Assess the performance of your ATES system at a glance

Webinar Brains 4 Buildings
16-06-2022
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Background

About the project

This presentation follows from a project we did for the Netherlands Enterprise Agency (RVO).

RVO was looking for a simple method to assess the performance of Aquifer Thermal Energy Storage systems (ATES systems).

We developed a simple and uniform data analysis to make this assessment. The method and underlying script are free accessible and ready to use.

The project was executed in a collaboration, by Renor and Halmos Adviseurs (Ed Rooijakkers).

The authors

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Renor

Ed Rooijakkers
Halmos Adviseurs

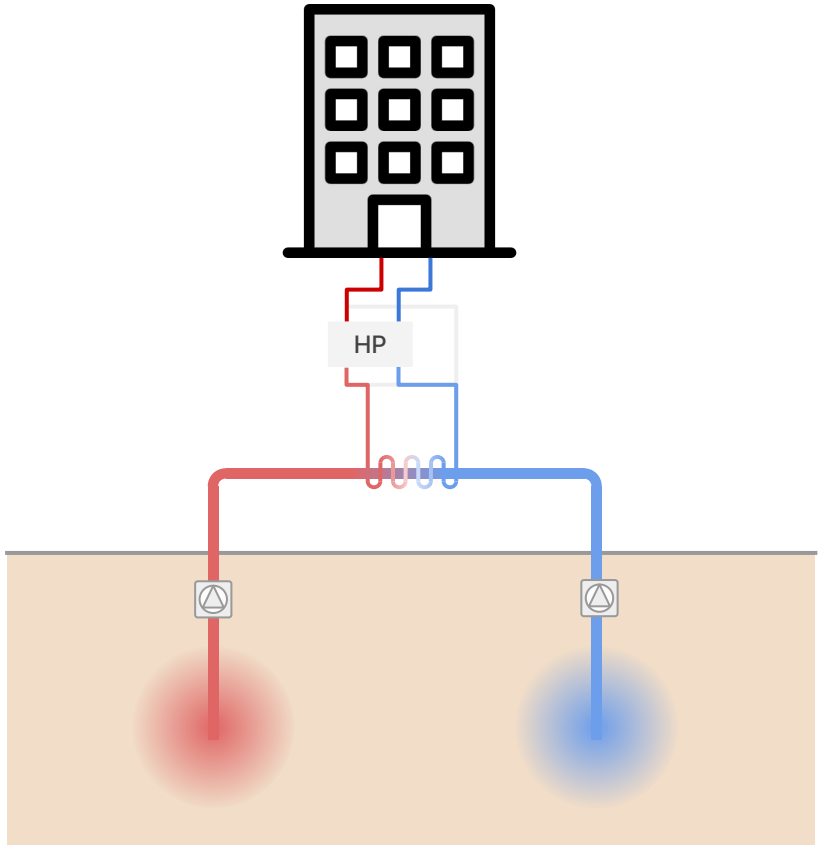
Rijksdienst voor Ondernemend Nederland

The project is funded by the Netherlands Enterprise Agency (RVO).

Background

ATES systems

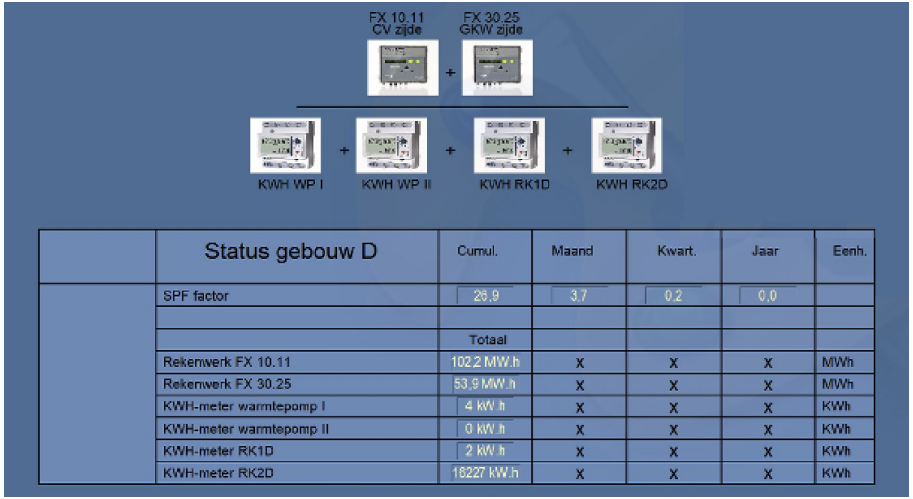
- the way-to-go solution to meet energy regulations for large commercial buildings
- a lot of these systems are functioning inefficient
- SPF is no good KPI for measuring efficiency



Background

ATES systems

- it is required to monitor a few basic KPI's for regulatory compliance (omgevingsdienst)
- data is often stored in building management system
- a BMS is not designed for monitoring purposes



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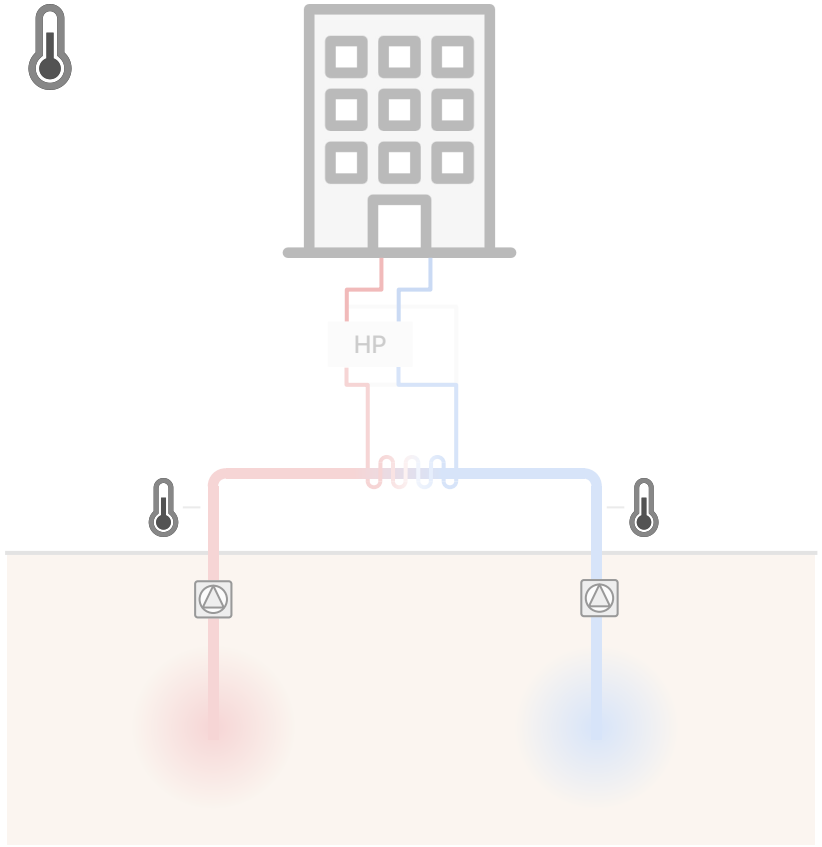
	Rekenwerk FX 30.25	53,9 MW.h	x	x	x	MWh
	KWH-meter warmtepomp I	4 kW.h	x	x	x	KWh
	KWH-meter warmtepomp II	0 kW.h	x	x	x	KWh
	KWH-meter RK1D	2 kW.h	x	x	x	KWh
	KWH-meter RK2D	16227 kW.h	x	x	x	KWh

A typical SPF calculation in a BMS

Intended solution

Data analysis with energy profiles

- assessment of ATES performance based on data analysis
- only using the 5 available (!) data points:
  - temperature injection and extraction
  - volume flow and -direction
  - outside temperature
- understandable for technical and non-technical stakeholders
- ready to use and fully scalable



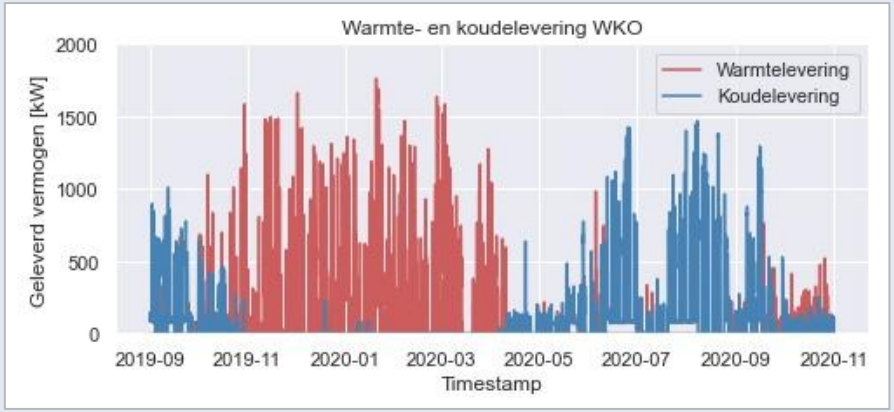
Plot example 1

Thermal energy supply

Plotting the supply of thermal energy gives a good indication on the activity level for heating and cooling of the ATES system.

From the plot we can derive:

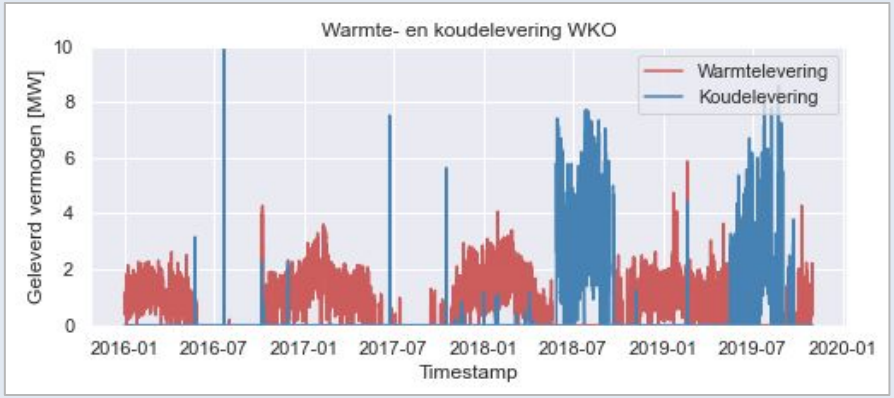
- ✔ Both heating- and cooling supply
- ✔ Continuous delivery of thermal energy



Plot example 1

Thermal energy supply

Another example of the same plot, different ATES system.

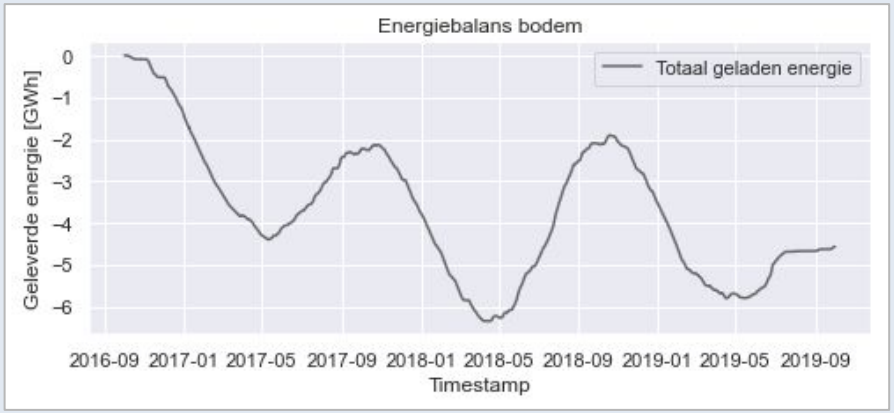


From the plot we can derive:

- ✔ Both heating- and cooling supply
- ! Two seasons with almost no supply of cooling energy
- ! High peak levels in cooling supply

Plot example 2

Ground energy balance



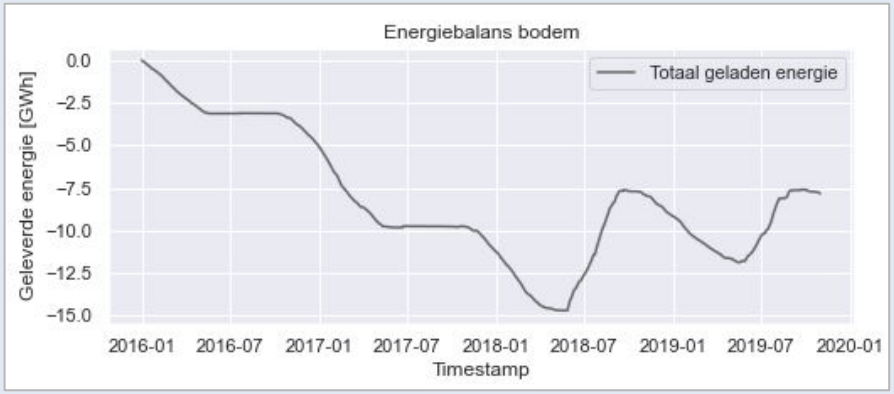
Plotting the ground energy balance shows the course of the (thermal) season and the balance between heating and cooling supply.

From the plot we can derive:

- ✔ Continuous sine wave visible
- ! Ground is slightly cooling down

Plot example 2

Ground energy balance



Another example of the same plot, different ATES system.

From the plot we can derive:

- ! Two seasons without cooling supply
- ! Ground is cooling down

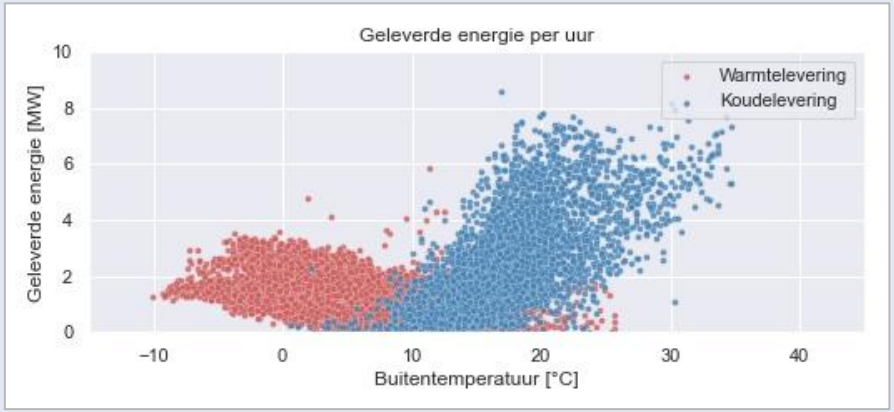
Plot example 3

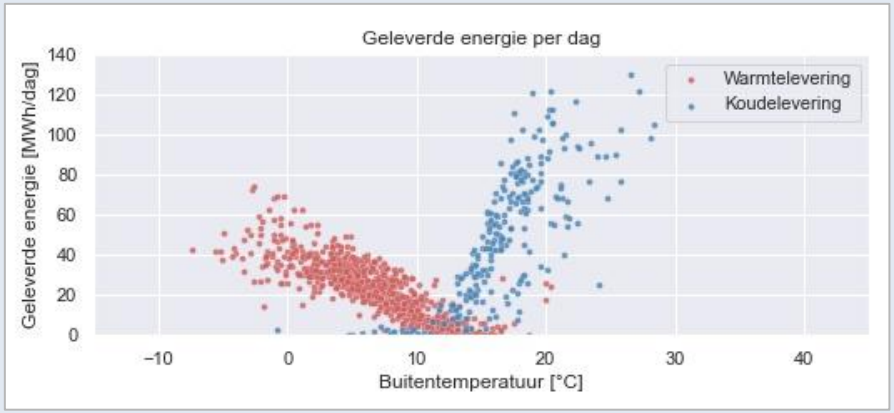
Energy supply scatters

The scatterplot of energy supply shows the heating and cooling supply at different outside temperatures.

From the plot we can derive:

- ✔ There is a narrow bandwidth around the imaginary trendline
- ✔ Only limited overlap between heating and cooling supply
- ✔ There is no anomalous heating or cooling supply given outside temperatures

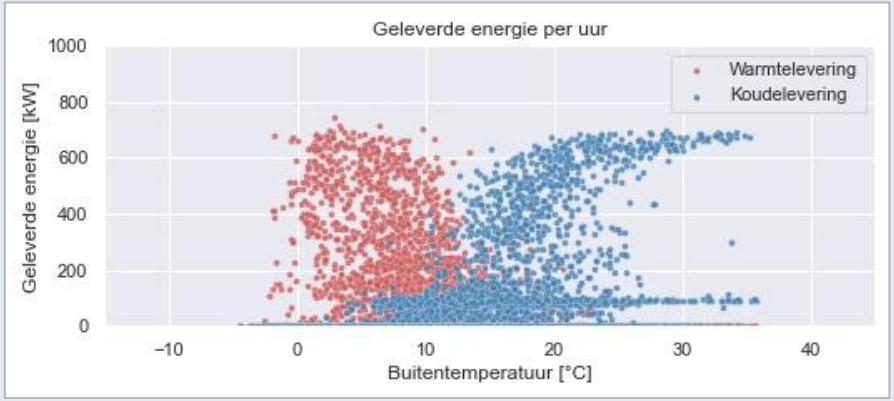


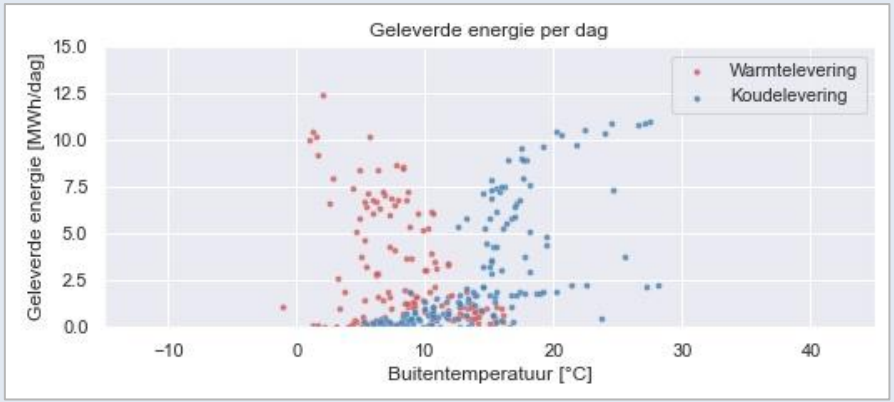


Plot example 3

Energy supply scatters

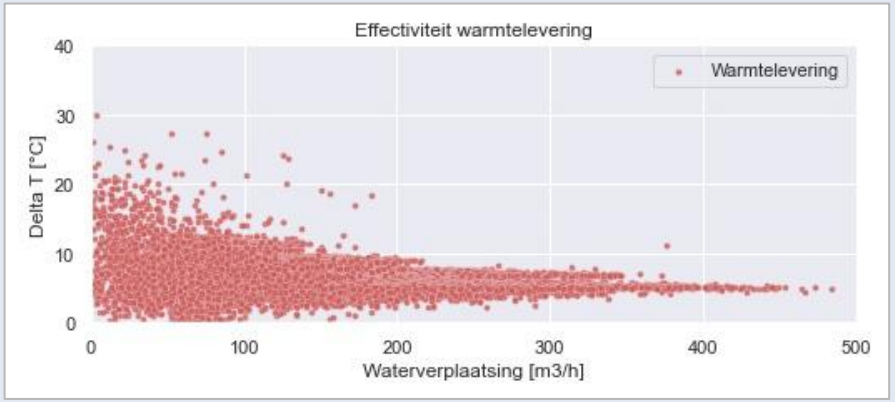
Another example of the same plot, different ATES system.

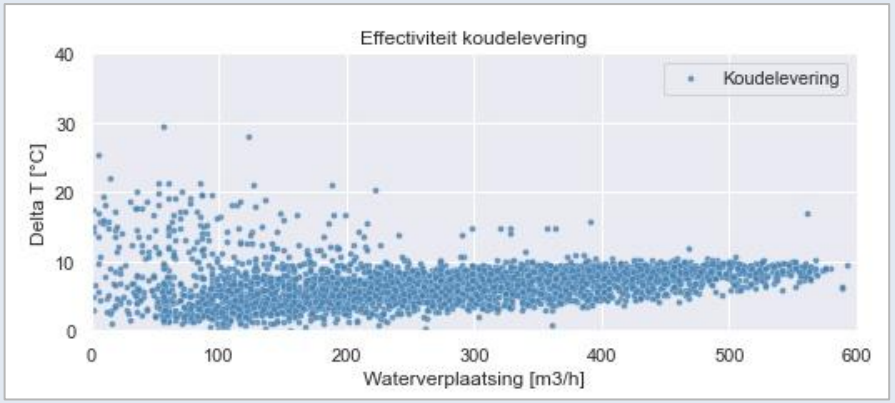




From the plot we can derive:

- ✔ There is no anomalous heating or cooling supply given outside temperatures
- ! There is a big bandwidth around the imaginary trendline
- ! Significant overlap between heating and cooling supply
- ! There is anomalous high energy supply at moderate outside temperatures





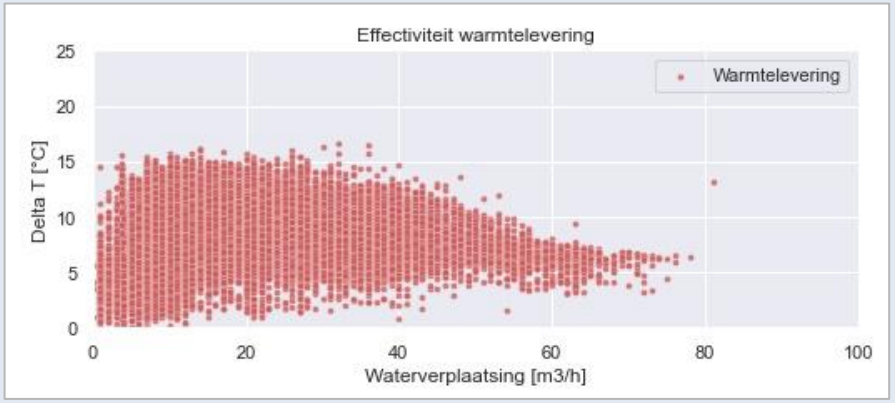
Plot example 4

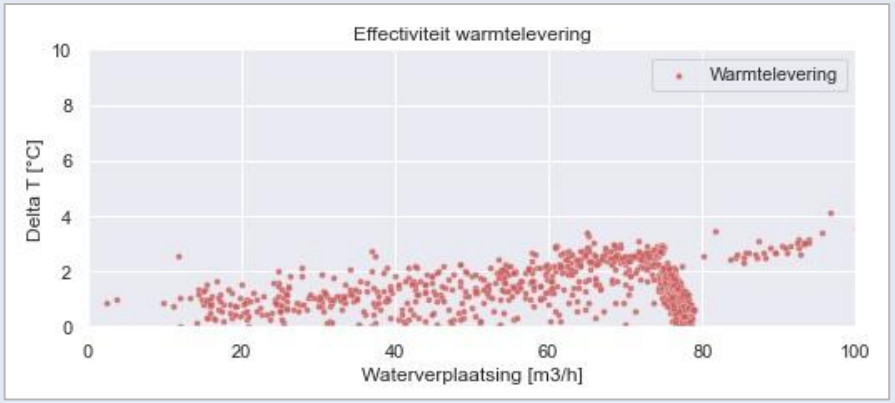
Effectiveness energy supply

The effectiveness of energy supply shows the proportion between volume flow and temperature difference (delta T).

From the plot we can derive:

- ✔ At high volume flow, the bandwidth in delta T is relatively small
- ✔ At high volume flow, the delta T converges to 6-8 K





Plot example 4

Effectiveness energy supply

Two other examples of the same plot, different ATES systems.

From plot 1 we can derive:

- ✔ At high volume flow, the delta T converges to 6 K
- ! There is a large vertical distribution

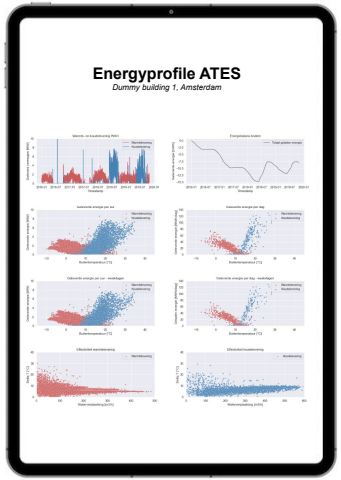
From plot 2 we can derive:

- ! Almost no low volume flows
- ! There is a very low delta T at high volume flows

Results

Dashboard energy profile

- Asses your ATES performance at one glance
- Based on 8 simple and accessible plots
- No additional sensors needed
- Highly scalable in automated script



Want to know more?
The publication including a description of all plots and the corresponding Python script is free accessible at:

Webpage RVO

Thanks for your attention!

For questions, feel free to contact me.

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