SCHOOL

JUMP2Excel
Joint Universal activities for Mediterranean PV integration Excellence

www.JUMP2Excel.eu

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e-shape H2020: enabling tools supporting PV integration by revamping the solar cadaster concept

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2 March 2022

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The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 810809

Programme for today

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- **Urban environments and photovoltaics**
- **Brief intro on solar cadasters**
- **Our work in the e-shape project**

The result from a team effort (alphabetical order):

Benoît Gschwind, Lionel Menard, Philippe Blanc, Raphaël Jolivet, Romain Besseau

MINES ParisTech | PSL

O.I.E.

Centre Observation, Impacts, Énergie
Renewables, Life Cycle Assessment, Earth Observation

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Assumptions for today

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Solar is good, fossils are not

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Urban environments & photovoltaics

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People

Business

Electricity needs

High surface availability

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Urban environments & photovoltaics

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Solar cadasters: a starting point

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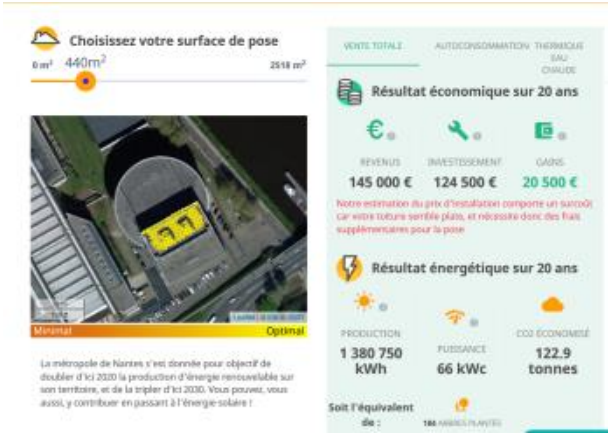
Accurate and easy-to-use to **assess rooftop PV potential at the urban level**



With the support of: IGN, MINES ParisTech, PSL, SoDa solar radiation data

Partial screenshots from In Sun We Trust website, https://nantes-metropole.insunwetrust.solar/simulateur

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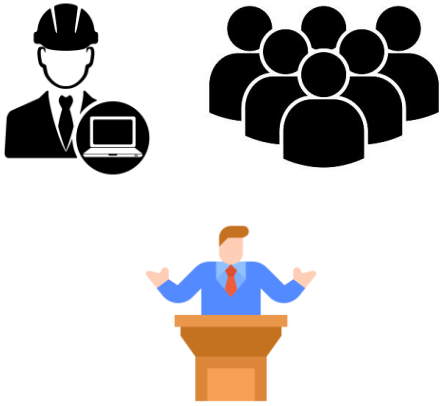

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Solar: more dynamic than “typical annual values”

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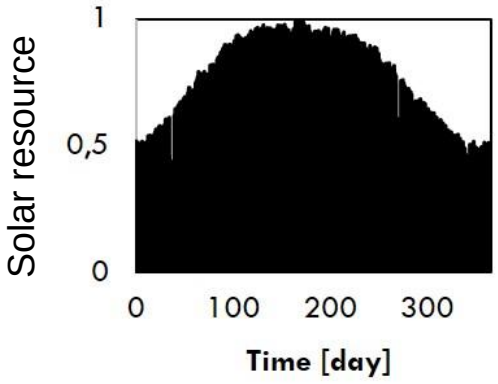
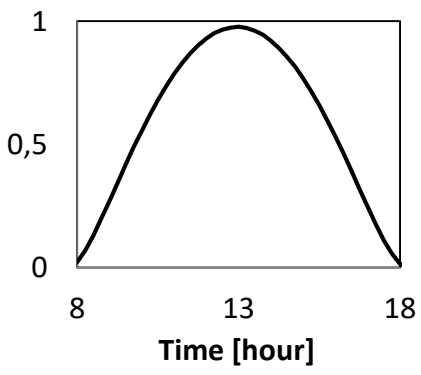
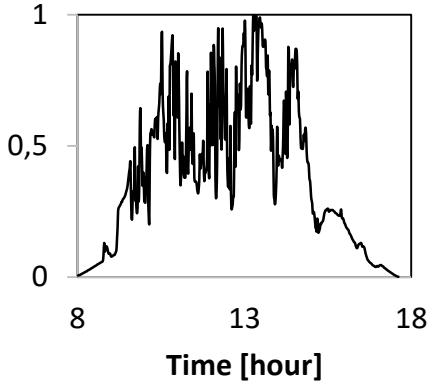
- Different levels of variability and uncertainty at different time scales







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Solar: more dynamic than “typical annual values”

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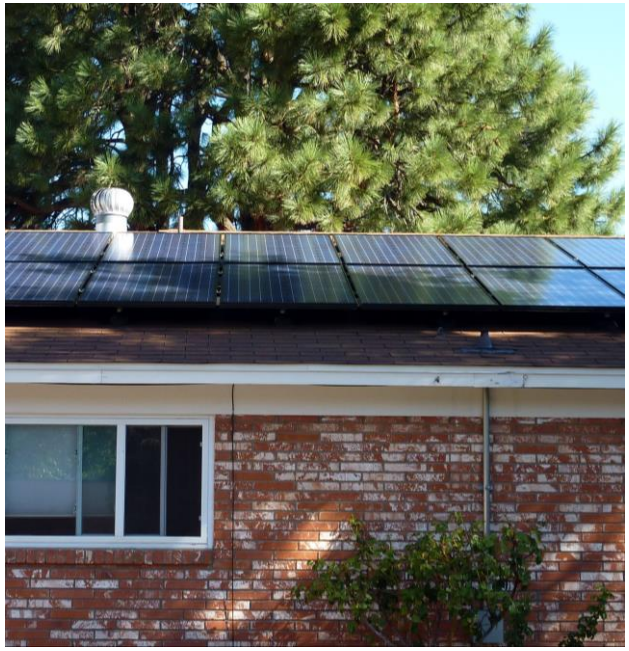
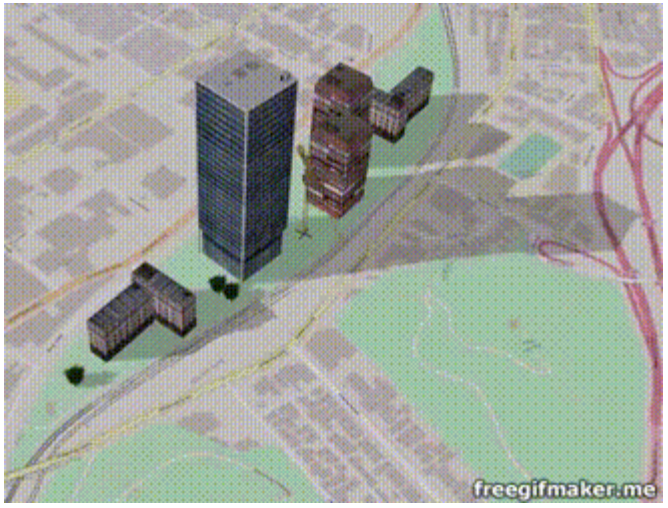
- Obstruction shadowing as an additional element for urban PV





Source: YouTube video from ArcGIS

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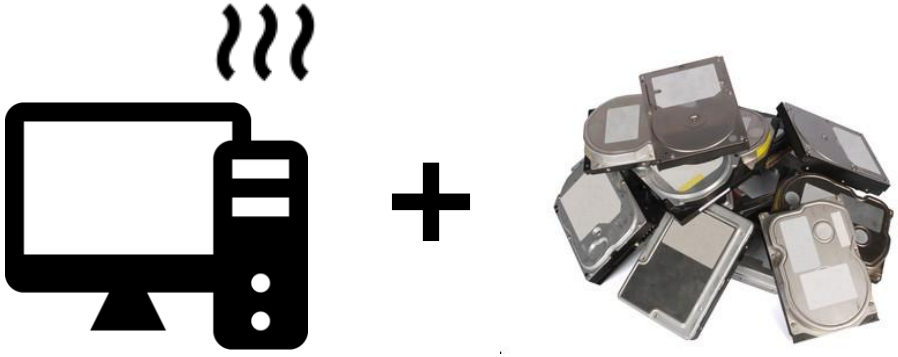
The issue with solar cadasters



Heavy computations!

Too much data!

COMPROMISE

- smaller regions of interest
- store only aggregate values

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The e-shape project

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e-shape
EuroGEO Showcases: Applications Powered by Europe

https://e-shape.eu/

4 years grant (2019-2023)

60 partners, 7 showcases

renewable energy

Promoting **users' uptake** of European Earth Observation resources

Development of **co-design pilots** (**33!**) to deliver **economic**, **social** and **policy value** to European citizens

EuroGEO GEO GROUP ON EARTH OBSERVATIONS Copernicus

The e-shape project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 820852

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Pilot #2: High PV penetration in urban areas

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Objective:

develop GIS-like tools to support **high PV penetration** at urban scale by providing **EO-based information**

Expected user community:

Urban planners, grid operators, market agents, researchers and citizens

There are two parts of the pilot

ARMINES is responsible for the part shown in this presentation

- **Partners:**

ARMINES, MINES ParisTech, PSL, TRANSVALOR, SoDa Solar radiation Data, DLR

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Our core value proposition

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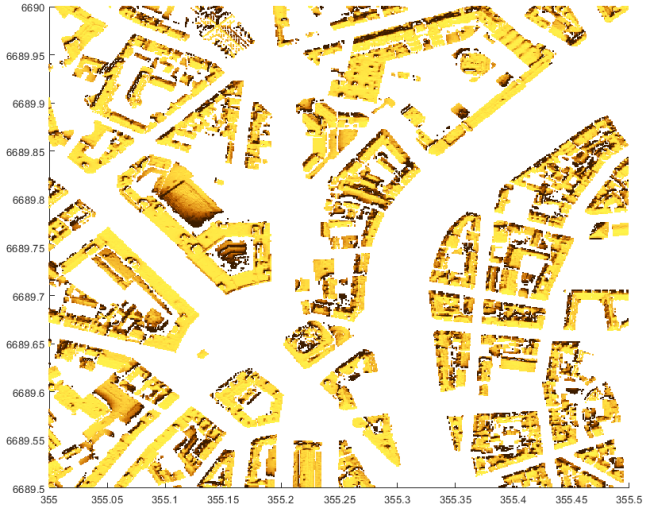
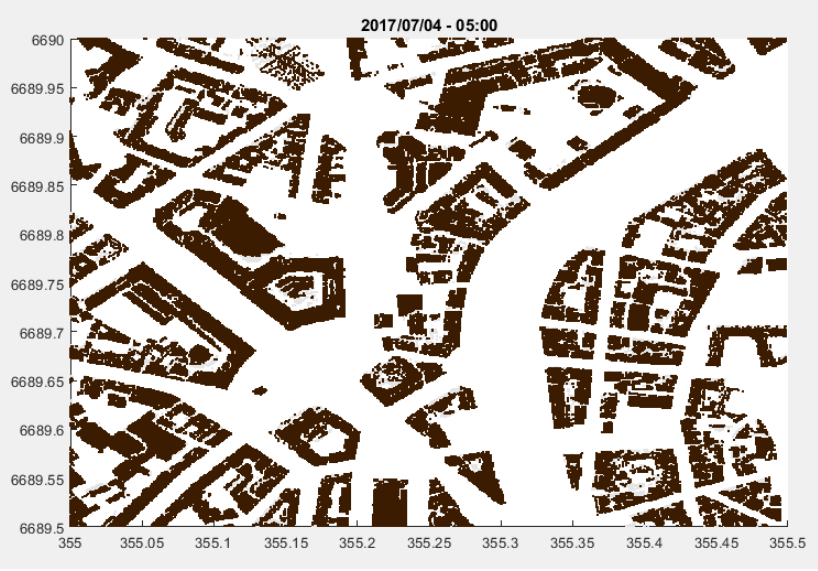
Shifting from a static solar cadaster to urban-scale solar variability



Traditional “static” solar cadaster



“Dynamic” solar cadaster

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Our core value proposition

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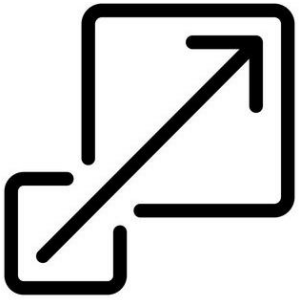
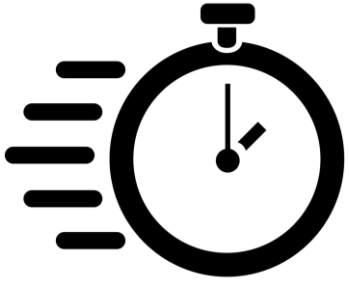
Solar calculations in urban environments based on Earth Observation data

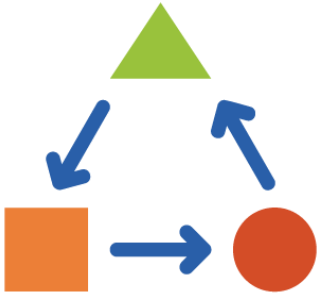
Cloud-based



Scalable



ON-demand the-fly



Interoperable

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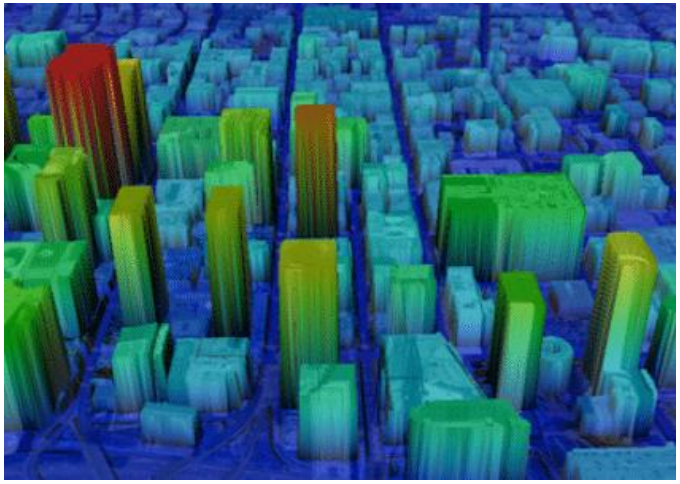
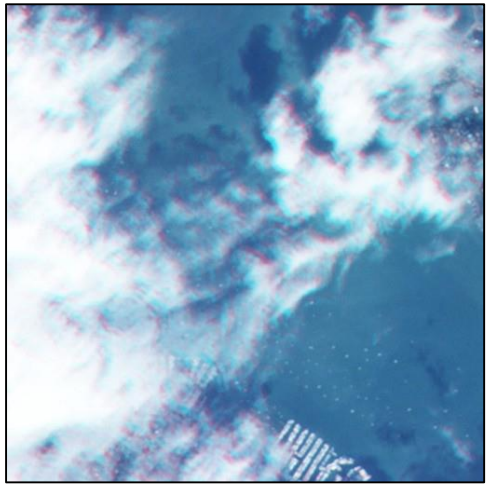
Exploring a variety of Earth Observation data



Digital Surface Model (DSM)



Satellite data

Ground measurements (when available)

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Leveraged use cases

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#1 PV sizing for self-consumption

IN SUN WE TRUST

#2 PV injection at distribution grid level

ENEDIS

#3 Forecasting for PV trading

Copérnico

#4 Shadowing impacts of new buildings

LISBOA e·nova
AGÊNCIA DE ENERGIA E AMBIENTE DE LISBOA

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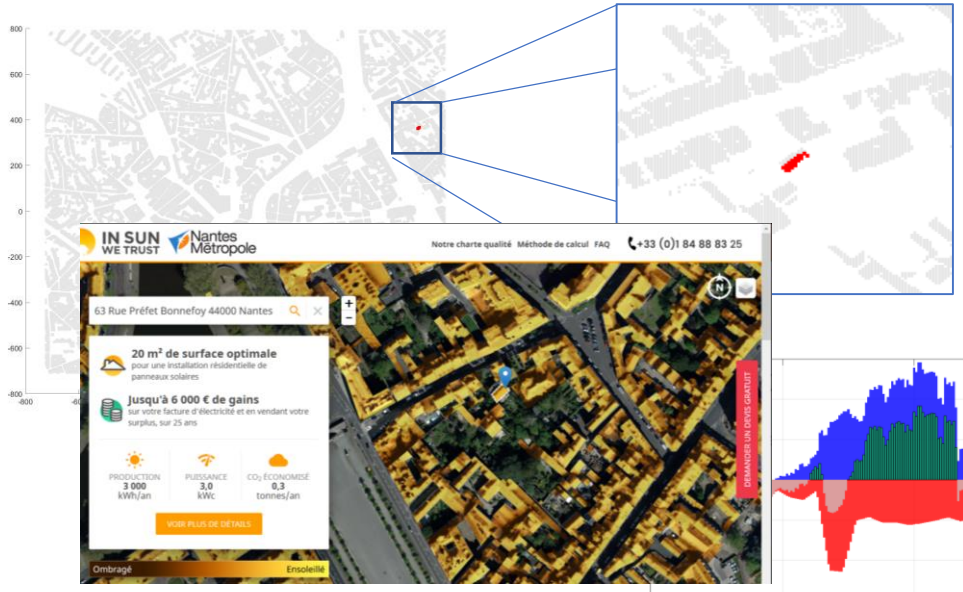
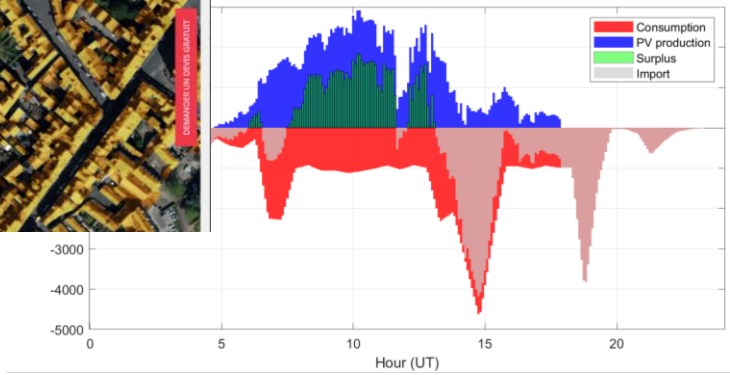
PV sizing for self-consumption

IN SUN WE TRUST



1-h electric consumption from the customers

Linky



Total consumption: 26.5 kWh

Total PV production: 16.7 kWh

Total used PV production: 4.8 kWh

Self-consumption ratio: 28.6%

Self-sufficiency ratio: 18.0%

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Leveraged use cases

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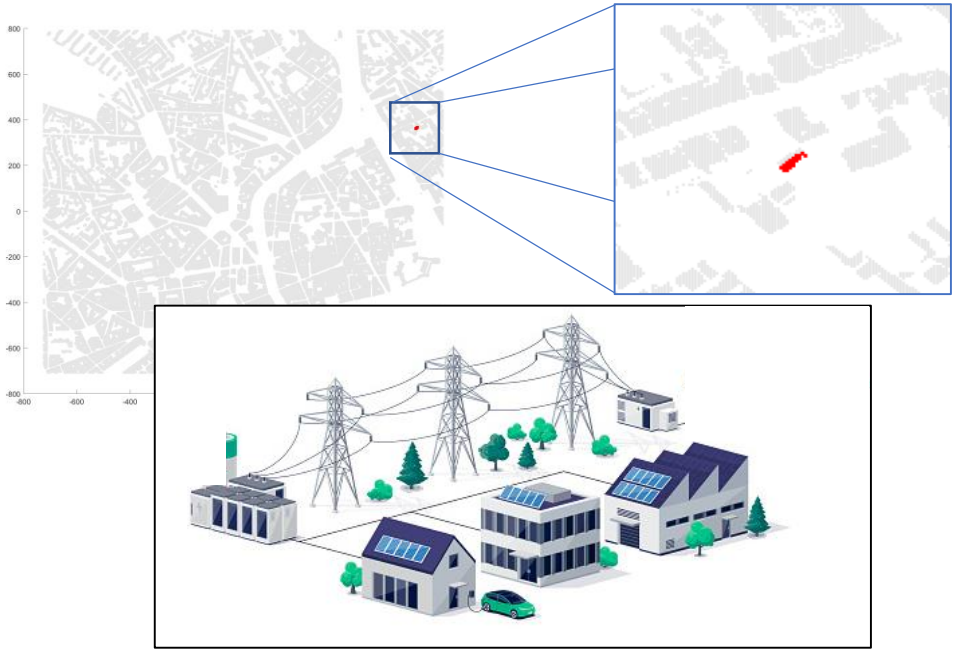
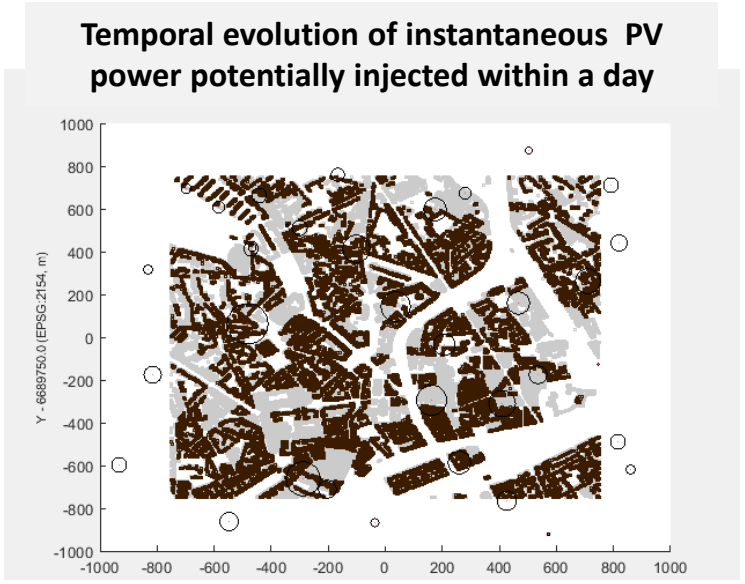
PV injection at distribution grid level





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Leveraged use cases

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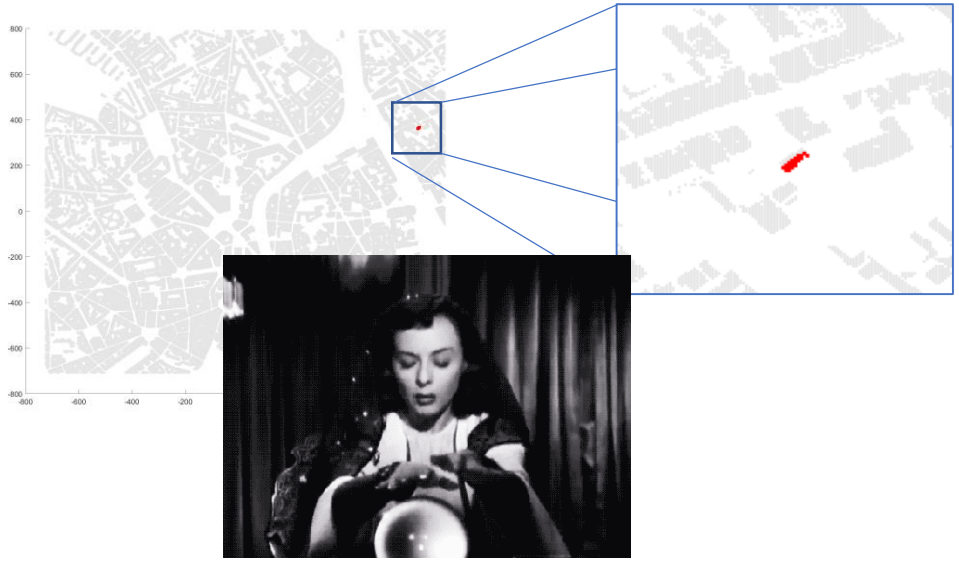
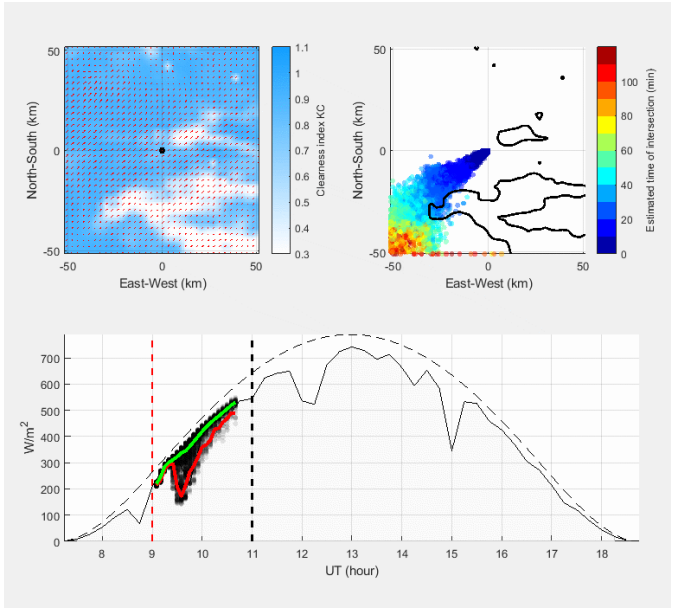
Forecasting for PV trading

Coopérnico



Forecasting algorithm



Carrière et al., Energies (2021)
A New Approach for Satellite-Based Probabilistic Solar Forecasting with Cloud Motion Vectors

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A quick look to one of our tools

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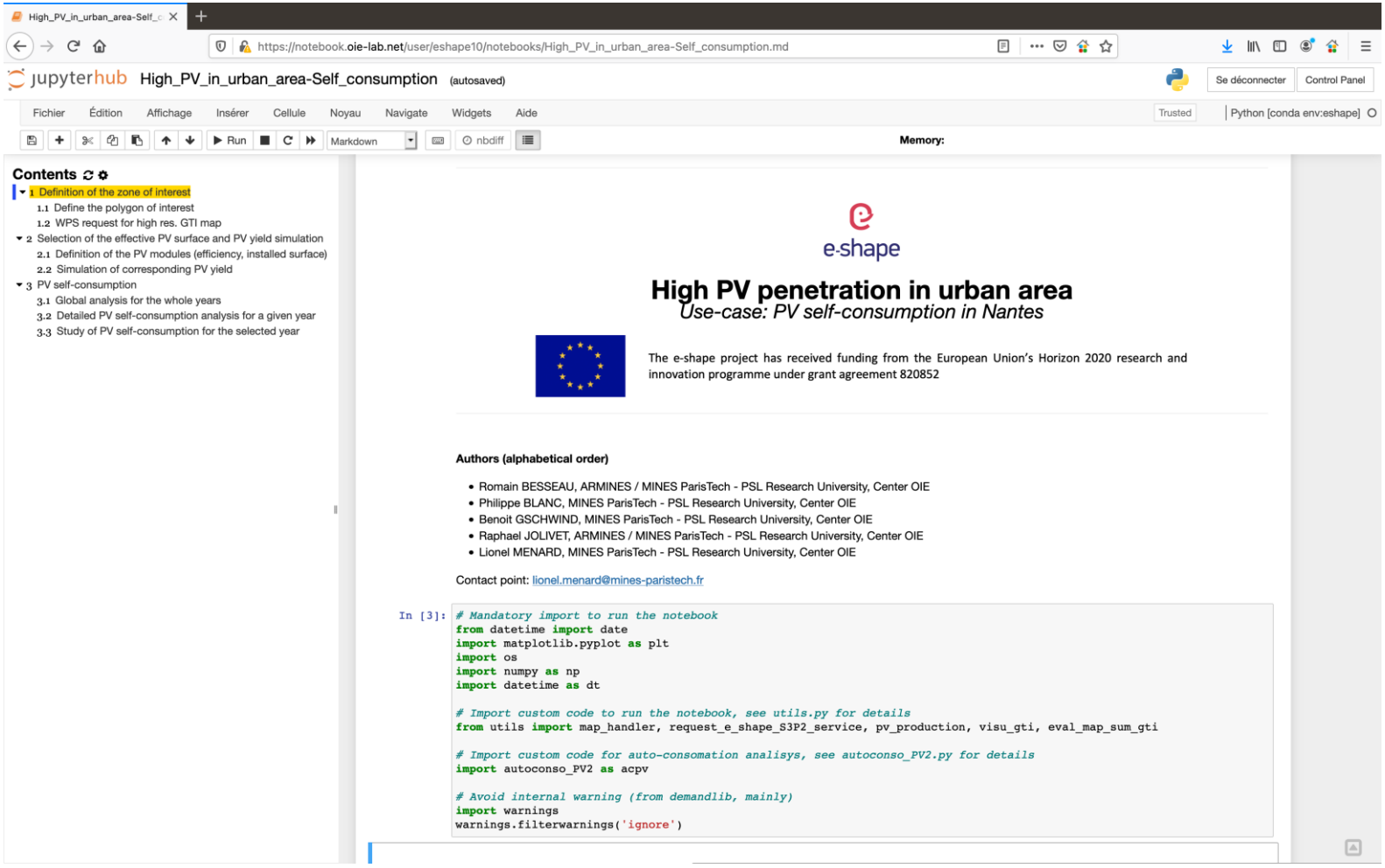

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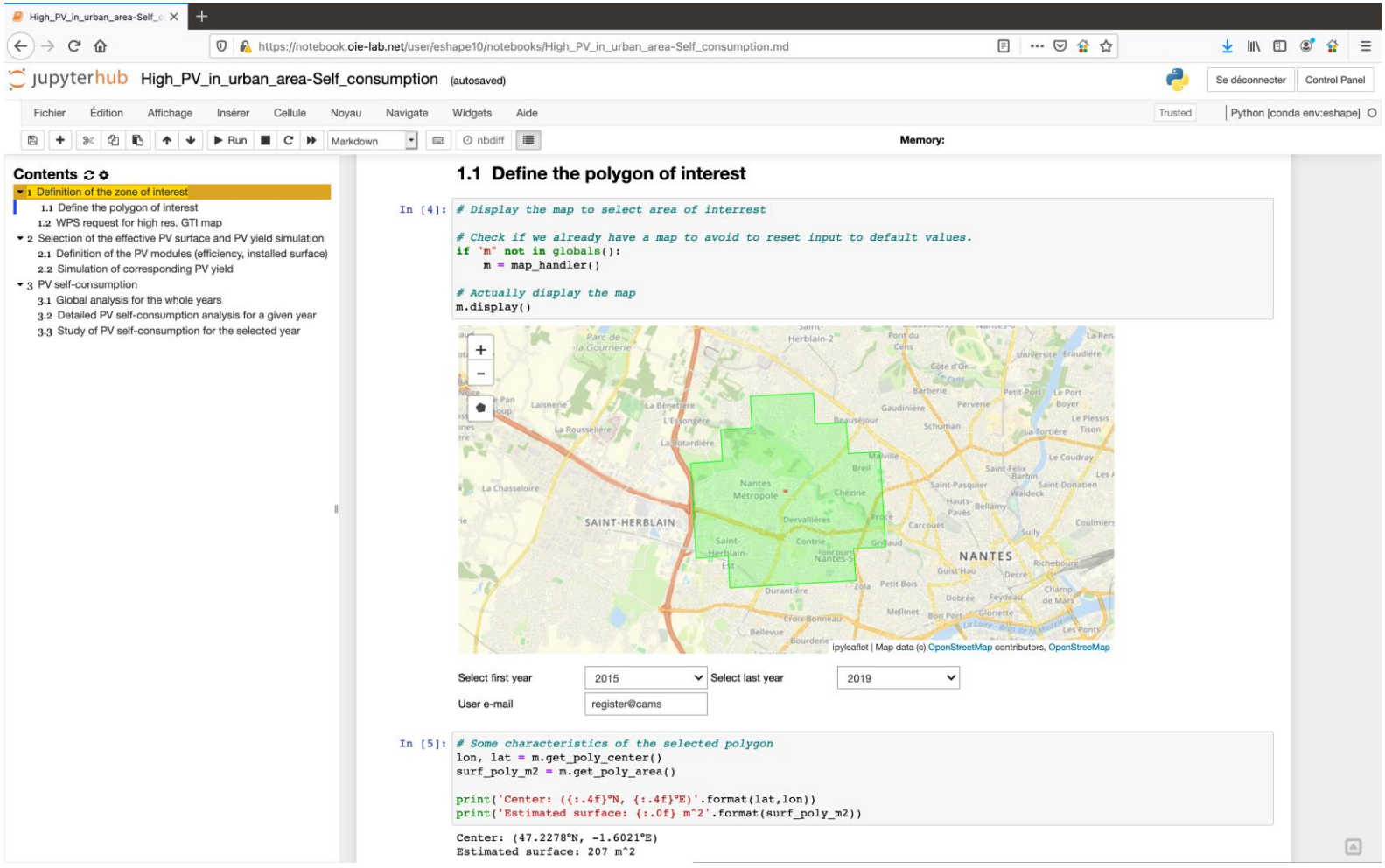

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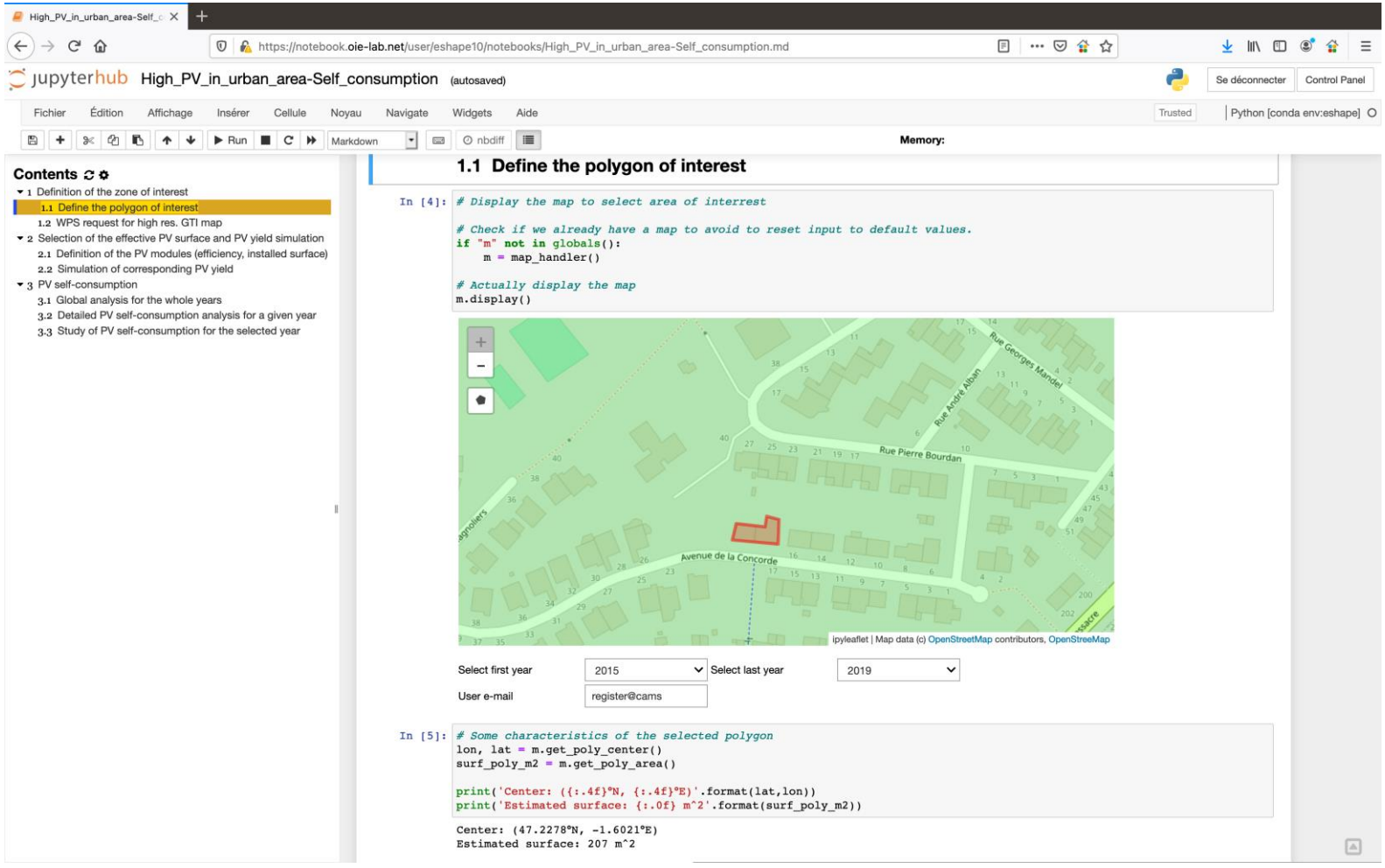

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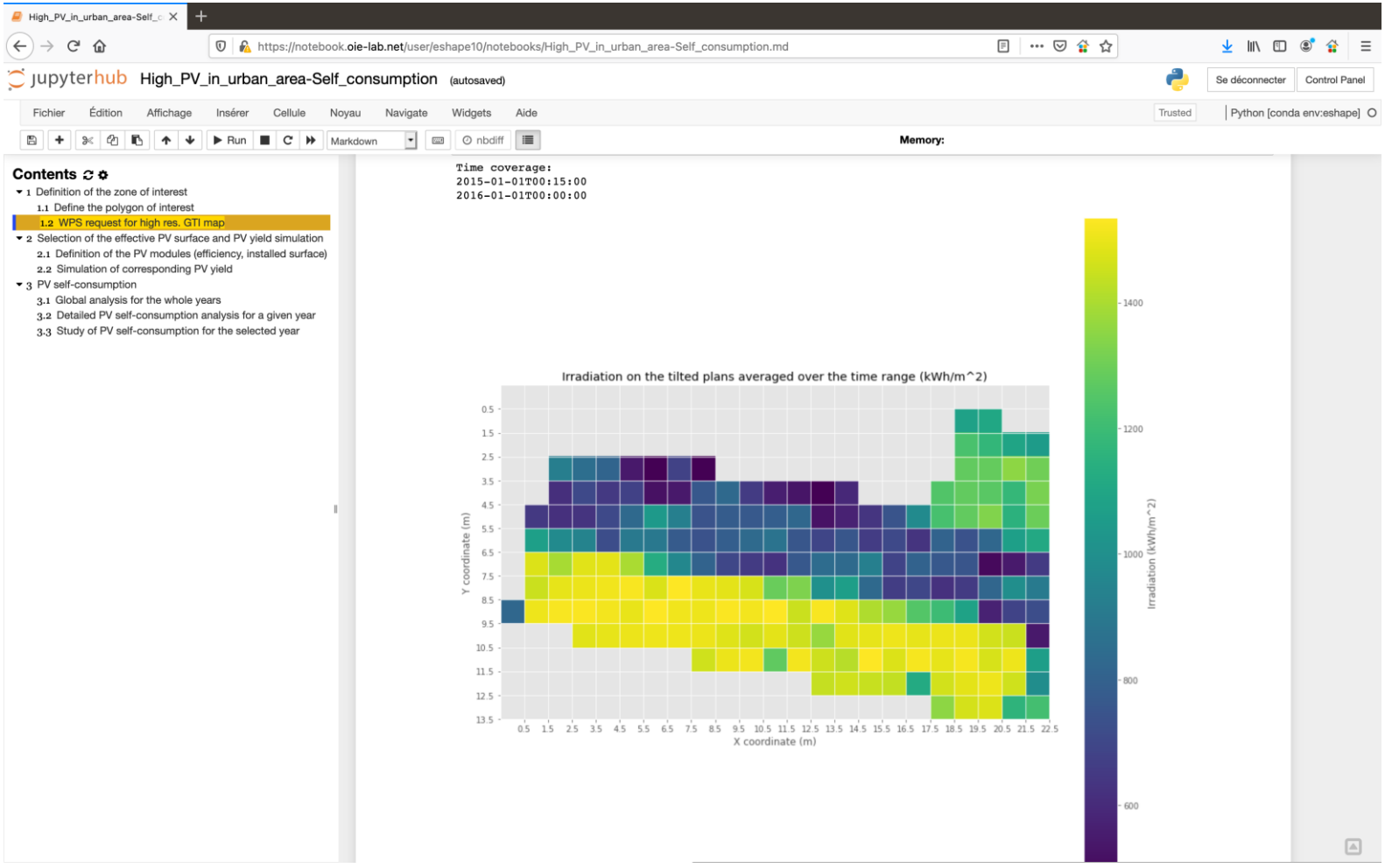

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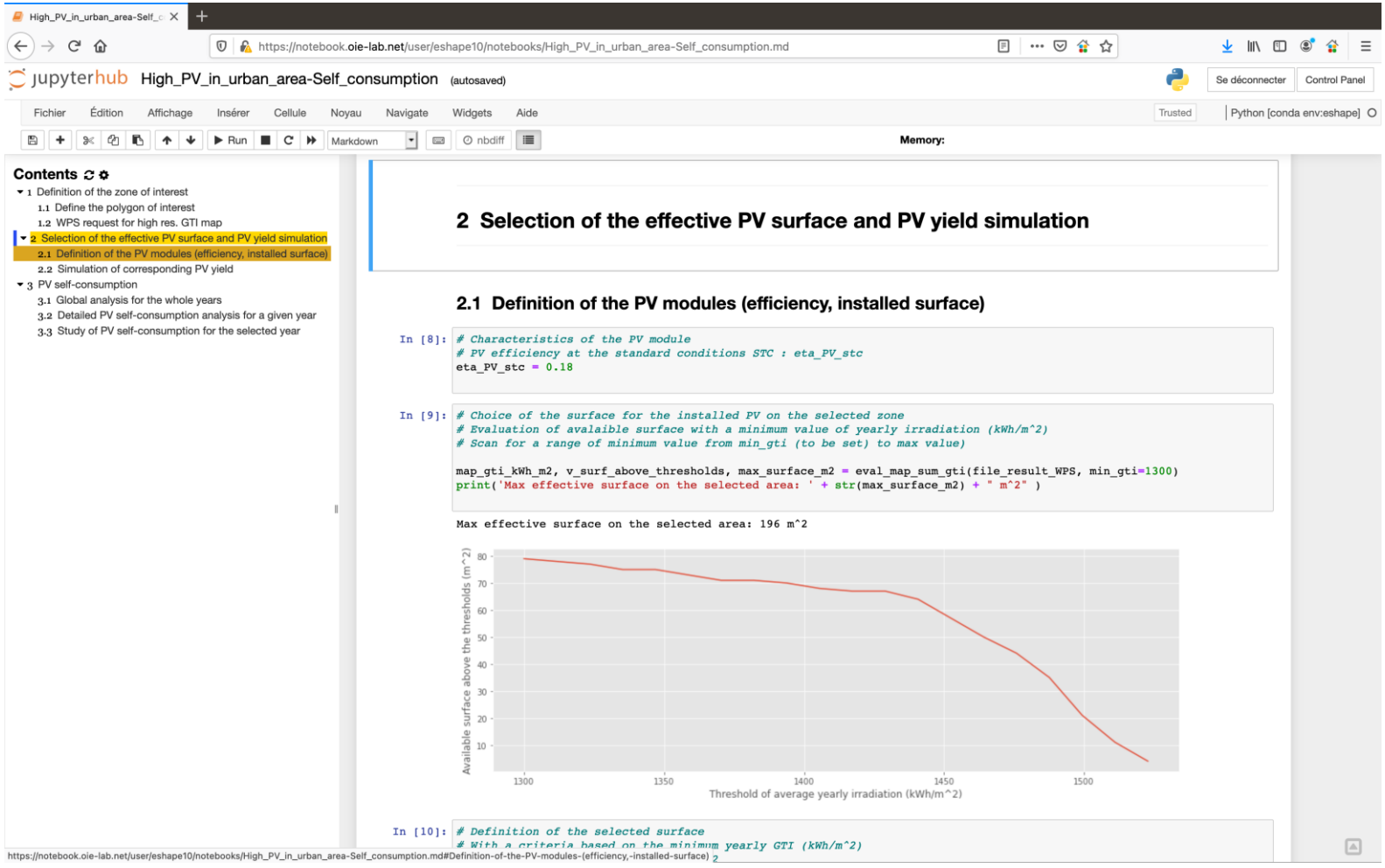

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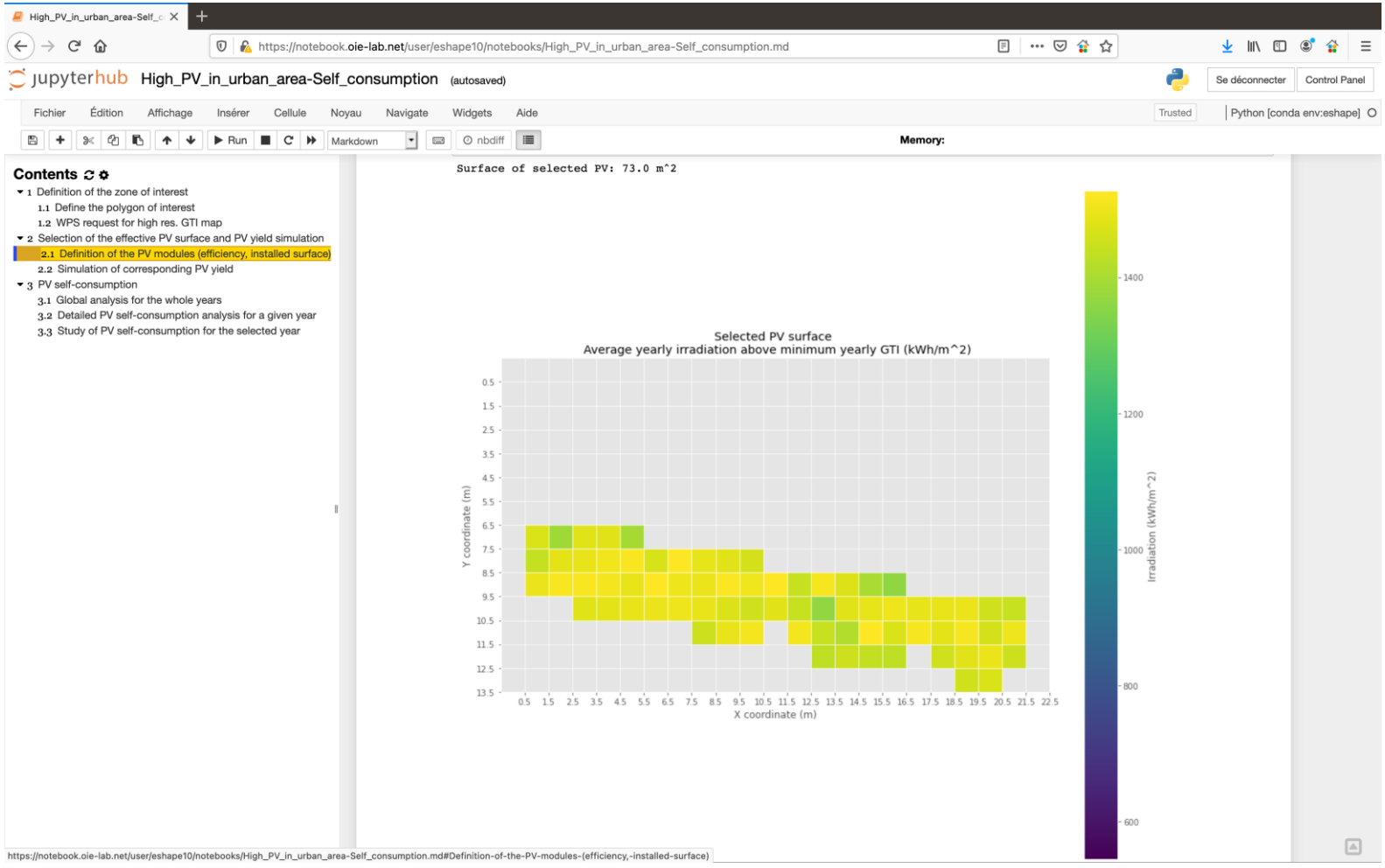

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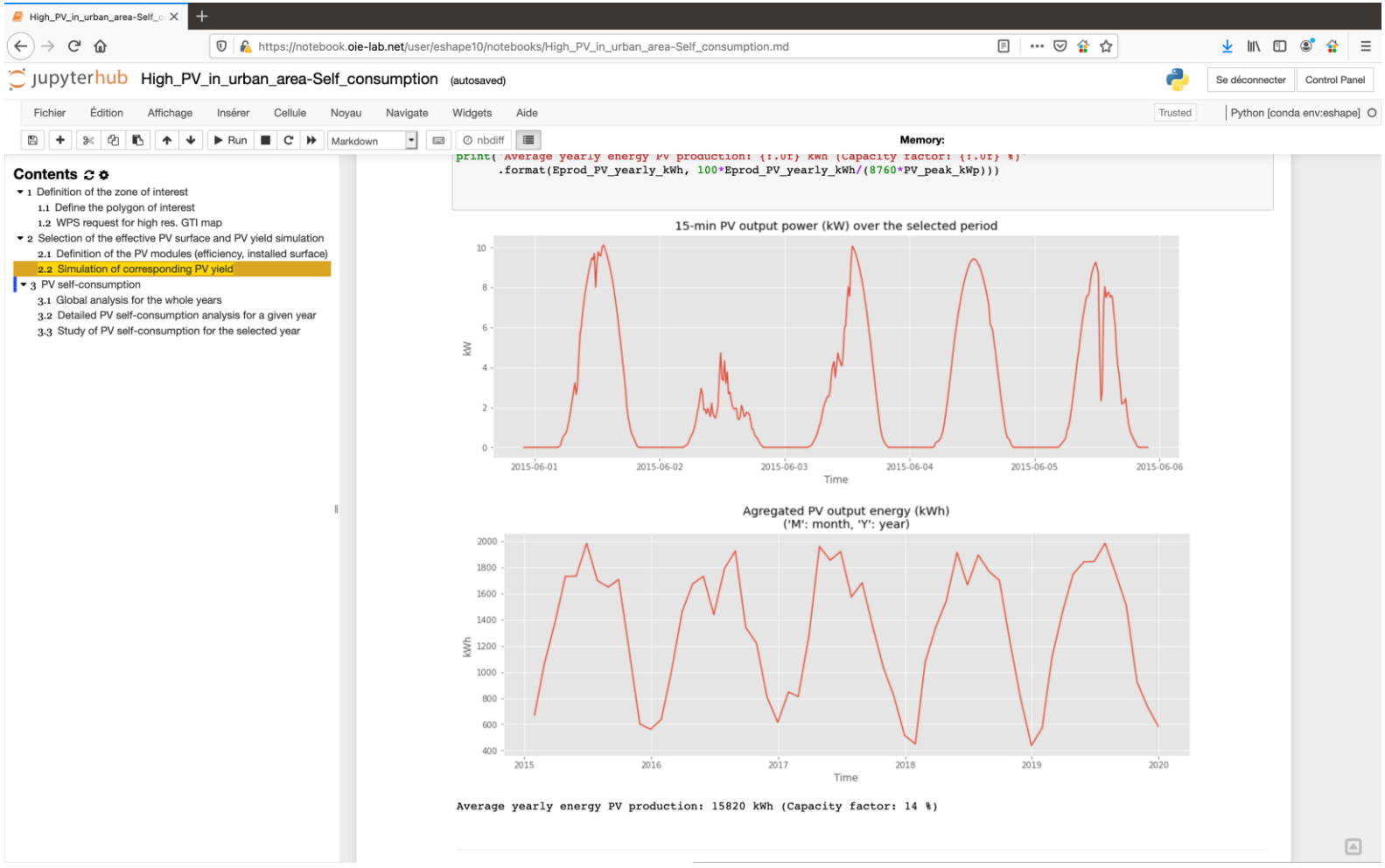

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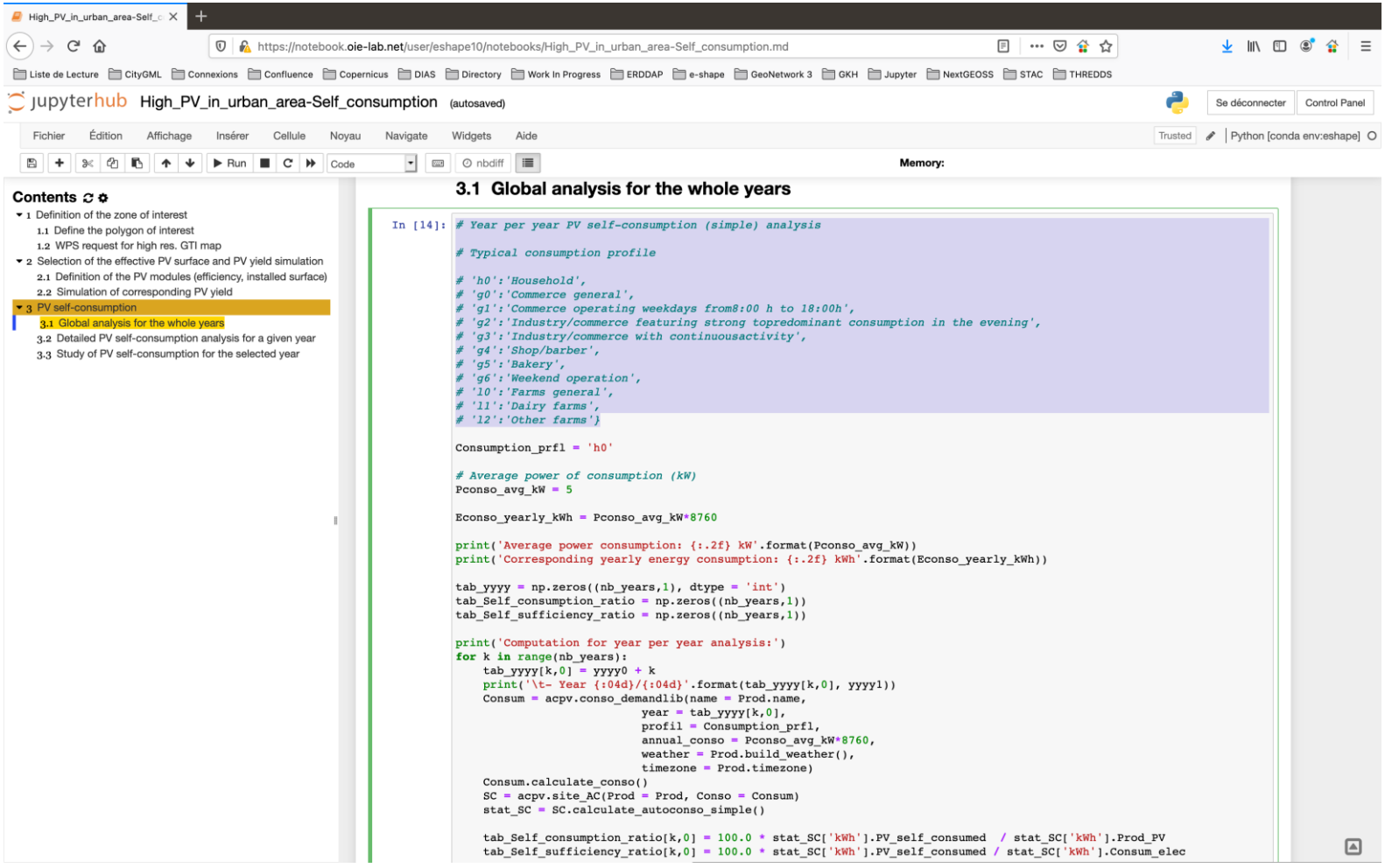

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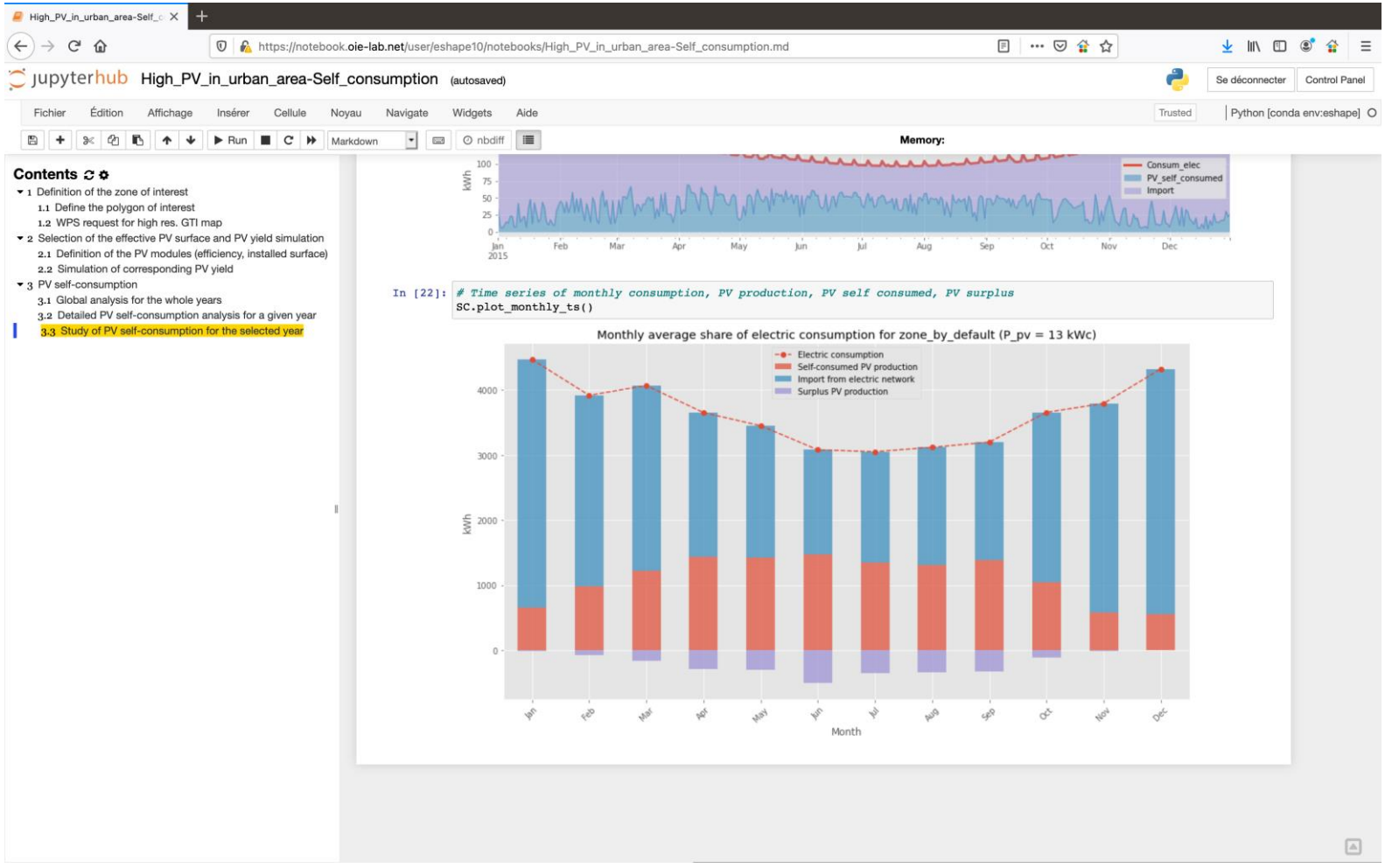

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Which can be available for you to try out

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- A **demonstration** can be found in **Youtube:** https://www.youtube.com/watch?v=Sj9eMoLFi0g

- **To get an account to test the pilot:** send me an e-mail rodrigo.amaro_e_silva@mines-paristech.fr

- As a **follow-up:**
  - we will send instructions together with a short feedback survey (4 questions!),
  - You will have access to a temporary access to test the tool and can apply any modification you want

- It is **possible** that we can schedule a **time slot for providing some live support** with the tool

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Closing words

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- **PV modelling in urban environments is a very rich topic**
- **Firm belief that on-the-fly dynamic solar cadasters can leverage multiple services**

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Stimulating scientific excellence and innovation capacity of MCAST Energy in the field of Photovoltaic (PV) integration research, as a regional leader.

www.JUMP2Excel.eu

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EXTRA SLIDES

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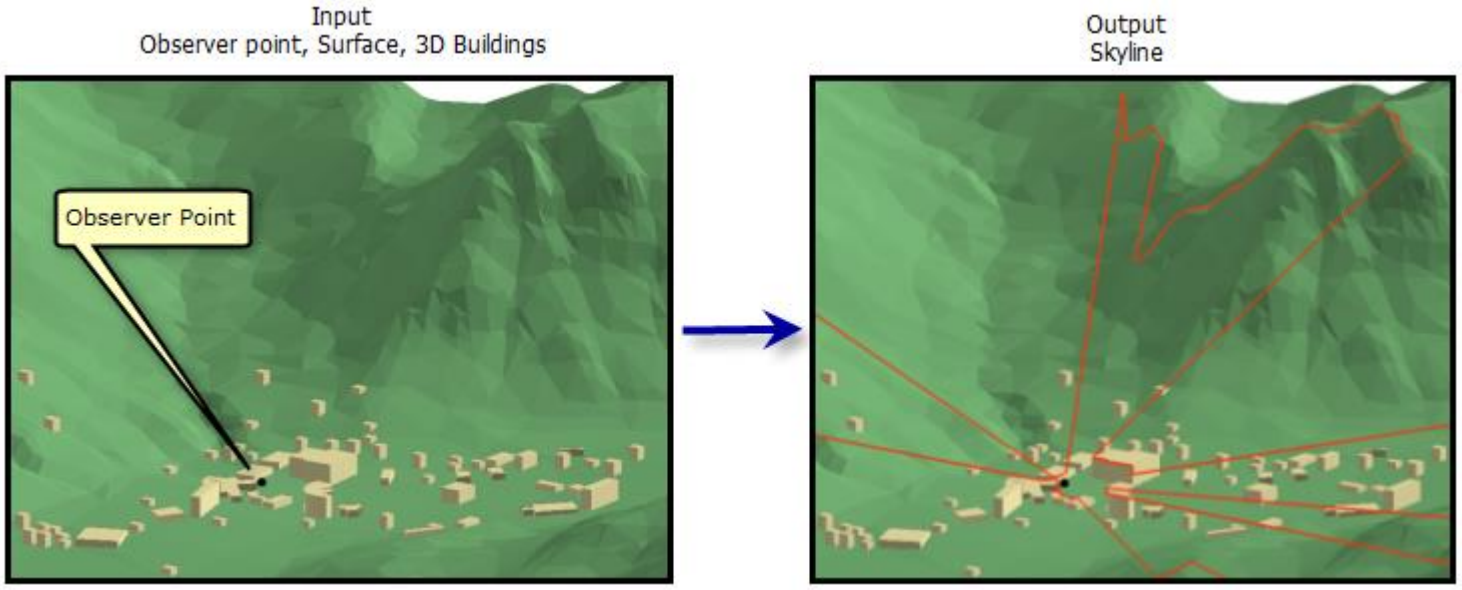
Brief description of shadow modelling



Mapping the horizon around each pixel
(both from terrain and urban orography)

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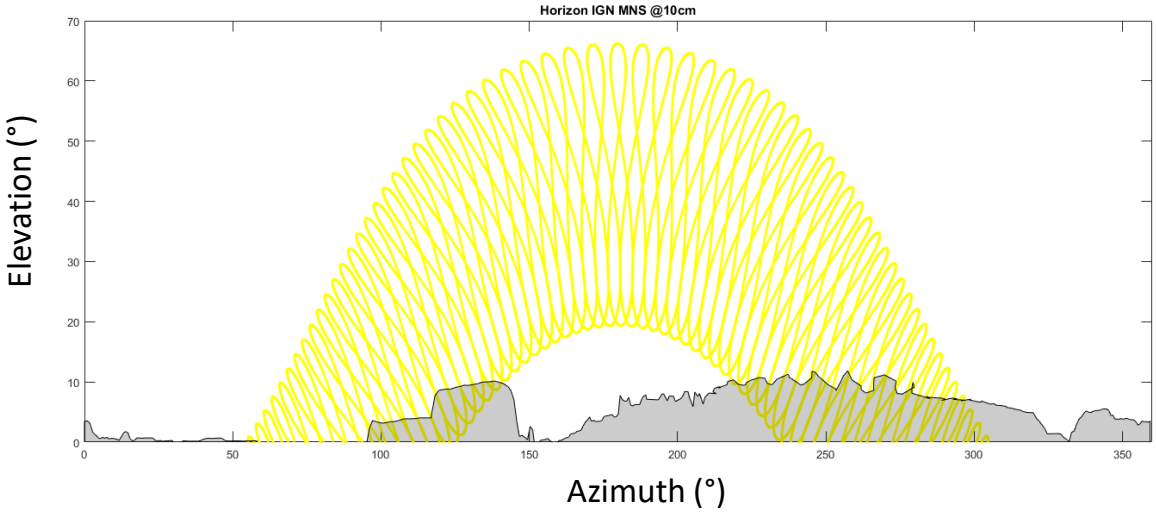
Brief description of shadow modelling



360º horizon profile superimposed with sun trajectory
(defining shadow events and shadow impacts)

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The IT setup behind the pilot

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Infrastructure

Data and Information Access Services (DIAS)
“The data infra-structure”

Web Processing Services (WPS)
“The external data fetcher”

Online Jupyter Notebooks
“The front-end”

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The data behind the pilot

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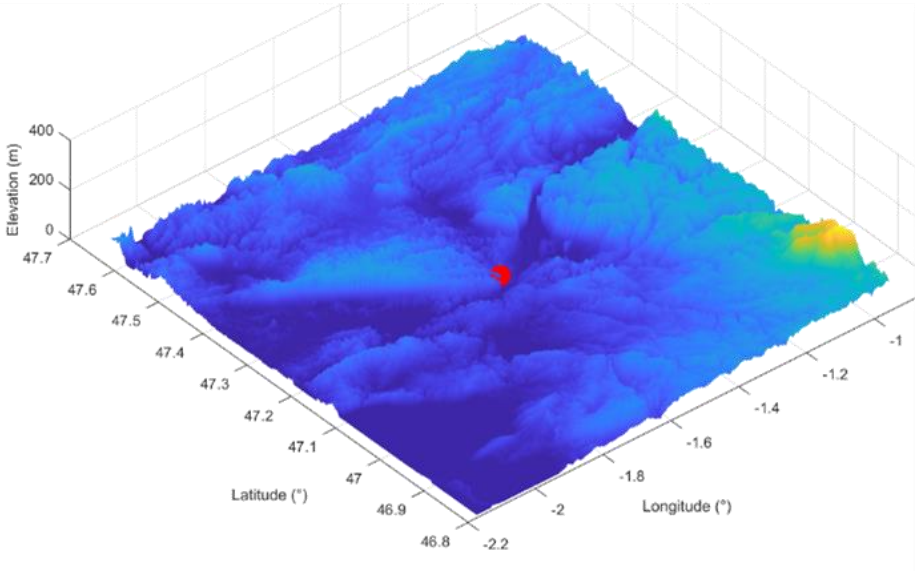
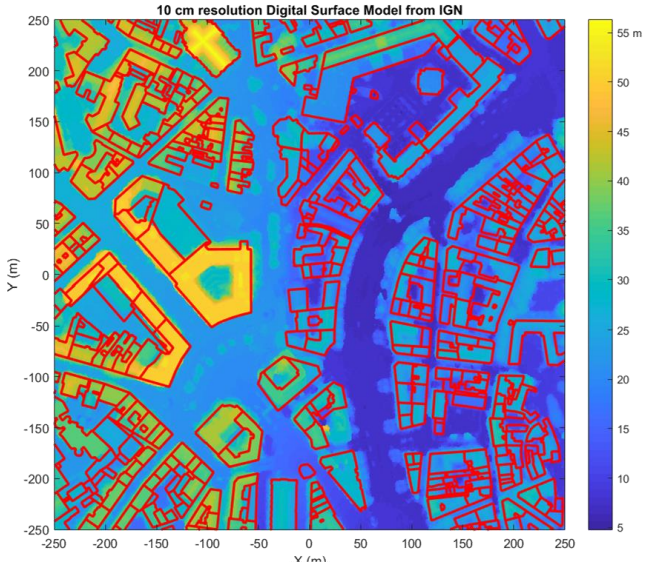
Urban surface modelling



Digital Terrain model (DTM)
decametric
(e.g. SRTM, ASTER)



Digital Surface Model (DSM) + map of buildings
high-resolution
(IGN - BDTOPO©)

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 810809

The data behind the pilot

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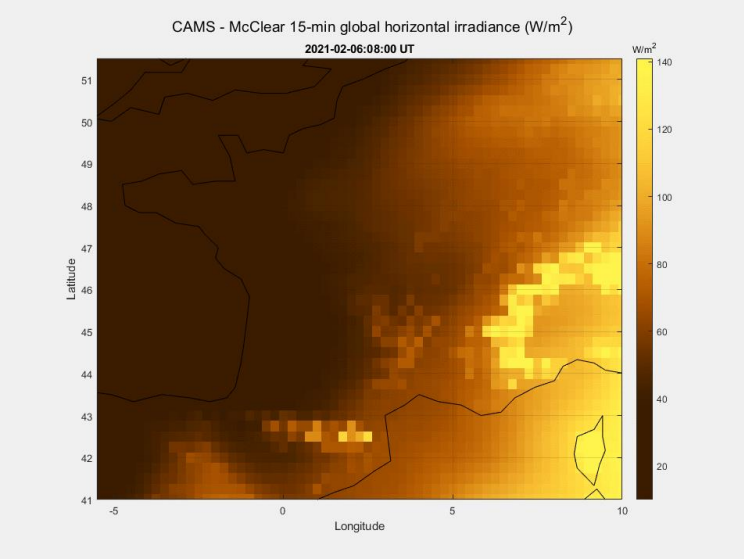
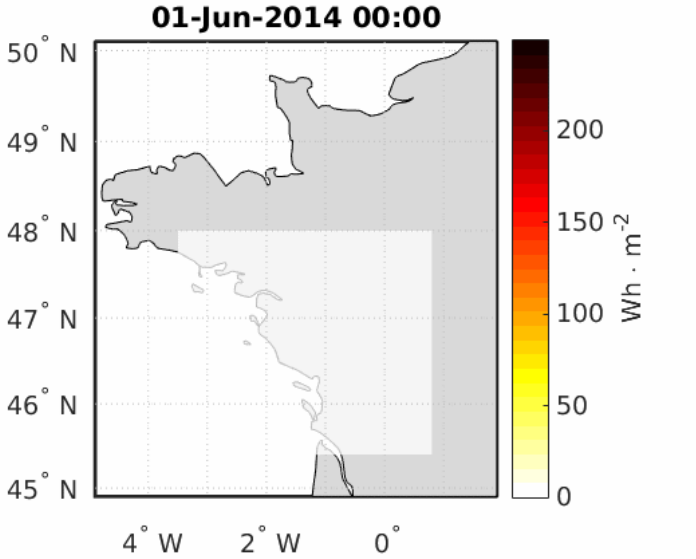
Joint Universal activities for Mediterranean PV integration Excellence

Satellite-based solar resource





Clear-sky irradiance
aerosols, water vapour
McClear (CAMS)

All-sky irradiance
clouds
CAMS-Rad / HelioClim3

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The algorithms behind the pilot

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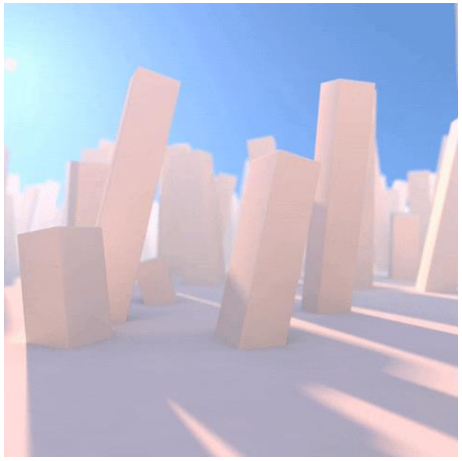

Shadowing

PV conversion

Forecasting

MCAST
MANCHESTER 1824 The University of Manchester
CENER ADItech
cea

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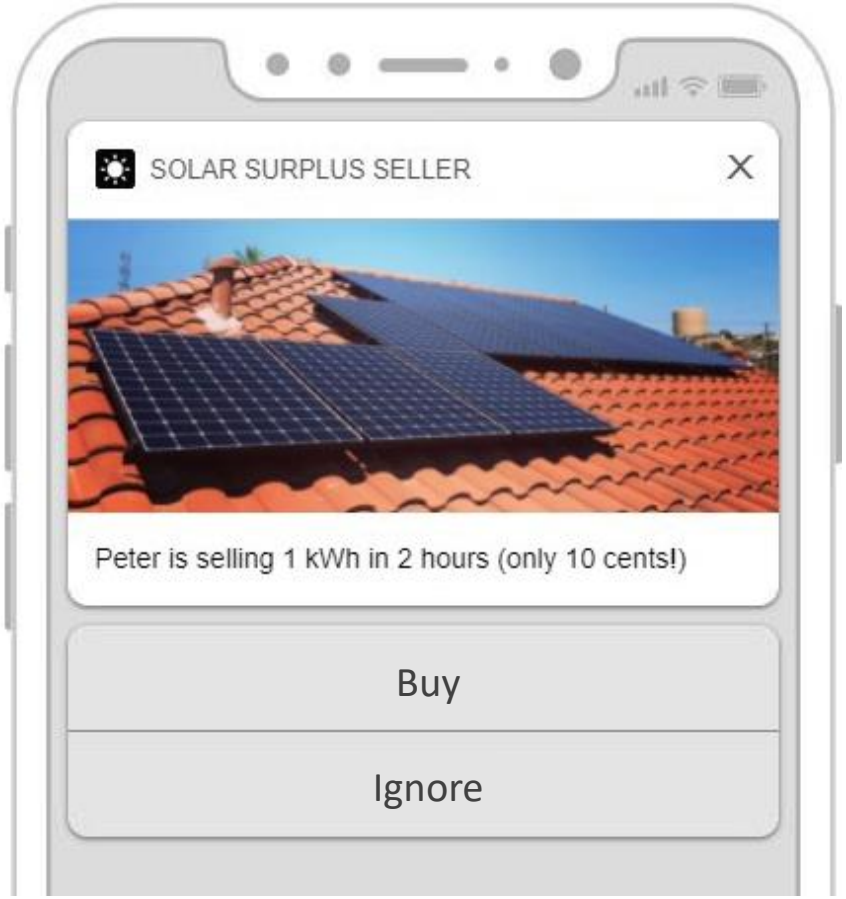
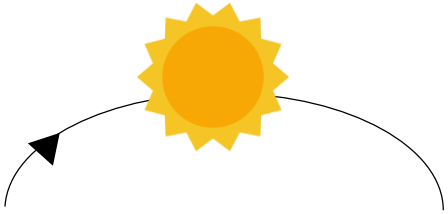
Why forecast for PV trading



Quantity
(1 kWh)

Horizon
(in 2 hours)

We will need to forecast the solar generation



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Impact of disregarding urban shadowing

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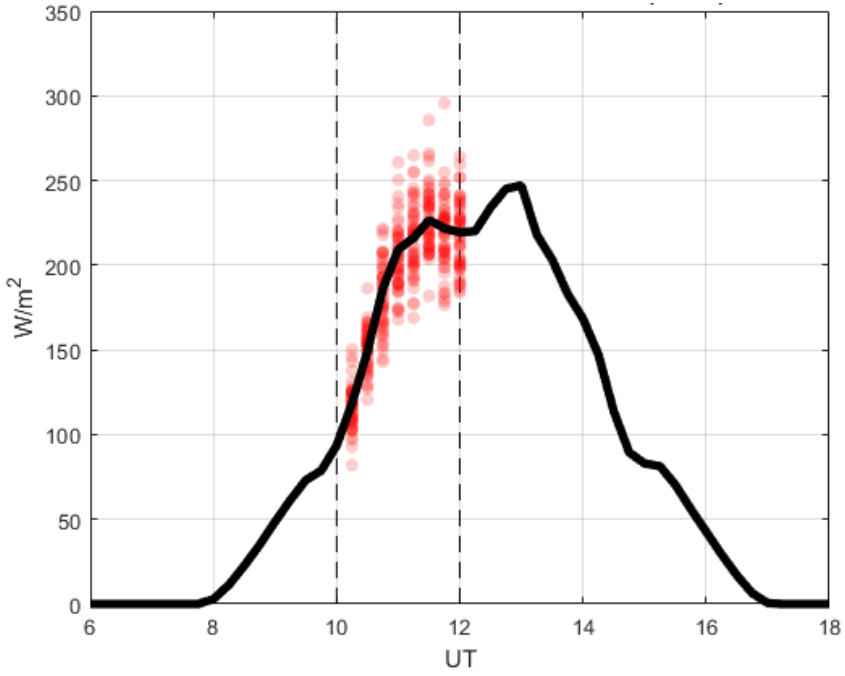

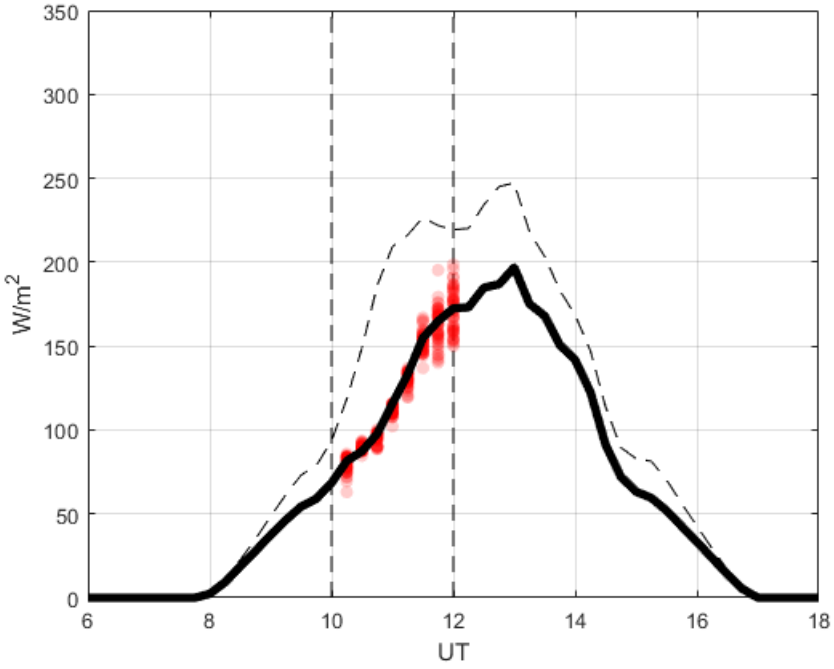

Left to right, the impacting of considering urban shadowing

dark line: satellite estimate, red dots: forecasting

We could overestimate our generation by 10-100% !

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