Cloud and Shadow Detection from RGB Image

📊Workflow Diagram

```
graph TD
    A[Step 1: Load RGB Image] --> B[Step 2: Resize and Normalize]
    B --> C[Step 3: Convert to GeoTIFF (Simulated Satellite Image)]
    C --> D[Step 4: Read Bands from TIFF]
    D --> E[Step 5: Calculate Brightness & NDVI]
    E --> F[Step 6: Generate Cloud & Shadow Masks]
    F --> G[Step 7: Visualize and Save Outputs]
    G --> H[Step 8: Compute Cloud Coverage Stats]
```

🗒️Step-by-Step Workflow with Details

Step 1: Load RGB Image

- Input example: `europe.jpg`
- A standard RGB image, used to simulate satellite data.

Step 2: Resize and Normalize

- Resize image to 256x256 pixels.
- Normalize RGB values to range [0, 1].

Step 3: Convert to Simulated GeoTIFF

- Create 3-band GeoTIFF:
- Band 1: Red
- Band 2: Green
- Band 3: Blue (as fake NIR)
- Save TIFF using `rasterio`.
- Output: `europe_rgb_as_satellite.tif`

Step 4: Read Bands from TIFF

- Load TIFF bands using `rasterio.open()`.
- Extract Red, Green, and NIR (Blue) bands.

Step 5: Calculate Brightness & NDVI

- Brightness = average of Red, Green, NIR.
- NDVI = (NIR - Red) / (NIR + Red).

Step 6: Generate Cloud & Shadow Masks

- Cloud: brightness > 0.6 and NDVI < 0.2
- Shadow: brightness < 0.2, NDVI < 0.2, and not cloud

Step 7: Visualize and Save Outputs

- Create and save plots:
- NIR Band (Grayscale)
- Cloud Mask (Red)
- Shadow Mask (Blue)
- NDVI Heatmap (Green/Red)
- Save to:
- `data/output.png`
- `data/ndvi_debug.png`

Step 8: Compute Cloud Coverage Stats

- Count total and cloud pixels.
- Compute percentage cloud cover.
- Display warnings if cloud >10% or >15%.

🔗Final Outputs

- **TIFF Image**: `europe_rgb_as_satellite.tif`
- **Masks**: `output.png`, `ndvi_debug.png`
- **Terminal Output**:
- Cloud cover %
- Cloud presence and warnings