Detection of water change and perfermance of land cover viewer mapping from Copernicus

ASMAE ZBIRI [1, *], AZEDDINE HACHMI[1], FATIMA EZZAHRAE EL ALAOUI-FARIS[1]

[1]Department of Biology
Mohammed V University, Faculty of Science
MOROCCO
*Corresponding author

Abstract: ─ Automated Mapping of water bodies using lcviewer data can detect change of wetland. In this study, theoretical hypothesis of hydrological modeling can be available with global land cover viewer data (Mapping) and SM2RAIN. The purpose of this study was to investigate relationship between a newly developed precipitation dataset, SM2RAIN-ASCAT (Advanced SCATterometer), and Copernicus land cover viewer to detect water change in Inaouen river. We compare statistical data of permanent water bodies and SM2RAIN of years from 2015 to 2017. The comparaison of permanent water bodies and SM2RAIN is strongly expressed and can be used to detect change of surface water. The theoretical hypothesis of monitoring SM2RAIN providing near real bio-geophysical parameters based on low-to-medium spatial resolution sensors and including the memory of water bodies. Statistical analysis shows similarities of rainfall expressed by SM2RAIN and permanent water bodies. The results of permanent water bodies (lcviewer) forecasts maps compared with SM2RAIN data revealed SM2RAIN algorithm indicated a superior forecast skill than the water body.

Key-Words: ─ Permanent water bodies, SM2RAIN-ASCAT, Land cover viewer, Copernicus, Inaouen river.

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1. Introduction

Forecasting of the hydrological variables is crucial in water resource system planning for the long-term sustainability of hydrological projects (Li et al., 2021, Wu et al., 2011) [1, 2].

Ensemble forecasts outperformed coupled atmospheric–hydrological modeling in comparison with deterministic forecasts to simulate inflow hydrographs (Tanhapour et al., 2023) [3].These systems provide a single value for hydrological forecasts, as deterministic forecasts, and, thus, do not take into account the forecast uncertainties.

Furthermore, the lead time of these forecasts is very short, especially in small and medium watersheds which have a short time of concentration (Banihabib M.E., and Arab, 2016, Maddah et al., 2021) [4, 5]. Determining effective strategies for reservoir operation during flood events is complex due to the hydrological forecast uncertainties in the river-reservoir systems (Nohara et al., 2016) [6]. The hydraulic potential of the study area is clearly decreasing. This means that Morocco is today among the countries that are very concerned by the problem of water stress (Hofste et al., 2019) [7]. Wetlands are a distinct ecosystem, permanently or seasonally covered by water with living vegetation, and are widely distributed across climatic regions in the forms of swamps, marshes, bogs, and similar areas (Schlesinger and Bernhardt, 2020) [8]. Similar to seagrass meadows and mangrove forests, wetlands are considered an effective solution for climate change through the maintenance of wetland ecosystem services, including water filtration, providing habitats for aquatic animals, coastal protection, carbon stock, production, water storage, and cultural services (Mitsch et al., 2015, Salimi et al., 2021) [9, 10]. Despite an improved awareness of the central role of wetlands, the habitat is narrowing in both terms of area and living conditions worldwide (Davidson, 2014, Ramsar Convention on Wetlands. Global Wetland Outlook, 2018) [11, 12].

2. Study Site and Methodology

2.1. Study Site

The Inaouen river is a Moroccan river that is formed near Taza city. The Inaouen meets the Idriss I dam 20 km north-east of Fez before crossing Sebou even closer to Fez. Zaouia Sidi Abdeljalil is a village located near a small town of Oulad Ayyad and Matmata village, located at 33. 97 W and - 4.46 N (Figure 1). The analysis of the Inaouene river hydrologic behavior has shown a mediterranean typical regime, characterized by the abundance of rain with high winter flow rates, therefore, heavy flooding, and on the other hand, by a strong dry season, thus, low flow. The annual module, as well as the different coefficients, highlights the hydroclimatic fluctuations, in relationship with a semi-arid climate. The hydrological balance highlighted the importance of water volumes routed upstream and downstream, confirming the morphometric parameters of the basin and the lithologic nature which involves two major different units (formations essentially karstic carbonate in the middle atlas at the southern part of the basin and, a marly impermeable substratum in the prerif; northern part of the basin) (Jamal and Benaabidate, 2014) [13].

Fig. 1 Full screan of land cover viewer of study area in Inaouen river.

2.2. Methodology

The hydrological study of Inaouen river is based on two methods spatial. The first one is visual maping and the second by spatiotemporal analysis. The mapping of water area was implemented in three years using permanent water bodies (Figure 2). Automatic extraction of water bodies (land cover viewer) are collected from Copernicus platform. Precipitation is collected from SM2RAIN-ASCAT dataset available at https://zenodo.org/record/3520620.

2.2.1. Permanent water bodies (Land cover viewer) of Copernicus

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 products are used to monitor water cycle (https://land.copernicus.eu/global/about) [14].

2.2.2. SM2RAIN images of ASCAT satellite

SM2RAIN-ASCAT is a new global scale rainfall product obtained from SM (Soil Moisture) data through the SM2RAIN algorithm (Wagner et al., 2013; Brocca et al., 2014) [15, 16].

3. Results and Discussion

3.1. Automated Water Extraction Using (Permanent water bodies of Land cover viewer with Copernicus

Recent advancements in remote sensing have improved the accuracy in the mapping of Copernicus wetland types, but there remain challenges in accurate and automatic wetland mapping, with additional requirements for complex input data for a number of wetland types in natural habitats (Zbiri et al., 2022) [17].

Here, we propose a remote sensing approach using the Permanent water bodies (Land cover viewer) of Copernicus to automate the extraction of water bodies and mapping of Inaouen river, a wetland type with high economic and cultural values in the Moroccan middle atlas.

Permanent water bodies mapping result given the diverse sizes and spatial distribution of the water bodies in the study sites. We observed small decrease of water in 2016. 2017 is considered a dramatic year, when the flow was low compared to the two previous years (Figure 2).

We note that automated water mapping images, which have a great potential to be integrated with remote sensing viewer model to improve its precision in recognizing water bodies.

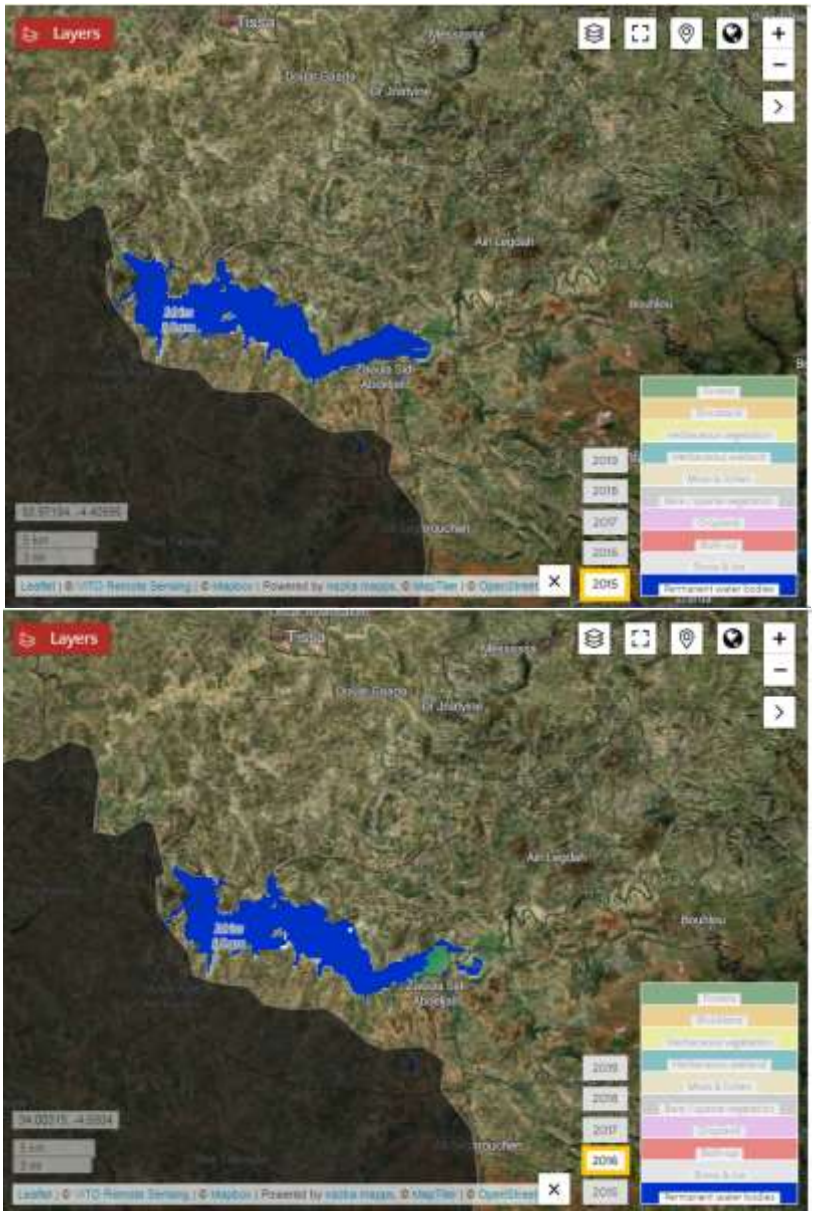


Fig. 2 Automated mapping of permanent water bodies Inaouen river using lcviewer (Copernicus) from 2015 to 2017.

3.2.Analysis of Seasonal Water Characteristics

To highlight the hydroclimatic fluctuations that have affected the Inaouène river, we observe spatiotemporal distribution of decadal SM2RAIN-ASCAT rainfall (Figures 3). The study of the relationship between precipitation permanent water bodies allows us to deduce that the two phenomena are generally synchronous (Figure 3). However, such a shift can be observed and will be linked to the variability of climatic conditions and to morphometric and litho-structural characteristics of watershed. This effect is highlighted by estimation of runoff coefficient of catchment which showed that this catchment is more runoffy at its upstream than at its downstream.

This is confirmed with result of methodology of curves of classified decadal estimates.

SM2RAIN rainfall results show that 2017 was a dry year, with the lowest estimates observed from October to January (Figure 3).

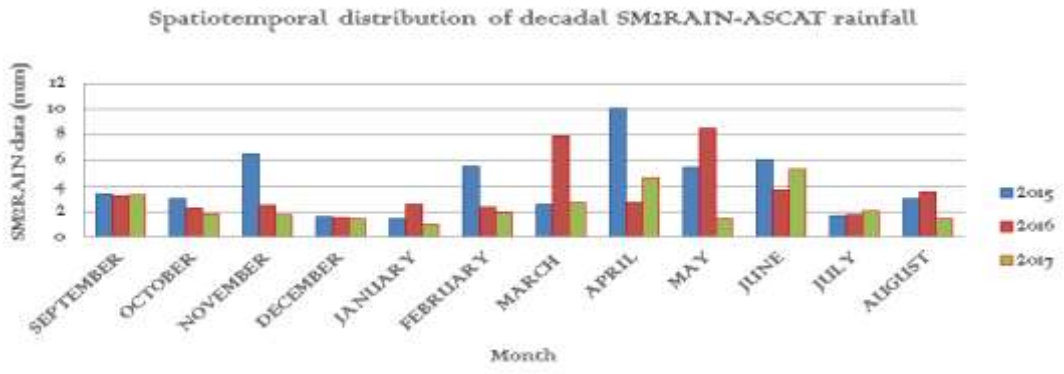
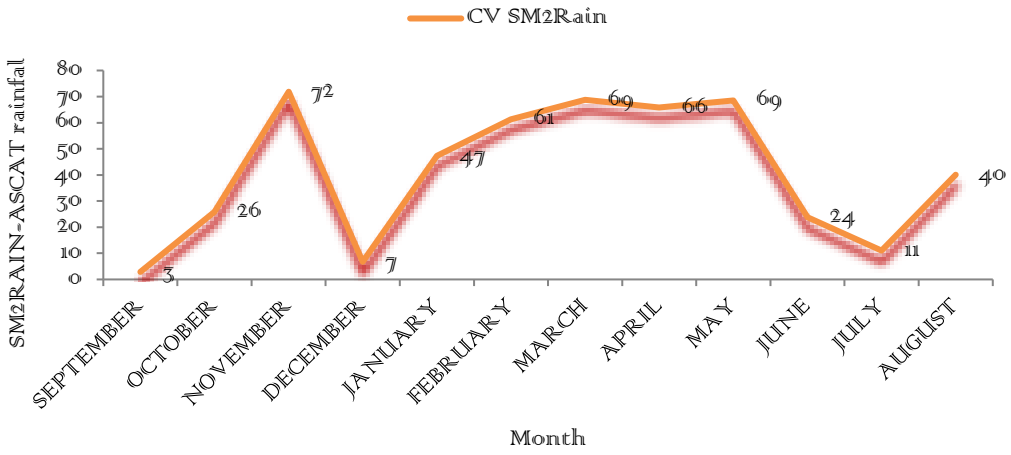


Fig. 3 Spatiotemporal distribution of SM2RAIN-ASCAT rainfall of Inaouen river.

3.3.Accuracy of water bodies

Using data from lcviewer with other analysis methods can lead to estimates of the wetland with greater accuracy. Figure 4 shows good details of SM2RAIN rainfall change.
As indicated by coefficient of variation, highest value is mentioned in November (CV = 72). While, poor variation is detected in December (CV = 7).
Based on results of SM2RAIN, water bodies estimates are logical and correct. In particular, the estimation with lcviewer model is all more important as it depends on soil typology and topography (Zbiri et al., 2022) [18]. Similarly, these results can be perfectly used to estimate water changes in drought years. They can also be useful to show the presence or absence of water in any area. Following this approach, an additional sub-model (i.e. coupling of both Sm2rain and water bodie data) improves accuracy and reliability of predictive results.



CV: coefficient of variation.

Fig. 4 Coefficient of variation of SM2RAIN-ASCAT rainfall of Inaouen river.

4. Conclusion

Detection of water bodie is emerging as an effective business model in countries worldwide, and in Morocco in particular it may secure a sustainable livelihood for population and is a potential method for the long-term maintenance of wetland areas.
We proposed an accurate, simple, and scalable approach to automate the mapping of water bodies and SM2RAIN rainfall in Moroccan Inaouen river. The technique derived a good distribution similarity of water bodies and rainfall data.
The workflow presented here is simple, fast, and applicable to various domains of remote sensing applications. The workflow is automatic and has the potential to be integrated into the management systems of water in countries worldwide.
Integration of the ASCAT SM2RAIN with permanent water bodies lcviewer (Copernicus) will be carried out in a future study to validate the performance of the proposed methods and improve the mapping accuracy of wetland types.

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