Co-funded by the Erasmus+ Programme of the European Union

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VISUALIZATION OF AVERAGE ANNUAL PRECIPITATION IN SERBIA FOR THE PERIOD FROM 1946 TO 2019

International Symposium "Water Resources Management: New Perspectives and Innovative Practices„
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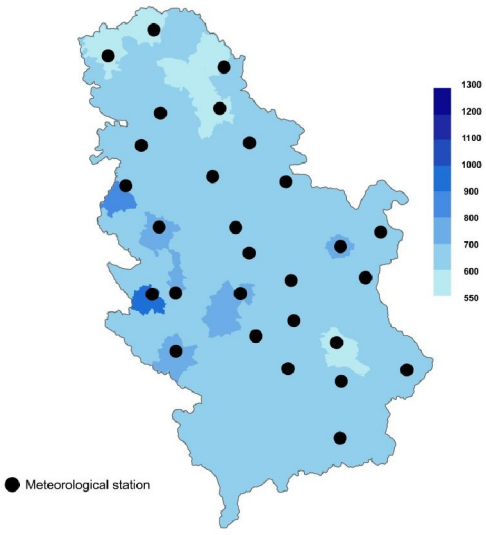
INTRODUCTION

This paper presents the application of GIS (geographic information system) which enables visualization of average precipitation annual data in Serbia for the period 1946-2019.

Precipitation is one of the key players in analysing of natural hazards such as droughts and floods.

Based on the data collected from meteorological stations, it is necessary to process and visualize them and do an assessment and possibly a warning.

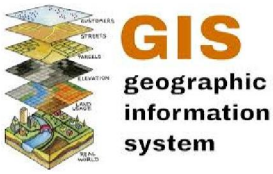


INTRODUCTION

This monitoring of climate change impacts requires an interdisciplinary approach, where IT experts still need to be involved to create web applications and systems that should provide data collection, storage, management and analysis for climate change research.

The Geographic Information System (GIS) can be used as a part of climate data processing. One of the approaches to data analysis is a spatio-temporal analysis for example precipitation data.

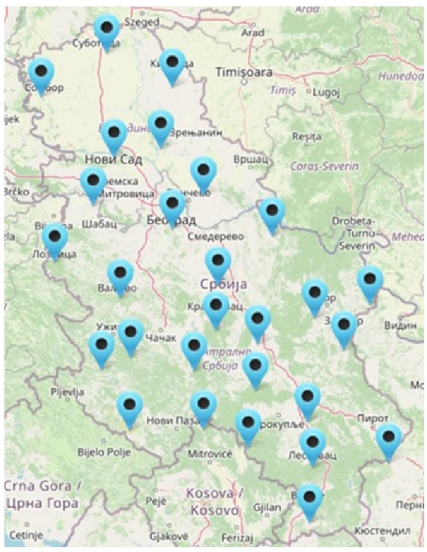
The research, design and practical implementation presented in this paper was the development of a specialized GIS application using some of the statistical software such as R to present average annual precipitation data in Serbia.



MATERIALS AND METHODS

Serbia is selected as a case study and monthly precipitation time series from 28 meteorological stations from the period 1946-2019 were analysed.

A map of Serbia with designated measuring stations in Serbia through a GIS application using the R language and its packages

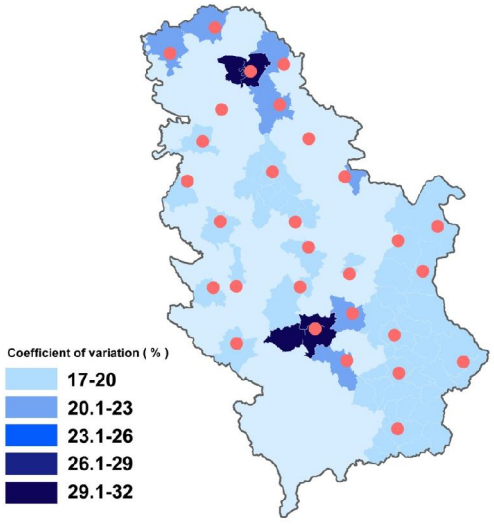


STATISTICAL PARAMETERS

The geographical description and statistical parameters (mean, standard deviation and coefficient of variation (CV)) for the annual precipitation data of the selected meteorological stations

The coefficient of variation is ranged from 17.1% (Zlatibor) to 30.9% (Kopaonik).

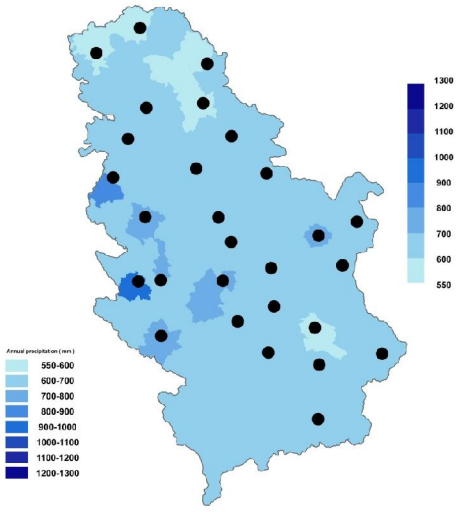
The majority of Serbia has a coefficient of variation less than 20%.



PRECIPITATION DATA IN SERBIA

The annual precipitation ranges from 540 to 820 mm.

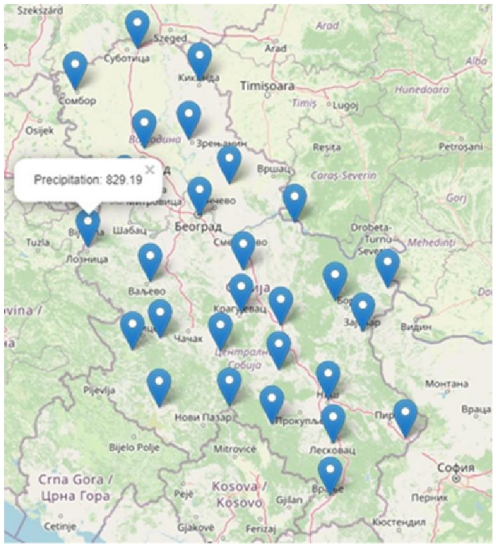
In areas with an altitude of over 1000 m, the stations have an average of 700 to 1000 mm of precipitation, and in some mountain peaks in the southwestern parts of Serbia, precipitation goes up to 1200 mm



R PROGRAMMING LANGUAGE

R programming language as an open-source programming language and software environment is used for statistical computing and creating graphics.

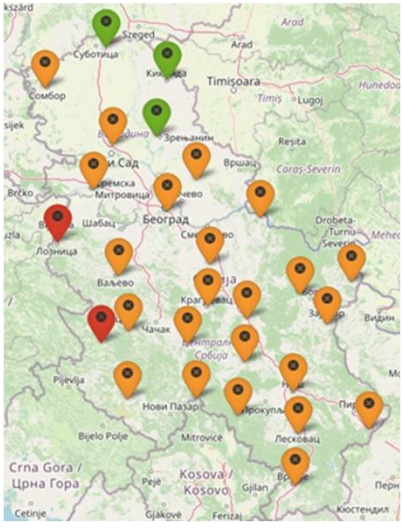
Input data for the calculation of annual precipitation, standard deviation and other statistical indicators are given from more Excel documents to R programming language.



R PROGRAMMING LANGUAGE

Using R language packages such as Shiny, RSQLite, and Sqldf data can be loaded and visualize

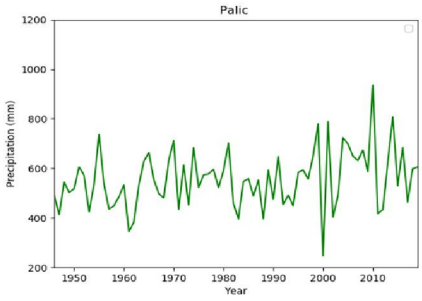
Information related to a specific location such as average annual precipitation can be read for the selected station

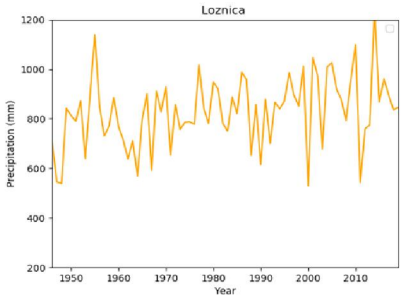


VISUALIZATION OF AVERAGE ANNUAL PRECIPITATION

The time series of annual precipitation of the selected five meteorological stations in Serbia: Palic, Loznica, Cuprija, Nis, Vranje

The average annual precipitation of selected stations varied between 554.6 mm (Palic) to 826.0 mm (Loznica) for the period 1946-2019.





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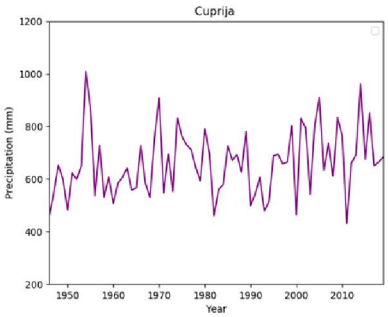

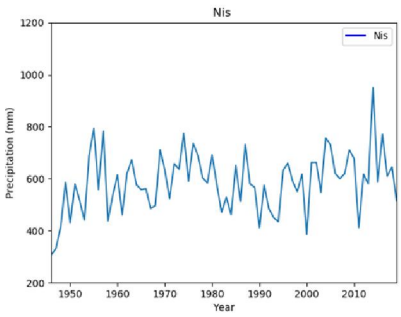

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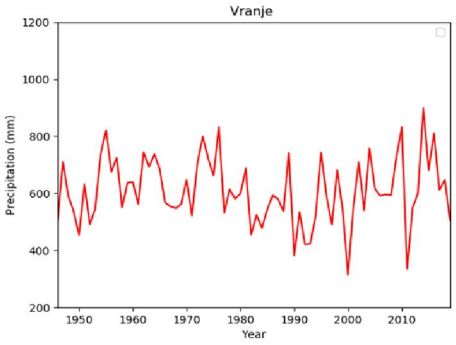
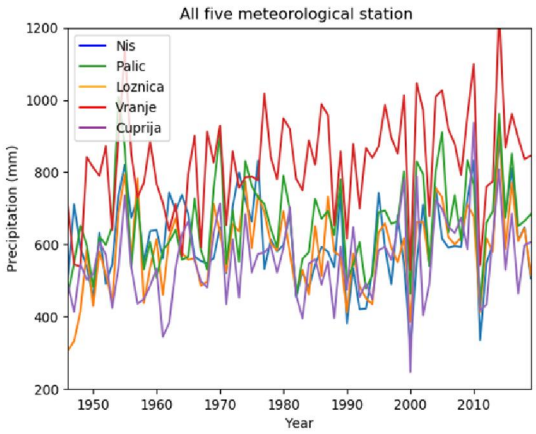


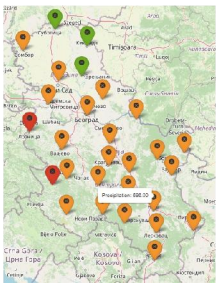


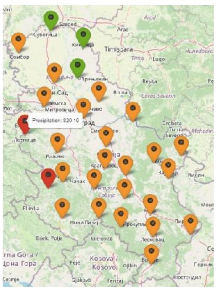
VISUALIZATION OF AVERAGE ANNUAL PRECIPITATION

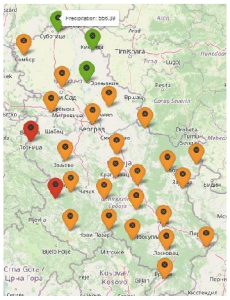
The annual amount of precipitation is shown on the map of Serbia in different colors.

- for precipitation below 580 mm the representation of the meteorological station is green,
- for precipitation between 580 and 800 mm the meteorological stations are presented in orange,
- for precipitation over 800 mm the stations are presented in red.

Nis presented in orange, b) Loznica presented in red and c) Palic presented in green measuring station of the city of Ćuprija represented in orange.







CONCLUSIONS

In this study, the approach for visualizing average annual precipitation data for 28 meteorological stations in Serbia for the period 1946-2019 is presented.

The spatial distribution of precipitation data can help us to better plan water resources.

The obtained results can be useful for the planning and management of water resources and agricultural production.

The presented application can be a part of the hydro-information system for drought analysing.

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