LACO-Wiki: A land cover validation tool and a new, innovative teaching resource for remote sensing and the geosciences

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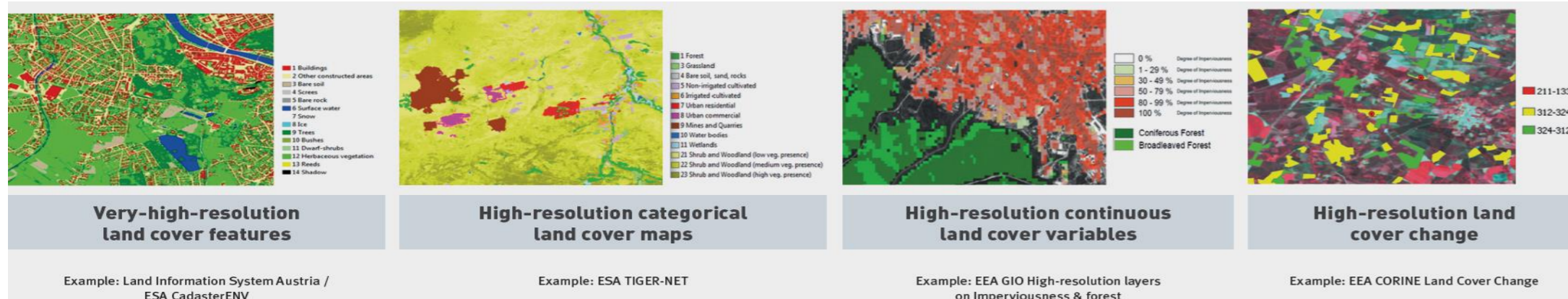**Try it out at www.laco-wiki.net**

Background

Validation is a key requirement for both users and producers of Earth Observation derived land cover and land cover change products, in order to provide evidence that a specific information service yields products of high quality.

Validation requires knowledge of sampling design, image interpretation and/or field-based in-situ reference data collection. The process of validation is taught within remote sensing courses at the undergraduate and graduate levels. However, it often requires specialized software or knowledge of computer programming. LACO-Wiki is the first online land cover validation tool that can be used by map producers, e.g. in validating products from the European Environment Agency (EEA) and the European Space Agency (ESA) , as well as teachers and students of remote sensing.

Very-high-resolution land cover features	High-resolution categorical land cover maps	High-resolution continuous land cover variables	High-resolution land cover change
Example: Land Information System Austria / ESA CadasterENV	Example: ESA TIGER-NET	Example: EEA GIO High-resolution layers on Imperviousness & forest	Example: EEA CORINE Land Cover Change

The LACO-Wiki framework

LACO-Wiki provides a framework for combining land cover validation methods and workflows in a single web interface including:

• Online storage, management and sharing of all necessary spatial data incl. user-generated maps;
• Guidance through the entire validation process in the form of "wizards";
• Methodologically sound sampling designs and rapid interpretation of samples in a user-friendly environment; and
• The generation of state-of-the-art accuracy reports for communication to all types of users.

Users upload their own map for validation and then use satellite imagery from Google Maps® and Bing® as well as an OpenStreetMap® layer to validate a sample generated automatically by the system. In the near future it will be possible to upload your own reference data or access additional reference layers for validation using a Web Map Service, e.g. aerial photographs.

Feature overview

The main features of the system are shown in the figure below. The five horizontal features represent the overall workflow of the LACO-Wiki system from the start of the process when the data are uploaded, the actual validation process and the final reporting at the end. A step-by-step example of the validation workflow is shown in more detail on the right hand side of the poster.

User management, data sharing, localization, performance and security are cross-cutting features of the system as shown vertically on the left and right hand side of the figure below.
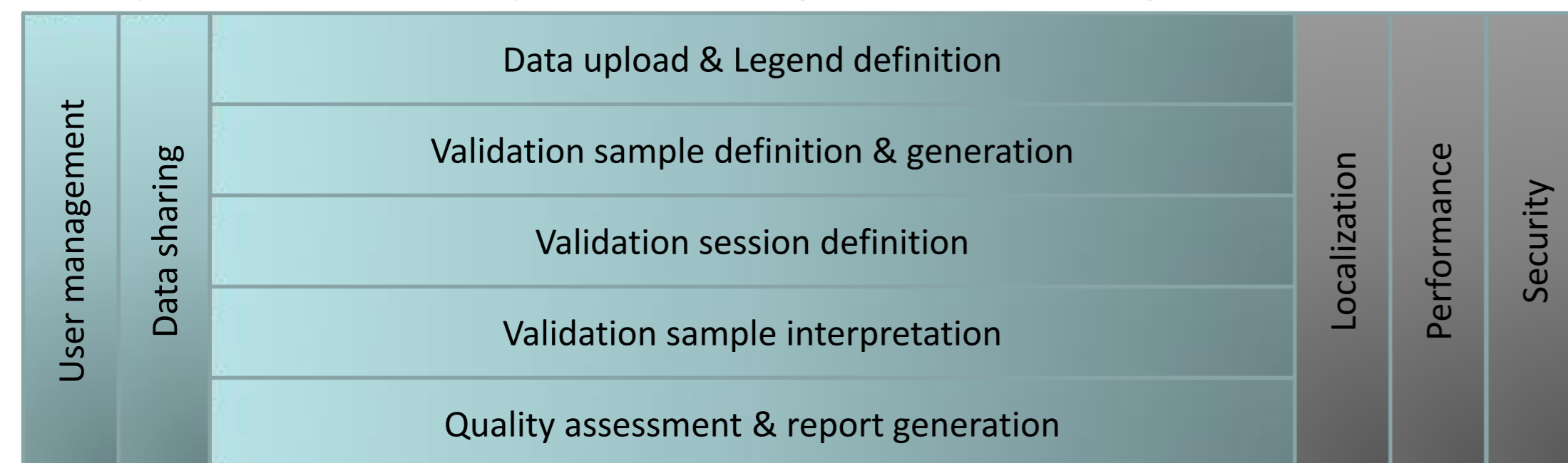
The user management has been simplified to make **use of different existing authentication providers (e.g. Geo-Wiki, Facebook and Google+)**. These providers allow users to access LACO-Wiki with existing user accounts on those platforms through the use of OAuth 2.0. This method will also appeal to students who are regular users of Facebook and Google+.

The data sharing feature captures the functionality of **managing and sharing the data, and the processing of results between users and groups**. This includes published data sets, validation samples, validation sessions and reports. This feature will allow teachers to either set individual student projects on validation or have students work in groups to complete a validation exercise.

Random sampling options are available for vector and raster data as well as point sampling options. Stratified sampling is currently available for raster and will be implemented in vector soon. This will allow students to compare the results of different sampling strategies and gain an appreciation for the differences.

A range of accuracy measures are available including standard measures such as **kappa, overall and producer's/user's accuracies** as well as others published in the literature. The **confusion matrix** can also be provided as part of the downloadable report so students can calculate other accuracy measures. New accuracy measures will be added in the future based on user needs.
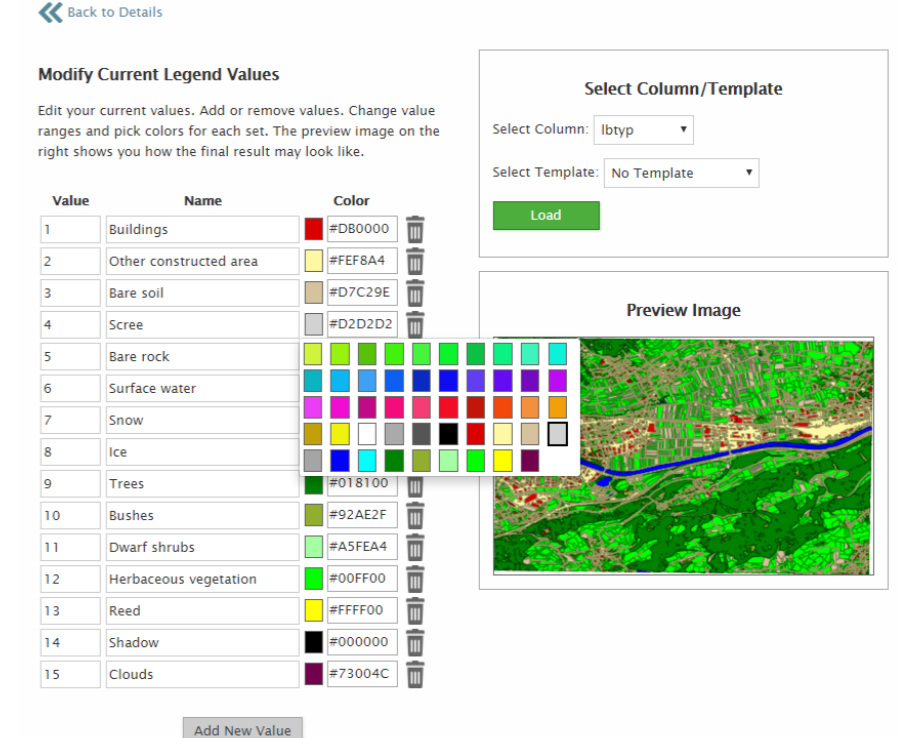
The LACO-Wiki validation workflow as a step-by-step process
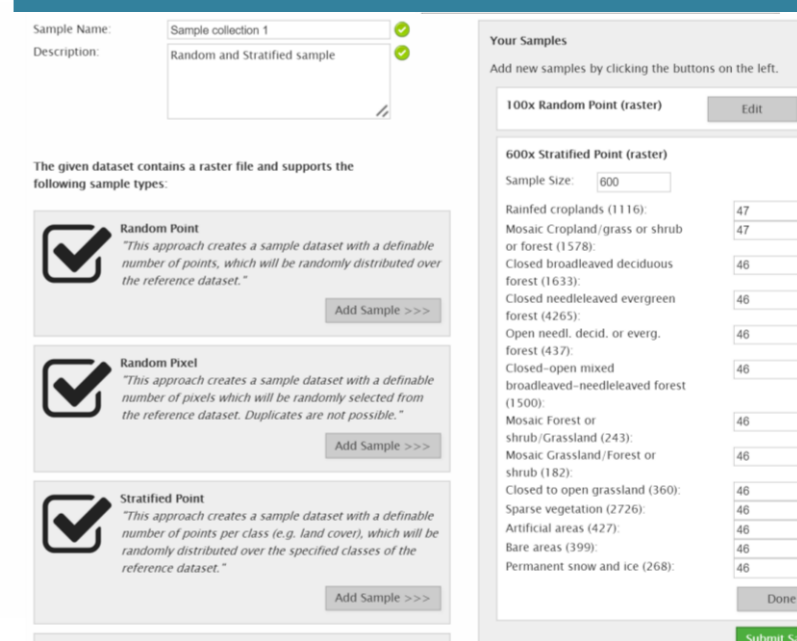
1 – Upload a new Data Set
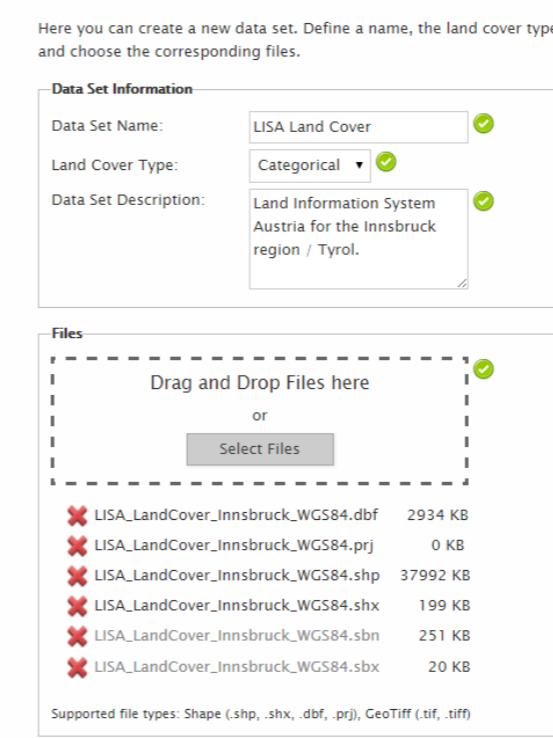
Upload data: categorical or continuous raster or vector
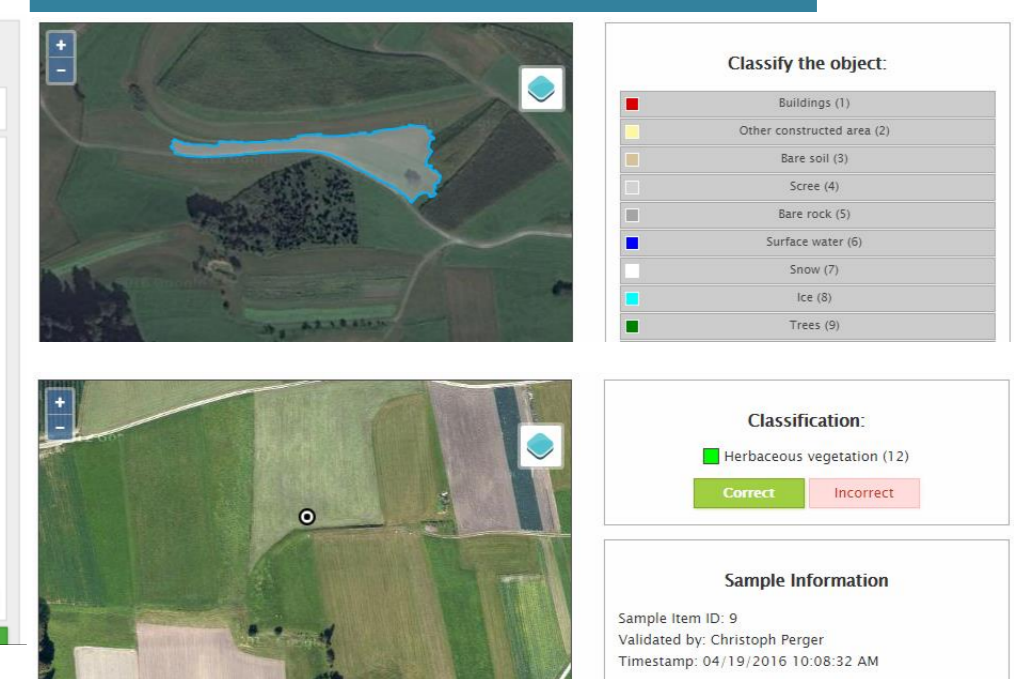
2 – Legend Designer

Define a legend: for vector select the column and then apply your settings to the automatically populated classes or ranges
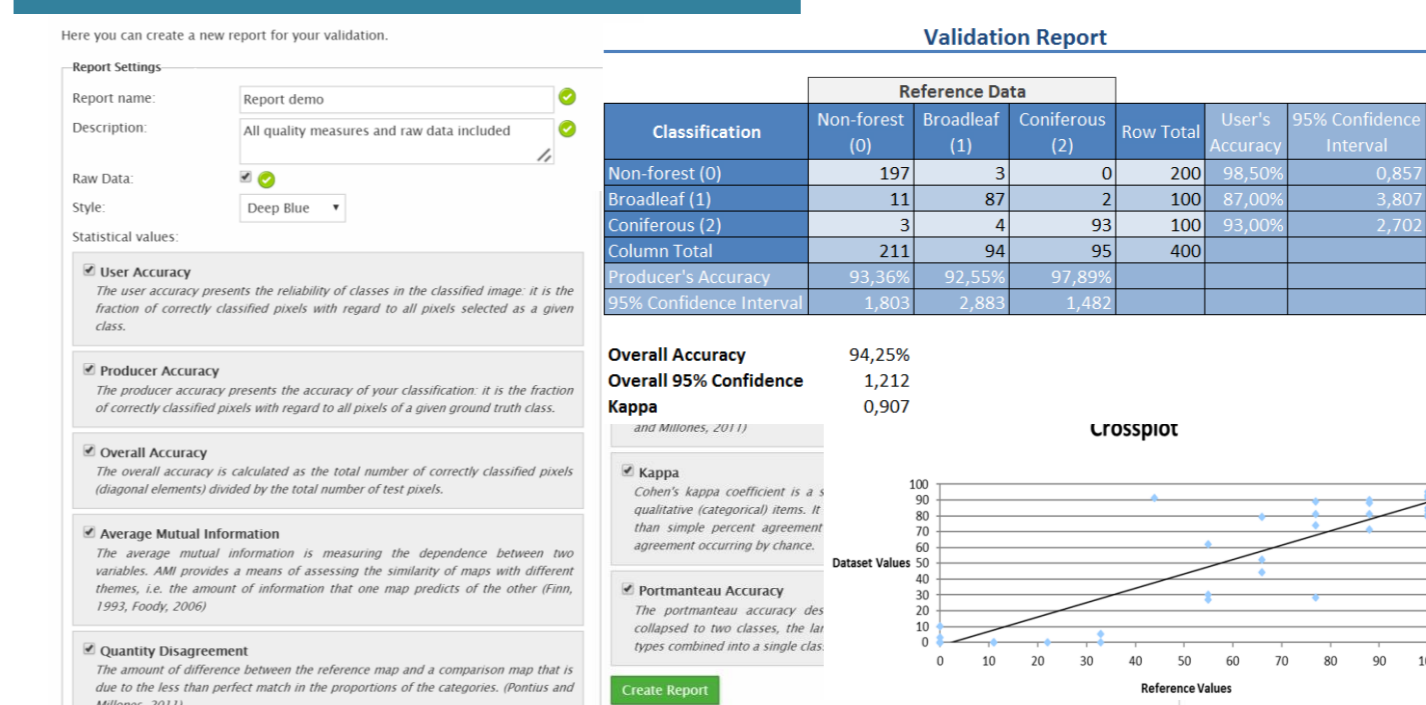
3 – Sample definition

Sampling: generate samples (random or stratified) and validation sessions (blind and plausibility)

4 – Sample interpretation

Validate: use the generated samples to validate the uploaded dataset using base imagery (e.g. Bing®, Google Maps®, OpenStreetMap®)

5 – Reporting & Download

Report: after interpreting the samples, the validation report can be compiled by selecting different quality measures to be included.

Export: The samples and the validation report can be downloaded in MS Excel format (.xlsx).*

LACO-Wiki as a validation and teaching tool

The concept and design of **LACO-Wiki was driven by the requirements of: the European land monitoring community; institutional users at various administrative levels; stakeholders from the global domain and service providers developing value-added services in land monitoring**. For this reason the tool is useful for operational map validation needs.

Yet another very important user group is teachers and students who can use LACO-Wiki for educational and research purposes. A number of resources are available from the website including a manual and how-to videos. More of these resources will be added in the future. Many interesting classroom experiments can be undertaken to evaluate and compare the performance of students in validation.

LACO-Wiki is available in many languages (English, German, Czech, Greek, Portuguese, Russian, Spanish and Ukrainian) but **is easily extended to new languages for use in classrooms around the world**. If you would like to use LACO-Wiki in a different language to that listed above and are willing to provide the translations, please contact us on info@laco-wiki.net.

A long term goal of LACO-Wiki is to build a massive reference database for validation data globally. Teachers and students can make a valuable contribution to this reference database by adding more data, both spatially and temporally. This will help to improve the development and validation of future global and regional land cover maps.

If you are interested in using LACO-Wiki in your teaching and/or research, contact us for the latest developments and support materials.