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Assessment of Climate Changes Using QGIS Software in Karnataka

Shaamlie Devi T R[1], Maithili K L[2], Saran K R[3], M Vijay[4], Arjun M[5]
[1,2]Assistant professor, Dept. of CE, AMC Engineering College, Bangalore, Karnataka, India.
[3,4,5,6]UG Scholar, Dept. of CE, AMC Engineering College, Bangalore, Karnataka, India.
Email ID: *shaamliedevi.tr@gmail.com[1], tmaithili@gmail.com[2], krsaran2004@gmail.com[3], maheshmohan2817@gmail.com[4], arjunvijay1517@gmail.com[5]*

Abstract
Climate change has emerged as a critical global issue, with localized impacts that require comprehensive analysis to inform sustainable development and adaptation strategies. This study aims to assess climate change trends and their spatial patterns in Karnataka state, India, using QGIS (Quantum Geographic Information System) software. QGIS, an open-source GIS platform, facilitates the integration, visualization, and analysis of geospatial and climatic data. Spatial interpolation and analytical tools in QGIS are employed to predict and map climate variability and identify vulnerable regions for the year 2030. By leveraging QGIS for climate assessment, this study demonstrates the potential of geospatial tools in supporting regional climate policy-making and fostering resilience in the face of changing environmental conditions. The findings aim to guide stakeholders in designing targeted interventions and sustainable practices to mitigate climate change impacts in Karnataka.
Keywords: *GIS, Data Access Viewer, QGIS, Geo TIFF, Shapefile.*

1. Introduction
Climate change is one of the most pressing global challenges of the 21st century, impacting ecosystems, economies, and communities worldwide. Understanding and assessing these changes are critical for effective planning, mitigation, and adaptation strategies. Geographic Information System (GIS) technologies, particularly Quantum GIS (QGIS), offer robust tools for analysing and visualizing spatial data related to climate variations. QGIS is an open-source software platform renowned for its flexibility, accessibility, and extensive analytical capabilities in Isinkaralar, O. (2024). It enables researchers and policymakers to process large datasets, perform spatial analysis, and generate interactive visualizations that highlight trends and anomalies in climatic patterns in Sansare, D. A.et.al. (2020). By leveraging QGIS's geospatial analysis features, this study aims to provide a comprehensive understanding of how climate dynamics are evolving over time in the Karnataka state and predict the 2030 temperature changes. The findings of this project will contribute to informed decision-making processes, emphasizing the role of geospatial technology in addressing climate change challenges. Oxoli, D et.al (2023). [1-4]

2. Tools and Methodology
- **Future Data Collection of 2030:** The POWER Data Access Viewer (DAV) is designed to offer easy access to NASA's environmental datasets. The platform supports multiple applications, including renewable energy design, agriculture, and climate research. [5]
- **Pre-Processing the Data:** Format data into acceptable GIS formats (CSV, Geo JSON, Shapefile).
- **Exporting the Data into QGIS:** Add Vector Layer (for shapefiles/Geo JSON). Ensure fields like latitude and longitude are correctly assigned. [6]
- **Using Tools Idw Interpolation for Analysis:** Set input point layer, interpolation attribute.
- **Assigning Proper Symbology:** Choose a

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colour ramp that fits the data range. [7]

- **Labelling the Map:** Choose label field (e.g., location name, value).
- **Exporting The Final Map:** Open Layout Manager and creating a new layout. Add a map item, legend, scale bar, north arrow, and title. Export as PDF, JPEG or any other convenient format. [8]

The process of assessing climate change using QGIS software involves a series of geospatial data handling and analysis steps. It begins with importing relevant data, such as climatic parameters (temperature, rainfall), vegetation indices (like NDVI), and land use/land cover (LULC) maps, into the QGIS environment in Congedo, L et.al. (2014). These datasets can be in raster or vector formats and must be projected to a common coordinate system for accurate analysis. Once the data is loaded, preprocessing tasks like clipping to the Karnataka boundary, reprojection, and alignment of raster layers are carried out. Raster data analysis is then performed using the Raster Calculator to compute climate anomalies and trends, such as changes in temperature or rainfall over time. Novaczek, I. (2011).Vector processing techniques, including the use of zonal statistics, help summarize raster data (e.g., average rainfall) for administrative units like districtsin. To analyze land cover changes, QGIS provides tools such as the Semi-Automatic Classification Plugin (SCP), which can classify satellite images from different years and identify LULC transitions. NDVI data is processed to monitor vegetation health over time, revealing patterns of degradation or improvement. The Time Manager plugin allows visualization of temporal trends by animating maps across different years. Damahe, L et.al (2024, November). All results are visually represented through thematic maps with appropriate symbology, labels, and legends. These maps and analytical outputs can be exported for reporting and further interpretation. Overall, QGIS facilitates a powerful and systematic approach to monitor, assess, and visualize the spatial and temporal dimensions of climate change in Karnataka. Oxoli, D et.al (2023). In QGIS, creating vector data inside a polygon for future climate data analysis involves using spatial and attribute data management tools. Begin by obtaining future climate datasets, such as raster temperature or precipitation projections, and ensure the data is geo-referenced in DiPaola et.al(2023). Import these datasets into QGIS and overlay them with your polygon layer representing administrative boundaries as shown in (Figure 1) [9-10]

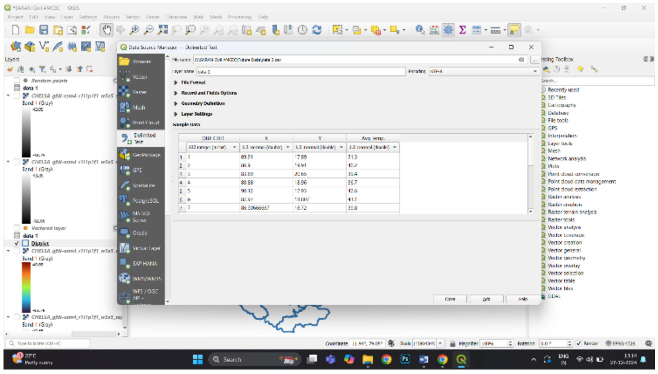

Figure 1 Importing the File into QGIS

To create detailed vector datasets, climate-related features are digitized within predefined polygon boundaries using tools in an editable layer within QGIS. Once the features are digitized, attribute data—including key climate variables—is integrated through the attribute table or by applying spatial joins using tools like Attributes by Location. This process enables the creation of spatially explicit vector layers that correspond to current or projected climate conditions, thereby supporting advanced geospatial analysis and informed decision-making. Daich, et.al (2022). (Figure 2) [10-11]

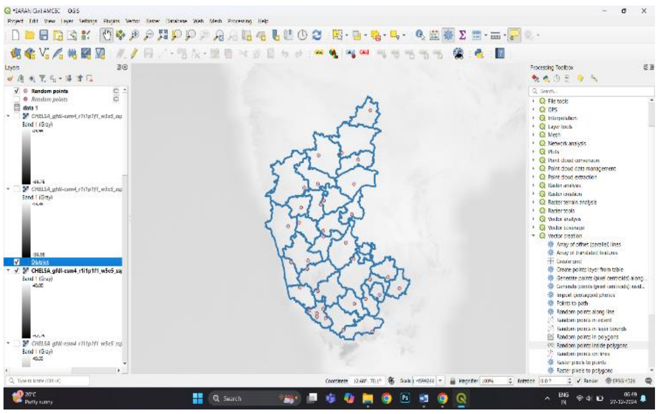

Figure 2 Vector Creation of the Map

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The process begins with the collection and preprocessing of climate data, such as temperature records. This includes data cleaning, error correction, and conversion to compatible GIS formats. After importing the cleaned data into QGIS, it is georeferenced and organized into thematic layers for visualization and analysis as indicated in Figure 2. To model continuous spatial variations in climate variables across Karnataka's districts, Inverse Distance Weighting (IDW) interpolation is employed in Kamel Boulos et.al (2023). IDW is a commonly used method for estimating unknown values at unsampled locations based on the values of nearby known points. It assumes that each point has a local influence that diminishes with distance, meaning closer points have more weight in determining interpolated values than farther ones. Kamel Boulos (2023). When applied to future climate scenarios, IDW interpolation facilitates the generation of projected spatial maps of variables like temperature and precipitation. Fu, P et.al. (2016). These continuous surface maps are vital for identifying regional climate trends and vulnerabilities. Furthermore, masking techniques in QGIS allow these interpolations to be restricted to specific areas of interest, such as state or district boundaries, ensuring relevance to the spatial scope of the analysis. De Filippis et.al (2019). (Figure 3) [12]

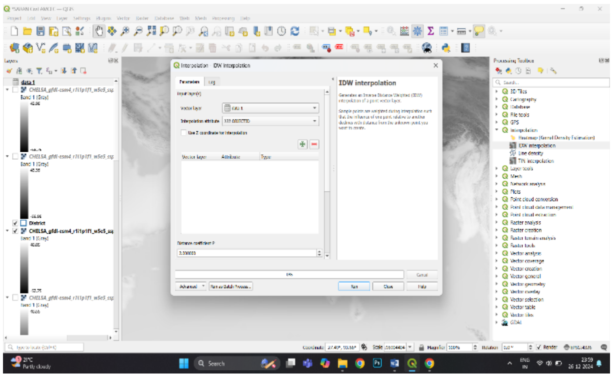

Figure 3 Interpolating & Masking in QGIS

By applying a mask layer, users can ensure that interpolated surfaces are limited to meaningful geographic extents, improving both the accuracy and relevance of the results for climate impact analysis and decision-making. Zhang, L et.al (2016). Together, IDW interpolation and masking provide powerful tools for visualizing and analyzing future climate scenarios within QGIS as indicated in Figure 3. Through spatial analysis functions, QGIS helps identify zones most affected by climate temperature changes. Further, symbology and labelling tools in QGIS make the data interpretation user-friendly by applying intuitive colour gradients and text annotations. This enhances the readability of complex climate patterns. Truong, P. M et.al (2023).

3. Results and Discussion

The predicted values displayed on the interpolated maps represent estimated climate variables (e.g., temperature) across Karnataka, derived from discrete observational or modelled point data using Inverse Distance Weighting (IDW) interpolation. Each cell or pixel on the resulting raster surface holds a numerical value corresponding to the predicted magnitude of the climate variable at that location. In this study, the IDW algorithm assigns weights to known data points based on their distance from the prediction location. Closer points exert greater influence, resulting in a smoothly varying surface that reflects local climatic patterns. Figure 4 shows the final climate prediction map for the year 2030. (Figure 4)

- These prediction values help identify spatial trends and anomalies in climate distribution:
- High prediction values (e.g., >35°C in the case of temperature) are indicative of hotter zones, typically observed in the northern interior regions of Karnataka.
- Moderate values are found in transitional zones, where climate conditions vary more gradually. [13]
- Low prediction values (e.g., <28°C) often correspond to high-altitude or coastal areas where moderating influences such as elevation or proximity to water bodies play a role.

These prediction surfaces are particularly useful in assessing future climate scenarios, as they allow researchers and policymakers to visualize where climate conditions are expected to intensify or moderate. The maps serve as a spatial decision-support tool for identifying vulnerable regions, prioritizing adaptation measures, and allocating

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resources for climate resilience planning.

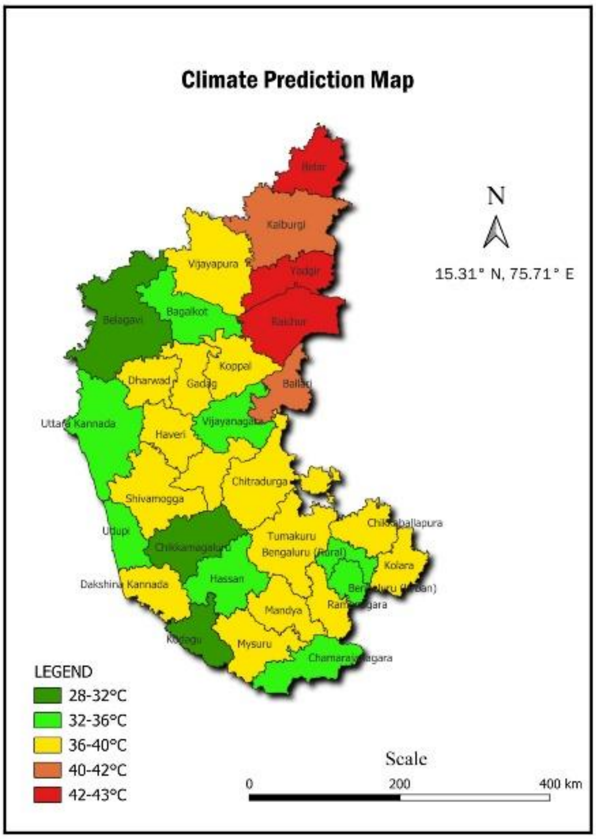

Figure 4 **Climate Prediction Map**

Conclusion

The application of GIS-based spatial analysis enabled the creation of high-resolution vector and raster datasets representing current and projected climate conditions across Karnataka. Digitization of spatial features within administrative boundaries, combined with the integration of climate attribute data, facilitated the development of detailed vector layers. These layers served as the foundational input for subsequent spatial interpolations. Using Inverse Distance Weighting (IDW) interpolation, continuous surface maps were generated to depict the spatial variability of temperature across the study area. The resulting interpolated surfaces revealed distinct patterns of climate variation, with higher temperatures predominantly concentrated in the northern and interior regions of Karnataka, and relatively lower temperatures observed in the southern and coastal zones. These masked maps provide a clear spatial context for understanding projected climate changes and support more targeted regional climate impact assessments. This study provides valuable insights for policymakers, planners, and researchers engaged in climate adaptation and environmental planning at the regional scale. [14-15]

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References

[1]. Isinkaralar, O. (2024). QGIS-based modeling and analysis of urban dynamics affecting land surface temperature towards climate hazards in coastal zones of Portugal. Natural Hazards, 120(8), 7749-7764.

[2]. Sansare, D. A., & Mhaske, S. Y. (2020). Natural hazard assessment and mapping using remote sensing and QGIS tools for Mumbai city, India. Natural Hazards, 100, 1117-1136.

[3]. Congedo, L., & Munafò, M. (2014). Urban sprawl as a factor of vulnerability to climate change: Monitoring land cover change in Dar es Salaam. In Climate change vulnerability in southern african cities: Building knowledge for adaptation (pp. 73-88). Cham: Springer International Publishing.

[4]. Daich, S., Saadi, M. Y., Khelil, S., & Piga, B. (2022). Study of land use/cover change impacts on thermal microclimate using QGIS in urban agglomeration. In PLEA STGO 2022: Will Cities Survive? (pp. 825-829).

[5]. DiPaola, F., Bhardwaj, A., & Sam, L. (2023). Generating an interactive online map of future sea level rise along the North Shore of Vancouver: methods and insights on enabling geovisualisation for coastal communities. arXiv preprint arXiv:2304.07469.

[6]. Kamel Boulos, M. N., & Wilson, J. P. (2023). Geospatial techniques for monitoring and mitigating climate change and its effects on human health. International Journal of Health Geographics, 22(1), 2.

[7]. Kamel Boulos, M. N., & Wilson, J. P. (2023).

Geospatial techniques for monitoring and mitigating climate change and its effects on human health. International Journal of Health Geographics, 22(1), 2.

[8]. Novaczek, I., MacFadyen, J., Bardati, D., & MacEachern, K. (2011). Social and cultural values are mapping as a decision-support tool for adaptation of climate change. The Institute of Island Studies, University of Prince Edward Island: Charlottetown, PE, Canada.

[9]. Zhang, L., & Weng, Q. (2016). Annual dynamics of impervious surface in the Pearl River Delta, China, from 1988 to 2013, using time series Landsat imagery. ISPRS Journal of Photogrammetry and Remote Sensing, 113, 86-96.

[10]. Fu, P., & Weng, Q. (2016). A time series analysis of urbanization induced land use and land cover change and its impact on land surface temperature with Landsat imagery. Remote sensing of Environment, 175, 205-214.

[11]. Truong, P. M., Le, N. H., Hoang, T. H. D., Nguyen, T. K. T., Nguyen, T. D., Kieu, T. K., ... & Tran, T. A. (2023). Climate change vulnerability assessment using GIS and fuzzy AHP on an indicator-based approach. International Journal of Geoinformatics, 19(2), 39-53.

[12]. Oxoli, D., Cedeno Jimenez, J. R., Capizzi, E., Brovelli, M. A., Siciliani de Cumis, M., Sacco, P., & Tapete, D. (2023). Qgis and Open Data Cube Applications for Local Climate Zones Analysis Leveraging Prisma Hyperspectral Satellite Data. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 48, 111-116.

[13]. De Filippis, G., Pouliaris, C., Kahuda, D., Vasile, T. A., Manea, V. A., Zaun, F., ... & Rossetto, R. (2019). Spatial data management and numerical modelling: Demonstrating the application of the QGIS-integrated FREEWAT platform at 13 case studies for tackling groundwater resource management. Water, 12(1), 41.

[14]. Oxoli, D., Cedeno Jimenez, J. R., Capizzi, E., Brovelli, M. A., Siciliani de Cumis, M., Sacco, P., & Tapete, D. (2023). Qgis and Open Data Cube Applications for Local Climate Zones Analysis Leveraging Prisma Hyperspectral Satellite Data. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 48, 111-116.

[15]. Damahe, L., Lachure, S., Thakare, K., Dekate, V., Shivde, V., & Gedam, S. (2024, November). Flood Prediction Map Using QGIS and ML-Case Study for Barpeta District Assam. In 2024 2nd International Conference on Emerging Trends in Engineering and Medical Sciences (ICETEMS) (pp. 388-393). IEEE.