



e-shape Workshop: EuroGEO showcase for Renewable Energy



31
May
2022

e-shape
accelerates
EO solutions

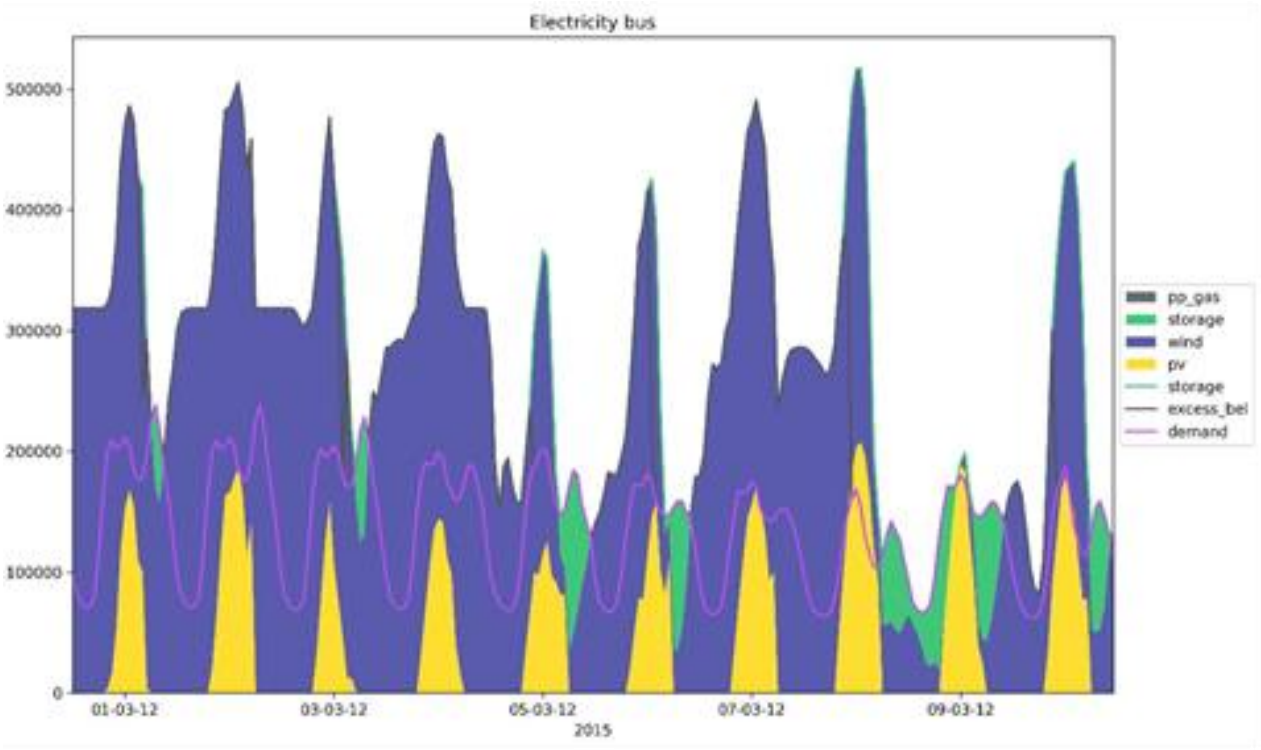
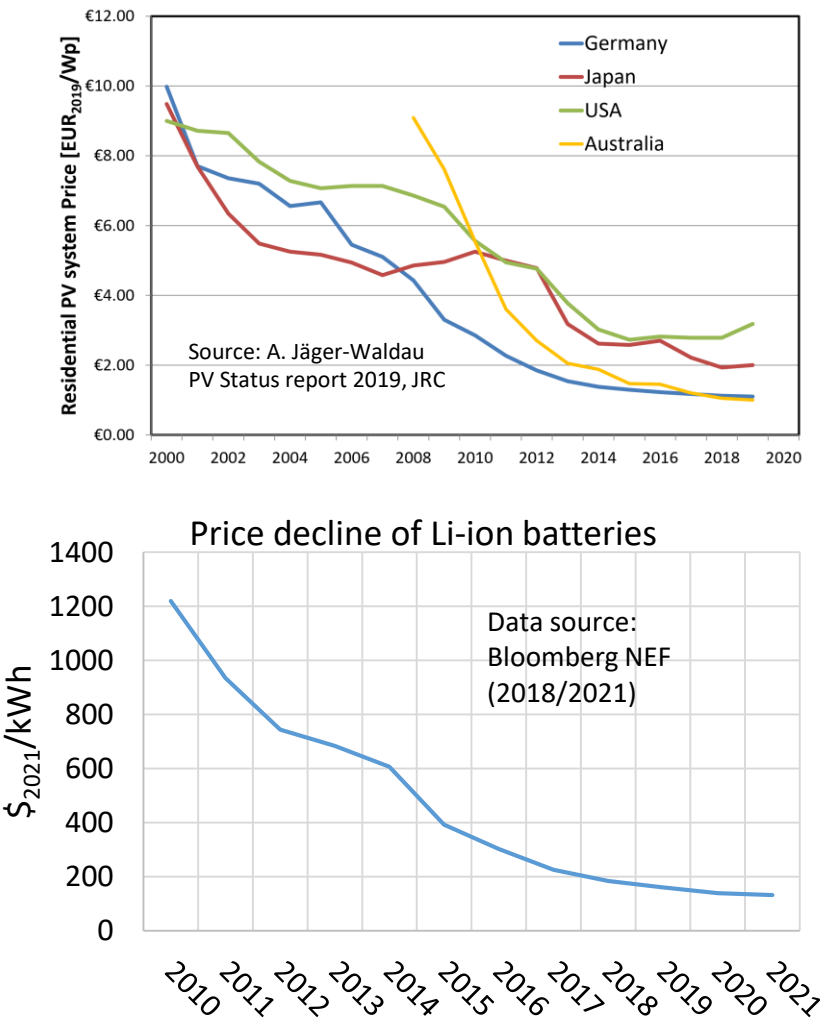
e-shape Workshop: EuroGEO showcase for Renewable Energy
Title: Energy Modeling Application – Coupling to FlexiGIS

Presenters: Susanne Weyand and Jethro Betcke
DLR – Institute of Networked Energy Systems, Oldenburg, Germany



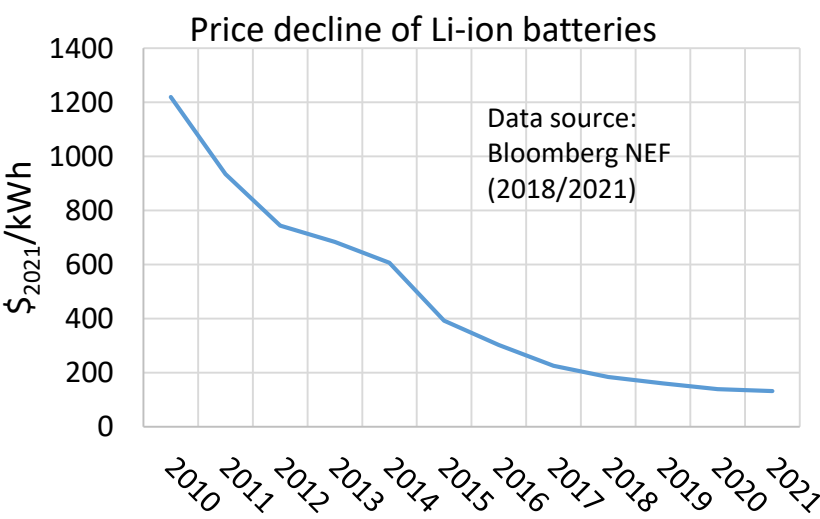
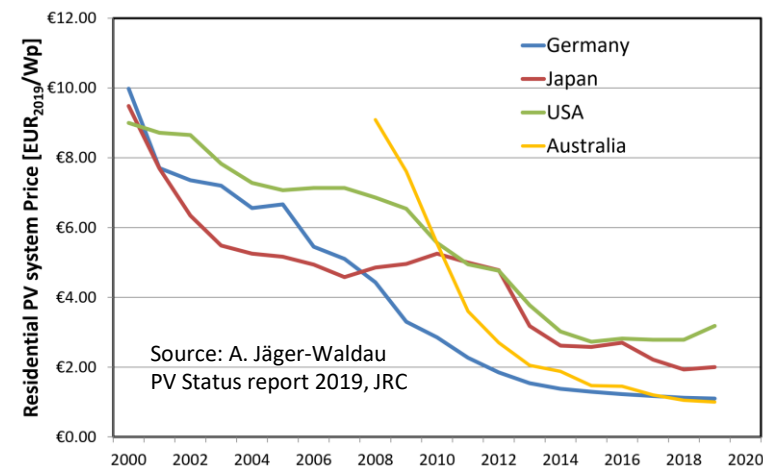
Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center

The costs of renewables and storage options are declining fast

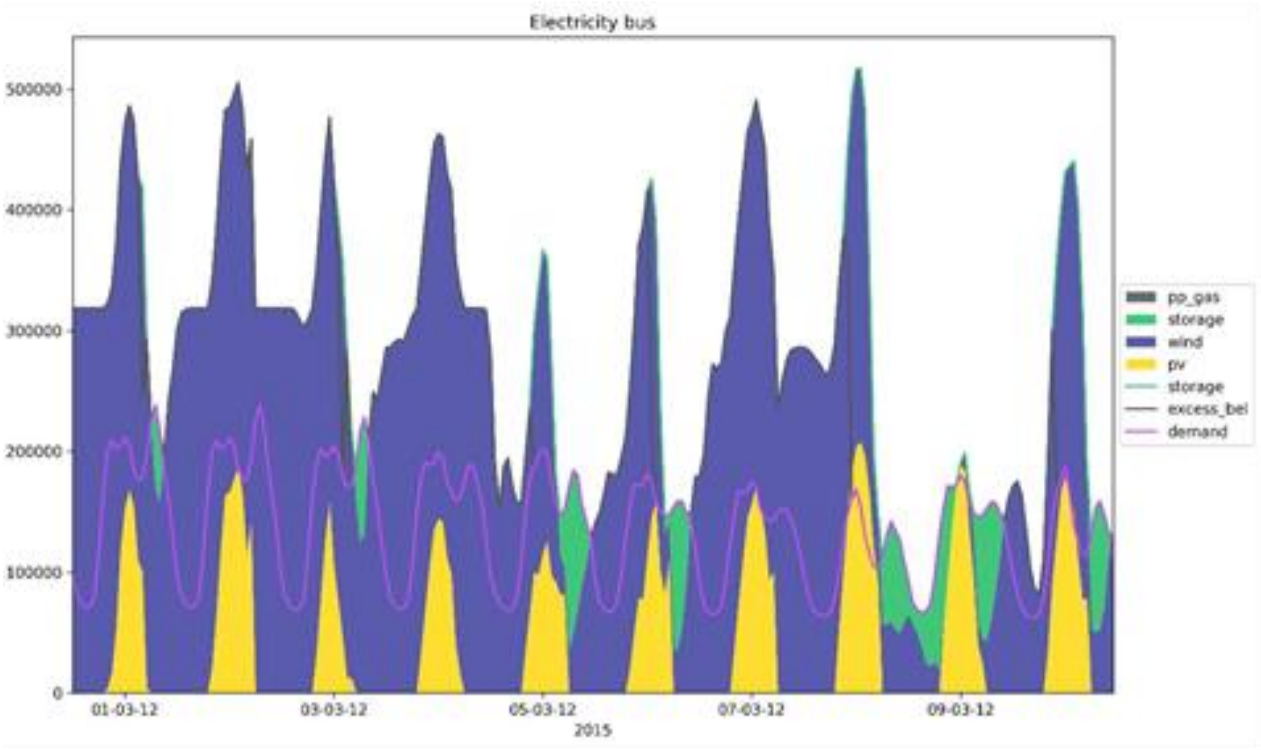
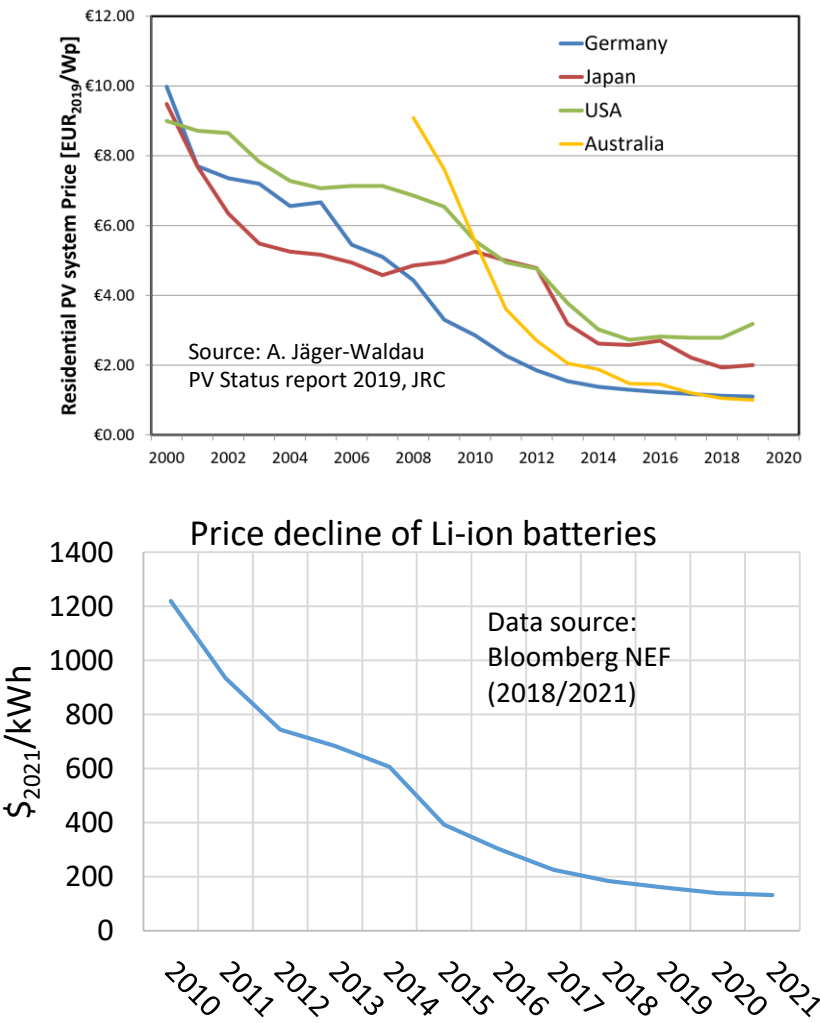


How to cost effectively increase the renewables share in local power systems, while balancing supply and demand?

The costs of renewables and storage options are declining fast



The costs of renewables and storage options are declining fast



How to cost effectively increase the renewables share in local power systems, while balancing supply and demand?

Motivation For FlexiGIS

Studies on optimizing grid integration of renewables mostly:

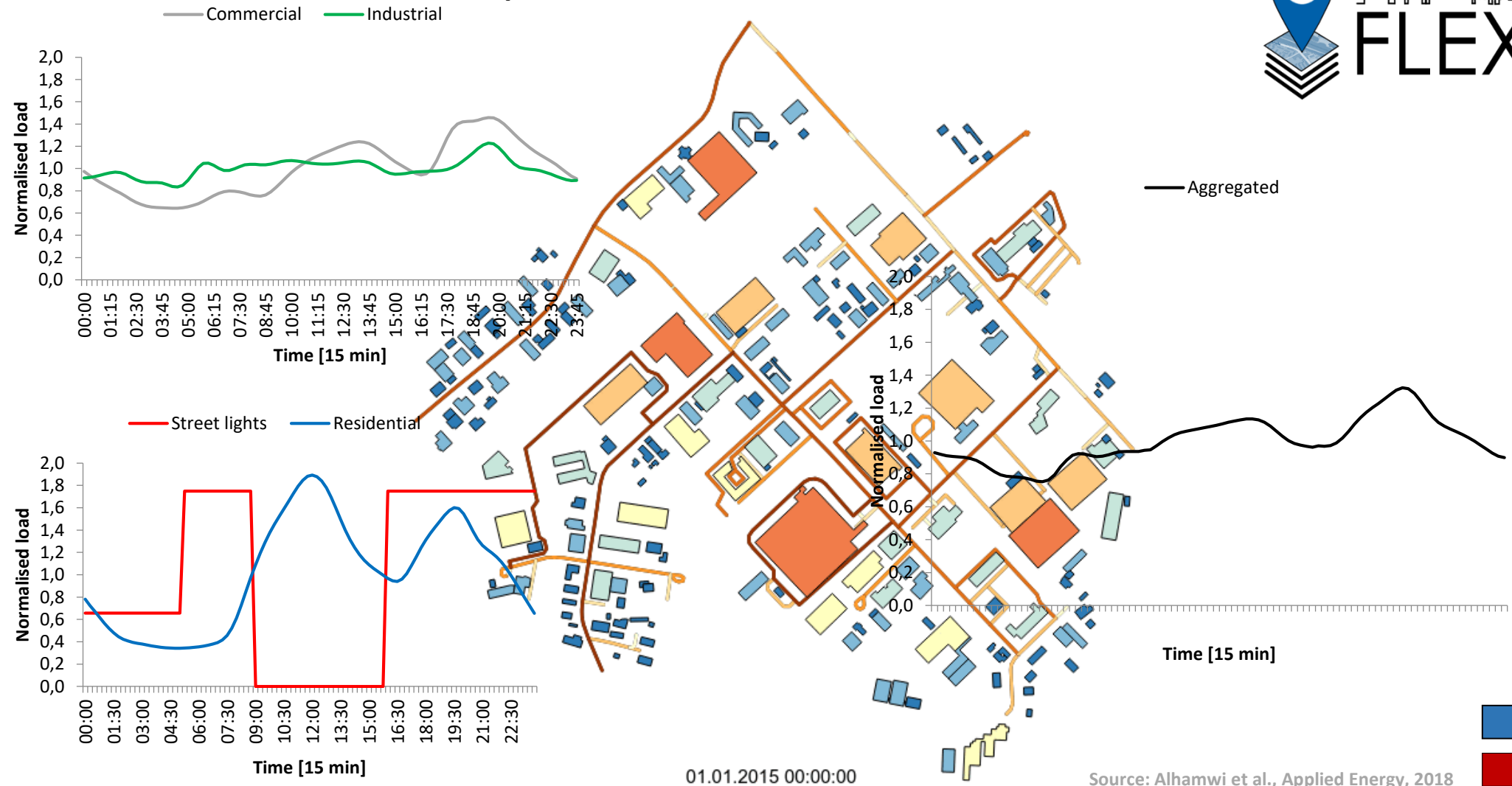
- are on a national or international grid scale
- use proprietary or one-time-use software
- Use proprietary data

→ need for open software, using open data on a local scale:



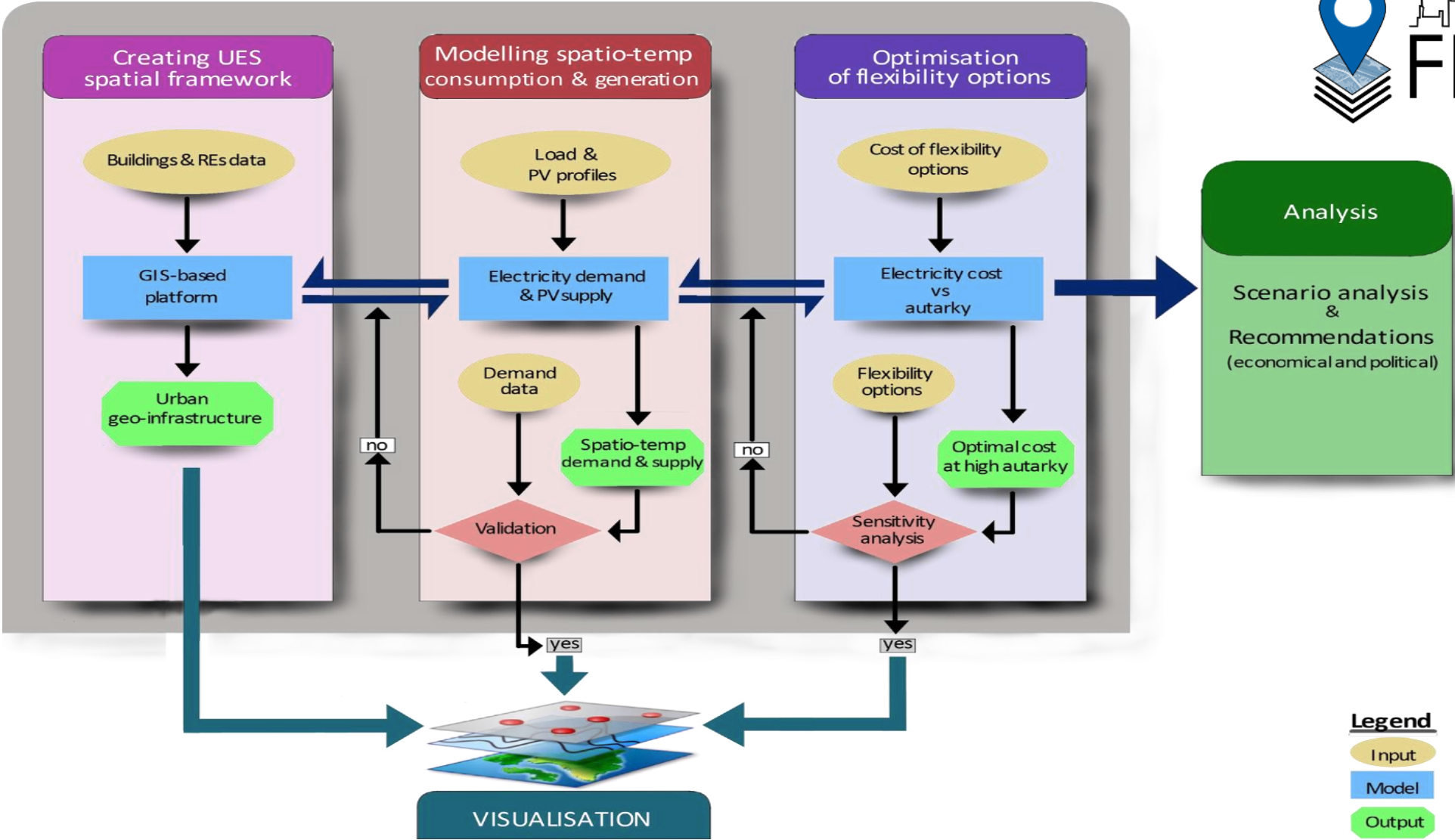
Open source GIS-based platform for the optimisation of flexibility options in urban areas

What can FlexiGIS provide? - Visualization

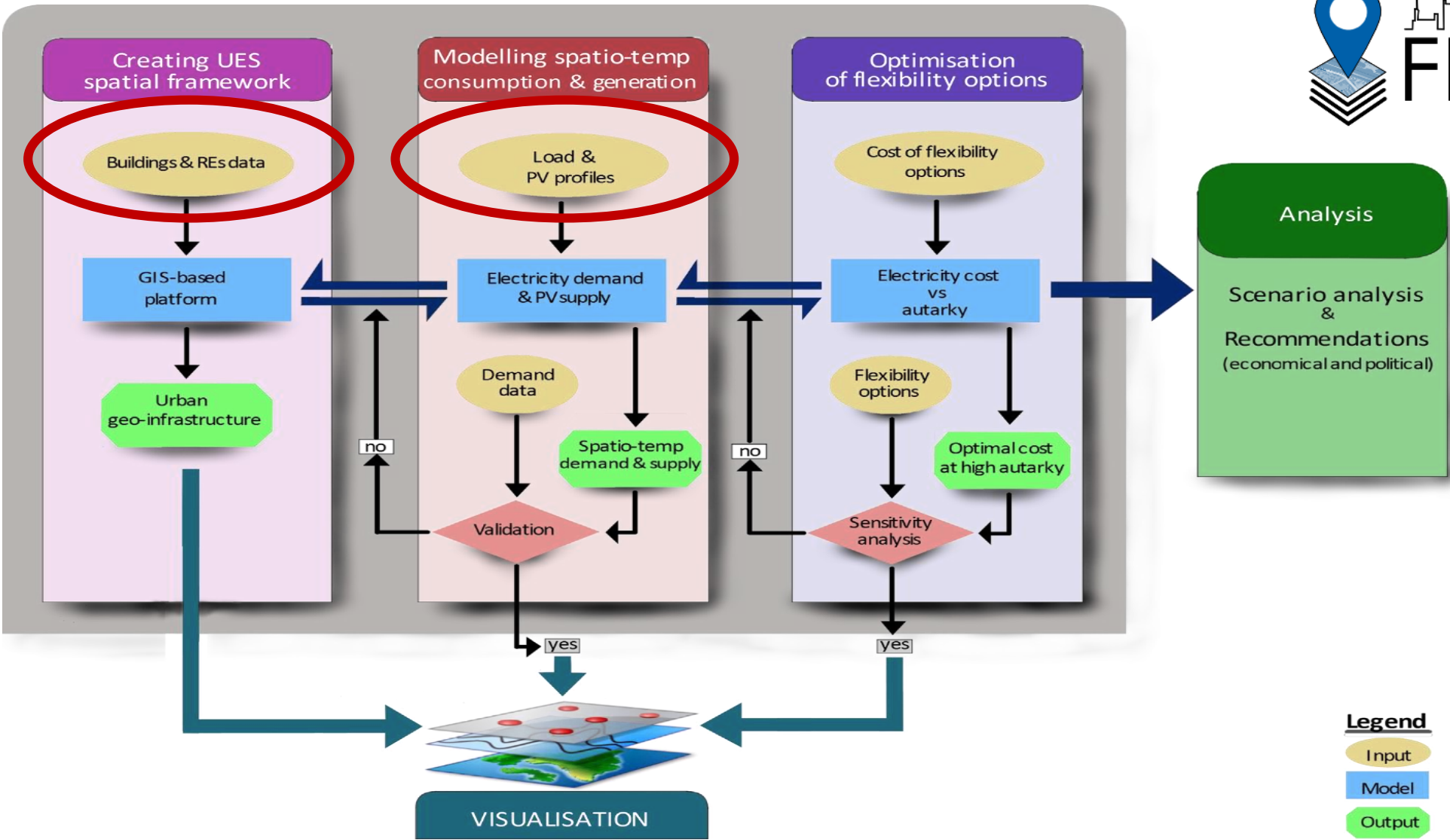


01.01.2015 00:00:00

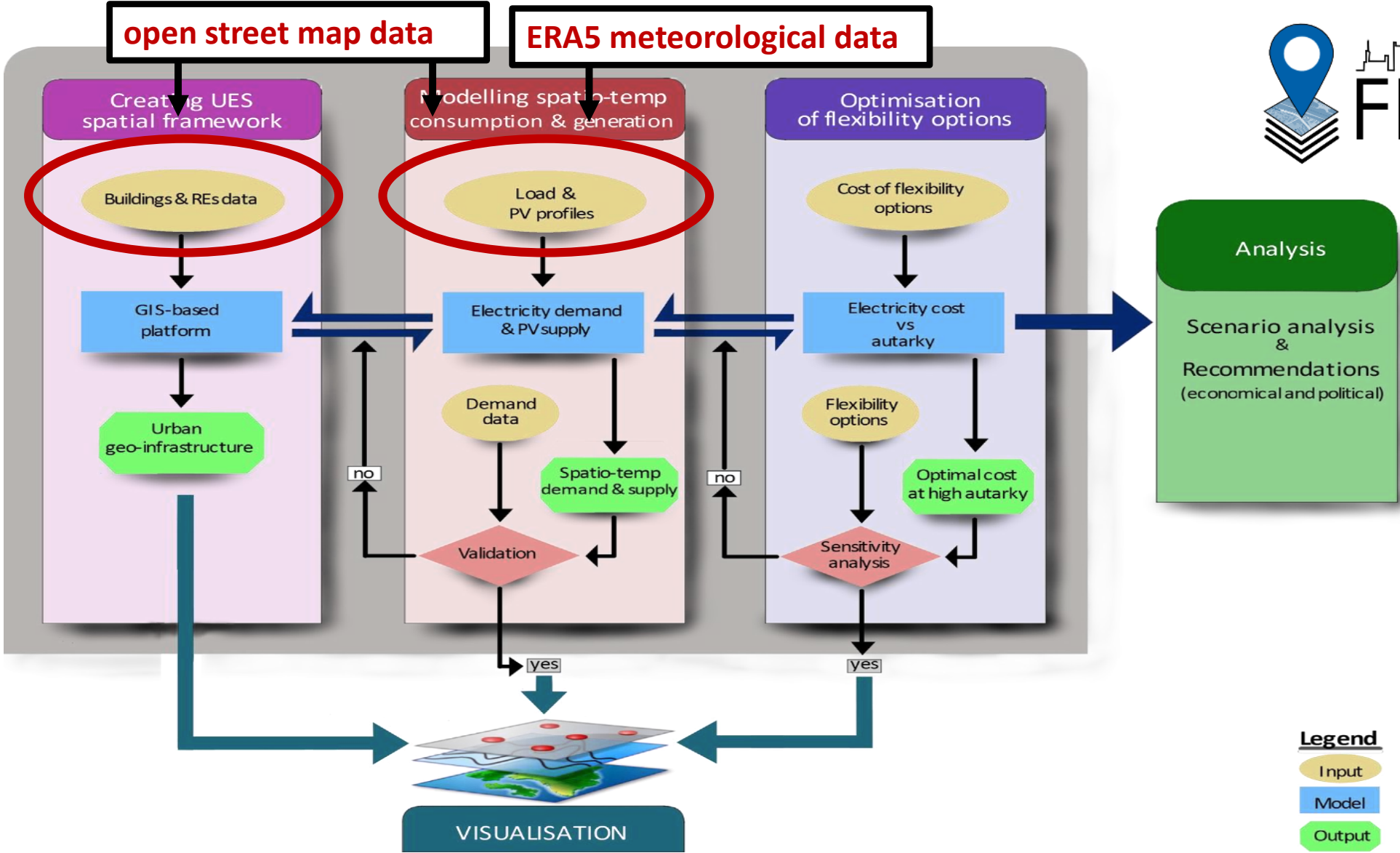
Source: Alhamwi et al., Applied Energy, 2018



Source: Alhamwi et al., 2017



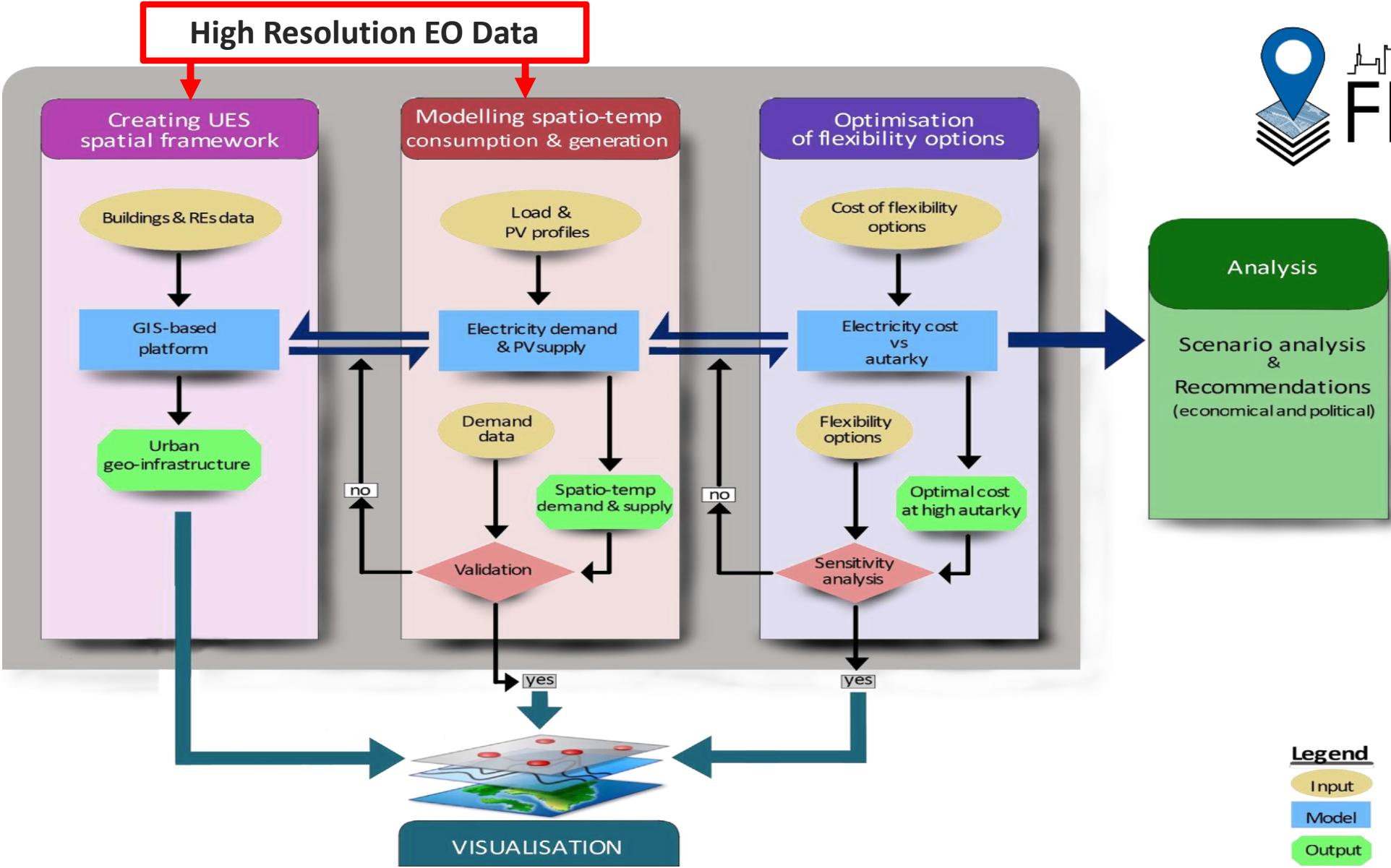
Source: Alhamwi et al., 2017



Source: Alhamwi et al., 2017

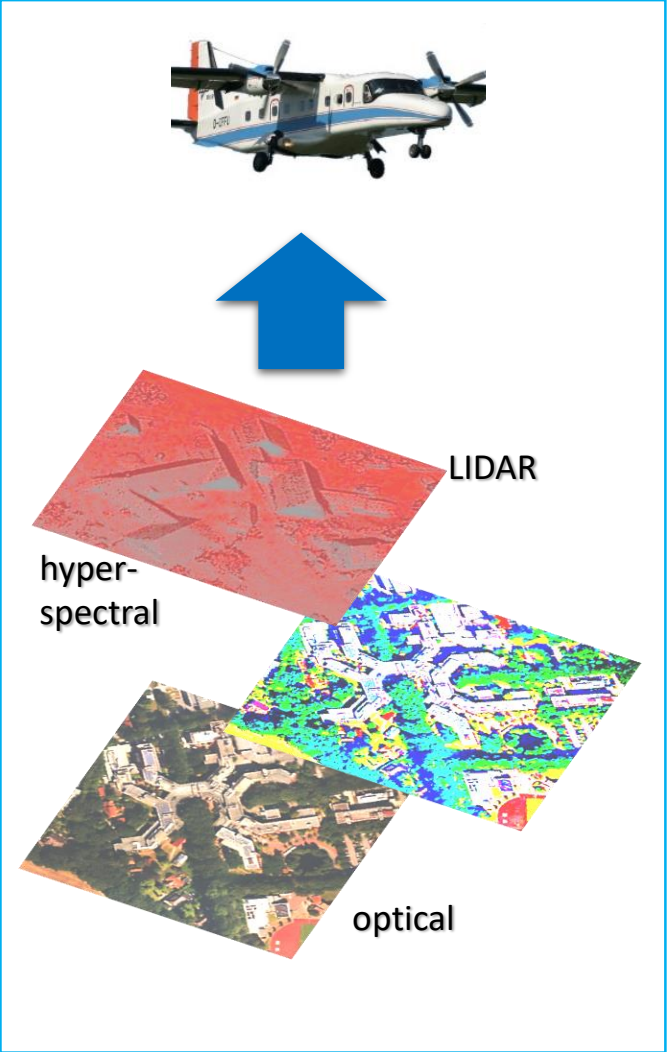
Why extend FlexiGIS with Earth Observation data?

Georeferenced Data	Meteorological data
Open Street Map data: <ul style="list-style-type: none">• Open source• Limited resolution• No data on roof geometry• No data on existing PV systems	ERA 5 Data: <ul style="list-style-type: none">• Analysis data• Windspeed, temperature, pressure and irradiance• 1h, 31km native resolution• Free to download
Airborne Earth observation data: <ul style="list-style-type: none">• Higher resolution• Data on roof geometry• Data on existing PV systems• Measurement campaign has to be commissioned	CAMS Radiation Service: <ul style="list-style-type: none">• Satellite based data• Only irradiance data• 15 min, 5 km native resolution (NW Europe)• Free to download
Future: satellite based data <ul style="list-style-type: none">• More technically challenging because of lower image resolution, and limited spectral channels• Partly free available	<ul style="list-style-type: none">• Future: Meteosat third generation• 10 minute, 2 km resolution (NW Europe)

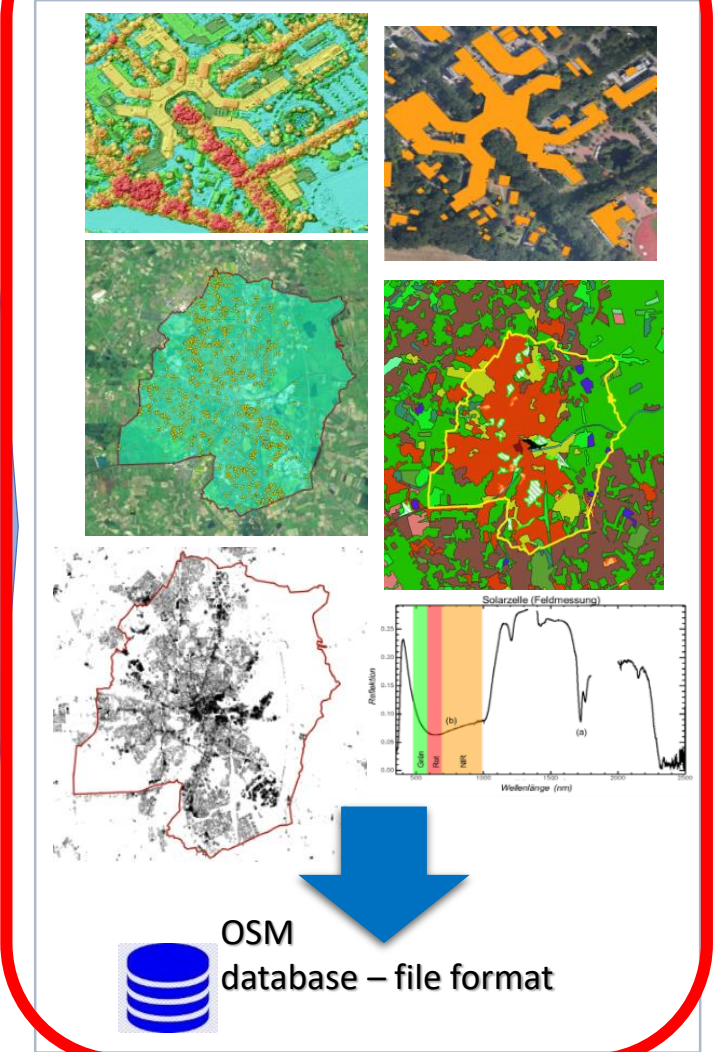


Source: Alhamwi et al., 2017

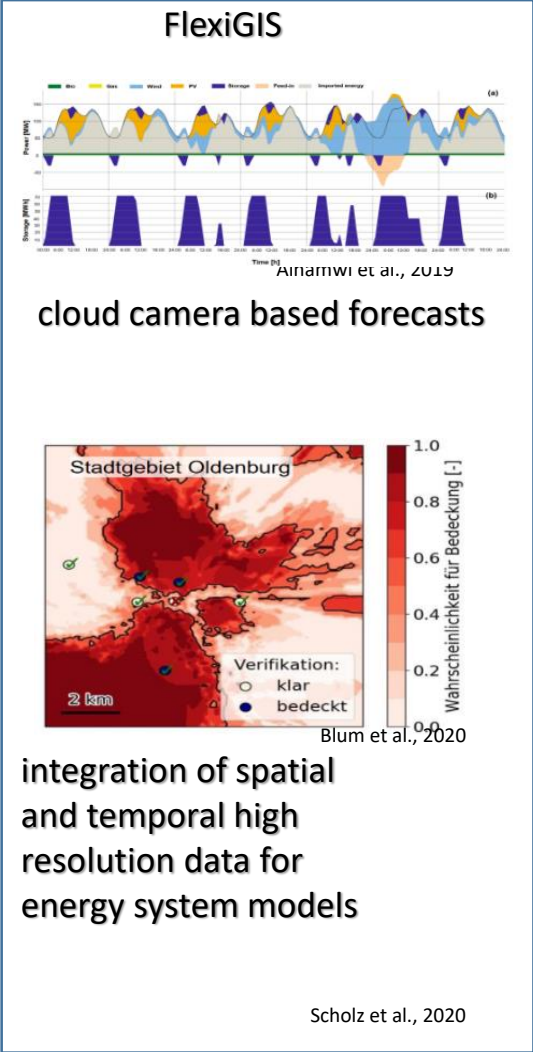
data acquisition



post-processing



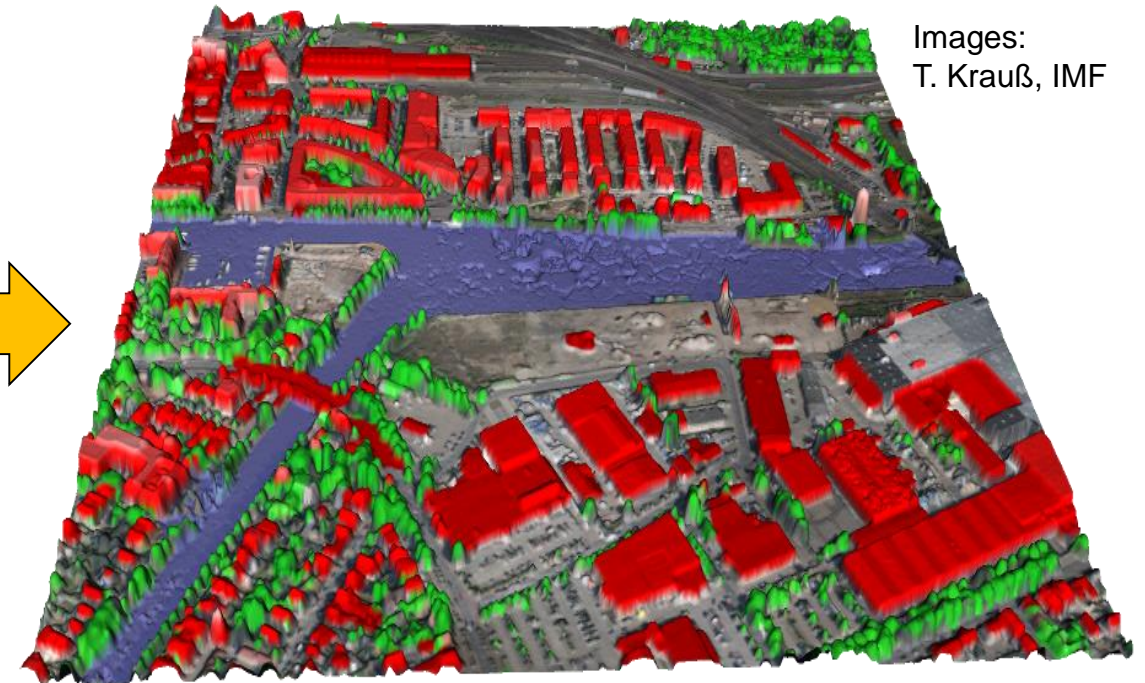
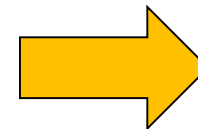
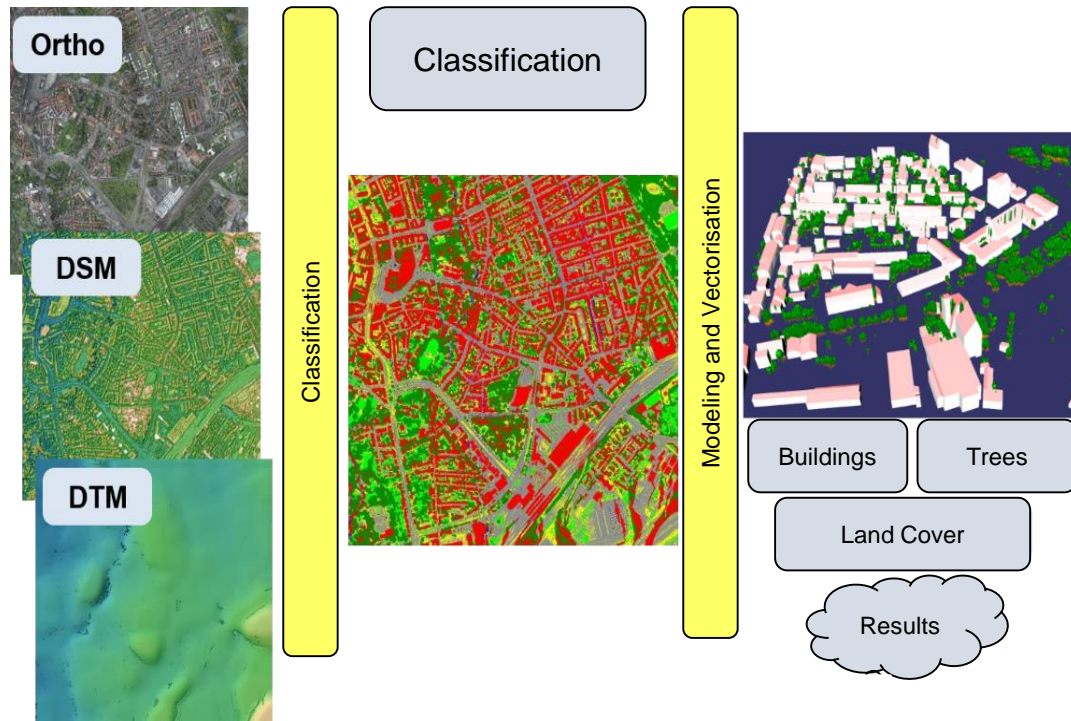
modeling & applications



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 (GRS) - Department: Land Surface Dynamics

High Resolution Data Sets

Building extraction with DLR toolchains

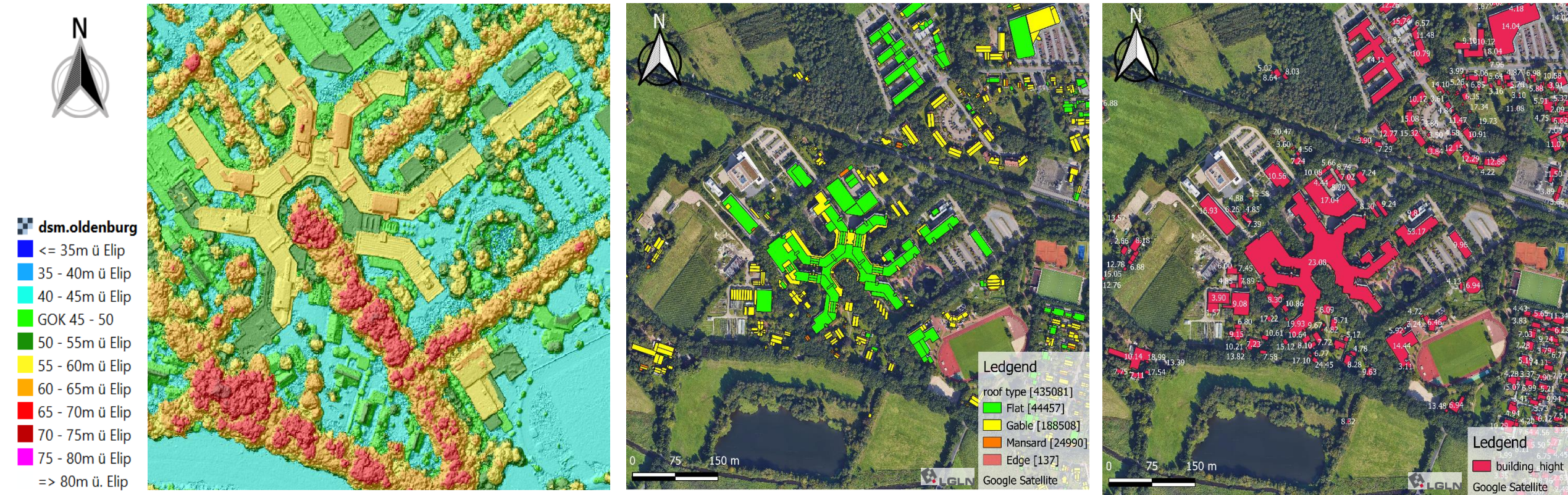


Images:
T. Krauß, IMF

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

High Resolution Data Sets

Building Parameters



High Resolution Data Sets

Detection of solar modules with Convolutional Neural Network (CNN)

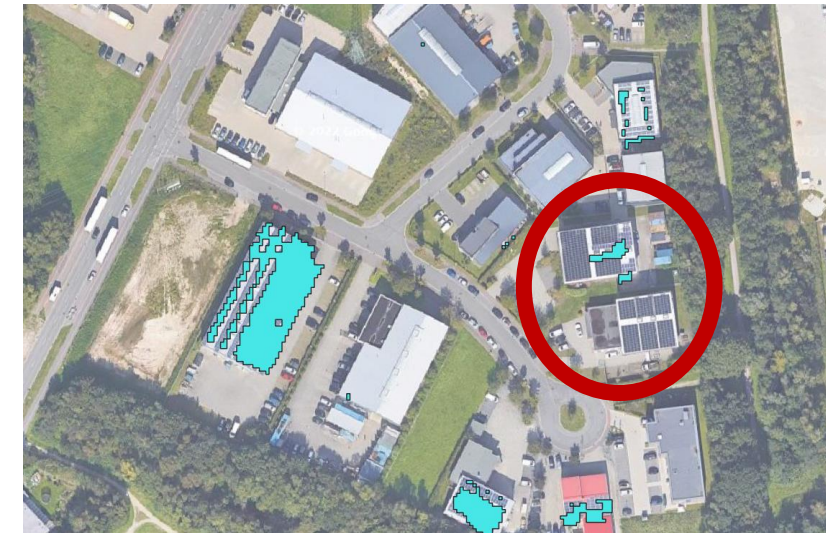
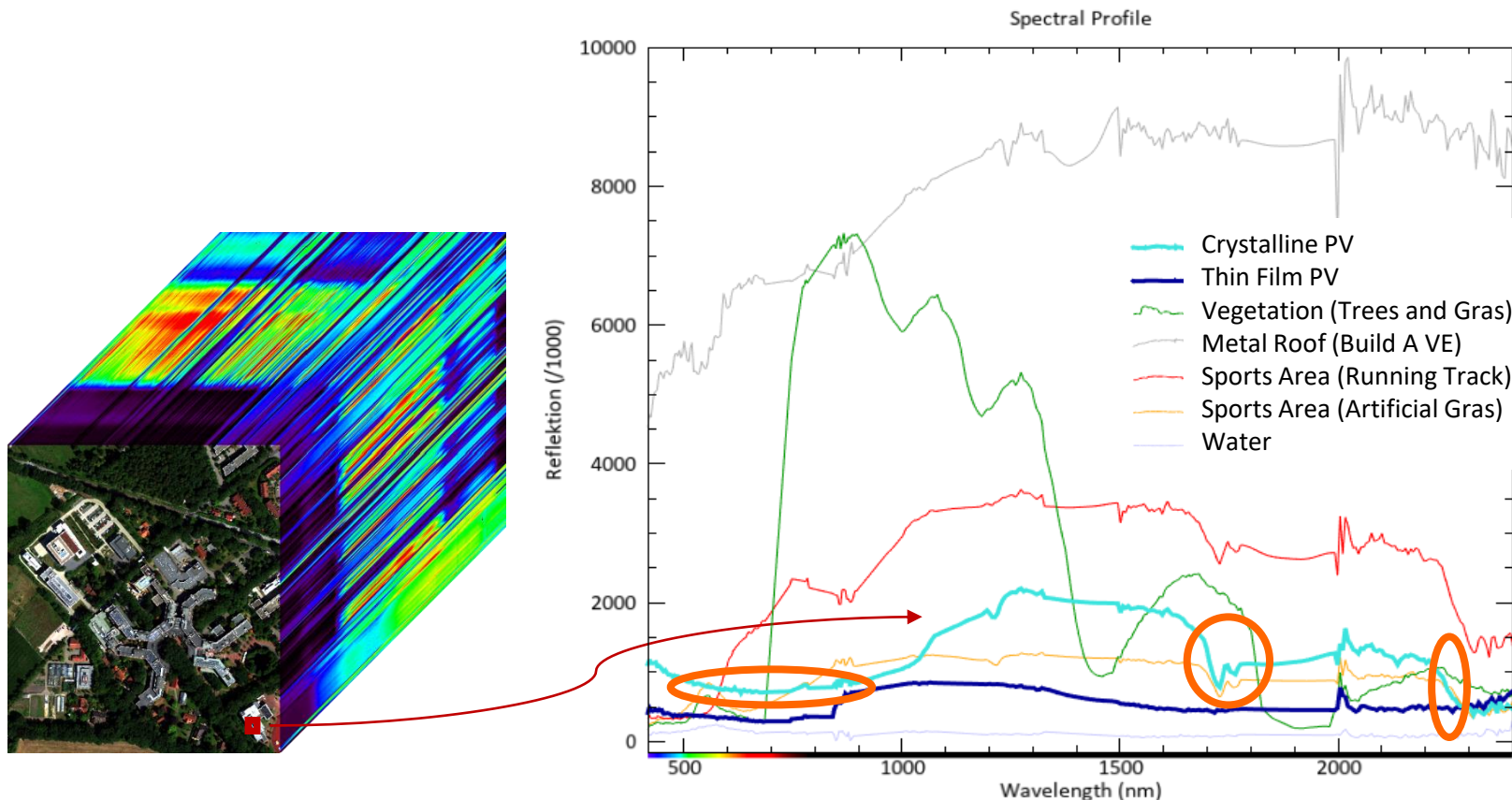
- Manually labeled training data
- Training of CNN
- Ground Truthing

The current accuracy of the trained network is
OA = 99,8%, UA = 72,8% and PA = 72,8%.
Therefore optimization of the network is ongoing.



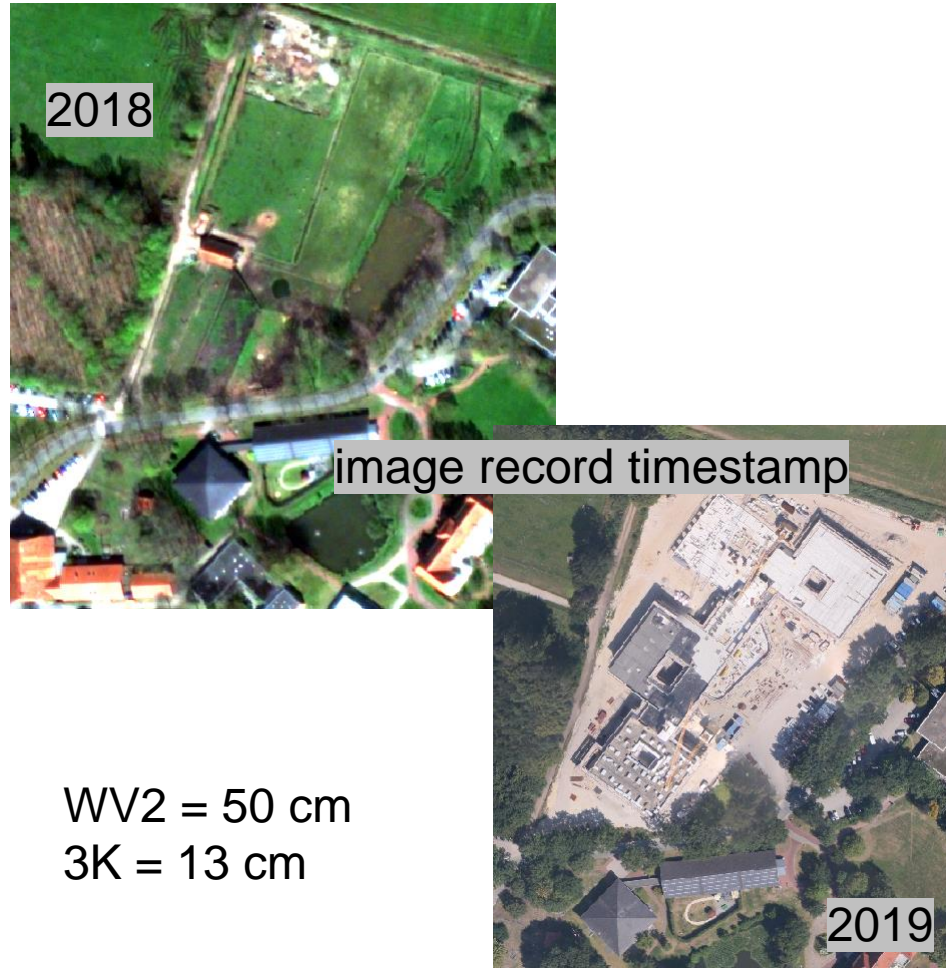
High Resolution Data Sets

- Solar module (PV) detection by characteristic spectral information
- Index Analysis results of C. Ji (DFD-LAX) – just crystalline PV modules detected
- Further PV extraction methodologies in progress



From Airborne to Satellite

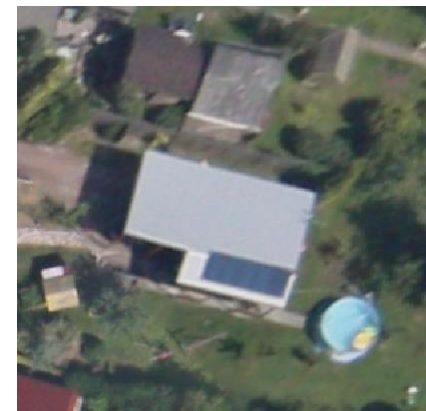
Impact on Energy System Analysis?



blooming

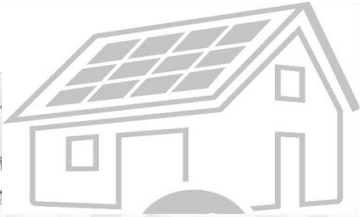


spatial resolution

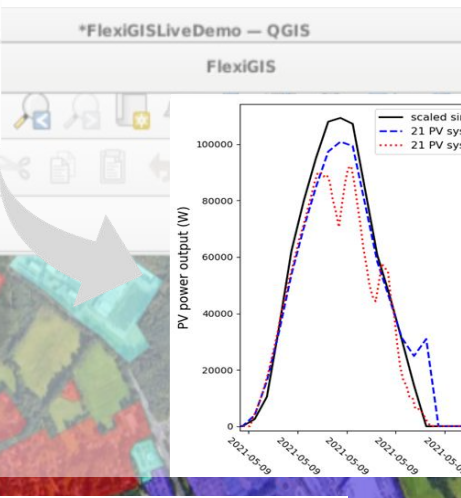
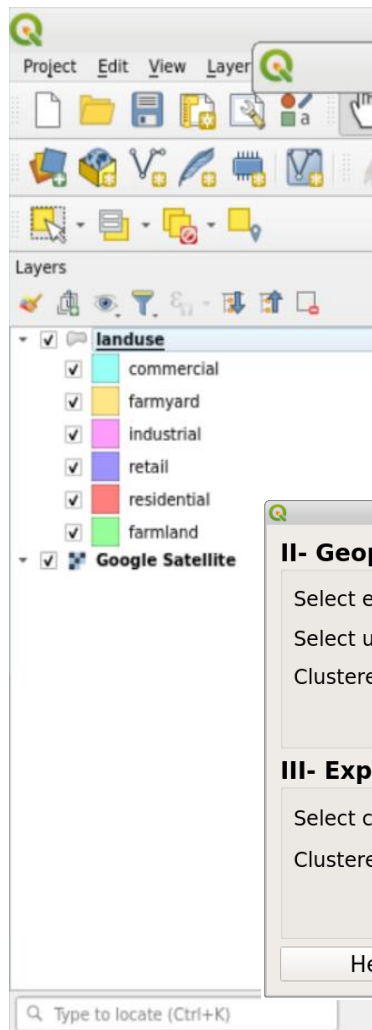




current



single scaled system



II- Geoprocessing urban datasets

Select extracted data (.pbf) ...

Select urban element (OSM key)

Clustered data file directory/name

III- Export urban infrastructure datasets

Select clustered-layer ☐ .shp ☒

Clustered data file path

II- Geoprocessing urban datasets

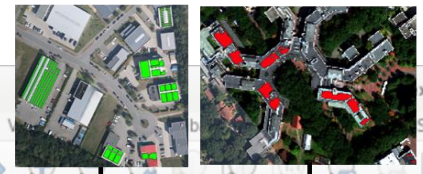
Select extracted data file (.pbf)

Select landuse data file (.shp)

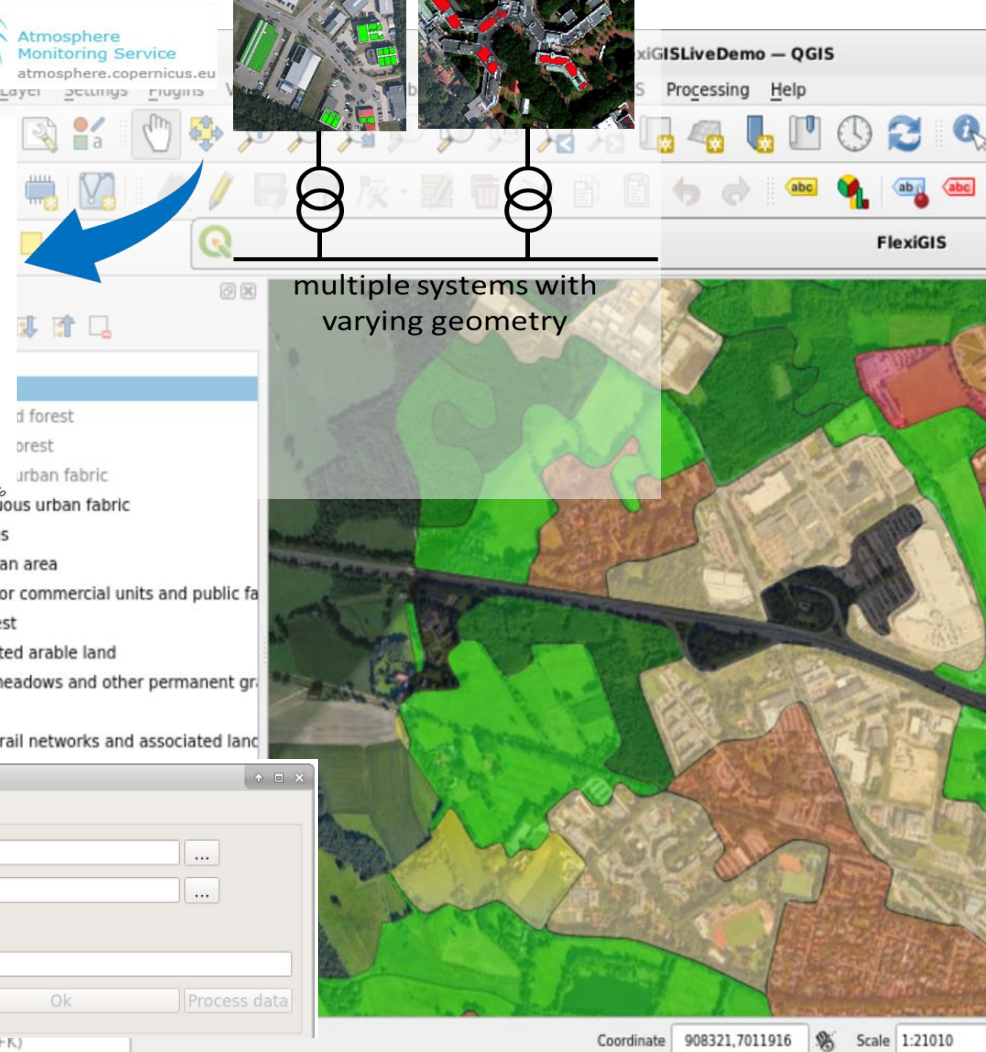
Select urban element (OSM key)

Clustered data file directory/name

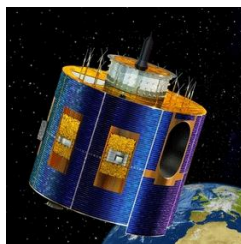
Ongoing implementation



multiple systems with varying geometry

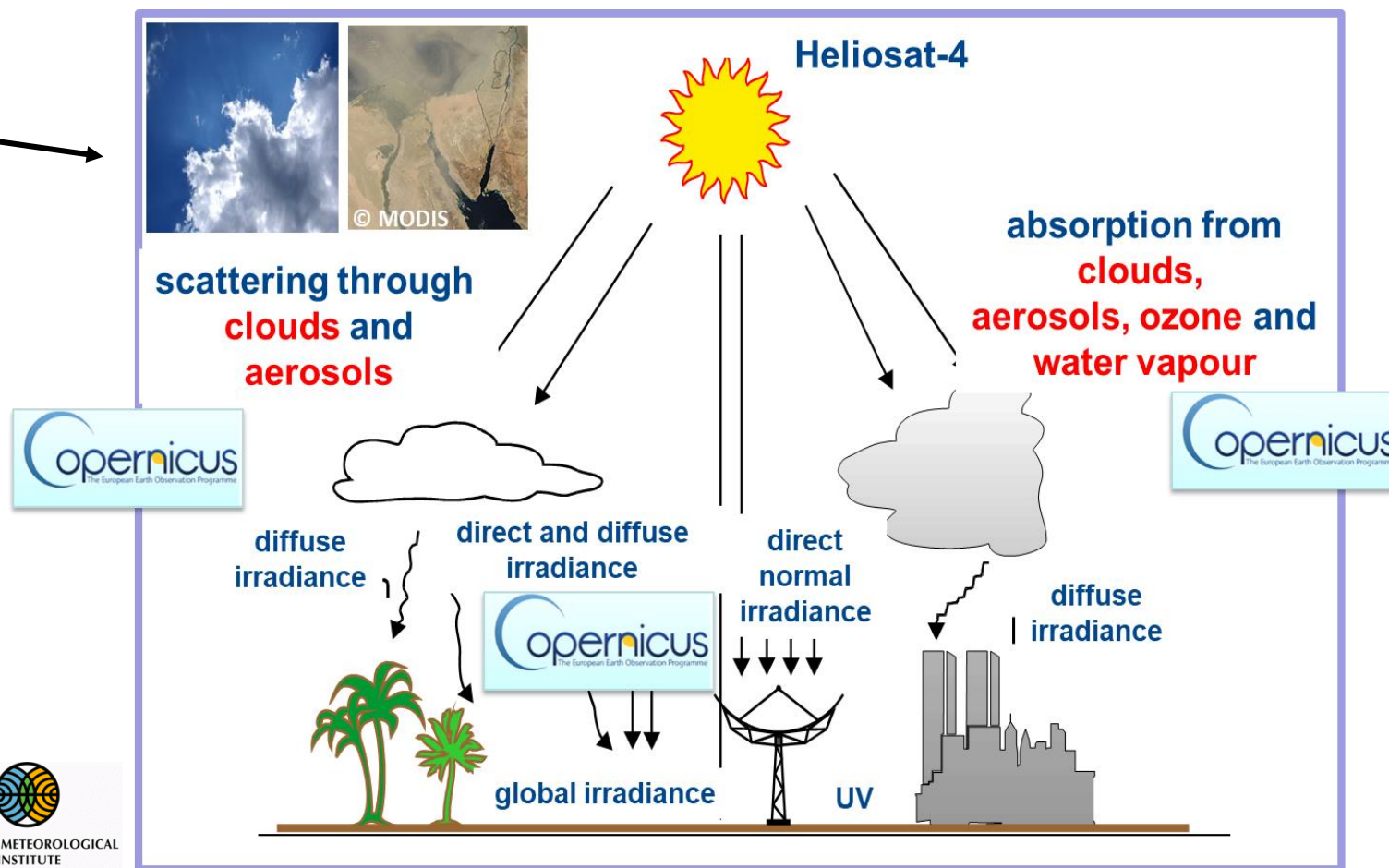


Better irradiance data from remote sensing Using CAMS Radiation service



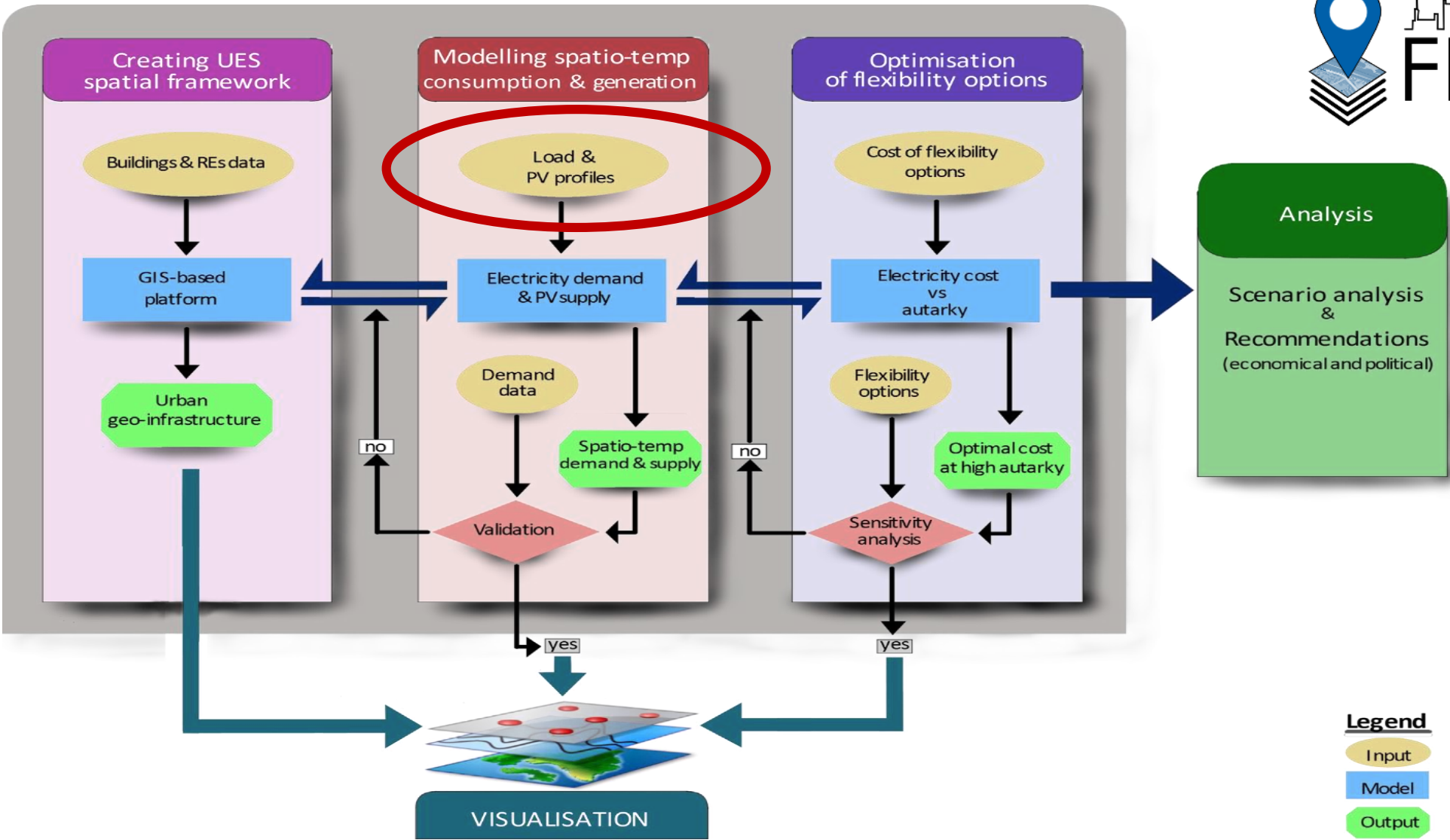
Meteosat second Generation:
Image courtesy EUMETSAT

- Higher spatial resolution
- Higher temporal resolution



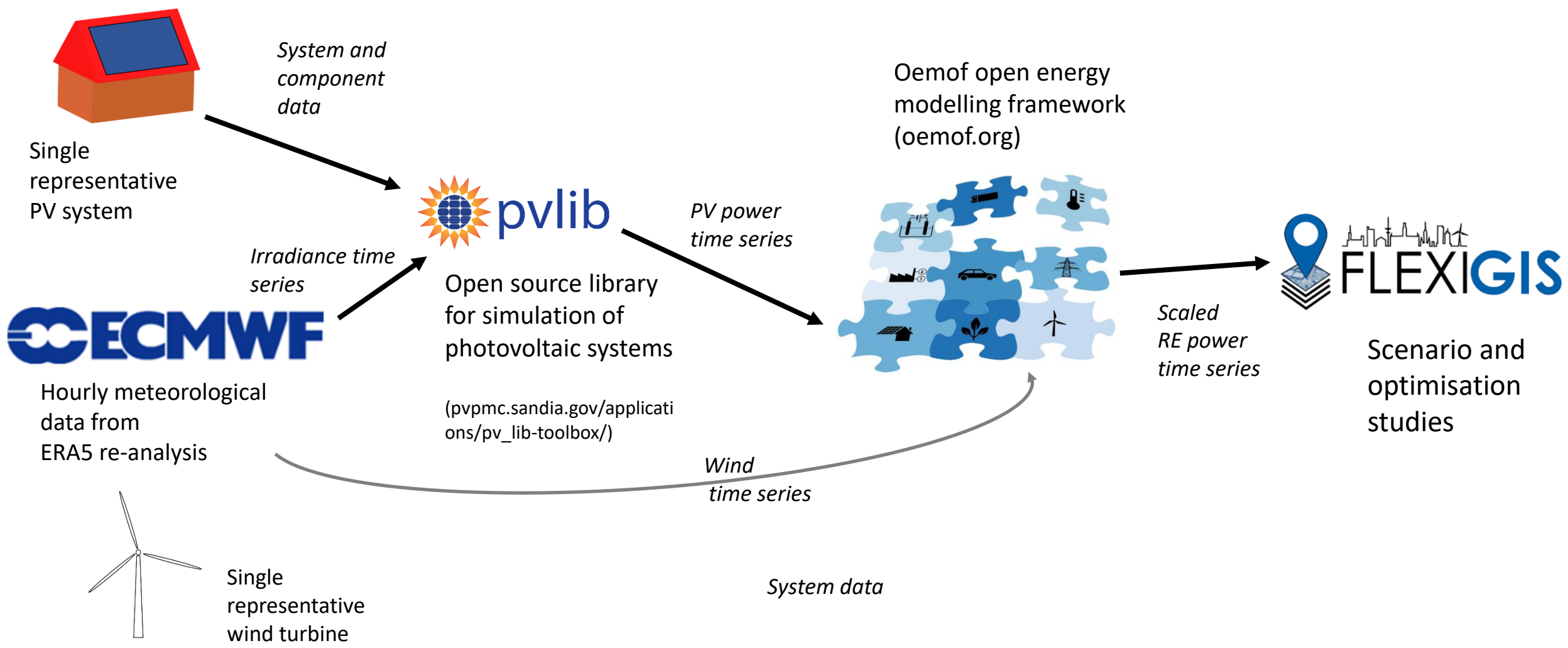
with



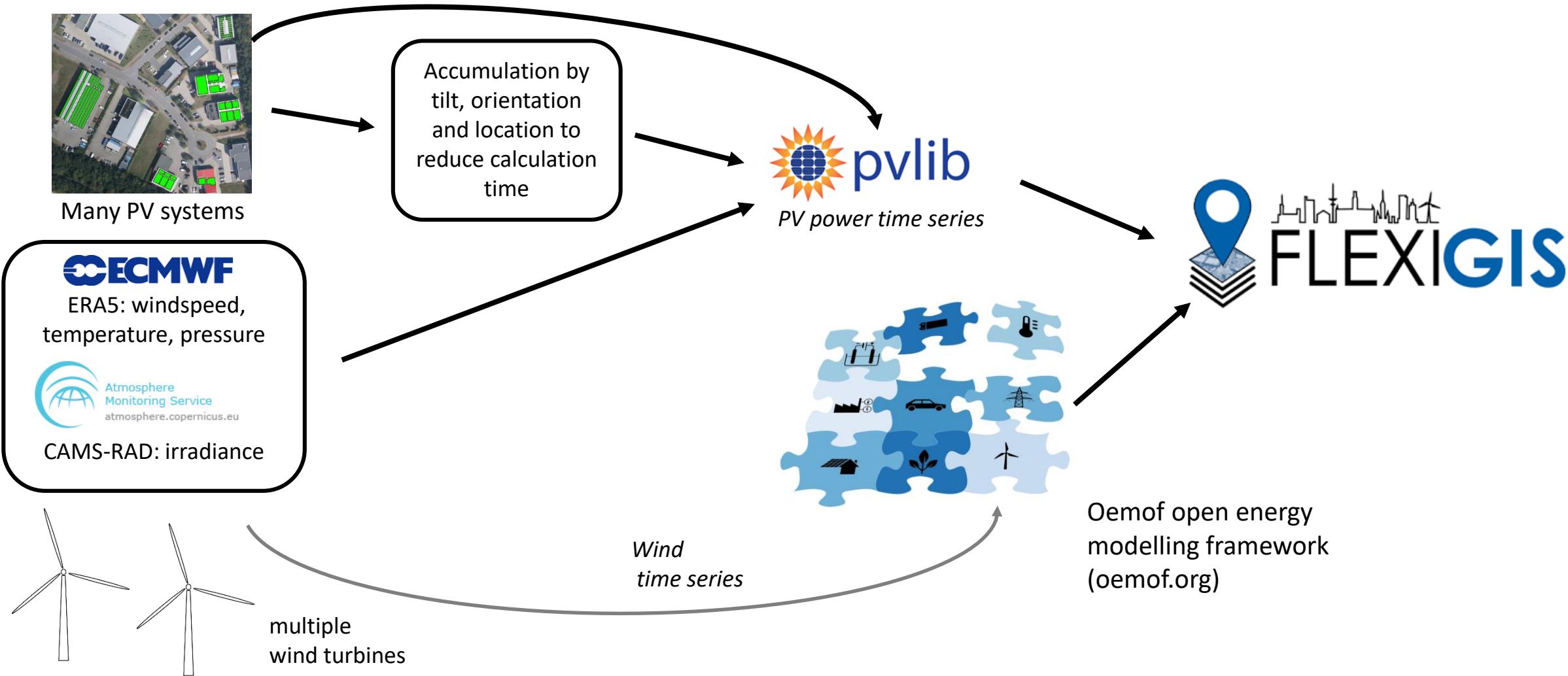


Source: Alhamwi et al., 2017

Previous set up of renewable power feedin module of FlexiGIS

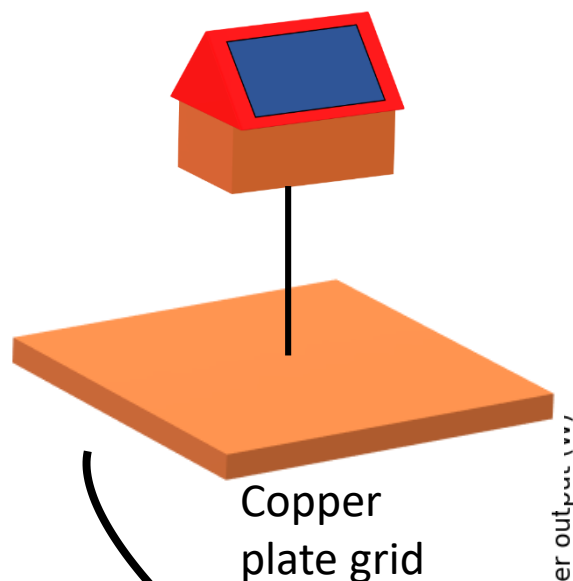


New set up of renewable power feedin module of FlexiGIS

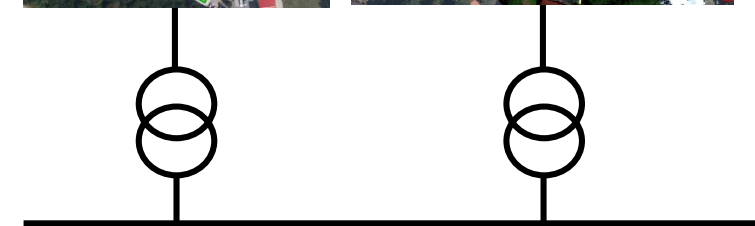
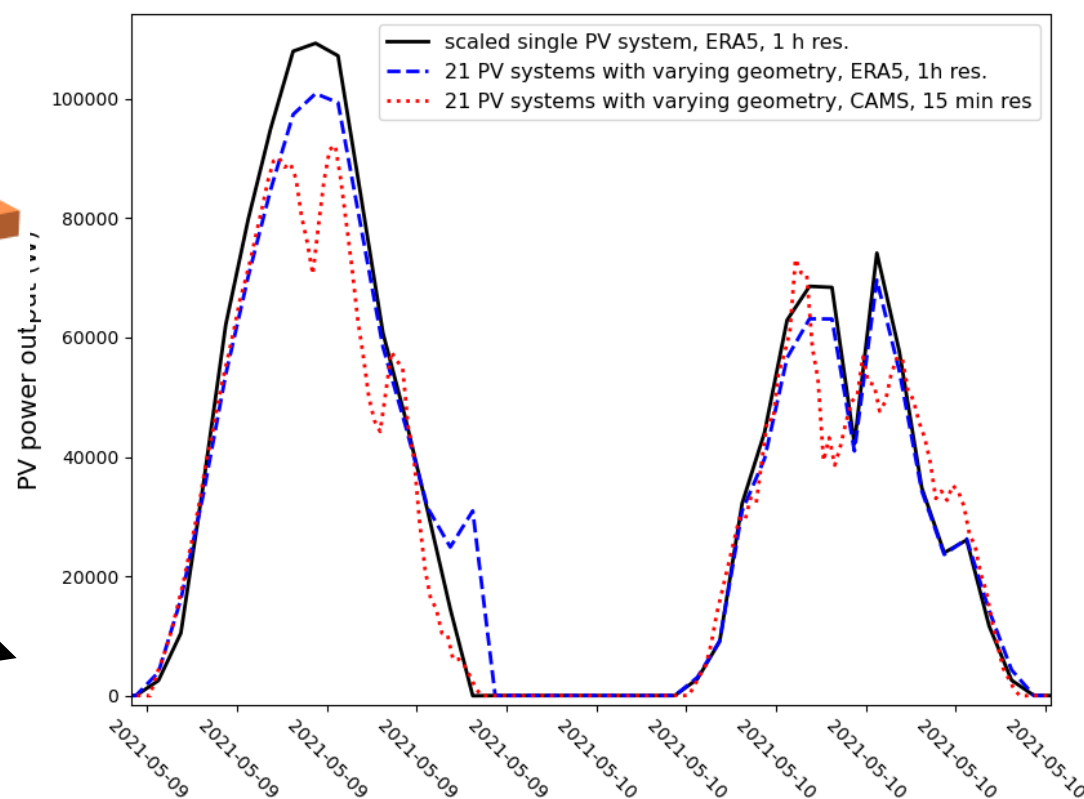


Previous PV model vs new PV model

- Use different geometries and technologies
- Calculate feedin per subgrid
- Use system data from earth observation
- Use a more representative temporal resolution



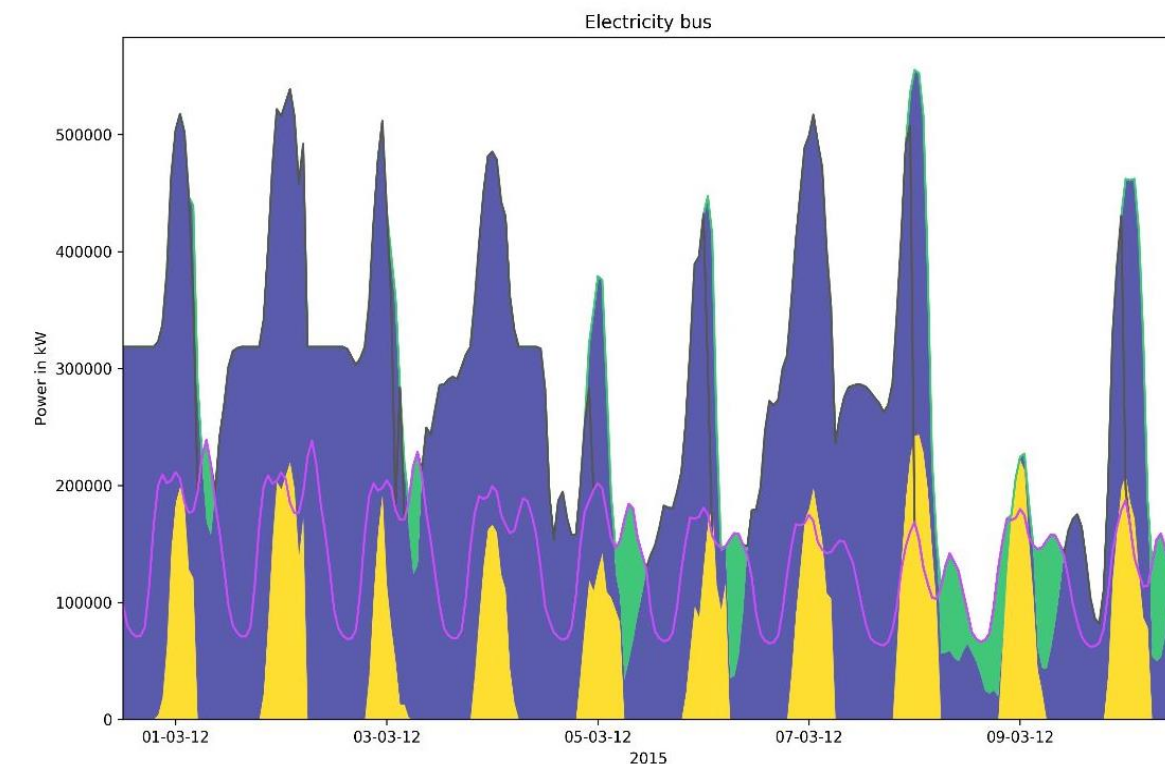
Single scaled system



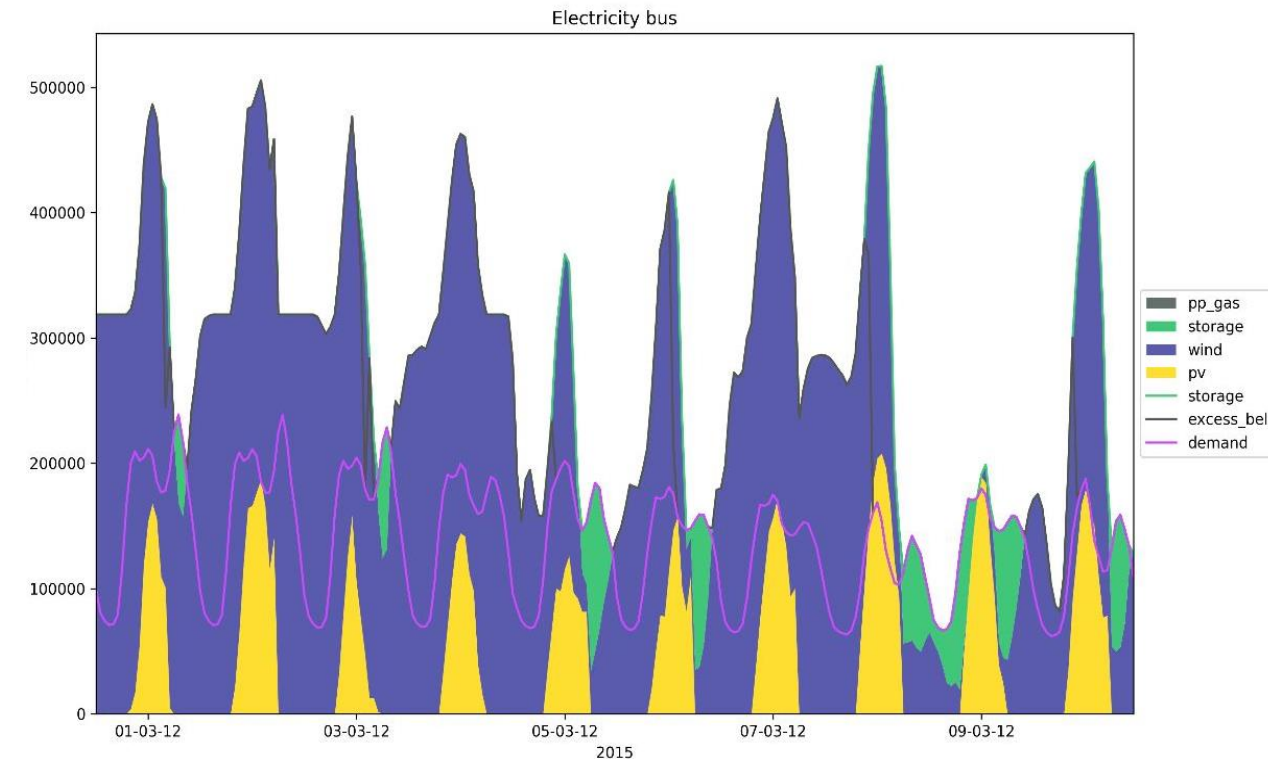
More realistic grid

21 systems with varying geometry

Results for an autonomous scenario for the city of Oldenburg



Modelling of PV system output using one representative system



Modelling of PV system output using 21 systems with varying array geometry

12% higher storage needs when using the more realistic set of PV systems

Summary

FlexiGIS

- supports potential users such as:
network operators, decision-makers in urban planning, industry, aggregators for solar power trading, citizens, operators and researchers
- In planning and evaluation:
 - self-consumption and 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

Earth observation data

- Increases the accuracy and realism of PV loads, and results in more realistic scenarios.

FlexiGIS Download

<https://github.com/FlexiGIS/>

Acknowledgements

This work is part of the E-Shape project supported by the EU EuroGEOS Program.

We wish to thank our colleagues from other DLR instates for carrying out the airborne measurement campaign over Oldenburg and its analysis and providing data and methodology.