



LIFE

Climate Change Mitigation

**Deliverable C.3: Interface development of a software application for accounting tree crop carbon sequestration**

February 2020

**LIFE CLIMATREE (LIFE14 CCM/GR/ 000635)**



A novel approach for accounting and monitoring carbon sequestration of tree crops and their potential as carbon sink areas

The **LIFE CLIMATREE** project “A novel approach for accounting and monitoring carbon sequestration of tree crops and their potential as carbon sink areas” (LIFE14 CCM/GR/000635) is co-funded by the EU Environmental Funding Programme **LIFE Climate Change Mitigation**.

**Implementation period:**

**Participating Beneficiaries:**



University Research Institute  
**U**rban  
**e**nvironment  
**h**uman  
**r**esources Panteion University, Athens



ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ  
AGRICULTURAL UNIVERSITY OF ATHENS



UNIVERSITY OF  
WESTERN MACEDONIA



terra nova

UNIVERSITÀ DEGLI STUDI DELLA BASILICATA



**CSIC**

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

## **Table of Contents**

<b>1. Introduction</b>	<b>4</b>
<b>2. Main page</b>	<b>4</b>
<b>3. User environment</b>	<b>5</b>
<b>4. Backend environment</b>	<b>11</b>

## 1. Introduction

In this section the web application, which is based on the algorithm presented in C4, will be described. The application is available in <http://climatree.open.gr/> . Its access is free for all users, but it requires to create an account.

The following sections describe (a) the login page, (b) the typical home page of a user, where a new calculation is created, saved for future reference and altered and comparisons for various scenarios are made. Lastly, the backed is presented where a user with privileged access can change the various parameters of the algorithm.

## 2. Main page

The main page is shown in Figure 1. It includes a link to the login page.

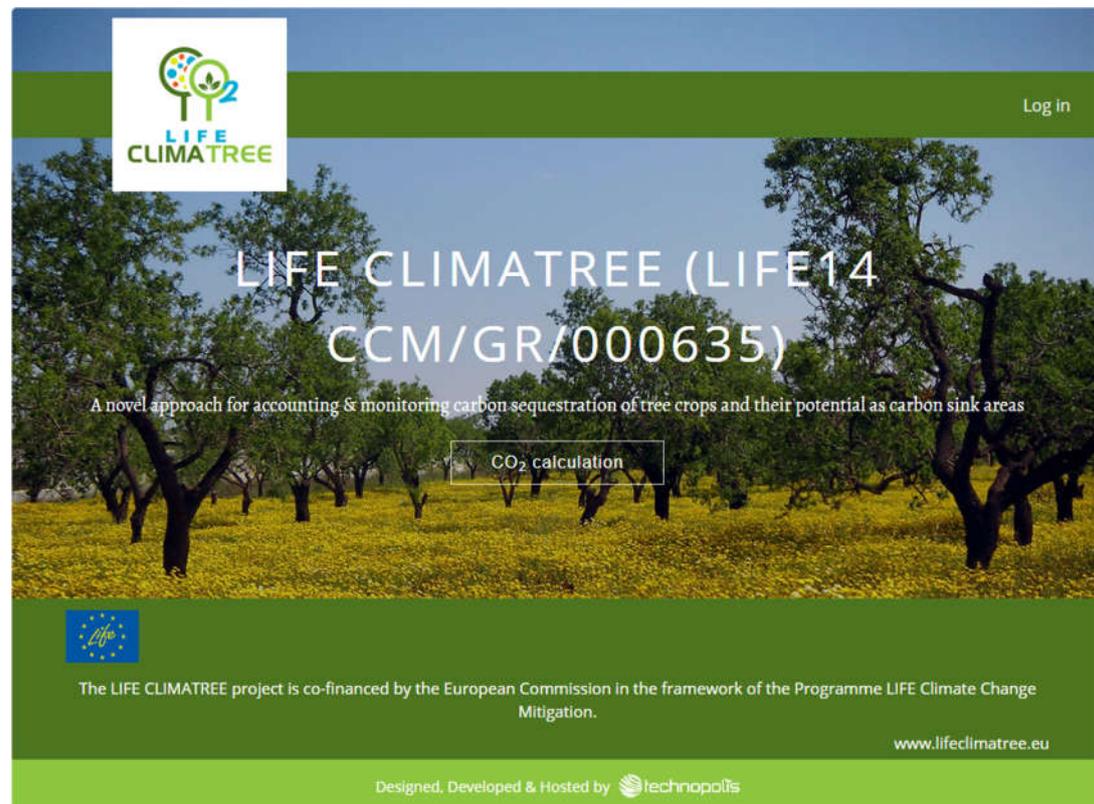
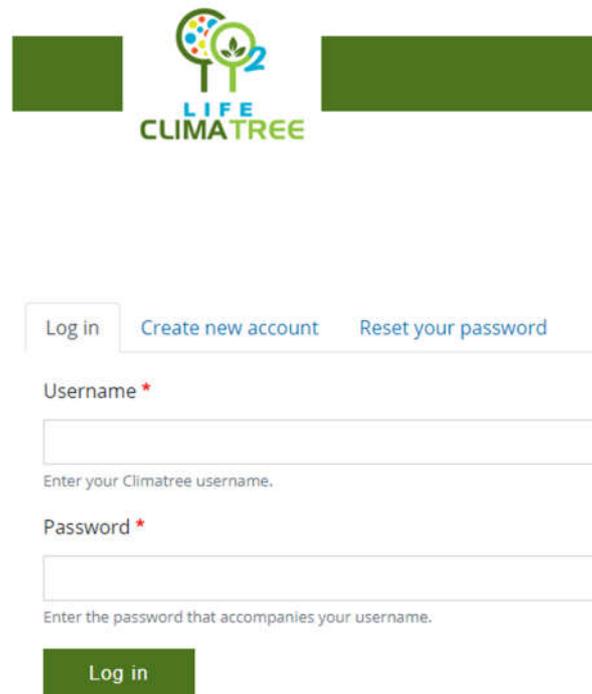


Figure 1. Main page of the web application.

In the login page, the user can create a new account (the first time), insert its credentials or reset a forgotten password (Figure 2).



Log in   Create new account   Reset your password

Username \*

Enter your Climatree username.

Password \*

Enter the password that accompanies your username.

Log in

Figure 2. Login page.

### 3. User environment

The environment is user specific and has three tabs on the left vertical bar. The *first option* holds the user information (“Edit account”) as can be seen in Figure 3.

The *second option* shows a list of previous calculations (“My calculations”) created in the user’s account and can create a new calculation (Figure 4).

In this page, the user, mainly, can create a new CO<sub>2</sub> calculation (1). Further, there is a list of previous calculations and each one has a label created automatically (2), a date that the calculation was created (3), the user type ( in 4 with options Policy maker or Local user) and three buttons (5), permitting the user to examine the calculation at any time, to edit the calculation or delete it.

[Edit account](#)  
[My calculations](#)  
[Comparison Page](#)

# mimis

**Email address \***

A valid email address. All emails from the system will be sent to this address. The email address is not made public and will only be used if you wish to receive a new password or wish to receive certain news or notifications by email.

**Username \***

Several special characters are allowed, including space, period (.), hyphen (-), apostrophe ('), underscore (\_), and the @ sign.

**Password**

**Password strength:**

**Confirm password**

**Passwords match:**

To change the current user password, enter the new password in both fields.

Save

Figure 3. Account information.

[Edit account](#)  
[My calculations](#)  
[Comparison Page](#)

## My CO2 Calculations

Create CO2 calculation 1

<input type="checkbox"/> Greece Total - Peach - 2019-11-23	Policy Maker	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<input type="checkbox"/> Florina - Orange - 2019-06-22	Local User	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<input type="checkbox"/> Ioannina - Apple - 2019-06-22	Local User	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<input type="checkbox"/> Greece Total - Apple - 2019-06-22	Policy Maker	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<input type="checkbox"/> Greece Total - Olive - 2019-06-16	Policy Maker	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Figure 4. List of previous calculations.

In “My calculations” page (Figure 4) by pressing “Create CO2 calculation”, a new calculation can be created. The new page has all the required input for the calculation and a typical page can be seen in Figures 5a, 5b and 5c. Selecting the compulsory fields (noted by a star) referring to the country (1), the user type (2 with options Policy maker or Local user), the regional unit (3) and tree type (in 4 with options orange, apple, peach almond and olive), has as a result, the rest of the fields in Figure 5a to be filled in automatically by using the country statistics. These fields are the yield density (5), the plant density (6), the surface (7) as well as the percentage of the trees in juvenile (8) and in mature phase (9).

**Create CO2 Calculation**

Country \*  
Greece 1

User Input \*  
Policy Make 2

Regional Unity (Greece)  
Argolida 3  
Please choose the cultivated tree from the list below.

Tree type \*  
Olive 4  
Please choose the cultivated tree from the list below.

YD (tn/ha)  
tn 2.01 5  
Please insert the annual total yield (Y) of the specific tree crop farm. In case this data is not available, it will be retrieved by algorithm's data base.

PD (trees/ha)  
127.91 6  
Please insert the planting density (PD) of the specific tree crop farm. In case this data is not available, it will be retrieved by algorithm's data base.

S (ha)  
ha 27691.15 7  
Please insert the surface (S) of the specific farm for which the calculation of the CO2 Removal Potential will be performed.

Tree Phase

JP  
% 7.53 8  
Please insert the percentage (JP) of the orchard's trees that are in the Juvenile Phase. In case this data is not available, it will be retrieved by algorithm's data base.

MP  
% 92.47 9  
Please insert the percentage (MP) of the orchard's trees that are in the Mature Phase. In case this data is not available, it will be retrieved by algorithm's data base.

Figure 5a. Input tree specific data required for a new CO<sub>2</sub> calculation.

Further down the same page (Figure 5b), management practices are defined. These include the fossil fuels and electricity consumed (10), the pruning information (11) and the fertilizers that are applied (12). The first two fields are filled in automatically

with typical values for the type of tree, cultivated. Despite that, the user can alter these values if he wishes to do so.

### Fossil fuels and electricity 10

**Diesel**

lt 188

Annual consumption Diesel (lt/ha)

**Gasoline**

lt 6.6

Annual consumption Gasoline (lt/ha)

**Electricity**

KWh 30

Annual consumption Electricity (KWh/ha)

Please insert the annual quantities of fossil fuels and electricity, which are consumed by the equipment and vehicles that are used in the plantation for cultivation, irrigation, protection, maintenance and harvesting purposes. In case these data are not available, they will be retrieved by algorithm's data base.

### Prunings 11

**Left in the field**

tn 0

**Burnt in the field**

tn 0.0389

**Use as a solid fuel outside the field**

tn 0.13615

**Other use different than burning**

tn 0.01945

Please choose from the list below the applied type of prunings management and their respective annual quantity.

### Fertilizers 12

Fertilizer	Annual Quantity
- None -	tn

Please choose from the list below the type of fertilizers that are applied and their respective annual consumption. If more than one fertilizers are applied, please indicate them in separate lines. In case these data are not available, they will be retrieved by algorithm's data base.

Figure 5b. Input data for management practices.

The last part of the input data required, has the present temperature (13) and the expected increase in temperature in 50 years' time (14). The current temperature is yearly mean temperature for the region chosen, in the first part the page (3). In this part, the save button is shown and by pressing it, the calculation is saved in the user's account.

Temperature	13
°C	12
Mean yearly temperature in Celsius	
Temperature increase	14
°C	0
Expected mean yearly increase in temperature in 50 years, in Celsius	
<input type="button" value="Save"/>	

Figure 5c. Temperature input required for soil calculations.

To illustrate the results, the user must press, in “My calculation” page, the first from the three buttons (5 in Figure 4). A typical output is shown in Figures 6a and 6b. In the upper part of the output (Figure 6a), the main input data are displayed. So, all the options inserted in Figures 5a-5c can be seen here. In the lower part of the output page (Figure 6b), all the indices created are presented. The TRP value (green) illustrates the total removal potential. The next set of value in yellow, RPBF, RPBW and SPS captures the CO<sub>2</sub> removal potential due to production of fruit biomass, the new trunks, branches and roots and soil respectively. The following set in red captures the emissions potentials due to the use of fertilizers (EPf), fossil fuels and electricity (EPff&e) and pesticides (EPP). The removal potential values (in yellow) summed up with the emissions potential (in red) results in the total CO<sub>2</sub> removal potential (in green).

The last part of the output page illustrates three removal potential indexes customized to give the user a broader image of the results. The first index, TRPA, captures the total removal potential per unit of cultivated area. The second, TRPP, captures the total removal potential per unit of produced product and the last, TRPT, illustrates the total removal potential per tree unit.

# Argolida - Olive - 2020-02-11

User Input: Policy Maker

## Input Data

YD (tn/ha): 2.010  
 PD (trees/ha): 127.910  
 S (ha): 27691.150

Tree Phase  
 JP (%): 7.530  
 MP (%): 92.470

Prunings  
 Left in the field (tn): 0.000  
 Burnt in the field (tn): 0.039  
 Use as a solid fuel outside the field (tn): 0.136  
 Other use different than burning (tn): 0.019

Fossil fuels and electricity  
 Diesel (lt): 188.00  
 Gasoline (lt): 6.60  
 Electricity (KWh): 30.00

## Charts

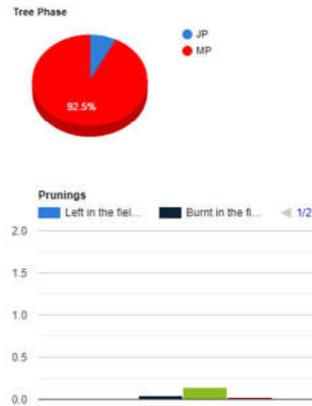


Figure 6a. Upper part of a typical output page.

## Total CO<sub>2</sub> Removal Potential

**TRP** 349.651 CO<sub>2</sub> Total Removal Potential of a specific tree crop farm or a broader area where tree crops are cultivated

## Analysis

Type	tn CO <sub>2</sub>	Description
RP <sub>BF</sub>	1.111	CO <sub>2</sub> Removal Potential due to the production of fruit biomass
RP <sub>BW</sub>	51,286.084	CO <sub>2</sub> Removal Potential regarding the production of annually new trunk, branches and roots biomass
SP <sub>S</sub>	311.540	CO <sub>2</sub> Storage Potential of soil regarding the carbon of the fallen biomass
EP <sub>f</sub>	-0.000	CO <sub>2</sub> Emissions Potential due to the use of fertilizers
EP <sub>ff&amp;e</sub>	-14,915.373	CO <sub>2</sub> Emissions Potential due to the use of fossil fuels & electricity
EP <sub>p</sub>		CO <sub>2</sub> Emissions Potential due to the use of pesticides

## CO<sub>2</sub> Removal Potential Indexes

TRP <sub>A</sub>	0.013	CO <sub>2</sub> Total Removal Potential of a specific tree crop farm or a broader area per unit of cultivated area
TRP <sub>P</sub>	173.956	CO <sub>2</sub> Total Removal Potential of a specific tree crop farm or a broader area per unit of produced product
TRP <sub>T</sub>	0.000	CO <sub>2</sub> Total Removal Potential of a specific tree crop farm or a broader area per tree unit

Figure 6b. Lower part of a typical output page.

In the main page, *the third option* helps the user to make comparisons (“Comparison Page”) between calculations already performed.

In order to illustrate the comparison page, two calculations have been made, the first one captured in Figures 5a-5c and 6a, 6b which is referring to olives in all Argolida and a similar one for Arkadia (Regions in Greece). So, by choosing the two calculations we want to compare the results, and this can be done by pressing the “Comparison Page”. The comparison is shown in Figure 7.

Arkadia - Olive - 2020-02-11		Argolida - Olive - 2020-02-11	
TRP	27.454	TRP	38.111
RP <sub>BF</sub>	1.454	RP <sub>BF</sub>	1.111
RP <sub>BW</sub>	35,764.269	RP <sub>BW</sub>	51,286.084
SP <sub>S</sub>		SP <sub>S</sub>	
EP <sub>f</sub>	-0.000	EP <sub>f</sub>	-0.000
EP <sub>ff&amp;e</sub>	-9,090.071	EP <sub>ff&amp;e</sub>	-14,915.373
EP <sub>p</sub>		EP <sub>p</sub>	
TRP <sub>A</sub>	0.002	TRP <sub>A</sub>	0.001
TRP <sub>p</sub>	10.439	TRP <sub>p</sub>	18.961
TRP <sub>T</sub>	0.000	TRP <sub>T</sub>	0.000

Figure 7. Comparison page.

## 4. Backend environment

In order to extend the lifetime of the web application and to be able to alter easily the various parameters of the algorithm, an interface has been designed which gives access, only to privileged users, to main values of the algorithm.

The parameters that are captured in that sense are clustered into two categories.

The first category includes all the statistical entries collected for Greek, Spanish and Italian regions and have the yield density (YD in tn/ha), the plant density (PD in

tree/ha) and the surface (S in ha) for orange, apple, peach, almond and olive trees. So, as seen in Figure 8, the rows (records) are the regions in a specific country and the columns (fields), for each tree, have the YD, PD and S. The values seen in Figure 8 are used in the calculations and if we want to change them there is a button  , at the end of each row permitting it.

The second category includes tree specific parameters used in the algorithm. These are tree specific parameters and management practice parameters (Figure 9). The parameters for orange, apple and peach are shown in Figure 9 where at the end of each line, there is a button  , permitting the editing of the dataset.

As seen in Figure 9, the tree specific parameters are the Carbon content of fruits biomass ( $C_f$ ), the trunk, branches and roots biomass development rates ADR1, ADR2 and the percentage of the trees in Juvenile and in mature phase and the biomass of the leaves (ML).

The management practices parameters are those referring to the biomass through pruning and the fuels and electricity consumption. For the pruning there are values for biomass left in the field, burnt in the field, used as a solid fuel outside the field and other uses different than burning. As far as fuels and electricity consumption is concerned, this is broken down to diesel, gasoline and electricity.

## Greek Regions

Regions	Orange trees			Apple trees			Peach trees			Almond trees			Olive trees			Actions
	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	
Greece Total	21.53	439.22	36,815.35	19.88	621.23	12,415.53	17.63	429.70	40,462.35	2.02	275.02	14,590.58	2.70	172.46	808,863.78	
Region of Eastern Macedonia and Thrace	13.33	333.33	0.23	11.19	694.00	164.15	6.73	382.94	188.90	3.54	275.36	1,360.48	3.20	189.16	16,627.43	
Rodopi	0.00	0.00	0.00	10.93	430.91	33.08	6.27	271.39	10.78	3.51	228.25	93.60	3.70	203.63	868.90	
Drama	0.00	0.00	0.00	14.36	460.06	23.98	4.99	351.11	11.90	2.11	263.00	44.40	2.83	276.54	712.43	
Evros	0.00	0.00	0.00	9.69	1,300.78	55.10	2.74	512.81	27.75	1.71	280.61	106.33	1.62	171.78	2,324.35	
Thasos	0.00	0.00	0.00	5.47	217.57	3.70	4.35	204.27	11.70	1.40	235.60	19.10	0.98	132.02	7,585.00	
Kavala	13.33	333.33	0.23	13.69	353.42	32.88	9.13	290.10	79.30	3.95	280.43	1,085.25	7.95	275.22	4,461.68	
Xanthi	0.00	0.00	0.00	6.00	294.42	15.43	6.92	539.44	47.48	2.24	246.12	11.80	1.91	211.36	675.08	

Figure 8. Backend for statistical data for the trees.

# Tree Data

Tree	Carbon content of fruits biomass	Trunk, branches and roots biomass development				Leaves biomass	Prunings biomass	Fuels & Electricity			Actions	
	Cf	ADR1	ADR2	JP	MP	ML		Diesel	Gasoline	Electricity		
Orange	0.019260	0.020000	0.012200	17.65	82.35	1.109000	1. Left in the field	0.210872	187.50	12.50	428.00	
							2. Burnt in the field	0.316308				
							3. Use as a solid fuel outside the field	0.000000				
							4. Other use different than burning	0.000000				
Apple	0.020250	0.013000	0.005720	19.05	80.95	1.329000	1. Left in the field	0.278964	583.00	334.00	163.00	
							2. Burnt in the field	0.418446				
							3. Use as a solid fuel outside the field	0.000000				
							4. Other use different than burning	0.000000				
Peach	0.012930	0.005720	0.002000	36.36	63.64	1.329000	1. Left in the field	0.278964	583.00	334.00	163.00	
							2. Burnt in the field	0.418446				
							3. Use as a solid fuel outside the field	0.000000				

Figure 9. Backend for tree parameters and management practices.