florence for the year 2023.

## 3. Mapping of surface air temperature at city scale

The Local Climate Zones method allow classifying each urban area according to their climatic characteristics. An automatic processing of Landsat satellite images is also used to spatially structure the surface air temperature and show the differences as a function of the Local Climate Zones. The results allow municipalities **to detect areas prone to urban heat islands effects** and **prioritize neighbourhoods** to be revegetated (Figs. 8-10).



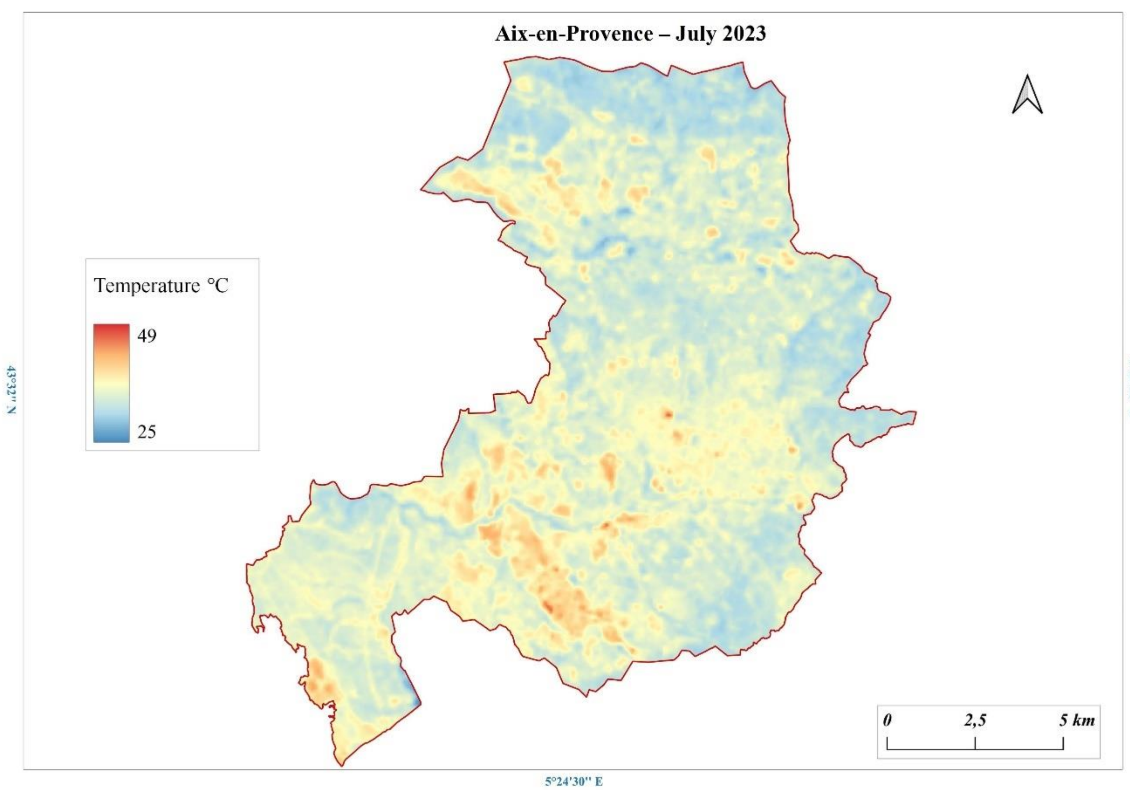




**Figure 8** – Surface mean air temperature in Aix-en-Provence in July 2022 (top) and July 2023 (bottom).

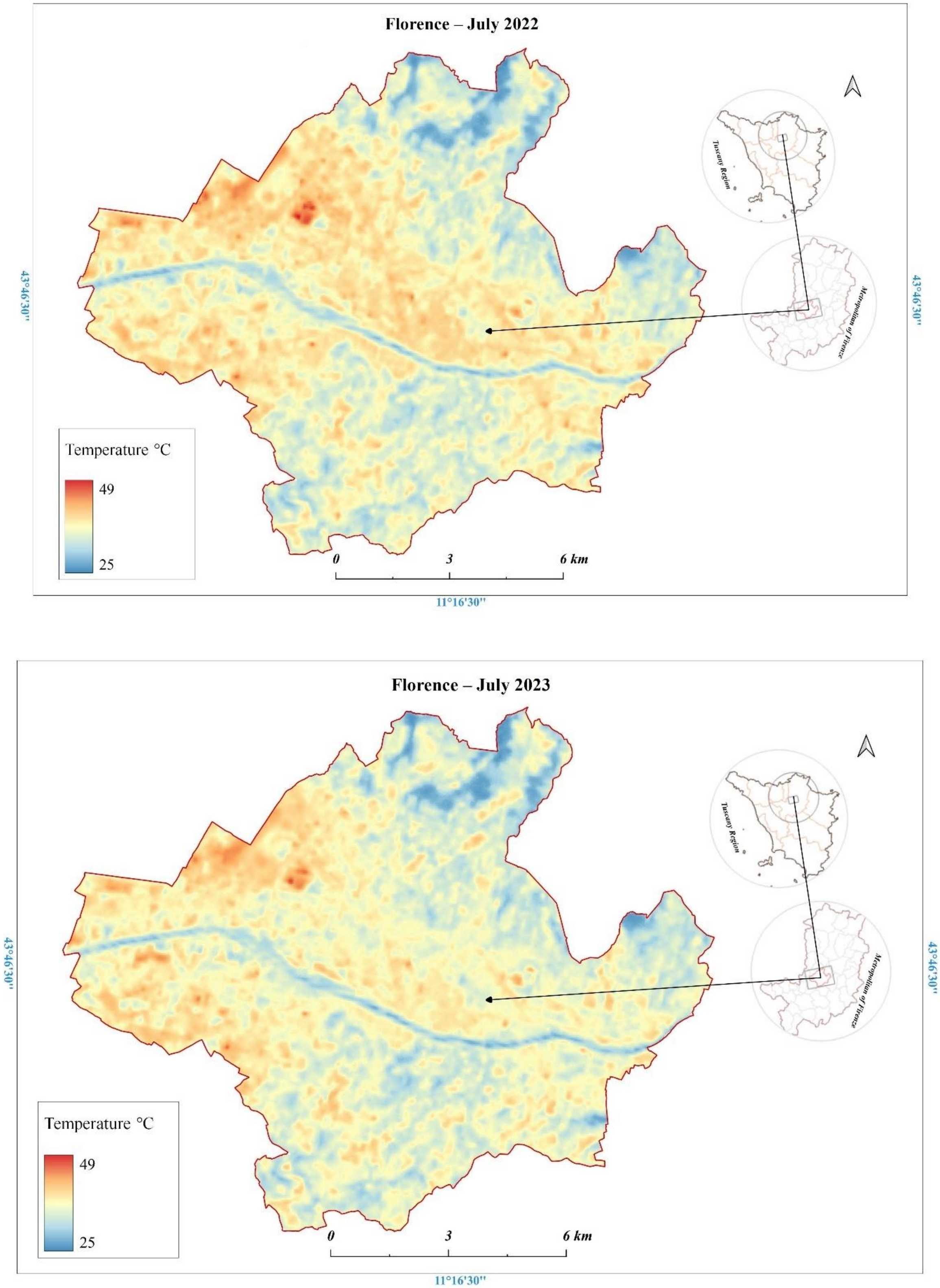



**Figure 9** – Surface mean air temperature in Florence in July 2022 (top) and July 2023 (bottom).

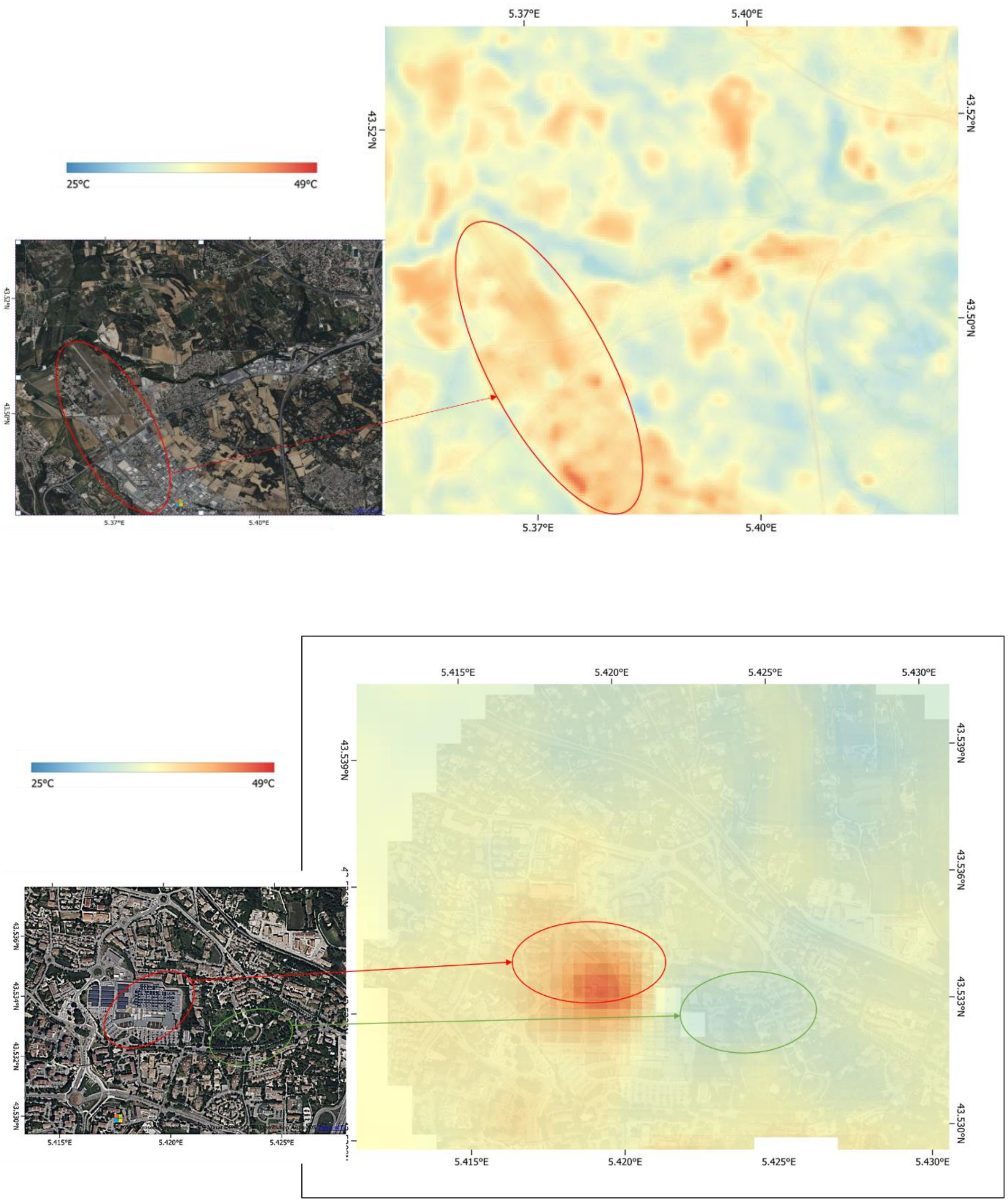



**Figure 10** – Hotspots prone to urban heat islands effects: aerodrome center (top) and a commercial close to a colder urban park (bottom) in Aix-en-Provence.

## 4. The 3-30-300 Rule Compliance

The 3-30-300 rule, introduced in 2021, mandates that every citizen should see at least three mature trees from their home, live in neighborhoods with at least 30% tree canopy cover, and be within 300 meters of a high-quality green space. In LIFE AIRFRESH, we developed a geospatial tool using remote sensing and Geographic Information System techniques to assess compliance with the 3-30-300 rule (see *Guidelines for City Planners*). The tool employs very-high-resolution satellite imagery for detecting trees and estimating canopy cover and integrates OpenStreetMap data to assess proximity to green spaces. The geospatial mapping and satellite-based approaches to assess the 3-30-300 rule compliance is instrumental in helping cities to develop resilient and climate-neutral Urban Greening Plans.

### Component 3

In Aix-en-Provence, 16,336 buildings (68%) complied with Component 3, and non-compliance primarily concentrated in the downtown area and scattered around the city's borders (Fig. 11a). Conversely, Florence exhibited the opposite pattern, with only 38% of buildings (14,521) meeting the criteria (Fig. 11b).

### Component 30

In Aix-en-Provence, our results showed that approximately 94% of buildings (22,537) complied with Component 30, while non-compliant buildings are predominantly found in the downtown area (Fig. 12a). Florence exhibited a starkly different configuration, with 90% (34,409 buildings) of non-compliant buildings widespread throughout the entire study area (Fig. 12b).

### Component 300

In Aix-en-Provence, 6,414 buildings (27%) complied with Component 300, while 17,606buildings (73%) are non-compliant scattered throughout the study area (Fig. 13a). In Florence, about 41% of buildings (15,659) complied with Component 300 (Fig. 13b).

### Rule 3.30.300 Compliance

In Aix-en-Provence, 4% of buildings are compliant with no component, 22% and 56% of buildings are compliant with one and two components, and 18% are fully compliant (Fig. 14a). In Florence, 37% of buildings are compliant with no component, 40% and 19% of buildings are compliant with one and two components, and only 4% are fully compliant (Fig. 14b).

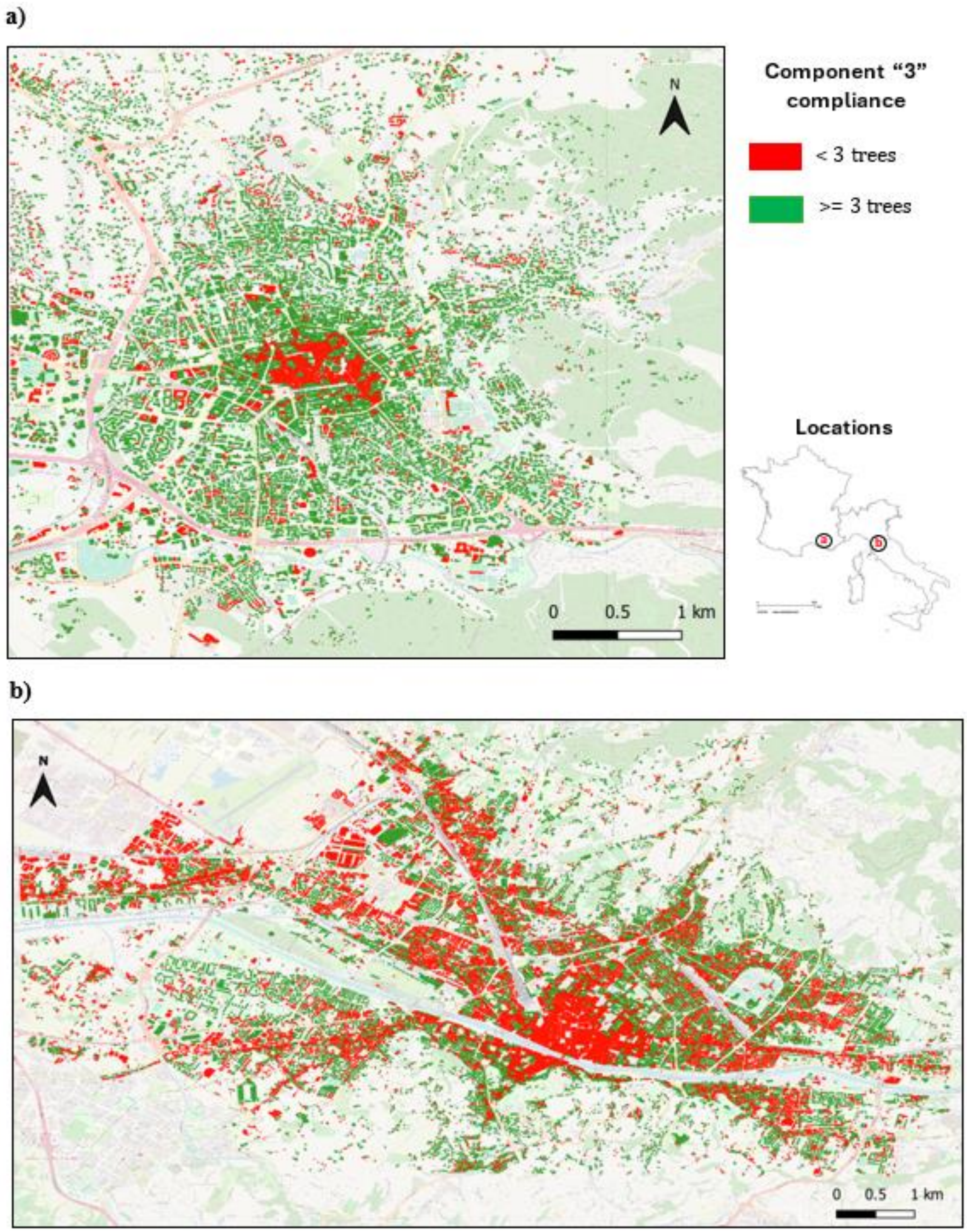



**Figure 11.** Compliance with Component 3 in Aix-en-Provence (a) and Florence (b) - Buildings meeting the requirement of having at least three trees in their surroundings (in green) and those that do not meet this criterion (in red).

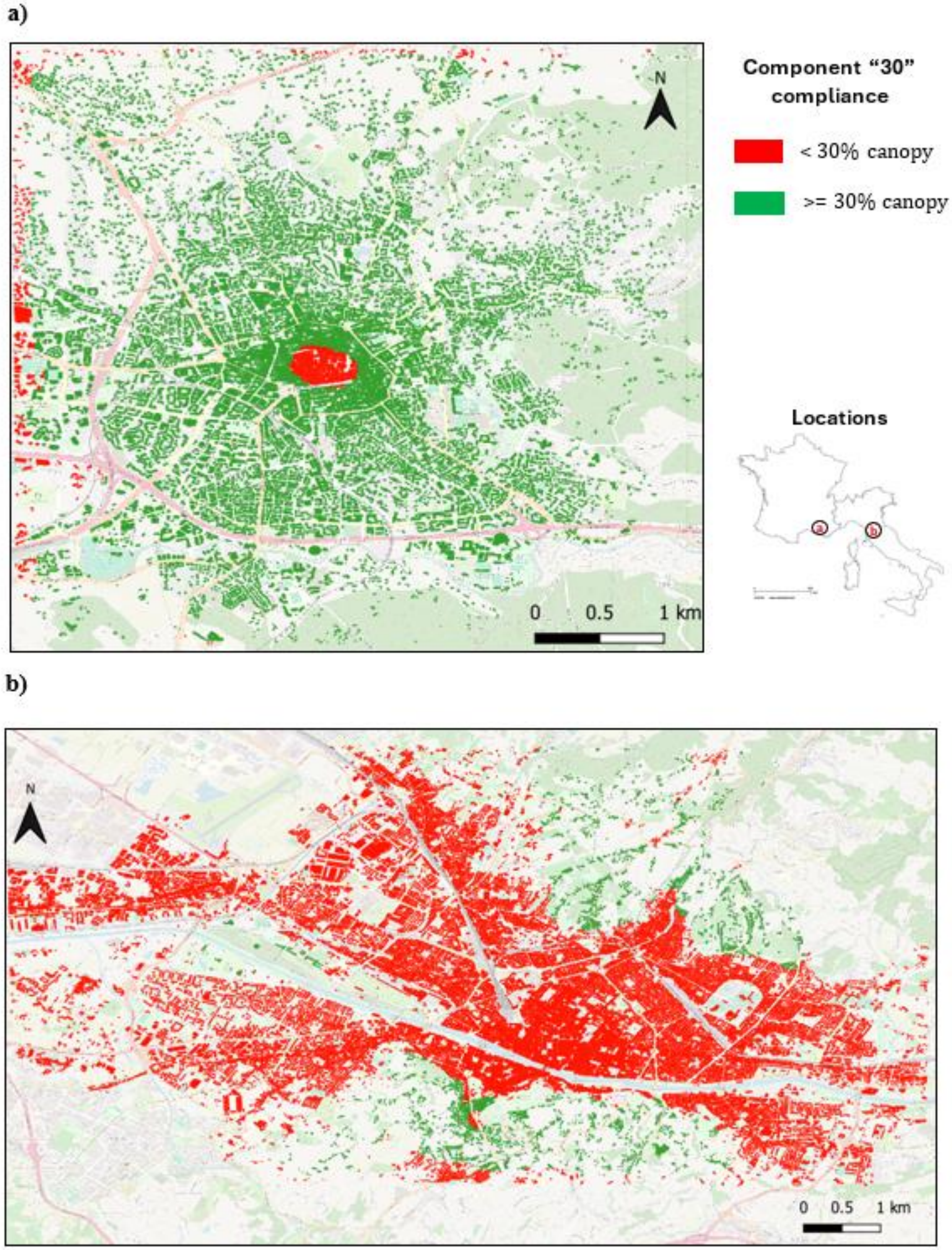



**Figure 12.** Compliance with Component 30 in Aix-en-Provence (a) and Florence (b) - Buildings that have at least 30% canopy cover within their neighborhoods (in green) and those with less than 30% canopy cover (in red).

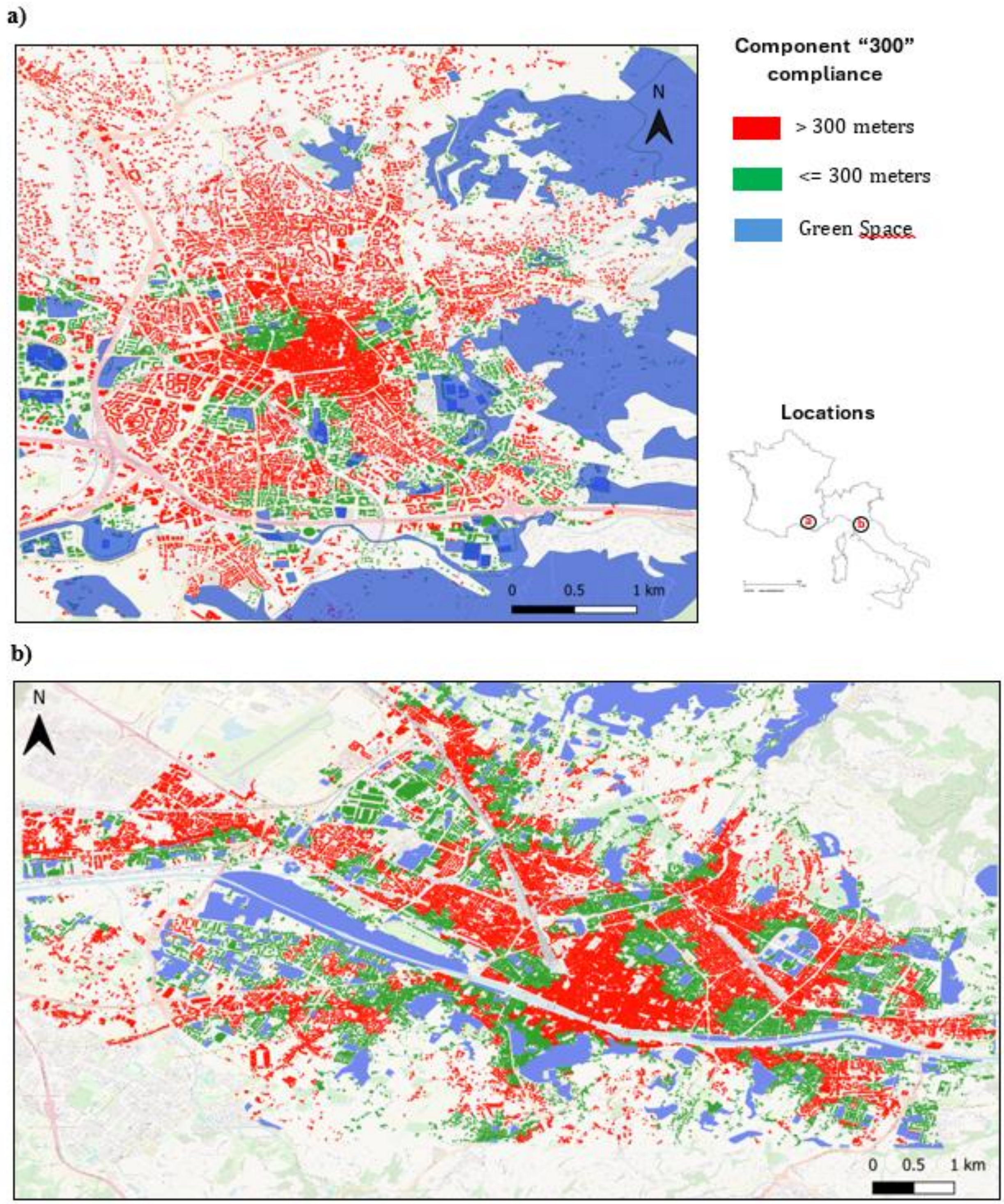



**Figure 13 -** Compliance with Component 300 in Aix-en-Provence (a) and Florence (b) – Buildings within 300 meters of a high-quality green space are marked in green, while non-compliant buildings are in red. High-quality green spaces are shown in blue.

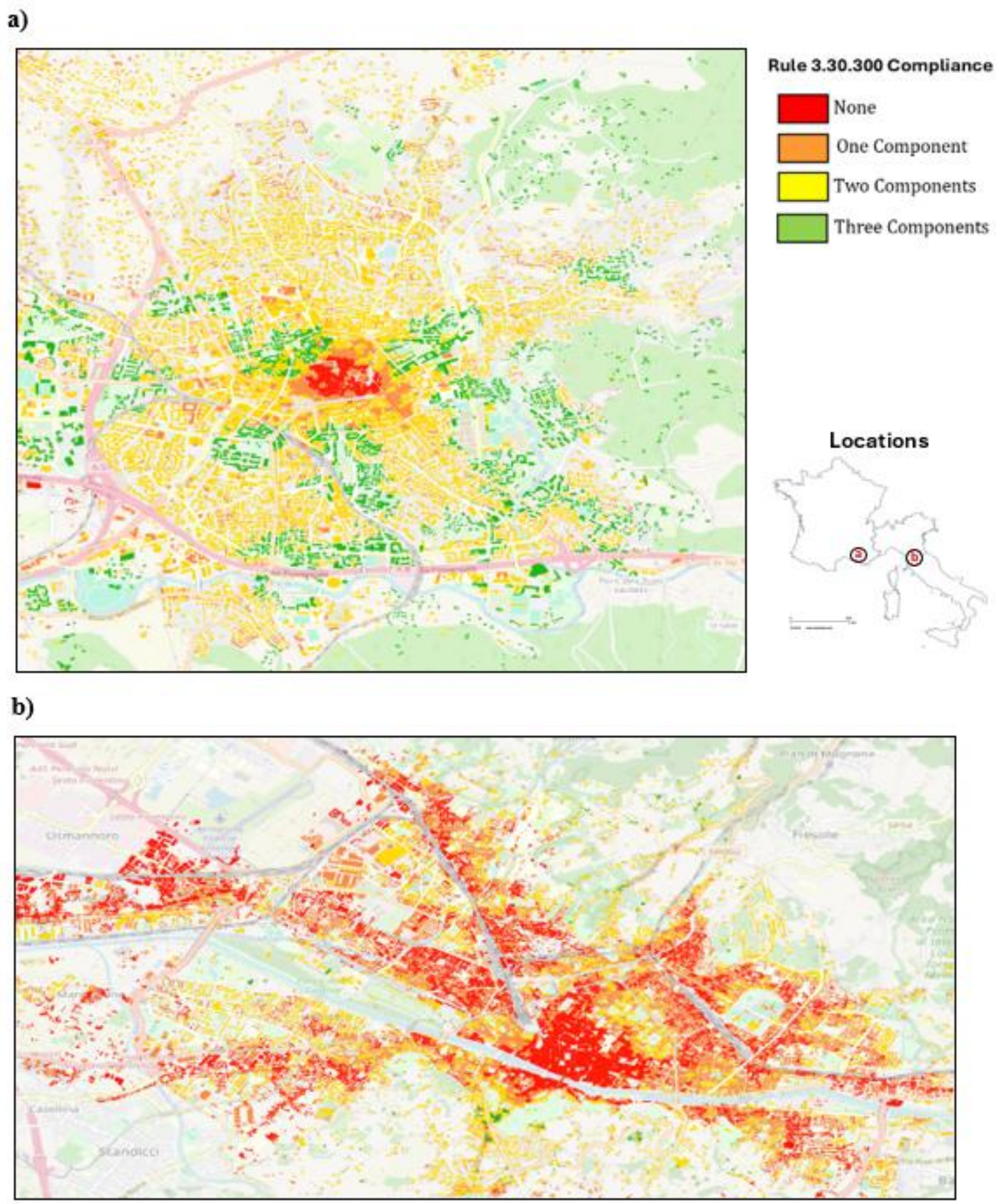



**Figure 14 -** Rule 3.30.300 Compliance in the study areas of Aix-en-Provence (a) and Florence (b) combining the three components: red for non-compliance, orange for compliance with one component, yellow for two components, and green for full compliance.

## 5. Air Pollution removal capacity of urban trees at conurbation scale

Results clearly indicated that removing all the urban and peri-urban vegetation consistently increases mean summertime surface $O_3$ concentrations in the three analyzed cities and their surrounding rural areas (figure 15). In Florence, we found a mean increase of 1.3 ppb (+2.8%) and 1.2 ppb (+2.6%) in Aix-en-Provence. The removal of vegetation reduces the amount of $O_3$ entering the leaves through plant stomata; in addition, the reduction of other non-stomatal deposition pathways, including uptake by leaf cuticles, branches or other woody surfaces contributes to decrease the amount of $O_3$ removed by deposition, thereby enhancing the concentrations remaining in the atmosphere.

Interestingly, the results highlight that planting both high and low BVOC-emitting trees reduces the mean daily summer $O_3$ concentration. The most pronounced effect occurs in Florence (-0.8 ppb, -1.7%), where we observe a negligible difference between the two planting strategies. In Aix-en-Provence, planting low BVOC-emitting trees is slightly more effective at reducing $O_3$ compared to planting high BVOC-emitting trees (-0.25 ppb vs. -0.18 ppb, -0.5% vs. -0.4%, respectively).

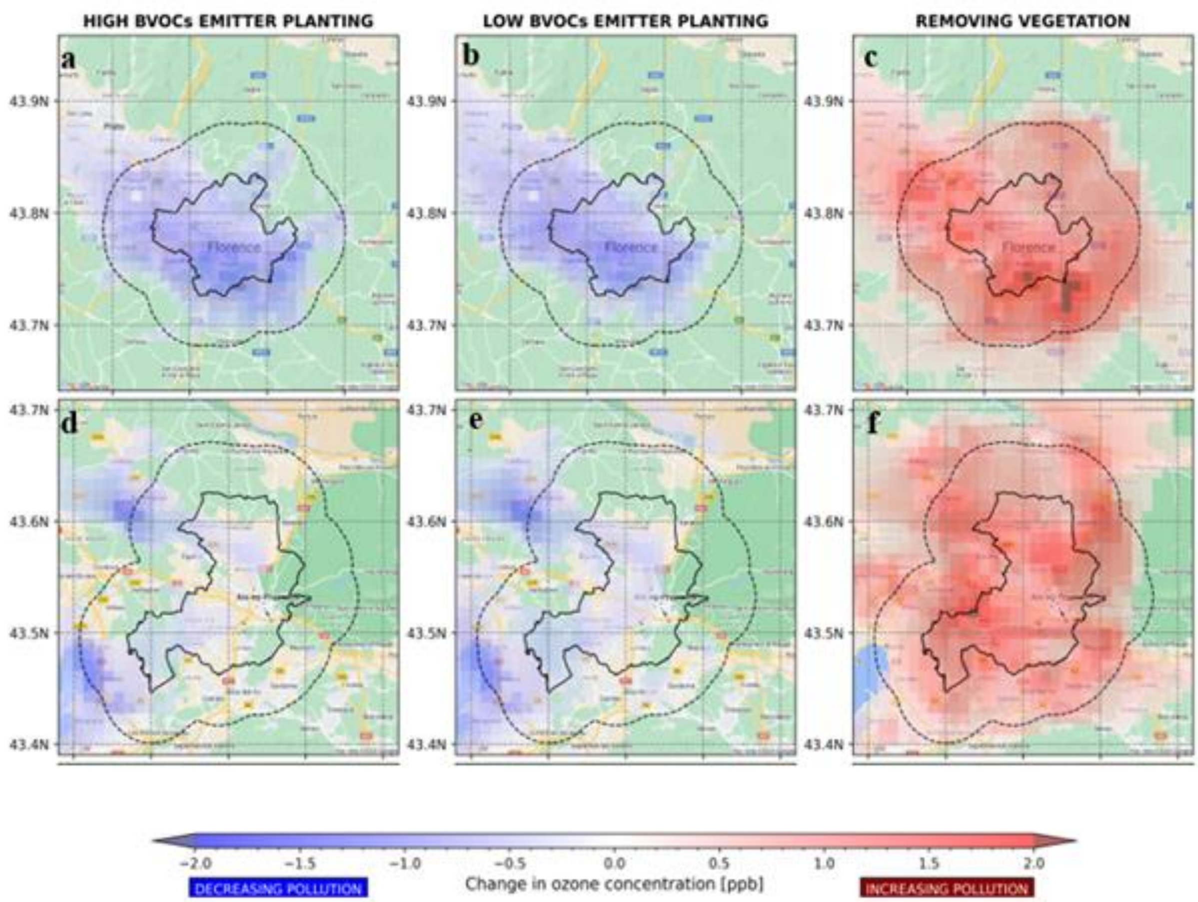



**Figure 15 -** Changes in surface $O_3$ concentration considering different tree planting scenarios. Difference in mean summer O3 concentration between the control run with current vegetation and three different planting strategies for the cities of Florence (a-c) and Aix-En-Provence (d-f).

Looking at fine particulate matter (figure 16), results indicate that removing urban and peri-urban vegetation reduces $PM_{2.5}$ concentrations, with a mean city-scale decrease of 1.3% in Florence and 2.2% in Aix-en-Provence. These differences are primarily driven by reductions in precursor BVOCs emissions and changes in ventilation, including both wind speed and mixing depth.

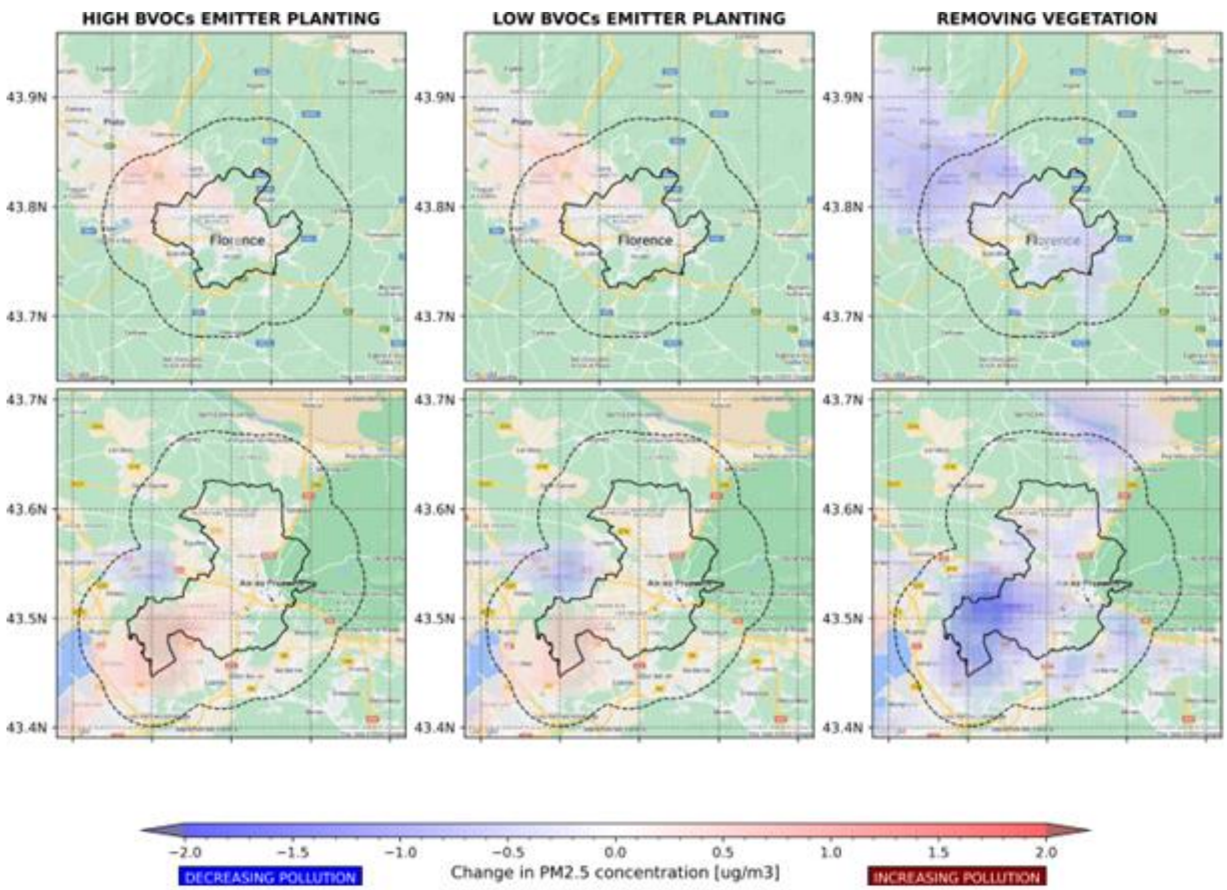



**Figure 16** - Change in $PM_{2.5}$ concentration. Spatial distribution of the mean change in daily summer $PM_{2.5}$ concentrations computed between the scenarios and the control simulation for the cities of Florence (a-c) and Aix-En-Provence (d-f).

**Annex 1 -** Net $O_3$ uptake (g tree$^{-1}$day$^{-1}$), $NO_2$ uptake (g tree$^{-1}$day$^{-1}$), PM10 deposition (g tree$^{-1}$day$^{-1}$) and $CO_2$ sequestration (t tree$^{-1}$year$^{-1}$) for each species and relative scoring.

| Genus | Species | Net $O_3$ uptake | $NO_2$ uptake | PM10 deposition | $CO_2$ seq. |
|---|---|---|---|---|---|
| *Acer* | *negundo* | 6.51 | 5.14 | 0.81 | 0.0969 |
| *Acer* | *platanoides* | 17.69 | 13.32 | 2.04 | 0.0568 |
| *Acer* | *pseudoplatanus* | 17.09 | 13.57 | 2.04 | 0.0568 |
| *Fagus* | *sylvatica* | 24.76 | 19.37 | 4.80 | 0.1001 |
| *Pseudotsuga* | *menziesii* | 8.24 | 31.31 | 12.63 | 0.0584 |
| *Quercus* | *cerris* | 8.37 | 9.36 | 1.56 | 0.0778 |
| *Quercus* | *palustris* | 3.93 | 8.66 | 1.46 | 0.1077 |
| *Tilia* | *cordata* | 22.48 | 16.76 | 1.72 | 0.0689 |
| *Tilia* | *platyphyllos* | 23.42 | 17.61 | 1.72 | 0.0689 |
| *Tilia* | *x europaea* | 17.35 | 13.04 | 1.26 | 0.0689 |
| *Abies* | *alba* | 3.82 | 4.55 | 2.04 | 0.0421 |
| *Aesculus* | *hippocastanum* | 13.20 | 9.86 | 0.31 | 0.0568 |
| *Alnus* | *glutinosa* | 2.50 | 3.91 | 0.43 | 0.0639 |
| *Carpinus* | *betulus* | 7.74 | 5.79 | 0.59 | 0.0719 |
| *Cedrus* | *atlantica* | 9.66 | 9.76 | 4.13 | 0.0401 |
| *Cedrus* | *deodara* | 4.93 | 4.74 | 2.00 | 0.0401 |
| *Cedrus* | *libani* | 16.20 | 22.10 | 9.56 | 0.0401 |
| *Fraxinus* | *angustifolia* | 8.69 | 6.69 | 0.20 | 0.0497 |
| *Fraxinus* | *excelsior* | 26.05 | 19.45 | 0.56 | 0.0497 |
| *Fraxinus* | *uhdei* | 9.23 | 6.89 | 0.20 | 0.0497 |
| *Fraxinus* | *velutina* | 9.06 | 6.77 | 0.20 | 0.0497 |
| *Juglans* | *regia* | 6.95 | 6.12 | 0.62 | 0.0523 |
| *Liriodendron* | *tulipifera* | 15.39 | 18.84 | 1.79 | 0.0475 |
| *Ostrya* | *carpinifolia* | 6.58 | 4.90 | 0.35 | 0.0639 |
| *Picea* | *abies* | 12.23 | 12.56 | 6.31 | 0.0421 |
| *Pinus* | *radiata* | 2.78 | 2.83 | 1.80 | 0.0589 |

| | | | | | |
|---|---|---|---|---|---|
| *Platanus* | *x acerifolia* | 6.73 | 16.67 | 1.58 | 0.0420 |
| *Taxus* | *baccata* | 3.33 | 3.67 | 1.65 | 0.0523 |
| *Ulmus* | *americana* | 12.00 | 8.98 | 0.89 | 0.0496 |
| *Zelkova* | *serrata* | 6.30 | 4.71 | 0.45 | 0.0728 |
| *Acer* | *campestre* | 2.92 | 2.21 | 0.37 | 0.0623 |
| *Ailanthus* | *altissima* | 4.37 | 3.27 | 0.32 | 0.0523 |
| *Alnus* | *cordata* | 3.03 | 2.57 | 0.29 | 0.0639 |
| *Catalpa* | *bignonioides* | 4.58 | 3.91 | 0.40 | 0.0399 |
| *Celtis* | *australis* | 4.97 | 3.79 | 0.40 | 0.0446 |
| *Fraxinus* | *pennsylvanica* | 5.43 | 4.06 | 0.12 | 0.0497 |
| *Gleditsia* | *triacanthos* | 12.66 | 9.78 | 0.89 | 0.0365 |
| *Parrotia* | *persica* | 2.40 | 2.75 | 0.32 | 0.0523 |
| *Paulownia* | *tomentosa* | 3.73 | 2.75 | 0.32 | 0.0523 |
| *Picea* | *smithiana* | 2.30 | 2.12 | 1.13 | 0.0421 |
| *Pinus* | *canariensis* | 2.12 | 2.81 | 1.80 | 0.0885 |
| *Pinus* | *densiflora* | 2.96 | 2.79 | 1.80 | 0.0435 |
| *Pinus* | *elliotii* | 0.89 | 2.84 | 1.80 | 0.0548 |
| *Pinus* | *resinosa* | 2.98 | 2.78 | 1.80 | 0.0435 |
| *Pinus* | *sabiniana* | 2.81 | 2.84 | 1.80 | 0.0435 |
| *Pinus* | *taeda* | 0.86 | 2.83 | 1.80 | 0.0643 |
| *Sophora* | *japonica* | 6.65 | 6.84 | 0.72 | 0.0393 |
| *Ulmus* | *minor* | 5.17 | 3.95 | 0.40 | 0.0444 |
| *Ulmus* | *parviflora* | 12.10 | 9.06 | 0.89 | 0.0300 |
| *Betula* | *nigra* | 2.02 | 1.55 | 0.34 | 0.0880 |
| *Castanea* | *sativa* | -3.51 | 8.95 | 0.92 | 0.0834 |
| *Celtis* | *occidentalis* | 4.65 | 3.52 | 0.40 | 0.0446 |
| *Cinnamomum* | *camphora* | 6.81 | 6.26 | 0.69 | 0.0272 |
| *Eucalyptus* | *globulus* | -411.49 | 16.04 | 1.62 | 0.1115 |
| *Laurus* | *nobilis* | 4.14 | 4.34 | 0.53 | 0.0272 |

| | | | | | |
|---|---|---|---|---|---|
| *Picea* | *alcoquiana* | 1.52 | 1.40 | 0.77 | 0.0421 |
| *Picea* | *asperata* | 1.61 | 1.48 | 0.77 | 0.0421 |
| *Picea* | *aurantiaca* | 1.46 | 1.33 | 0.77 | 0.0421 |
| *Picea* | *koyamai* | 1.52 | 1.40 | 0.77 | 0.0421 |
| *Picea* | *likiangensis* | 1.63 | 1.51 | 0.77 | 0.0421 |
| *Picea* | *meyeri* | 1.52 | 1.40 | 0.77 | 0.0421 |
| *Picea* | *morrisonicola* | 1.63 | 1.51 | 0.77 | 0.0421 |
| *Picea* | *orientalis* | 1.58 | 1.46 | 0.77 | 0.0421 |
| *Picea* | *rubens* | 1.77 | 2.21 | 1.19 | 0.0421 |
| *Pinus* | *halepensis* | 1.10 | 1.26 | 0.80 | 0.0427 |
| *Pinus* | *palustris* | 0.64 | 2.93 | 1.80 | 0.0435 |
| *Pinus* | *ponderosa* | 2.62 | 2.83 | 1.80 | 0.0228 |
| *Pinus* | *sibirica* | 1.92 | 2.84 | 1.80 | 0.0435 |
| *Pinus* | *strobus* | 1.98 | 2.91 | 1.80 | 0.0435 |
| *Quercus* | *coccinea* | -233.79 | 6.80 | 1.46 | 0.0778 |
| *Quercus* | *douglasii* | -20.96 | 11.38 | 1.99 | 0.0778 |
| *Quercus* | *ilex* | -84.51 | 17.61 | 3.13 | 0.0533 |
| *Quercus* | *petraea* | -67.49 | 13.88 | 2.16 | 0.0778 |
| *Quercus* | *robur* | -124.79 | 10.36 | 1.65 | 0.0778 |
| *Quercus* | *rotundifolia* | -9.45 | 15.16 | 2.73 | 0.0778 |
| *Quercus* | *rubra* | -0.04 | 12.88 | 2.17 | 0.0723 |
| *Quercus* | *suber* | -68.03 | 10.18 | 1.90 | 0.0778 |
| *Acer* | *monspessulanum* | 1.26 | 1.14 | 0.20 | 0.0623 |
| *Chamaecyparis* | *lawsoniana* | 0.72 | 0.69 | 0.36 | 0.0523 |
| *Cupressus* | *arizonica* | 1.08 | 1.14 | 0.64 | 0.0523 |
| *Cupressus* | *sempervirens* | 0.58 | 0.56 | 0.28 | 0.0523 |
| *Eriobotrya* | *japonica* | 2.60 | 2.42 | 0.31 | 0.0322 |
| *Eucalyptus* | *camaldulensis* | -18.83 | 4.34 | 0.43 | 0.1115 |
| *Eucalyptus* | *viminalis* | -0.83 | 4.36 | 0.45 | 0.1115 |

| | | | | | |
|---|---|---|---|---|---|
| *Ginkgo* | *biloba* | 4.07 | 3.39 | 0.58 | 0.0223 |
| *Liquidambar* | *styraciflua* | -55.50 | 6.03 | 0.57 | 0.0559 |
| *Melia* | *azedarach* | 1.67 | 1.27 | 0.14 | 0.0523 |
| *Pinus* | *contorta* | 1.95 | 2.86 | 1.80 | 0.0208 |
| *Pinus* | *nigra* | 1.74 | 3.00 | 1.80 | 0.0254 |
| *Pinus* | *pinea* | -4.83 | 3.98 | 2.46 | 0.0435 |
| *Quercus* | *frainetto* | -179.24 | 3.84 | 0.63 | 0.0778 |
| *Betula* | *pendula* | 1.65 | 1.56 | 0.34 | 0.0318 |
| *Camellia* | *sasanqua* | 2.17 | 1.97 | 0.25 | 0.0190 |
| *Cercis* | *siliquastrum* | 1.98 | 1.48 | 0.17 | 0.0393 |
| *Cupressus* | *macrocarpa* | 0.42 | 0.45 | 0.24 | 0.0523 |
| *Eucalyptus* | *glaucescens* | -124.62 | 3.59 | 0.37 | 0.1115 |
| *Fraxinus* | *ornus* | 1.38 | 1.10 | 0.04 | 0.0497 |
| *Magnolia* | *grandiflora* | -1.40 | 7.00 | 0.78 | 0.0226 |
| *Picea* | *engelmanii* | -4.91 | 1.37 | 0.77 | 0.0421 |
| *Picea* | *omorika* | -2.10 | 1.41 | 0.77 | 0.0421 |
| *Picea* | *sitchensis* | -1.59 | 2.25 | 1.18 | 0.0421 |
| *Pinus* | *clausa* | -1.91 | 2.84 | 1.80 | 0.0435 |
| *Pinus* | *pinaster* | -6.00 | 2.86 | 1.80 | 0.0435 |
| *Populus* | *alba* | -38.02 | 7.62 | 0.70 | 0.0431 |
| *Populus* | *nigra* | -115.46 | 7.68 | 0.70 | 0.0431 |
| *Prunus* | *laurocerasus* | 1.78 | 1.61 | 0.21 | 0.0242 |
| *Quercus* | *pubescens* | -48.26 | 2.03 | 0.36 | 0.0778 |
| *Rhus* | *typhina* | 2.37 | 2.14 | 0.27 | 0.0190 |
| *Robinia* | *pseudoacacia* | -6.64 | 4.19 | 0.42 | 0.0420 |
| *Acacia* | *dealbata* | 1.16 | 0.93 | 0.10 | 0.0393 |
| *Arbutus* | *unedo* | 1.88 | 1.81 | 0.22 | 0.0190 |
| *Morus* | *alba* | 1.71 | 1.29 | 0.14 | 0.0320 |
| *Morus* | *nigra* | 1.74 | 1.31 | 0.14 | 0.0320 |

| | | | | | |
|---|---|---|---|---|---|
| *Prunus* | *dulcis* | 1.85 | 1.35 | 0.16 | 0.0242 |
| *Ficus* | *carica* | 0.27 | 1.64 | 0.19 | 0.0320 |
| *Morus* | *platanifolia* | 1.16 | 0.88 | 0.10 | 0.0320 |
| *Olea* | *europaea* | 1.27 | 1.25 | 0.71 | 0.0111 |
| *Photinia* | *x fraserii* | 0.76 | 0.69 | 0.09 | 0.0231 |
| *Pinus* | *sylvestris* | -0.96 | 2.84 | 1.80 | 0.0128 |
| *Populus* | *tremula* | -17.66 | 1.46 | 0.15 | 0.0431 |
| *Prunus* | *domestica* | 0.90 | 0.66 | 0.07 | 0.0242 |
| *Pyrus* | *calleryana* | 1.25 | 0.92 | 0.10 | 0.0344 |
| *Pyrus* | *coronaria* | 1.24 | 0.91 | 0.10 | 0.0266 |
| *Pyrus* | *kawakamii* | 1.24 | 0.91 | 0.10 | 0.0333 |
| *Pyrus* | *malus* | 1.24 | 0.91 | 0.10 | 0.0266 |
| *Sorbus* | *americana* | 1.18 | 0.87 | 0.10 | 0.0231 |
| *Sorbus* | *aria* | 1.16 | 0.86 | 0.10 | 0.0231 |
| *Sorbus* | *aucuparia* | 1.18 | 0.87 | 0.10 | 0.0231 |
| *Chamaerops* | *humilis* | -4.18 | 1.43 | 0.41 | 0.0190 |
| *Cornus* | *alternifolia* | 0.54 | 0.39 | 0.01 | 0.0208 |
| *Cornus* | *nuttallii* | 0.54 | 0.39 | 0.01 | 0.0208 |
| *Juniperus* | *communis* | 0.02 | 0.02 | 0.01 | 0.0523 |
| *Lagestroemia* | *indaca* | 1.13 | 0.82 | 0.03 | 0.0079 |
| *Magnolia* | *stellata* | 0.17 | 0.29 | 0.04 | 0.0226 |
| *Malus* | *communis* | 1.07 | 1.00 | 0.09 | 0.0153 |
| *Picea* | *mariana* | -0.51 | 0.21 | 0.12 | 0.0421 |
| *Picea* | *montigena* | 0.21 | 0.19 | 0.12 | 0.0421 |
| *Prunus* | *cerasifera* | 0.86 | 0.63 | 0.07 | 0.0139 |
| *Punica* | *granatum* | 1.11 | 0.81 | 0.10 | 0.0190 |
| *Pyrus* | *communis* | 1.07 | 0.90 | 0.10 | 0.0120 |
| *Salix* | *alba* | -6.51 | 0.63 | 0.06 | 0.0431 |
| *Salix* | *amygdaloides* | -0.71 | 0.19 | 0.02 | 0.0431 |

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|---|---|---|---|---|---|
| *Salix* | *atrocineria* | -2.55 | 0.44 | 0.05 | 0.0431 |
| *Salix* | *babylonica* | -16.78 | 0.44 | 0.05 | 0.0431 |
| *Salix* | *matsudana* | -3.27 | 0.43 | 0.05 | 0.0431 |
| *Sambucus* | *canadensis* | 1.10 | 0.80 | 0.03 | 0.0190 |
| *Sambucus* | *nigra* | 1.10 | 0.81 | 0.03 | 0.0190 |
| *Sambucus* | *simpsonii* | 1.10 | 0.80 | 0.03 | 0.0190 |
| *Acer* | *japonicum* | 0.40 | 0.33 | 0.06 | 0.0092 |
| *Cornus* | *florida* | 0.53 | 0.39 | 0.01 | 0.0208 |
| *Cornus* | *mas* | -0.64 | 0.68 | 0.02 | 0.0208 |
| *Cytisus* | *battandieri* | 0.02 | 0.01 | 0.00 | 0.0393 |
| *Cytisus* | *multiflorus* | 0.02 | 0.01 | 0.00 | 0.0393 |
| *Cytisus* | *praecox* | 0.02 | 0.01 | 0.00 | 0.0393 |
| *Diospyros* | *kaki* | 0.38 | 0.29 | 0.03 | 0.0190 |
| *Ilex* | *cassine* | 0.46 | 0.42 | 0.05 | 0.0190 |
| *Ilex* | *cornuta* | 0.46 | 0.42 | 0.05 | 0.0190 |
| *Ilex* | *opaca* | 0.45 | 0.41 | 0.05 | 0.0190 |
| *Ligustrum* | *coriaceum* | 0.44 | 0.39 | 0.01 | 0.0266 |
| *Ligustrum* | *lucidum* | 0.44 | 0.39 | 0.01 | 0.0266 |
| *Ligustrum* | *vulgare* | 0.40 | 0.36 | 0.01 | 0.0266 |
| *Picea* | *glauca* | -0.20 | 0.19 | 0.12 | 0.0421 |
| *Picea* | *pungens* | -0.48 | 0.54 | 0.33 | 0.0152 |
| *Salix* | *lasiandra* | -0.72 | 0.18 | 0.02 | 0.0431 |
| *Salix* | *lasiolepis* | -0.71 | 0.19 | 0.02 | 0.0431 |
| *Buxus* | *sempervirens* | -0.70 | 0.22 | 0.03 | 0.0190 |
| *Cotinus* | *coggygria* | 0.39 | 0.29 | 0.01 | 0.0194 |
| *Cytisus* | *scoparius* | -0.14 | 0.01 | 0.00 | 0.0393 |
| *Phillyrea* | *angustifolia* | 0.10 | 0.11 | 0.01 | 0.0266 |
| *Pistacia* | *chinensis* | -0.12 | 0.63 | 0.07 | 0.0194 |
| *Prunus* | *avium* | 0.16 | 0.12 | 0.01 | 0.0242 |

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|---|---|---|---|---|---|
| *Prunus* | *persica* | 0.14 | 0.11 | 0.01 | 0.0242 |
| *Prunus* | *serotina* | 0.16 | 0.12 | 0.01 | 0.0242 |
| *Prunus* | *serrulata* | 0.15 | 0.11 | 0.01 | 0.0346 |
| *Prunus* | *spinosa* | 0.15 | 0.11 | 0.01 | 0.0242 |
| *Prunus* | *virginiana* | 0.16 | 0.11 | 0.01 | 0.0242 |
| *Pyracantha* | *coccinea* | 0.10 | 0.09 | 0.01 | 0.0231 |
| *Rhamnus* | *alaternus* | -2.48 | 0.92 | 0.12 | 0.0190 |
| *Rubus* | *fruticosus* | 0.01 | 0.01 | 0.00 | 0.0231 |
| *Rubus* | *ideaus* | 0.01 | 0.01 | 0.00 | 0.0231 |
| *Rubus* | *occidentalis* | 0.01 | 0.01 | 0.00 | 0.0231 |
| *Rubus* | *parviflorus* | 0.01 | 0.01 | 0.00 | 0.0231 |
| *Rubus* | *ulmifolius* | 0.01 | 0.01 | 0.00 | 0.0231 |
| *Rubus* | *ursinus* | 0.01 | 0.01 | 0.00 | 0.0231 |
| *Salix* | *discolor* | -0.36 | 0.04 | 0.01 | 0.0431 |
| *Salix* | *interior* | -0.37 | 0.04 | 0.01 | 0.0431 |
| *Salix* | *lutea* | -0.36 | 0.04 | 0.01 | 0.0431 |
| *Salix* | *scouleriana* | -0.18 | 0.05 | 0.01 | 0.0431 |
| *Viburnum* | *tinus* | 0.15 | 0.13 | 0.02 | 0.0190 |
| *Callistemon* | *citrinus* | -0.39 | 0.13 | 0.02 | 0.0190 |
| *Ceanothus* | *arborescens* | 0.02 | 0.02 | 0.00 | 0.0190 |
| *Ceanothus* | *arboreus* | 0.02 | 0.02 | 0.00 | 0.0190 |
| *Ceanothus* | *crassifolius* | 0.02 | 0.02 | 0.00 | 0.0190 |
| *Ceanothus* | *cuneatus* | 0.02 | 0.02 | 0.00 | 0.0190 |
| *Ceanothus* | *greggii* | 0.02 | 0.02 | 0.00 | 0.0190 |
| *Ceanothus* | *leucodermis* | 0.01 | 0.02 | 0.00 | 0.0190 |
| *Ceanothus* | *maritimus* | 0.02 | 0.02 | 0.00 | 0.0190 |
| *Ceanothus* | *spinosus* | 0.02 | 0.02 | 0.00 | 0.0190 |
| *Cistus* | *albidus* | 0.01 | 0.01 | 0.00 | 0.0190 |
| *Cistus* | *incanus* | 0.01 | 0.01 | 0.00 | 0.0190 |

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|---|---|---|---|---|---|
| *Cistus* | *salvifolius* | 0.00 | 0.01 | 0.00 | 0.0190 |
| *Hibiscus* | *syriacus* | 0.04 | 0.03 | 0.00 | 0.0190 |
| *Hypericum* | *perforatum* | 0.01 | 0.01 | 0.00 | 0.0190 |
| *Lavandula* | *luisieri* | 0.01 | 0.01 | 0.00 | 0.0190 |
| *Pittosporum* | *phillyraeoides* | 0.05 | 0.04 | 0.01 | 0.0190 |
| *Pittosporum* | *tobira* | 0.08 | 0.07 | 0.01 | 0.0190 |
| *Pittosporum* | *undulatum* | 0.08 | 0.07 | 0.01 | 0.0190 |
| *Rosmarinus* | *officinalis* | 0.01 | 0.01 | 0.01 | 0.0190 |
| *Cistus* | *ladanifer* | -0.05 | 0.01 | 0.00 | 0.0190 |
| *Erica* | *arborea* | 0.00 | 0.00 | 0.00 | 0.0190 |
| *Erica* | *multiflora* | 0.00 | 0.00 | 0.00 | 0.0190 |
| *Lavandula* | *stoechas* | 0.00 | 0.01 | 0.00 | 0.0190 |
| *Myrtus* | *communis* | -0.68 | 0.03 | 0.00 | 0.0190 |
| *Capparis* | *spinosa* | NA | 0.01 | 0.00 | 0.0190 |
| *Cassia* | *corymbosa* | NA | 0.03 | 0.00 | 0.0393 |
| *Cordyline* | *indivisa* | NA | 0.53 | 0.07 | 0.0190 |
| *Cornus* | *controversa* | NA | 0.40 | 0.01 | 0.0208 |
| *Quercus* | *turneri* | NA | 0.98 | 0.20 | 0.0778 |
| *Ruscus* | *aculeatus* | NA | 0.00 | 0.00 | 0.0190 |
| *Sorbus* | *domestica* | NA | 0.86 | 0.10 | 0.0231 |
| *Teucrium* | *fruticans* | NA | 0.02 | 0.00 | 0.0190 |

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