Scanning the Earth's Surface for Water Bodies

CASE STUDY - IMAGE PROCESSING AND MACHINE VISION OF THIRD YEAR (SEMESTER-VI)

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Introduction

- Project focuses on utilizing image processing techniques for water body detection in satellite imagery.
- Methodology involves employing the Normalized Difference Water Index
- NDWI leverages the differences in reflectance between near-infrared (NIR) and visible green bands in satellite images.
- By exploiting distinct spectral properties, the NDWI method accurately identifies water bodies. -
- Application of image processing in environmental monitoring and analysis is highlighted through this project.

Project Goals:

- Develop a water body detection system using satellite imagery and image processing techniques.
- Incorporate stages such as data acquisition, image preprocessing, NDWI computation, thresholding, post-processing, visualization, and evaluation into the system.
- Establish a foundational framework for water body detection without focusing on real-time applications or hardware development.

Methodology:

1. DATA ACQUISITION

Obtain satellite imagery from publicly available sources (e.g., Landsat, Sentinel).

Ensure the dataset includes relevant spectral bands (e.g., NIR, green) for water body detection.

2. PREPROCESSING

Read satellite imagery using rasterio library in Python.

Perform radiometric and geometric correction to enhance image quality and accuracy.

Methodology:

3. NDWI COMPUTATION

Calculate the Normalized Difference Water Index (NDWI) using the formula: (NIR - Green) / (NIR + Green).

This enhances the contrast between water and non-water features in the imagery.

4. THRESHOLDING

Apply thresholding techniques to the NDWI image to create a binary mask.

Pixels with NDWI values above a chosen threshold are classified as water, while others are classified as non-water.

Methodology:

5. POST-PROCESSING

Apply morphological operations (e.g., dilation, erosion) to refine the binary water mask.

This helps remove noise, fill gaps, and smoothen boundaries of detected water bodies.

6. PARAMETER SELECTION

Choose threshold value empirically based on analysis and validation against ground truth data.

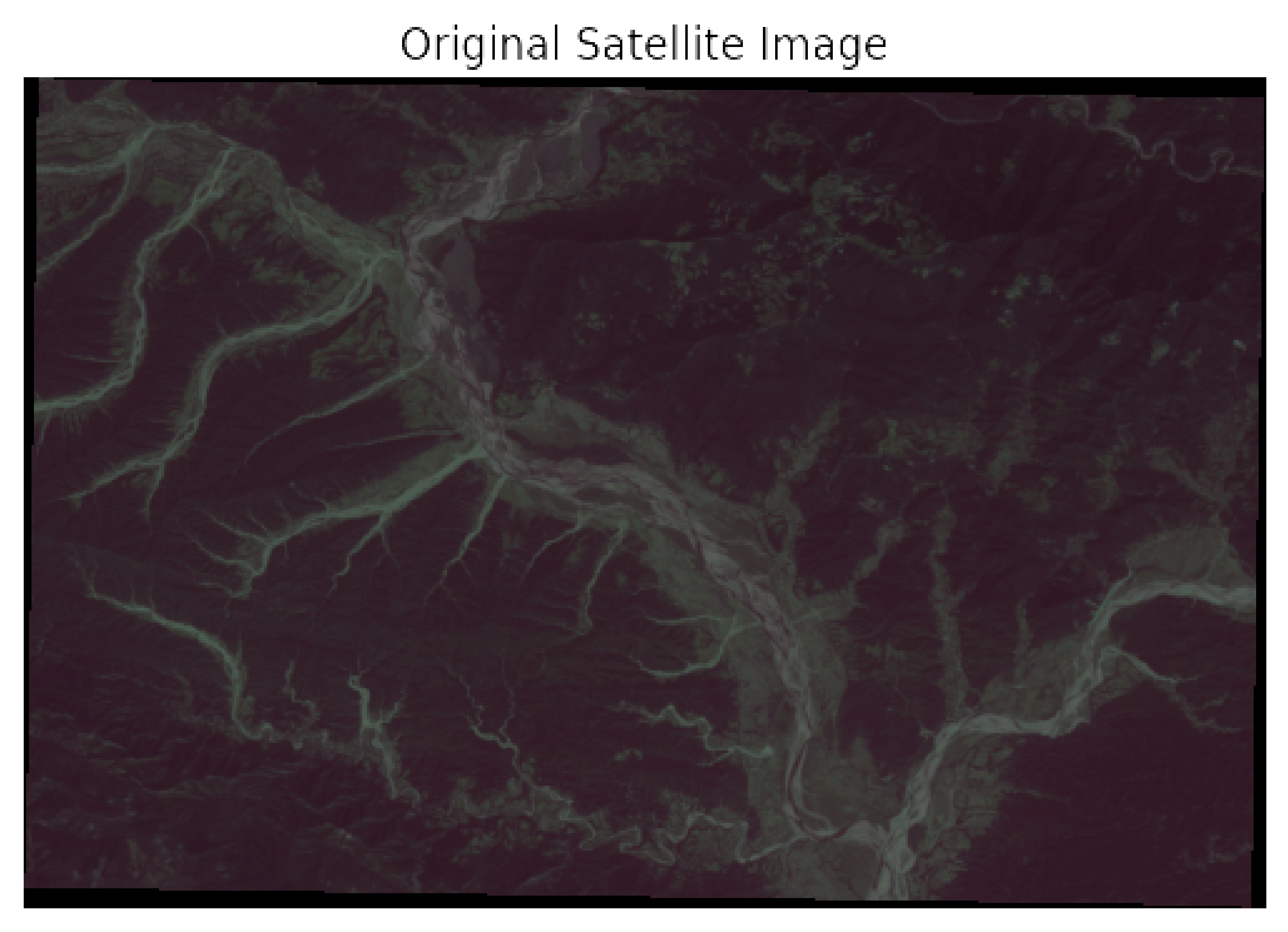
Select appropriate kernel size for morphological operations to balance between preserving true water bodies and filtering out false positives.

Results:

ORIGINAL SATELLITE IMAGE

The original satellite image serves as the starting point of our analysis

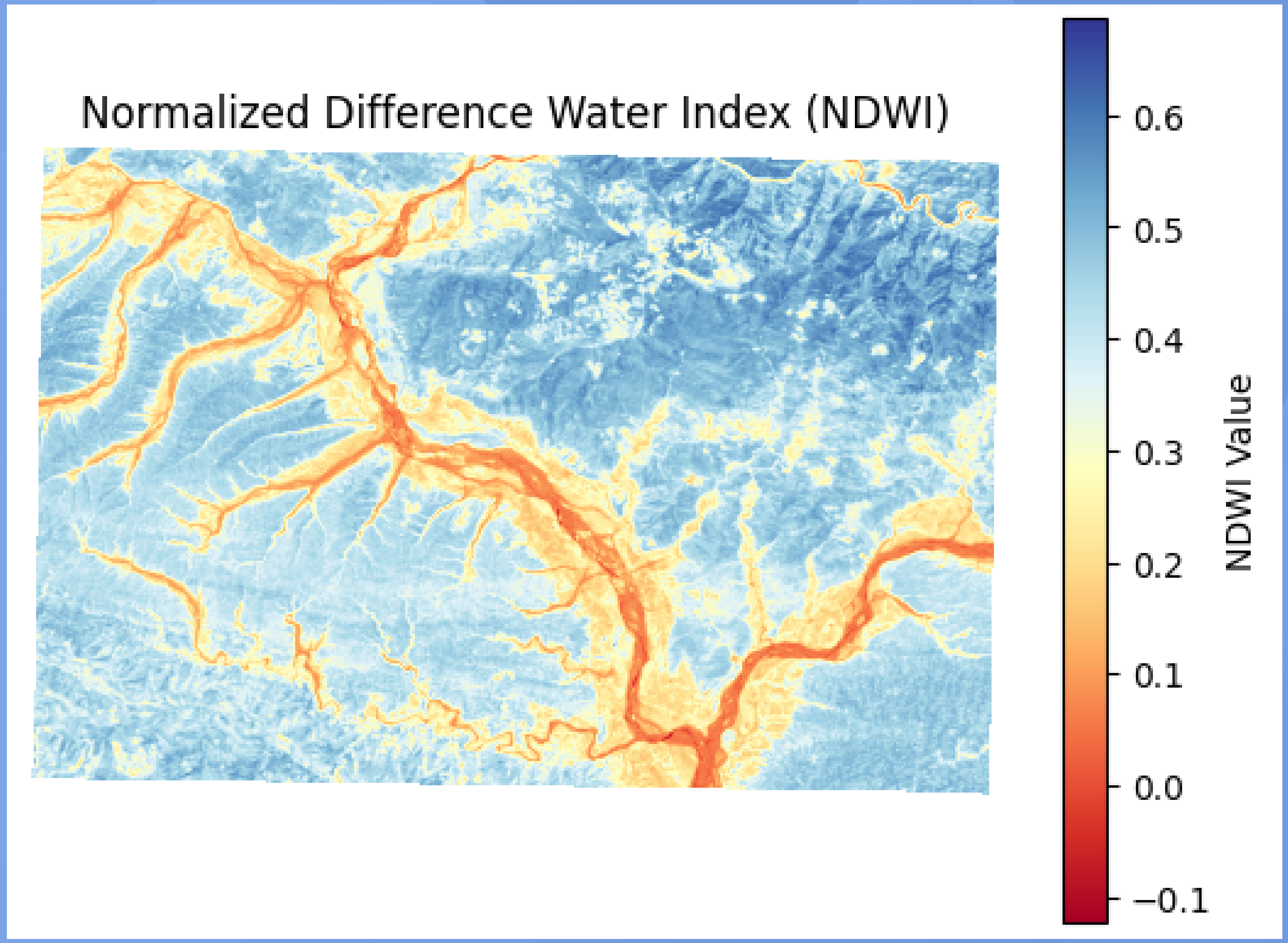
The image contains various land cover features, including vegetation, urban areas, and water bodies.



Results:

NORMALIZED DIFFERENCE WATER INDEX

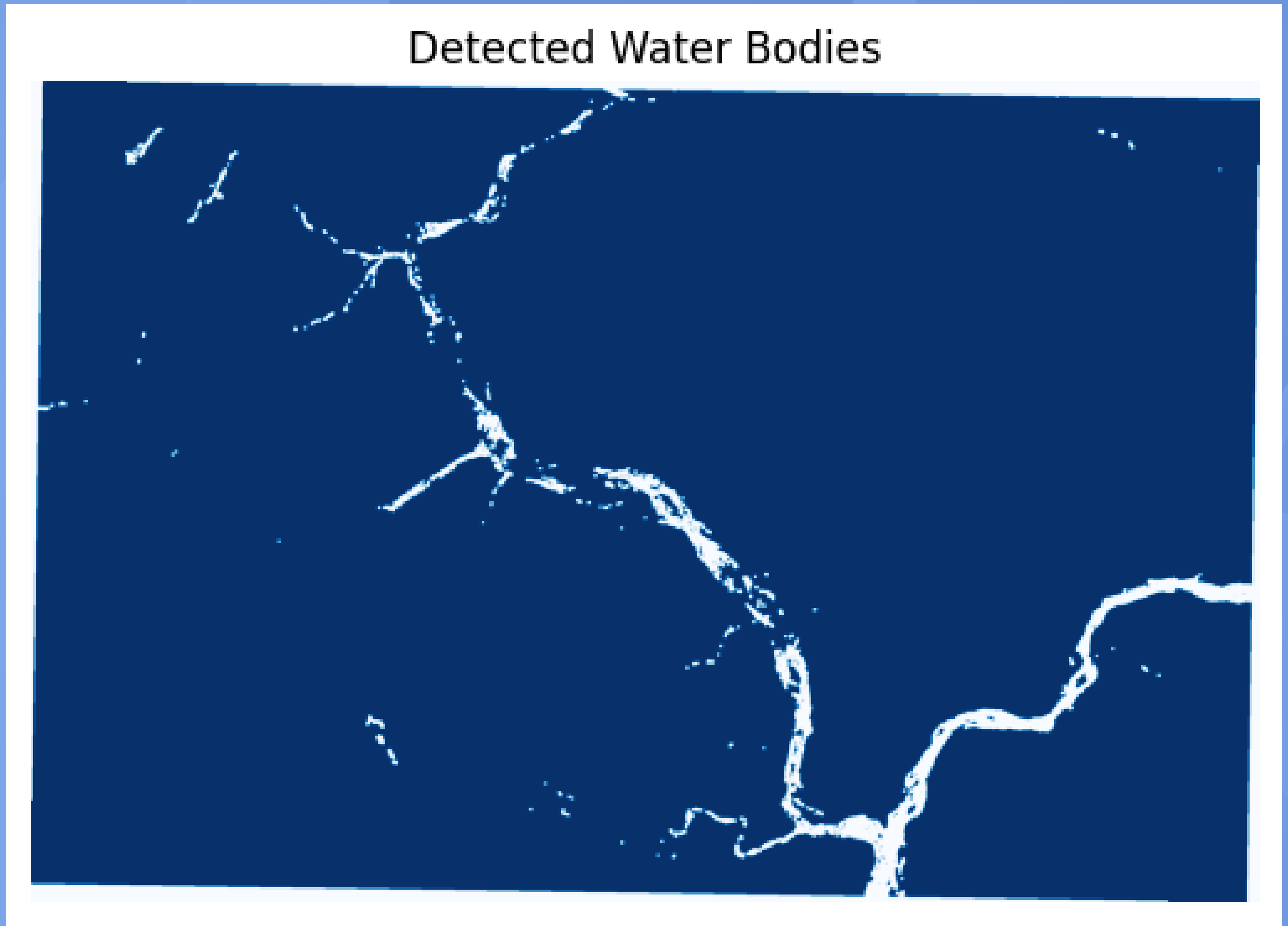
Water absorbs near-infrared (NIR) light and reflects green light, leading to higher values of NDWI in water bodies compared to other features.



Results:

DETECTED WATER BODIES

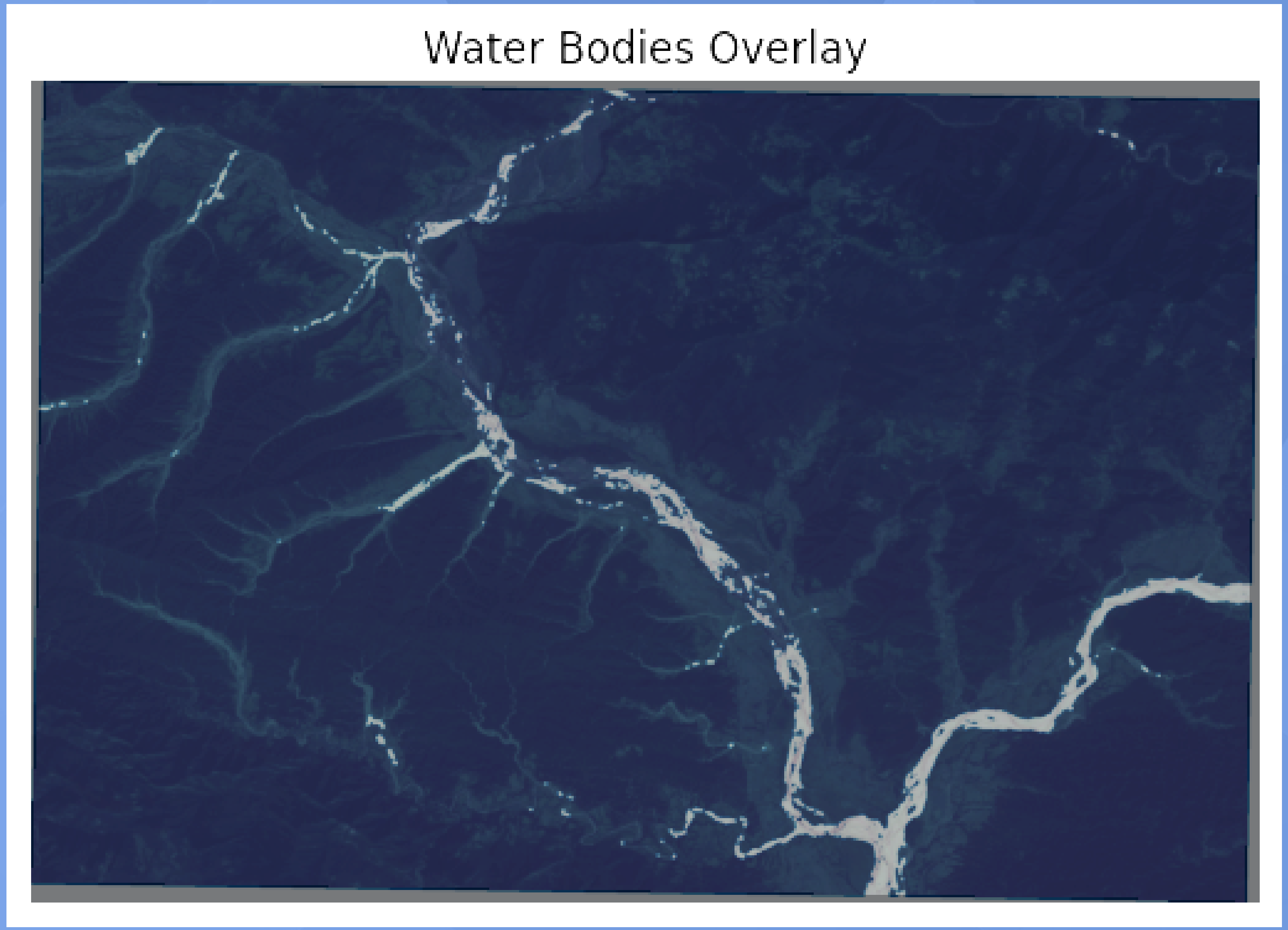
Detection was achieved through the computation of the Normalized Difference Water Index (NDWI) followed by thresholding techniques



Results:

WATER BODIES OVERLAY

The overlay helps in clearly distinguishing water bodies from other land cover features present in the imagery.



Conclusion

- Our project successfully utilized image processing techniques, particularly the NDWI, for detecting water bodies in satellite imagery.
- The developed algorithm demonstrated accurate and reliable detection of water bodies.
- The results provide valuable insights for applications such as water resource management and environmental monitoring.
- Further refinement and validation of the algorithm will enhance its effectiveness in real-world scenarios.
- Our project highlights the significance of remote sensing and computational methods in addressing water resource challenges.

Thank You