

Estimation of area for REDD+ using stratified sampling design: application with SEPAL tools

Webinar GOFC-GOLD, 2017/06/06

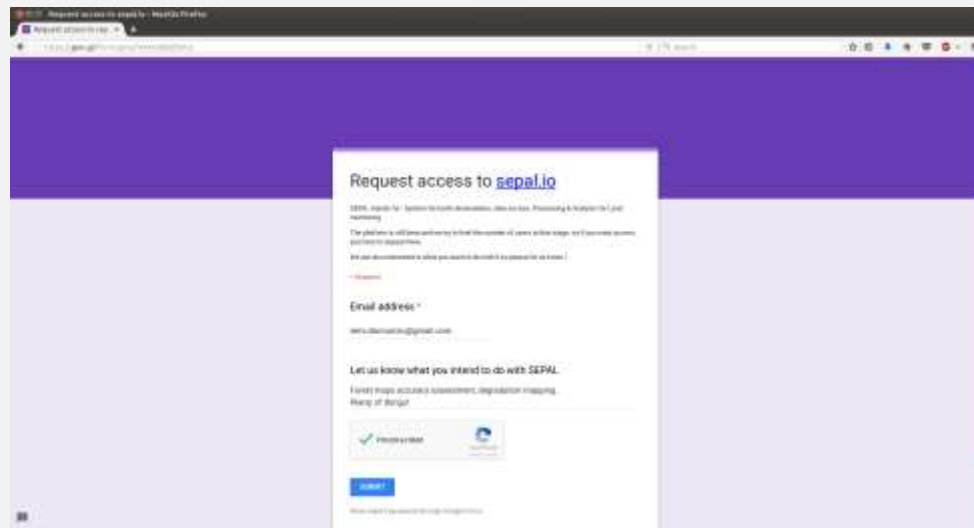
remi.dannunzio@fao.org



Request access to SEPAL

SEPAL stands for : System for Earth observations, data access, Processing & Analysis for Land monitoring.

The platform is still beta and we try to limit the number of users at that stage



The screenshot shows a Google Form titled "Request access to sepal.io". The form is displayed on a purple background. The text on the form includes: "SEPAL, stands for : System for Earth observations, data access, Processing & Analysis for Land monitoring.", "The platform is still beta and we try to limit the number of users at that stage, we therefore require you to request access.", "Email address *", "Let us know what you intend to do with SEPAL.", "I intend to use SEPAL for: (check all that apply) Forest mapping, Land use/cover mapping, Policy development, Other (specify):", and a "Submit" button.

If you want access, you have to request [in this Google Survey](https://goo.gl/forms/9cz2BGCch32H331y1)

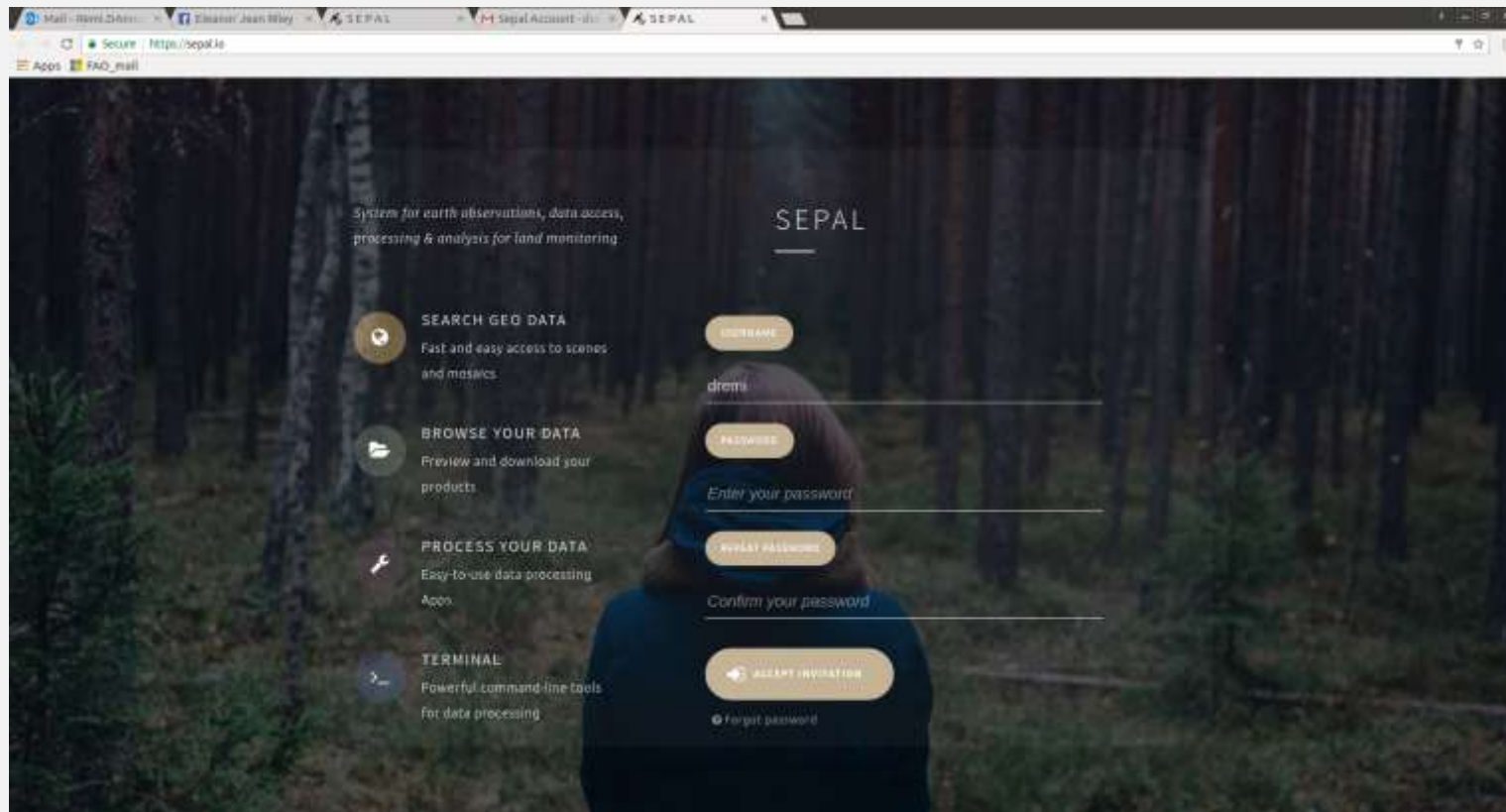
(<https://goo.gl/forms/9cz2BGCch32H331y1>)

You will then receive an email with a link to activate your access.

Remember to check in your **SPAMS**, it might be there.

Setup your password in SEPAL

It needs at least one upper case, one lower case and one number.
The minimum size is 6 digits.



You can always reach the platform at <https://sepal.io>

Check your status, budget, parameters

The screenshot shows the SEPAL web application interface. The browser address bar displays 'https://sepal.io'. The interface is divided into two main sections: 'USER' on the left and 'USED RESOURCES' on the right. The 'USER' section contains fields for NAME (Dannunzio Remi), USERNAME (dremi), PASSWORD (with a 'CHANGE' button), EMAIL (dannunzio.remi@gmail.com), ORGANIZATION (FAO), and GOOGLE ACCOUNT (with a 'USE MY ACCOUNT' button). A 'SAVE' button is at the bottom of the user section. The 'USED RESOURCES' section displays a table of resource usage:

	Quote	Used
Monthly Instance Budget	1 USD	0 USD
Monthly Storage Budget	1 USD	NaN USD
Storage	20 GB	0 GB

Below the resources section, there is a 'SESSIONS' table with columns for 'Type of instance', 'Time', and 'Cost'. The bottom of the interface features a navigation bar with the SEPAL logo and a 'LOGOUT' button. A red box highlights a top-left arrow icon in the top left corner of the application area, and another red box highlights the 'LOGOUT' button in the bottom right corner.

Go back to main page (top left arrow)

Start the PROCESS tab

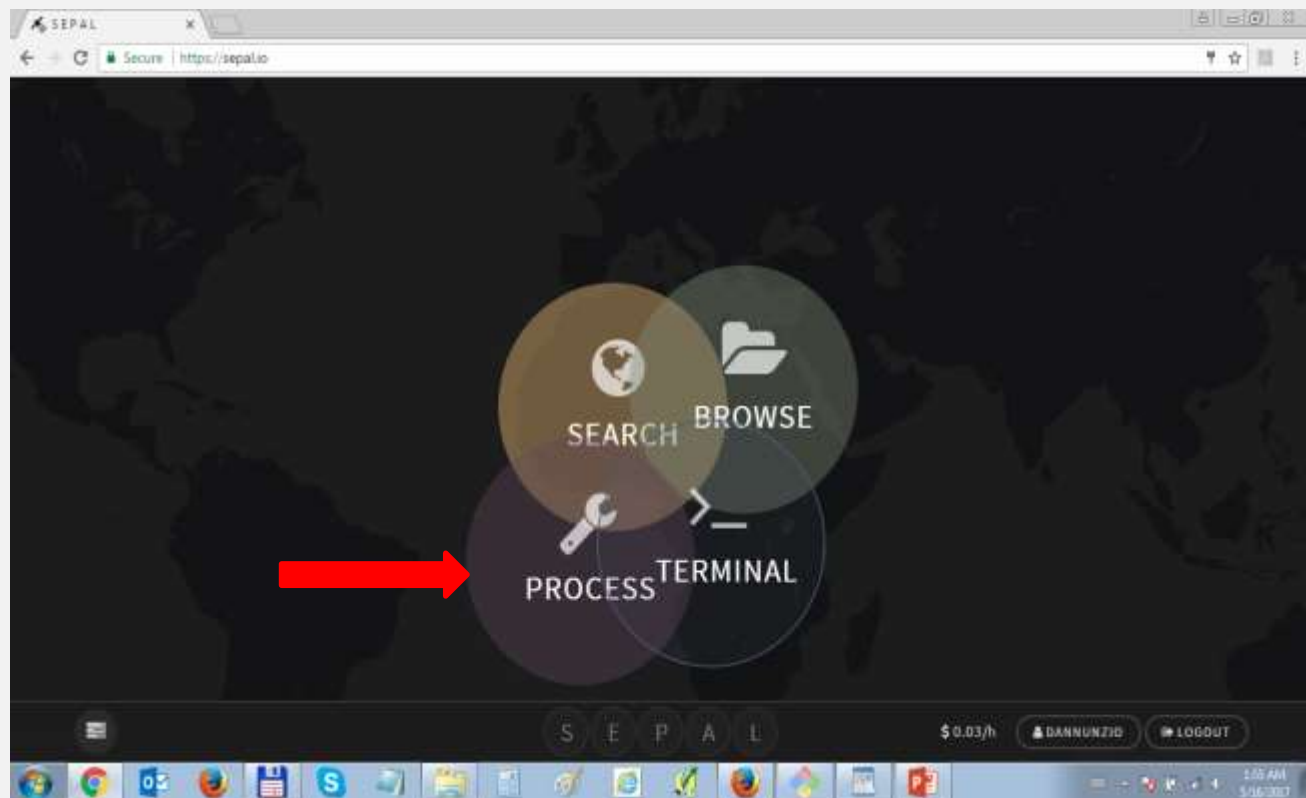
There are four fields in SEPAL

SEARCH for imagery and creating mosaics

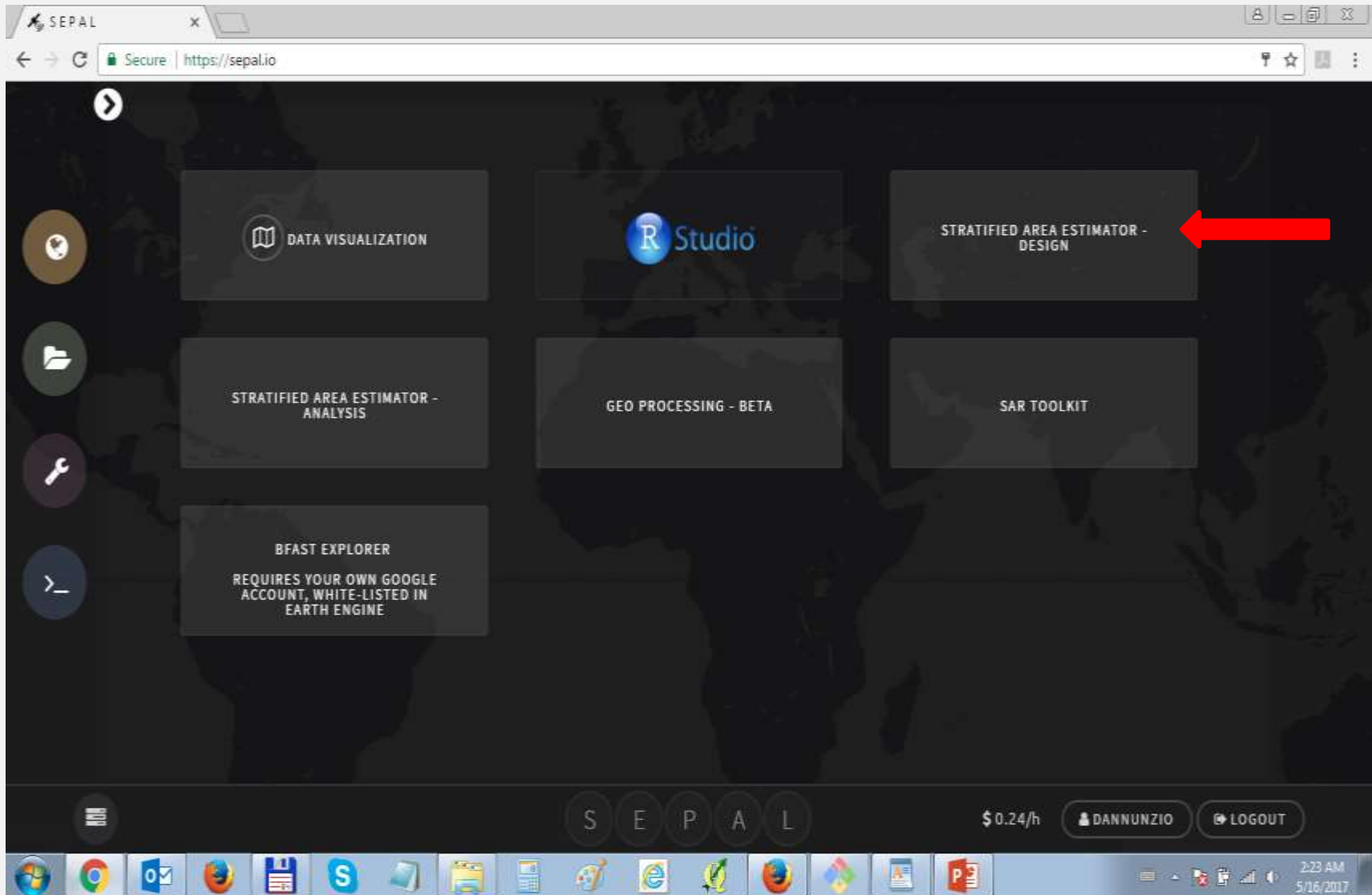
BROWSE through your personal folders and visualize your data

TERMINAL to access all the command lines possibilities of the LINUX server

PROCESS access pre-loaded tools and chains of processing



Select SAE – DESIGN tool



Introduction TAB: Select your language

Check the description tabs and the tool structure.
Steps need to be performed one after the other.

The screenshot displays the SEPAL Stratified estimator web application. On the left is a dark sidebar with navigation links: Introduction, Map input, Strata areas, Strata selection, Sampling size, Sample allocation, Source code, and Bug reports. The main content area has a green header with the title 'SEPAL Stratified estimator'. Below the header, there are three main sections: 'Language', 'Description', and 'Background'. The 'Language' section features a dropdown menu with 'English' selected and highlighted by a red box. The 'Description' section contains text about the tool's purpose and a link to the Open Foris support forum. The 'Background' section explains the tool's aim and concept. At the bottom, there is a 'How to use the tool?' section with a list of five steps. The footer includes logos for SEPAL, UN-REDD, and Open Foris, along with a disclaimer.

SEPAL Stratified estimator

Language

English

English

Français

Español

Description

This interactive tool creates stratified designs to estimate areas. The objective of this tool is to provide a simple user interface for generating a probability dataset with stratified random sampling. For support ask [Open Foris support forum](#)

Background

The aim of this stratified sampling design tool is to produce a sampling design that can be used for area estimates. The idea is to combine a map (used as a stratification of the landscape of interest) with a visual map interpretation of samples to produce an area estimation.

The concept is derived from map accuracy assessment principles; characterized frequency of errors (omission and commission) for each map class may be used to compute area estimates and also to estimate the uncertainties (confidence intervals) for the areas for each class.

How to use the tool ?

You have to go through all the steps in the left panel, in this order:

1. Select the map data which will be assessed. The required input is either vector (.shp supported) or raster (.tif supported)
2. Compute the areas of each strata
3. Select the expected accuracies of the strata
4. Compute the sampling size
5. Draw the sampling points and export as a Collect Earth file

Disclaimer **Reference and Documents**

FAO declines all responsibility for errors or deficiencies in the database or software or in the documentation accompanying it for program maintenance and upgrading as well as for any damage that may arise from them. FAO also declines any responsibility for updating the data and assumes no responsibility for errors and omissions in the data provided. Users are, however, kindly asked to report any errors or deficiencies in this product to FAO.

SEPAL UN-REDD OPEN FORIS

Introduction TAB: reference documents

Access reference and background documents, the link will bring you directly there

SEPAL - Mozilla Firefox

Request access to sep... x SEPAL x +

https://sepal.io

90% Search

SEPAL Stratified estimator

Introduction

Map input

Strata areas

Strata selection

Sampling size

Sample allocation

Source code

Bug reports

Language

English

How to use the tool ?

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Disclaimer

Reference and Documents

REDD Compass

Olofsson et al. (2014): Good practices for estimating area and assessing accuracy of land change

FAO NPMA paper N46: Map accuracy assessment and area estimation

STEP 1 Map input

1. Download the test dataset (note it is downloaded to your SEPAL workspace)
2. Select the map you just downloaded (INPUT/sae_data_test/test_map_congo.tif)

The screenshot shows the SEPAL Stratifed estimator web interface. On the left sidebar, the 'Map input' option is highlighted with a red box. In the main content area, the 'Data type' section has a 'Download test data' button highlighted with a red box and a red '1'. Below this, the 'Input' field is highlighted with a red box and a red '2'. A file browser window is open, showing the file 'aa_test_congo.tif' selected. The browser window also shows the path 'aa_data_test'.

STEP 2 Strata areas

Display map by checking box

Generate the legend by clicking on the button: you can further EDIT the legend

SEPAL - Mozilla Firefox

Request access to sep - SEPAL

https://sepal.io

90% Search

SEPAL Stratified estimator

Introduction

Map input

Strata areas

Strata selection

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Bug reports

Area calculation

Map areas are calculated by counting the frequency of the pixels for each map class or by summing the areas of all the polygons. If using raster data the map area can be calculated using R or Open Foris Geospatial Toolkit (OFT). It is compatible with all systems and OFT is only compatible with Linux. Area calculations of large raster files using R will take some time.

☐ OFT

☐ R

Area calculation and legend generation

☒ Do you want to display the map?

Legend and Areas


The areas for each of the map categories need to be calculated in order to calculate the overall and stratified sample size. Make sure to click on the submit legend button to load the map area table. [Click on area calculation and legend generation.](#) [Click on submit legend before continuing.](#)

Legend labeling

The legend classes need to be specified and submitted. Please wait for the map values to appear. Then type the names of the classes and submit the legend. After submitting the legend the table with the map classes and area will appear. The legend names can be modified at any time in this tab.

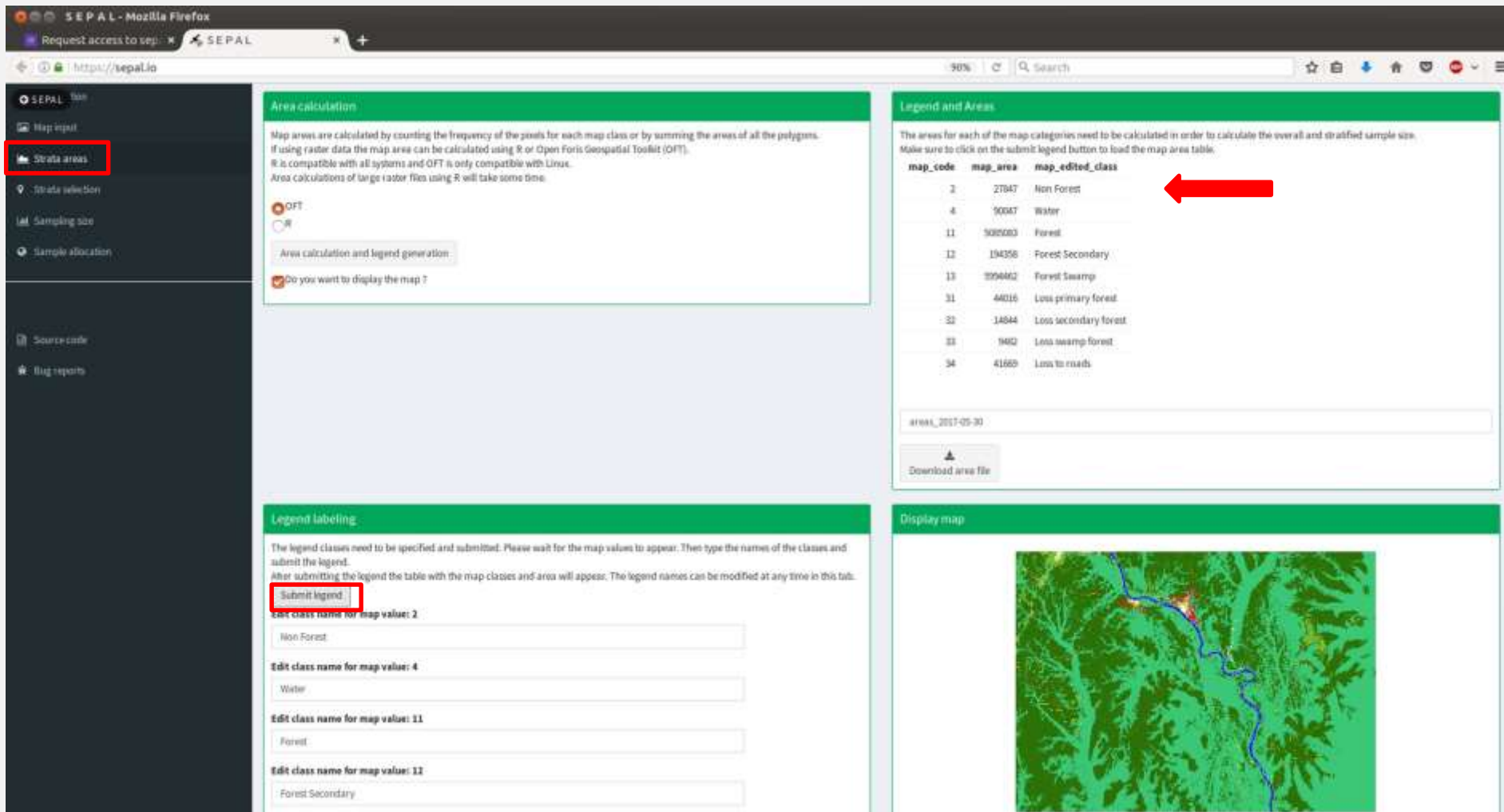
map_code	map_edited_class	
2	Non Forest	<input type="text"/>
4	Water	<input type="text"/>
11	Forest	<input type="text"/>
12	Forest Secondary	<input type="text"/>
13	Forest Swamp	<input type="text"/>
31	Loss primary forest	<input type="text"/>
32	Loss secondary forest	<input type="text"/>
33	Loss swamp forest	<input type="text"/>
34	Loss to roads	<input type="text"/>

Display map



STEP 2 Strata areas

Submit the legend : you can edit as much as you want but remember to SUBMIT
The classes name will be showing in later stage for data collection



The screenshot shows the SEPAL web application interface. The left sidebar contains a menu with 'Strata areas' highlighted. The main content area is divided into three sections: 'Area calculation', 'Legend and Areas', and 'Legend labeling'.

Area calculation

Map areas are calculated by counting the frequency of the pixels for each map class or by summing the areas of all the polygons. If using raster data the map area can be calculated using R or Open Foris Geospatial ToolKit (OFT). It is compatible with all systems and OFT is only compatible with Linux. Area calculations of large raster files using R will take some time.

☐ OFT
☐ R

Area calculation and legend generation:

☒ Do you want to display the map ?

Legend and Areas

The areas for each of the map categories need to be calculated in order to calculate the overall and stratified sample size. Make sure to click on the submit legend button to load the map area table.

map_code	map_area	map_edited_class
2	27847	Non Forest
4	90047	Water
11	5025003	Forest
12	194356	Forest Secondary
13	3994462	Forest Swamp
31	44016	Loss primary forest
32	14844	Loss secondary forest
33	1902	Loss swamp forest
34	41669	Loss to roads

areas_2017-05-30

Download area file

Legend labeling

The legend classes need to be specified and submitted. Please wait for the map values to appear. Then type the names of the classes and submit the legend. After submitting the legend the table with the map classes and area will appear. The legend names can be modified at any time in this tab.

Edit class name for map value: 2

Non Forest

Edit class name for map value: 4

Water

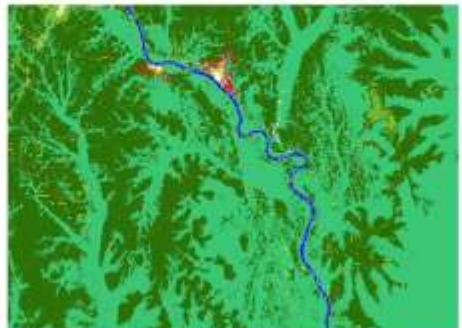
Edit class name for map value: 11

Forest

Edit class name for map value: 12

Forest Secondary

Display map



STEP 3 Select strata of interest and associated EUA

SEPAL Stratified estimator

Introduction

Map input

Strata areas

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Bug reports

What are the expected accuracies?

Some classes are identified easier than other classes. Usually common classes, which occupy the majority of the map, are the easiest to identify. Rare classes, such as land change classes, which occupy a small portion of the map area, can be very difficult to identify. This measure will influence the overall sample size.

More classes with lower confidence will increase the overall sample size

- Stable classes are expected to have high user accuracies and should be assigned a higher confidence. Here the value chosen is 0.9
- Rare classes are expected to have the lower user accuracies and should be assigned a low confidence. Here the value chosen is 0.7

Choose classes expected user's accuracies

high confidence (Expected UA = 0.9)

Non Forest Water Forest Forest Secondary Forest Swamp

low confidence (Expected UA = 0.7)

Loss primary forest Loss secondary forest Loss swamp forest

Loss to roads

Expected User's Accuracy (EUA) values for specific classes

High expected user accuracy

0.5 0.75 0.9 1

0.9

Low expected user accuracy

0.5 0.75 0.9 1

0.7

STEP 4 Sampling distribution

Tweak the standard error of overall accuracy & minimum sample size

Samples are allocated by minimum size first and the rest is distributed proportionally to strata size

SEPAL

Stratified estimator

Introduction

Map input

Strata areas

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Bug reports

Sampling size

In the sampling design, the sample size for each map category is chosen to ensure that the sample size is large enough to produce sufficiently precise estimates of the area of the class (GFOI, 2013)

Standard error of expected overall accuracy

0.01

Minimum sample size per strata

50

☐ Do you want to modify the sampling size?

Formula to calculate the overall sample size

The equation below calculates an adequate overall sample size for stratified random sampling that can then be distributed among the different strata.

- N is number of units in the area of interest (number of overall pixels if the spatial unit is a pixel, number of polygons if the spatial unit is a polygon)
- S(O) is the standard error of the estimated overall accuracy that we would like to achieve
- W_i is the mapped proportion of area of class i
- S_i is the standard deviation of stratum i.

$$n = \frac{(\sum W_i S_i)^2}{[S(\bar{O})]^2 + (1/N) \sum W_i S_i^2} \approx \left(\frac{\sum W_i S_i}{S(\bar{O})} \right)^2$$

Distribution of samples

The computed overall size is : 904

Map Class	Proportional	Adjusted	Final
Non Forest	2	50	50
Water	7	50	50
Forest	401	277	277
Forest Secondary	15	50	50
Forest Swamp	473	327	327
Loss primary forest	3	50	50
Loss secondary forest	1	50	50
Loss swamp forest	0	50	50

Baseline of csv to export

sampling_2017-05-30

Download csv with sample design

STEP 5 Sample allocation

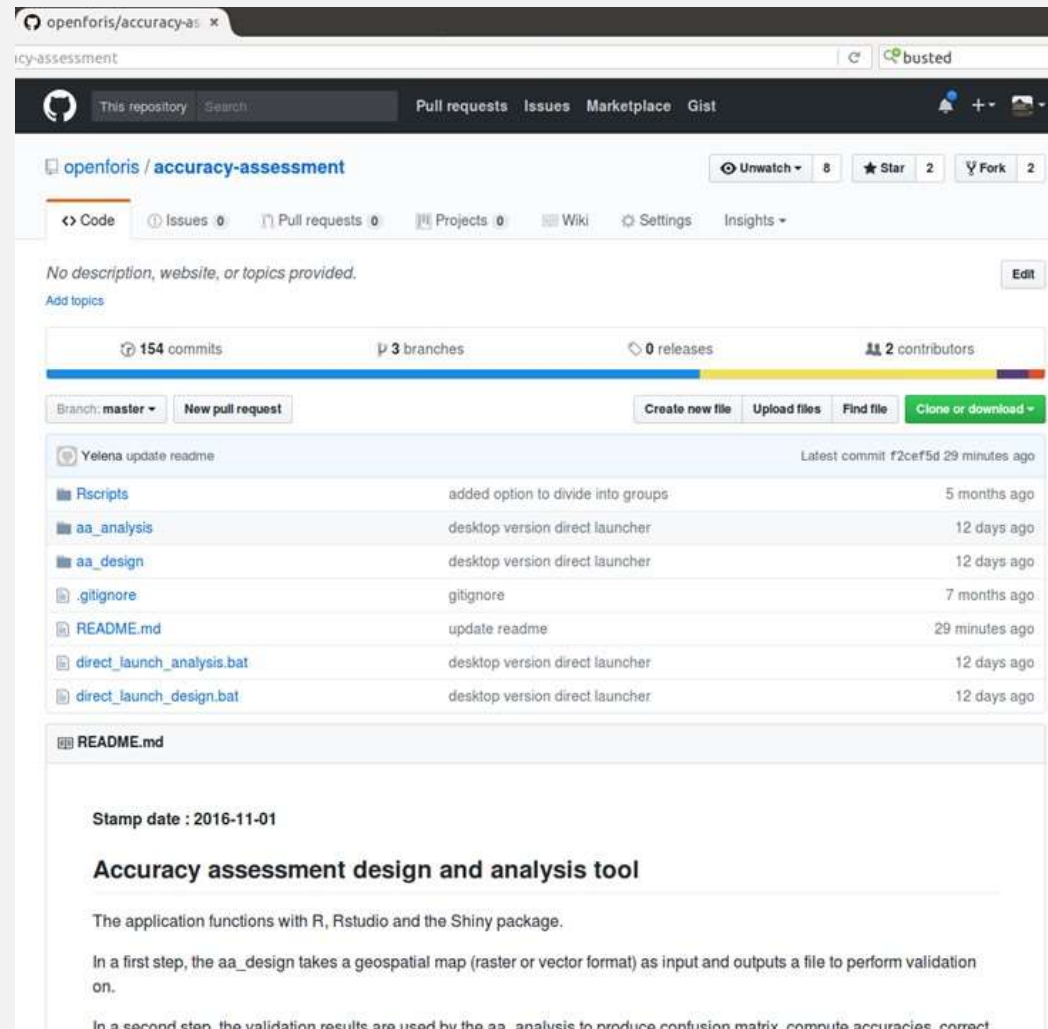
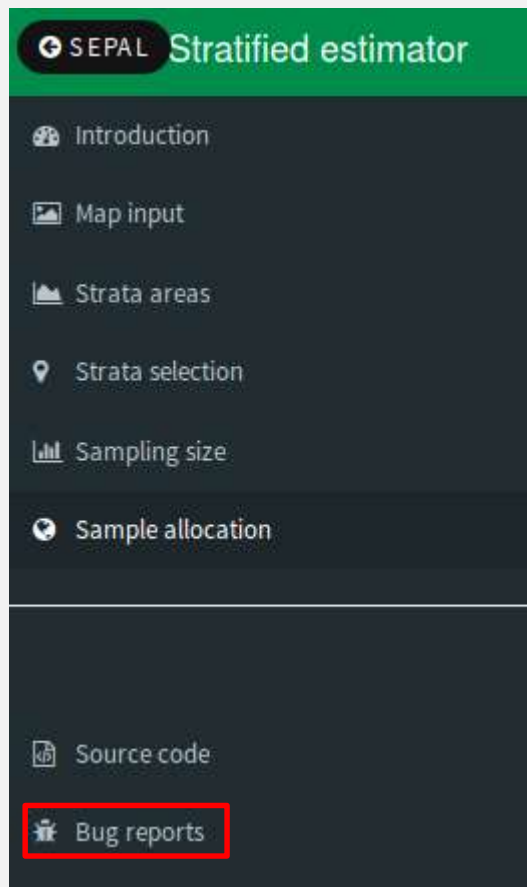
Click on “Generate sampling points” → wait (see task bottom right)

Download CEP project AND tabular data → saves to your computer (and backup in SEPAL workspace)

The screenshot shows the SEPAL Stratified estimator web application. The left sidebar contains navigation links: Introduction, Map input, Strata areas, Strata selection, Sampling size, **Sample allocation** (highlighted with a red box), Source code, and Bug reports. The main content area is titled 'Create a stratified random sample on the map' and includes a map of the Republic of Congo with sampling points. A red box highlights the 'Generate sampling points' button. The right-hand panel, titled 'Create a Collect Earth Project file (.cep) to start validation work', contains fields for 'Choose country name if you want additional national data for the samples' (Republic of Congo), 'Number of operators' (5), 'Size of the interpretation box (in m)' (30), and 'Basename of sampling design files to export' (CE_2017-05-30). Below these fields are three download buttons: 'Download as Collect Earth project (.cep)', 'Download as tabular data (.csv)', and 'Download as vector data (.shp)', each with a red arrow pointing to it. A file download dialog is open in the foreground, showing the file 'CE_2017-05-30.cep' and asking 'What should Firefox do with this file?'. The dialog has options for 'Open with', 'DownloadThemAll!', 'dTa OneClick!', and 'Save File' (selected). A progress bar at the bottom right indicates 'Generating random points'.

Report any bugs, it is work in progress

<https://github.com/openforis/accuracy-assessment>

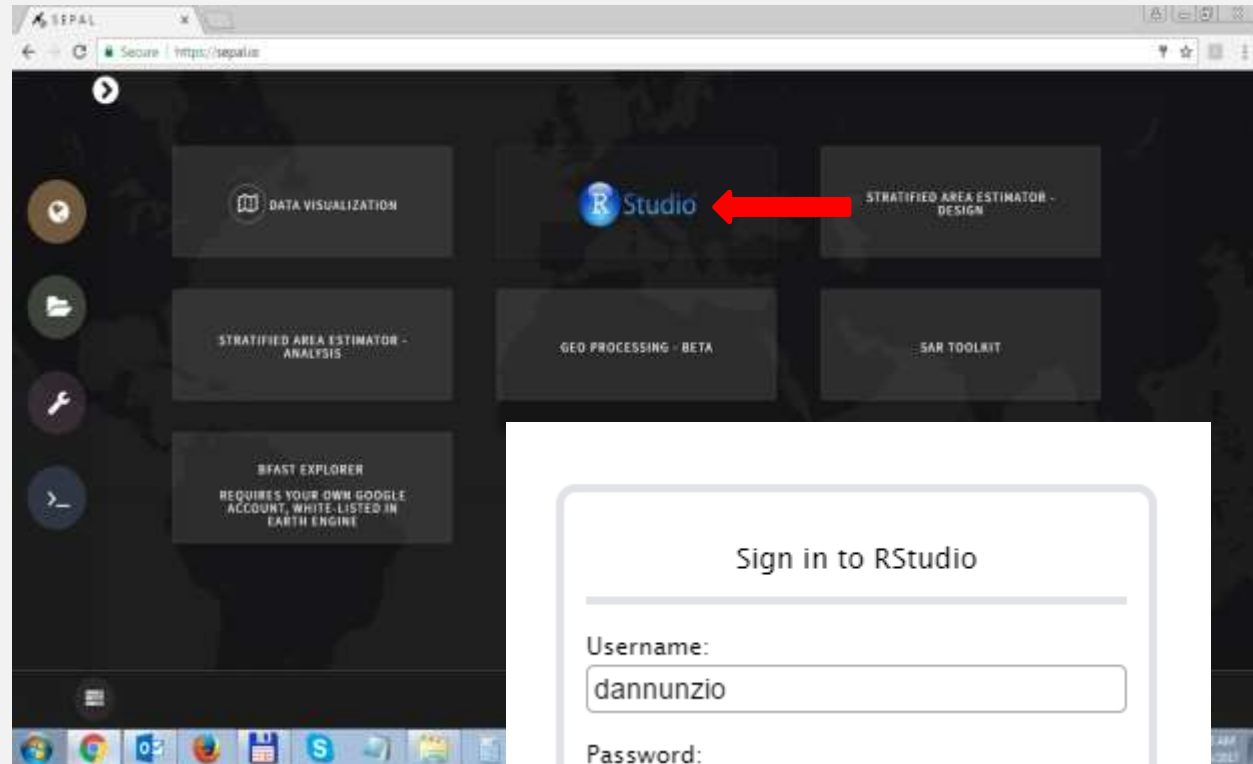
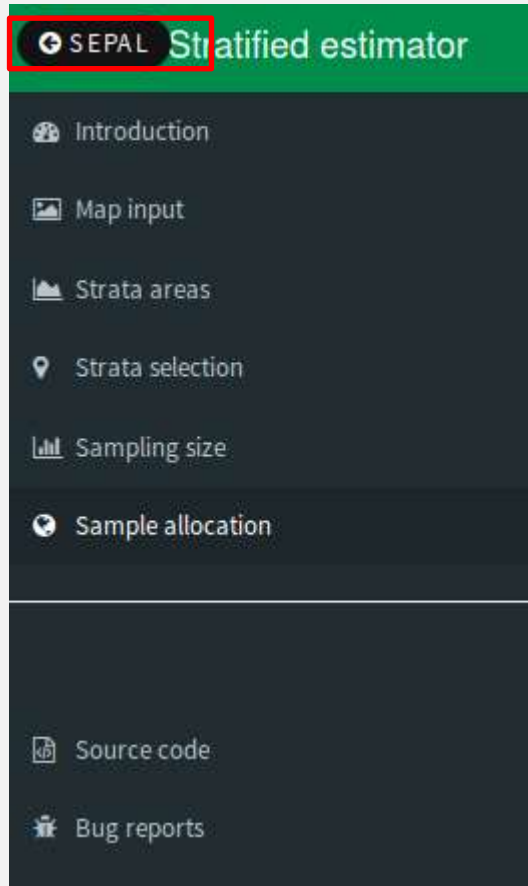




How to upload your own map in SEPAL ?

Select RSTUDIO and sign in

Go back to tools



Sign in to RStudio

Username:
dannunzio

Password:

☐ Stay signed in

Sign In

Only lowercase
in the username

Upload data from your computer

If multiple files (e.g. shapefile), make a zip first

The screenshot shows the SEPAL web interface. On the left, a 'File Upload' dialog is open, displaying a list of files in the 'dannunzio' directory. The file 'test_shapefile.zip' is selected. On the right, the 'Environment' panel shows an empty environment with a red box highlighting the 'More' button in the 'Files' tab.

File Upload Dialog:

Name	Size	Modified
aa_design_output		19:34
aa_test.cpg	5 bytes	31 Mar 2016
aa_test.dbf	212.6 kB	31 Mar 2016
aa_test.prj	390 bytes	31 Mar 2016
aa_test.qpj	599 bytes	31 Mar 2016
aa_test.shp	5.0 MB	31 Mar 2016
aa_test.shx	8.5 kB	31 Mar 2016
aa_test_congo.tif	737.5 kB	23 Aug 2016
FC_2014_Kampongthom_province.dbf	1.5 MB	13 May
FC_2014_Kampongthom_province.prj	402 bytes	12 May
FC_2014_Kampongthom_province.sbn	221.0 kB	13 May
FC_2014_Kampongthom_province.sbx	15.2 kB	13 May
FC_2014_Kampongthom_province.shp	85.5 MB	13 May
FC_2014_Kampongthom_province.shx	174.5 kB	13 May
ipcc_1416.tif	6.2 MB	15 May
test_shapefile.zip	3.8 MB	17:36

Environment Panel:

Environment is empty

Files | Plots | Packages | Help | Viewer

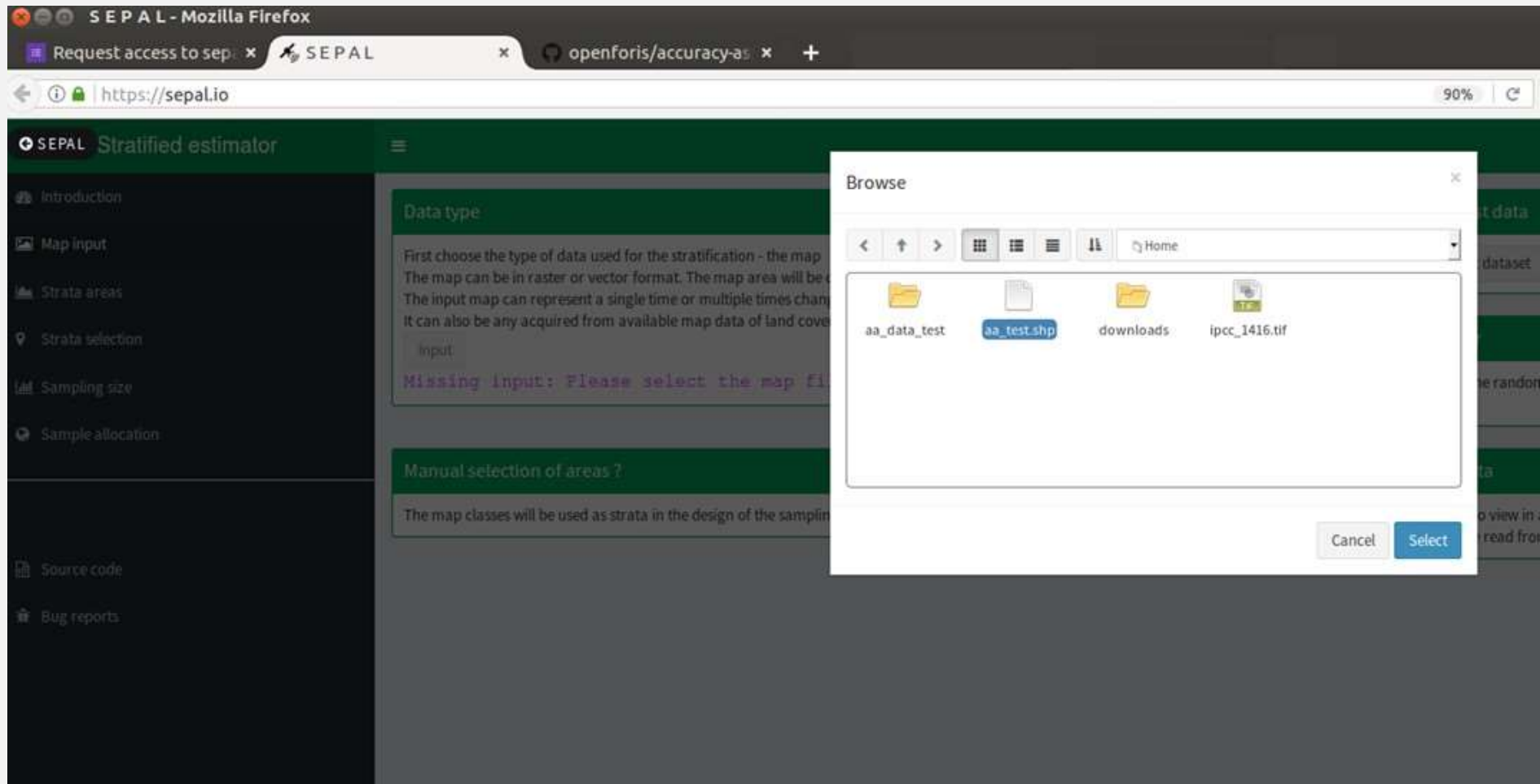
New Folder | Upload | Delete | Rename | More

Home

Name	Size	Modified
aa_data_test		
downloads		

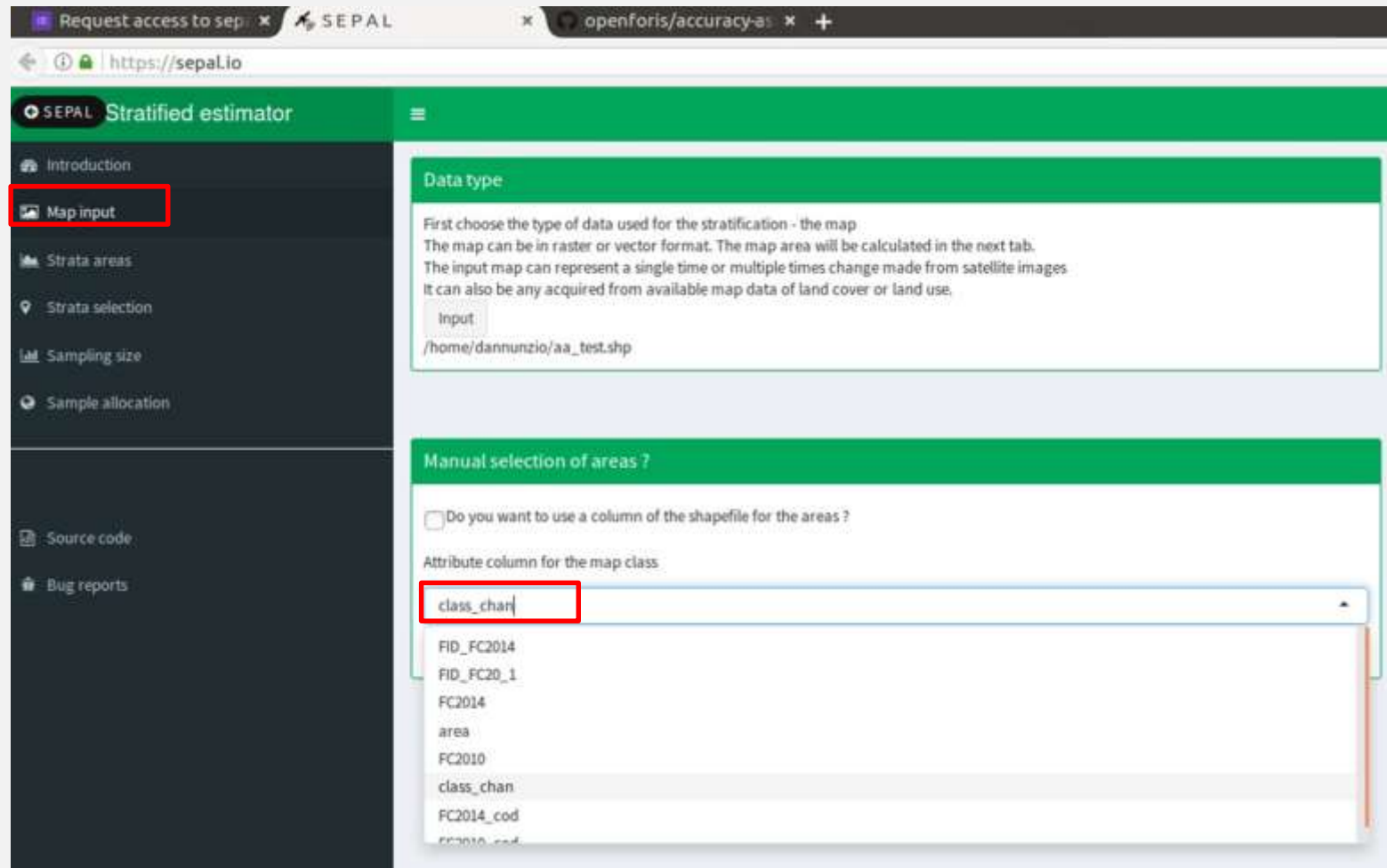
Go back to SAE – Design application

Your own map is available for use inside the application



Shapefile as input map

Select the right column for class attribute
Rest of the process is identical



Request access to sep... x SEPAL x openforis/accuracy-as x +

https://sepal.io

SEPAL Stratified estimator

- Introduction
- Map input**
- Strata areas
- Strata selection
- Sampling size
- Sample allocation

Source code

Bug reports

Data type

First choose the type of data used for the stratification - the map.
The map can be in raster or vector format. The map area will be calculated in the next tab.
The input map can represent a single time or multiple times change made from satellite images.
It can also be any acquired from available map data of land cover or land use.

Input:
/home/dannunzio/aa_test.shp

Manual selection of areas ?

☒ Do you want to use a column of the shapefile for the areas ?

Attribute column for the map class

class_chan

- FID_FC2014
- FID_FC20_1
- FC2014
- area
- FC2010
- class_chan
- FC2014_cod
- FC2010_cod

Data collection : soon available in SEPAL

<http://www.openforis.org/tools/collect-earth.html>

Google Earth Pro

Rechercher

Land cover transition class

Forest degradation Forest preservation

Sustainable forest Deforestation - Logging

Deforestation - Other Deforestation - Rubber

Forest abandonment Other land

Confidence

Yes No

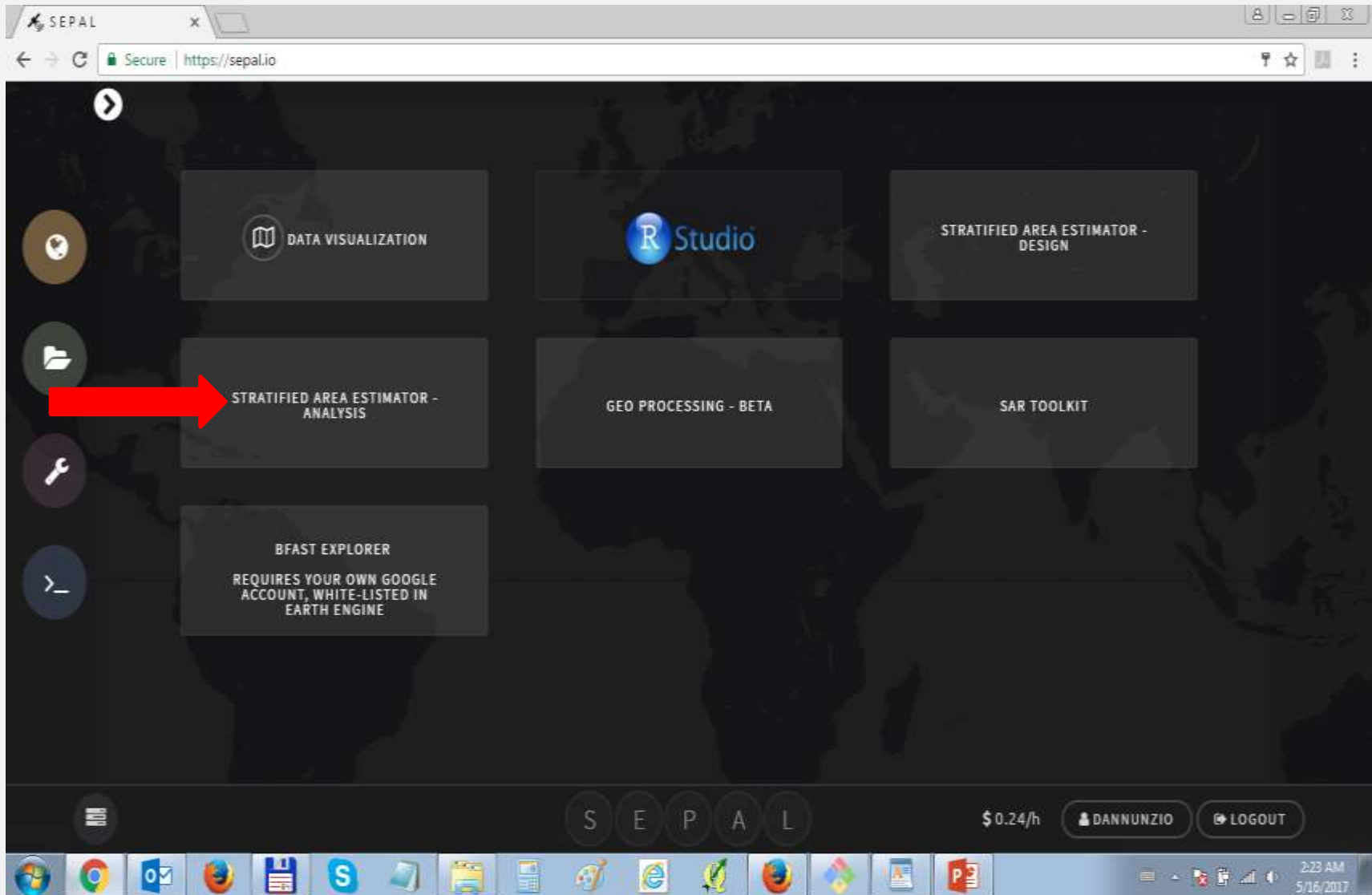
Collect Earth

Save

Google earth

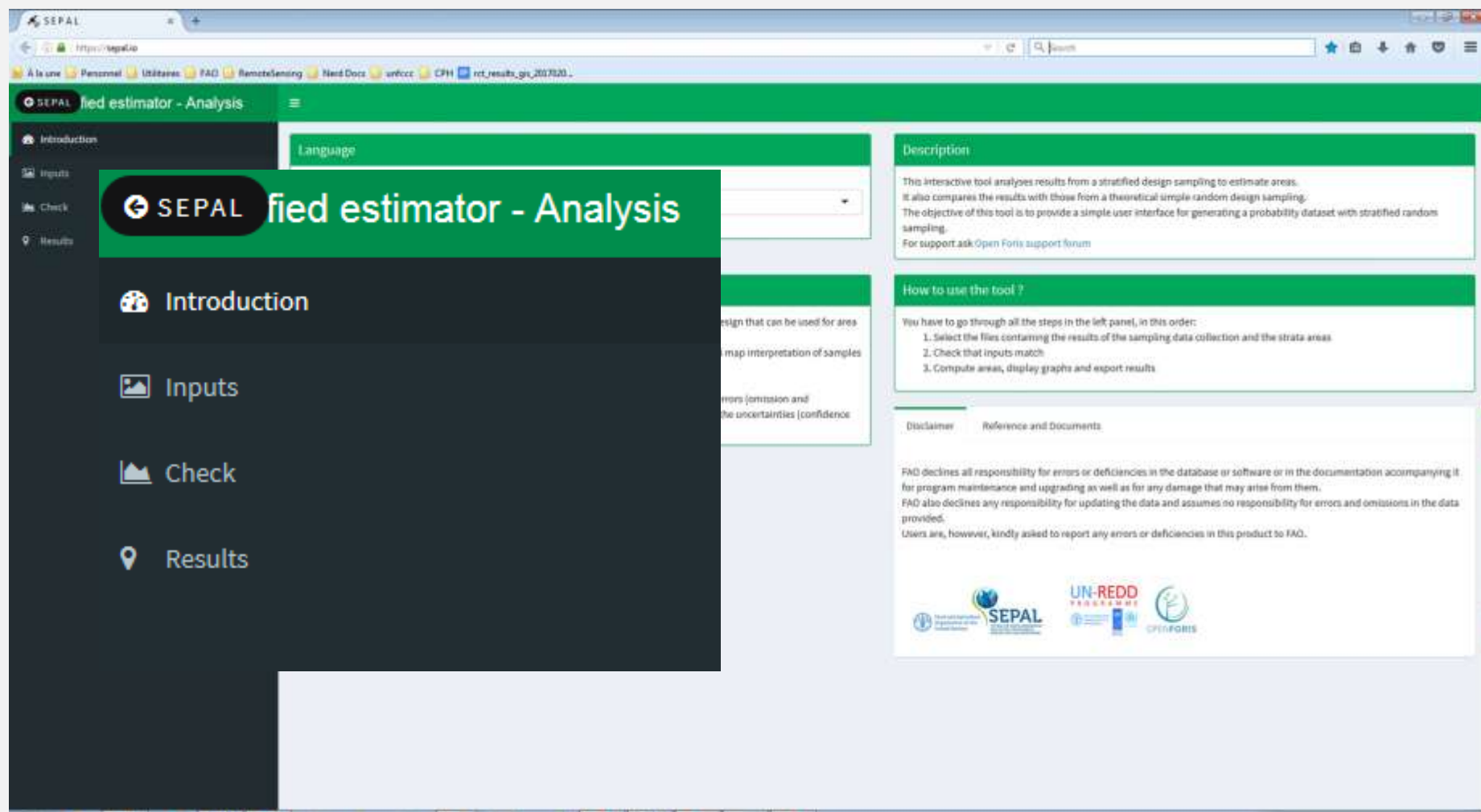
Date des images satellite : 2/12/2010 11:44:52.977N 105:04:46.967E 44m - Mm - altitude : 1.31 km

Select SAE – ANALYSIS tool



Similar structure

Only 3 steps



The screenshot displays the 'SEPAL field estimator - Analysis' web application. The interface features a dark sidebar on the left with navigation links: Introduction, Inputs, Check, and Results. The main content area is divided into several sections:

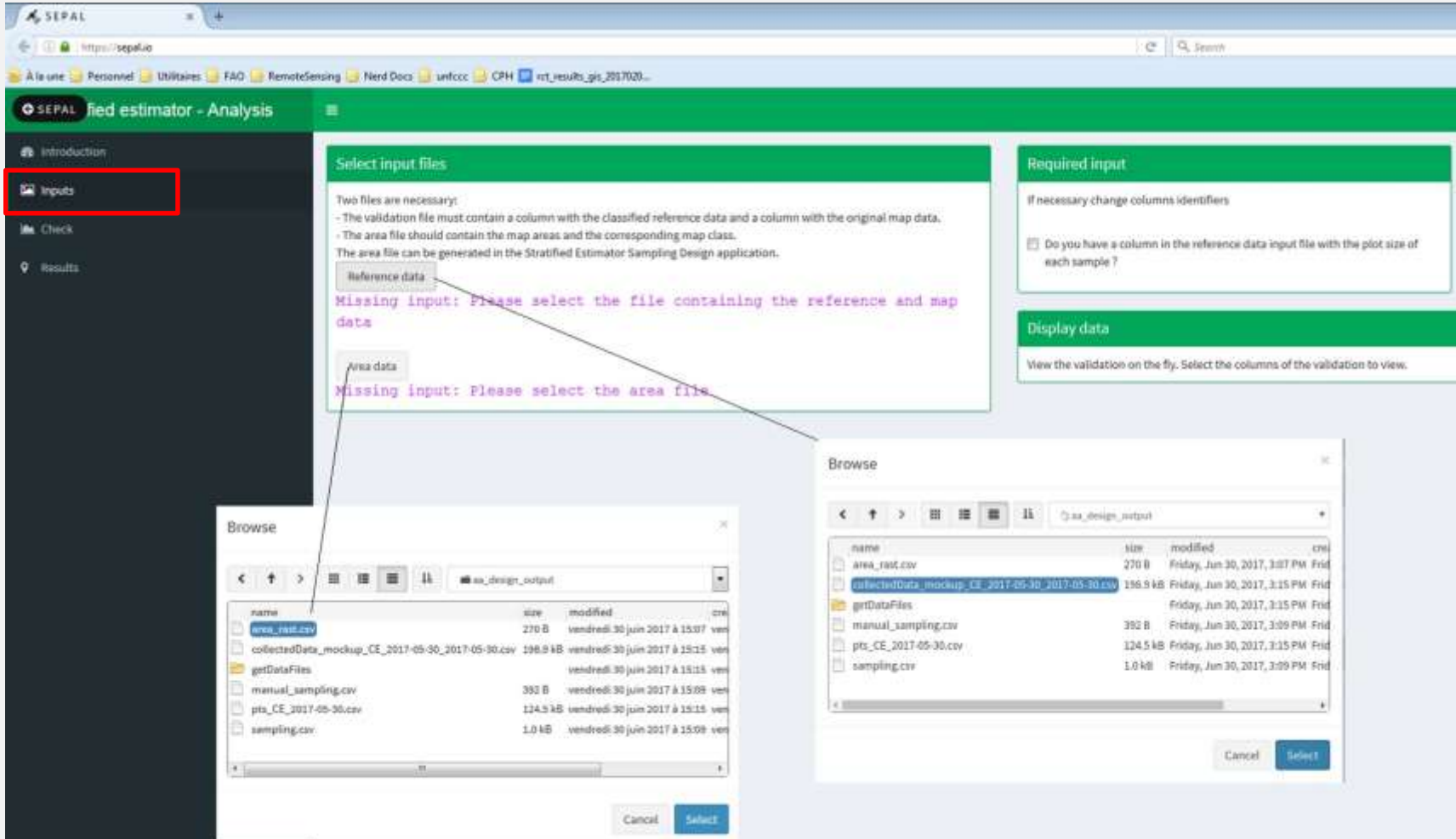
- Language:** A dropdown menu for selecting the language.
- Description:** A text box explaining the tool's purpose: 'This interactive tool analyzes results from a stratified design sampling to estimate areas. It also compares the results with those from a theoretical simple random design sampling. The objective of this tool is to provide a simple user interface for generating a probability dataset with stratified random sampling. For support ask Open Foris support forum'.
- How to use the tool ?** A section with a numbered list:
 1. Select the files containing the results of the sampling data collection and the strata areas
 2. Check that inputs match
 3. Compute areas, display graphs and export results
- Disclaimer:** A text box stating: 'FAO declines all responsibility for errors or deficiencies in the database or software or in the documentation accompanying it for program maintenance and upgrading as well as for any damage that may arise from them. FAO also declines any responsibility for updating the data and assumes no responsibility for errors and omissions in the data provided. Users are, however, kindly asked to report any errors or deficiencies in this product to FAO.'

At the bottom of the page, there are logos for SEPAL, UN-REDD PROGRAMME, and OPENFORIS.

Two input files are needed

Reference vs Map file
Strata area file

Both are located next to the map:
“sae_data_test/sae_design_test_map_congo/”



Select input files

Two files are necessary:

- The validation file must contain a column with the classified reference data and a column with the original map data.
- The area file should contain the map areas and the corresponding map class.

The area file can be generated in the Stratified Estimator Sampling Design application.

Reference data
Missing input: Please select the file containing the reference and map data

Area data
Missing input: Please select the area file

Required input

If necessary change columns identifiers

☐ Do you have a column in the reference data input file with the plot size of each sample?

Display data

View the validation on the fly. Select the columns of the validation to view.

Browse

name	size	modified	cre
area_rast.csv	270 B	Vendredi, 30 juin 2017 à 15:07	ven
collectedData_mockup_CE_2017-05-30_2017-05-30.csv	198.9 kB	Vendredi, 30 juin 2017 à 15:15	ven
getDataFiles		Vendredi, 30 juin 2017 à 15:15	ven
manual_sampling.csv	392 B	Vendredi, 30 juin 2017 à 15:09	ven
pts_CE_2017-05-30.csv	124.5 kB	Vendredi, 30 juin 2017 à 15:15	ven
sampling.csv	1.0 kB	Vendredi, 30 juin 2017 à 15:09	ven

Browse

name	size	modified	cre
area_rast.csv	270 B	Friday, Jun 30, 2017, 3:07 PM	Frid
collectedData_mockup_CE_2017-05-30_2017-05-30.csv	198.9 kB	Friday, Jun 30, 2017, 3:15 PM	Frid
getDataFiles		Friday, Jun 30, 2017, 3:15 PM	Frid
manual_sampling.csv	392 B	Friday, Jun 30, 2017, 3:09 PM	Frid
pts_CE_2017-05-30.csv	124.5 kB	Friday, Jun 30, 2017, 3:15 PM	Frid
sampling.csv	1.0 kB	Friday, Jun 30, 2017, 3:09 PM	Frid

Check point location

SEPAL field estimator - Analysis

Introduction

Inputs

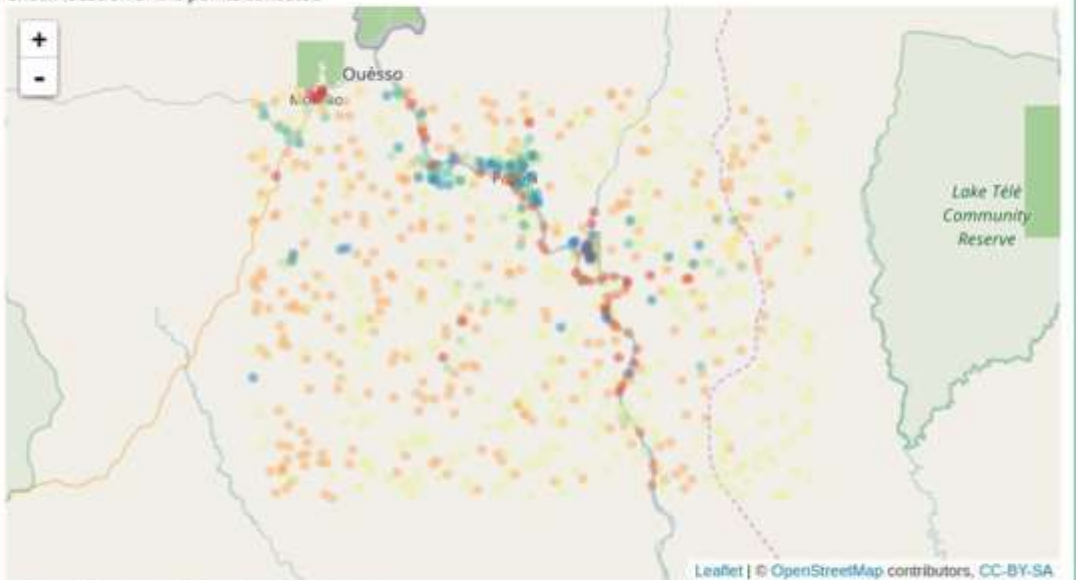
Check

Results

Check inputs

View samples

Check that columns contain the right information
Check location of the points collected



Choose the column with the X coordinate

location_x

Choose the column with the Y coordinate

location_y

Get results and download

You can filter by one field (e.g. CONFIDENCE)

SEPAL

Secure https://sepal.io

Apps FAQ_mail

SEPAL field estimator - Analysis

Introduction

Inputs

Check

Results

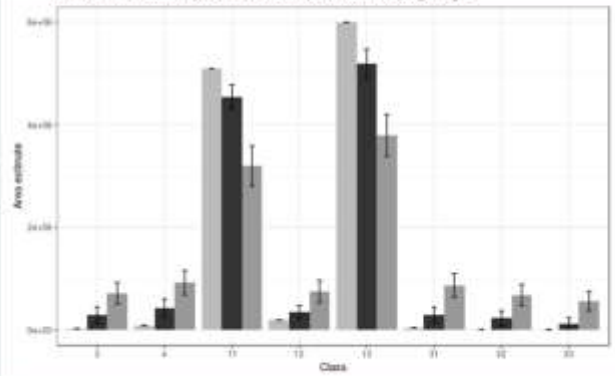
Confusion Matrix

	2	4	11	12	13	31	32	33
2	27	2	1	0	3	0	0	0
4	1	36	0	2	1	1	0	0
11	5	6	182	3	3	1	3	3
12	0	1	0	33	1	2	0	0
13	6	8	2	4	211	9	6	2
31	0	0	0	2	0	37	1	0
32	0	1	1	0	2	0	30	1
33	3	0	1	0	1	1	0	27

Download confusion matrix as tabular data (.csv)

Graph

Area estimates from map, stratified and simple random sampling designs



Sample design

- Map (grey)
- Stratified-random (black)
- Simple random (light grey)

Area estimates

Stratified and simple random area estimations and accuracies.

Area estimates for stratified random sample and simple random sample

Class	Number of samples	Stratified random area estimate	Stratified random confidence interval	Simple random area estimate	Simple random confidence interval
2	42	394293	157172	717794	210203
4	54	427903	177044	922879	236070
11	187	4542543	233134	3195896	389258
12	44	350679	127901	751975	214808
13	222	5185297	279336	3794058	468567
31	51	295930	146744	671608	229974
32	40	232905	141971	683614	205461
33	33	100000	100000	100000	100000

Filter data

You can filter the data on one of the columns (i.e. Confidence in visual interpretation)

☒ Do you want to filter the data?

Columns to filter:

confidence

Values to filter from column: confidence

TRUE

FALSE

Get results and download

You can filter by one field (e.g. CONFIDENCE)
Download confusion matrix and results

The screenshot shows the SEPAL web application interface. The left sidebar has a 'Results' link highlighted with a red box. The main content area displays a 'Confusion Matrix' table. Below the table, a red box highlights the 'Download confusion matrix as tabular data (.csv)' link. Two download dialogs are open. The first dialog, 'Opening matrix_2017-06-02.csv', shows options to 'Open with Microsoft Excel (default)', 'DownThemAll!', 'dTa OneClick!', or 'Save File'. The 'Save File' option is selected. The second dialog, 'Opening area_2017-06-02.csv', shows similar options, with 'Save File' also selected. A third dialog, 'Filter data', is open, showing a checkbox for 'Do you want to filter the data?' which is checked. Below this, the 'Columns to filter:' dropdown is set to 'confidence', and the 'Values to filter from column: confidence' dropdown is set to 'TRUE'.

Confusion Matrix

	2	4	11	12	13	31	32	33
2	27	2	1	0	3	0	0	0
4	1	30	0	2	1	1	0	0
11	5	6	182	3	3	1	3	3
12	0	1	0	33	1	2	0	0
13	6	8	2	4	211	9	6	2
31	0	0	0	2	0	37	1	0
32	0	1	1	0	2	0	30	1
33	3	0	1	0	1	1	0	27

Download confusion matrix as tabular data (.csv)

Opening matrix_2017-06-02.csv

You have chosen to open:

matrix_2017-06-02.csv
which is: Microsoft Excel Comma Separated Values File (260 bytes)
from: <https://sepal.io>

What should Firefox do with this file?

☐ Open with **Microsoft Excel (default)**

☐ DownThemAll!

☐ dTa OneClick! **C:\Users\dannunzio\Downloads**

☒ **Save File**

☐ Do this automatically for files like this from now on.

OK **Cancel**

Opening area_2017-06-02.csv

You have chosen to open:

area_2017-06-02.csv
which is: Microsoft Excel Comma Separated Values File (2,1 KB)
from: <https://sepal.io>

What should Firefox do with this file?

☐ Open with **Microsoft Excel (default)**

☐ DownThemAll!

☐ dTa OneClick! **C:\Users\dannunzio\Downloads**

☒ **Save File**

☐ Do this automatically for files like this from now on.

OK **Cancel**

Filter data

You can filter the data on one of the columns (i.e. Confidence in visual interpretation)

☒ **Do you want to filter the data?**

Columns to filter:

confidence

Values to filter from column: confidence

TRUE

FALSE