A novel approach to tracking sewer inflow and infiltration

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HSY water sector in a nutshell

- **HSY**: We produce and organise water services, waste management services and environmental regional information
- **Water services**: raw water treatment and distribution, waste water collection and treatment, investments required by city growth
- **Operation area:** Espoo, Helsinki, Kauniainen, and Vantaa, and some other municipalities via separate agreements (1,1 Million inhabitants)
- **Net revenue** 240 Million Euros
- **Investments** 135 Million Euros
- **Infrastructure**:
  - 2 Water Treatment Plants
  - 2 Waste Water Treatment Plants
  - Pipeline networks 8500 km (water 3100, waste water 2800, storm water 2600)
  - 550 Waste Water Pumping Stations
  - 12 Watertowers

SmartWater (ÄlykäsVesi) as a part of HSY's REPA project

- HSY's own consortium of projects
- SmartWater (ÄlykäsVesi) is focused on data management of the networks
- Goal is to produce new tool in collaboration with companies

- Almost 3 years execution time
- Budget 660 000 €, under the auspices of Tekes
- Innovatiiviset Julkiset Hankinnat (IJH) – financing program

SmartWater (ÄlykäsVesi), goals and filosophy in long term

- Reliable and adequate data from the network (flow, pressure, etc.) should be as the basis
- Integrated data systems -> integrating existing data sources -> new knowledge
- New knowledge -> new tools:
  - Identifying leakage and I/I
  - Allocating renovations
  - Managing network's capacity
  - Scenario tools
  - Compensating to the climate change

Sewer condition management in HSY

- Sewer pipe lines approx. 2800 km
  - Only a small proportion is renovated (less than 0,5 % annually)
  - Slow process with currenty used methods

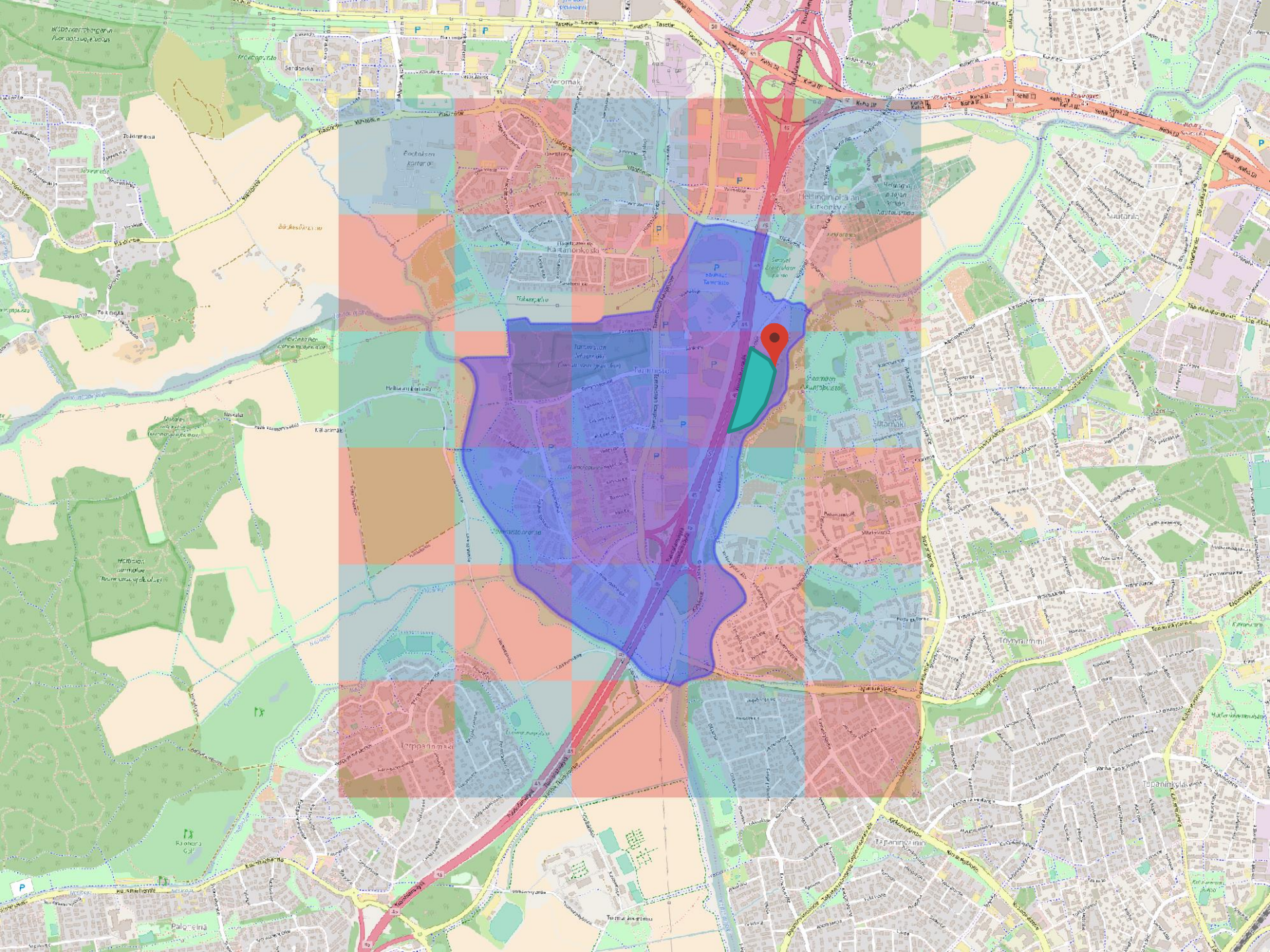
- Traditional CCTV inspection
  - Appr. 120 km annually
  - Manually operated and analyzed
  - Slow
  - Subjective

- Need for tools to get a faster overview of the network
  - Data analysis
  - Digitalizing the inspections
  - Machine learning techniques
  - …

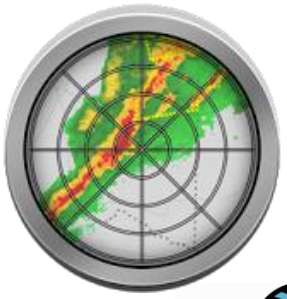
Objective

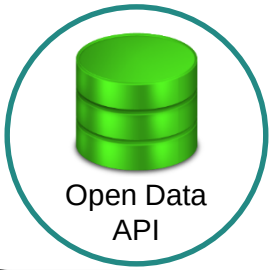
- A novel approach to tracking sewer inflow and infiltration
- Develop and demonstrate an approach for automate quantification and tracking of sewer inflow and infiltration components.
- Approach:
  - Uses operational data already being collected
  - Combines existing and published data analysis methods
  - Automated and continuous


Pumping station
(first analysis)
Siltamäen liikuntapuisto
Vantaa
Tammistonmäentie
Kirkkotie
Keravanjoki
Trapaninkyläntie
Vanha Tuusulantie
45
5
2D
Google
Imagery ©2017 Google, Map data ©2017 Google
Terms
www.google.com/maps
Send feedback
100 m


Veromäki
Tammisto
Kartanonkoski
Suutarila
Siltamäki
Töyrynummi
Tepanrinkylä
Palopelma

Data flow



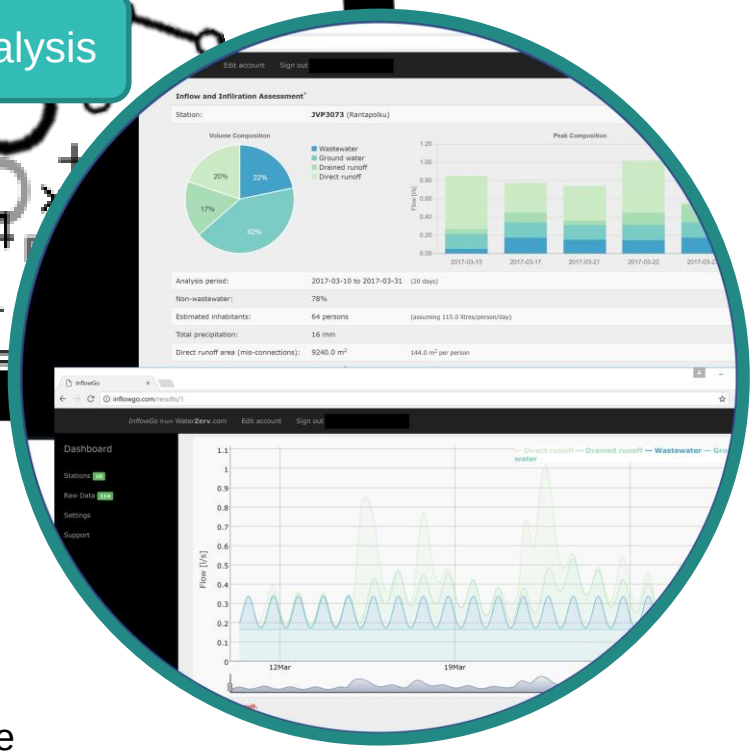


FINNISH METEOROLOGICAL INSTITUTE

Precipitation rate
(via web service)

Hourly

Analysis



Hourly

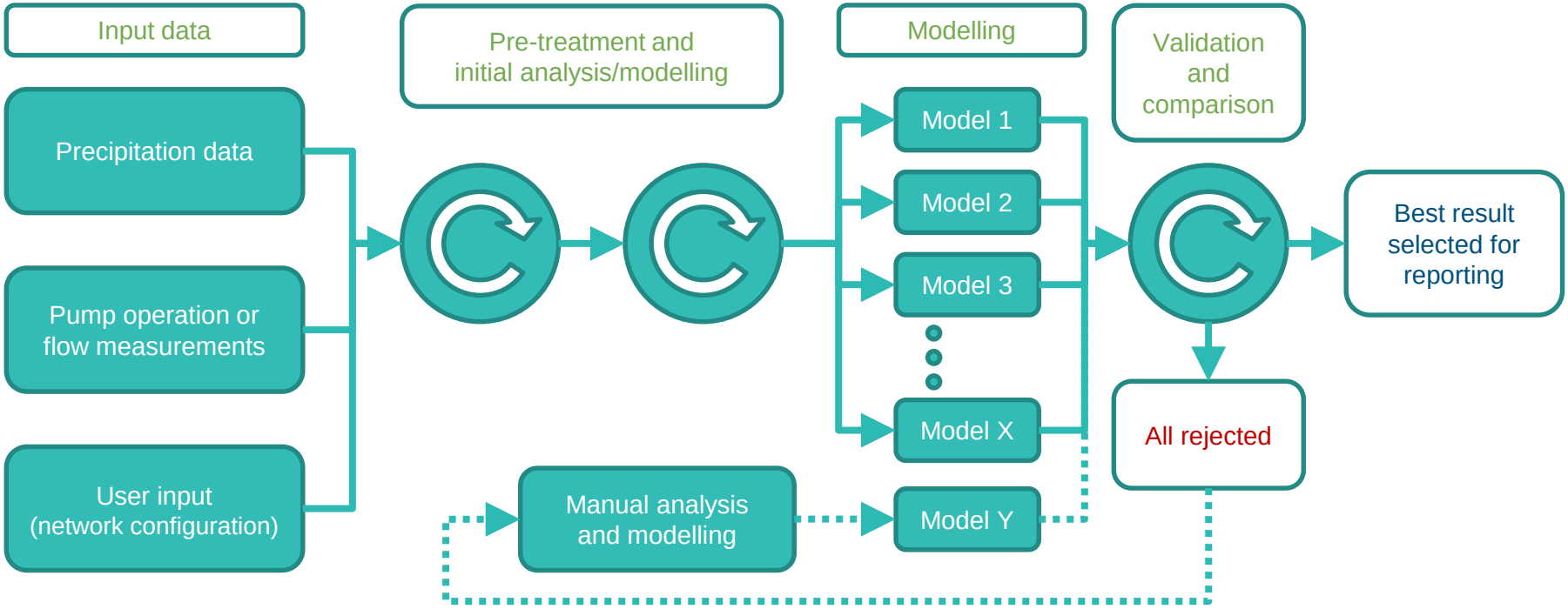
HSY

Pumping station data:
- level measurements
- pump activations
- cumulated pumping time

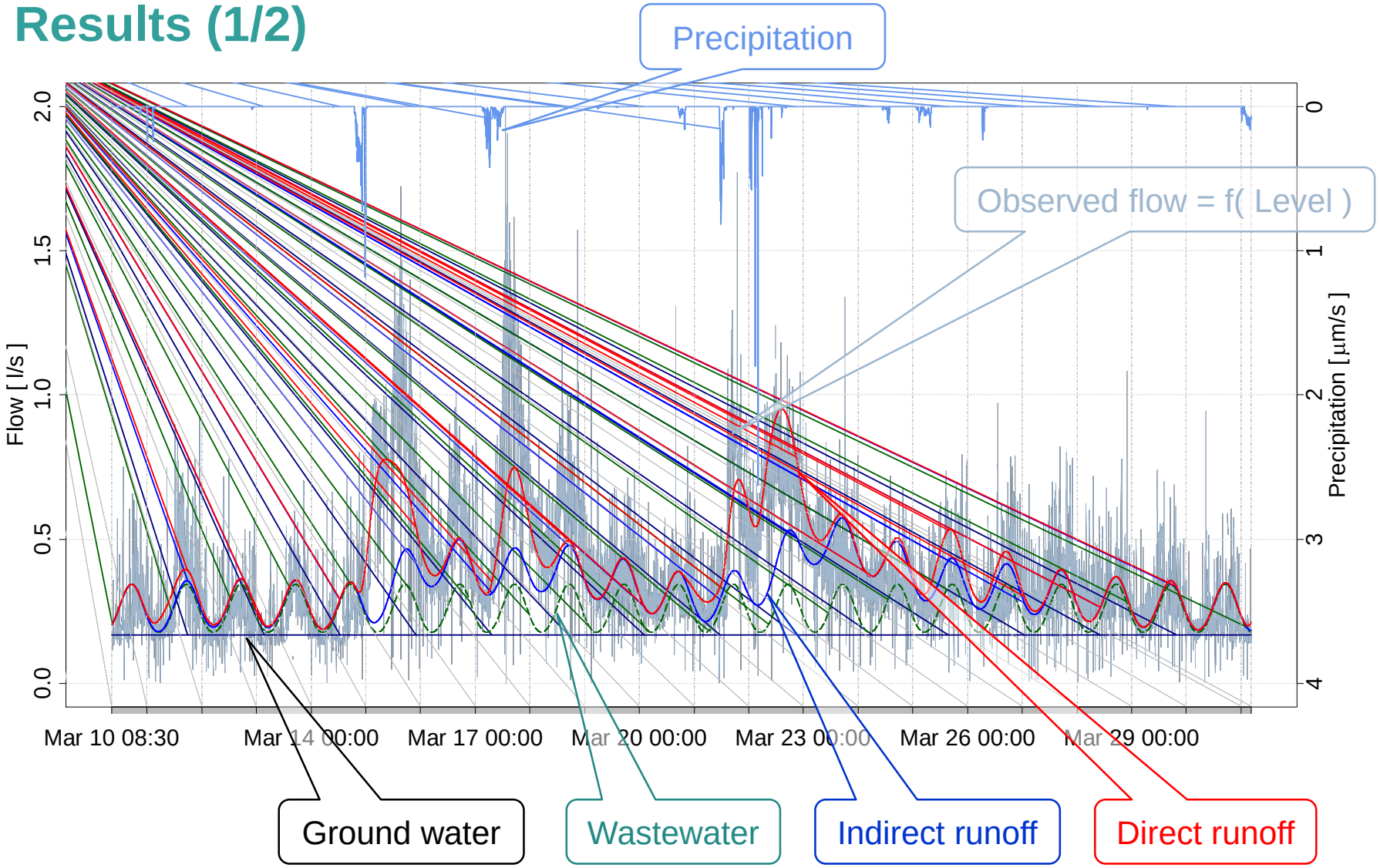
(via ftp)

Improved information for wastewater asset management and operations.

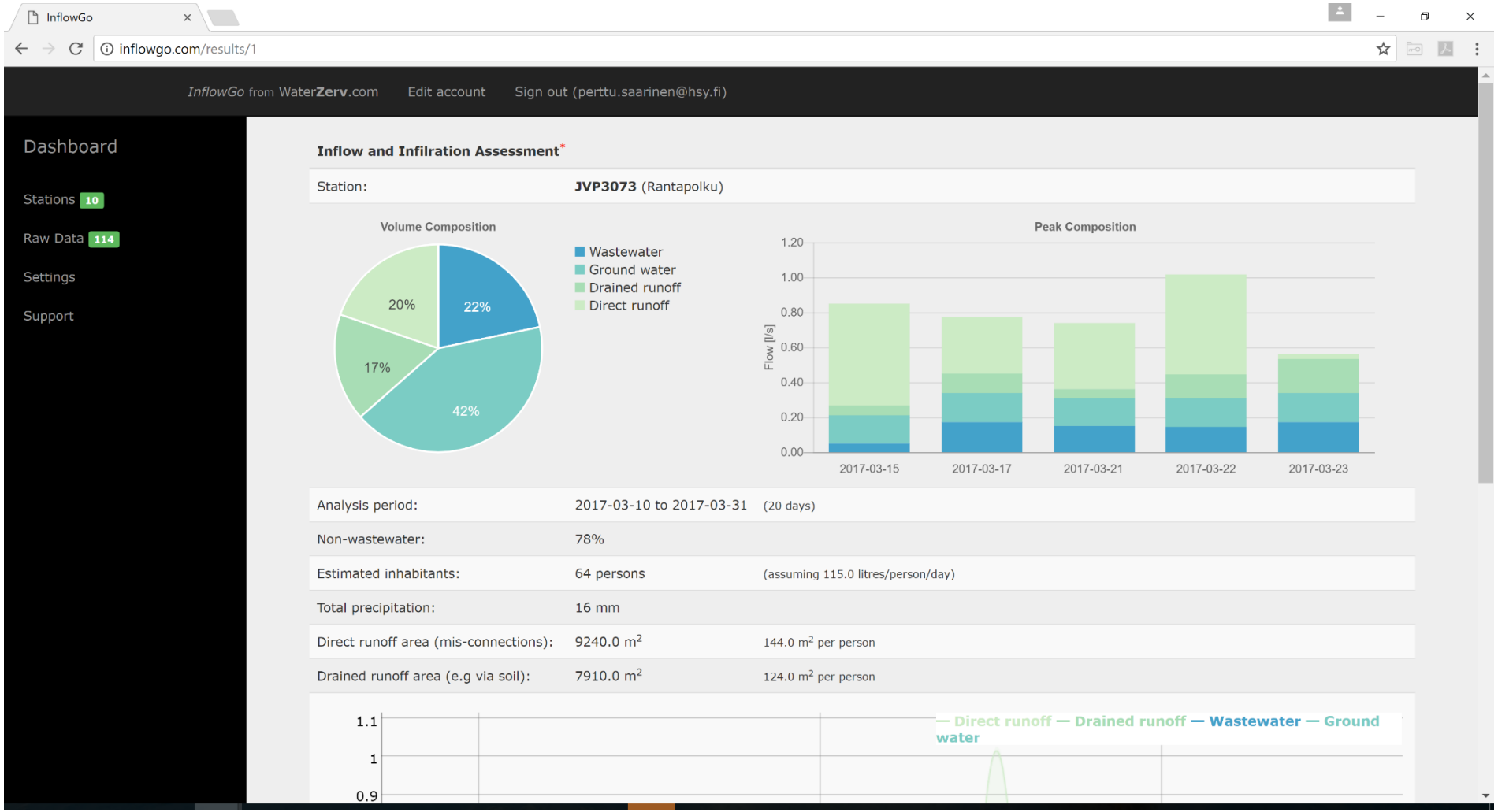
Analysis approach and automation



Results (1/2)


Precipitation
Observed flow = f(Level)
Flow [l/s]
Precipitation [µm/s]
0.0
0.5
1.0
1.5
2.0
0
1
2
3
4
Mar 10 08:30
Mar 14 00:00
Mar 17 00:00
Mar 20 00:00
Mar 23 00:00
Mar 26 00:00
Mar 29 00:00
Ground water
Wastewater
Indirect runoff
Direct runoff

Results (2/2), results in *InflowGo*



Preliminary conclusions

- Inflow and infiltration components found using existing data sources
- Preliminary results promising

Further work

- Experience from more pumping stations
- Experience from longer periods
- Add snow/slush-melt processes
- Long term ground water variations
- Alternative modelling approaches and model structures
- Trend detection and rehabilitation impact assessment
- …