Sentinel-2 Image Matching: Potential Improvements

Current Results

Pair	Seasons	Keypoints	Raw Matches	Inliers	Inlier Ratio
1	winter-summer	6511, 6120	59	27	46%
2	winter-spring	6511, 6514	65	28	43%
3	winter-autumn	6511, 6730	111	75	68%
4	summer-spring	6120, 6514	175	147	84%
5	summer-autumn	6120, 6730	258	229	89%
6	spring-autumn	6514, 6730	124	96	77%

Average: 116 raw matches, 100 inliers per pair, 68% inlier ratio.

Current approach uses SIFT and RANSAC. Performance varies significantly based on seasonal similarity.

Proposed Improvements

1. Deep Learning Matcher (SuperGlue)

Replace SIFT with SuperGlue neural network matcher.

Benefits:

- 5-10x more matches on difficult pairs (winter-summer/spring)
- Better handling of appearance changes
- State-of-the-art performance

2. Multi-Scale Matching

Detect features at multiple image scales (0.5x, 1x, 2x).

Benefits:

- 30-50% more matches
- Better feature coverage across different resolutions

3. Vegetation Masking

Use NDVI to focus matching on stable structures (buildings, roads) instead of vegetation.

Benefits:

- Improved performance on winter pairs (snow coverage)
- Reduced false matches from seasonal vegetation changes

4. Dataset Expansion

Add more images:

- Monthly coverage (12 images/year)
- Multiple geographic locations (5-10 tiles)
- Different landscapes (urban, rural, forest)

Benefits:

- More robust evaluation
- Better generalization

5. Hybrid Approach

Combine SIFT (fast) + SuperGlue (accurate).

Benefits:

- Use SIFT for easy pairs (summer-autumn)
- Use SuperGlue for hard pairs (winter-summer)
- Optimal speed/accuracy tradeoff

Priority

1. Multi-scale matching (most cost-effective)
2. Vegetation masking (high impact on winter pairs)
3. SuperGlue integration (major upgrade for difficult pairs)