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 Datase**t:-

  Import the satellite images from **UGSC** website.

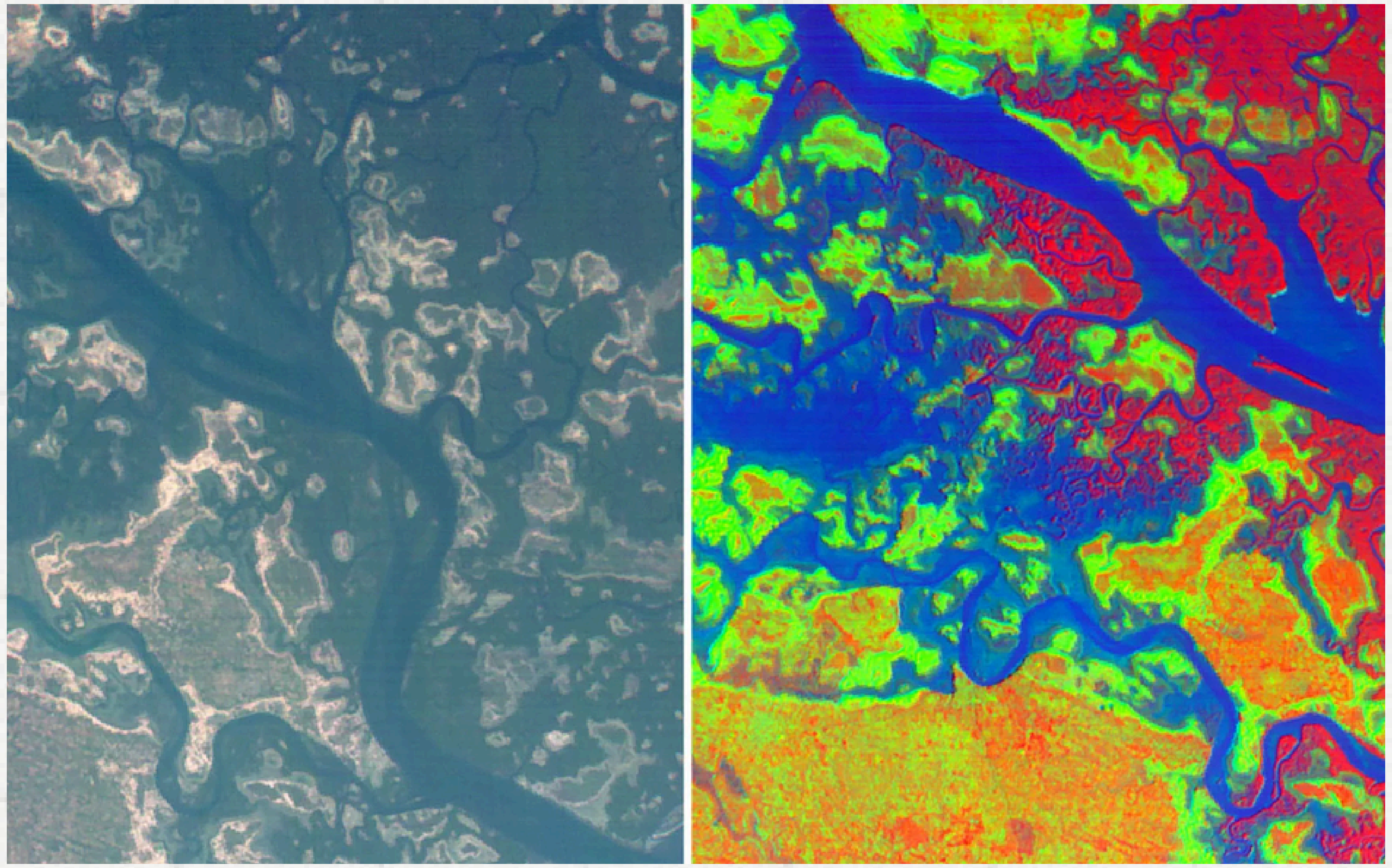
- **Feature Extraction**:-

  -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.

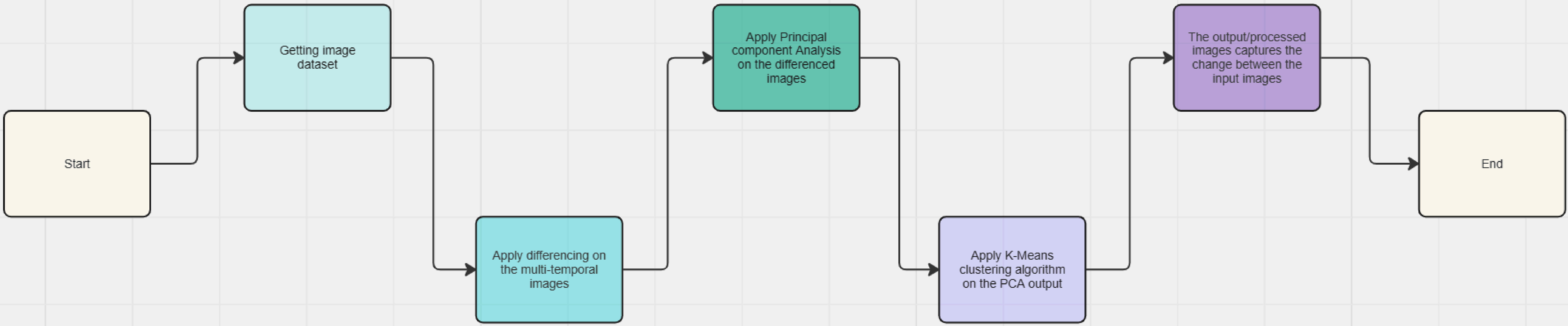
  -Apply **K-means clustering** to the difference image to:

  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:

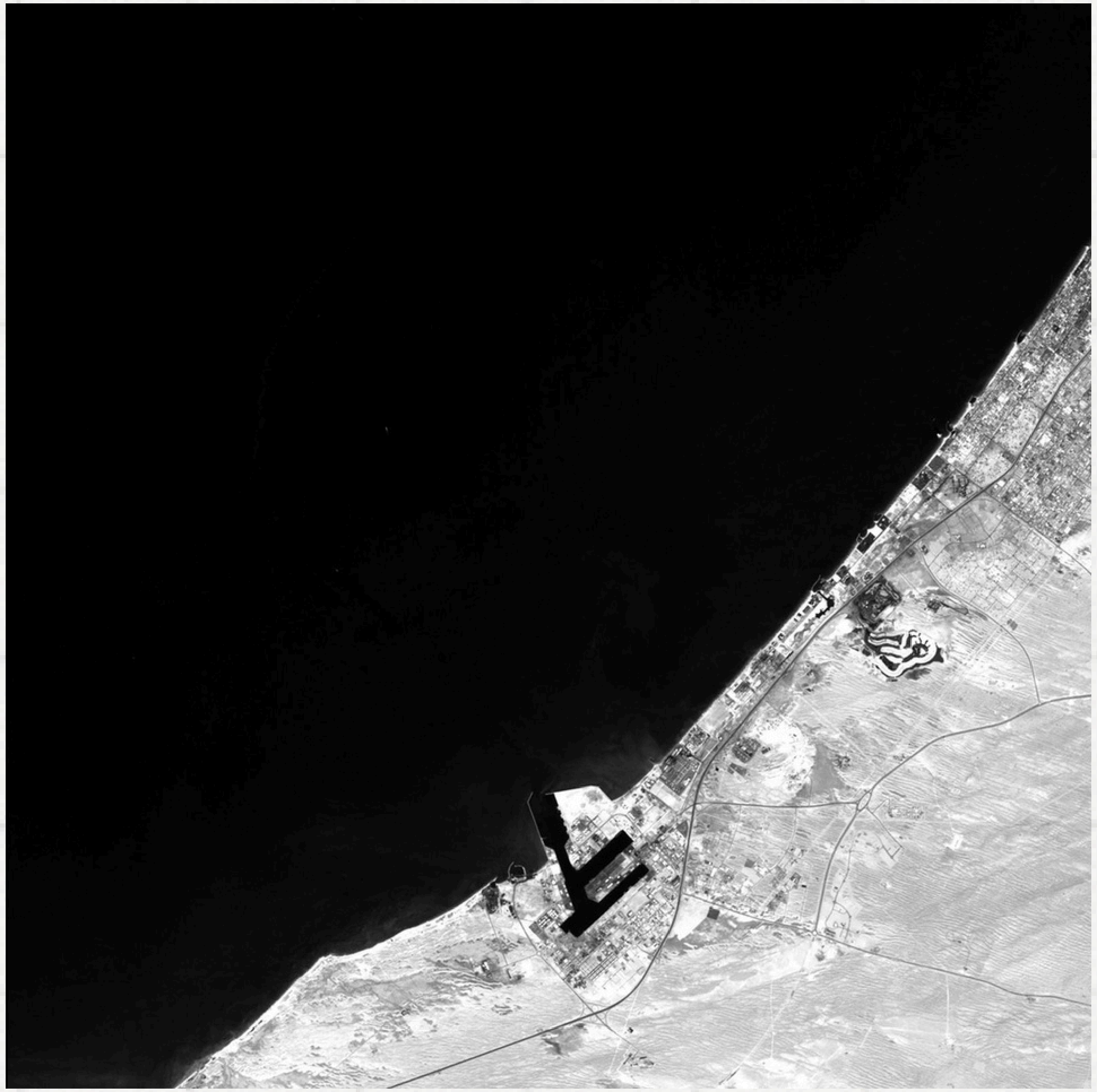
1. **Data Representation:**
   - Each pixel in the difference image is treated as a data point in a high-dimensional space.
   - The intensity values of pixels represent coordinates in this space.
2. **Principal Component Calculation:**
   - PCA identifies principal components that capture maximum variance 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

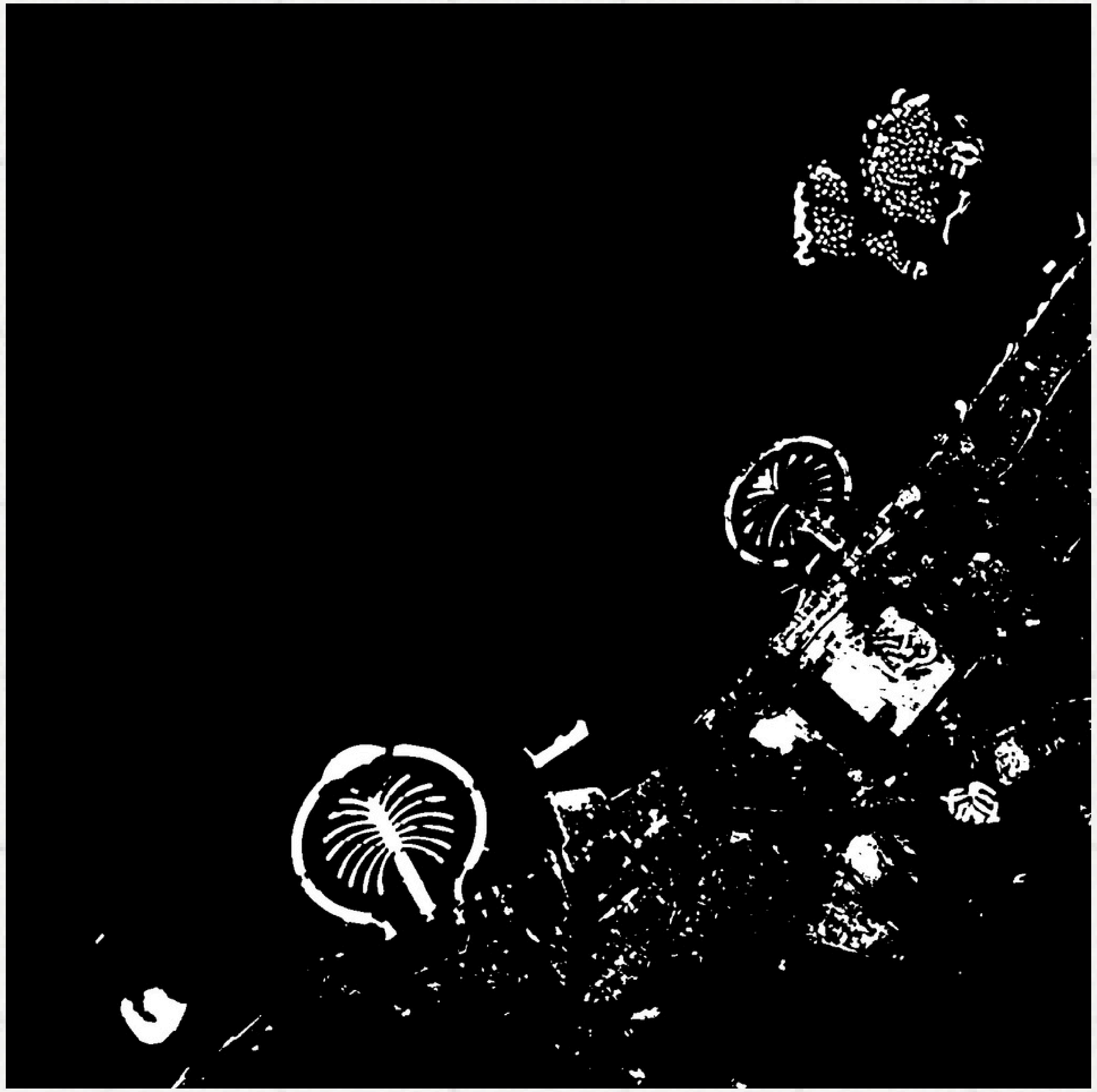


Dubai - 27 Nov 2000

Dubai - 12 Nov 2012

PROCESSED IMAGES

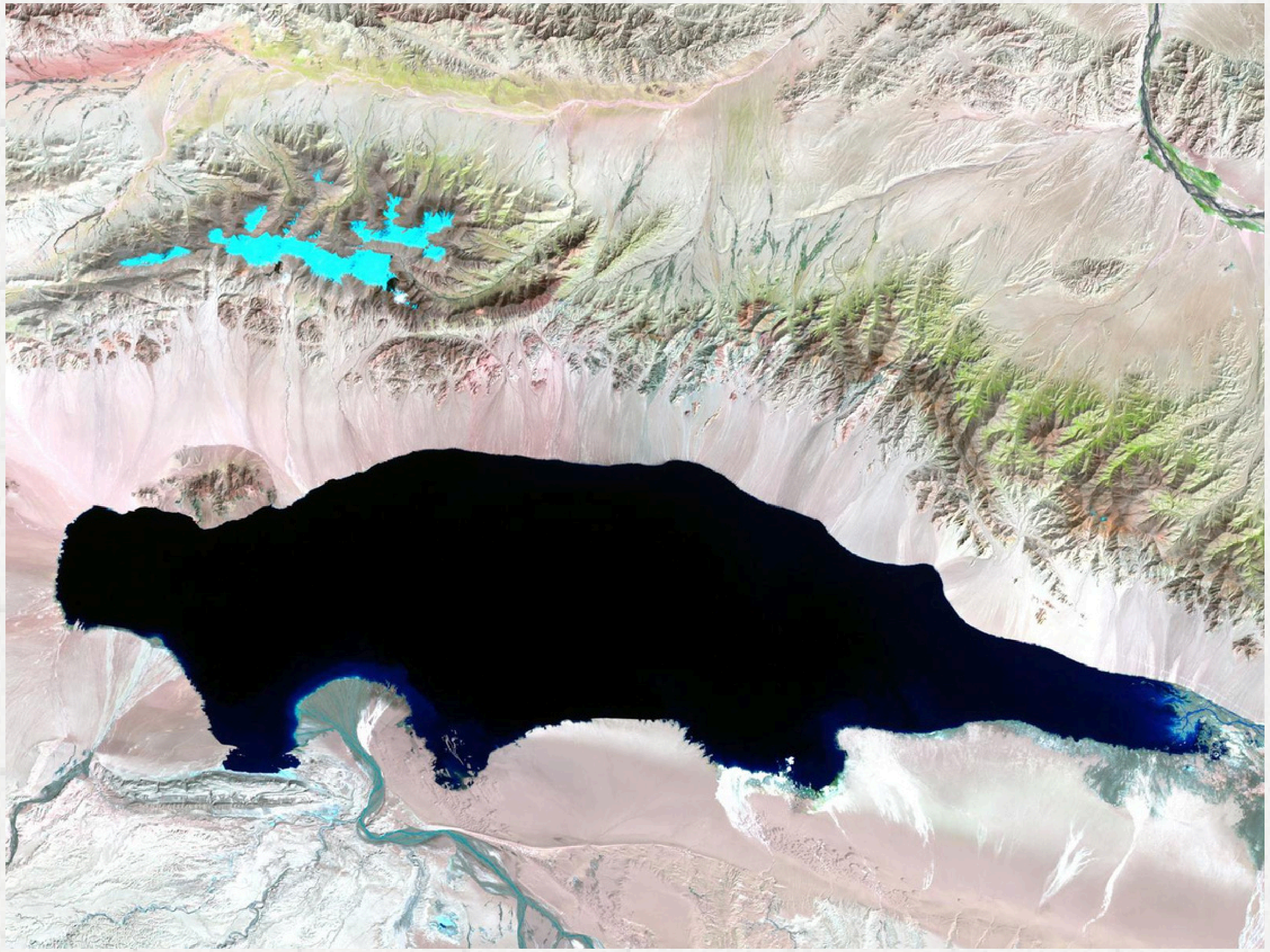
Difference Image



Change Map

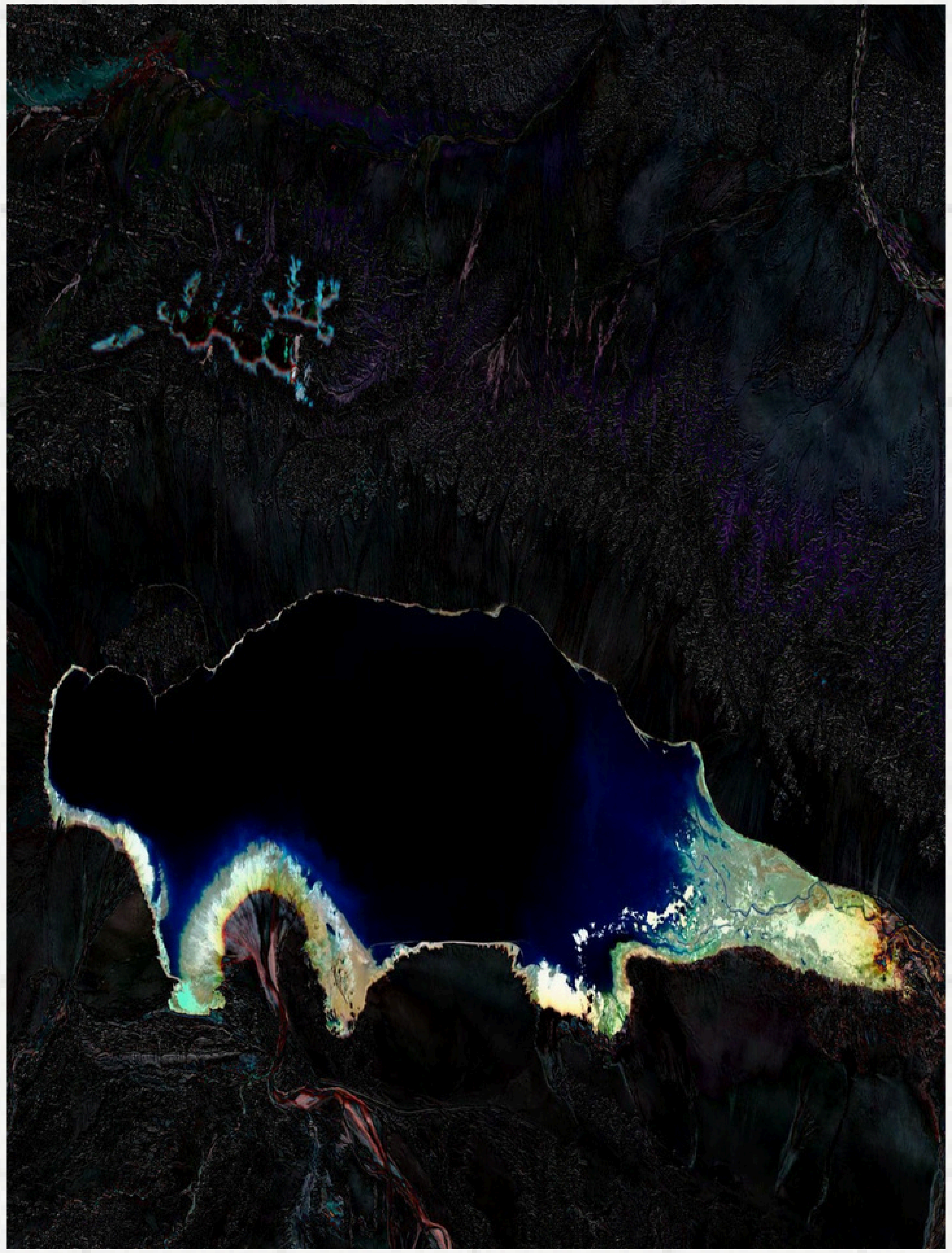
INPUT IMAGES

Ayyakum Lake - 21 Sep 2003



Ayyakum Lake - 13 Sep 2012

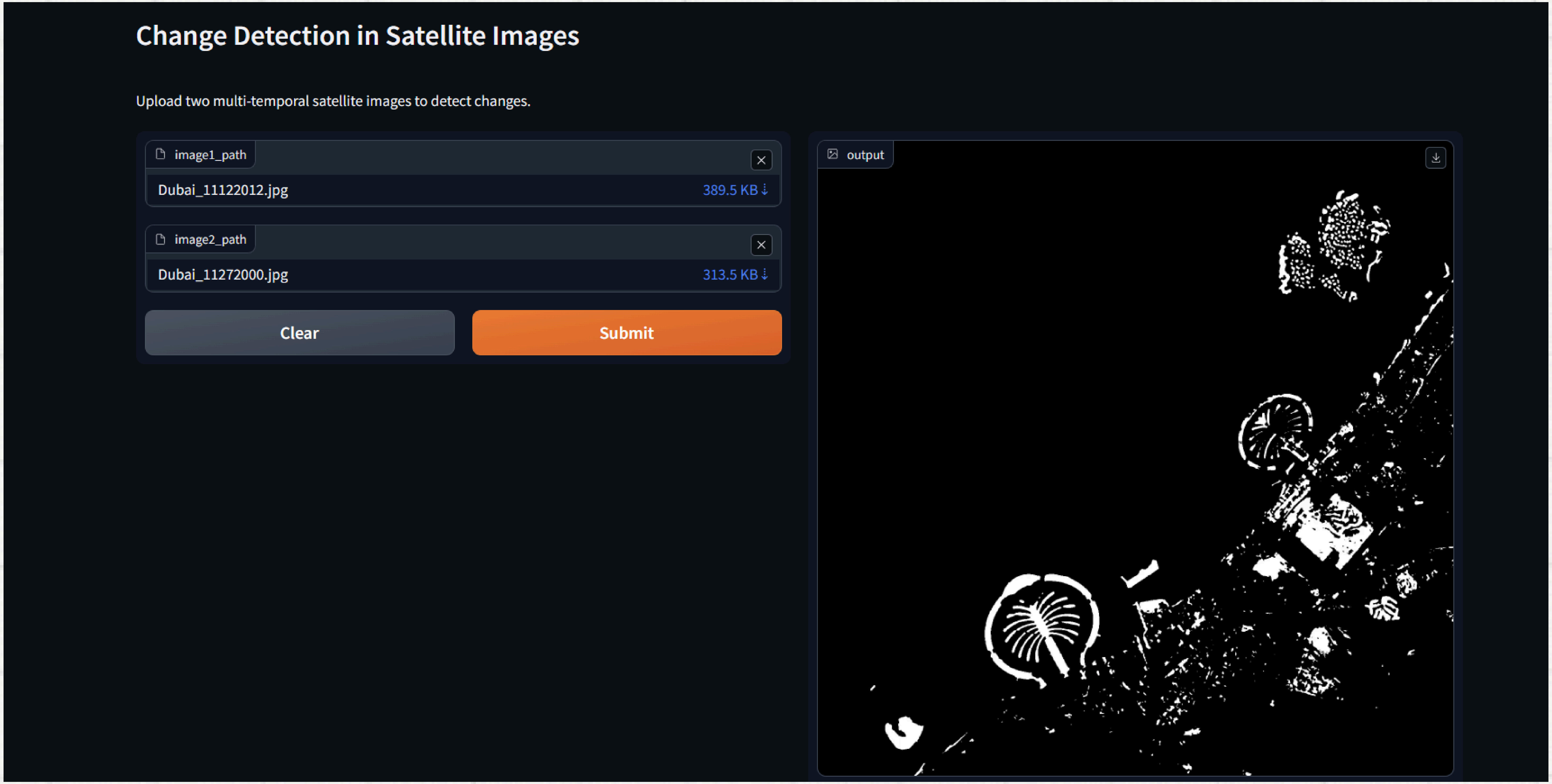
PROCESSED IMAGES



Difference Image

Change Map

User Interface



Thank you very much!