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***Abstract*—This paper presents four contributions that highlight different aspects of spatial and geospatial data management and analysis. The first contribution focuses on the application of Interferometric Synthetic Aperture Radar (InSAR) method to estimate the surface deformation of the May Embankment Dam in Turkey. The second contribution proposes a methodology for handling physical datasets of urban water infrastructure systems in a Geographic Information Systems (GIS) environment to obtain reliable simulation results. The third contribution presents the development of a web-based GIS application for efficient data management, allowing the dynamic presentation, analysis, and manipulation of spatial or non-spatial data for various purposes. The fourth contribution proposes a methodological approach for improving the accuracy of hydrodynamic models of urban drainage systems using GIS capabilities. Together, these studies highlight the crucial role of accurate and comprehensive geospatial data in the management of water infrastructure systems and demonstrate the benefits of using modern technology, such as InSAR and Web-GIS, to improve data accuracy, accessibility, and management. By applying these methods and techniques, policymakers, planners, and stakeholders can make informed decisions to sustainably manage urban drainage systems and ensure the safety and well-being of communities.**

Keywords*—*Interferometric SAR; surface displacement; Sustainable water management; Geospatial analysis; Web-GIS application; hydrodynamic modeling.

I. Introduction

Earth observation systems and geospatial technologies have become increasingly important in modern society due to the growing demand for accurate and reliable information about the environment, resources, and infrastructure. These technologies enable the collection, analysis, and visualization of spatial data to provide valuable insights in fields as diverse as urban planning, natural resource management, disaster management, and public health. The use of geospatial technologies has expanded rapidly in recent years, driven by technological advancements and the availability of large amounts of spatial data from various sources such as satellites, drones, and mobile devices. However, the potential of GIS has not been fully realized, and there are still many challenges and opportunities for further research and applications. This paper presents multi-contributor research that aims to explore the use of GIS and geospatial data management in urban water systems planning as well as applications of earth observation systems for environmental monitoring and resource management from different perspectives and contexts.

II. Contributions

The four papers presented in this collection cover a range of topics related to geospatial technologies and their applications in various fields. Each paper makes a significant contribution to its respective field and highlights the importance of geospatial data in decision-making and planning.

The first paper, titled "Application of InSAR Method to Estimate the Surface Deformation of the May Embankment Dam, Turkey" by Rouhollah Nasirzadehdizaji and Anil Olgac [1], presents the use of Interferometric Synthetic Aperture Radar (InSAR) to investigate the deformation of the May Embankment Dam in Turkey. The paper highlights the potential risks associated with dam failure and demonstrates how the use of earth observation systems can aid in monitoring and identifying potential threats. This study emphasizes the significance of using the Interferometric Synthetic Aperture Radar (InSAR) method to monitor dam surface changes and prevent potential threats to the lives of downstream residents and agricultural fields. The authors' findings show that the dam's surface displacement is -9.5 cm in the processed 7-year SAR data, with a cumulative displacement rate of -22.16 cm estimated between 2015 and 2022. This paper emphasizes the need for regular monitoring of infrastructure using geospatial technologies to ensure public safety and prevent potential disasters.

The second paper, titled "Geo-processing Approaches for Urban Water Supply and Drainage Systems' Data Rehabilitation" by Cagri Cimen, Suleyman Canberk Tuskan, and Anil Olgac [2], focuses on the importance of accurate and comprehensive physical data in Integrated Urban Water Management (IUWM) and sustainable planning of water resources. The paper presents a methodology for handling physical datasets of infrastructure systems in a GIS environment to obtain reliable simulation results. The authors' proposed method resulted in high-precision planning and reliable simulation results,

highlighting the significance of accurate physical data in the sustainable management of urban infrastructure systems.

The third paper, titled "Development of a Web-Based Geospatial Application for Efficient Spatial Data Management" by Rouhollah Nasirzadehdizaji and Anil Olgac [3], presents the design and development of a Web-GIS application that allows the dynamic presentation, analysis, and manipulation of spatial or non-spatial data for various purposes. The authors demonstrate how Web-GIS applications can be used as an efficient decision support mechanism for decision makers and authorities for quick and accurate decisions. This paper highlights the potential of geospatial technologies in facilitating efficient spatial data management and decision-making processes.

In the fourth study titled "Development of Data Quality Improvement Method for Hydrodynamic Model of Urban Drainage System Using GIS Capabilities", Cagri Cimen, Anil Olgac, and Rouhollah Nasirzadehdizaji [4] proposed a methodological approach to improve the accuracy of analysis results and reflect the real-world situation of urban drainage systems. The approach involved the use of GIS to prepare critical large-scale data for hydrodynamic model setup. Through geospatial analysis and the use of GIS environmental capabilities, key input data, such as Digital Elevation Models (DEMs), land use, buildings' polygons, and catchment areas, were prepared to represent real-world conditions in the model scenarios. The prepared data in the GIS environment provide a detailed and precise representation of complex structures for mathematically realistic simulations. This approach can help improve the accuracy and efficiency of urban drainage services. The main finding of this work highlights the importance of using geospatial analysis and GIS tools to prepare input data for hydrodynamic models of urban drainage systems. The approach can contribute to the development of sustainable urban drainage systems, which are critical for adapting to the impacts of climate change.

Overall, the four papers in this collection demonstrate the potential of earth observation systems and geospatial technologies and their applications in various fields, including infrastructure monitoring, urban water management, spatial data management and dynamic presentation of the data, and environmental risk assessment. They highlight the importance of accurate and up-to-date geospatial data in decision-making and planning processes and emphasize the need for regular monitoring and assessment of natural and human systems to ensure sustainable development.

III. Conclusion

Water system facilities' management and safety are critical issues that require continuous assessment and evaluation. To maintain the safety and reliability of systems, new technologies and methodologies are being developed and utilized, such as remote sensing techniques (e.g., InSAR method). These technologies and methods enable more efficient and accurate management of water system facilities and the identification of potential risks and hazards. On the other hand, the integration of hydrodynamic models with GIS capabilities has great potential for addressing the challenges posed by urbanization, industrialization, population growth, and climate change. In addition, Web-GIS applications are powerful tools that can enhance monitoring, simulation, and spatial data management. The four contributions presented in this paper demonstrate the effectiveness of this approach for improving the accuracy and efficiency of hydrodynamic modeling in urban drainage systems. The contributions also highlight the importance of addressing the challenges and uncertainties associated with climate change, population growth, urbanization, and resource scarcity. These challenges require innovative and adaptive management strategies that can foster resilience and adaptability in water resources and infrastructure systems. Finally, the contributions suggest the need for continued research and development in sustainable management of water resources and infrastructure systems, particularly in the areas of data acquisition, analysis, and modeling. These efforts can facilitate evidence-based decision-making, enhance the effectiveness of management practices, and promote the sustainable use of water resources for future generations.

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References

[1] Rouhollah Nasirzadehdizaji and Anil Olgac, "Application of InSAR Method to Estimate the Surface Deformation of the May Embankment Dam, Turkey", in Special Track: Geospatial and Earth Observation Systems Applications (GEOSA), along with GEOProcessing 2023, IARIA XPS Press, 2023.

[2] Cagri Cimen, Suleyman Canberk Tuskan, and Anil Olgac, "Geoprocessing Approaches for Urban Water Supply and Drainage Systems' Data Rehabilitation", in Special Track: Geospatial and Earth Observation Systems Applications (GEOSA), along with GEOProcessing 2023, IARIA XPS Press, 2023.

[3] Rouhollah Nasirzadehdizaji and Anil Olgac, "Development of a Web-Based Geospatial Application for Efficient Spatial Data Management", in Special Track: Geospatial and Earth Observation Systems Applications (GEOSA), along with GEOProcessing 2023, IARIA XPS Press, 2023.

[4] Cagri Cimen, Anil Olgac, and Rouhollah Nasirzadehdizaji, "Development of Data Quality Improvement Method for Hydrodynamic Model of Urban Drainage System Using GIS Capabilities", in Special Track: Geospatial and Earth Observation Systems Applications (GEOSA), along with GEOProcessing 2023, IARIA XPS Press, 2023.