



Metrology for Real-World
Domestic Water Metering

Initial Results on the Flow Dynamics of Household Water Consumption



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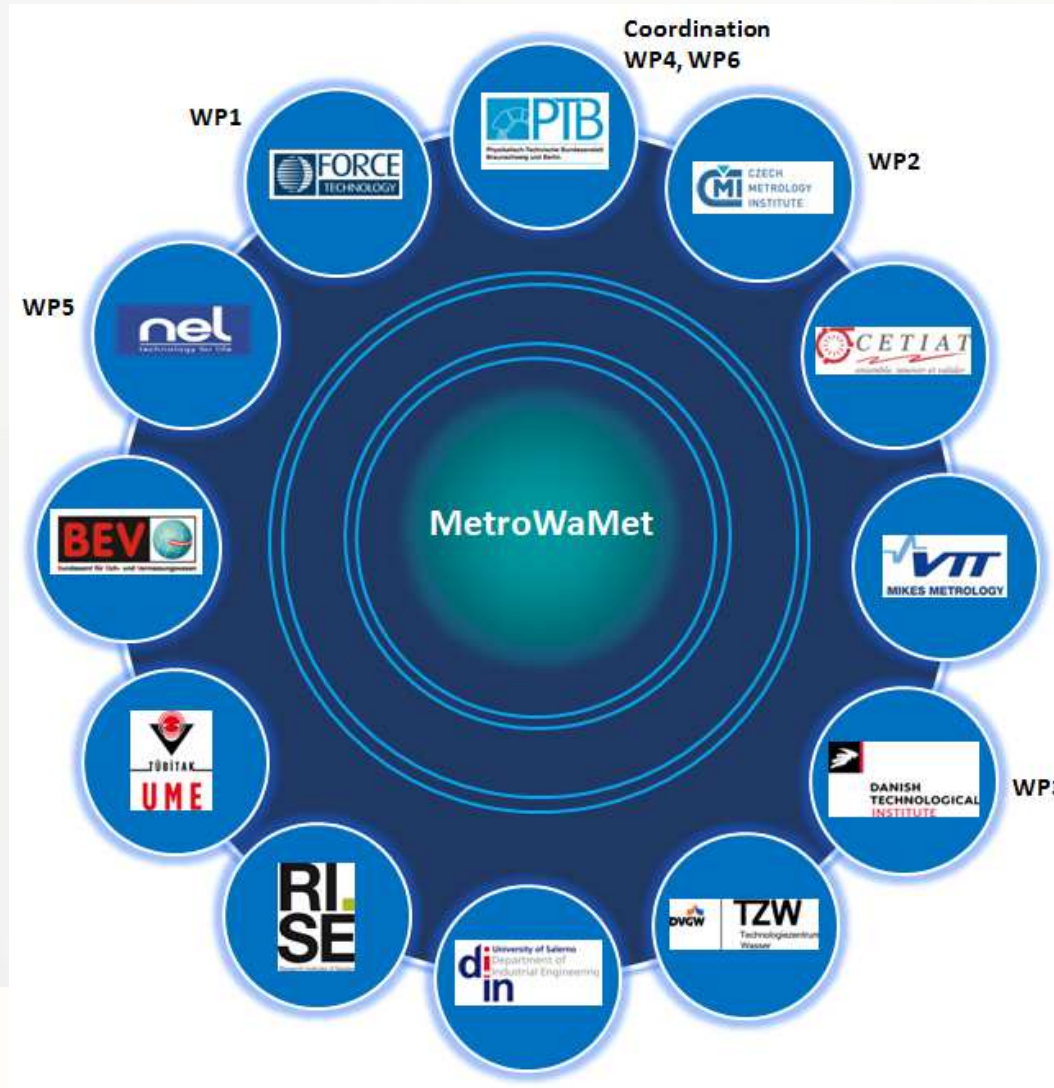
FLOMEKO 2019 Lisbon

Introduction and MetroWaMet



- The project MetroWaMet (Metrology for Real World Domestic Flow Metering) is funded by EMPIR (The European Metrology Programme for Innovation and Research) and started almost a year ago.
- EMPIR is the main programme for European research on metrology. It coordinates research projects to address grand challenges, while supporting and developing the SI system of measurement units. And it has been developed as an integrated part of Horizon 2020.
- The project MetroWaMet aims at establishing a metrological infrastructure which will enable an integral characterization of domestic water meter performance close to real-world conditions and not at laboratory conditions as presently done.
- According to OIML R49 and ISO 4064, water meters used for household consumption are tested/calibrated at constant flow rates in laboratory conditions. On the other hand, the measurements conducted at households showed that water meters are exposed to highly changing flow rates.

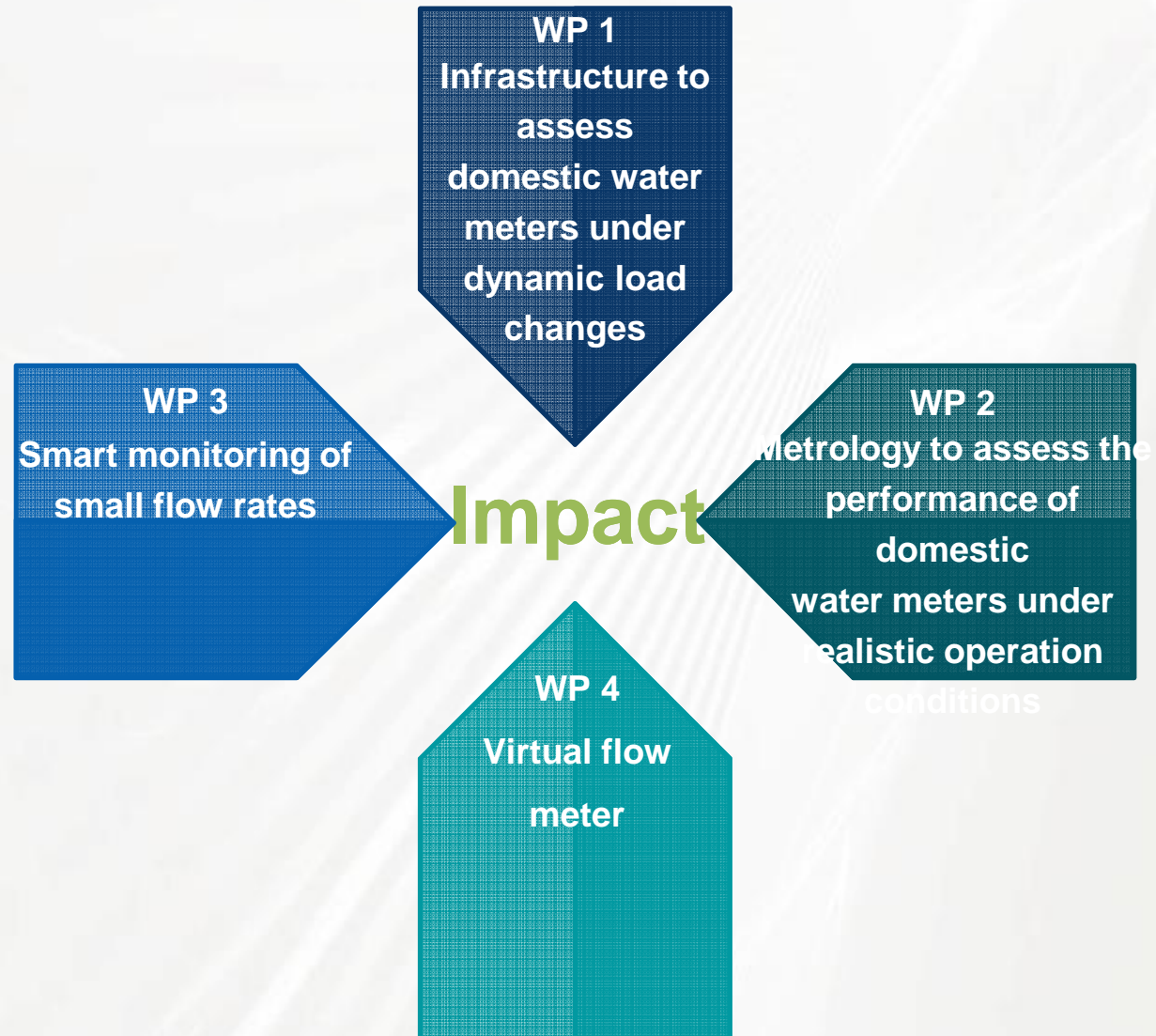
Introduction and MetroWaMet



Supporters



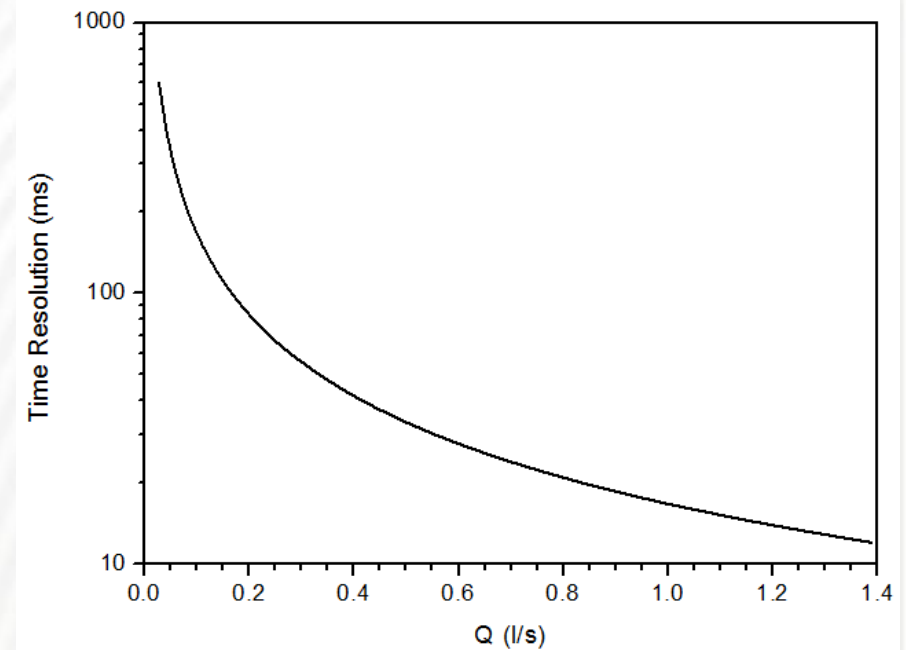
Introduction and MetroWaMet



Measurements

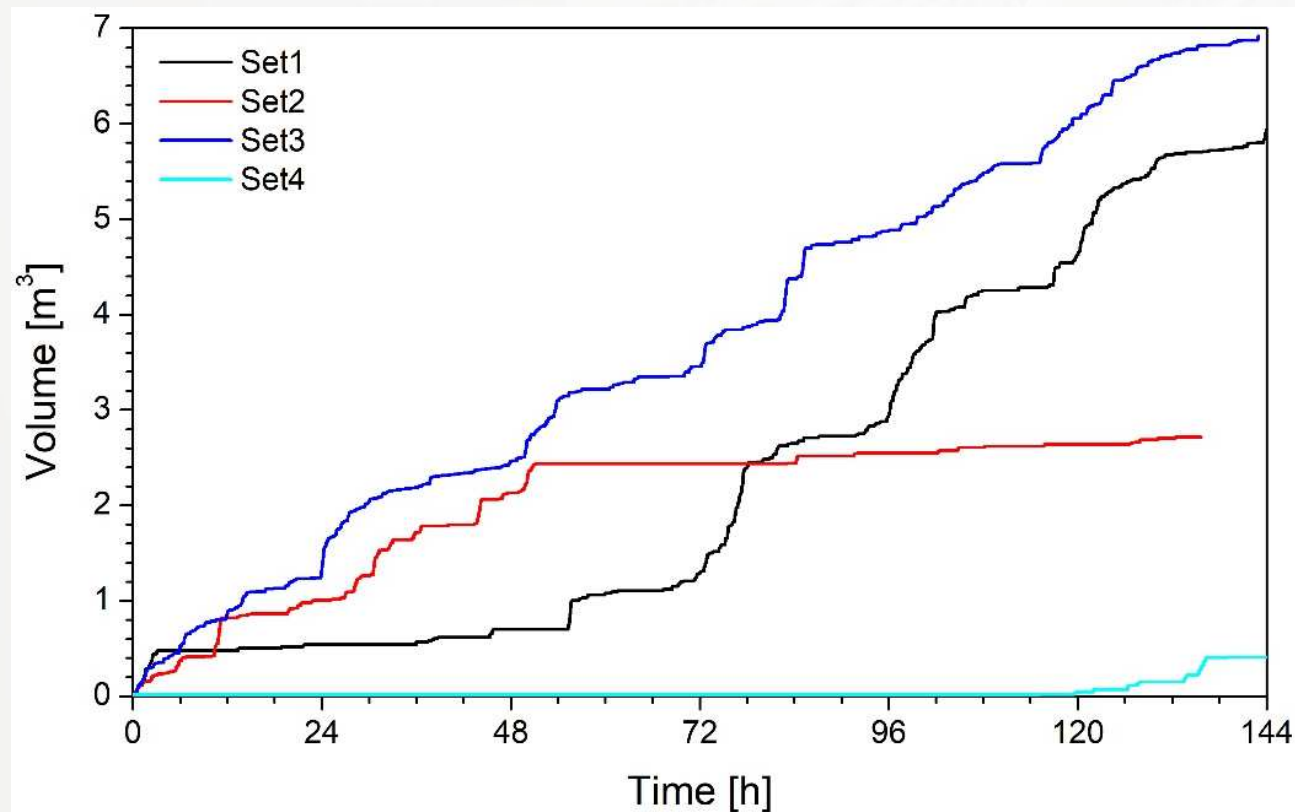
Test Measurement Unit:

- A commercial volumetric household meter was modified to give 60 pulses/l.
- A pulse recorder was developed to detect and record each pulse.
- The unit allows max. 12 ms time resolution (@ 1.4 l/s) and at least one week recording time with the used power supply.



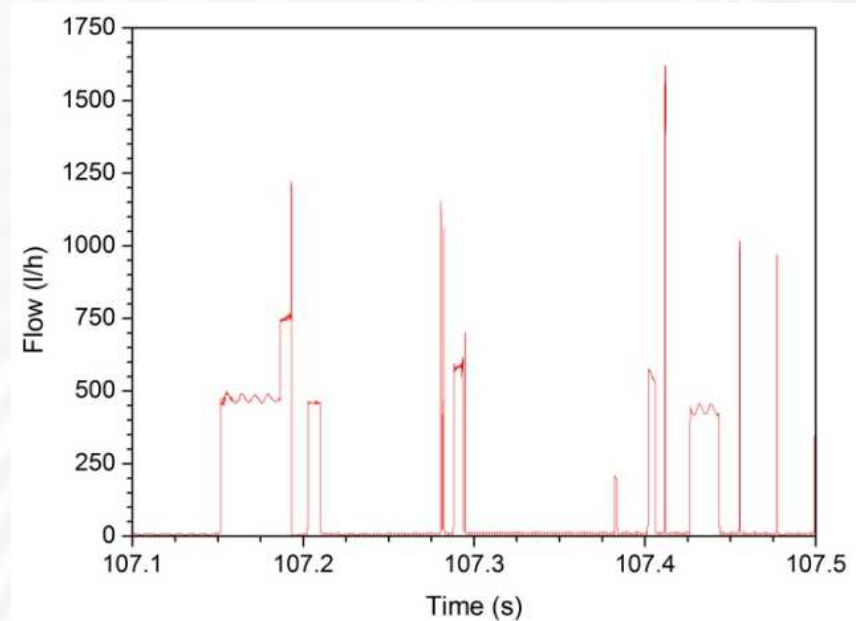
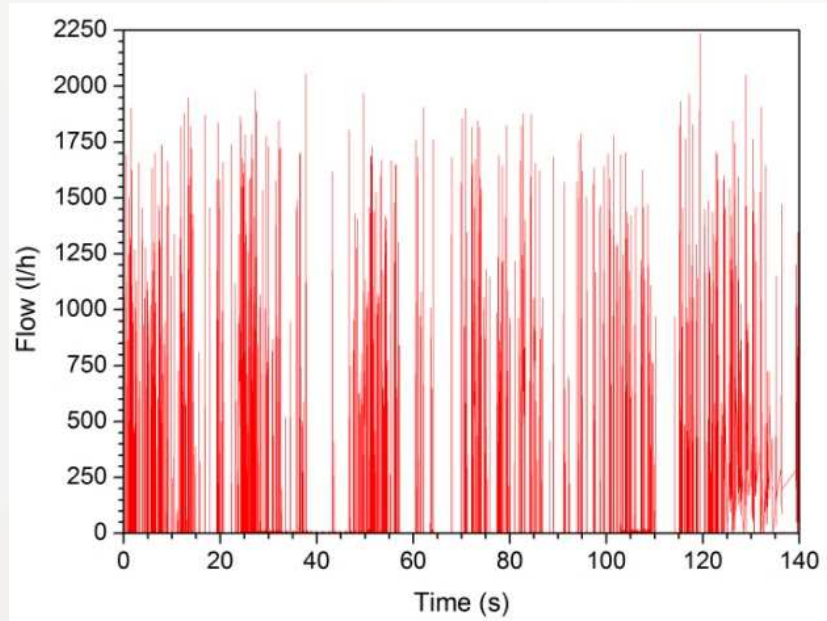
Measurements

- Four measurements (sets) were done and each of them was around 6 days long.
- In the case of set2 and set4, the corresponding houses were not occupied everyday during the measurement interval.



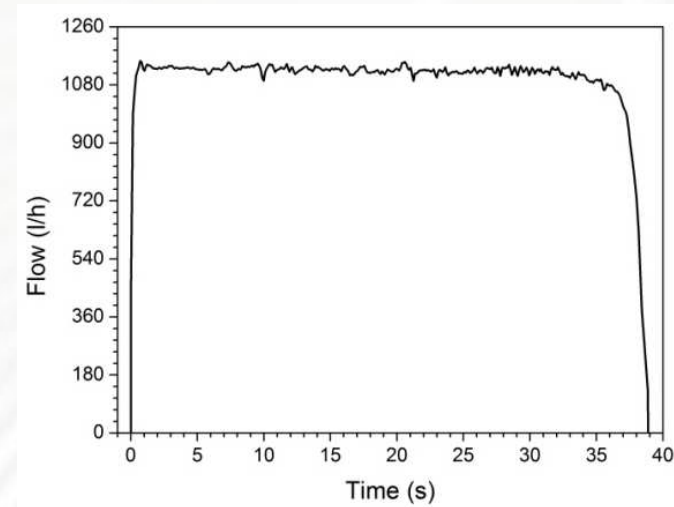
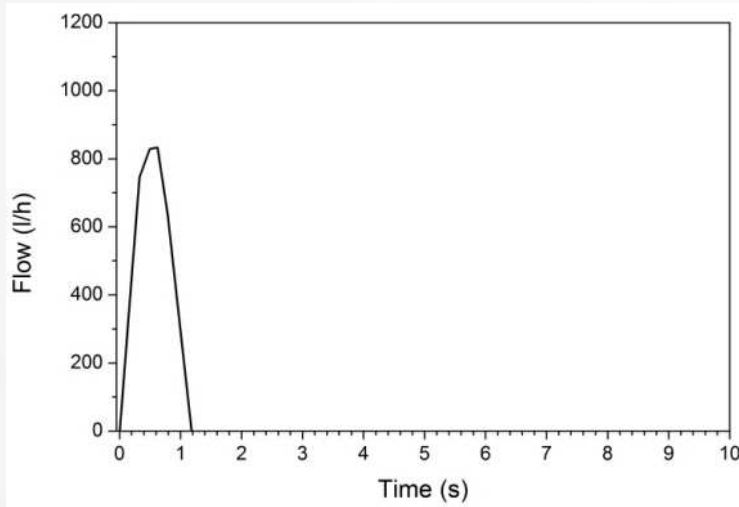
Data Processing

Flow rate variation in time:

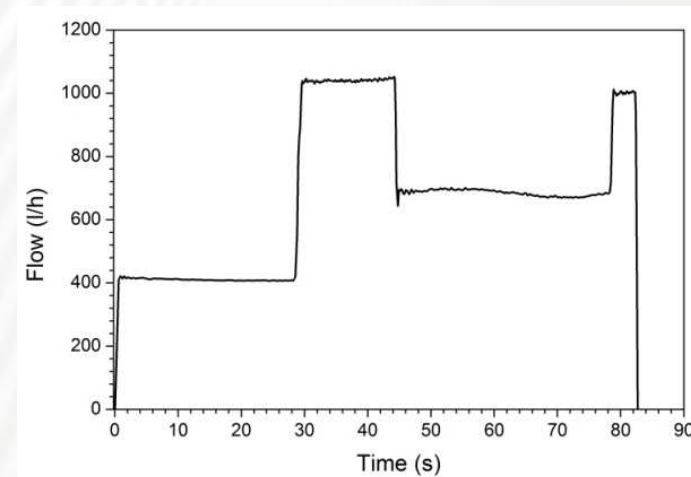
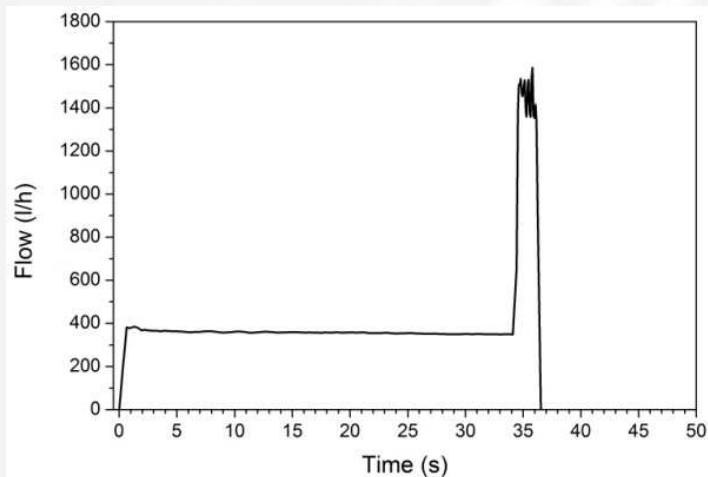


Data Processing

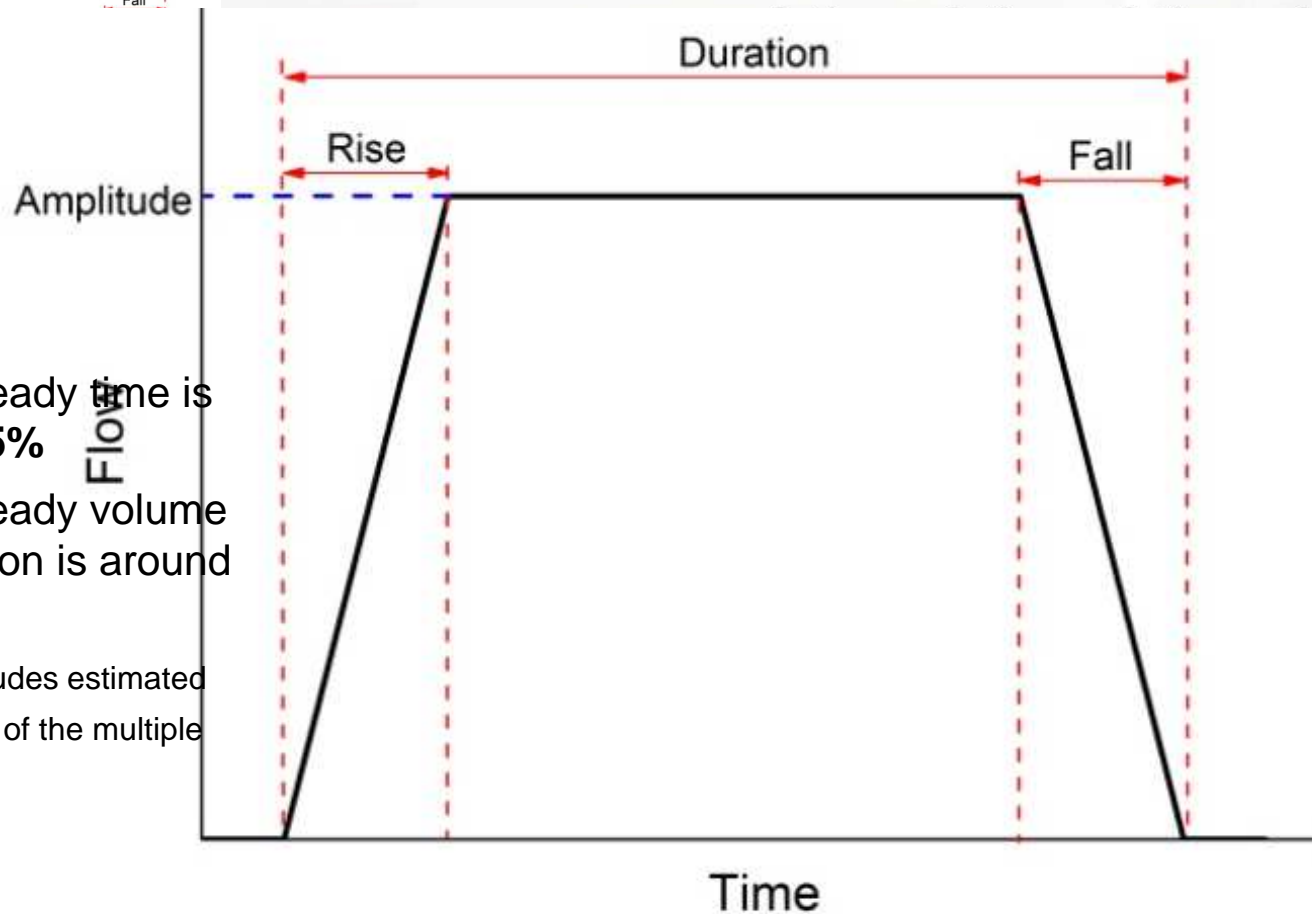
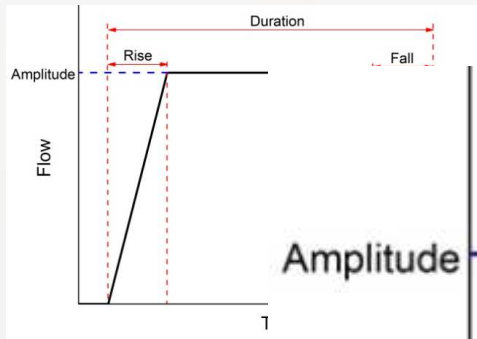
Single amplitude flow events



Multi amplitude flow events



Results

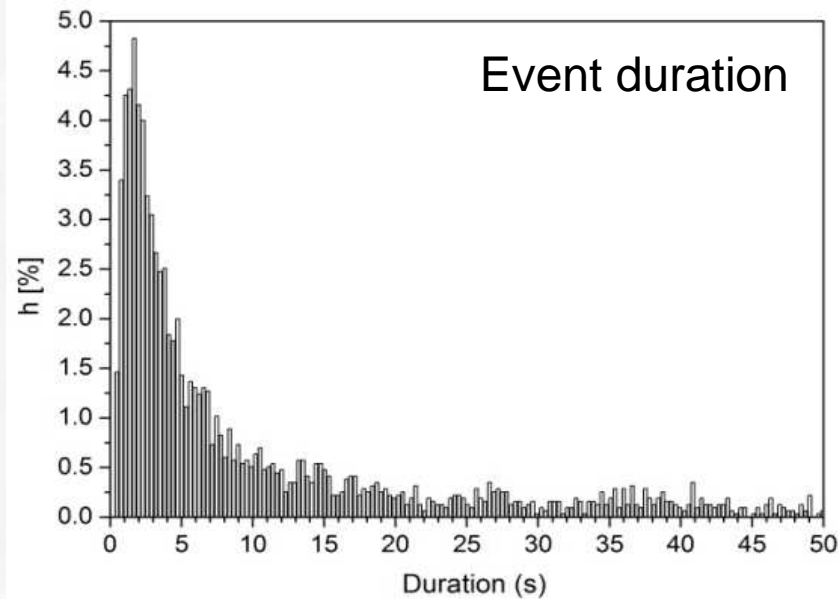
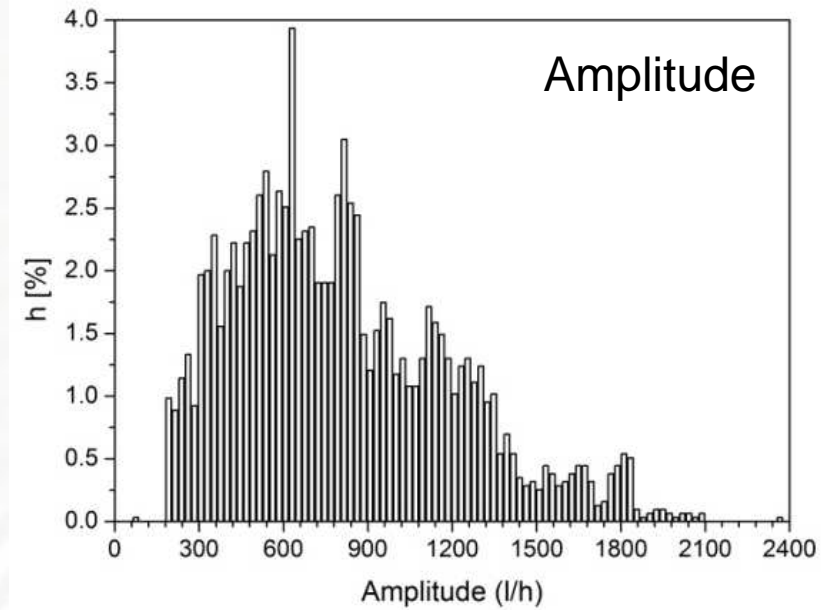
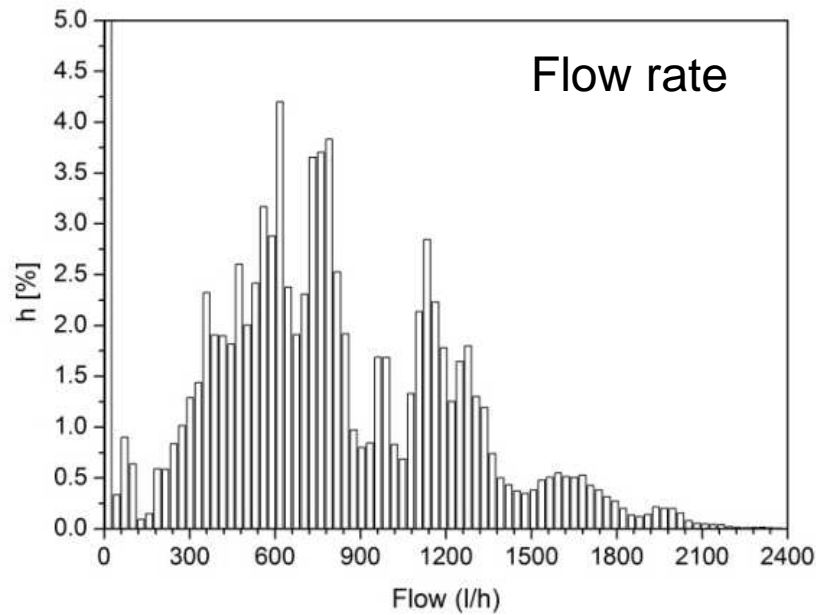


- Total unsteady time is around **5.5%**
- Total unsteady volume consumption is around **6.5%**

These values includes estimated unsteady portions of the multiple amplitude events.

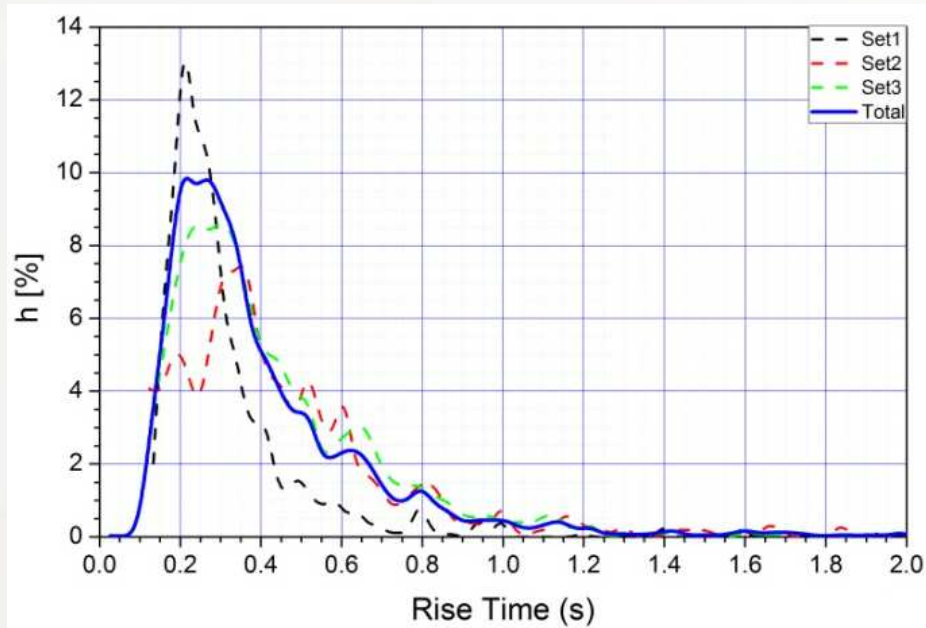
4	Total
	3200
0.3	446 - 13.9
3	15.1
3	21.05
6	1.83
4	2.25
3	1.87
2	2.96
6	4.72
99	23.68
90	0.433
10	0.533

Results

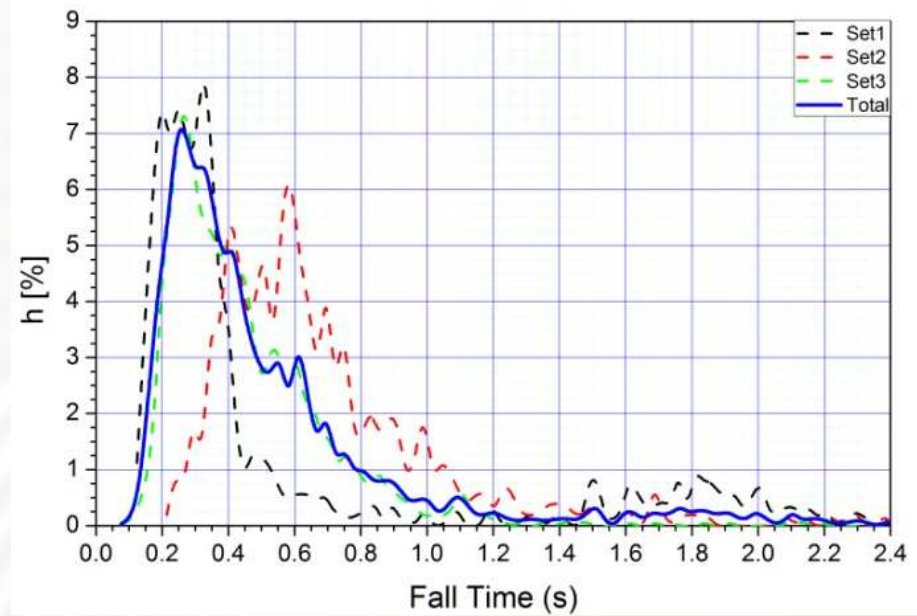


Results

Rise time



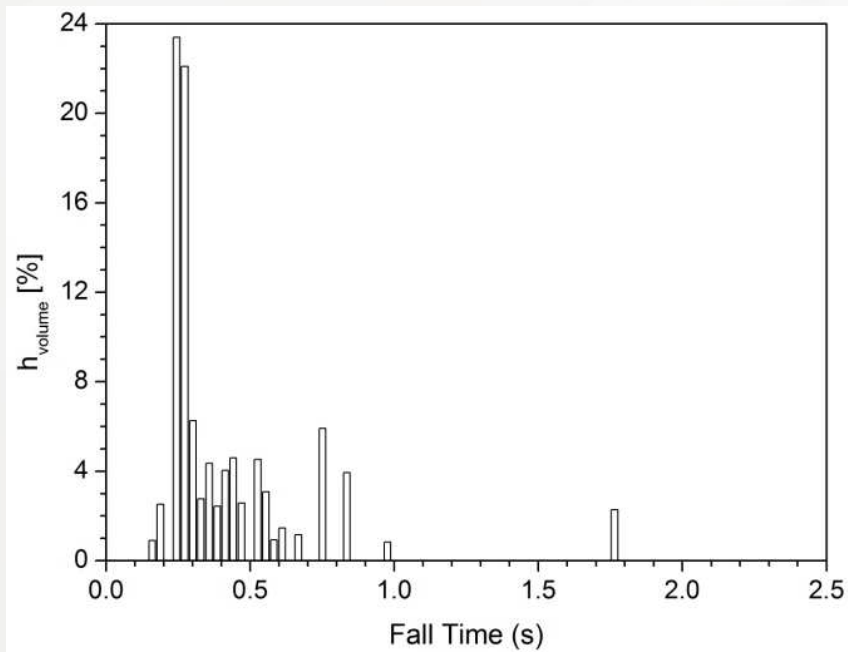
Fall time



Results

Cross distributions:

Fall time vs total volume of events



Fall time interval [s]	h[%]	h _{duration} [%]	h _{volume} [%]
0.05 – 0.2	7.62	4.2	3.42
0.2 – 0.4	42.6	34.56	61.3
0.4 – 0.6	23.02	24.89	19.72
0.6 – 0.8	12.73	16.67	8.54
0.8 – 1	4.95	5.21	4.75
1 – 3.5	9.08	14.46	2.27

Rise time interval [s]	h[%]	h _{duration} [%]	h _{volume} [%]
0.05 – 0.2	10.1	8.15	≈ 0.01
0.2 – 0.4	57.5	43.12	54.94
0.4 – 0.6	15.2	23.09	17.22
0.6 – 0.8	9.6	13.45	8.71
0.8 – 1	3.4	3.54	0.68
1 – 3.5	4.25	8.64	18.45

Future Work

- ✓ Consumption profile measurements
- ✓ Development of dynamic test-rigs to simulate consumption profiles
- ✓ Intercomparisons of test rigs
- ✓ Testing various water meters under simulated consumption profiles
- ✓ Dynamic/static aging tests of water meters with realistic conditions (e.g. hardness, particles and PH)
- ✓ Leak measurement and detecting
- ✓ Virtual flow meter



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Thank you...