e-shape Pilot 3.2: High photovoltaic penetration at urban scale

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with thanks to DFD, IMF and IHR colleagues

German Aerospace Center (DLR)

Institute of Networked Energy Systems

21. September 2021

DLR

Scope

FlexiGIS supports potential users such as

- network operators
- decision-makers in urban planning
- industry
- aggregators for solar power trading
- citizens
- operators and researchers

for example, to plan

- self-consumption of PV system
- modeling of urban distribution network energy systems
- support planning and monitoring tasks
- short-term forecast of the spatial / temporal variability of the power consumption and power generation of PV roof systems

Replacement of OSM input Data with EO data for FlexiGIS simulations

Implementation into modeling software

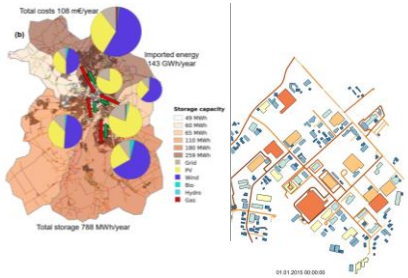
Currently:

FLEXIGIS

EO shapefile data download from Geofabrik.org

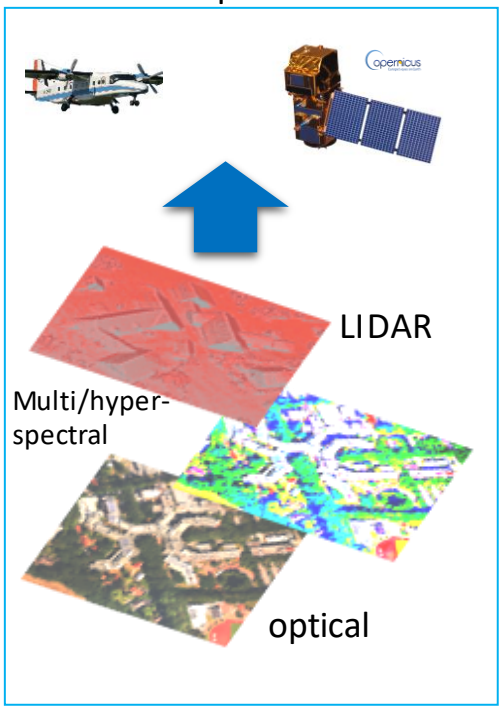
data filtering and application of modeling algorithms

Data Output: filtered shape files; energy modeling graphs



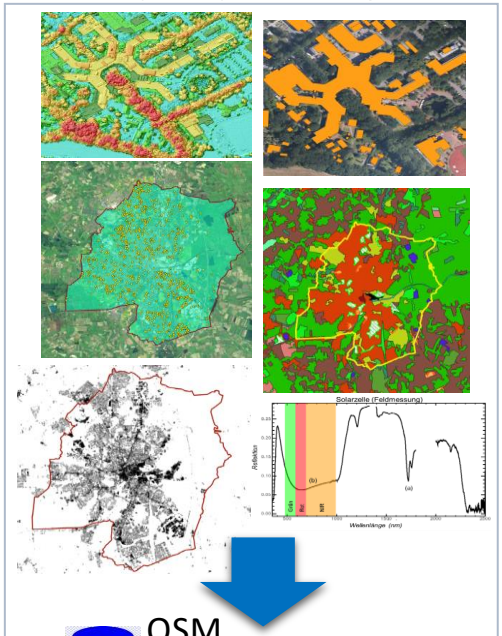
Prospective:

data acquisition



Processing

post-processing

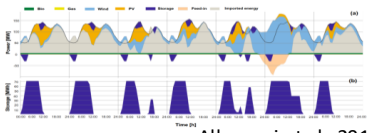


OSM database – file format

Usage

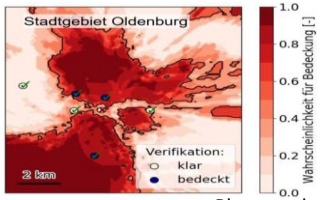
modeling & applications

FlexiGIS



Alhamwi et al., 2019

cloud camera based forecasts



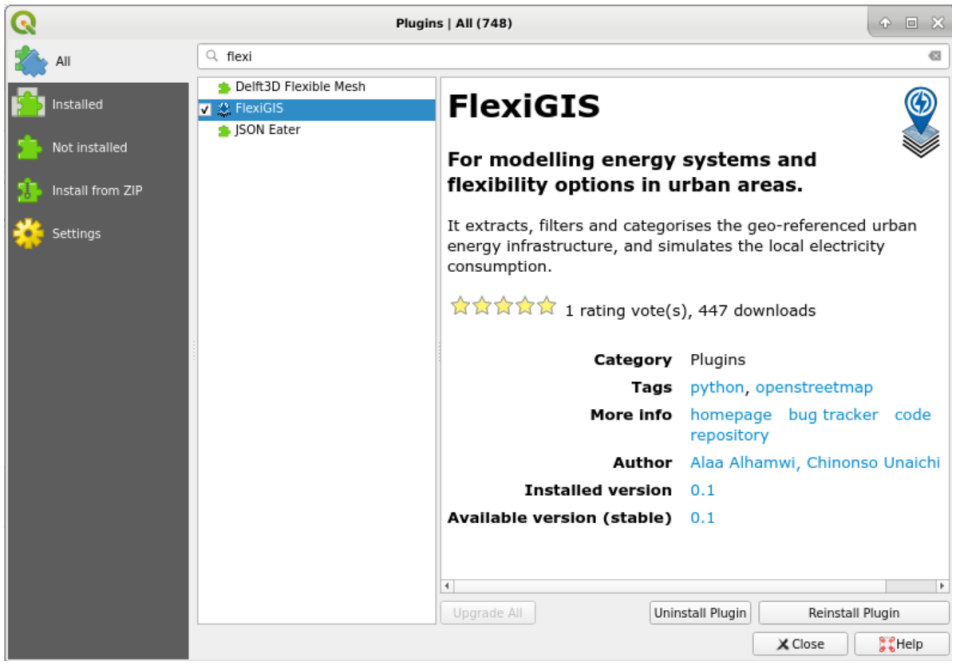
Blum et al., 2020

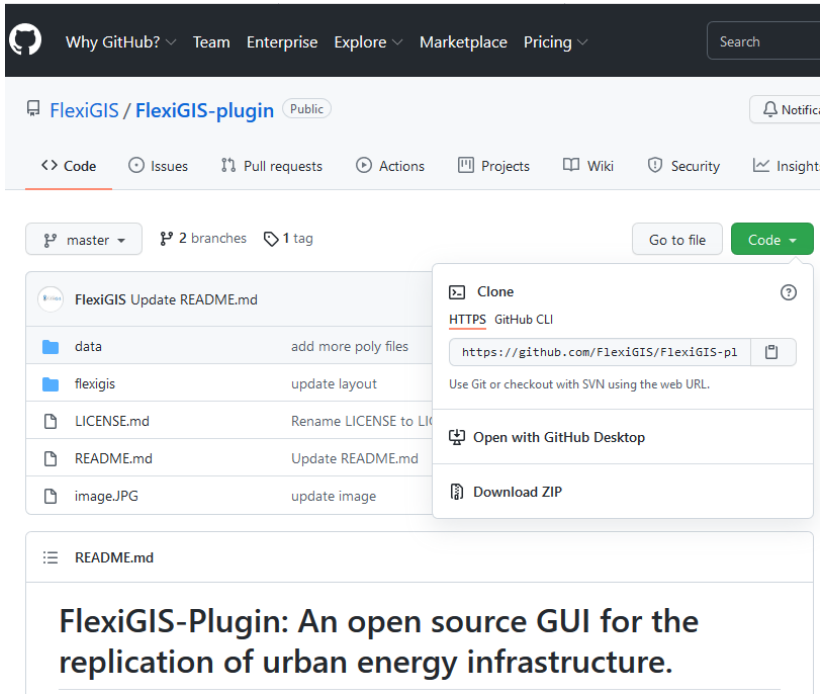
integration of spatial and temporal high resolution data for energy system models

Scholz et al., 2020

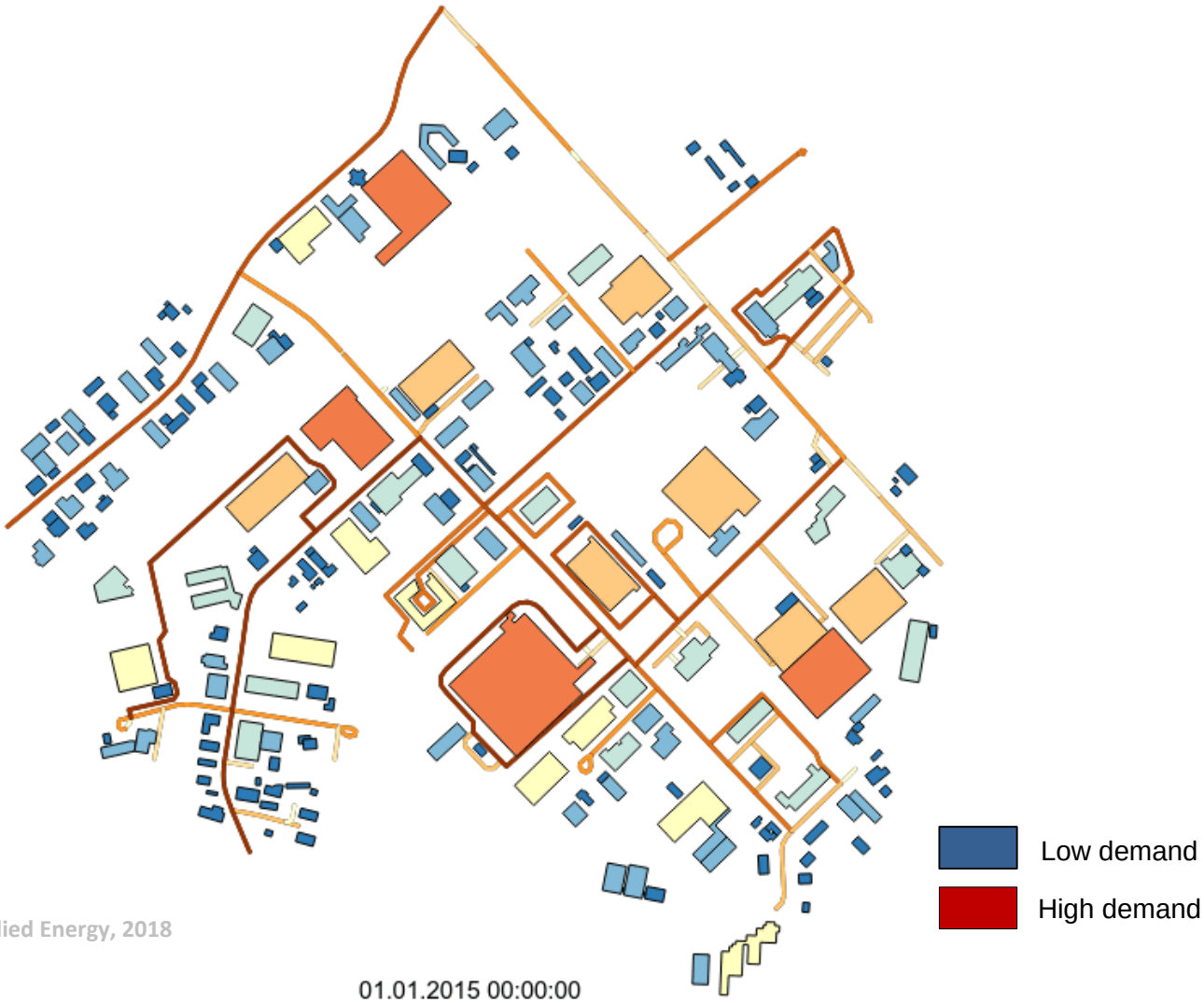
Data acquisition and post-processing support from Remote Sensing Technology Institute (IMF) - Department: Photogrammetry and Image Analysis, as well as from German Remote Sensing Data Center (*DFD*) - Department: Land Surface Dynamics

Availability of the modeling software FlexiGIS





Visualization of simulation



Source: Alhamwi et al., Applied Energy, 2018

DLR

3 key points

User needs co-creation and co-production

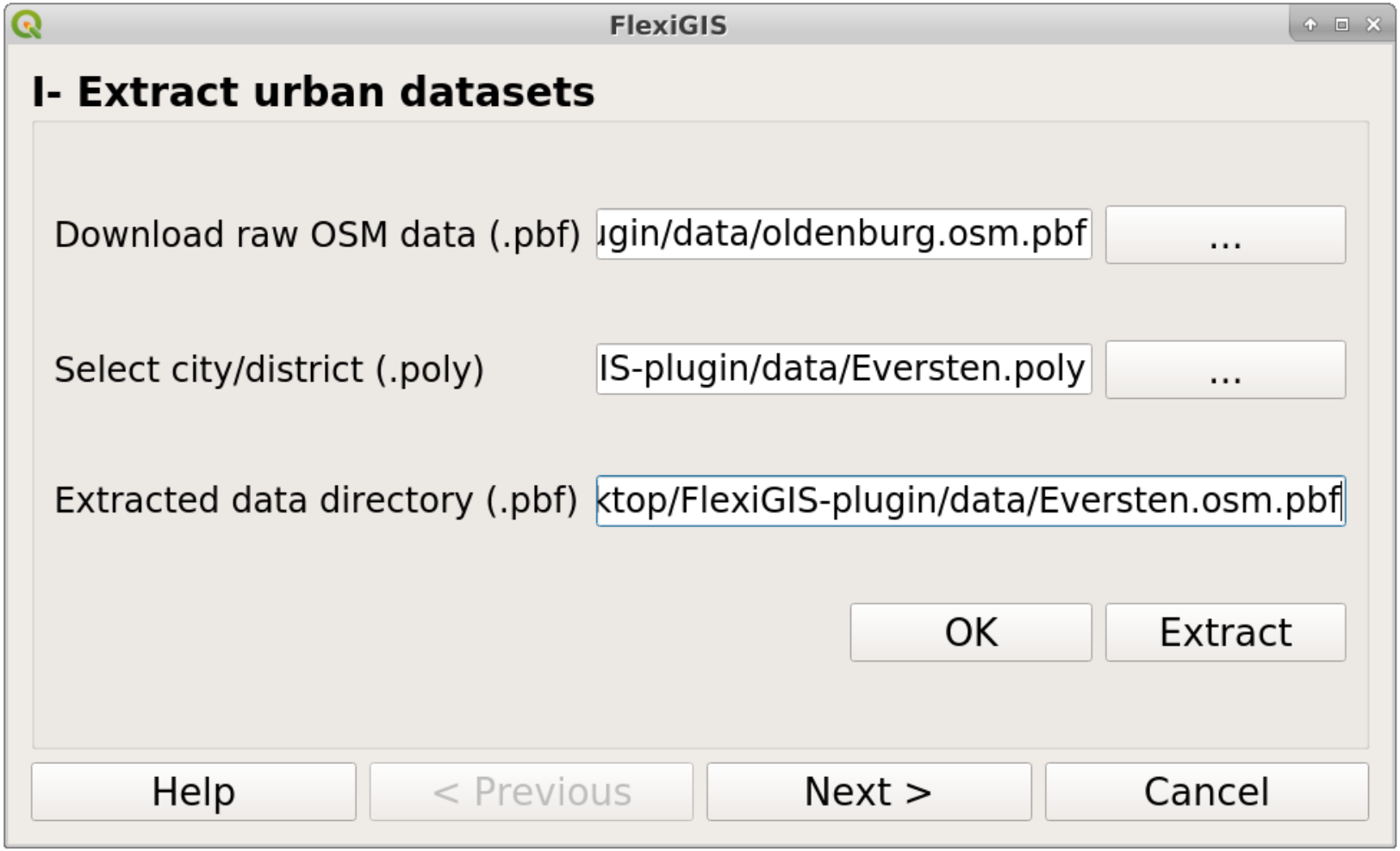
- Close contact to system modelers inside our institute
- Cooperations with other energy system analyses institutes, like Fraunhofer
- Starting contacts to local and regional companies
- Show need of energy system analysis software for modelling, monitoring and planning purposes

Knowledge sharing

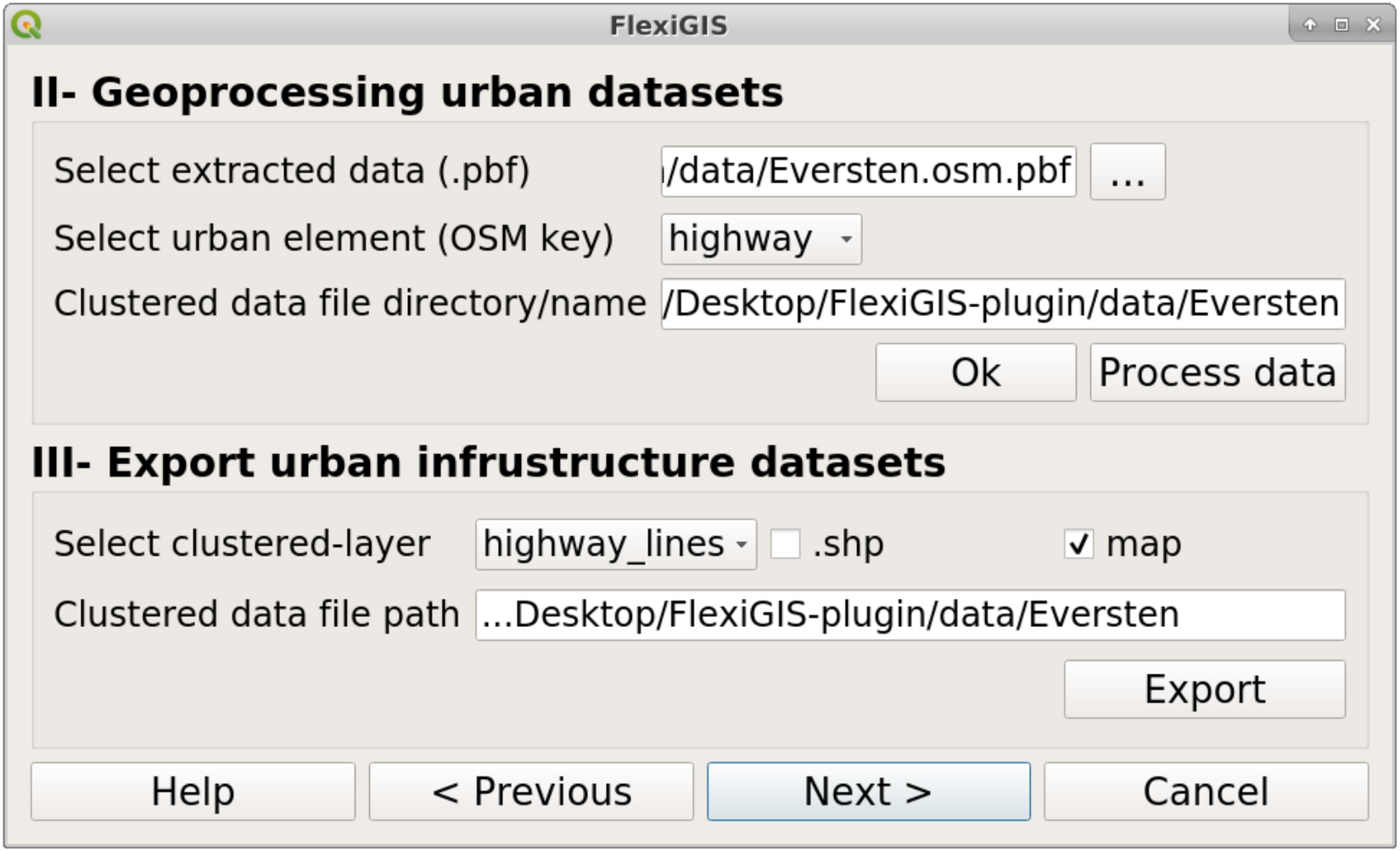
- We join energy system analysis user oriented workshops like the FNE-Vernetzungstreffen GIS Workshop
- We have the position of an energy focusing user

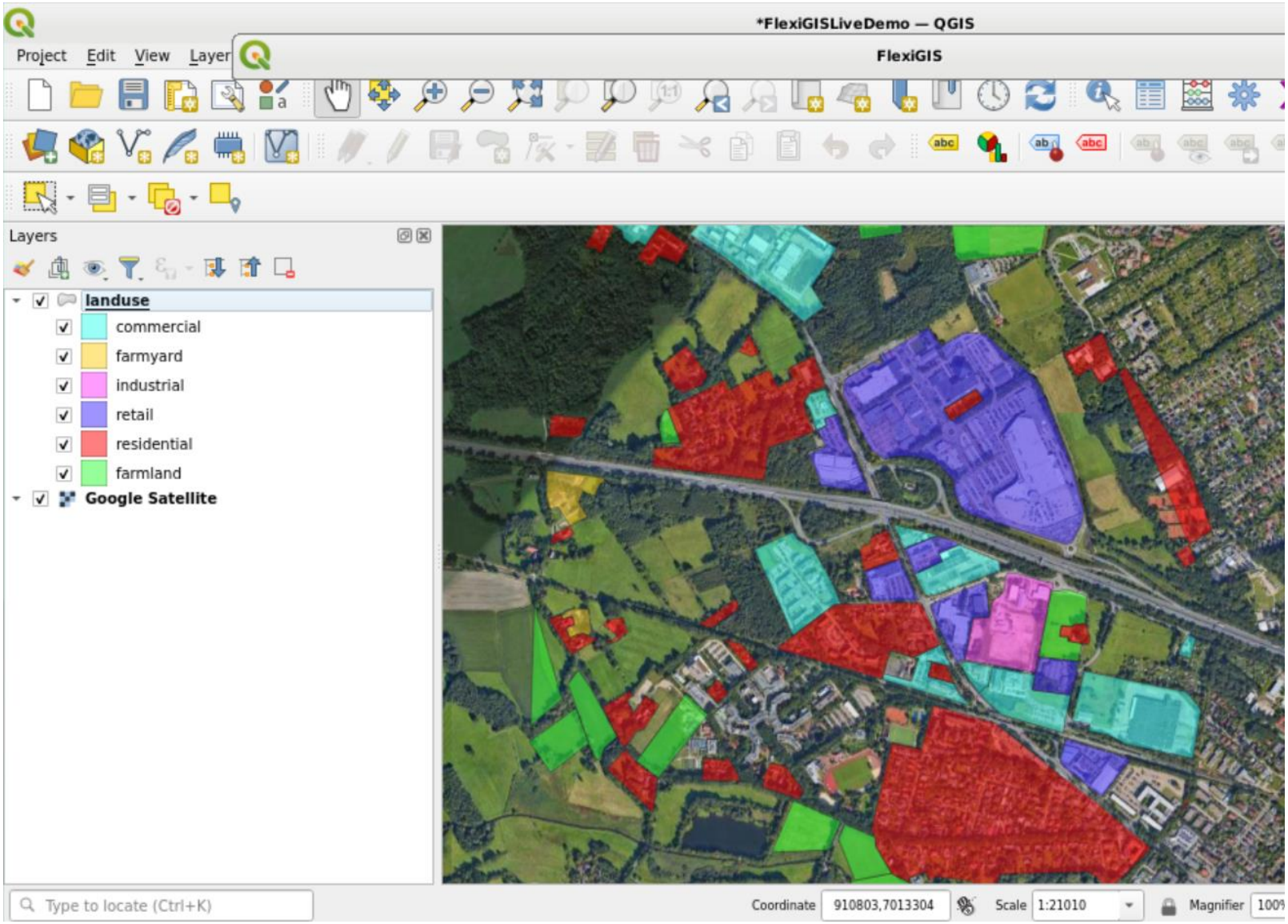
Capacity development

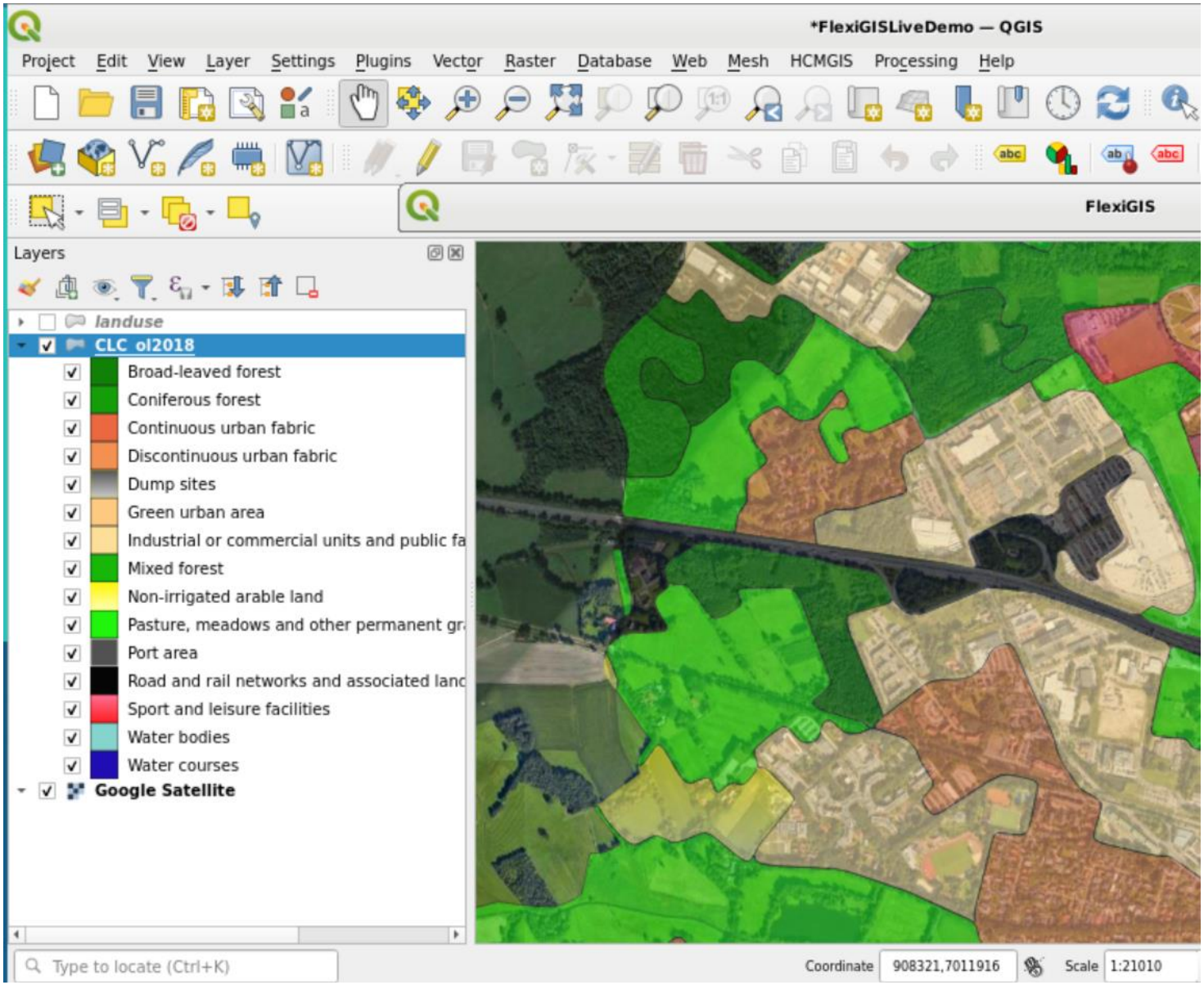
- Energy system analysis community shows the importance of very high resolution data for energy applications is necessary
- A main bottleneck is the price of such airborne or satellite images, current costs limit the study areas to small regions.
- A possible solution could be the establishment of a public open data or flat rate data access.

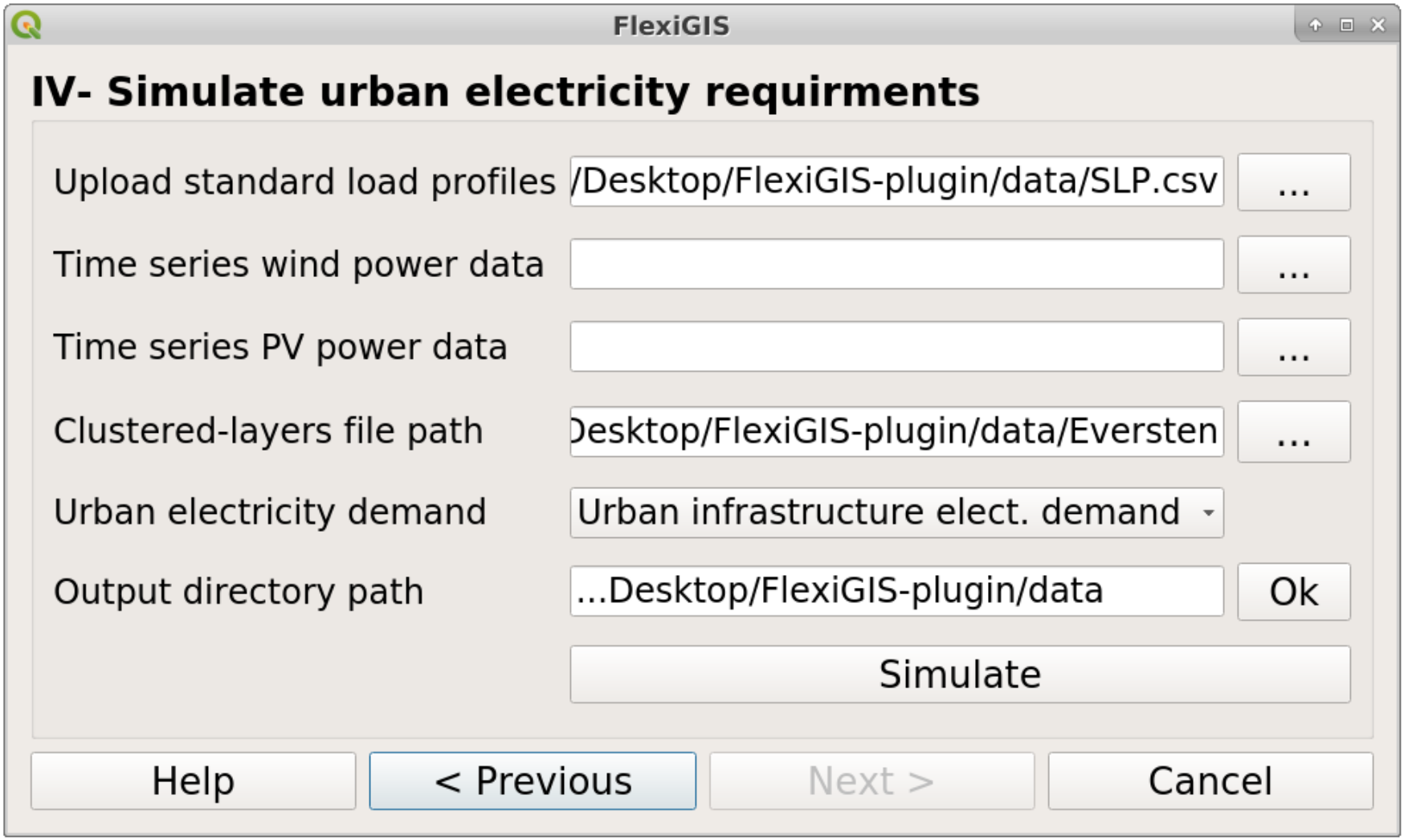


Note: OSM pbf files and poly files of your urban location of interest are available e.g. from Geofabrik


FlexiGIS
II- Geoprocessing urban datasets
Select extracted data (.pbf)
/data/Eversten.osm.pbf
...
Select urban element (OSM key)
highway
Clustered data file directory/name
/Desktop/FlexiGIS-plugin/data/Eversten
Ok
Process data
III- Export urban infrustructure datasets
Select clustered-layer
highway_lines
.shp
map
Clustered data file path
...Desktop/FlexiGIS-plugin/data/Eversten
Export
Help
< Previous
Next >
Cancel


*FlexiGISLiveDemo — QGIS
Project
Edit
View
Layer
FlexiGIS
Layers
landuse
commercial
farmyard
industrial
retail
residential
farmland
Google Satellite
Type to locate (Ctrl+K)
Coordinate
910803,7013304
Scale
1:21010
Magnifier
100%


*FlexiGISLiveDemo — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh HCMGIS Processing Help
FlexiGIS
Layers
landuse
CLC ol2018
Broad-leaved forest
Coniferous forest
Continuous urban fabric
Discontinuous urban fabric
Dump sites
Green urban area
Industrial or commercial units and public fa
Mixed forest
Non-irrigated arable land
Pasture, meadows and other permanent gr
Port area
Road and rail networks and associated lanc
Sport and leisure facilities
Water bodies
Water courses
Google Satellite
Type to locate (Ctrl+K)
Coordinate 908321,7011916
Scale 1:21010



Note: Select the directory path, where the generated layers are stored – Slide 2

Output of Simulation

Name	Size	Type
pv_rooftop_generation.csv	881,9 kB	CSV docume
urban_building_elect_demand.csv		

urban_building_elect_demand.csv - LibreOffice Ca

File Edit View Insert Format Sheet Data Tools Window Help

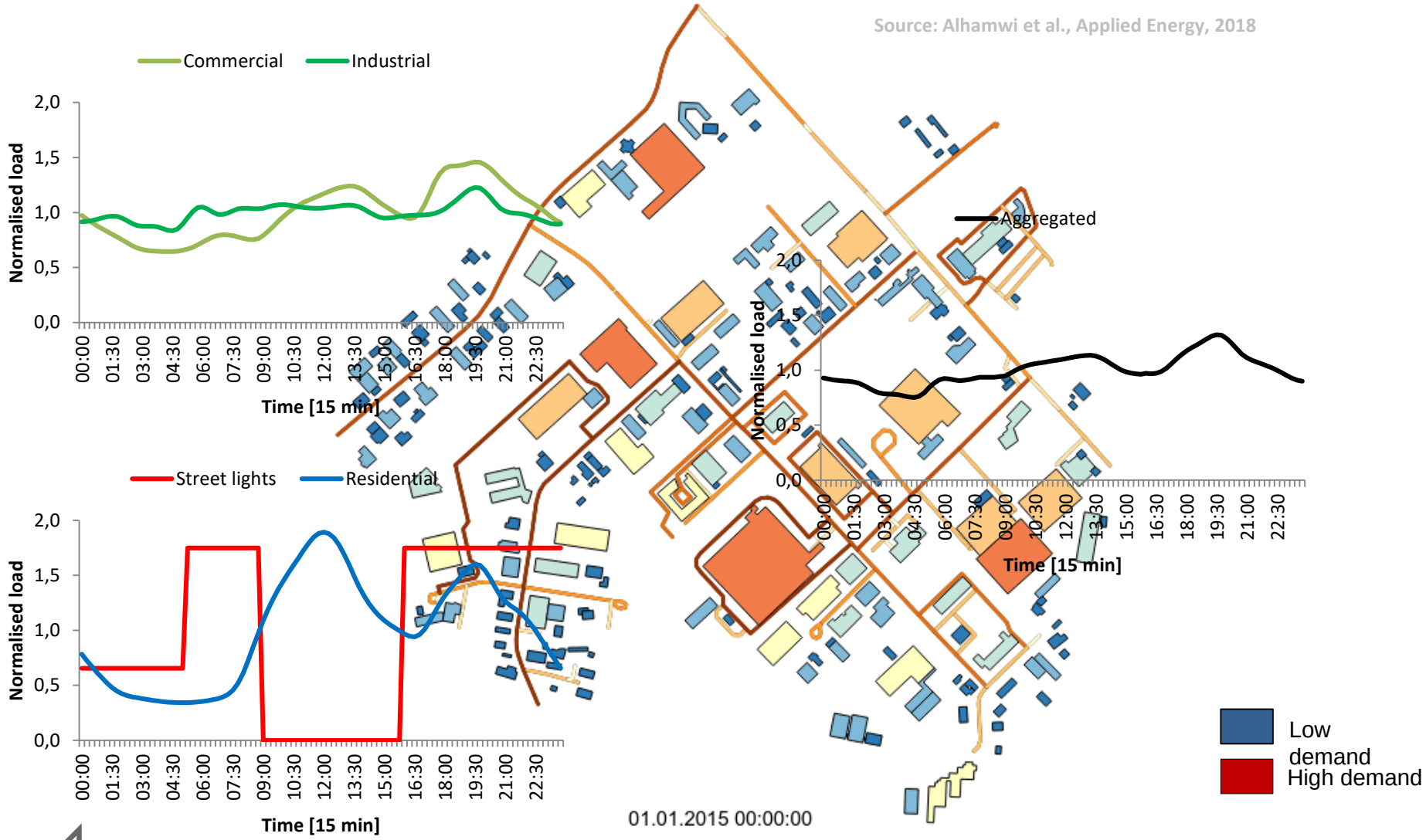
Liberation Sans 10

A1

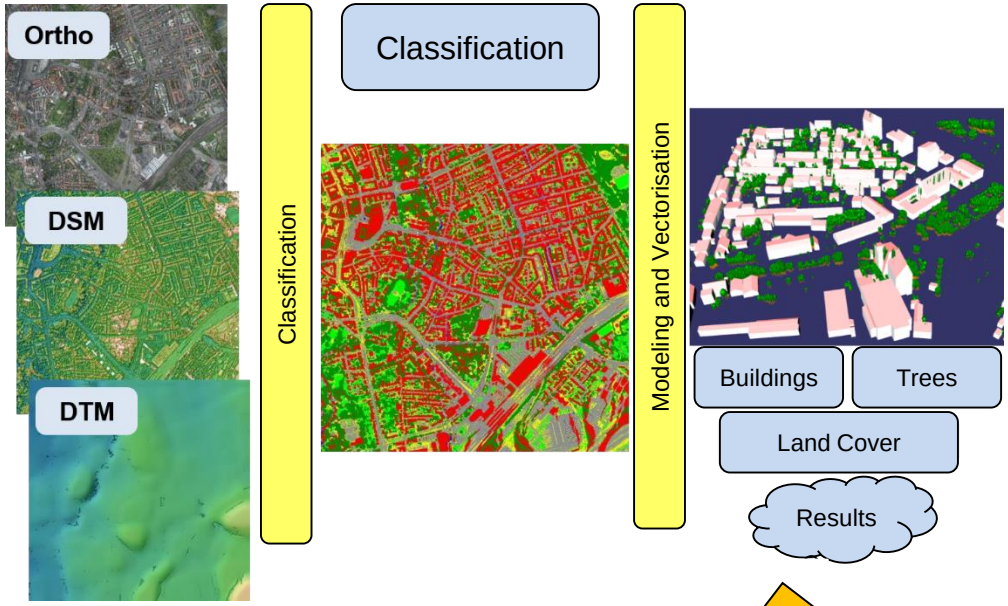
	A	B	C	D	E	F	G
1		time	agricultural	commercial	educational	industrial	residential
2	0	2014-01-01 00:00:00	16.8424902291	1477.1661830127	78.098963787	118.7858409185	707.520717256
3	1	2014-01-01 01:00:00	15.7294100894	1319.6475058872	78.8768404226	123.2330294382	532.1653654028
4	2	2014-01-01 02:00:00	15.0424808296	1157.4900039446	80.5881799144	120.5109478439	407.1293664698
5	3	2014-01-01 03:00:00	14.4827606825	1038.2921434284	76.3098421832	113.1512410686	365.7411595004
6	4	2014-01-01 04:00:00	14.3873542931	1013.4844600859	75.9986938334	109.6562237392	341.1260616071
7	5	2014-01-01 05:00:00	15.2714575887	1043.1326266805	80.977114566	119.6707981399	334.8089072575
8	6	2014-01-01 06:00:00	20.5251949386	1165.3558257014	89.1448396648	133.1131799401	349.6215348947
9	7	2014-01-01 07:00:00	33.2079463064	1247.0396492366	87.8224442518	128.3747398642	401.0300636333
10	8	2014-01-01 08:00:00	50.5592734105	1197.4243068663	90.5450182373	133.6508741889	660.904503728
11	9	2014-01-01 09:00:00	55.9402201276	1279.1081304016	94.6677707952	135.095929418	1108.7686067105
12	10	2014-01-01 10:00:00	44.3133046248	1541.1014139634	93.6565268744	137.7844060472	1448.8055018416
13	11	2014-01-01 11:00:00	39.9500310644	1728.0666478781	96.7680417963	134.8270829667	1712.383102349
14	12	2014-01-01 12:00:00	37.9210449906	1853.9201850233	98.7127370513	134.8606879317	1826.5274575431
15	13	2014-01-01 13:00:00	30.3648223687	1938.0242744993	91.3228938254	137.2131041409	1599.9814191219
16	14	2014-01-01 14:00:00	28.9464401379	1853.3151367742	89.9227152529	131.0632164935	1251.4490436963
17	15	2014-01-01 15:00:00	27.2418377214	1646.3827757134	96.8458312406	122.9977866056	1048.6467671849
18	16	2014-01-01 16:00:00	27.7761164021	1503.5873526677	100.6574323063	125.2157802623	938.6412333884
19	17	2014-01-01 17:00:00	35.0143163693	1770.4211924259	99.179467432	126.7280467675	1026.4278327359
20	18	2014-01-01 18:00:00	49.7260538109	2196.3871713073	105.3247015468	135.7008362893	1304.8180608806
21	19	2014-01-01 19:00:00	59.5465995052	2264.1544960763	108.0472723899	153.5455977454	1508.709496861
22	20	2014-01-01 20:00:00	49.4970767973	2215.7492988338	99.9573430201	149.5800960971	1462.3111255036
23	21	2014-01-01 21:00:00	32.9662493228	1956.7813294619	95.912376764	130.4583082758	1218.9919709994
24	22	2014-01-01 22:00:00	26.5549084616	1741.9831223296	87.9780199979	125.383809126	1056.0530880104
25	23	2014-01-01 23:00:00	21.4919843992	1544.731825032	86.422262537	117.4191995183	804.4562766972
26	24	2014-01-02 00:00:00	18.7951505469	1737.1425904479	79.4991465493	128.5763750392	611.3311240164
27	25	2014-01-02 01:00:00	18.0191748826	1826.0871874908	78.8768404226	133.617269224	498.6573979153

Visualization of Simulation

Source: Alhamwi et al., Applied Energy, 2018



3K Overflight



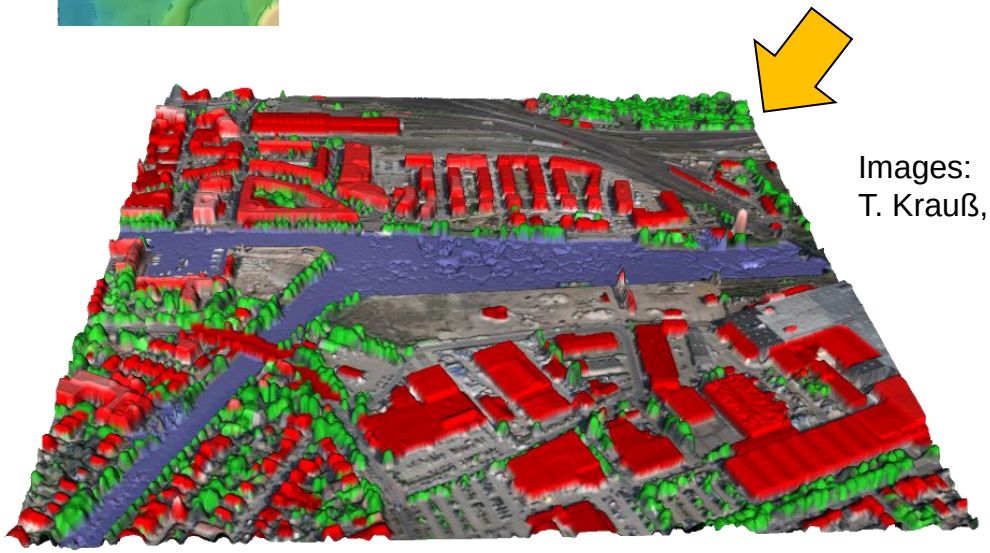
<u>Ziel:</u> Extraction of buildings and detection of solar modules

- Extraction of buildings with DLR toolchains

- Detection of solar modules

  Currently with Convolutional Neural Network (CNN)

  - Manuelly labeled data
  - Training of CNN
  - Ground Truthing

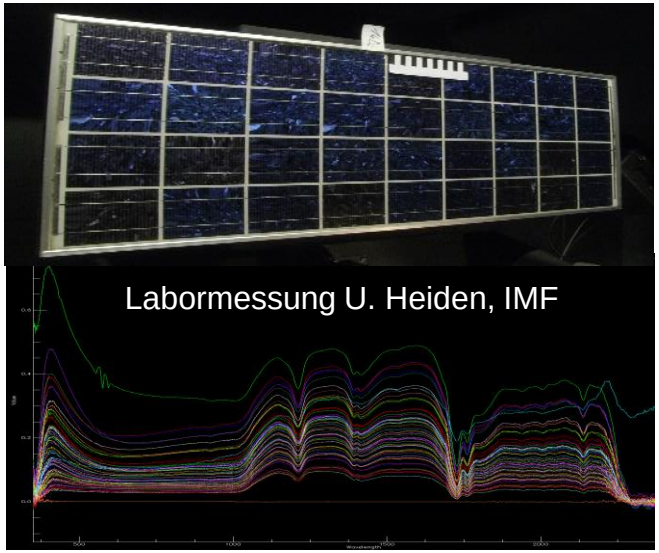


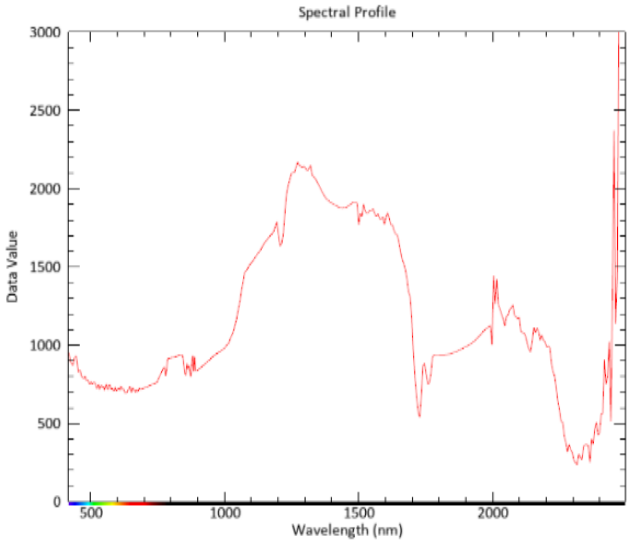
Images:
T. Krauß, IMF

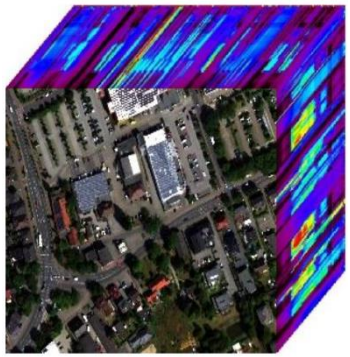
Example: Port area Oldenburg, 3K-Overflight at 30.07.2019

HySpex Overflight

Aim: Extraction of solar modules

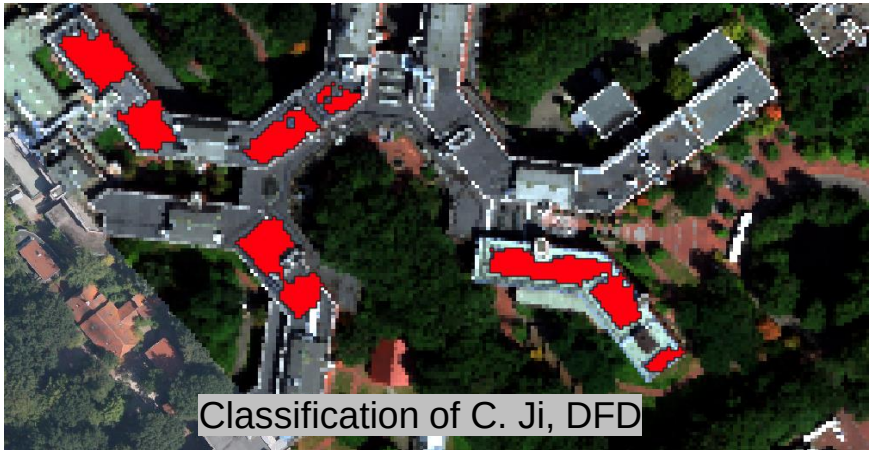






HySpex 2019

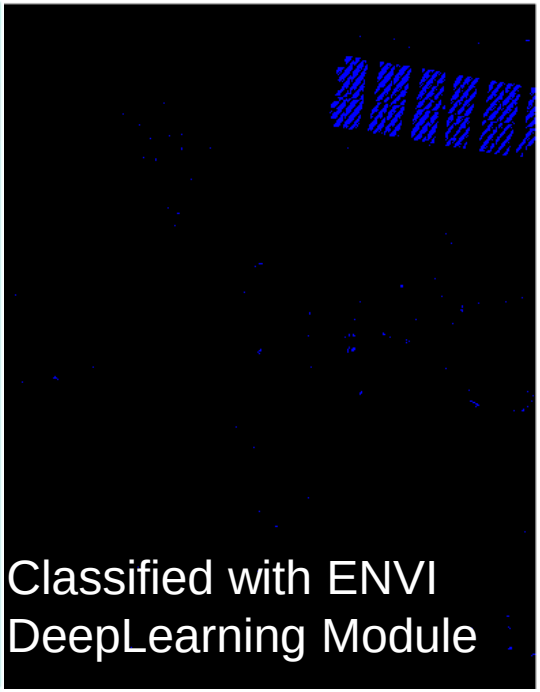
Characteristical features

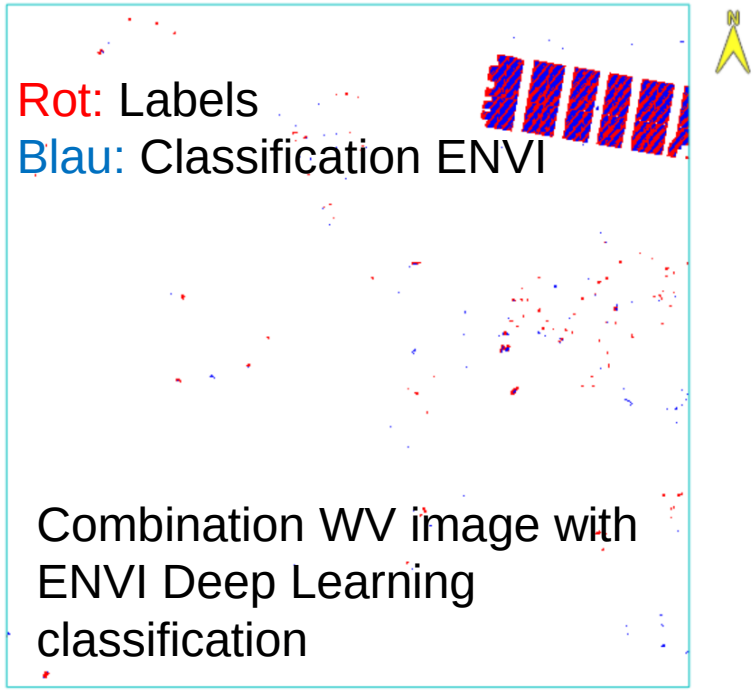


Paper „Solar photovoltaic module detection using laboratory and airborne imaging spectroscopy data “ accepted at RSE

WorldView-2 Data

- Aim: Extraction of solar modules





- Checking the influence by changing the spatial resolution