Sensitivity analysis when assessing the photovoltaic potential on rooftops

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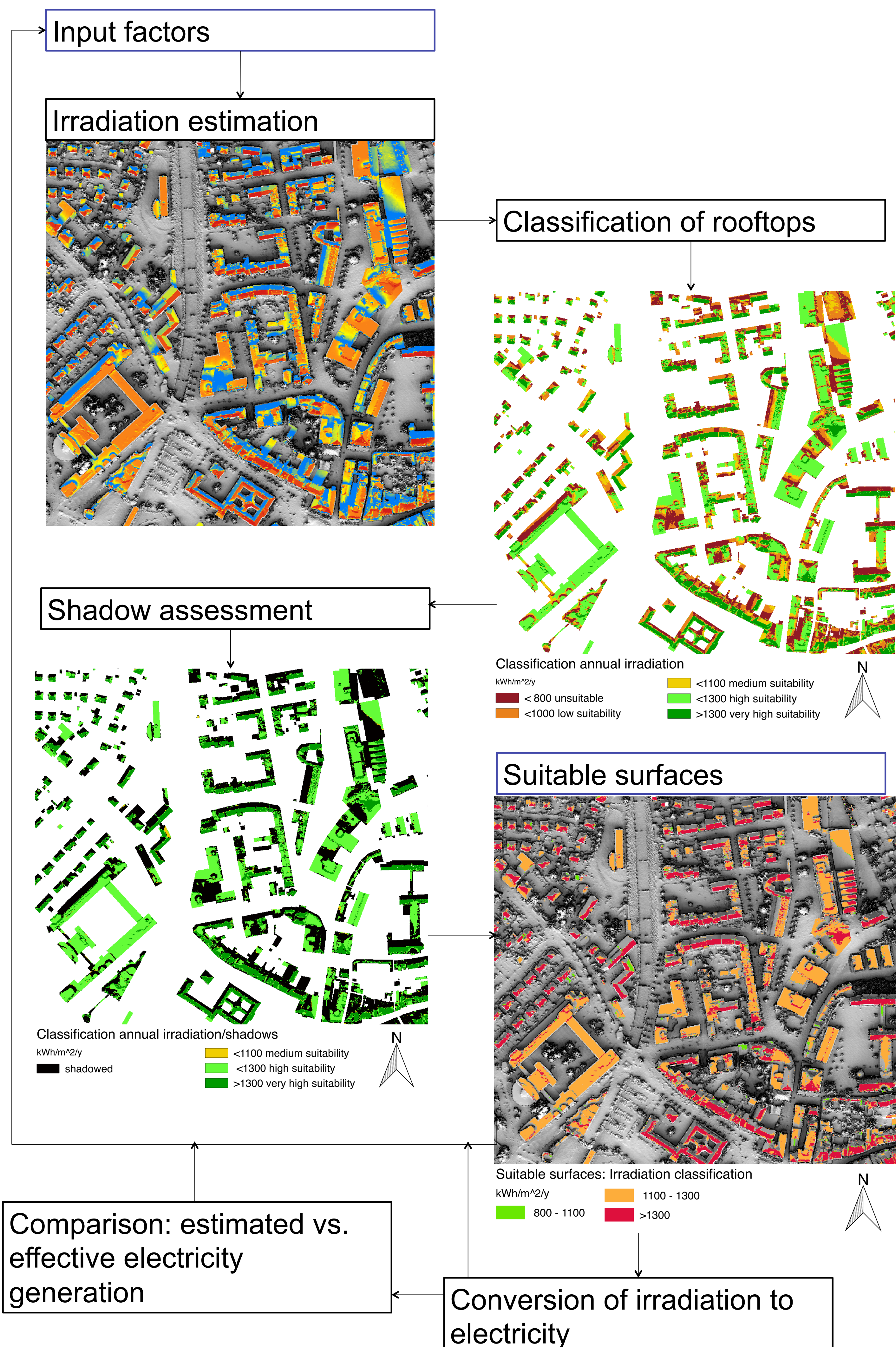**Supervision: Rene Buffat, Stefano Grassi**

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Research question

The electricity generation of photovoltaic systems on rooftops is affected by various impact factors on different scales. A long-term assessment of the installable potential and the resulting energy production needs to take into account spatial data from solar radiation to the characteristics of the rooftops. Different datasets with different spatiotemporal resolutions are available.
A sensitivity analysis should help to determine crucial impact factors and their impact on the different steps of the photovoltaic potential estimation.
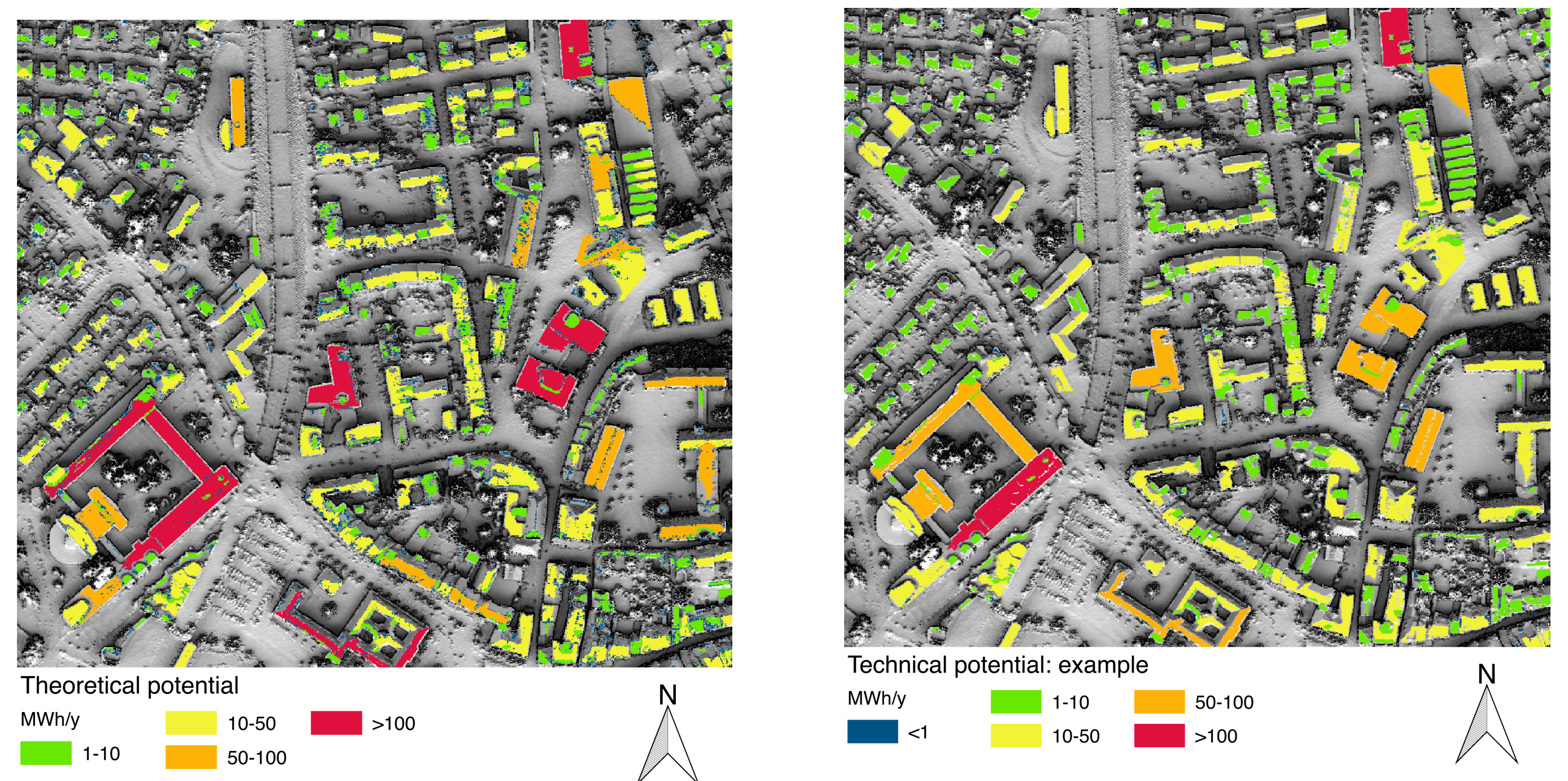
Workflow

The **Photovoltaic potential assessment** was carried out several times, using different input factors and datasets:

Input factors

Irradiation estimation

Classification of rooftops

Shadow assessment

Classification annual irradiation
kWh/m^2/y
< 800 unsuitable   <1100 medium suitability
<1000 low suitability <1300 high suitability
<1100 medium suitability >1300 very high suitability

Suitable surfaces

Classification annual irradiation/shadows
kWh/m^2/y
shadowed   <1100 medium suitability
            <1300 high suitability
            >1300 very high suitability

Suitable surfaces: Irradiation classification
kWh/m^2/y
800 - 1100   1100 - 1300
             >1300

Comparison: estimated vs. effective electricity generation

Conversion of irradiation to electricity

Results

Photovoltaic potential estimation:

The method results in a shape file, consisting of the rooftop polygons theoretical and technical photovoltaic potential are stored in the attribute table and further analysis can be carried out.

Theoretical potential
MWh/y
1-10   10-50   >100
        50-100

Technical potential: example
MWh/y
<1   1-10   50-100
       10-50   >100

Sensitivity analysis:

The sensitivity analysis was carried out concerning different parameters influencing different steps of the photovoltaic potential assessment.

Differences 10min-1h [%]
0.1-0.25   0.35-0.45   0.55-0.60
0.25-0.35 0.45-0.55
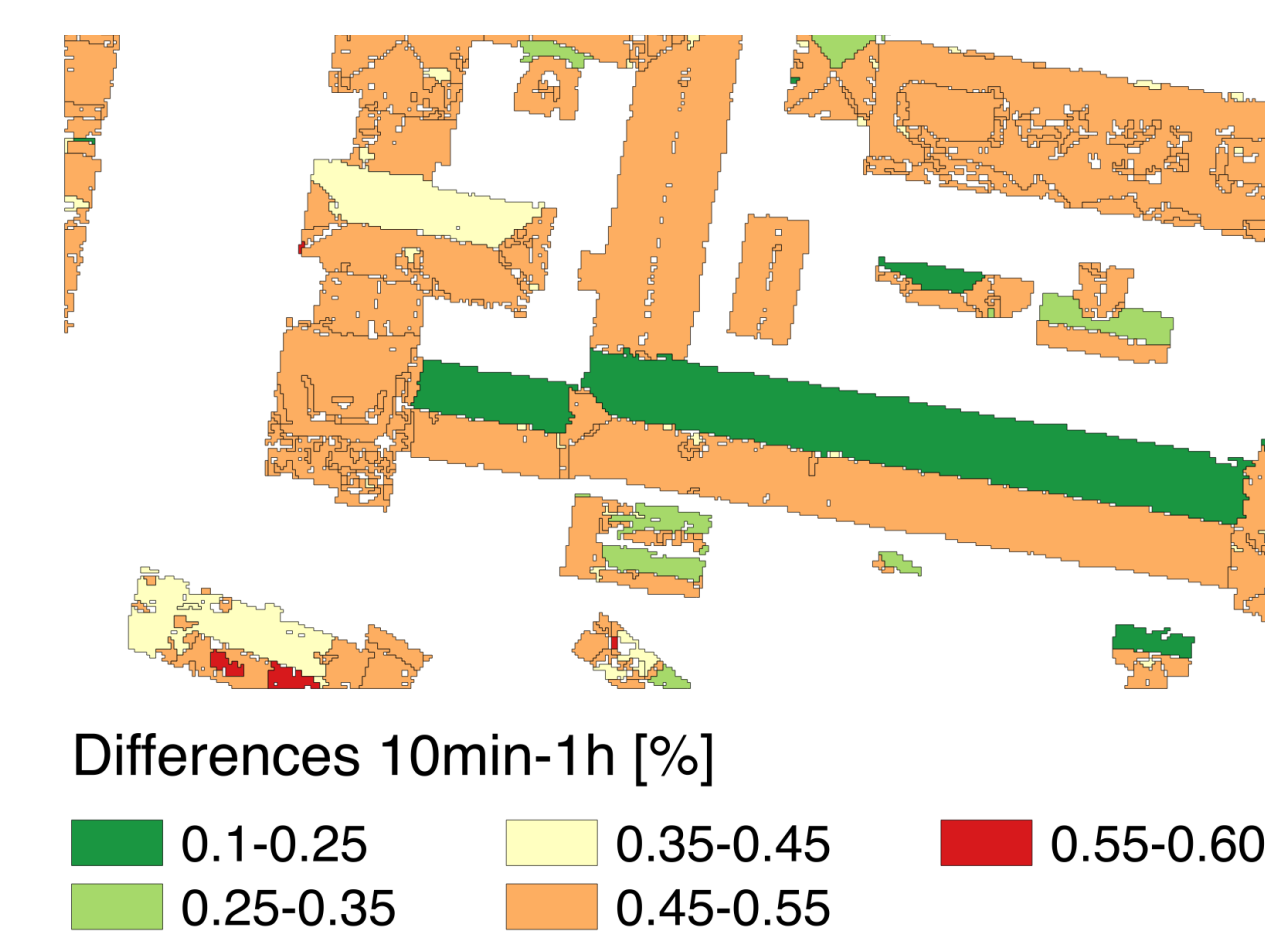
Temporal resolution: The estimation was performed using different time steps (10min, 30min, 1hour).
→30min: differences <0.01%
→1h: differences <1%

Spatial resolution: The estimation was performed using different DSM (0.5m,1m). Resulting differences in irradiation estimation are <3%, Differences resulting from polygon generation 14%

DOM 0.5m   DOM 1m

Possible energy generation[MW/y]
1   5-10   30-50   80-130
1-5   10-30   50-80
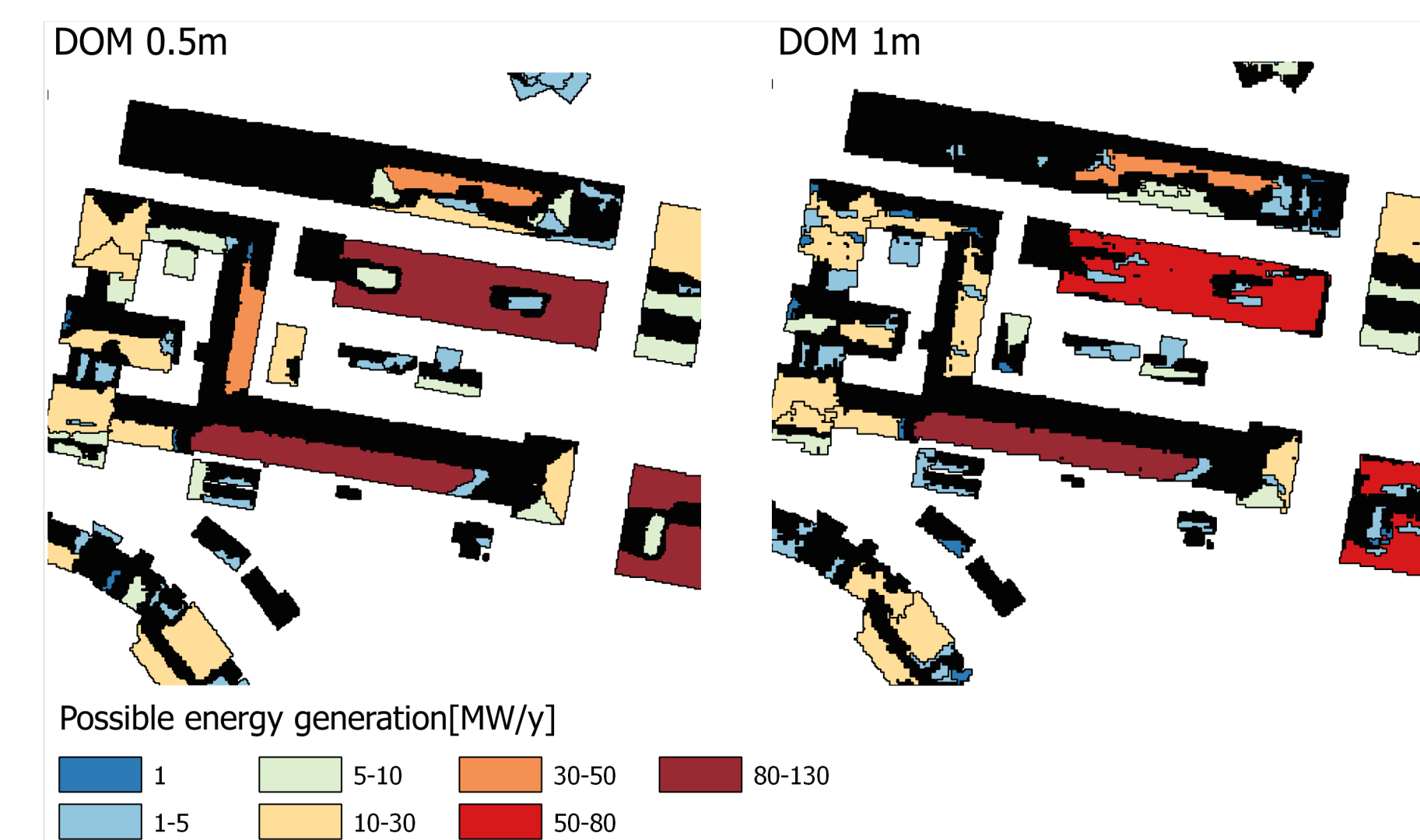
Module type: PV modules differ in nominal power and size, using different module types result in differences of 27% of the estimated electricity generation

Conclusion

Temporal resolution changes result in small differences. The observed differences resulting from different DSMs is mainly not due to the resolution. Polygon generation should be observed further. Meteorological factors have a big impact on irradiation, but are difficult to model. Electricity generation strongly depends on the efficiency of the module type.