

Mangrove Change Detection App User Guide

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Introduction

This guide explains how to use, modify, and maintain the **Mangrove Change Detection Application**. The app helps you analyze changes in mangrove vegetation using raster data files. No prior knowledge of R programming or statistics is required to follow this guide.

Getting Started

What Does This App Do?

The app: - Loads raster data files (TIF format) and displays vegetation information. - Shows trends, patterns, and changes in mangrove vegetation. - Forecasts future vegetation trends using advanced statistical models. - Provides interactive maps to visualize raster data and differences between files.

Step 1: Input Files

How to Load Raster Data

1. Gather your **TIF files** (raster data files).
 2. Place all the files in one folder on your computer.
 3. In the app:
 - Go to the **TIF Comparison** section.
 - Find the text box labeled “**Enter Directory Path for TIF Files**”.
 - Enter the full path to your folder. For example:
`C:/Users/YourName/Documents/MangroveData`
 4. Click the **Load TIF Files** button to load your data.
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Step 2: Explore the App

Mangrove Analysis Section

What Can You Do Here?

1. **Set a Date Range:**
 - Use the slider to choose the time period for analysis.
 - Only data within the selected dates will be analyzed and displayed.
 2. **Explore Trends:**
 - **Trend Analysis** tab: Shows a graph of vegetation counts over time.
 - **Forecasting** tab: Predicts future vegetation counts based on trends.
 3. **Compare Data:**
 - **Yearly Comparison:** View vegetation changes year by year.
 - **Same Month Comparison:** Compare vegetation counts for the same month across different years.
 4. **Seasonal Patterns:**
 - **Grouped Bar Plot:** Shows monthly vegetation counts grouped by year.
 - **Stacked Bar Plot:** Aggregates monthly counts across years.
 5. **Downloadable Tables:**
 - Explore detailed data in the **Data Table** tab.
 - All results include vegetation counts, percentage changes, and affected hectares.
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TIF Comparison Section

What Can You Do Here?

1. **View Raster Files:**
 - Navigate through raster files using the **Previous** and **Next** buttons.
 - Use the slider to jump to a specific file.
 2. **Visualize Data:**
 - **Interactive Map:** Displays the raster data overlayed with the Aruba map.
 - **Difference Map:** Highlights areas where changes occurred between files.
 3. **Customize the Visualization:**
 - Adjust transparency and colors directly in the map interface.
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Step 3: How Graphs and Tables Are Created

Vegetation Counts

1. The app reads your raster files and counts pixels where vegetation is detected.

- Pixels with a value of 1 are considered vegetation.
- The count of such pixels is used to calculate vegetation areas.

2. **Area in Hectares:**

- Each vegetation pixel represents 0.09 hectares.
- Total area (in hectares) is calculated as:

$$\text{Hectares} = \text{Vegetation Count} * 0.09$$

3. **Percentage Change:**

- Vegetation changes between time points are calculated as:

$$\text{Percent Change} = (\text{Current Count} - \text{Previous Count}) / \text{Previous Count} * 100$$

Trend Analysis

- The app aggregates vegetation counts by date.
 - A line plot shows changes over time with a smooth trendline.
 - **How It Works:**
 - Counts are grouped by date and smoothed using a `loess` method to show trends.
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Seasonal Patterns

1. **Grouped Bar Plot:**

- Displays monthly vegetation counts for each year.
- Example: January 2019, January 2020, January 2021, etc., are grouped together.

2. **Stacked Bar Plot:**

- Shows cumulative monthly vegetation counts across all years.
 - Example: January counts for all years are stacked together.
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Forecasting

1. The app predicts future vegetation counts using ARIMA (Auto-Regressive Integrated Moving Average).
2. Results are displayed as a time-series forecast plot.
3. **How to Change Forecast Duration:**
 - Update this line in the code:

```
forecast(model, h = 12)
```

- Replace 12 with the number of months you want to forecast.
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Step 4: Modifying the Application

Changing File Paths

1. Update the **shapefile**:

- Replace this line with your new shapefile path:

```
ne_shp <- vect("Path/To/Your/Shapefile.shp")
```

2. Update the **raster data directory**:

- Replace this path in the app:

```
textInput("tifDirectory", "Enter Directory Path for TIF Files:", value = "Your/Directory/Path")
```

Customizing Visualizations

1. **Trend Analysis**:

- Change the smoothing method (e.g., linear trends):

```
geom_smooth(method = "lm", color = "red", se = FALSE)
```

2. **Map Colors**:

- Adjust colors for vegetation visualization:

```
color_pal <- colorNumeric("Blues", domain = c(1), na.color = "transparent")
```

3. **Difference Map Thresholds**:

- Change thresholds for difference visualization:

```
diffRaster[diffRaster == 0] <- NA
```

Adding New Features

1. Add new tabs or plots by copying and modifying existing sections.
2. Use this structure for a new plot: “r tabPanel(“New Tab Name”, plotOutput(“newPlot”))