Work Package 6 – Smart sensing and monitoring in urban drainage

- **Urban drainage systems are key infrastructures in cities, but knowledge about their functioning remains poor due to insufficient and low-quality monitoring**

- **Three main tasks in WP 6:**

  - **Task 6.1:** identify and evaluate new sensors and technologies for hydrology and hydraulics, pollutant load monitoring, and UD underground asset inspection

  - **Task 6.2**: define and evaluate new methods and tools to improve evidence base for reliable and validated urban drainage monitoring data

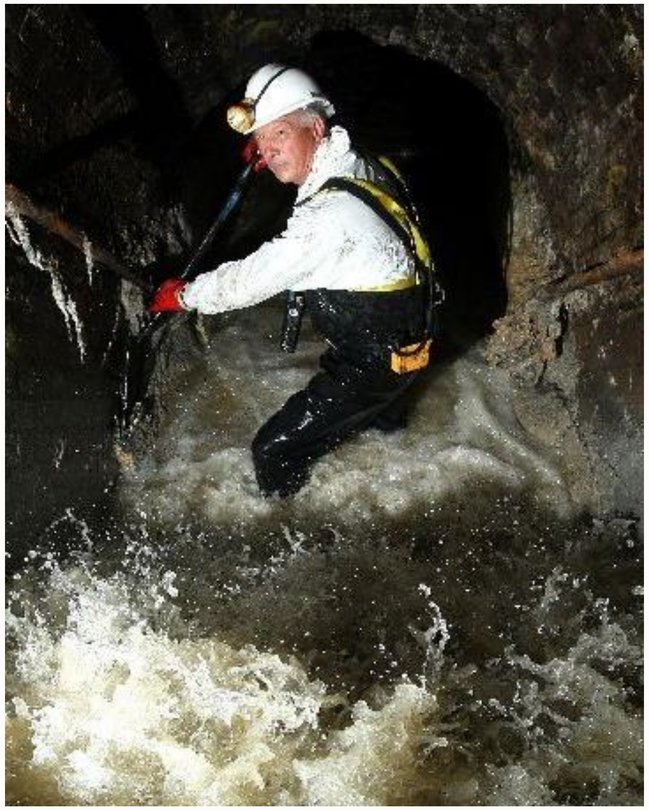
  - **Task 6.3**: define and evaluate new methods to analyze and interpret urban drainage space and distributed data

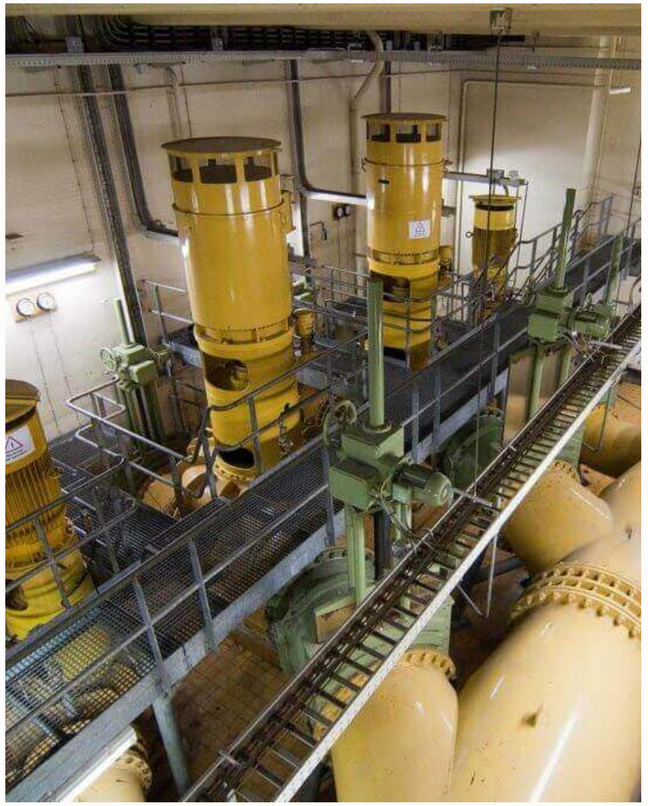
Task 6.1: Introduction

Urban Drainage Systems are designed to handle different urban water aspects – quantity and quality

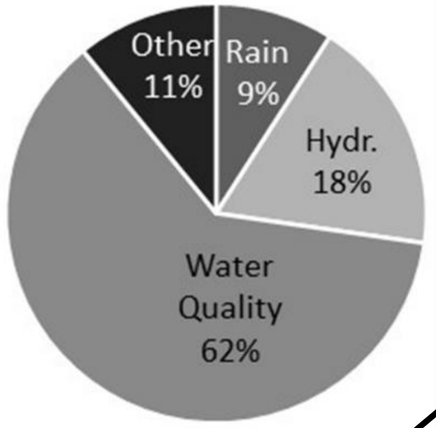
Task 6.1: Introduction

Better sensors are required for better management





Task 6.1: Sensor selection



55 initial sensors

Pre-selection

15 sensors

ID	Parameter	Sensor title	Type	Brand	Model	Proposer	TRL_est*
6*	Coliforms (faecal, E. coli, total)	Proteus	Meas.	Proteus	Mult. Par. Water Quality Sensor	UoS	8
7*	Conductivity	LoRaWan Conductivity	Meas.	in-house development	inductive EC probe	EAWAG	4
9	CSO event	LoRaWan CSO detector	Meas.	in-house development	capacitative sensor	EAWAG	4
12*	Discharge	Camera Flow Meter	Meas.	Photrack	Discharge Keeper	EAWAG	5
13	Discharge	Coriolis flowmeter	Meas.	Serv instrumentation		INSA	4
14	Discharge	laser based discharge Meas.	Meas.	Ijinus	ISCO laser	INSA	9
24*	Multi	Submersible spectrometer	Meas.	Go-Sys	ISA	INSA	9
26	Multi	SQUID	Meas.	in-house development	SQUID	EAWAG	4
27*	Multi	Non-contact quality sensor	Meas.	Headwall photonics	Hyperspec MV.X	EAWAG	0
31*	PAH	PAH probe	Meas.	Aquams	TriOS	INSA	9
33*	Pipe mapping	FSB	Meas.	Deltares	FSB	EAWAG	5
38	Rain	Raingauge with Corriolis flowmeter	Meas.	in-house development	NA	INSA	0
43*	Sediment	3d LiDAR sediment mapping	Meas.	Intel RealSense	LiDAR Camera L515	UDC	2
44	Sediment	3d mapping of sediment with SfM	Meas.	in-house development	Photo camera	UDC	4
55	Water quality	Microsensors	Meas.	Unisense	various	UoS	9-1

Final list: 8 sensors

Sensor Number	Sensor name	Measured parameter
1	Proteus	Coliform concentration
2	LPICM	Conductivity
3	DischargeKeeper	Flow
4	ISA spectrometer	Multi – UV-visible absorbance
5	MV.X hyperspectral imager	Multi – VNIR reflectance
6	PAH probe	PAH
7	Pipe Mapping FSB	Pipe mapping
8	3D Lidar Sediment Mapping	Sediment mapping

Task 6.1: Methodology for sensor testing

	PAH	Proteus	LPICM	ISA	MV.X	DK	PM FSB	Lidar SM
1) TRL	5	5	4	5	4	5	2	5
2) Quality of testing	3	3	5	5	5	5	3	5
3) Operational performance	1	1	5	4	4	4	2	5
4) Technical performance	1	1	5	4	4	4*	3	5
4a) *Range*	5	4	5	5	5	4	4	4
4b) *Accuracy*	1	1	5	4	4	4	3	4

Quantitative results: scale between 1 and 5

[D6.2 in: https://co-udlabs.eu/dissemination/deliverables/](https://co-udlabs.eu/dissemination/deliverables/)

1.Detailed presentation of 2/8 sensors: 1) the hyperspectral camera and 2) the ISA spectrometer

Task 6.1: MV.X. hyperspectral camera (1)

Sensor description and methods for testing

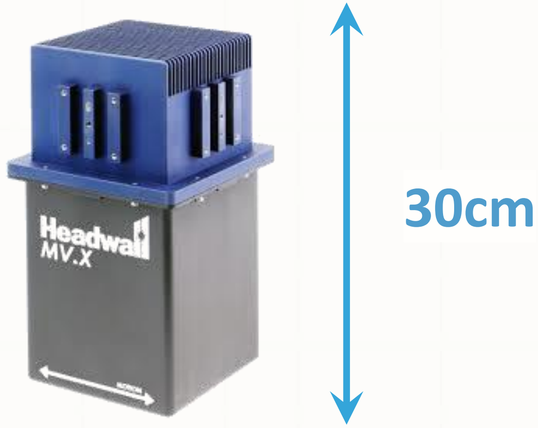
General information

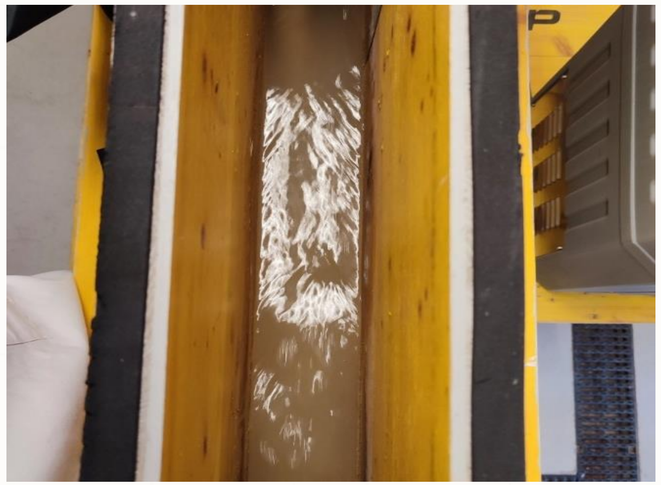
- 400-1000 nm (2 nm)
- IP 66, 67
- Field of view: 10 cm
- Multi parameter

Tests information

- Tested at five different sites
- Turbidity modeling

Lab tests



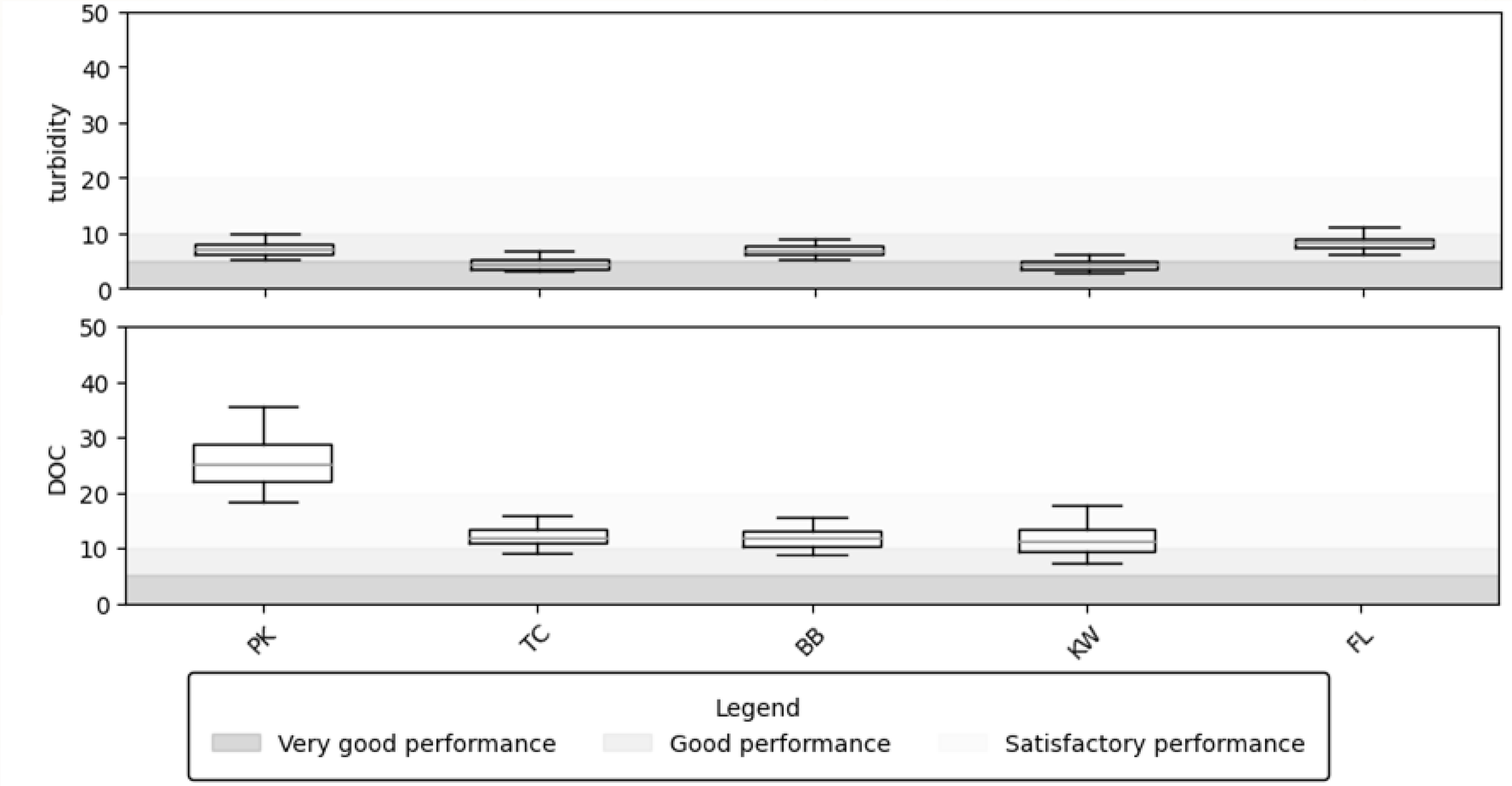


Flume tests

1.Detailed presentation of 2/8 sensors: 1) the hyperspectral camera and 2) the ISA spectrometer

Task 6.1: MV.X. hyperspectral camera (2)

Results

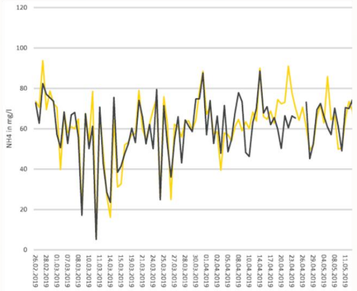


Task 6.1: ISA (1)

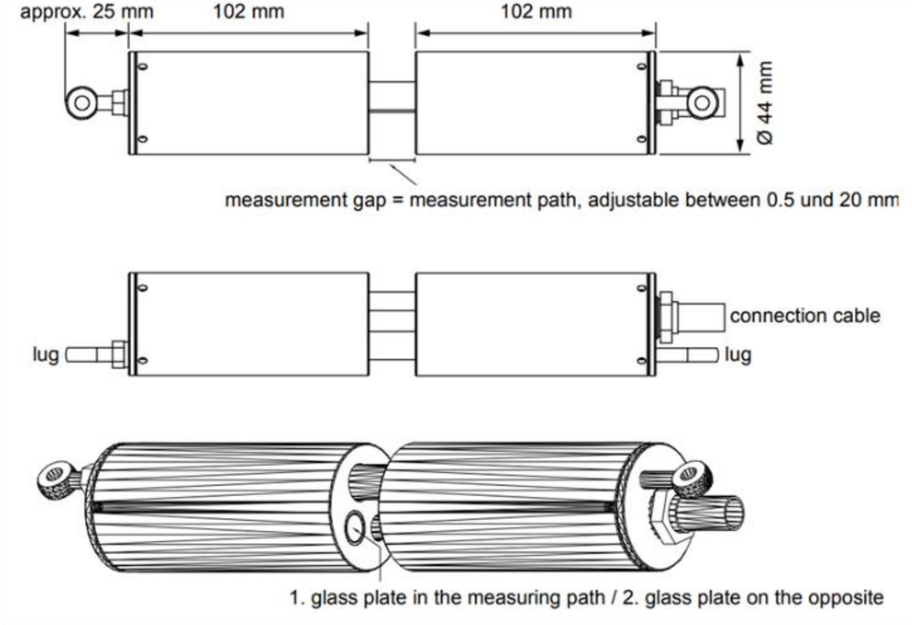
Sensor description and methods for testing

- UV-vis absorbance (200-735 nm)
- Flexible model
- Adaptable path length
- Has been used to measure ammonium

Ammonium in WWTP influent



- Tested at two independant locations



1.Detailed presentation of 2/8 sensors: 1) the hyperspectral camera and 2) the ISA spectrometer

Task 6.1: ISA (2)

Results

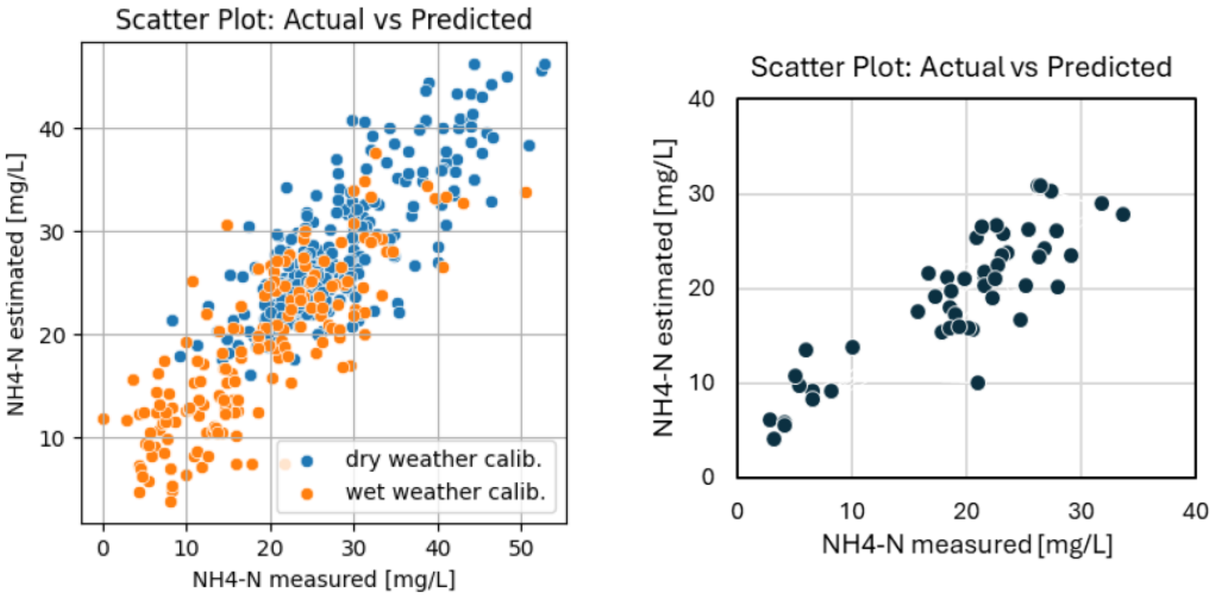
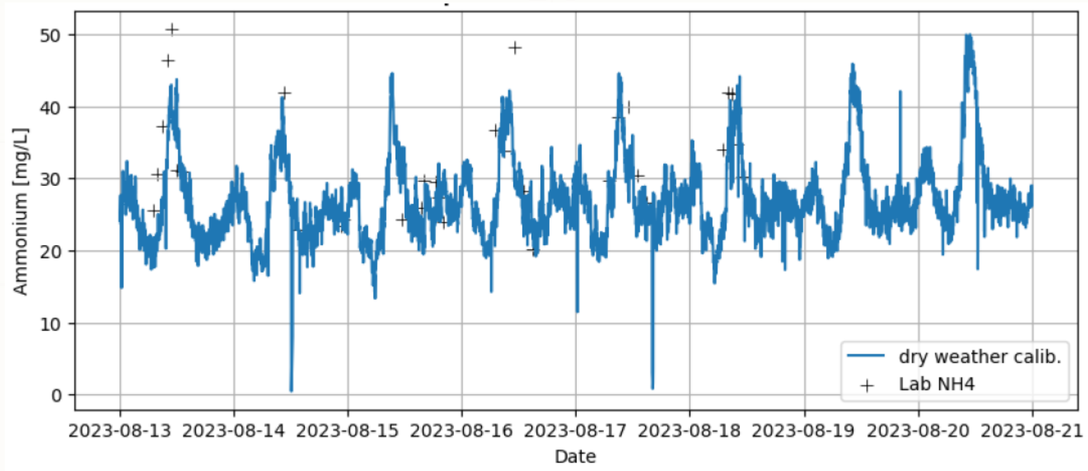


Figure 13: Scatter plot for actual vs predicted NH_4-N concentration (a) at Eawag, (b) at UDC.



Task 6.1: Summary and conclusion

	PAH	Proteus	LPICM	ISA	MV.X	DK	PM FSB	Lidar SM
1) TRL	5	5	4	5	4	5	2	5
2) Quality of testing	3	3	5	5	5	5	3	5
3) Operational performance	1	1	5	4	5	4	2	5
4) Technical performance	1	1	5	4	4	4*	3	5
4a) *Range*	5	4	5	5	5	4	4	4
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