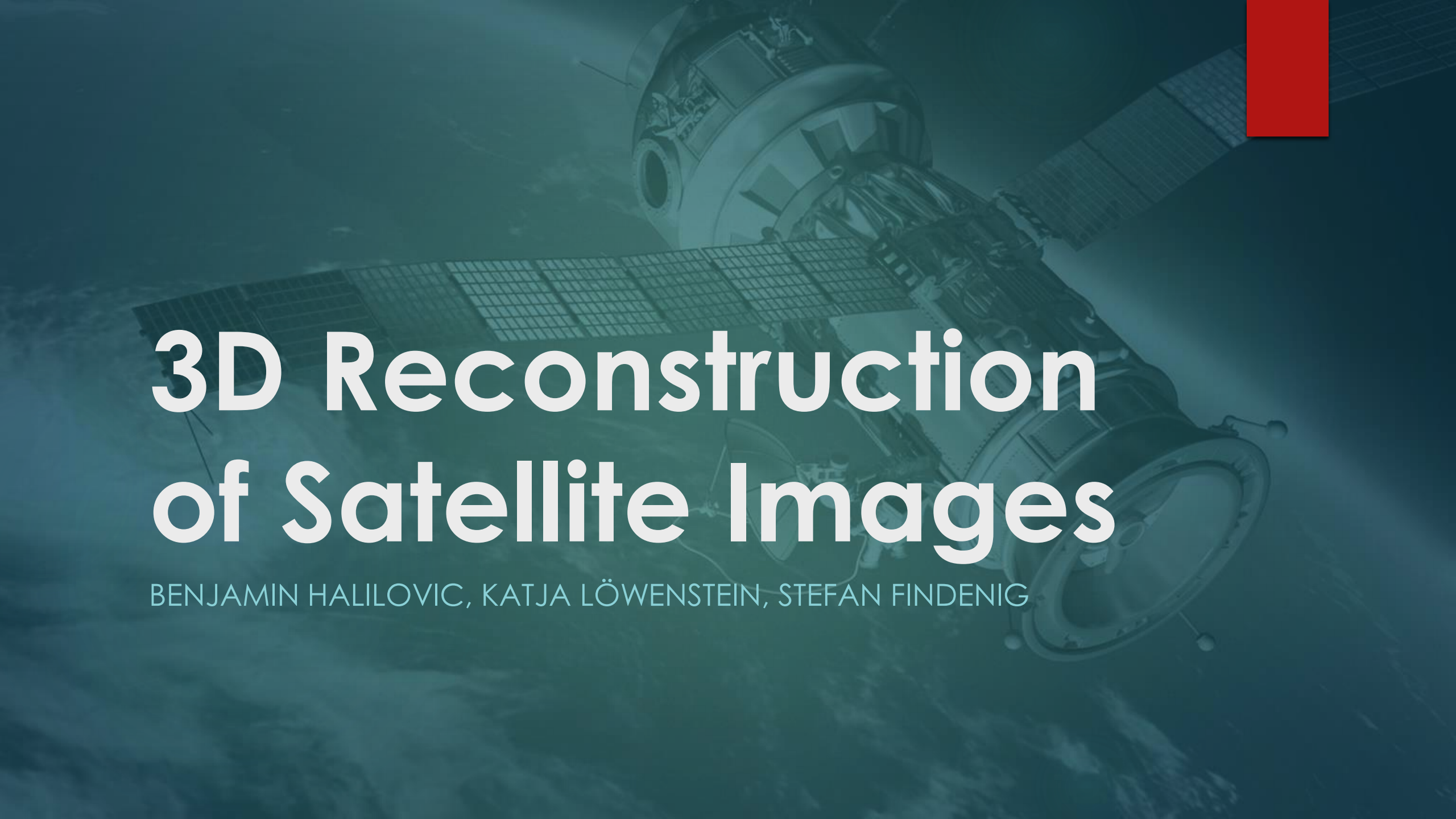


3D Reconstruction of Satellite Images

BENJAMIN HALILOVIC, KATJA LÖWENSTEIN, STEFAN FINDENIG

Content

- Image format: geoTIFF
- Preprocessing
- Workflow
- Results
- Challenges

Image Format: geoTiff

- Format combines .tif image and meta data (containing geodata information)
- In our case: seperate files (.tif and .txt)

$$\sum_{i=1}^{20} C_i \cdot \rho_i(P,L,H) = \begin{matrix} C_1 & +C_6 \cdot L \cdot H & +C_{11} \cdot P \cdot L \cdot H & +C_{16} \cdot P^3 \\ +C_2 \cdot L & +C_7 \cdot P \cdot H & +C_{12} \cdot L^3 & +C_{17} \cdot P \cdot H^2 \\ +C_3 \cdot P & +C_8 \cdot L^2 & +C_{13} \cdot L \cdot P^2 & +C_{18} \cdot L^2 \cdot H \\ +C_4 \cdot H & +C_9 \cdot P^2 & +C_{14} \cdot L \cdot H^2 & +C_{19} \cdot P^2 \cdot H \\ +C_5 \cdot L \cdot P & +C_{10} \cdot H^2 & +C_{15} \cdot L^2 \cdot P & +C_{20} \cdot H^3 \end{matrix}$$

$$r_n = \frac{\sum_{i=1}^{20} \text{LINE\_NUM\_COEF}_i \cdot \rho_i(P,L,H)}{\sum_{i=1}^{20} \text{LINE\_DEN\_COEF}_i \cdot \rho_i(P,L,H)} \quad \text{and} \quad c_n = \frac{\sum_{i=1}^{20} \text{SAMP\_NUM\_COEF}_i \cdot \rho_i(P,L,H)}{\sum_{i=1}^{20} \text{SAMP\_DEN\_COEF}_i \cdot \rho_i(P,L,H)}$$

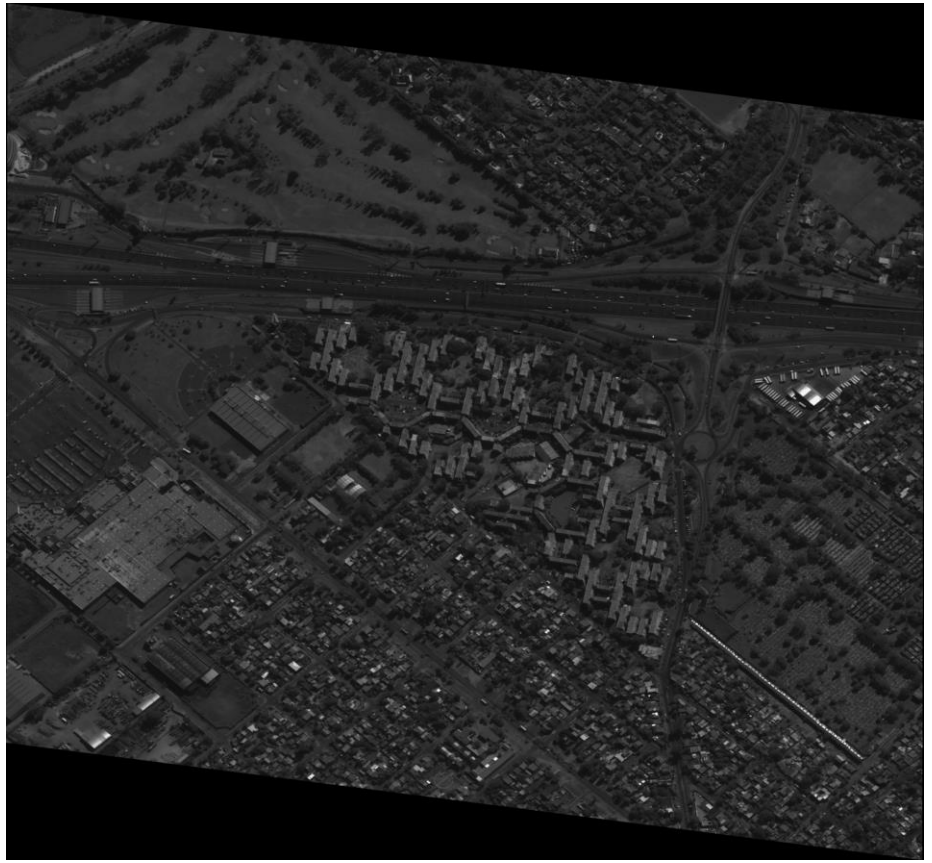
```python
def convert_rcp(filepath: str) -> dict:
    # Regular expression pattern to extract the RPC values
    pattern = r'(-?\d+(?:\.\d+)?)'

    # Read the RPC values from the text file
    with open(filepath, 'r') as file:
        rpc_values = file.read()

    # Extract the RPC values using the regular expression
    values = [str(x) for x in re.findall(pattern, rpc_values)]

    (variable) rpc_dict: dict[str, str]  nd values
    rpc_dict = {
        'LINE_OFF': values[0],
        'SAMP_OFF': values[1],
        'LAT_OFF': values[2],
        'LONG_OFF': values[3],
        'HEIGHT_OFF': values[4],
        'LINE_SCALE': values[5],
        'SAMP_SCALE': values[6],
        'LAT_SCALE': values[7],
        'LONG_SCALE': values[8],
        'HEIGHT_SCALE': values[9],
        'LINE_NUM_COEFF': ' '.join(values[10:30]),
        'LINE_DEN_COEFF': ' '.join(values[30:50]),
        'SAMP_NUM_COEFF': ' '.join(values[50:70]),
        'SAMP_DEN_COEFF': ' '.join(values[70:90]),
        'MIN_LONG': values[91],
        'MIN_LAT': values[92],
        'MAX_LONG': values[93],
        'MAX_LAT': values[94],
        'sampleOFFSET': values[95],
        #'lineOFFSET': values[96],
    }
    return rpc_dict
```

Preprocessing

Warping image to real world coordinates

Before:

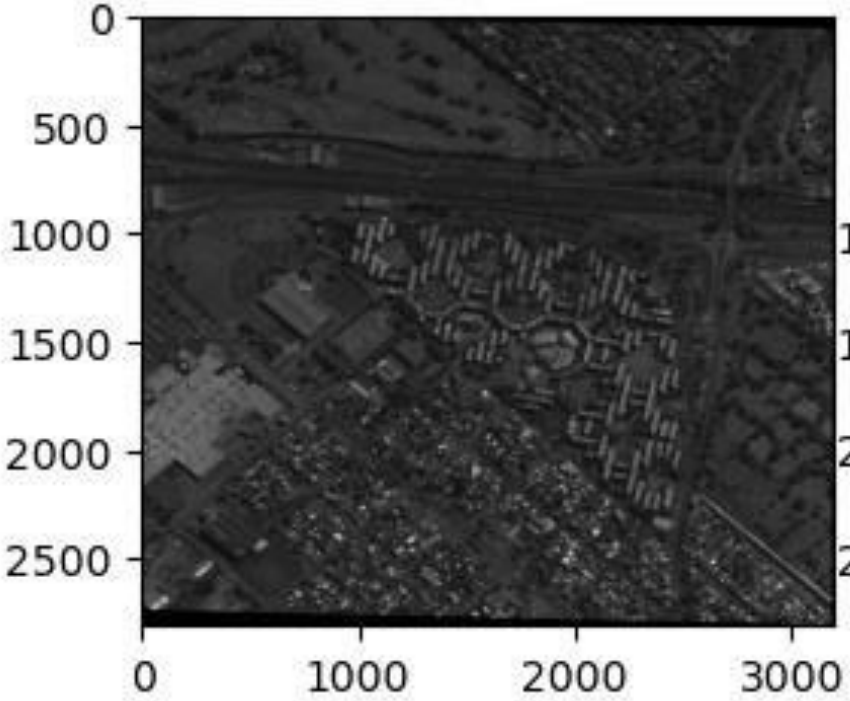
After:



Workflow

Disparity Map

Image 01



Disparity Map

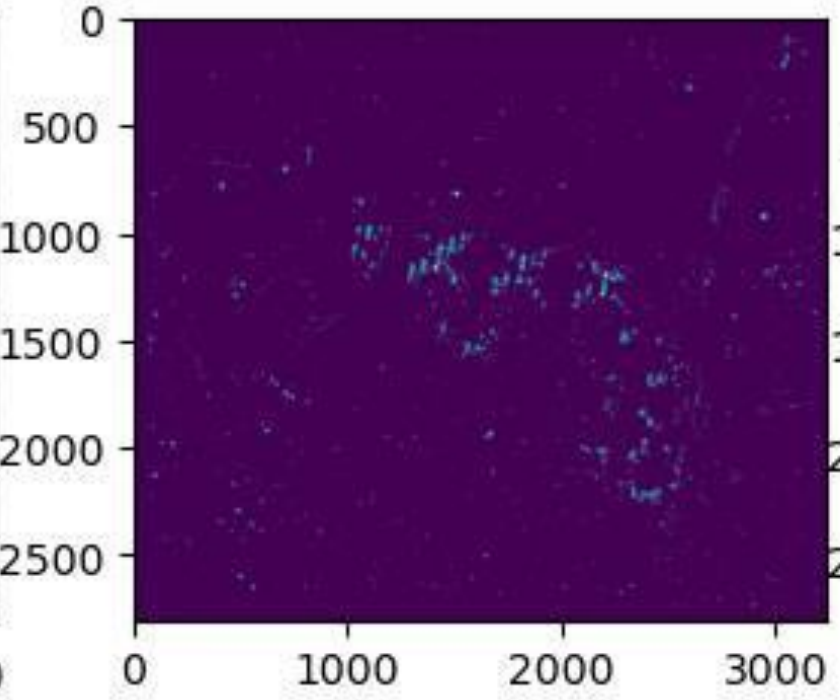
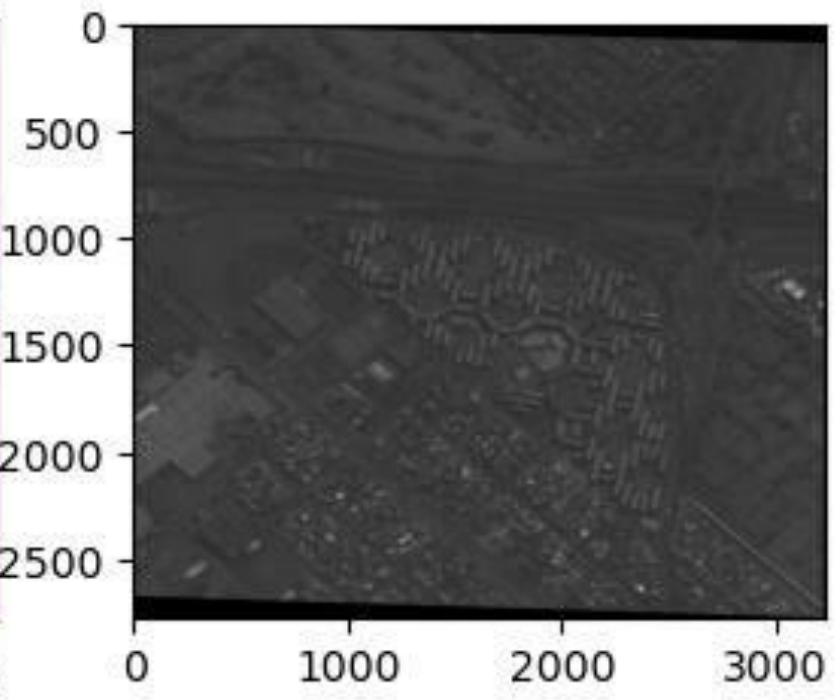


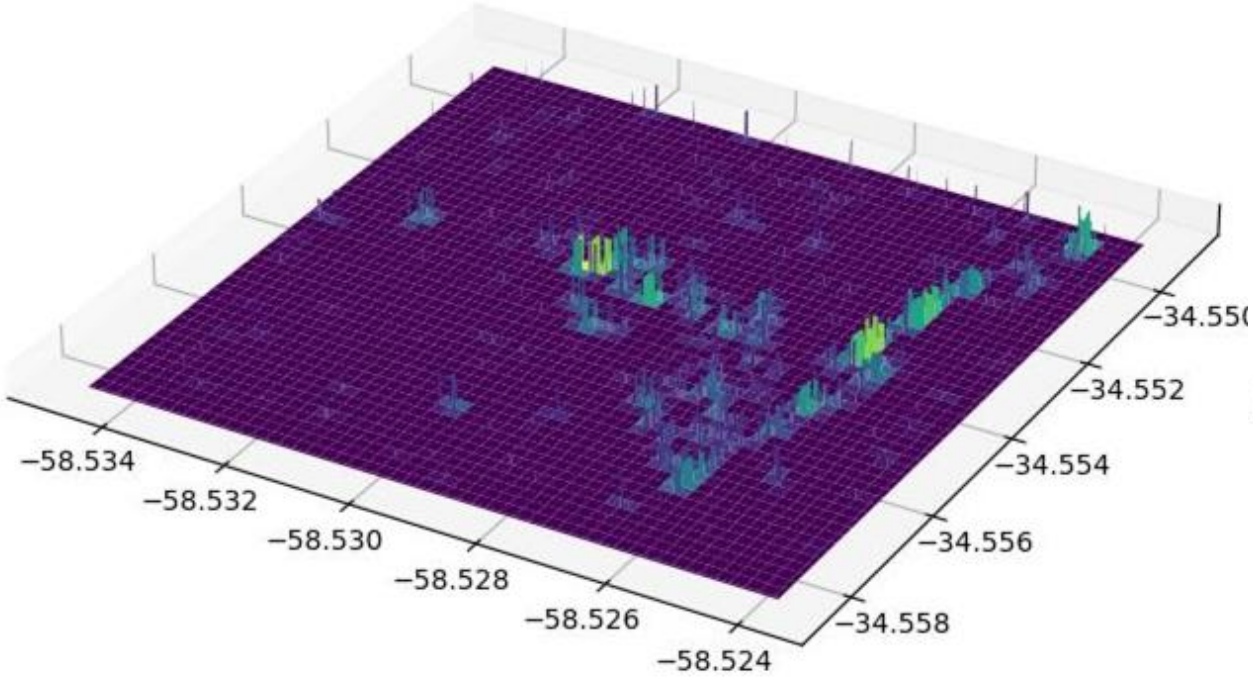
Image 02



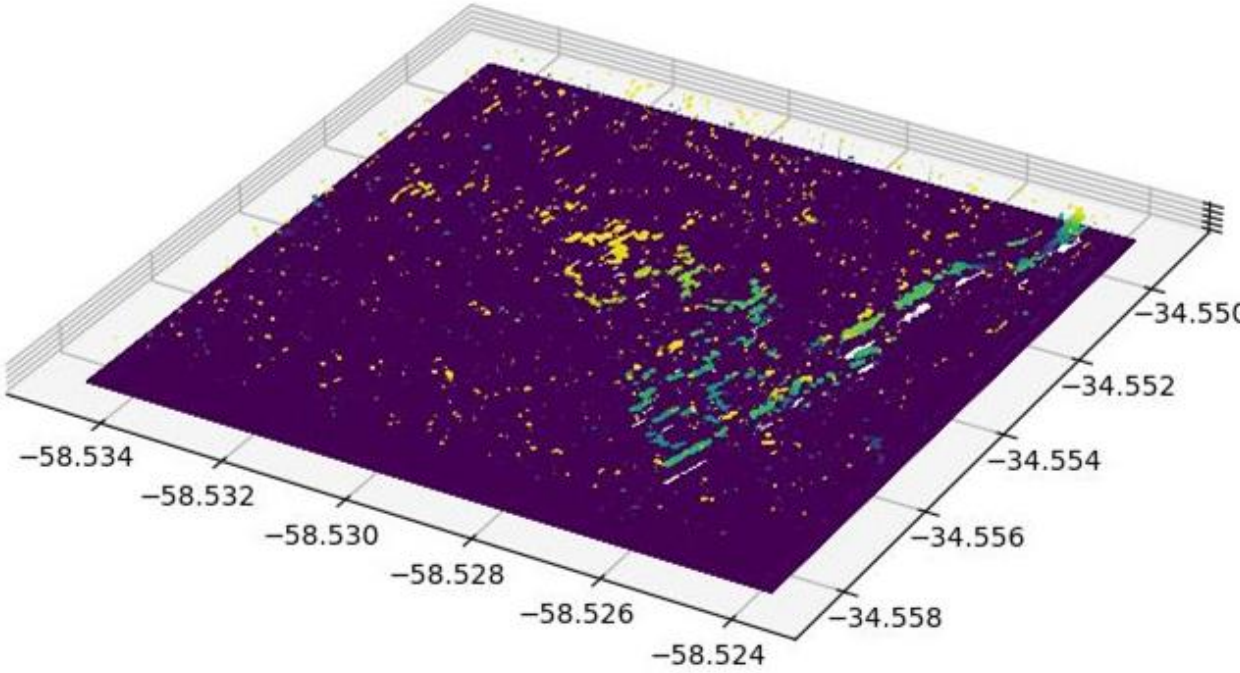
Workflow

Surface Plot - Point Cloud

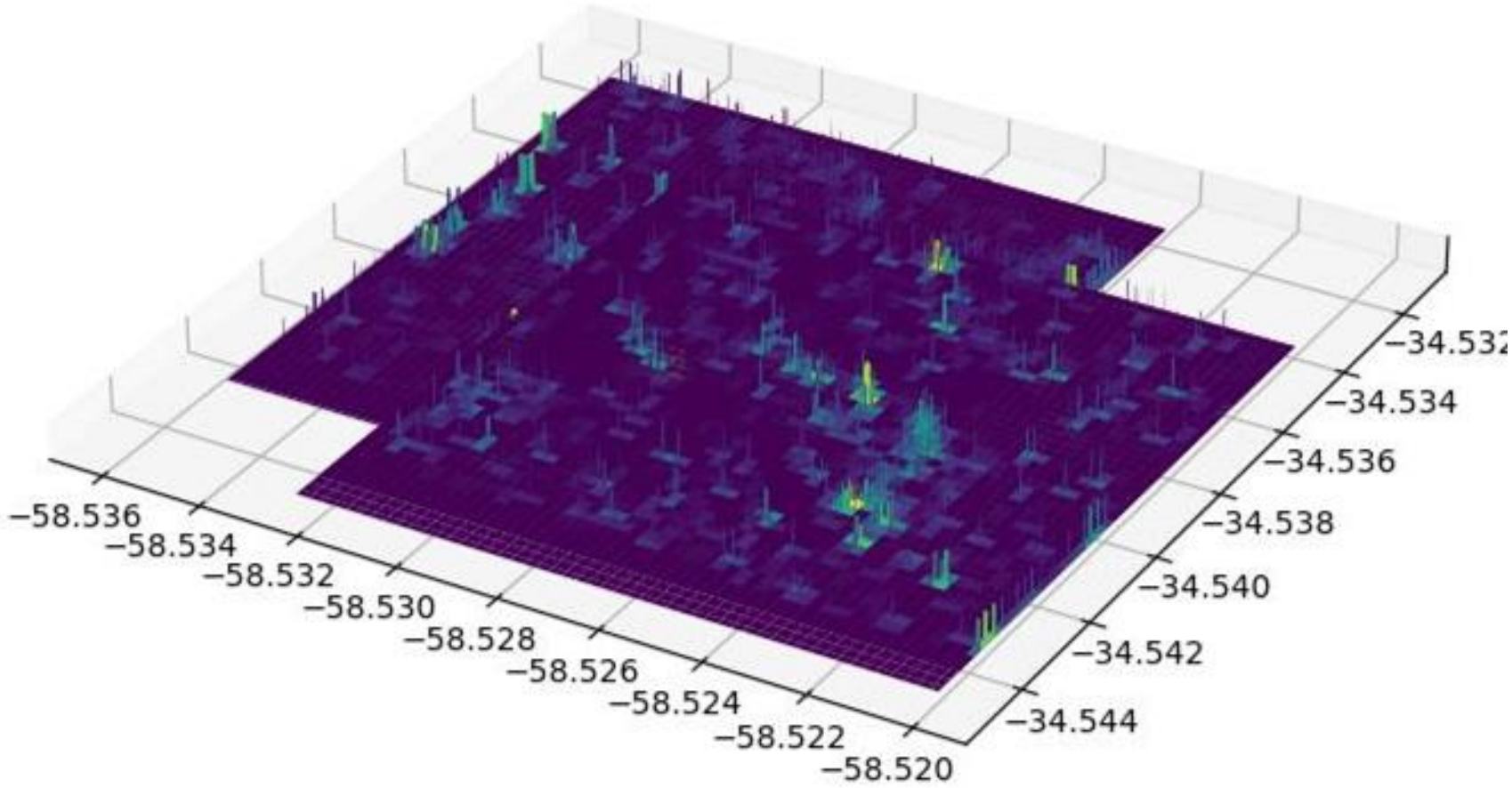
Surface Plot



Point Cloud

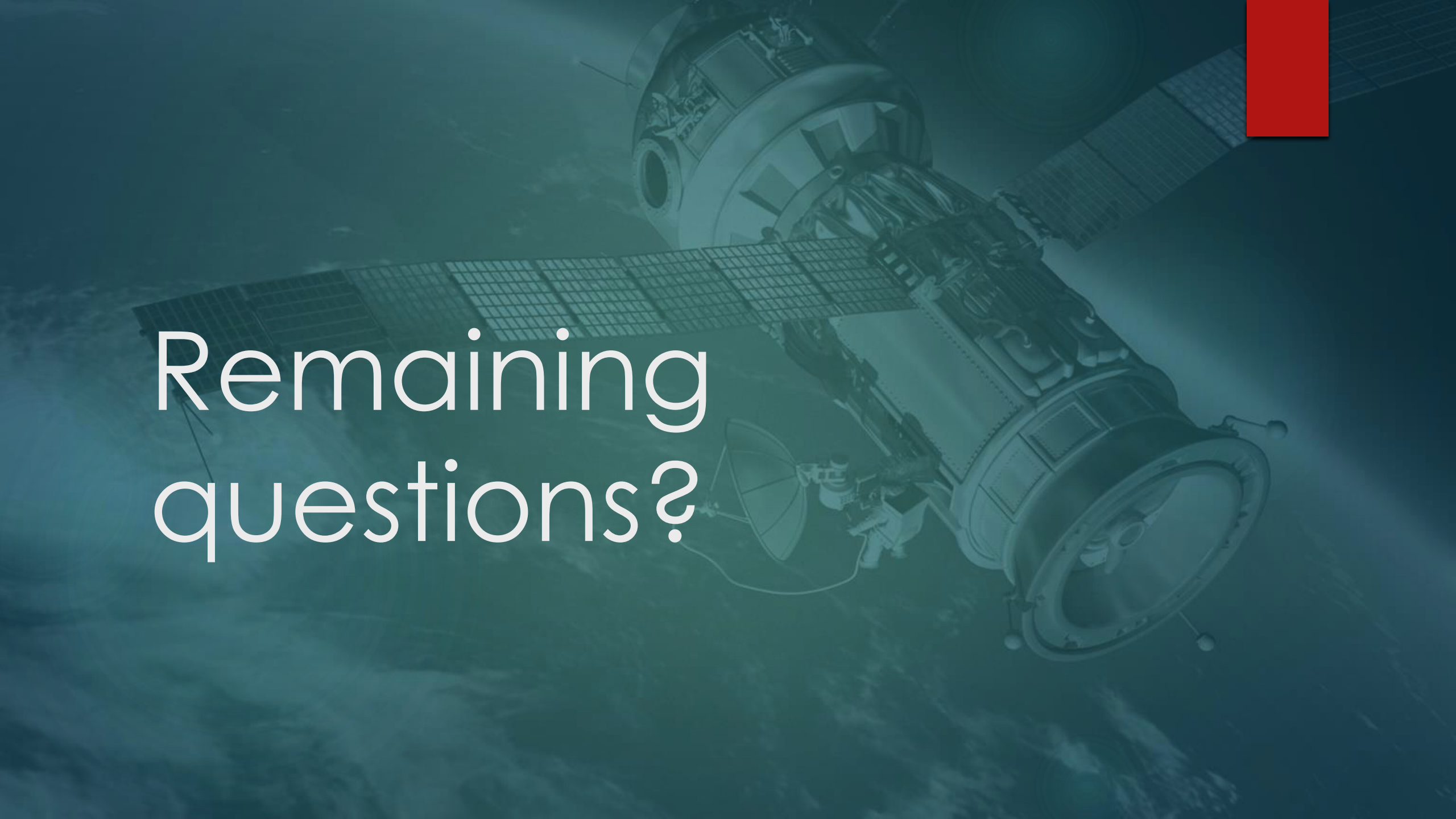


Results


−58.536
−58.534
−58.532
−58.530
−58.528
−58.526
−58.524
−58.522
−58.520
−34.532
−34.534
−34.536
−34.538
−34.540
−34.542
−34.544

Challenges

- Understanding data
- Issues with dependencies with s2p
- High computational effort impeded further progess



Remaining questions?