Quick start guide

for the

LACO-WIKI ONLINE TOOL

An Open Access Online Portal for Land Cover Validation

http://laco-wiki.net

Date of release: 30.04.2020

Table of Contents

1 INTRODUCTION 3

2 STEPS IN THE VALIDATION PROCESS 4

2.1 LOGIN 4
2.2 UPLOAD 5
2.3 LEGEND 7
2.4 GENERATING A SAMPLE COLLECTION 9
2.5 VALIDATING A SAMPLE COLLECTION 10
2.6 GENERATING AN ACCURACY REPORT 14

3 NEW FEATURES ADDED TO LACO-WIKI 17

3.1 ADDITION OF NDVI PROFILES 17
3.2 ADDITION OF FLICKR PHOTOGRAPHS 19
3.3 MULTIPLE VALIDATIONS AT THE SAME LOCATION 20
3.4 DELETION OF DATA SETS IN LACO-WIKI 21
3.5 ADDITION OF WMS LAYERS SECURED VIA BASIC AUTHENTICATION 23
3.6 COMPILE A SINGLE ACCURACY REPORT FROM MULTIPLE SESSIONS 23
3.7 ABILITY TO BOOKMARK VALIDATIONS 24
3.8 PRODUCTION OF A REPORT FOR COPERNICUS LOCAL COMPONENT PRODUCTS 26
3.9 IMPROVEMENTS TO SUPPORT LARGE SHAPEFILES 27

1 Introduction

LACO-Wiki is an open access online tool for land cover validation. This document provides an overview of the basic functionality of LACO-Wiki and guides you through uploading and validating a data set.

LACO-Wiki enables you to set-up statistically robust **sampling designs** and then visually interpret the samples in a **user-friendly environment.** You can then generate **state-of-the-art accuracy reports** for communication to map users.

The tool also includes data management and **sharing functionality** so that every data set uploaded or generated in LACO-Wiki can be managed by you and shared with other users.

Key Features

LACO-Wiki offers:

- A single online access point for the complete map validation process.
- A user-friendly environment to upload new maps and create sampling designs.
- State-of-the-art accuracy reports generated with just a few clicks.
- Easy access to shared data sets and validation sessions, allowing users to share the workload with other people in their team so that multiple people can validate a set of samples at the same time.

2 Steps in the Validation Process

The following section guides you through an example of a complete validation session from login to generating the final accuracy report.

2.1 Login

LACO-Wiki currently supports three different login options:

- An existing Geo-Wiki account, created at https://www.geo-wiki.org
- Facebook
- Google.

To get started, go to https://laco-wiki.net and use one of the three options to log into LACO-Wiki (Figure 1). Note that LACO-Wiki will ask you for permission to access your email address and public profile.

Figure 1: Login with your Geo-Wiki, Facebook or Google account

The first time you log into LACO-Wiki, you will be asked to review some **Terms of Use** and to accept these before you continue (Figure 2). The **Terms of Use** of LACO-Wiki were originally listed on the **About** page and did not require agreement by users. To be compliant with the European Union's General Data Protection Regulation, you are now required to read and agree to the Terms of Use before using the software. At the bottom of the Terms of Use is a link to the **Privacy Policy**; hence, users agree to both when they log in the first time. The user can view the Terms of Use and Privacy Policy at any time from the **About** page of LACO-Wiki:

https://laco-wiki.net/en/About

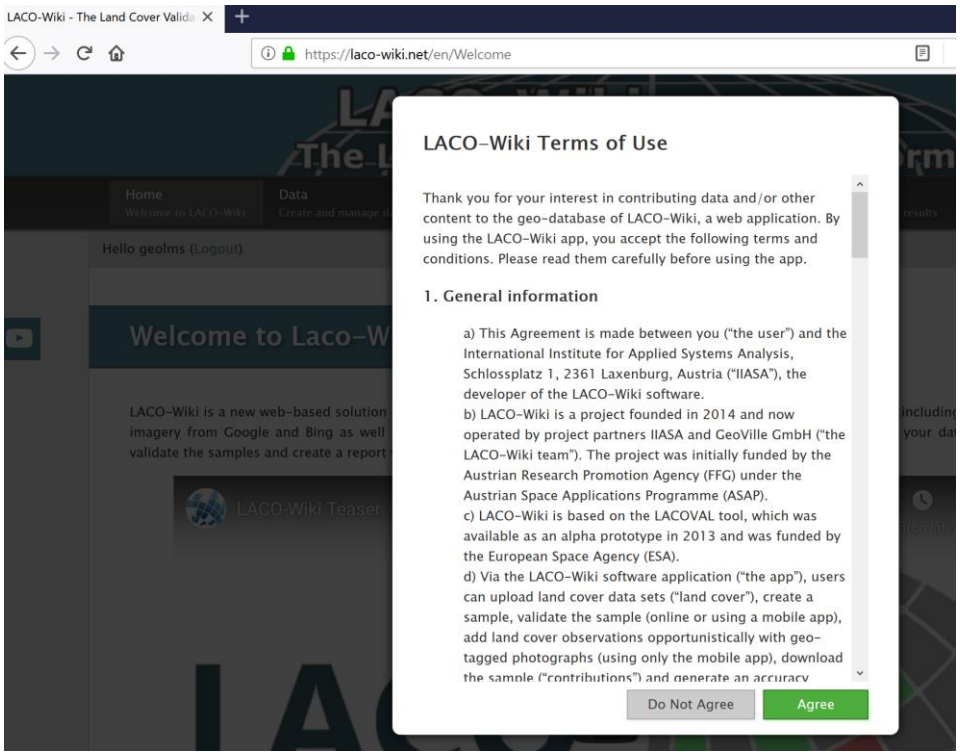


Figure 2: LACO-Wiki Terms of Use, which are displayed the first time that you log into LACO-Wiki

2.2 Upload

After logging in, you are ready to upload and create your first data set.

Select **Data** from the menu at the top of the application and then press the **Upload** button at the bottom of the page to begin creating a new data set in the system (Figure 3).

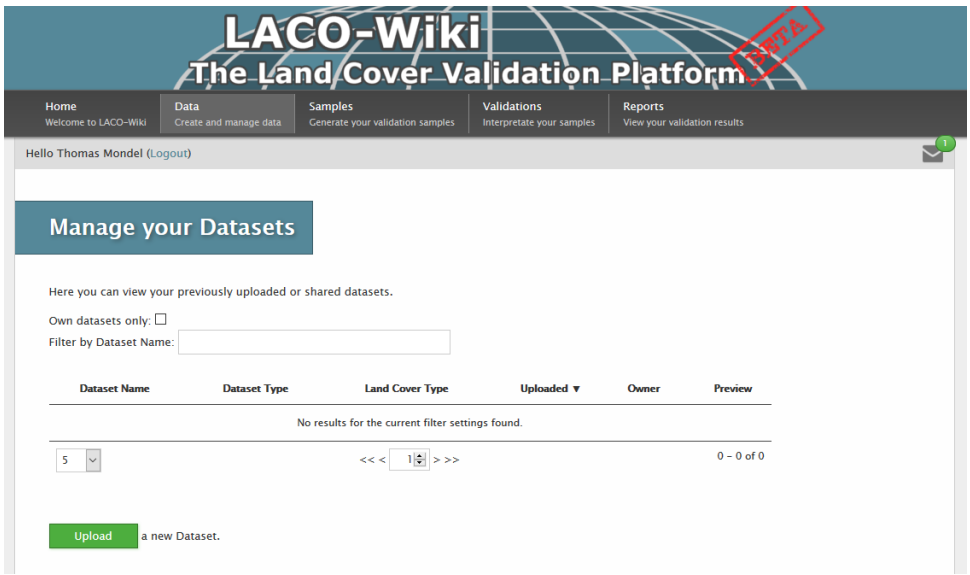


Figure 3: Click Upload to create your first data set

You will be forwarded to the **Create a new Dataset** screen (Figure 4). Here you can enter the details about your data set such as the name, land cover type and the description.

LACO-Wiki currently supports three different land cover types for your data set:

- **Categorical:** Also called thematic, discrete or classified data, categorical data can be in vector or raster format to represent discrete information. Examples of categorical data are land cover or land use maps such as the pan-European CORINE land cover data set, the Urban Atlas as well as global land cover maps such as ESA's CCI, GlobCover, etc.
- **Continuous:** Continuous data represent phenomena such as percentages, elevations or densities such as the Copernicus high resolution impervious layer, forest density or maps of population density.
- **Background:** In addition to base maps from Google Maps and Bing Maps, you can add your own background layers to aid in the validation process. Examples of such a data set would be an orthophoto of your study area.

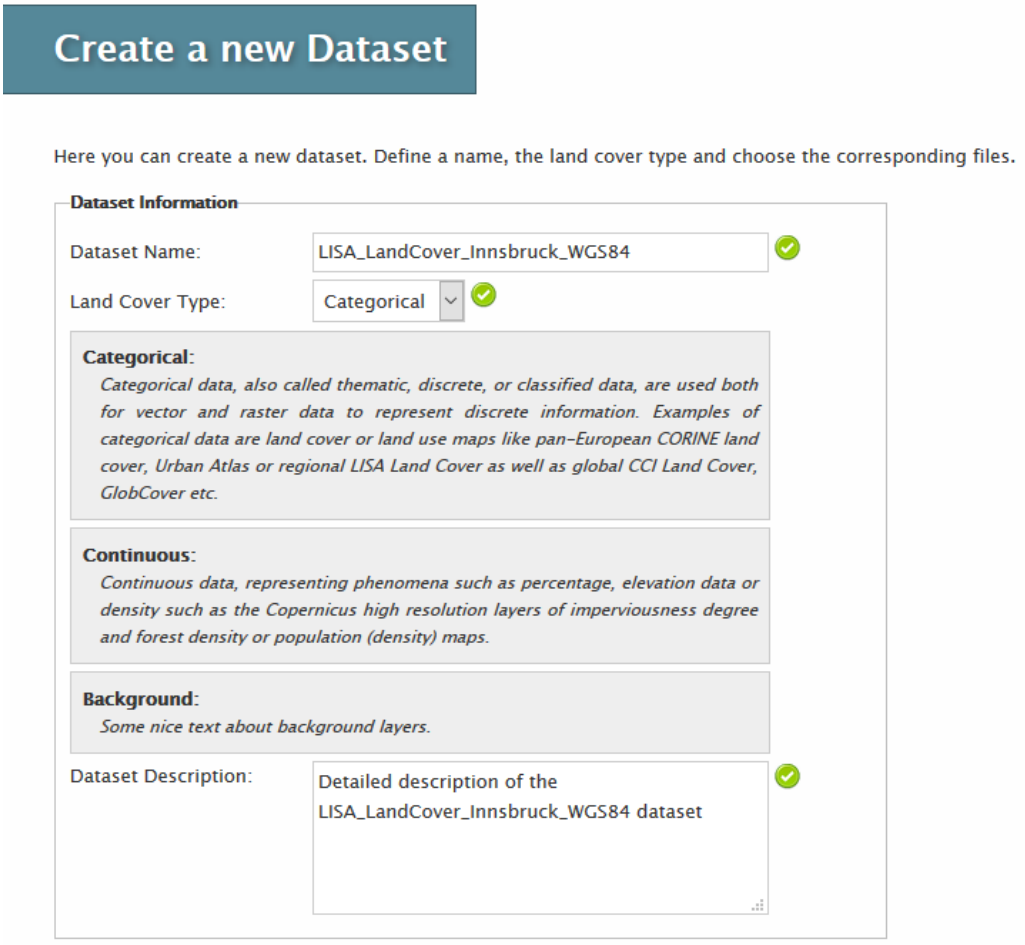


Figure 4: Enter your data set information

The final step is to add shape files or GeoTiffs to your new data set. Currently the following file types are supported:

- **Support file types:** Shape (.shp, .shx, .dbf, .prj) and GeoTiff (.tif, .tiff)
- **Supported spatial reference systems/projections:** WGS84 or ETRS89 LAEA

Add your files to the data set by clicking the **Select Files** button and manually select them using the file browser or simply drag-and-drop them into the area bounded by a dotted line (Figure 5).

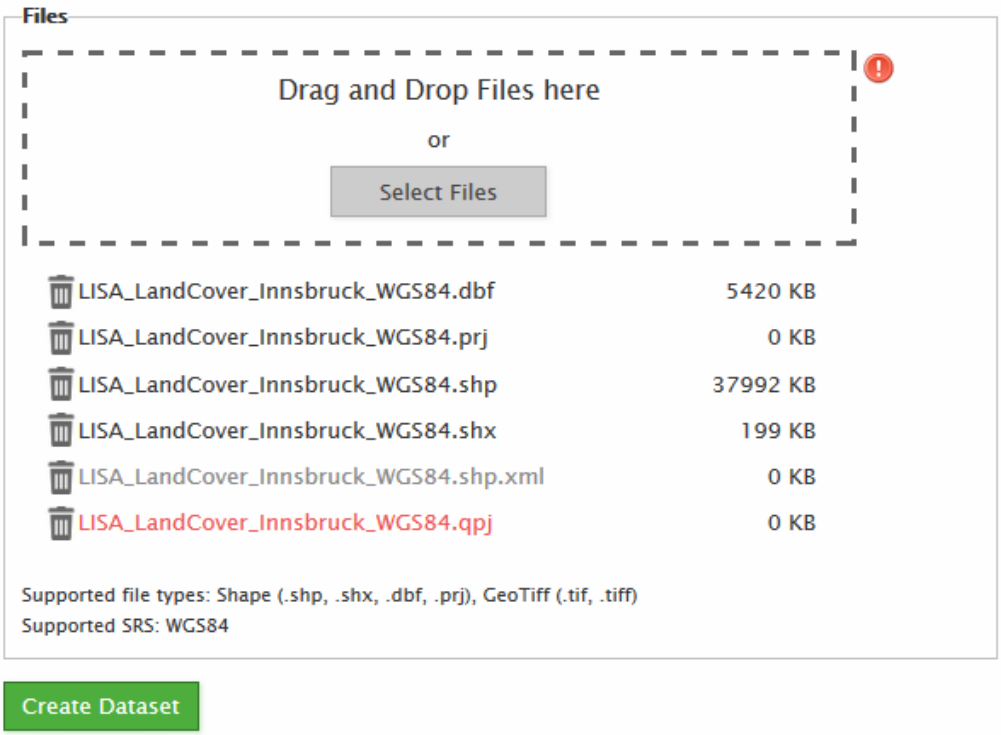


Figure 5: Adding files to the new data set

Unsupported file types are shown in red. Unknown file types are shown in grey. You can remove these files from the list by clicking the trash bin icon on the left.

Once you are happy with your selection, press the **Create Dataset** button to start the upload process and create your first data set in LACO-Wiki.

2.3 Legend

After the upload is finished, LACO-Wiki will automatically direct you to the **Dataset Details** page (Figure 6) while processing the data set in the system.

In the **Dataset Details** screen, you can see basic information about the new data set, share it with other users and define a legend.

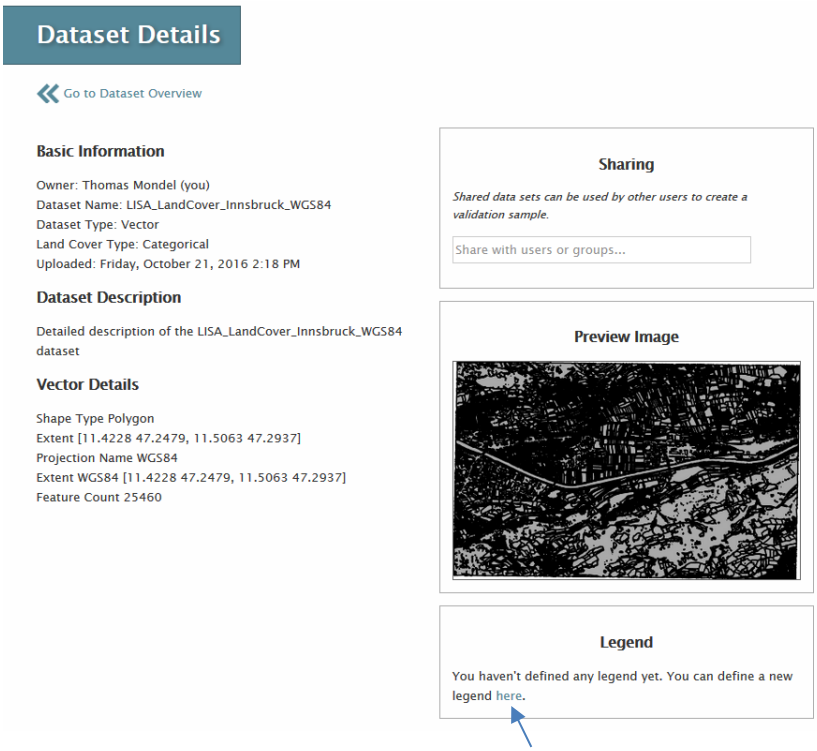


Figure 6: Data set details page. Click on **here** to define a legend.

In the **Legend** box, click on **here** to define the legend for your data set as shown in Figure 6.

You can define legend entries for all data values in the data set, add new values, remove existing ones or select the legend from a pre-defined set of legend templates (Figure 7). The preview screen shows you what your data set will look like when using the defined legend.

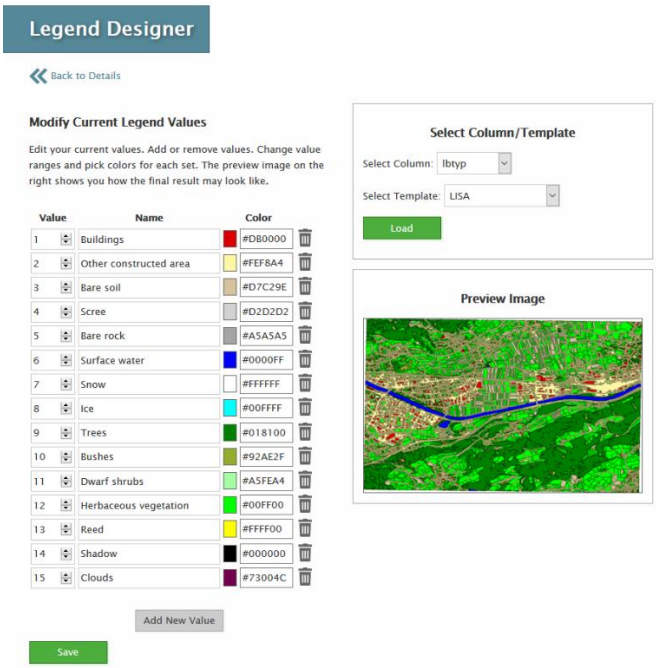


Figure 7: Define your data set classes (categorical) or range of values (continuous) and the associated colors in the legend designer

Once you are satisfied with your selection, click on the **Save** button and return to the **Dataset Details** page.

2.4 Generating a Sample Collection

The next step in the process is to create a **Sample Collection** based on your data set. A **Sample Collection** is a set of samples that will either be generated by LACO-Wiki using one of several possible sampling schemes or you can upload your own sample that you have generated outside of LACO-Wiki, e.g., using GIS software.

To start the process in which you generate the sample using LACO-Wiki:

1. Click the button in the **Validation Samples** section on the **Dataset Details** screen. This will direct you to the **Create a new Sample Collection** page (Figure 8).
2. Add the name and a description to your sample collection.
3. Add different sampling methods to your collection. Depending on type of data that you uploaded (vector or raster), different sampling methods will be available.

Currently the following sampling methods are supported:

- **Random Point:** This approach creates a sample with a number of points defined by the user that will be randomly distributed over a reference data set, e.g., the data set that you uploaded or a data set that has been shared.
- **Random Pixel:** This approach creates a sample with a number of pixels defined by the user that will be randomly selected from a reference data set. Duplicates are not possible.
- **Random Polygon:** This approach creates a sample with a number of polygons defined by the user that will be randomly selected from a reference data set. Duplicates are not possible.
- **Polygon at Random Point:** This approach creates a sample with a number of polygons defined by the user, which will be randomly selected from a reference data set, where the probability for selection is influenced by the size of the polygons (i.e., large polygons have a higher probability of being selected). Duplicates are not possible.
- **Stratified Random Point:** This approach creates a sample with a number of points per class defined by the user, which will be randomly distributed over the specified classes of a reference data set.
- **Stratified Random Pixel:** This approach creates a sample with a number of pixels per class defined by the user, which will be randomly selected from the specified classes of a reference data set.
- **Stratified Random Polygon:** This approach creates a sample with a number of polygons per class defined by the user, which will be randomly selected from the specified classes of a reference data set.

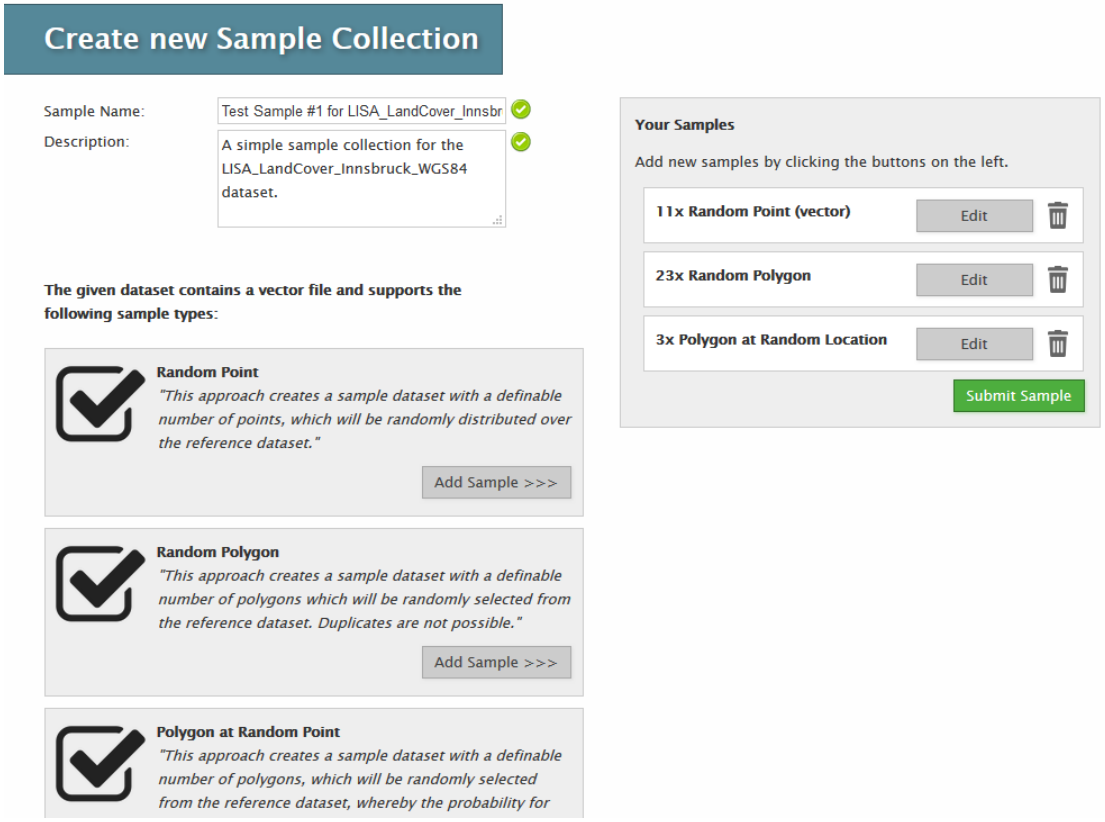


Figure 8: Create a new sample collection by adding different sampling methods to the collection. Different sampling methods are available depending on whether the data set is point, polygon or raster

2.5 Validating a Sample Collection

Your sample collection will now appear on the **Dataset Details** page. You can then add a new validation session based on the sample collection you created.

Click on **Add a validation session** to get started.

This will take you to the **Create your validation exercise** screen (Figure 9).

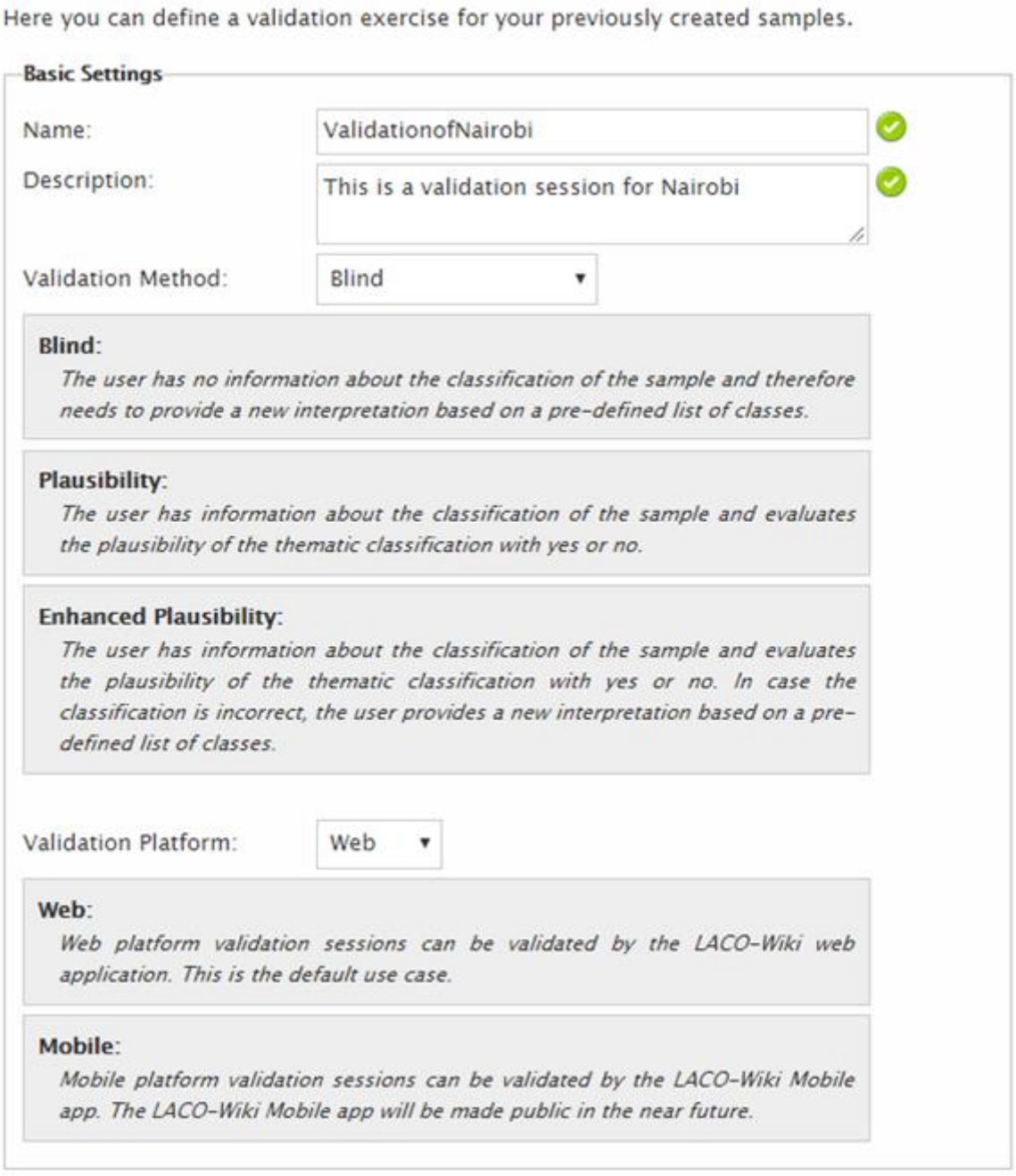


Figure 9: Create your Validation exercise

Enter a name for the validation session along with a description, and then choose a validation method. The following validation methods are currently supported:

- **Blind:** The user has no information about the classification of the sample and therefore needs to provide a new interpretation based on a pre-defined list of classes.
- **Plausibility:** The user has information about the classification of the sample and evaluates the plausibility of the thematic classification with yes or no.

- **Enhanced Plausibility:** The user has information about the classification of the sample, can answer yes and no, and if no (i.e., incorrect), they can correct the classification based on a pre-defined list of classes.

You can also choose your validation platform. There are two supported validation platforms available:

- **Web:** The validation process will be carried out inside a web browser using a number of base imagery data sets.
- **Mobile:** The validation process will be carried out using the LACO-Wiki mobile smartphone app on the ground. The mobile app can be downloaded from the Google Playstore and the Apple AppStore.

After choosing web or mobile, you can select some additional validation settings shown in Figure 10 such as the option to add a comment field, geo-tagged photographs from Flick and NDVI (normalized difference vegetation indices) profiles to the validation session.

Figure 10: Additional validation settings

Finally, you can set the minimum and maximum zoom level, the sample navigation (feature extent or fixed zoom level) and define the base layers and overlays (Figure 11).

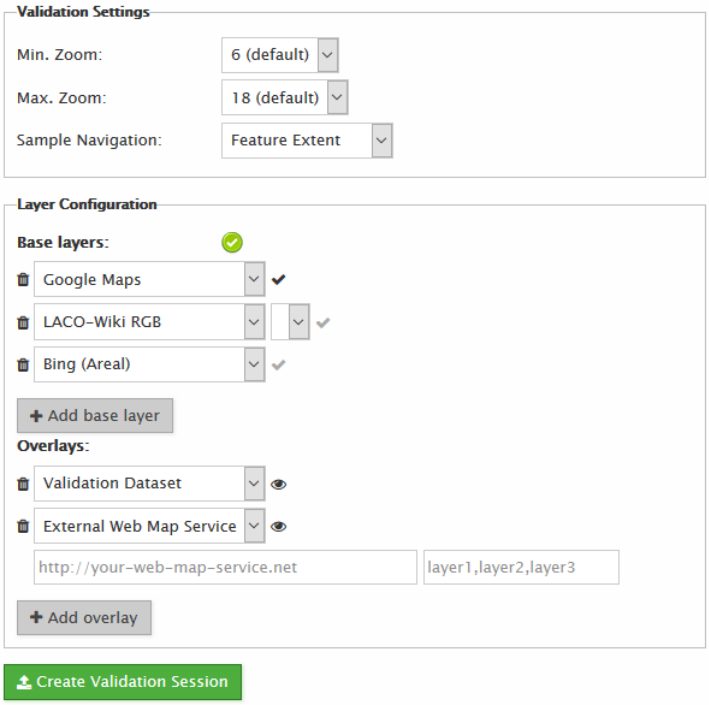


Figure 11: Configure your validation settings and layer configuration

When you have selected all the features, click on the **Create Validation Session** button to start validating your sample collection (Figure 12).

The process of validating your samples can be paused at any time and then continued when required. See the example in Figure 12 where the session was paused.

LACO-Wiki also allows you to split the validation workload by sharing the current validation session with other users. These users can then contribute to validating your data set.

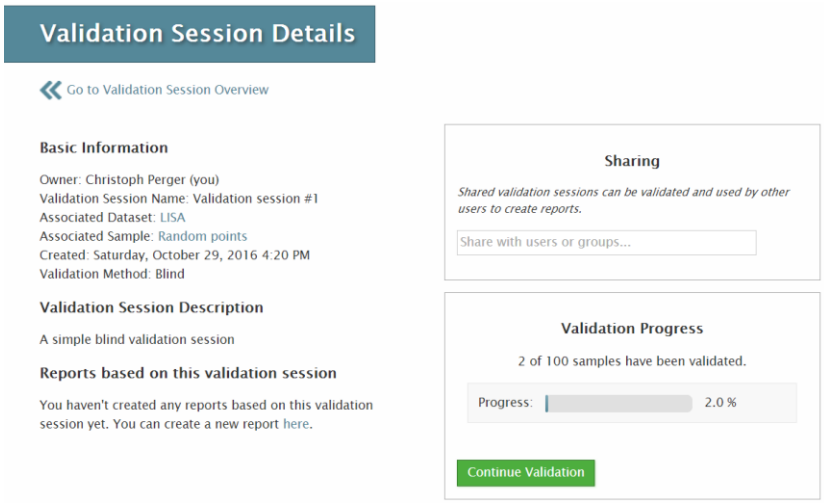


Figure 12: Details page of the validation session that has been created

The actual validation is done by classifying the object (point, polygon or raster grid cell) using one of the legend items. Figure 13 shows an example of blind validation of a point object. In this case you would classify the object by choosing one of the legend items on the right.

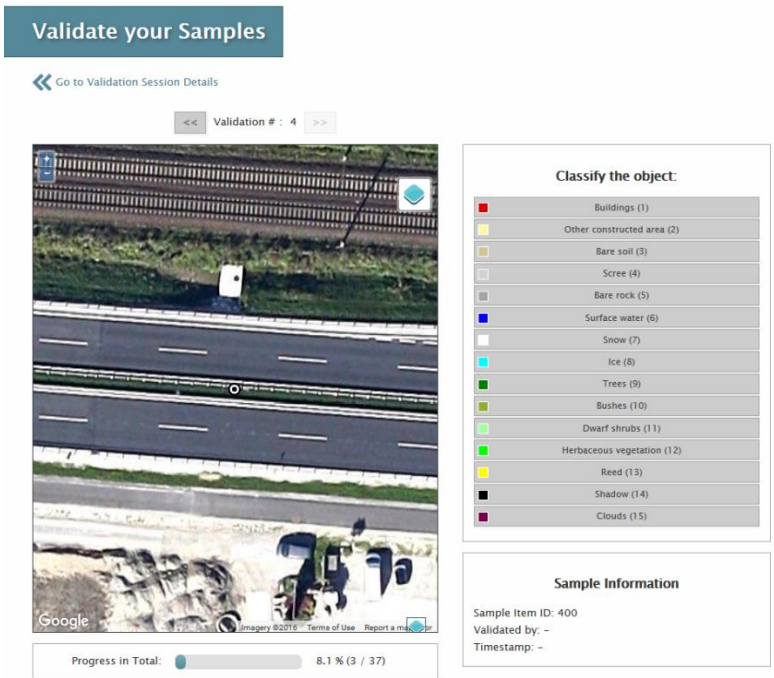


Figure 13: Details page of the validation session that has been created

2.6 Generating an Accuracy Report

After validating all the samples in the sample collection, you can go back to the **Validation Session Details** page to generate a report.

To do this, click on **Create a new report** in the section called **Reports based on this validation session**.

This will take you to the **Create your Report** screen (Figure 14).

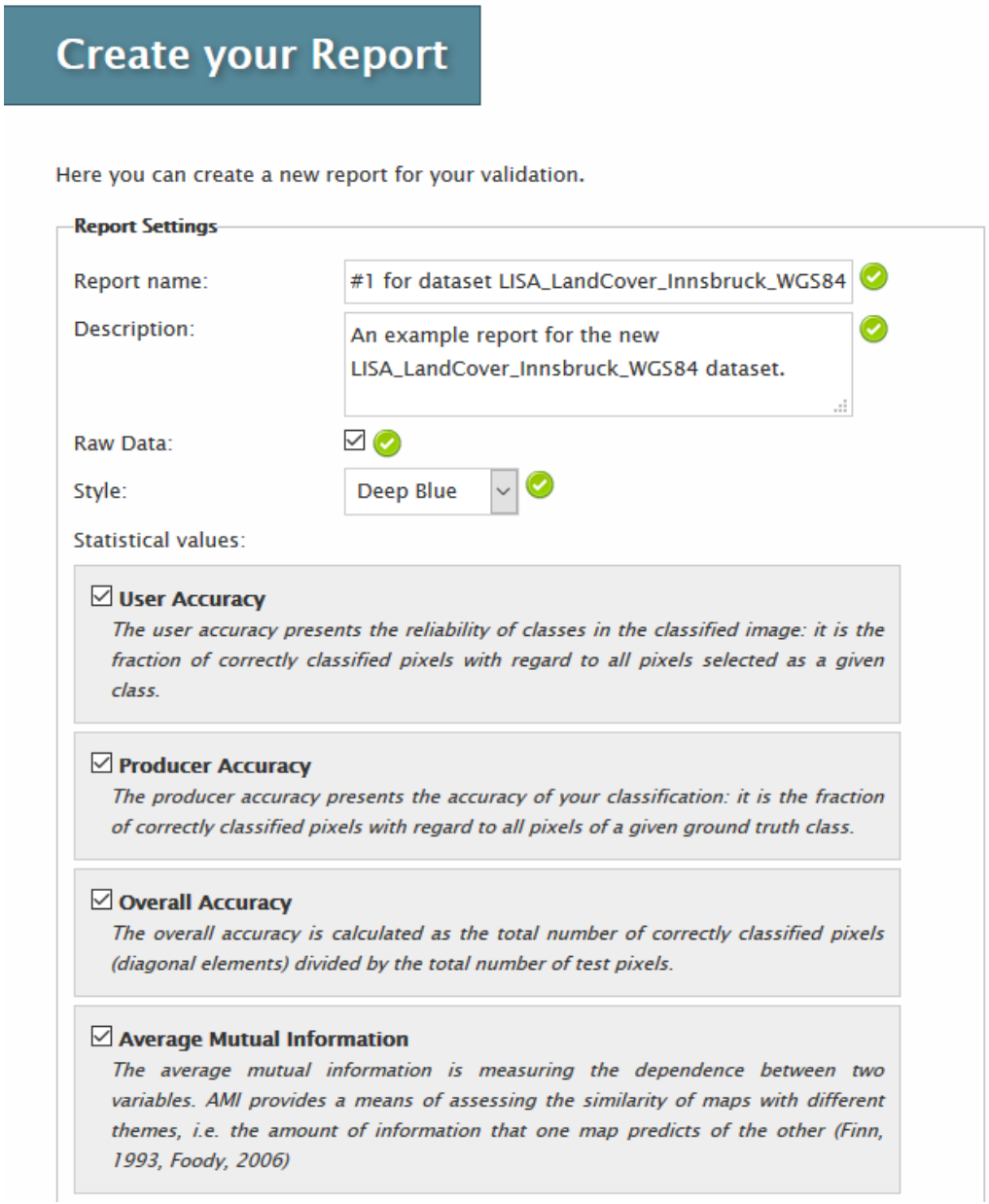


Figure 14: Create your Report screen

Start by giving the report a name and a description. You can then select from different pre-defined styles for the color scheme of the report.

Next, select the statistical values or accuracy measures that you want to add to the report. Currently the following values are supported:

- **User Accuracy:** The user accuracy is the reliability of classes in the classified image: it is the fraction of correctly classified samples compared to all samples selected for a given class.
- **Producer Accuracy:** The producer accuracy is the accuracy of your classification: it is the fraction of correctly classified samples compared to all samples of a given ground truth class.
- **Overall Accuracy:** The overall accuracy is as the total number of correctly classified samples (diagonal elements of a confusion matrix) divided by the total number of samples.
- **Average Mutual Information (AMI):** The average mutual information measures the dependence between two variables. AMI provides a means of assessing the similarity of maps with different themes, i.e., the amount of information that one map can predict from the other (Finn, 1993, Foody, 2006).
- **Quantity Disagreement:** The amount of difference between a reference map and a comparison map that is due to the less than perfect match in the proportions of the categories (Pontius and Millones, 2011).
- **Allocation Disagreement:** The amount of difference between a reference map and a comparison map that is due to the less than optimal match in the spatial allocation of the categories, given the proportions of the categories in the reference and comparison maps (Pontius and Millones, 2011).
- **Kappa:** Cohen's kappa coefficient is a statistic that measures inter-rater agreement for qualitative (categorical) items. It is generally thought to be a more robust measure than a simple percent agreement calculation, since kappa takes the agreement occurring by chance into account.
- **Portmanteau Accuracy:** The portmanteau accuracy describes the overall accuracy when the data are collapsed into two classes: the land cover type of interest, and all other land cover types combined into a single class.
- **Portmanteau Accuracy Partial:** Partial portmanteau accuracy eliminates true negatives from the calculation, so this measure is the number of correctly mapped samples in a class, divided by the total number of samples mapped or validated in a class.

Finally, generate your report by clicking the **Create Report** button. The report can then be downloaded in Excel format. An example is shown in Figure 15.

LACO-Wiki Validation Report, generated on 10/21/2016 3:02:56 PM

Classification Data	Reference Data: Buildings (1)	Other constructed area (2)	Bare soil (3)	Scree (4)	Bare rock (5)	Surface water (6)	Snow (7)	Ice (8)	Trees (9)	Bushes (10)	Dwarf shrubs (11)	Herbaceous vegetation (12)	Reed (13)	Shadow (14)	Clouds (15)	Row Total	User Accuracy
Buildings (1)	3	0	0	0	0	0	0	0	1	1	0	1	0	0	0	6	50.00%
Other constructed area (2)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.00%
Bare soil (3)	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0.00%
Scree (4)	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	3	0.00%
Bare rock (5)	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	3	0.00%
Surface water (6)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.00%
Snow (7)	0	1	0	0	0	0	0	0	1	0	0	3	0	0	0	5	0.00%
Ice (8)	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	4	0.00%
Trees (9)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.00%
Bushes (10)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.00%
Dwarf shrubs (11)	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2	0.00%
Herbaceous vegetation (12)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0.00%
Reed (13)	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	4	0.00%
Shadow (14)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00%
Clouds (15)	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0.00%
Column Total	6	1	1	0	0	0	0	0	10	8	0	11	0	0	0	37	
Producer Accuracy	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Portmanteau Accuracy	83.78%	94.59%	89.19%	91.89%	91.89%	97.30%	86.49%	89.19%	70.27%	75.68%	94.59%	67.57%	89.19%	100.00%	94.59%		

Allocation Disagreement	0.216216
Average Mutual Information	0.975478
Kappa	0.032308
Overall Accuracy	0.081081
Quantity Disagreement	0.702703

Figure 15: An example validation report in Excel

You have now successfully uploaded, created, sampled and validated your first data set using the LACO-Wiki online tool and downloaded your first accuracy report.

3 NEW FEATURES ADDED TO LACO-WIKI

Below is a description of the new features that have been added to LACO-Wiki during 2019 and the first two months of 2020 (as part of the CrowdVal project funded by the European Space Agency (ESA) and in support of the implementation of the Copernicus Land monitoring service, funded by the European Environment Agency (EEA).

3.1 Addition of NDVI profiles

The option to display NDVI profiles has been added to LACO-Wiki, which can help in visual interpretation, particularly for those land cover classes that are difficult to differentiate from the satellite imagery alone or that have a seasonal component.

To add NDVI profiles to a validation session, this feature must first be enabled when creating the session. An example is shown in Figure 16 in which the **Vegetation indices** check box is turned on if NDVI profiles are to be displayed.

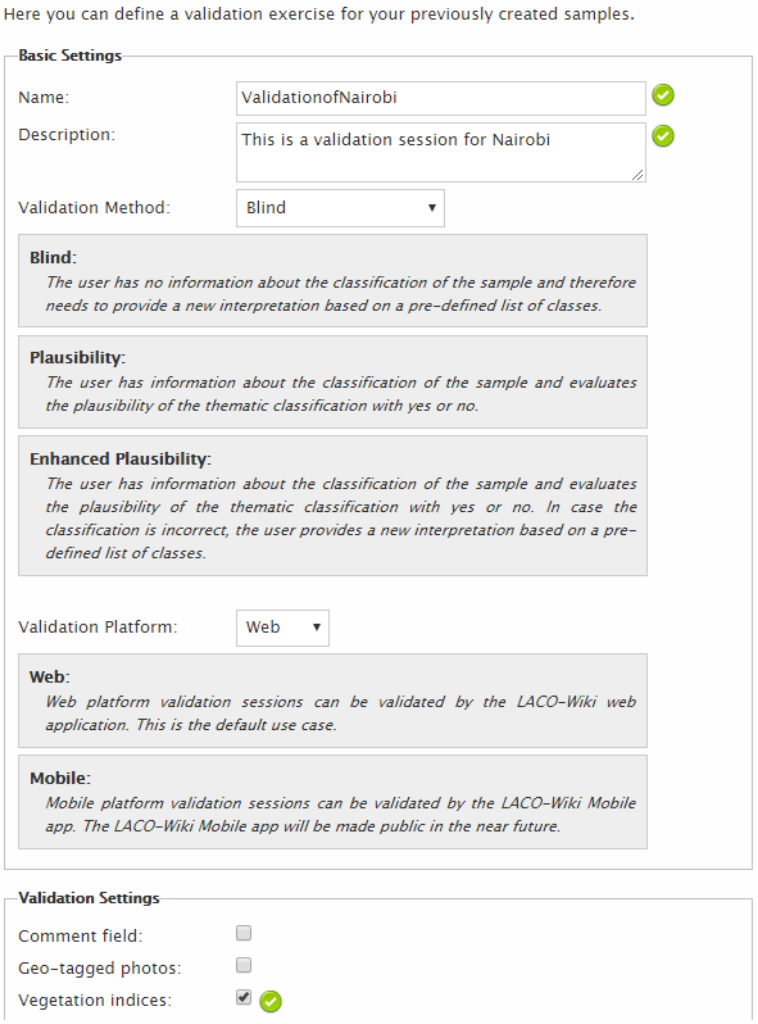


Figure 16: Enabling the NDVI profiles in a validation session

Once you enter the validation session, two sets of NDVI profiles will appear below the main validation area, as shown in Figure 17. The chart on the left shows a time series of 32-day composites from Landsat 7 and 8, a 16-day composite from MODIS and daily time series from the PROBA-V satellite. On the right is the average NDVI from each of these sources.

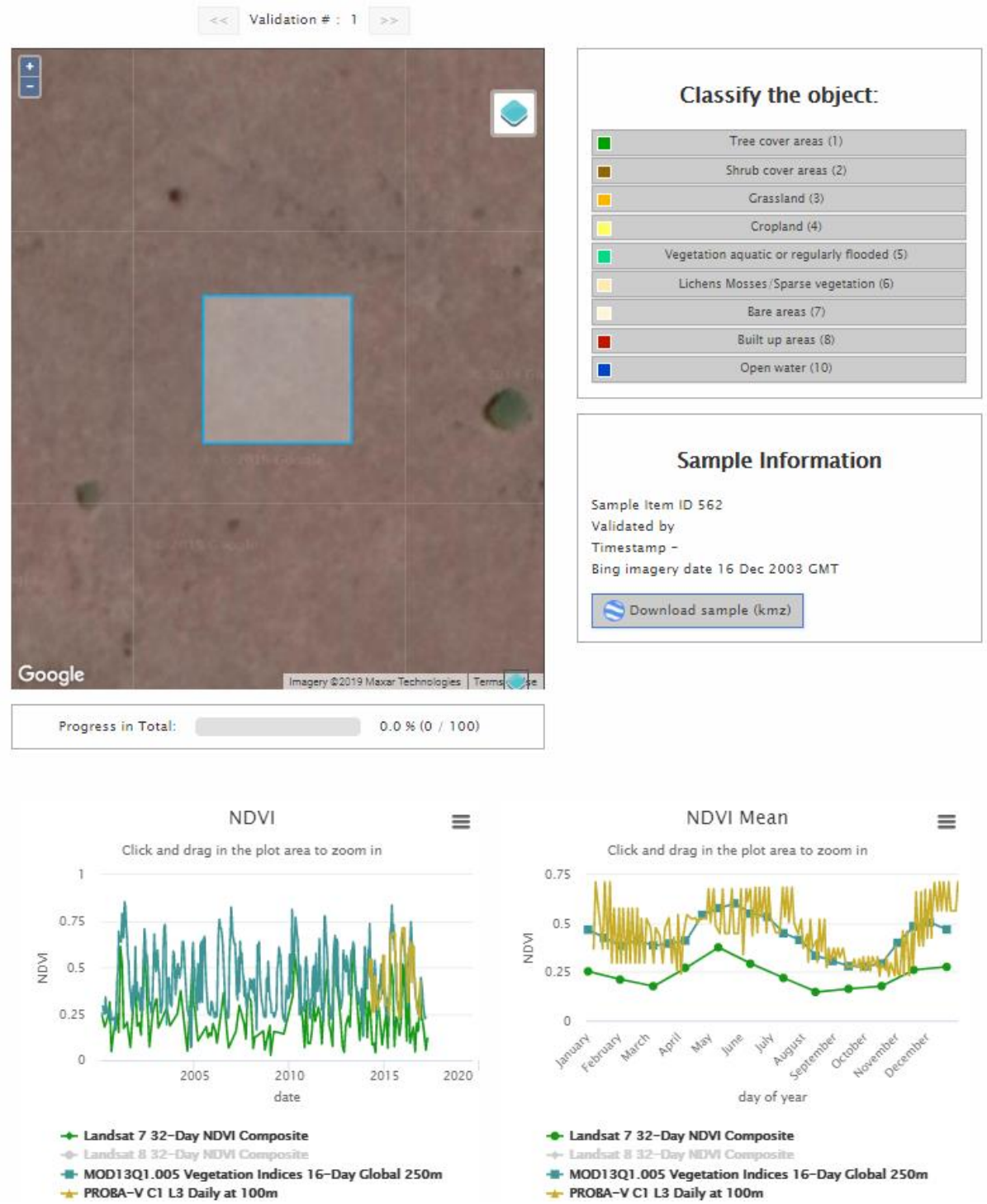


Figure 17: NDVI profiles that are displayed during a validation session

3.2 Addition of Flickr photographs

To aid in visual interpretation, geo-tagged photographs from Flickr have been added to LACO-Wiki. Similar to the NDVI profiles, this feature must be turned on during the creation of a validation session as shown in Figure 18.

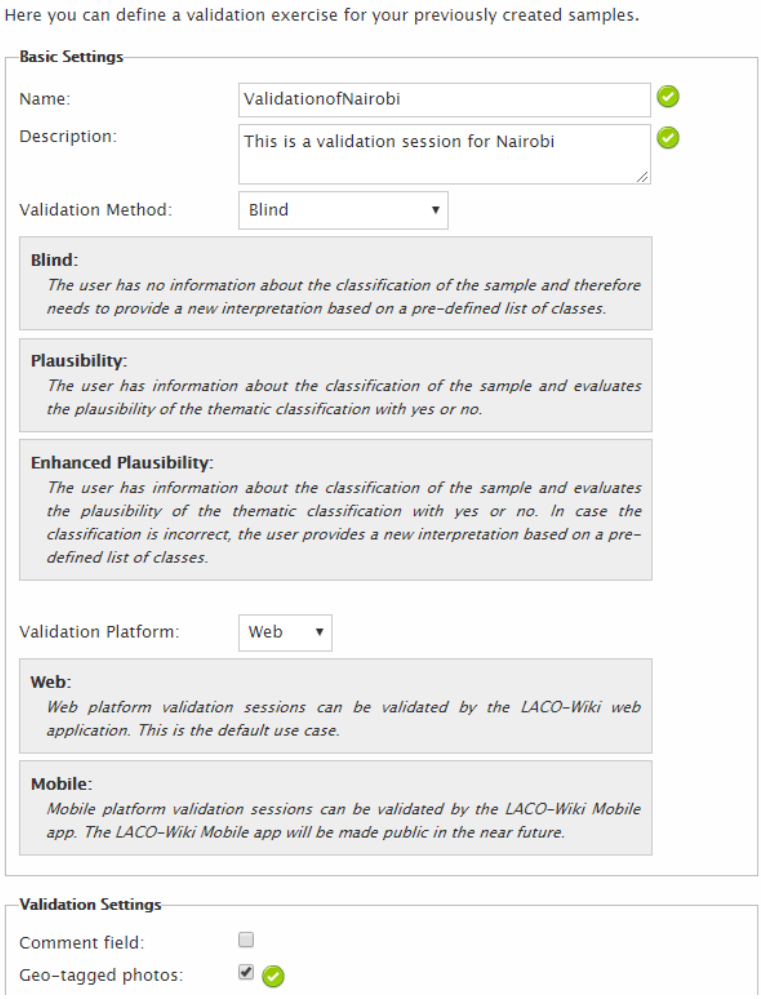


Figure 18: Enabling geo-tagged photos in a validation session

If a geo-tagged photograph is present, it will appear as a yellow dot on the satellite imagery. In most cases, users will need to zoom out to see whether photographs are present. Figure 19 shows an example of zooming out, where the pixel to be validated appears on the left near the top of the screen (small blue box) and a yellow dot indicates the presense of a geo-tagged photograph. Clicking on one of the dots displays the photograph, which in Figure 19 shows a Grassland type of land cover.

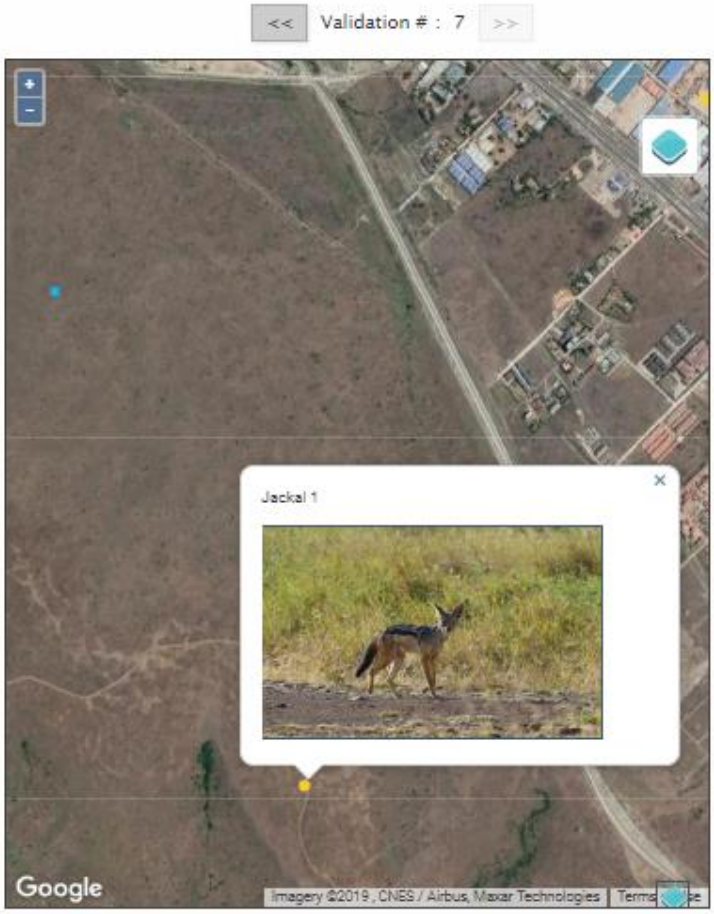
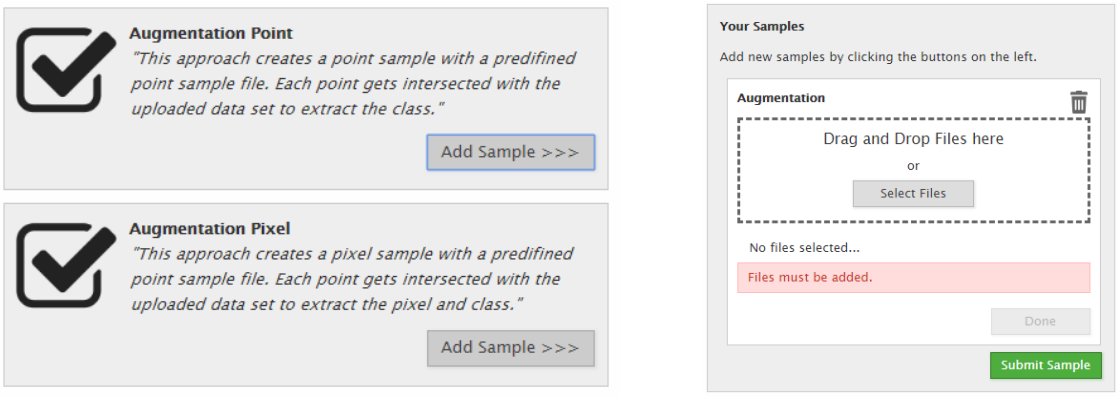


Figure 19: A geo-tagged photograph in the vicinity of the pixel being validated (shown as a small box in blue on the upper left-hand side)

3.3 Multiple validations at the same location

For reasons of quality assurance and the application of approaches such as majority voting to the validation data set, having multiple validations at the same location is possible in LACO-Wiki. This can be implemented as follows:

1. Create an initial sample of any type, i.e., random, stratified, etc.
2. Download the created sample as a shapefile from LACO-Wiki.
3. Create a second sample using the augmentation option that has been added to LACO-Wiki (see Figure 20a). Load the shapefile (see Figure 20b) downloaded in step 2.
4. Repeat step 3 to create the number of sample sets that correspond to the number of times you want a location to be validated.



(a) (b)

Figure 20: Implementing multiple validations in LACO-Wiki using (a) the augmentation feature to (b) upload a sample that was created initially and downloaded using LACO-Wiki

The process outlined above produces multiple samples of the same data set. These are then turned into multiple validation sessions that are assigned to (or shared with) different individuals, who then carry out the validation. Accuracy reports can be created for each validation session so that the results can be compared across individuals or the raw data can be downloaded to produce a combined validation data set (using external software such as a GIS package, Excel, R, etc.).

3.4 Deletion of data sets in LACO-Wiki

It is now possible to delete a data set uploaded to LACO-Wiki along with all the associated files, i.e., sample collections, validation exercises and accuracy reports. Figure 21 shows an example of a data set that was uploaded and the **Delete data set** button at the bottom of the page.

Deleting a data set before any sample collections, validation exercises or accuracy reports have been created is straight forward and the data set will be removed from the list of data sets.

Once any sample collections, validation exercises or accuracy reports have been created, you need to decide whether you want to delete all the files (in which case you should check the box entitled **Delete all associated files**), or whether you only want to delete the data set and keep the associated files accessible, e.g., you may not want the data set to remain in LACO-Wiki but you would like to keep the accuracy report.

You should also note that if you have shared the data set with other users (or everyone), then you need to be aware that checking the **Delete all associated files** check box will also deleted any associated files that other users have created.

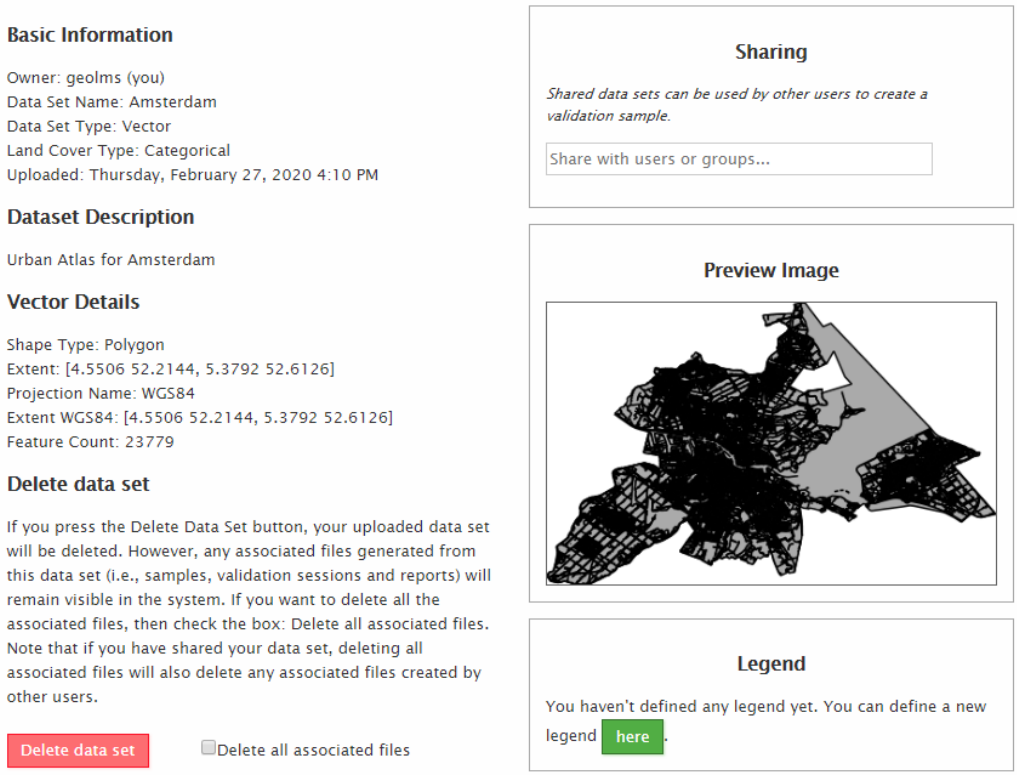
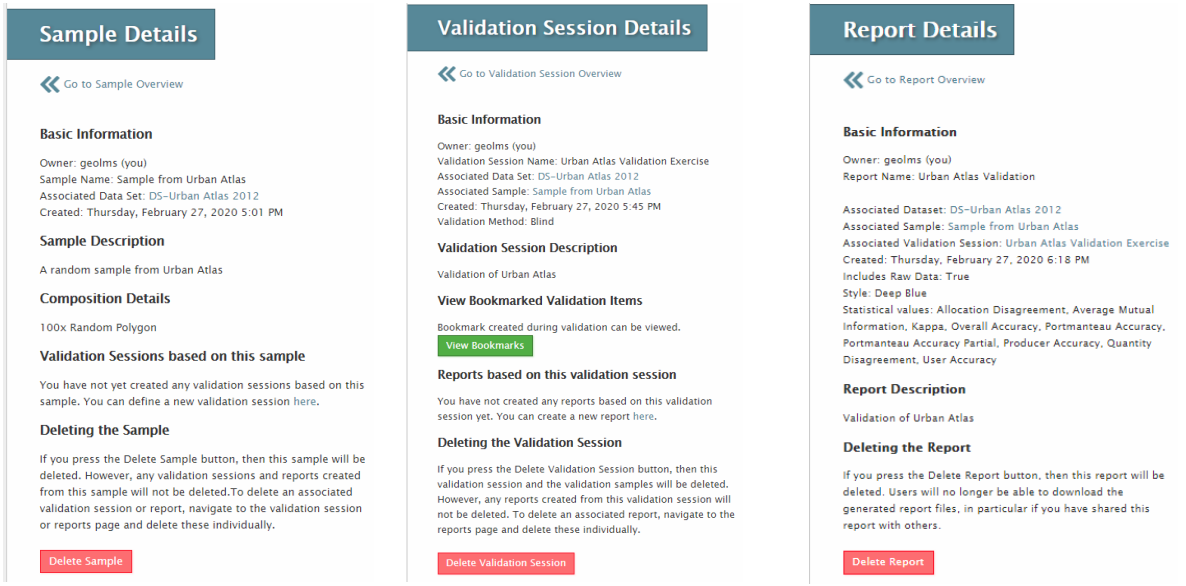


Figure 21: The Delete data set option is now available and visible once you have uploaded a new data set to LACO-Wiki

Deletion options are also available for individual associated files, e.g., if you create a sample collection from a data set, you can delete that sample collection while retaining the data set. Deletion options for different file types in LACO-Wiki are shown in Figure 22.



(a) (b) (c)

Figure 22: Deletion options for (a) a sample (b) a validation session and (c) an accuracy report

3.5 Addition of WMS layers secured via basic authentication

In addition to adding WMS layers that are openly available with no authentication, you can now load a WMS layer with basic authentication, e.g., a set of your own orthophotos sitting on a secure server.

In the **Create your Validation Exercise** in the **Layer Configuration** box, you can now add an **External Web Map Service** that is secured via basic authentication (i.e., accessible with a username and password) as either a base layer or an overlay as shown in Figure 23.

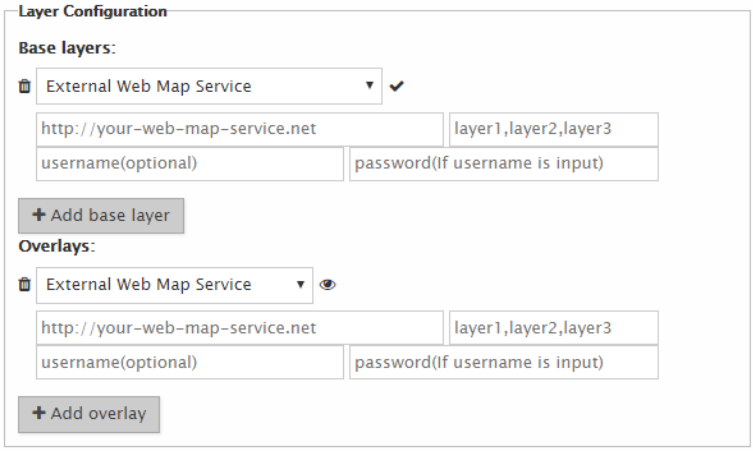


Figure 23: Adding a WMS to a validation session that has a username and password

3.6 Compile a single accuracy report from multiple sessions

There are situations in which you may wish to validate a single layer in multiple sessions. The reason for this is either because your map is greater than 2GB, which is the limit for shapefiles, or you want to assign certain classes to different validators, e.g., those with specific expertise in interpreting certain classes. These multiple sessions then need to be combined into a single accuracy report. This feature has now been added to LACO-Wiki. From the **Manage your Reports** screen (Figure 24), you can select multiple validation sessions in the drop-down box next to the **Create** button. This will combine the validations into a single confusion matrix and calculate one set of accuracy measures.

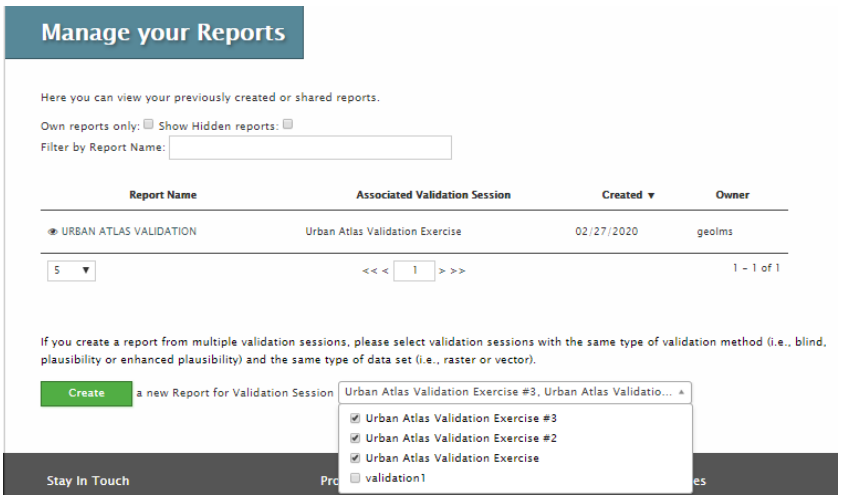


Figure 24: Creating a single report from multiple validation sessions

Note that the user must choose the correct validation sessions. This means they must have been interpreted using the same validation method (i.e., blind, plausibility or enhanced plausibility) and the same type of data set (i.e., raster or vector).

3.7 Ability to bookmark validations

During a validation exercise, you might encounter an example that you want to bookmark for future use, e.g., as a screen shot to be added to the Local Components Validation Report (see 3.8). While in any validation session, you will see the option to add a bookmark at the bottom of the page. For example, Figure 25 shows a ploughed field; if you want to bookmark this, you give the bookmark a name (e.g., PloughedField) and press the **Add Bookmark** button.

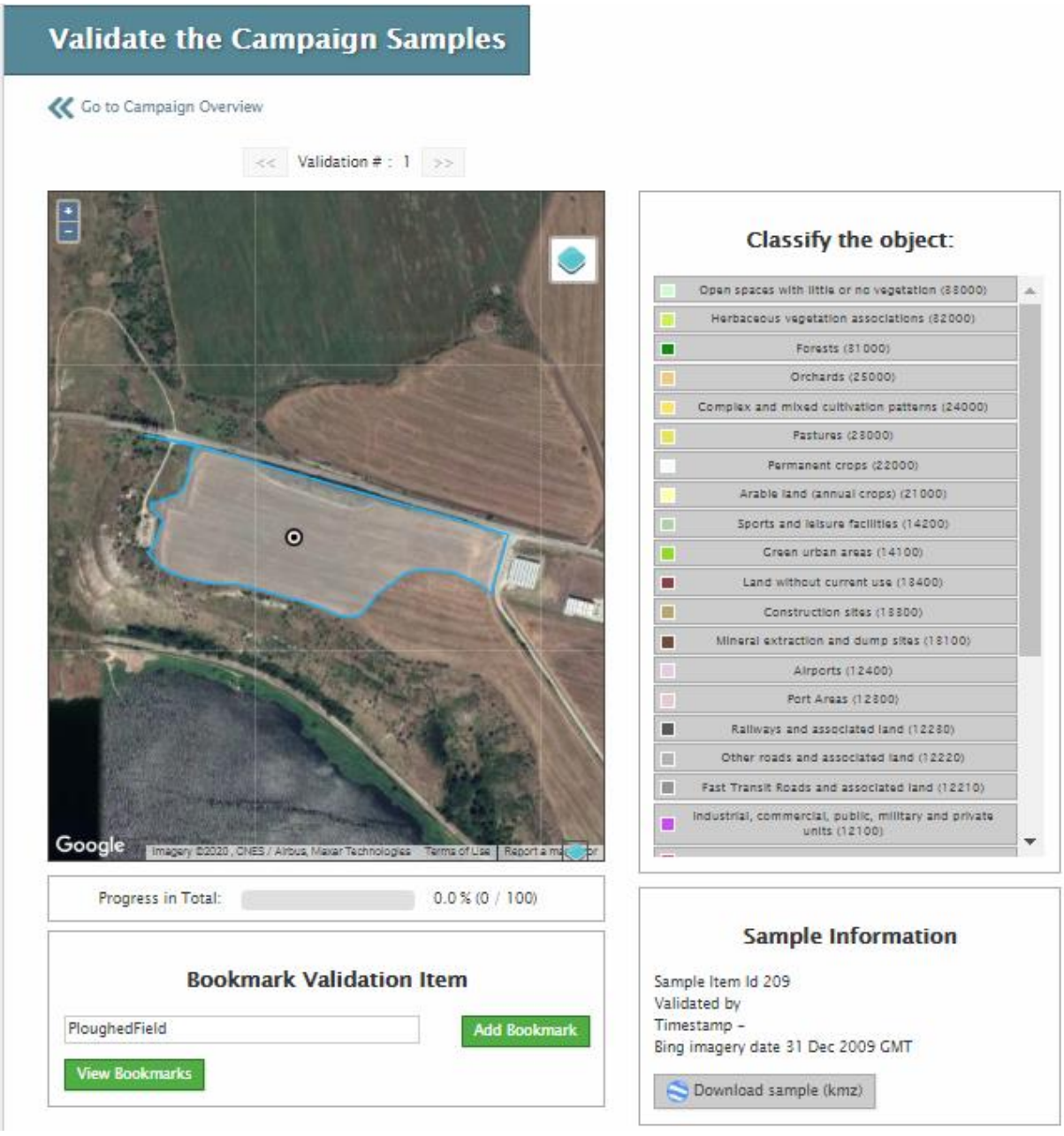


Figure 25: Adding a bookmark to an individual validation sample

Once the bookmark is created, it can also be deleted, as shown in Figure 26.

Figure 26: The Delete button can be used to delete the bookmark that was created.

From the **Validation Session Details** page, you can view your bookmarks by clicking on the **View Bookmarks** button (Figure 27), which then displays them in a list (Figure 28).

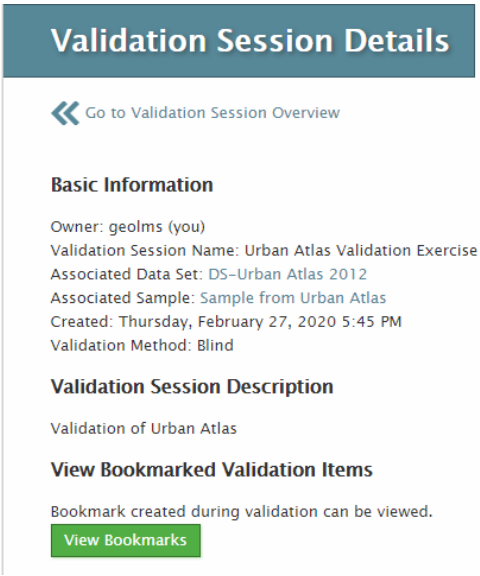


Figure 27: The **View Bookmarks** button can be used to view all bookmarks associated with that validation session in a list

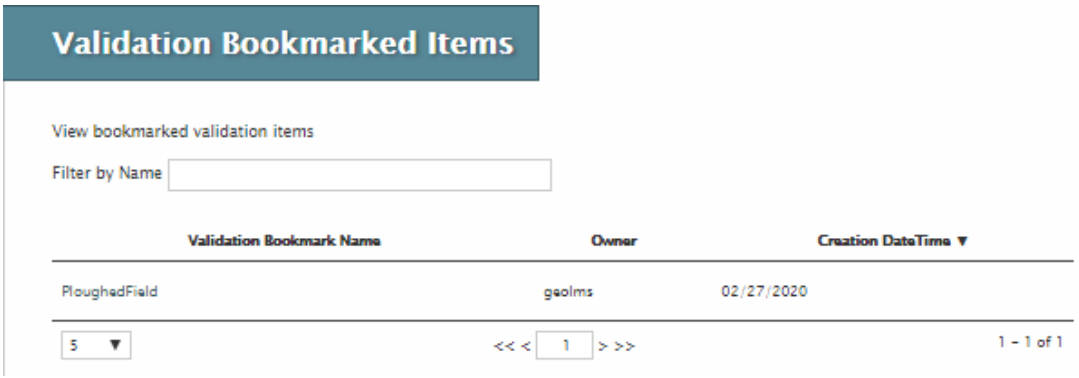


Figure 28: The list of bookmarked validation items

3.8 Production of a verification report for Copernicus Local Component Products

This feature was implemented to allow users involved in the verification of local component products from Copernicus (e.g., Urban Atlas, Natura 2000 sites, etc.) to produce a verification report that matches the one specified in the **Guidelines for Verification of Local Component Products**. This includes all the information required plus placeholders for missing pieces (e.g., screenshots that were bookmarked using the feature outline in 3.7).

The option to create these reports will only be enabled when you have uploaded a vector polygon data set (or used the augmentation feature outlined in section 3.3 to upload a polygon sample) and enabled the **Geometry validation** option in the creation of a validation session (Figure 29).

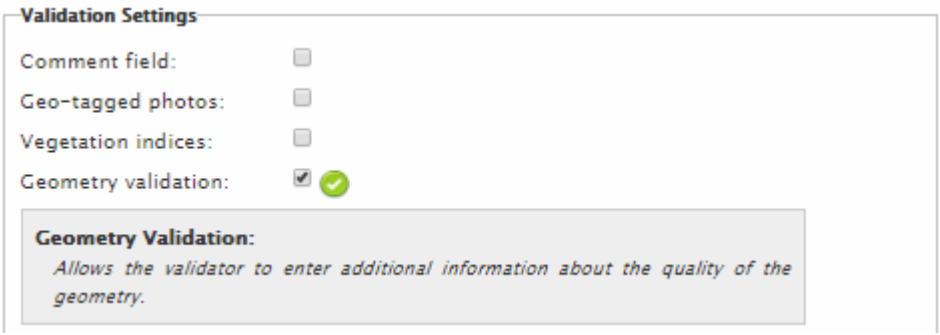


Figure 29: The **Geometric validation** option must be enabled in the validation session to generate the verification report

When a report is then generated, the option to download the **Verification Report Template** will appear as shown in Figure 30.

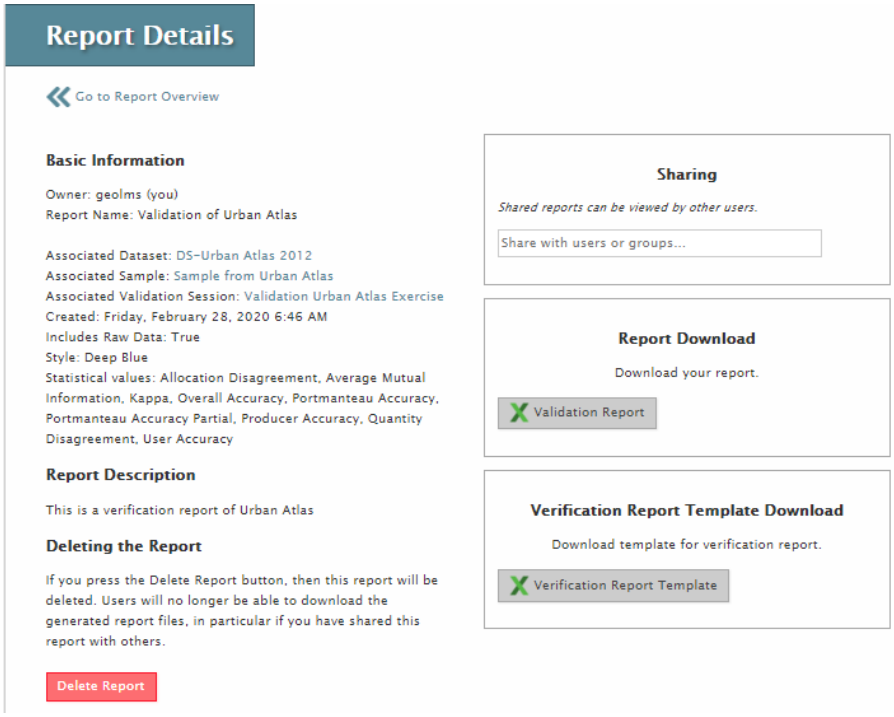


Figure 30: The **Verification Report Template** can be downloaded from the **Report Details** page

The report consists of three main components:

1. A sheet containing the **Metadata**. Most of the information on this sheet must be filled in by you.
2. A sheet containing the **Overall characterization of the dataset**. Most of the information is populated by LACO-Wiki including the summary statistics, but you will need to add a map of the data set.
3. Multiple sheets containing the **Characterization of the dataset by LU/LC class**, where there is one sheet per class. Most of the information is populated automatically by LACO-Wiki but you will need to add screenshots from the bookmarked validations.

The Excel report can also be converted to a Word document if you prefer this format.

3.9 Improvements to support large shapefiles

To accommodate large shapefiles (i.e., the .shp or .dbf component approaches 2 GB in size or there are many millions of features in the shapefile), the processing of shapefiles has been improved in LACO-Wiki. After uploading a shapefile, the processing of the data set takes place in the background so you can continue to use LACO-Wiki (see **Vector Details** in Figure 31). An email is sent to your registered email address telling you that the process has started. When the process is completed, you will be sent another email to your registered email account.

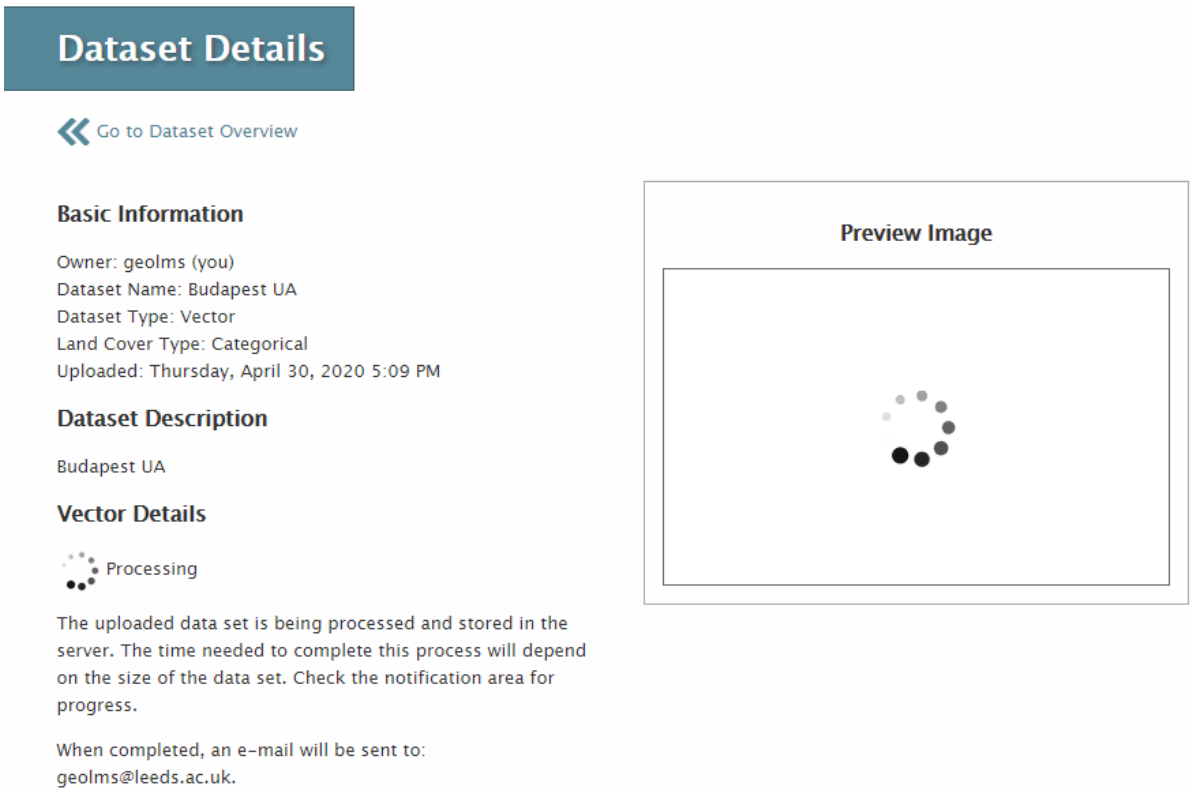


Figure 31: Under **Vector Details**, you are provided with information about the progress in analyzing this data set, and that you will be sent an email when the processing is completed.

Similarly, when you select a legend template or define a legend, the processing will take place in the background and you will receive an email telling you that the process has started and another email

when the process is completed. Figure 32 shows the processing happening in the background, telling you that an email will be sent to your registered email address when complete.

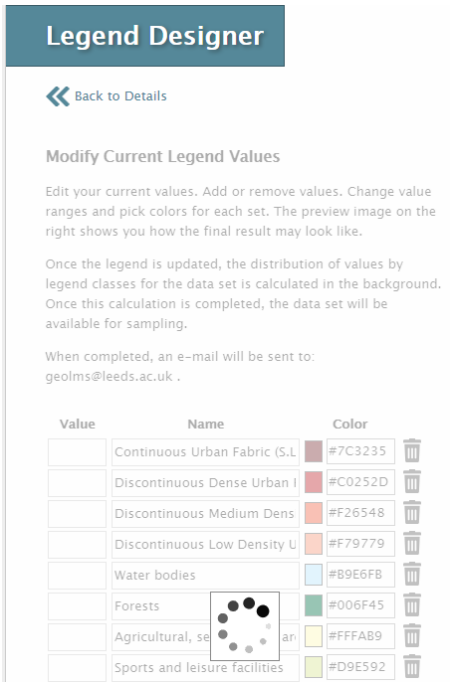


Figure 32: Under **Vector Details**, you are provided with information about the progress in analyzing this data set, and that you will be sent an email when the processing is completed.

In the future, we plan to support File Geodatabases, which will mean that larger files can be uploaded to LACO-Wiki. For the moment, if you have problems with your shapefile, contact us at info@laco-wiki.net or create your sample outside of LACO-Wiki. Then upload it using the Augmentation feature (see section 3.3).