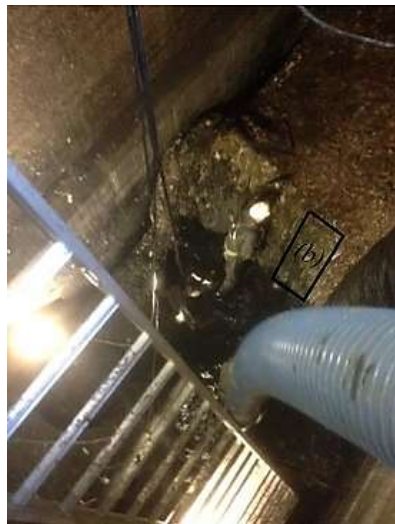


CCTV for recording FOG dynamics

Antonio Moreno-Rodenas, Alex Duinmeijer & Francois Clemens-Meyer
(Deltares, Engineering Consultants Rotterdam)

Fat, Oil & Grease issues in WW pumping stations

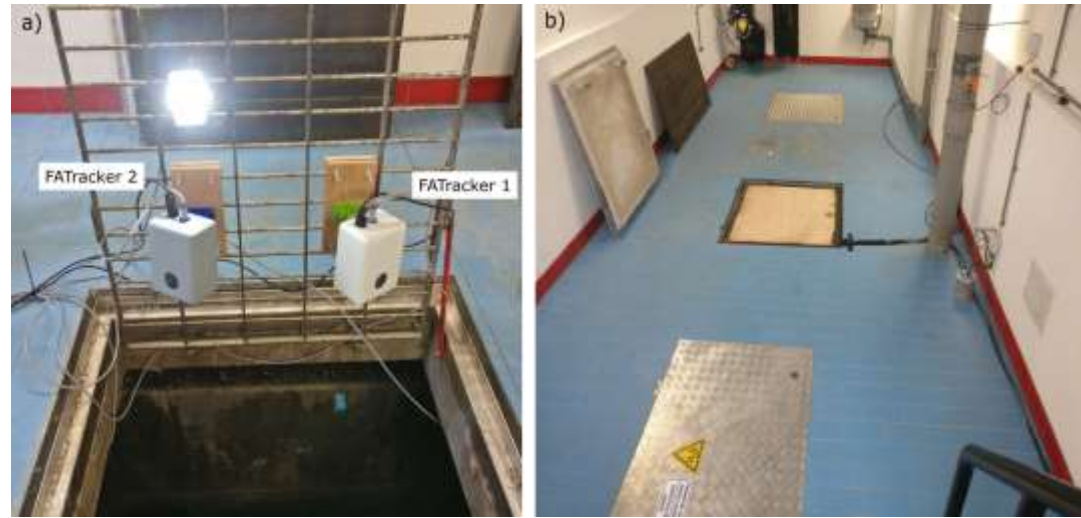
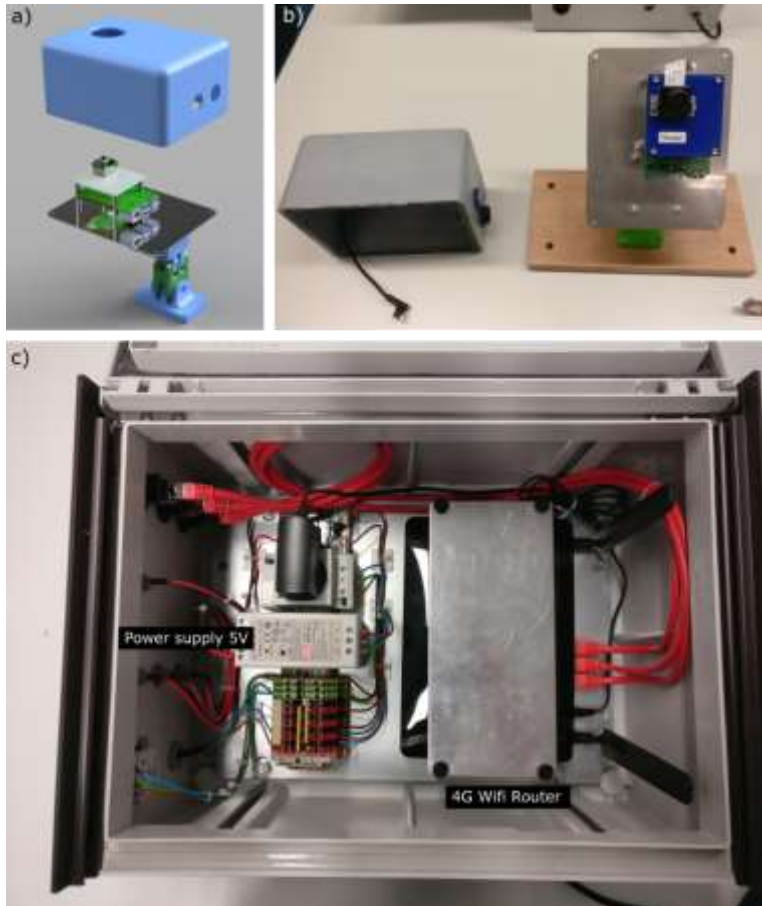
- Causes malfunction (pump- and/or valve blockage, obstruction of measurement etc.)
- Comes at a price: ~ 20 million Euro/year for The Netherlands
- Cleaning out a WWPS is not a fun job



What has been done

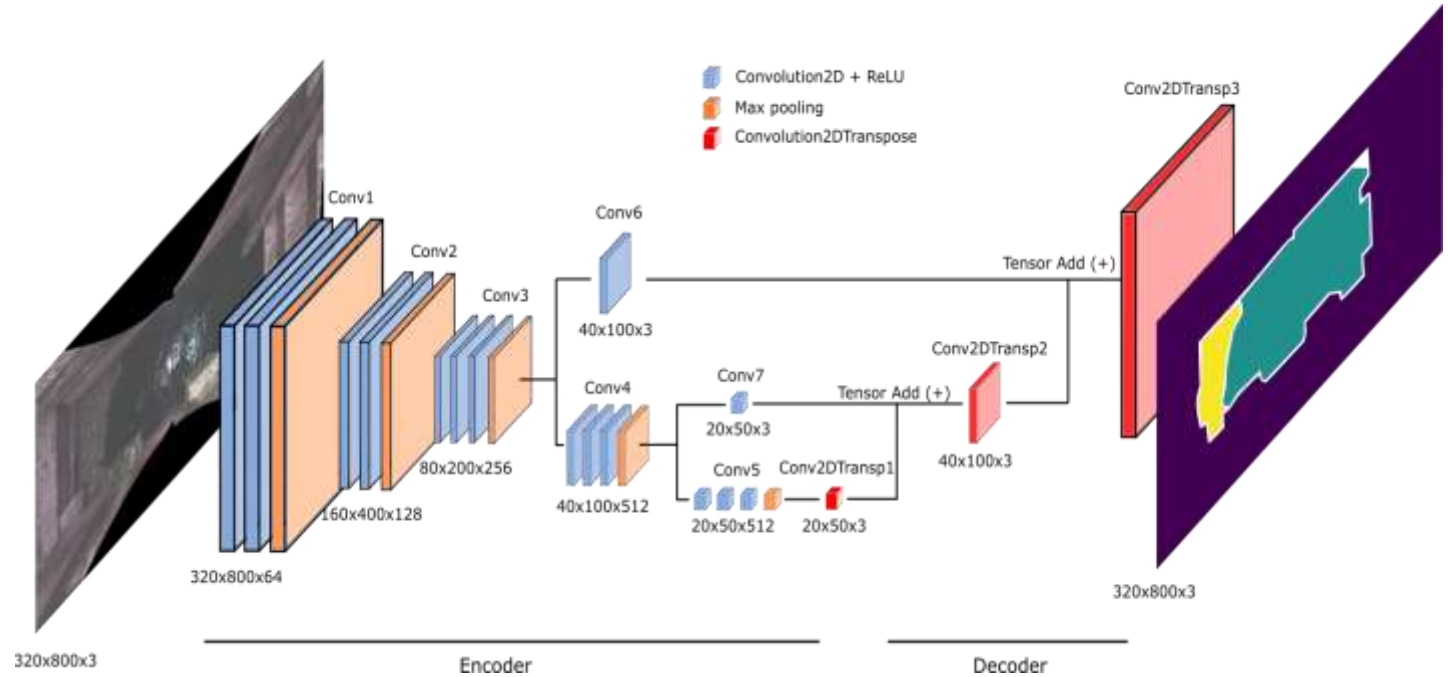
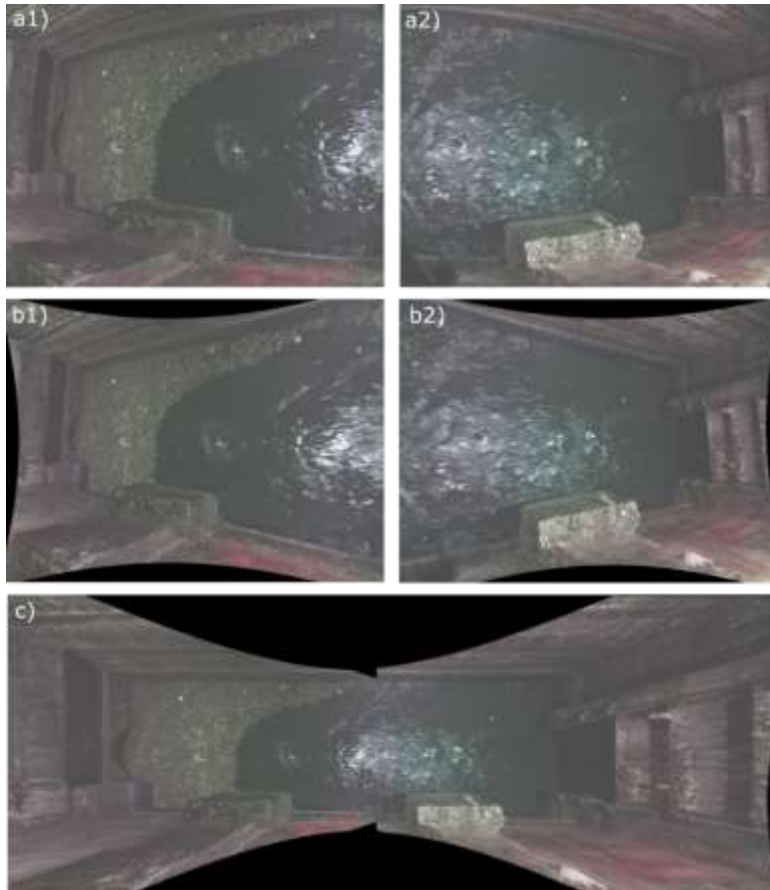
- 2018: M.Sc. thesis: statistical relations between occurrence of FOG in WWPS and concentration of pubs/restaurant, turbulence level and economic parameters (average income of inhabitants).
- 2020: PhD thesis Alex Duinmeijer: 'can vortices be used to transport FOG in a wwps? -> answer yes/no, fundamentally unpredictable.
- 2020: FATracker I-> datadriven AM, use images & deep learning)
- 2021/2022: starting up in November 2021: FATracker II (7 wwps; Arnhem, Limburg & location in France).

Hardware

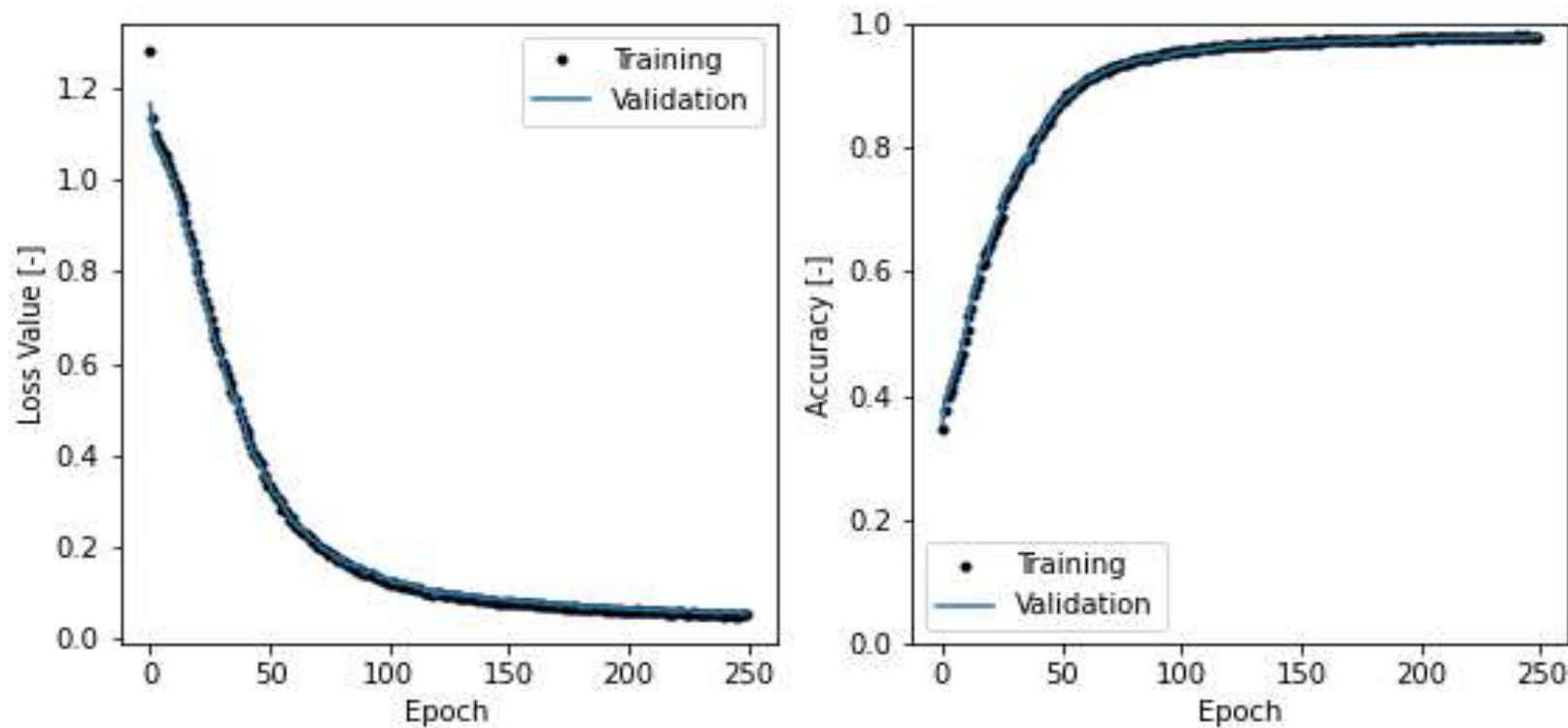


- Raspberry Pi 4 Model B, ARM CPU Quad core Cortex-A72
- 8-megapixel camera (Sony IMX219) mounting a 98° Field Of View (FOV) fisheye lens (ENTANIYA RP-L98).
- Three LED floodlight lamps (KONIG LED, 750 lumens, 10W)
- 3D printed casing (survived > 12 months in sewer atmosphere)
- On-location postprocessing at a processing time of 9.8 seconds per image.

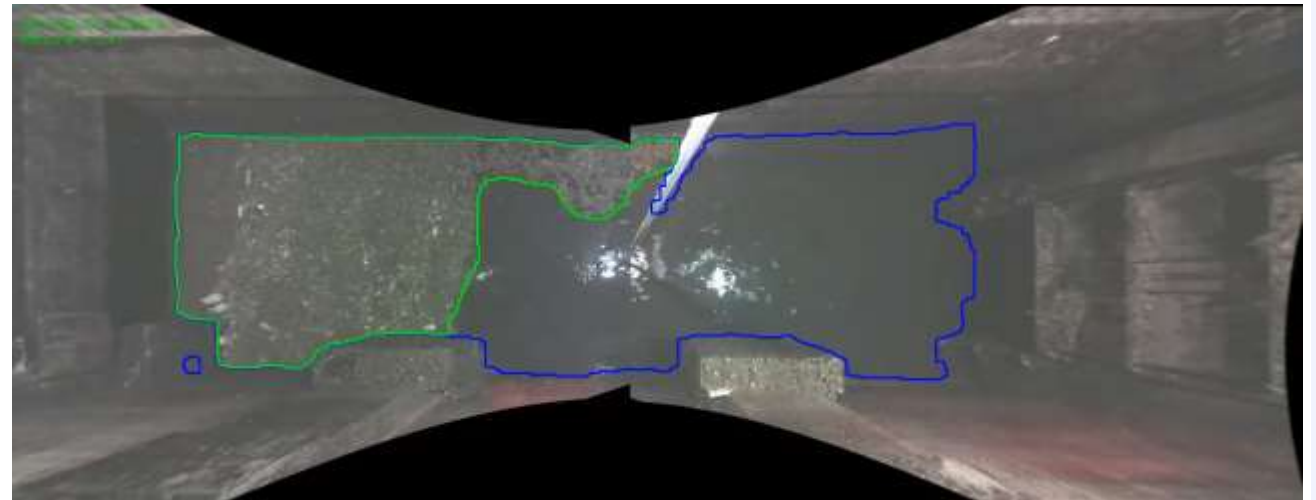
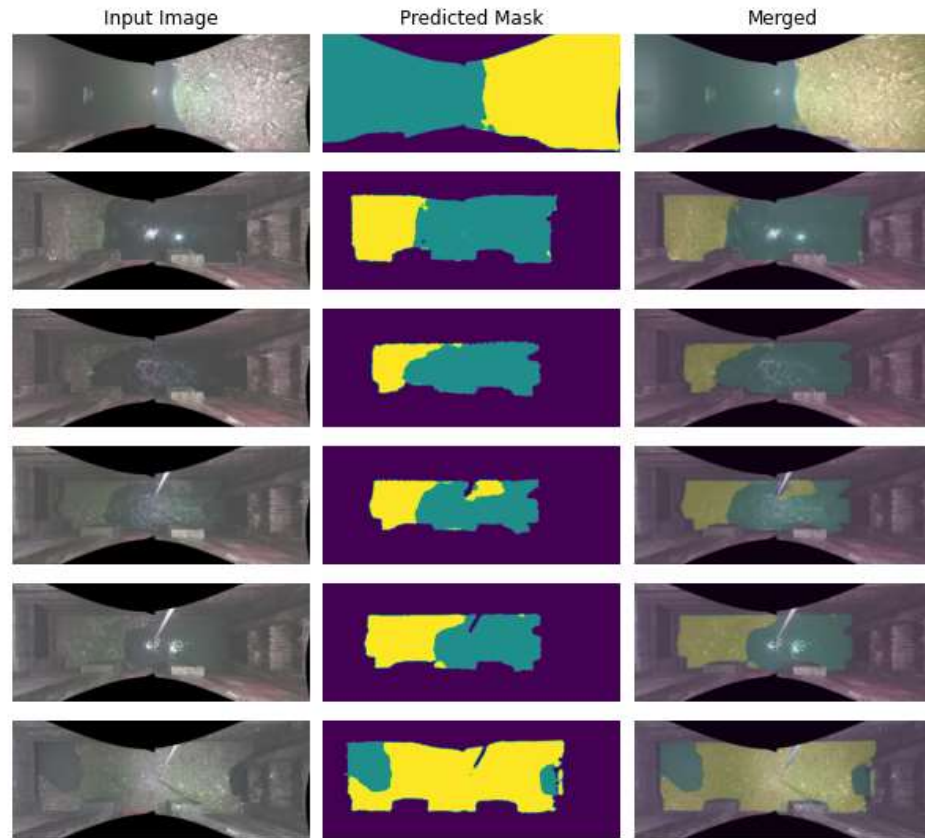
Postprocess sequence semantic segmentation algorithm

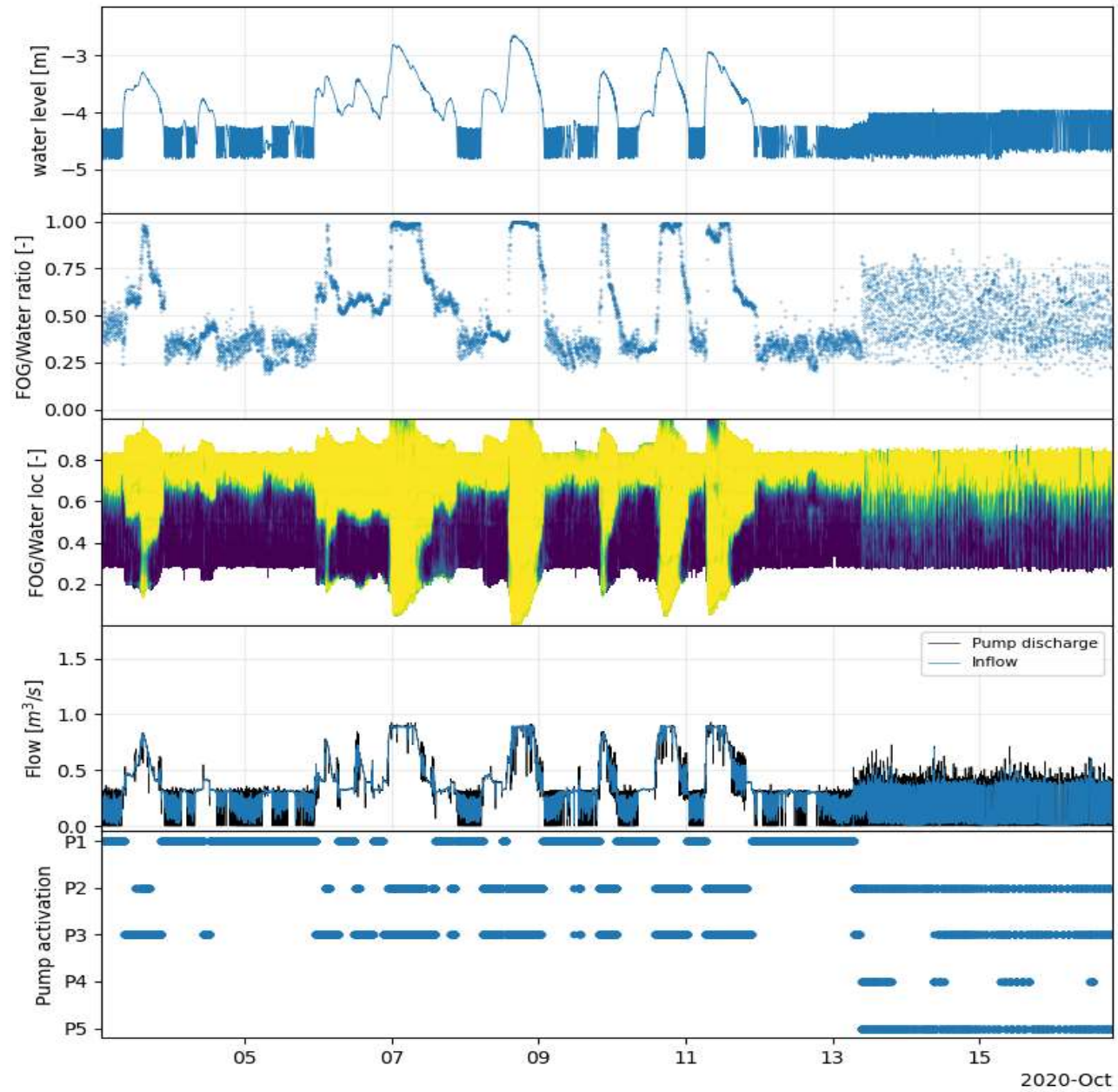


Training & validation result (using tensorflow with a pretrained network (*Tensorflow, ImageNet*))

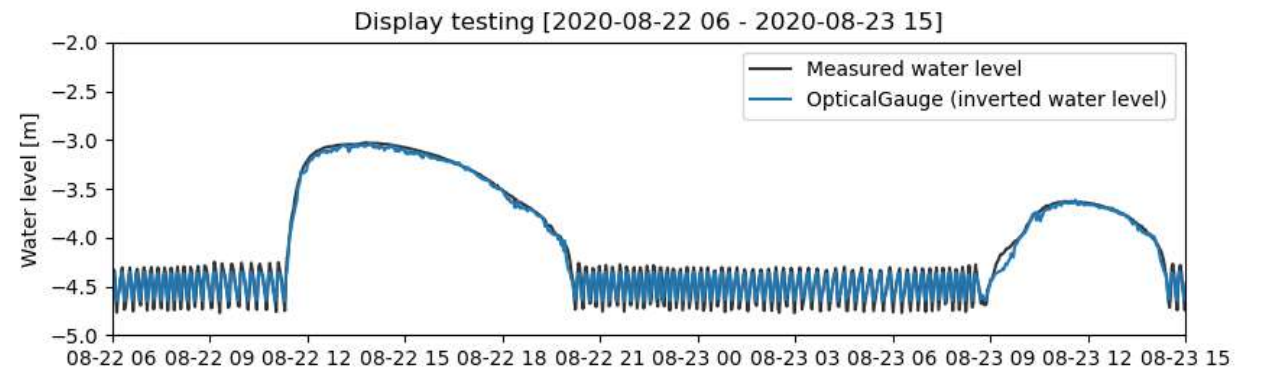
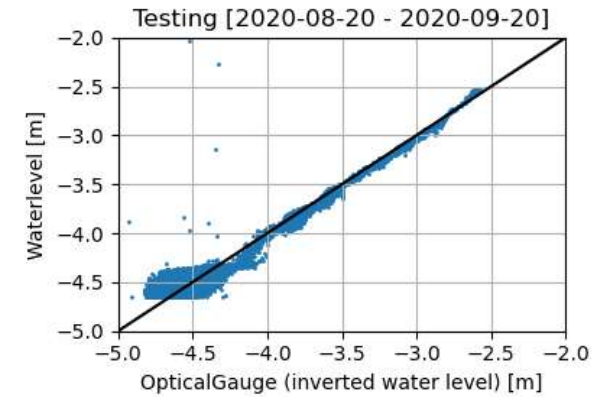
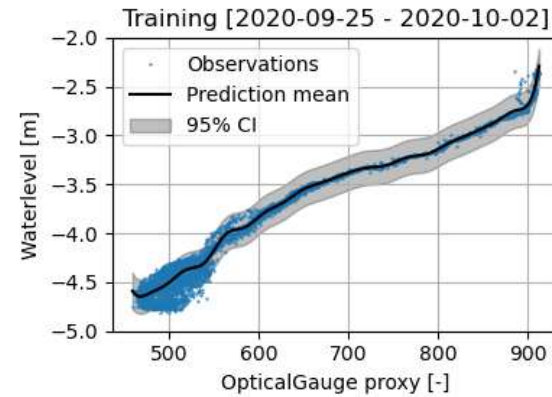
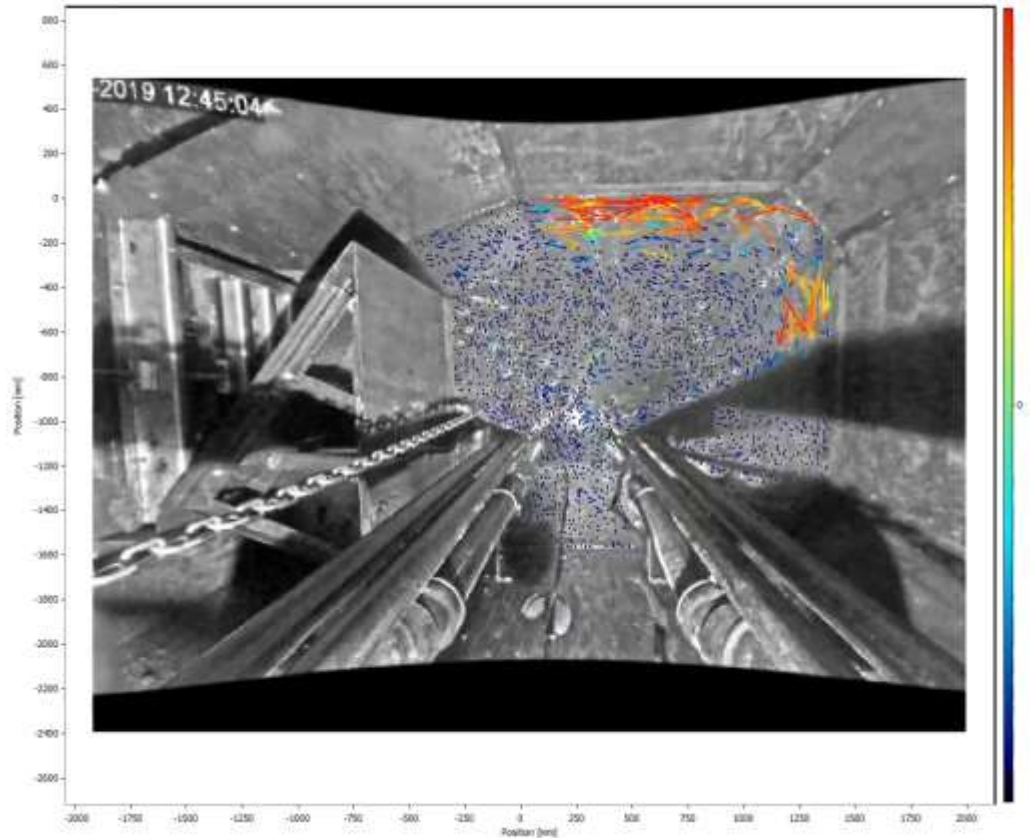


Some validation examples





Additional information obtained from the footage



Conclusions & outlook

- Using cheap hardware a robust monitoring system for WWPS can be obtained
- Data on FOG can be used to plan maintenance (cleaning out) only when needed
- The data can be used as an alternative for waterlevel measurement -> operational control of the WWPS.
- Detection of vortices -> air suction can be detected -> optimize control
- Quantification of velocity fields -> design verification (validate against e.g. CFD results)
- Details: Moreno-Rodenas, Duinmeijer & Clemens-Meyer (2021) **Deep-learning based monitoring of FOG layer dynamics in wastewater pumping stations.** (*Water Research: preprint*: <https://doi.org/10.1016/j.watres.2021.117482>)