Visualization of land cover viewer statistics from Copernicus to monitoring small smart land project

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Abstract: ─ We studied the effectiveness of the lcviewer data to detect change of land at regional scale. In this article, we propose theoretical hypothesis that ecological modeling can be available with global land cover viewer data in a larger scale (for any place in the world). The study uses the Copernicus land cover viewer version 3 to detect land change in Taza – Al Hoceima - Taounate located in the Moroccan middle atlas. We compare statistical data from five consecutive years from 2015 to 2019. The visualization interface gives percentages of the classes Forests, Shrubland, Herbaceous vegetation, Bare / sparse vegetation, Cropland, Built-up, Permanent water bodies. Globally, lcviewer display all informations of land use. The systematic monitoring at global scale that reliably and routinely providing near real time bio-geophysical parameters at global scale, based on low-to-medium spatial resolution sensors and including the consitution of long term, consistent time series. Statistical report can be downloading to make easy monitoring of areas. The detection of similarities and differences of land cover classifications is strongly expressed by lcviewer report. Values of percent or area expriment by (% or km²) show quality and validation of lcviewer to facilitate their use in land monitoring in these areas.

Key-Words: ─ Land cover viewer, Copernicus, Monitoring land project.

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1. Introduction

IN the past, in order to do a fieldwork it was necessary to have a lot tools and time. Sometimes, even with good experts, it is not possible to acquire a large area. Land is monitored annually at a considerable cost across hundreds of thousands of acres of conservation lands (Guenther and Hayes, 2008) [1]. Although the visual estimation methods are faster than destructive sampling, land monitoring is still time consuming and costly, especially when performed over large landscapes. Moreover, the typical ground-based method suffers from several potential drawbacks (Tsalyuk et al., 2015) [2].

In contrast to observer-collected monitoring approaches, remote sensing provides information to support a synoptic and temporal view of the landscape. Advances over recent decades in the application of remote sensing for monitoring and assessing rangeland ecosystems include forecasting forage yields, measuring primary productivity and vegetation cover, and quantifying the effects of restoration practices on forage productivity (Todd et al., 1998; Washington-Allen et al., 2006; Malmstrom et al., 2009; Zbiri et al., 2019) [3, 4, 5, 6]. The main advantages of remote sensors are ability to monitor large areas and capture spatial variability of Earth's surface, as well as repeatability of data collection that provide opportunity for index analysis. The interest of remote sensing for rangelands lies in fact that several biophysical variables representative of state, development of vegetation are accessible. Numerous indices have been developed to describe vegetation cover while considering atmospheric effects or soil type (Morel, 2014) [7].

From a functional perspective, vegetation can be classified as photosynthetic (green leaves) and non photosynthetic (abovegrounddead biomass, litter and wood). The amount of photosynthetic and non photosynthetic biomass determine key ecosystem features like the rate of carbon and nutrient uptake, the exchange of latent and sensible heat between the surface and the atmosphere, and surface albedo. Non photosynthetic vegetation also plays a key role in determining fire frequency and intensity, and in controlling wind and water erosion (McTainsh et al., 2006) [8]. Developing tools that allow monitoring of vegetation in space and time is a key step needed to improved management of savannas.

Remote sensing is an important tool for estimating the fractional cover of vegetation as a key descriptor of ecosystem function (Asner and Heidebrecht, 2003; Asner et al., 2005) [9, 10]. Two complementary spectral properties of vegetation have been used in remote sensing analyses to discriminate green and dry vegetation from soils. Firstly, the Normalized Difference Vegetation Index (NDVI) utilizes absorption by chlorophyll in the red wavelength and scattering by cellulose in near infra-red wavelengths to distinguish green vegetation (Tucker,

1979; Ustin et al., 2004) [11, 12]. Secondly, the Cellulose Absorption Index (CAI) is based on the absorption feature in the 2000 to 2200 nm region due to cellulose and lignin in plant biomass (Nagler et al., 2003) [13].
The objective of this study is to highlight the use of the validation model and study of behaviour of land cover viewer statistics from Copernicus. Accurate estimation of fractional cover is especially important for monitoring and modeling Forests, Shrubland, Herbaceous vegetation, Bare / sparse vegetation, Cropland, may hide more details that could be important for future behavior of carbon cycle.

2. Remote Sensing Data Acquisition

2.1 Copernicus Global Land Service

The Copernicus Global Land Service (CGLS) is a component of the Land Monitoring Core Service (LMCS) of Copernicus, the European flagship programme on Earth Observation. The Global Land Service systematically produces a series of qualified bio-geophysical products on the status and evolution of the land surface, at global scale and at mid to low spatial resolution, complemented by the constitution of long term time series. The products are used to monitor the vegetation, the water cycle, the energy budget and the terrestrial cryosphere (https://land.copernicus.eu/global/about) [14].

2.2 Copernicus Land Monitoring Service – Part of the Copernicus Programme

Copernicus is a European programme for monitoring the Earth, in which data is collected by Earth observation satellites and combined with observation data from sensor networks on the earth's surface.

Once collected the data is then processed, providing reliable and up-to-date information within six thematic areas. These areas are: land, marine, atmosphere, climate change, emergency management and security.

2.3 What Is the Copernicus Land Monitoring Service?

Copernicus Land Monitoring Service (CLMS) provides geographical information on land cover to a broad range of users in the field of environmental terrestrial applications. This includes land use, land cover characteristics and changes, vegetation state, water cycle and earth surface energy variables.

CLMS products are divided into five categories:

- Systematic biophysical monitoring
- Land cover & land use mapping
- Thematic hotspot mapping
- Reference data
- Ground motion service

These categories enable applications to be developed in a wide range of areas. These include:

- Spatial and urban planning
- Forest management
- Water management
- Agriculture & food security
- Nature conservation and restoration
- Ecosystem accounting
- Mitigation to climate change

The products and services (and their priorities) are continually evolving and their creation and development are defined in consultation with stakeholder communities, who receive advice from the Copernicus User Forum. The priorities are set by the European Commission and EU Member States and participating countries within the Copernicus Committee. The European Environment Agency (EEA) also works in collaboration with other Copernicus Services, such as Copernicus Marine Environment Monitoring and Copernicus Emergency Management, to create new products.

The Copernicus Land Monitoring Service has been jointly implemented by the European Environment Agency (EEA) and the Joint Research Centre (JRC) since 2011.

2.4 Who Can Use the Copernicus Land Monitoring Service?

Any citizen or organisation around the world can access the Copernicus Land Monitoring Service on a free, full and open access basis. This is in line with the Copernicus Programme's overall data and information policy which promotes the use and sharing of Copernicus information and data.

There is no restriction on the use, reproduction or redistribution of the information and data. The Copernicus Land Monitoring Service is free to access by any citizen or organisation in the world (https://land.copernicus.eu/about) [15]. The discrete global land cover V2.0 map and the nine cover fraction layers were validated using an independent validation dataset containing around 21 600 points generated in collaboration with regional experts. In addition, the CGLS_LC100m V2.0 discrete map was qualitatively and quantitatively compared against other existing global land cover maps. The validation procedure and the detailed results are presented into the Validation Report ''CGLOPS1_VR_LC100_V2.0'' (Buchhorn et al., 2019) [16]. The third edition of the CGLS-LC100 layers (Collection 3) is currently available covering the 2015 reference year and annual LC changes from 2016 to 2019 over the entire globe. Firstly, the map for 2015 is improved with additional training data (~ 40,000 points) focusing on regions with lower accuracies. Secondly, for users looking to map land change processes, such as desertification, de- or re-forestation, urbanization, the impact of major infrastructure developments and so on, it is important to compare LC maps across different years. The new and additional yearly LC layers facilitate these processes.

Continuity of the service from 2020 onwards is feasible through the use of Sentinel-1 and Sentinel-2 EO data in the processing line, or going back prior to 2015 through the use of Landsat EO data (Buchhorn et al., 2020) [17].

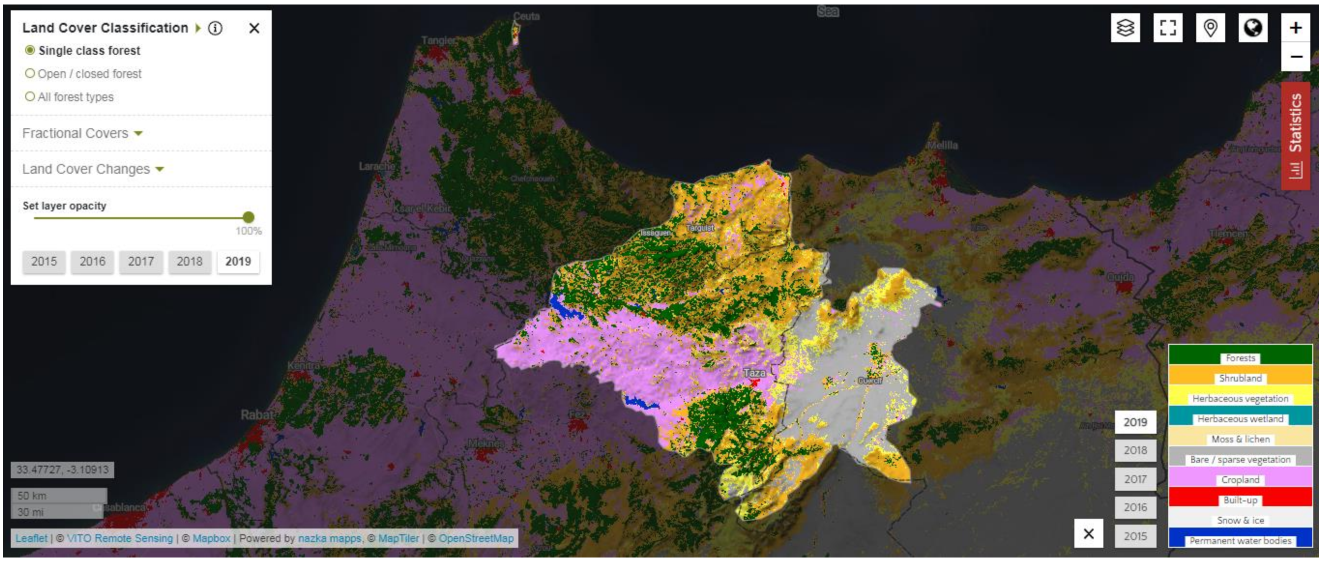


Fig. 1 Full screan of Land Cover Viewer of Taza region in Morocco of year 2019.

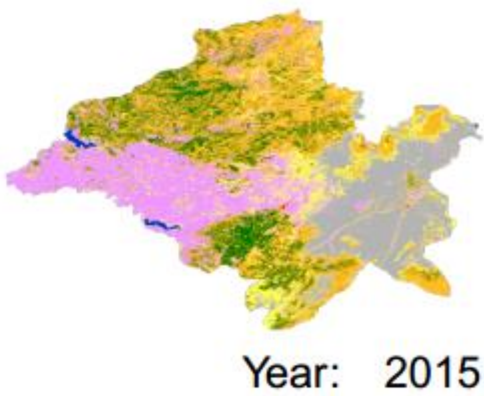
3. Results

3.1 Copernicus Lcviewer Maps

With total area of 21,645km² in Moroccan country, land cover composition can be gived by lcviewer of our region of study in Taza – Al Hoceima – Taounate Located at 33. 477 W and - 3.109 N.

Using land cover composition data, we were able to differentiate between different categories of phenological classes that are poorly estimated at the level of field areas.

In order to lcviewer coherent estimations nine areas at level of Taza region were raised. First with tow classes are (Closed forests and Open forests). While, second, which has high values of middle atlas Shrubland; Herbaceous vegetation; Bare / sparse vegetation. Thus, two types of classes Permanent water bodies and Snow reflects water resources in National park of Tazekka and Jebel Bouiblane. Cropland is also present on the summits of the middle atlas (Figure 2).



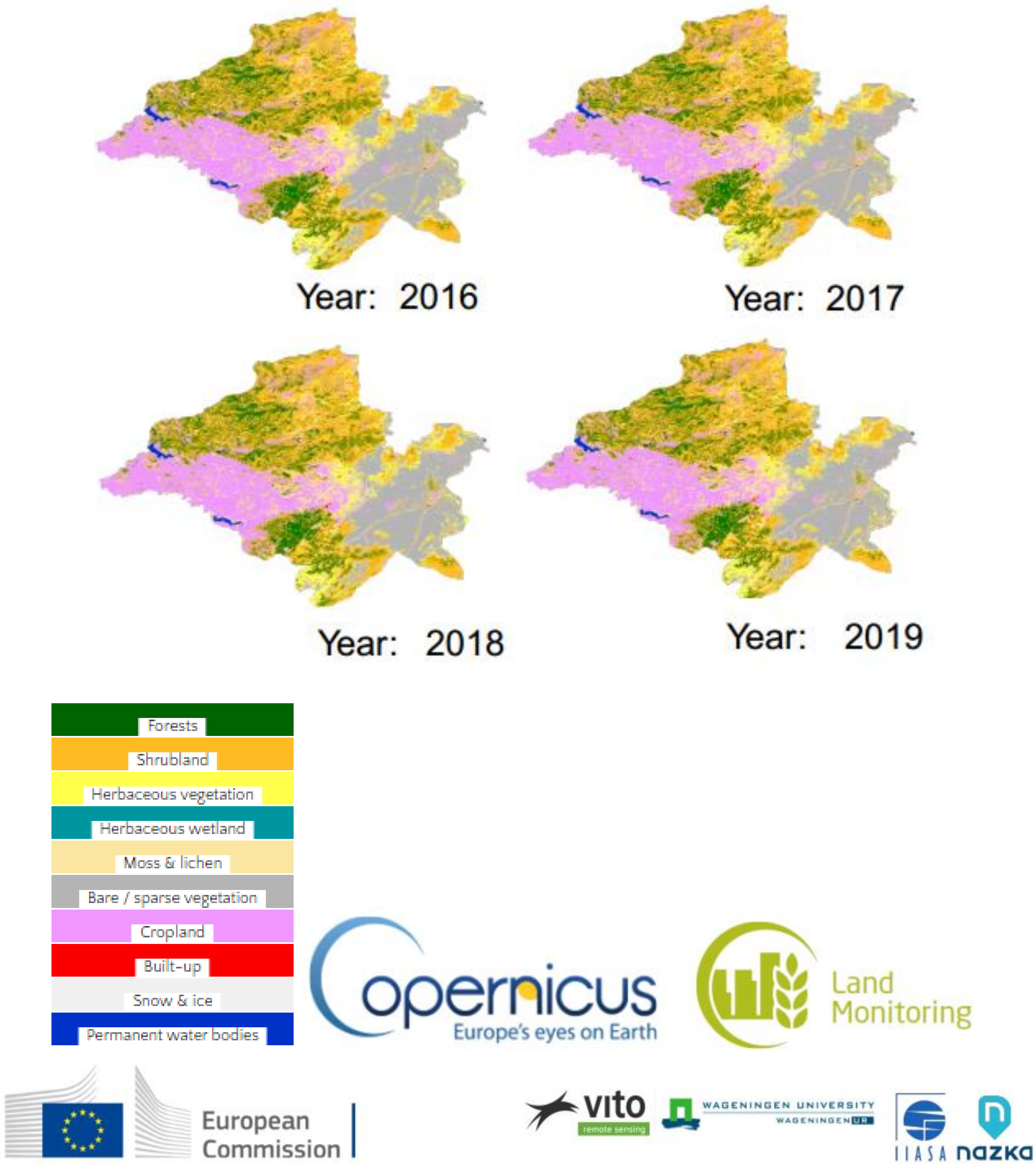


Fig. 2 Land Cover composition of Taza region via lcviewer from 2015 to 2019.

3.2 Copernicus Lcviewer Statistical Report

Figures 3, 4, 5 and 6 show that change in land cover area is expressed with low percentage values between all years. In terms of surface area, the estimate seems clearer and more significant, which means the accuracy of the pixel values of the recorded data. By comparison between 2015 and 2019, we notice a decrease in the number of (Closed forests and Open forests); Shrubland; Herbaceous vegetation; Bare / sparse vegetation; Permanent water bodies. While, the Herbaceous wetland, Cropland and Built-up reports an increase. Overall, the following years show stability in agricultural, hydrolytic and building systems.

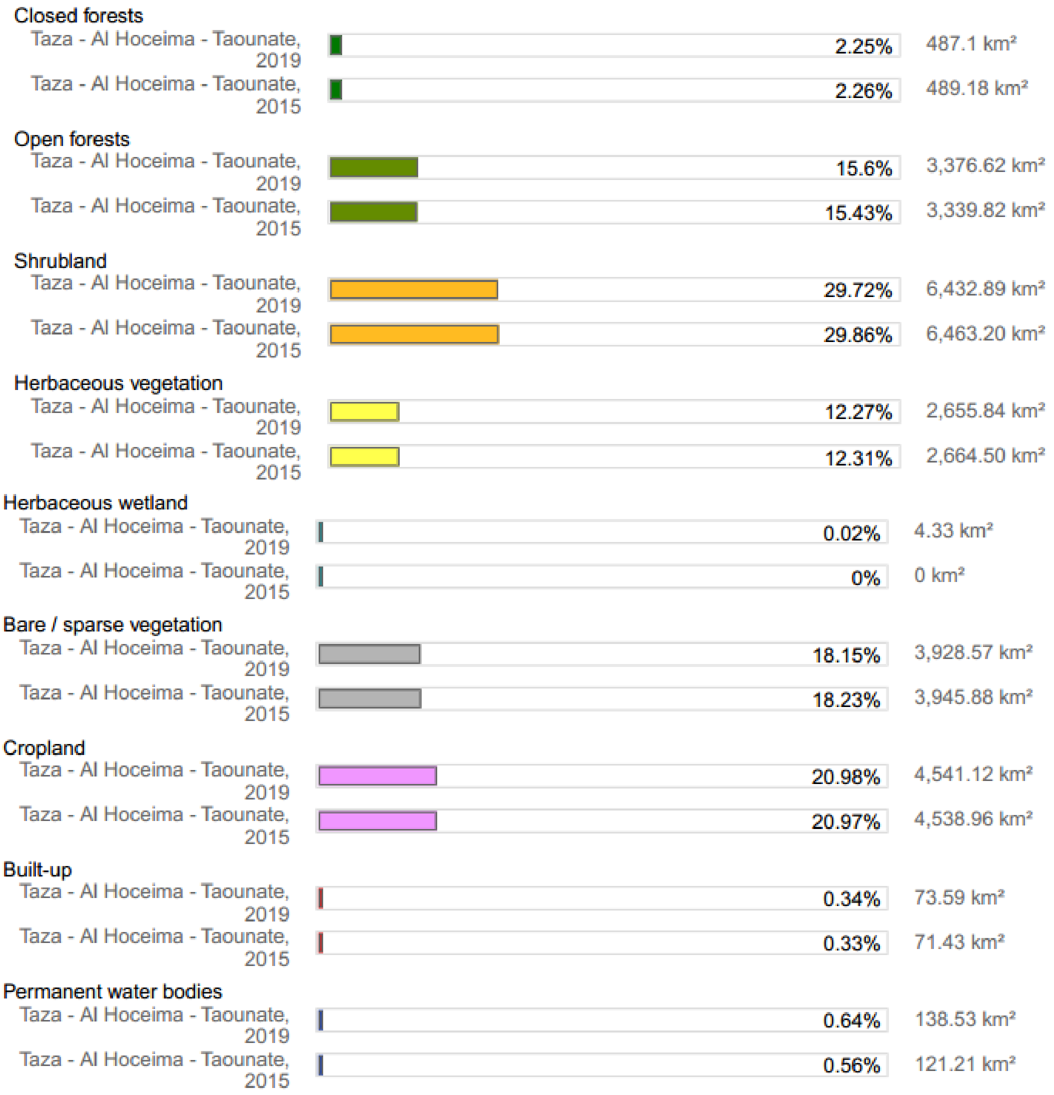


Fig. 3 Statistical report of lcviewer (comparison of land cover composition of Taza between 2015 and 2019).

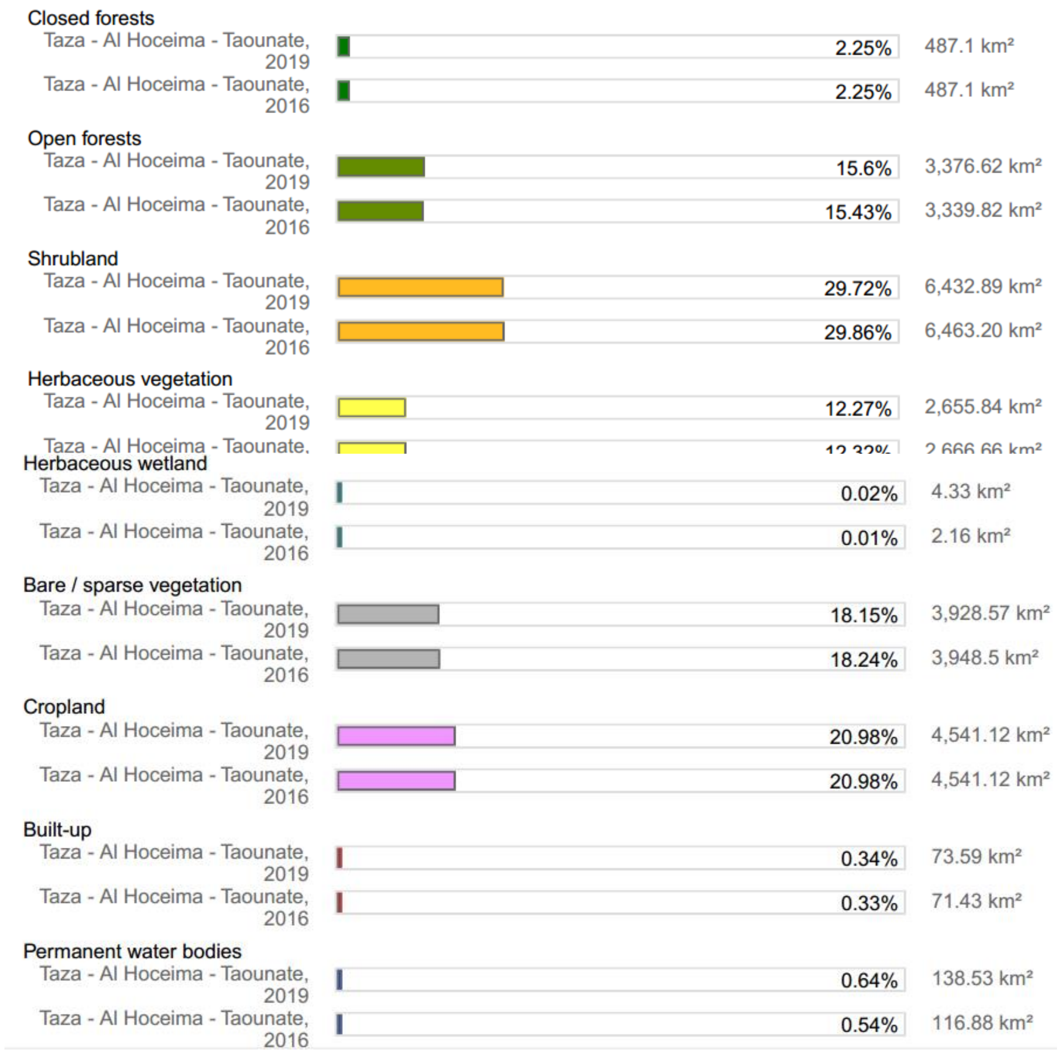
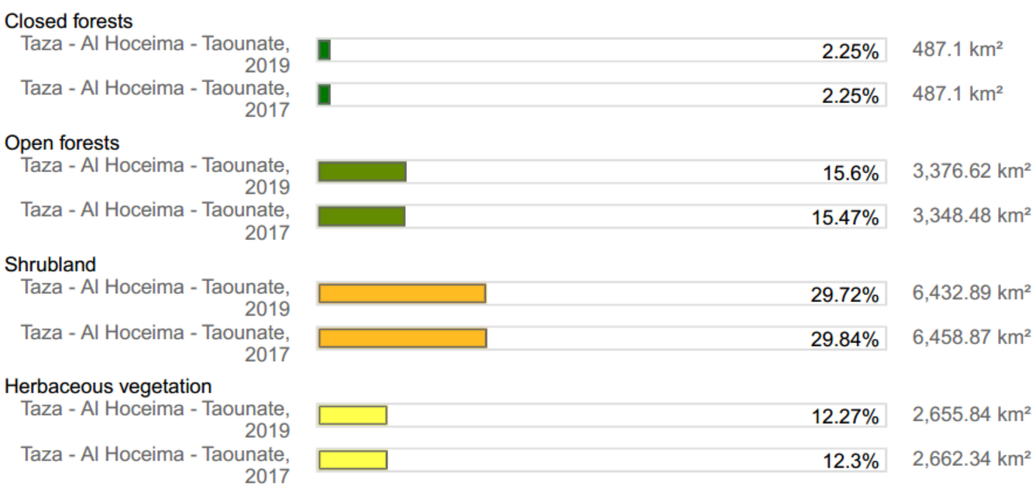


Fig. 4 Statistical report of lcviewer (comparison of land cover composition of Taza between 2016 and 2019).



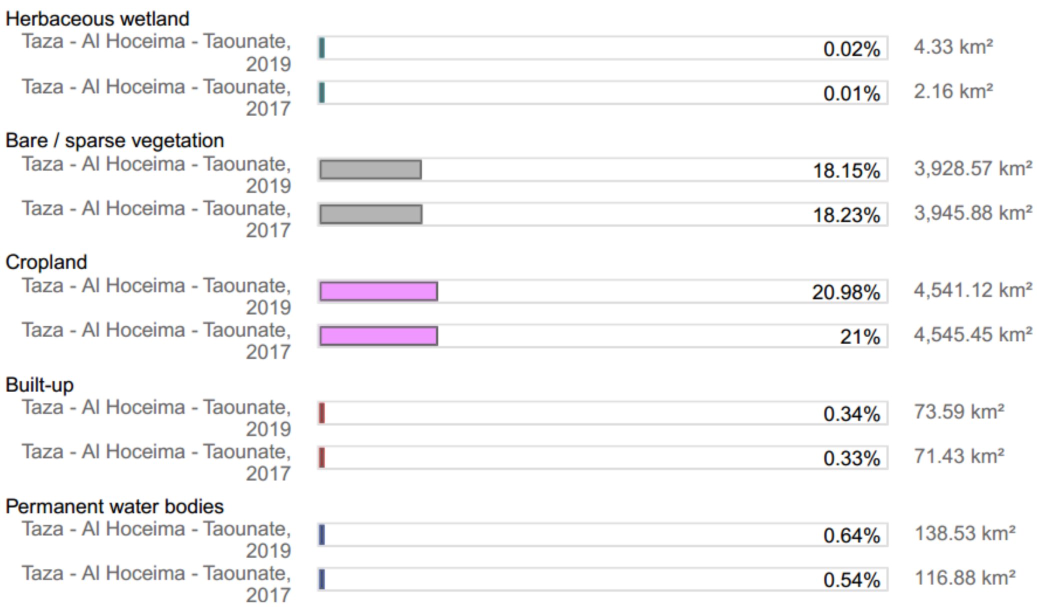


Fig. 5 Statistical report of lcviewer (comparison of land cover composition of Taza between 2017 and 2019).

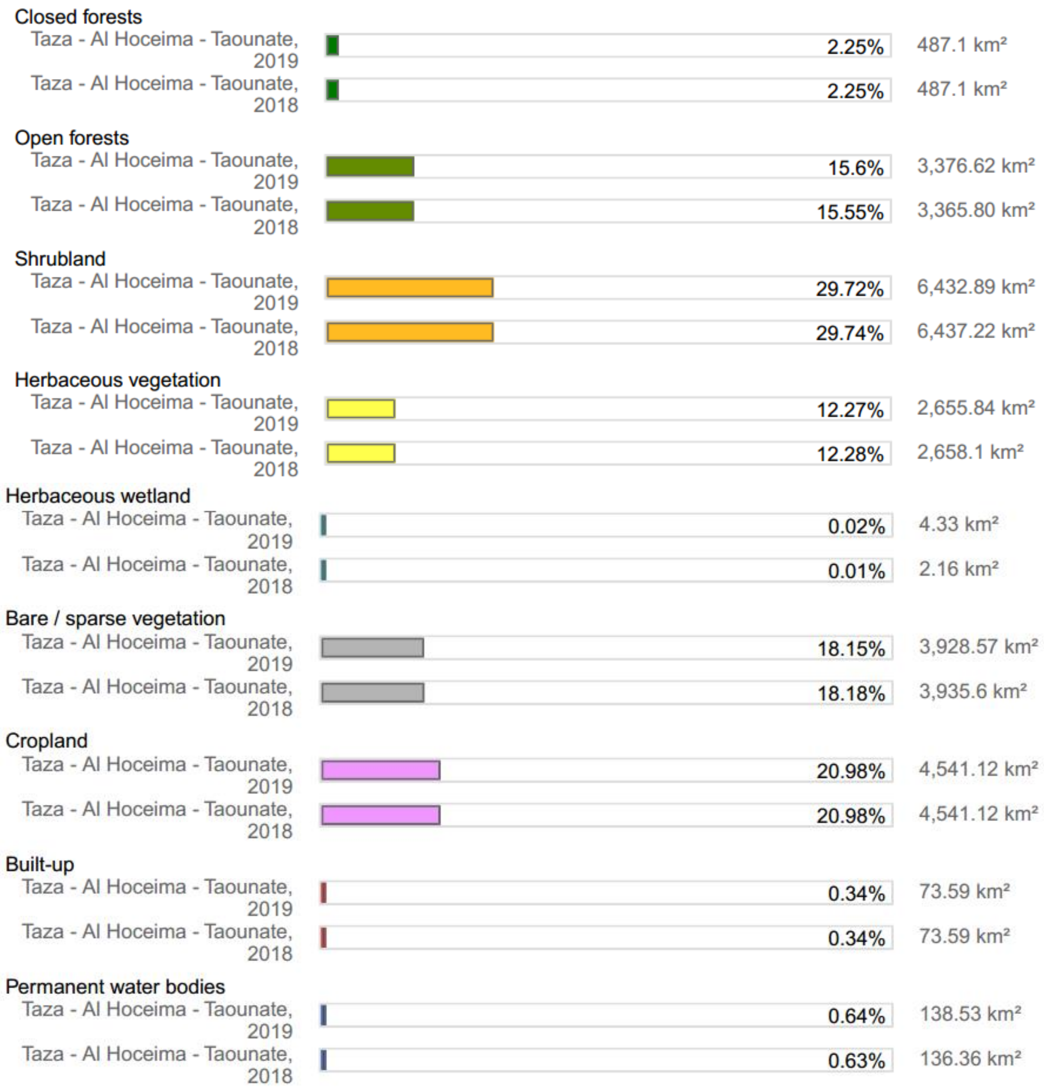


Fig. 6 Statistical report of lcviewer (comparison of land cover composition of Taza between 2018 and 2019).

3.3 Further Analysis with Lcviewer Statistical Report

Using data from lcviewer with other analysis methods can lead to estimates of the areas with greater accuracy. Table 1 shows good details of land use change in percent. As indicated by means, highest value is mentioned for shrub land (29,80%). While, standard deviation shows a significant change of open forests (0,076). Poor variation is detected in closed forests.

Based on results of lcviewer shrub land occupies a high dominance in terms of surface area with 645108 km².

However, the areas that have seen the greatest change are bare / sparse vegetation and cropland (table 2).

In particular, estimation with lcviewer model is even more important because it depends on soil typology and topography. Similarly, these results can pefectly used in estimation of change in land after severed degradation due to fire and drought. Also, its can be useful to show water in any area. According to Buchhorn et al. 2020, to include topographic metrics (elevation, slope, aspect) in the CGLS-LC100 product workflow, the Copernicus COP-DEM-GLO-90 dataset is used as primary input. The Copernicus DEM is a Digital Surface Model (DSM) which represents the surface of the Earth including buildings, infrastructure and vegetation. This DEM is derived from an edited DSM named WorldDEMTM and provided as a CORE product of the Copernicus service (Copernicus, 2019) for the reference year 2015. The COPDEM-GLO-90 dataset was used for the Strait of Gibraltar us an example [18]. .

Table 1 Result of lcviewer estimation (%) of Taza from 2015 to 2019.

Period/ lcviewer estimation (%)	**Closed forests**	**Open forests**	**Shrubland**	**Herbaceous vegetation**	**Herbaceous wetland**	**Bare / sparse vegetation**	**Cropland**	**Built-up**	**Permanent water bodies**
2015	2,26	15,43	29,86	12,31	0	18,23	20,97	0,33	0,56
2016	2,25	15,43	29,86	12,32	0,01	18,24	20,98	0,33	0,54
2017	2,25	15,47	29,84	12,30	0,01	18,23	21,00	0,33	0,54
2018	2,25	15,55	29,74	12,28	0,01	18,18	20,98	0,34	0,63
2019	2,25	15,60	29,72	12,27	0,02	18,15	20,98	0,34	0,64
Mean	**2,25**	**15,50**	**29,80**	**12,30**	**0,01**	**18,21**	**20,98**	**0,33**	**0,58**
SD	**0,004**	**0,076**	**0,068**	**0,021**	**0,007**	**0,039**	**0,011**	**0,005**	**0,049**

Mean: average; SD: standard deviation.

Table 2 Result of lcviewer estimation (km²) of Taza from 2015 to 2019.

Period/ lcviewer estimation (km²)	**Closed forests**	**Open forests**	**Shrubland**	**Herbaceous vegetation**	**Herbaceous wetland**	**Bare / sparse vegetation**	**Cropland**	**Built-up**	**Permanent water bodies**
2015	489,18	333982	646320	266450	0	394588	453896	71,43	121,21
2016	487,10	333982	646320	266666	2,16	39485	454112	71,43	116,88
2017	487,10	334848	645887	266234	2,16	394588	45454	71,43	116,88
2018	487,10	336580	643722	26581	2,16	39356	454112	73,59	136,36
2019	487,10	337662	643289	265584	4,33	392857	454112	73,59	138,53
Mean	**487,52**	**335411**	**645108**	**218303**	**2**	**252175**	**372337**	**72,29**	**125,97**
SD	**0,930**	**1645,799**	**1481,088**	**107176,621**	**1,531**	**194218,507**	**182733,288**	**1,183**	**10,649**

Mean: average; SD: standard deviation.

4. Conclusion

The results revealed that the lcviewer test could accurately detect change of water resourses and decrease or increase of land production. The experience shows that virtual work with remote sensed data such us Copernicus global land cover version 3 is another excellent tools of ecological modeling. The results obtained with lcviewer from Copernicus can be used in assessment of ecosystems across the world and monitoring small smart land project. Overall, we encourage researchers, organizations responsible for forest conservation or agricultural and rangelands management to take part in this visualization to better manage their land.

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