# GNR602

**CREATE A MODEL TO DETECT CHANGES IN MULTI-TEMPORAL SATELLITE IMAGES. IT USES PRINCIPAL COMPONENT ANALYSIS (PCA) AND K-MEANS CLUSTERING TECHNIQUES OVER DIFFERENCE IMAGE.**

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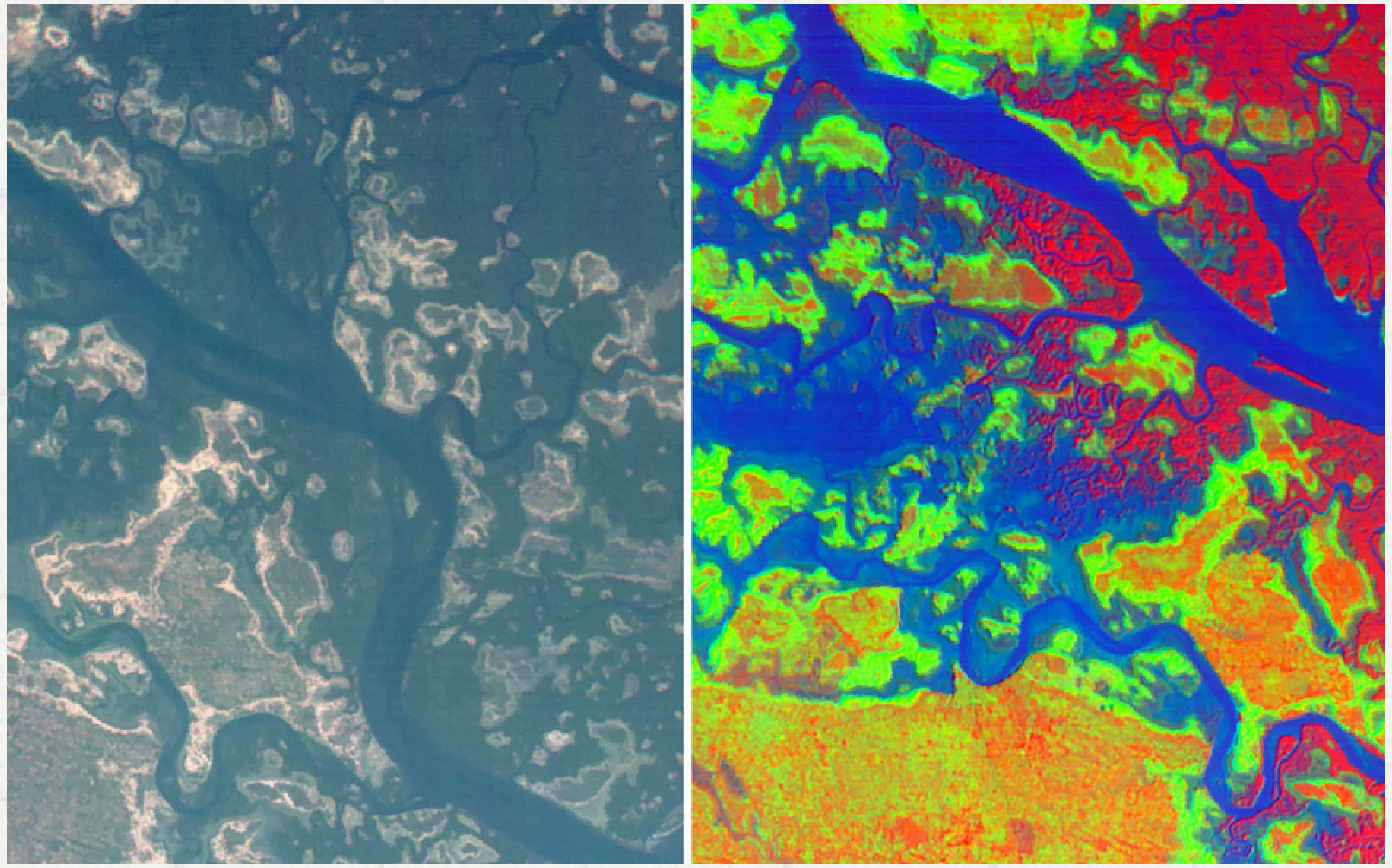
# ABOUT

- **Getting Dataset**:-
  Import the satellite images from **UGSC** website.

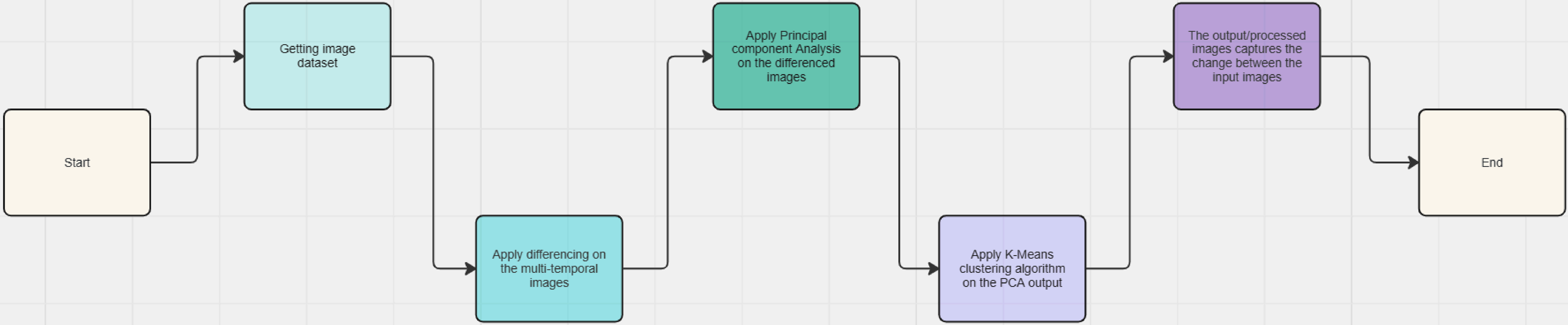
- **Feature Extraction**:-
  -Use **Principal Component Analysis (PCA)** to:
    Reduce dimensionality while preserving variance.
    Create a difference image by subtracting PCA transformed images from different time periods.
    This highlights significant changes.

  -Apply **K-means clustering** to the difference image to:
    Group pixels with similar change patterns.
    Identify distinct types of change (e.g., urban expansion, deforestation).
    Visualize resulting clusters on original satellite images for interpretation.



In conclusion, by leveraging PCA and K-means clustering, our model effectively detects and interprets changes in multi-temporal satellite images, providing valuable insights into landscape dynamics

# FLOWCHART



Start
Getting image dataset
Apply differencing on the multi-temporal images
Apply Principal component Analysis on the differenced images
Apply K-Means clustering algorithm on the PCA output
The output/processed images captures the change between the input images
End

# Principal Component Analysis

Applying PCA on the difference image involves transforming the pixel values into a lower dimensional space while retaining essential information about the differences between multi-temporal satellite images:

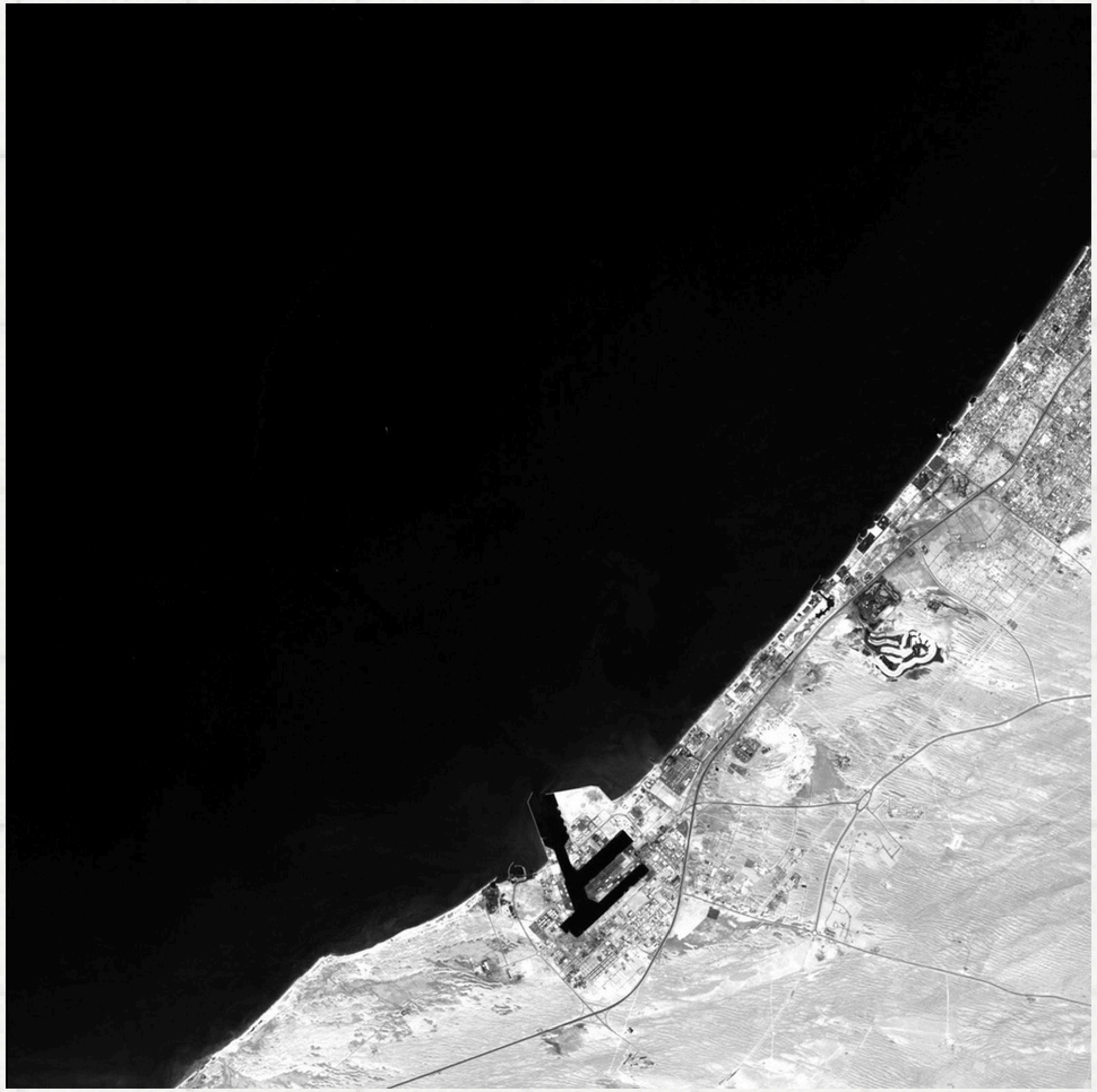
1. **Data Representation:**
   - Each pixel in the difference image is treated as a data point in a high-dimensional space.
   - The intensity values of pixels represent coordinates in this space.
2. **Principal Component Calculation:**
   - PCA identifies principal components that capture maximum variance in the data.
   - These components represent the most significant patterns or variations in the difference image.
3. **Dimensionality Reduction:**
   - A subset of principal components is selected to reduce dimensionality.
   - This step simplifies subsequent analysis while retaining essential information.
4. **Feature Extraction:**
   - Transformed dataset retains essential information about image differences.
   - Each pixel represents a linear combination of selected principal components.

# K-Means Clustering

K-means clustering efficiently organizes pixels into clusters, refining centroids iteratively to identify patterns or changes in satellite images. These clusters provide valuable insights for change detection and interpretation.

1. **Data Clustering**:
    - K-means clusters data points (pixels) in the transformed image into K groups based on similarity.
    - each pixel in the transformed image is considered a data point, and K-means aims to group these pixels into clusters representing different types of changes or patterns.
2. **Centroid Initialization**:
    - Initially, K cluster centers (centroids) are randomly initialized within the feature space.
    - These centroids serve as the initial guesses for the cluster centers.
3. **Assignment and Update**:
    - Data points are assigned to the nearest cluster center, and centroids are updated iteratively.
4. **Convergence**:
    - Iteration continues until cluster assignments and centroids stabilize.
5. **Interpretation**:
    - The final clusters represent groups of pixels with similar characteristics or patterns.
    - These clusters can help in interpreting changes in the satellite images, as each cluster may correspond to a specific type of change or feature.

# INPUT IMAGES

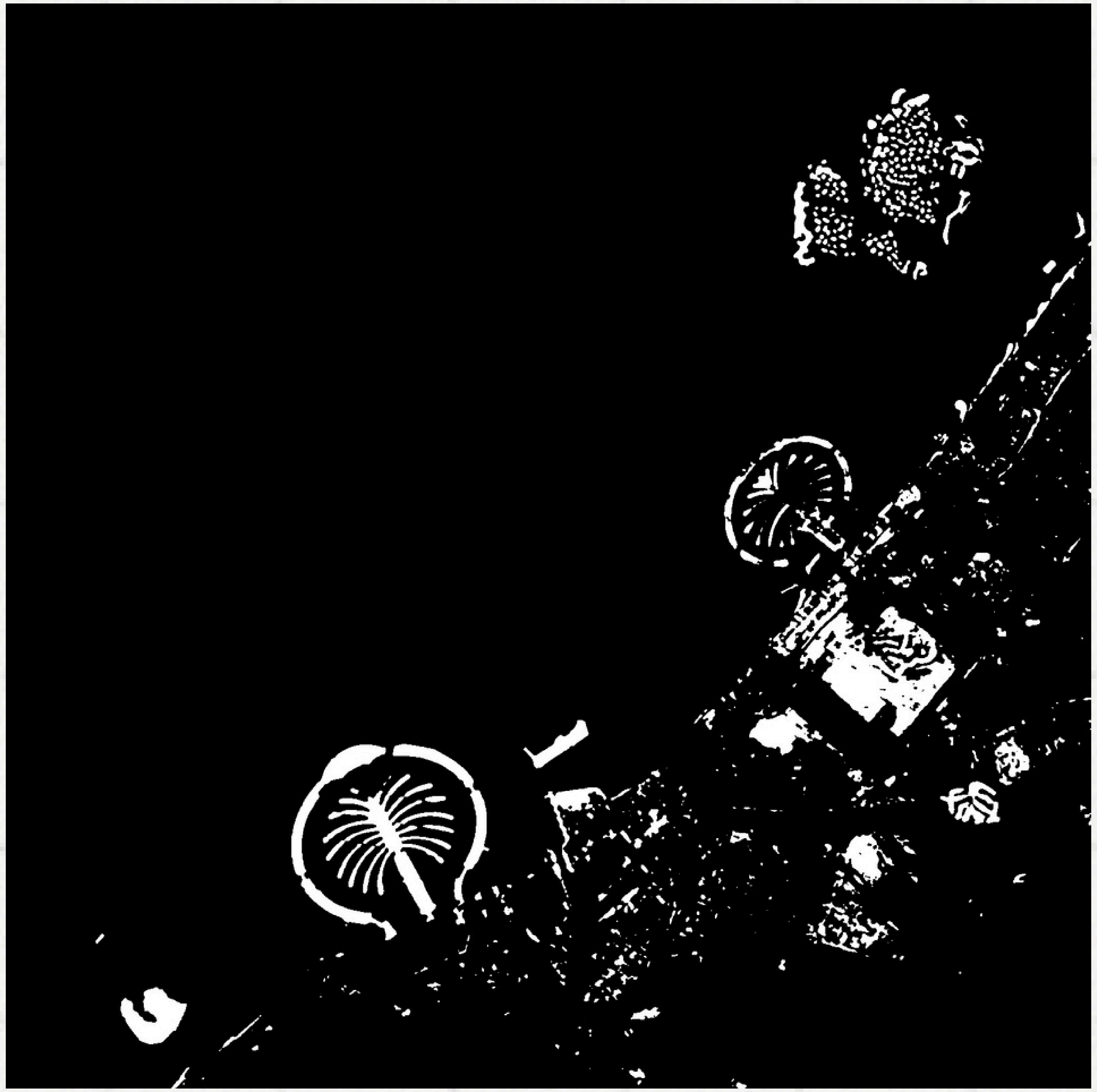


Dubai - 27 Nov 2000

Dubai - 12 Nov 2012

# PROCESSED IMAGES

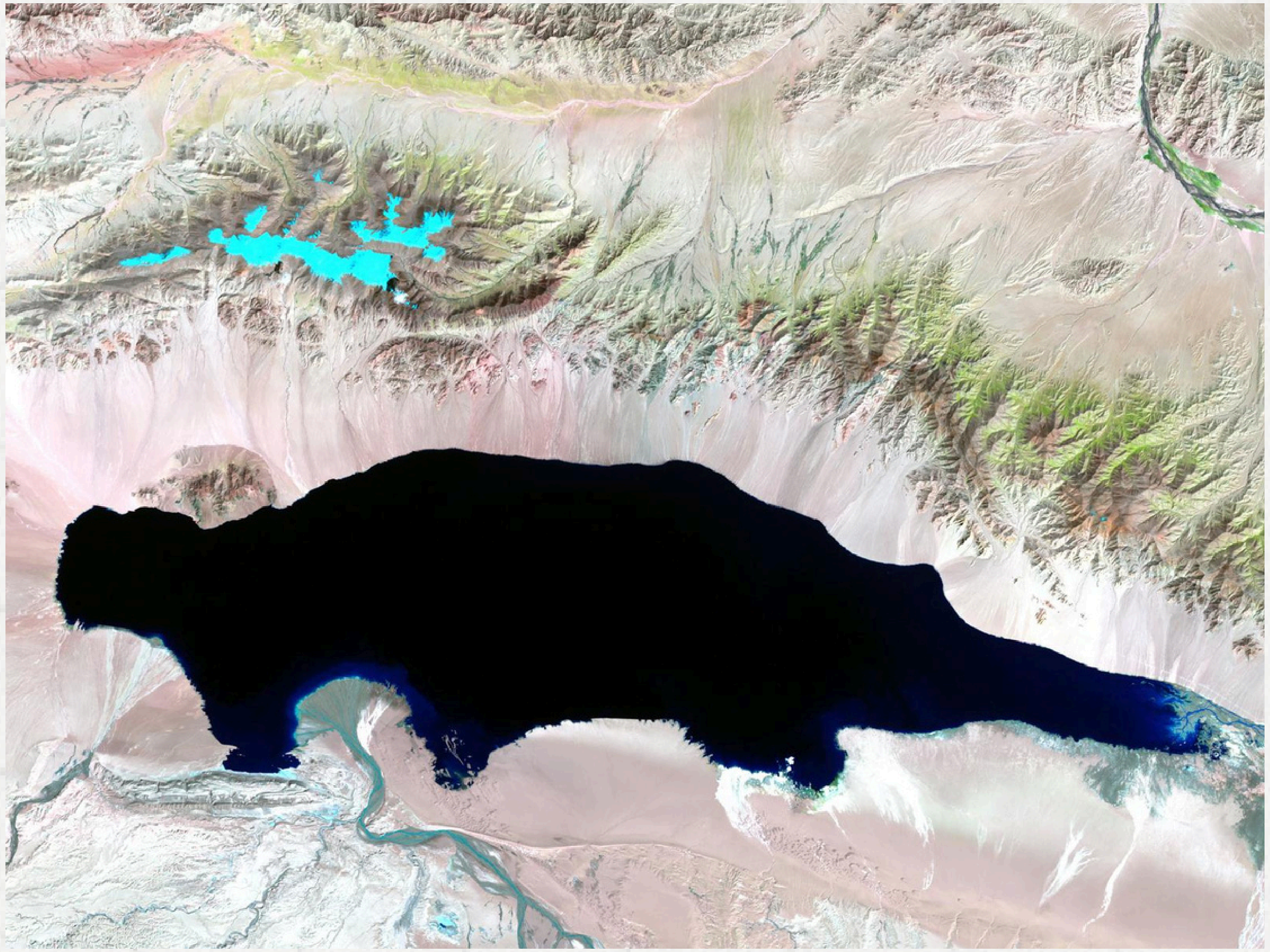
Difference Image



Change Map

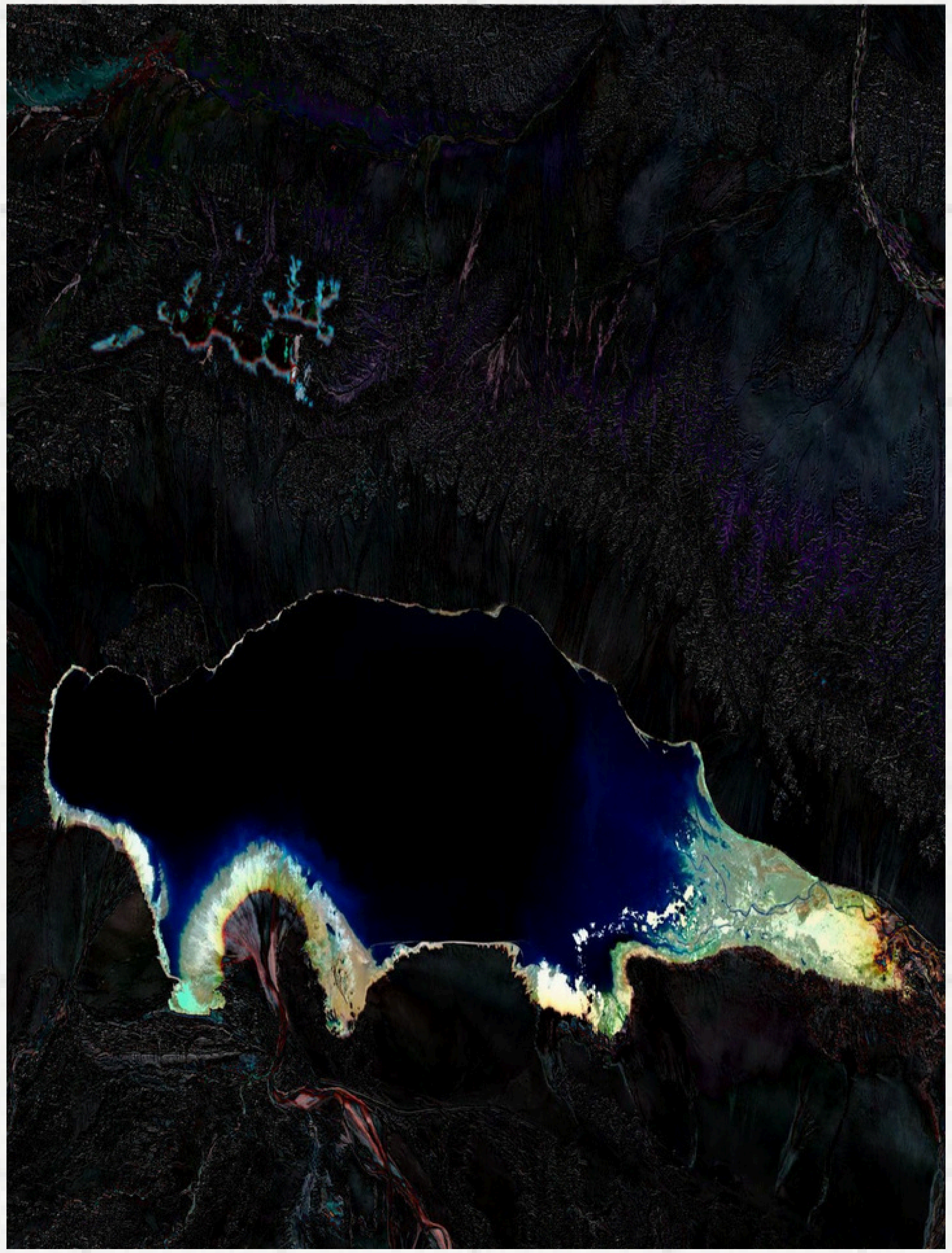
# INPUT IMAGES

Ayyakum  Lake - 21 Sep 2003



Ayyakum Lake - 13 Sep 2012

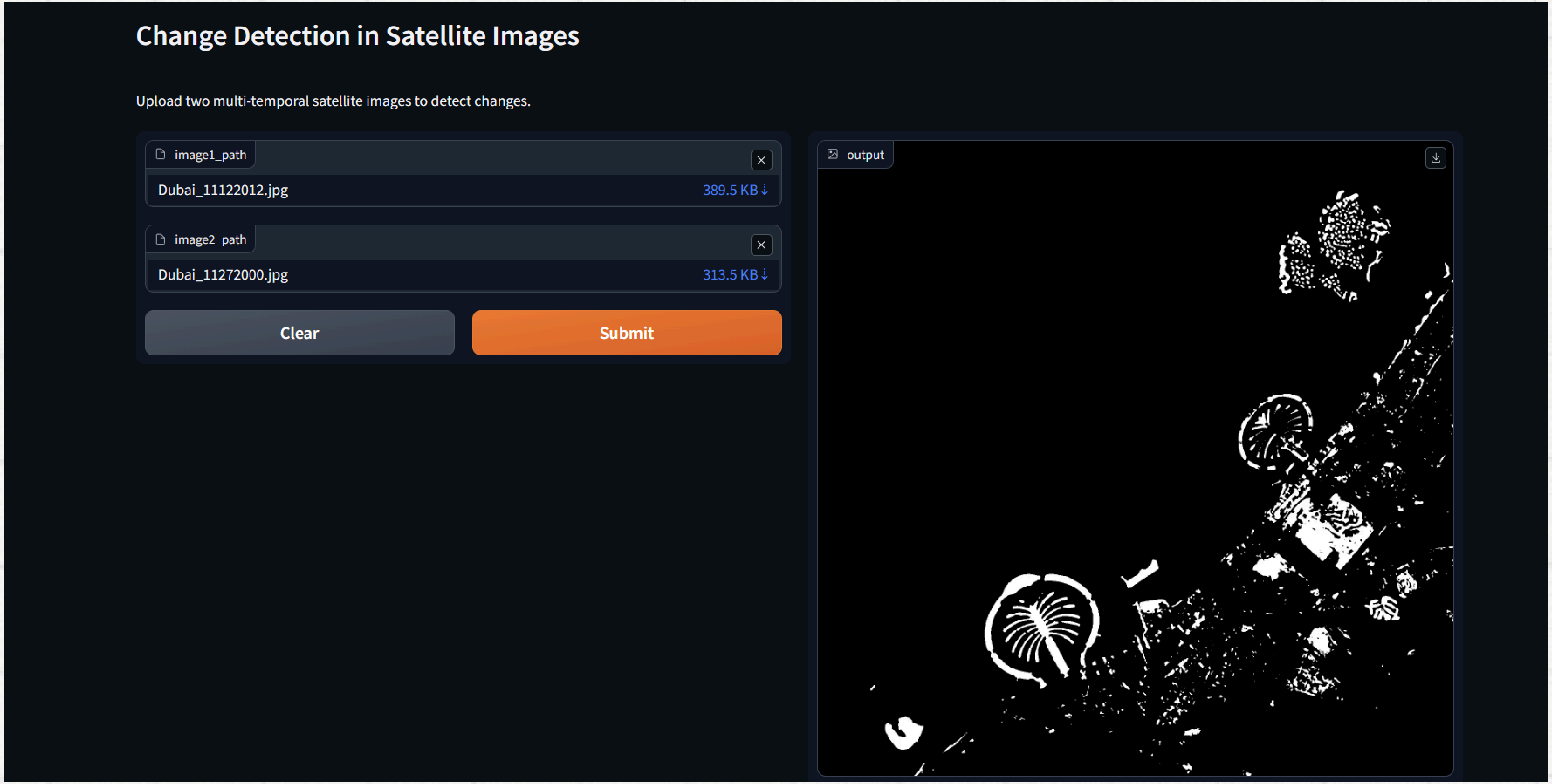
# PROCESSED IMAGES



Difference Image

Change Map

# User Interface



# Thank you very much!

22B0410

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| | | | |
|---|---|---|---|
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| **Department** | Chemical Engineering | **Program** | B.Tech. |
| **Category (Refer rules)** | 1 | | |

Payment | Performance Summary | New Entrants | Graduation Requirements | Personal Information | Forms/Requests

## Academic Performance Summary

| Year | Sem | SPI | CPI | Sem Credits Used for SPI | Completed Semester Credits | Cumulative Credits Used for CPI | Completed Cumulative Credits |
|---|---|---|---|---|---|---|---|
| 2023 | Spring | 8.33 | 8.27 | 36.0 | 36.0 | 144.0 | 144.0 |
| 2023 | Autumn | 8.8 | 8.25 | 30.0 | 30.0 | 108.0 | 108.0 |
| 2022 | Spring | 8.31 | 8.04 | 39.0 | 39.0 | 78.0 | 78.0 |
| 2022 | Autumn | 7.77 | 7.77 | 39.0 | 39.0 | 39.0 | 39.0 |

## Semester-wise Details

*This registration is subject to approval(s) from faculty advisor/Course Instructor/Academic office.

### Year/Semester: 2023-24/Spring

| Course Code | Course Name | Credits | Tag | Grade | Credit/Audit |
|---|---|---|---|---|---|
| CL 208 (S2) | Chemical Reaction Engineering | 6.0 | Core course | BB | C |
| CL 210 | Separation Processes | 6.0 | Core course | BC | C |
| CL 232 | Chemical Engineering Lab. I | 6.0 | Core course | AA | C |
| CL 238 (S2) | Introduction to Numerical Analysis | 6.0 | Core course | BB | C |
| CL 242 | Fundamentals of Heat and Mass Transfer | 6.0 | Core course | BB | C |
| DE 250 (S5) | Design Thinking for Innovation | 6.0 | Core course | AB | C |
| DS 303 (M) | Introduction to Machine Learning | 6.0 | Minor | CD | C |
| GNR602 | Advanced Methods in Satellite Image Processing | 6.0 | Additional Learning | CD | C |