Leuven case study

International workshop & project meeting Leuven,
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Johan Van Assel (Aquafin)
Laurens Cas Decloedt, Patrick Willems (KU Leuven)

National partners involved

- WP1
  - Radar
    - Owned by Aquafin
    - Operated jointly by Aquafin and KU Leuven
    - Technical Service and Maintenance : DHI (DK)
  - Raingauges
    - Existing raingauge netwerk owned and operated by Aquafin
    - Additional raingauges + new telemetry system owned and operated by Aquafin
- WP2
  - All radar and raingauge data analysis and calibration by KU Leuven
  - All rainfall forecast calculations by KU Leuven
  - Data collection and transformation to model input by Aquafin

National partners involved (2)

- WP3
  - Flood and forecast modelling by Aquafin
  - Provision of data for model update and validation :
    - Municipalities of Leuven and Herent (Observers)
  - Provision of realtime and forecast watercourse data (still to be discussed)
    - Flemish Environmental Agency (VMM) (Observer)
- WP4
  - Flood forecast and management system setup by Aquafin
  - Advise and support by National Observers Group

LAWR City Radar

- Marine X band technology (type Furuno) operating at 9.41GHz with a wavelength of 3.2cm, pulse length of 0.8µs and peak output of 4kW
- Logarithmic receiver with a 0.4m radome antenna
- Vertical opening angle of 20°(lower half is cut of by pit wall) horizontal opening angle of 4°(only 1 elevation)
- Range of 15km for qualitative precipitation estimation (QPE) and 30km for forecasting rainfall
- Spatial resolution of 250x250m (range: 30km) up to 50x50m (range: 7.5km)
- Temporal resolution of 1 or 5 minutes (1 minute is used) with 450 samples per rotation and 24 rpm

LAWR City Radar (2)

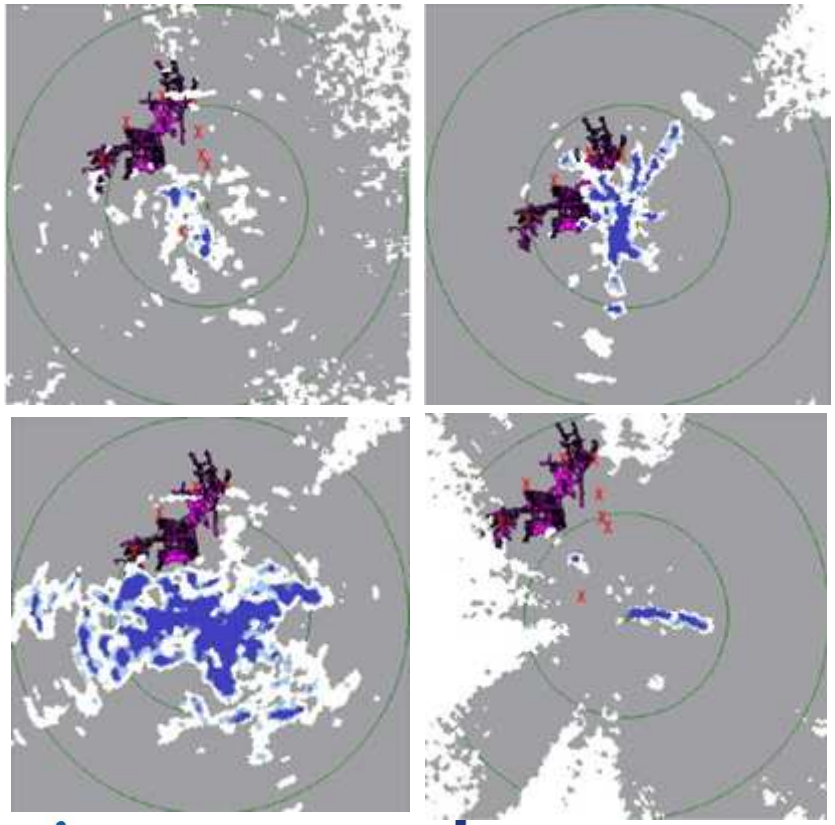
Location : Province building

- Chosen after initial clutter tests 2007
- Advantages :
  - highest building in surroundings
  - power, broadband available,
  - roof acts as natural clutter fence
- Disadvantages :
  - blind sectors due to
    - proximity of airport (obligatory)
    - maintenance crane on roof (de facto)
  - access on request

LAWR City Radar (3)

Blinding and natural clutter fence on rooftop

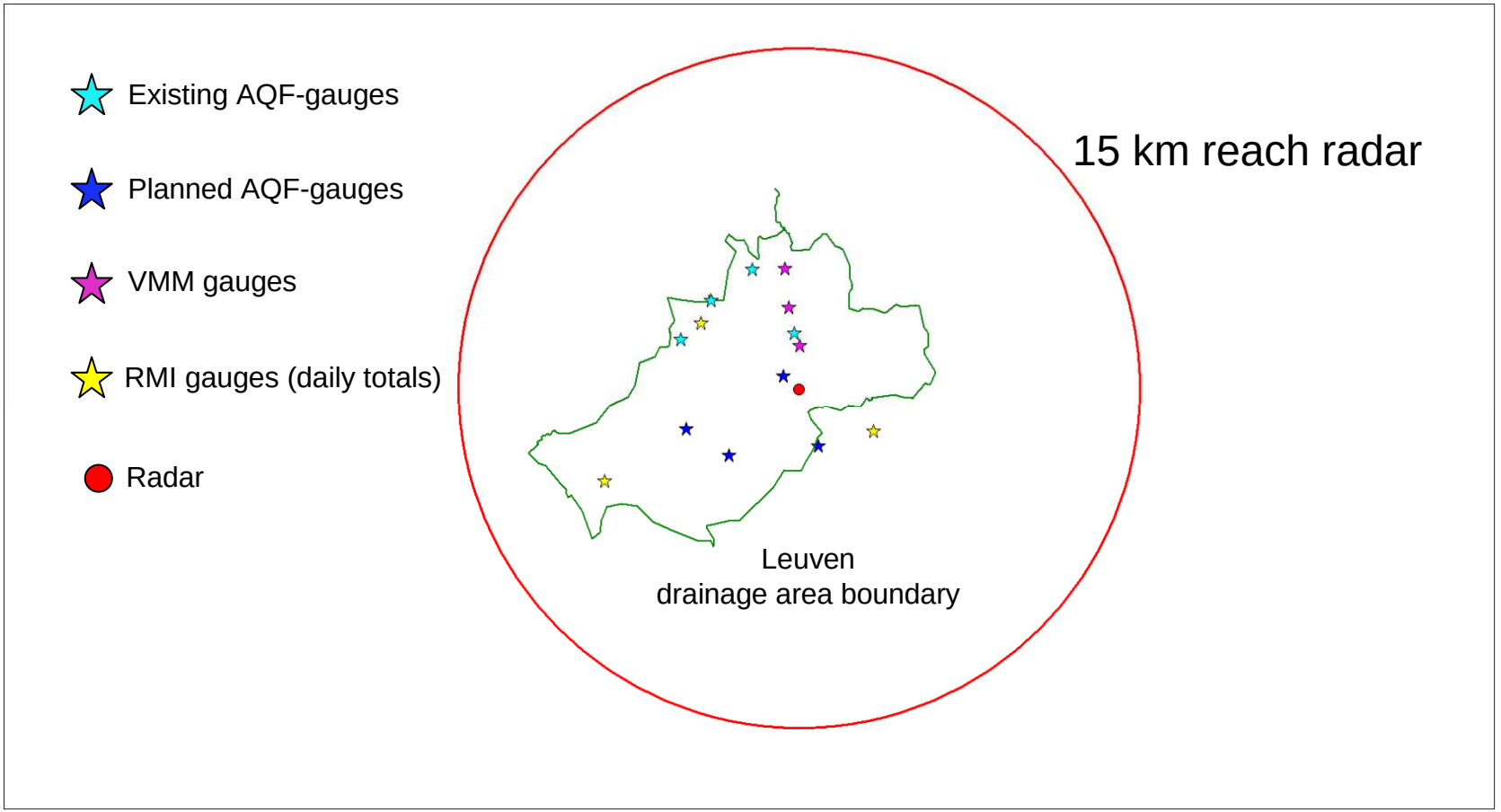
Comparison of clutter at various candidate locations



Rain gauge network

- Aquafin rain gauge network
  - Currently 4 gauges; to be extended to 8 shortly
  - Realtime data retrieval to be installed shortly
  - TBR 0.2 mm – 2 min interval
  - Dynamic calibration carried out by KU Leuven (2007) (correction for tipping losses)
  - Wind effect corrections to be investigated
- RMI rain gauge network
  - 3 gauges within appr. 10 km distance
  - Daily totals (only for historic data -no subscription)
  - 0.1 mm resolution
  - Used for historic validation and wind effect calibration
- VMM rain gauge network
  - 3 gauges linked to CSO Monitoring scheme
  - Monthly data exchange
  - TBR 0.2 mm – 10 min interval
- Other
  - used in river flood forecast systems
  - Availability of data to be investigated

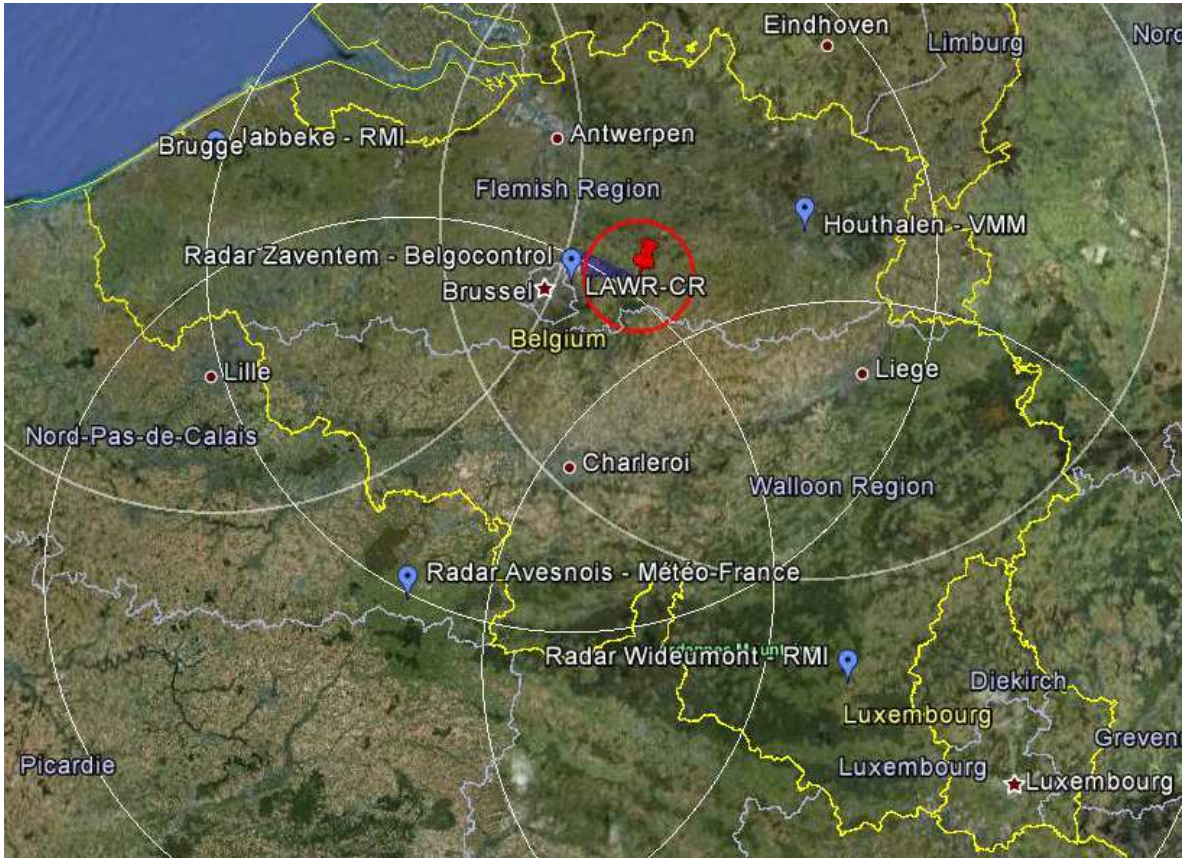
Rain gauge network



Other radars

- RMI
  - Existing C-band radars in Zaventem (owned by Belgocontrol) and Wideumont
  - Startup (test) of new dual pol C-band radar in Jabbeke
- VMM
  - New dual pol C-band radar planned in Houthalen (timing : end 2013?)
  - Subscription to realtime Belgian-Dutch-French composite data

Other radars

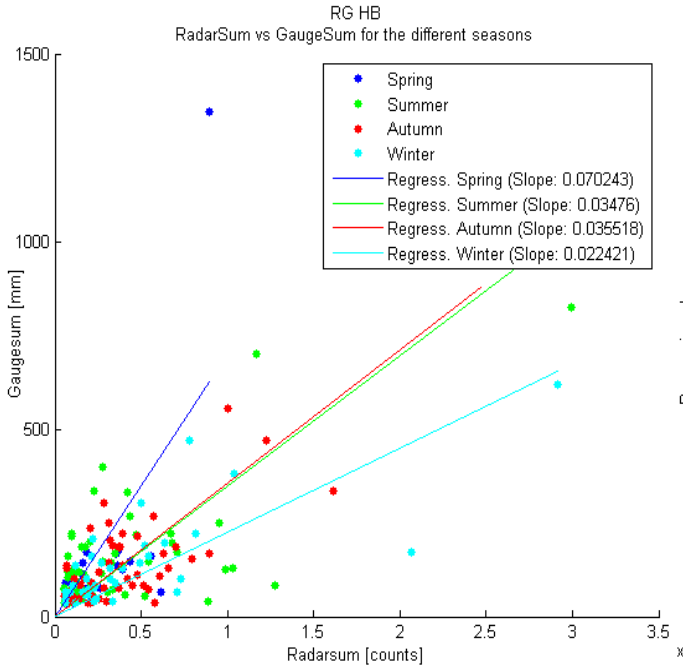


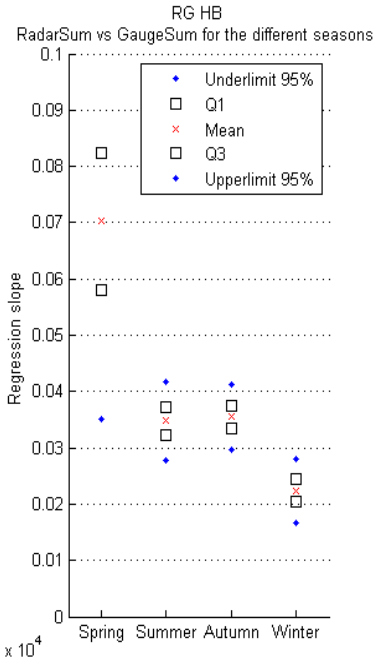
Radar calibration activities

- Extra parameters influencing the radar-rain gauge relationship investigated:
  - Seasonal variance
  - Convective or stratiform nature
  - Mean rainfall intensity
  - Wind speed & direction
  - Temperature
  - Size of precipitating system
- Extra algorithms implemented and adapted to obtain extra parameters
  - Convective stratiform separation algorithm (Steiner et al. 1995)
  - Cloud movement and direction algorithm
- Significant correlations for some parameters

Influential parameters

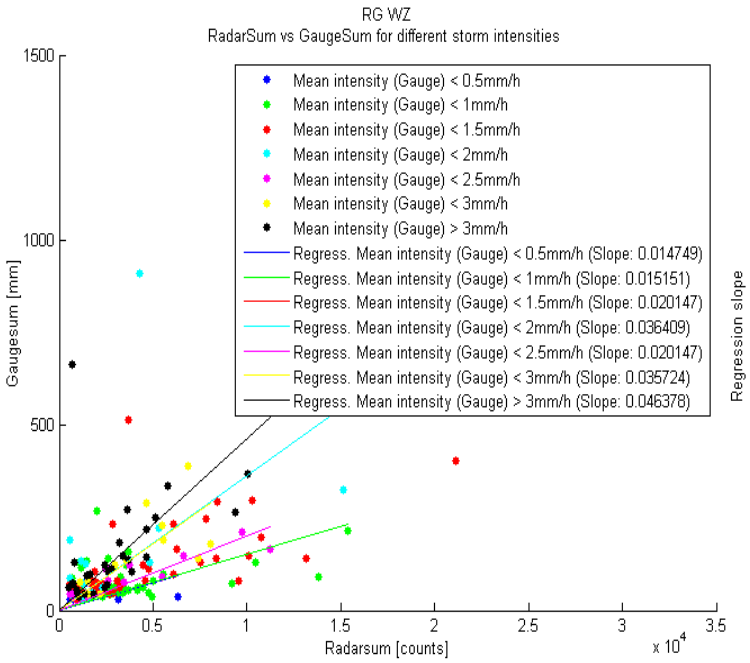
- Season:
  - Spring higher, summer and autumn similar and winter lower
  - Supports Convective / Stratiform separation algorithm
- Direction:
  - Nearly no East
  - West & North similar
  - South higher
- Velocities within direction:
  - West: increasing relation found

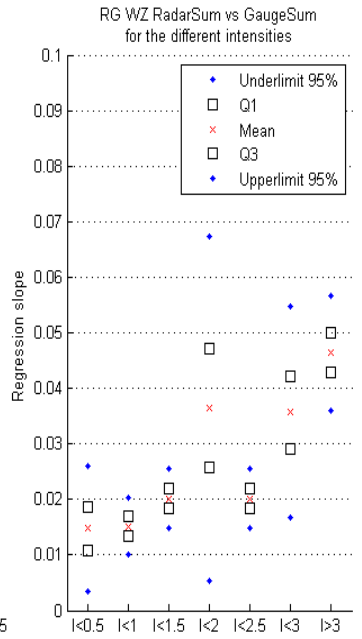




Influential parameters

- Area:
  - No increasing relation, however, for relative radar filling levels within 40-50%, a higher relation is eminent
  - Supports Convective / Stratiform separation algorithm
- Temperature:
  - T <10°lower,
  - 10°< T<20°higher
  - T > 20°mean
  - Supports Conv./Strat.
- Intensities:
  - Increasing relation, but not super clear





Sewer system

- Drainage area Leuven
  - Central WWTP : approx. 120000-150000 PE
  - Approx. 120 km²
  - Spread over 6 municipalities
    - Leuven, Herent, Bertem, Lubbeek, Holsbeek, Oud-Heverlee
  - Characteristics :
    - Combination of moderately steep parts and flat valleys
    - Storage trunk sewers, as well as pumps+rising mains
    - Mostly combined; separate in new developments or recent project areas

Drainage area

– 2 main sub-areas : North (approx. 30000 PE) – South (approx. 120000 PE)

– North : all major drainage projects completed
  - Case study for first phase

– South : some major projects still planned/under construction
  - (largely) to be included in second phase case study

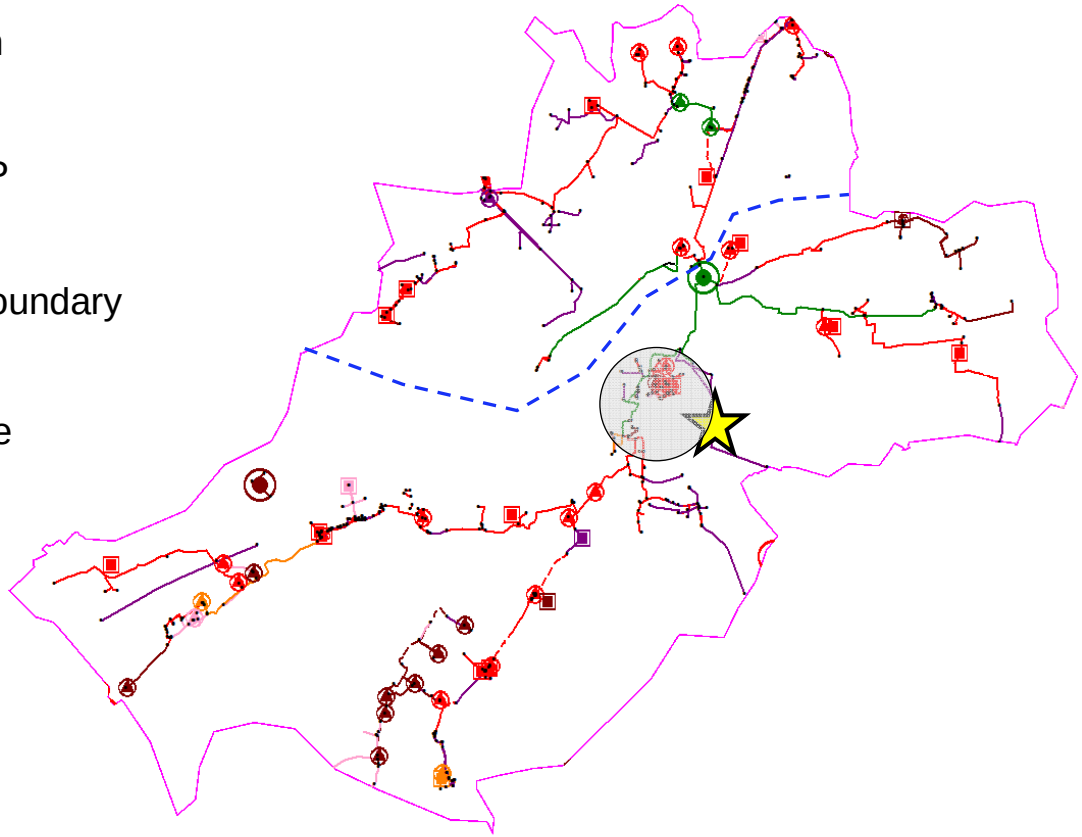
Drainage area

Radar location

Central WWTP

North/south boundary

Leuven Centre



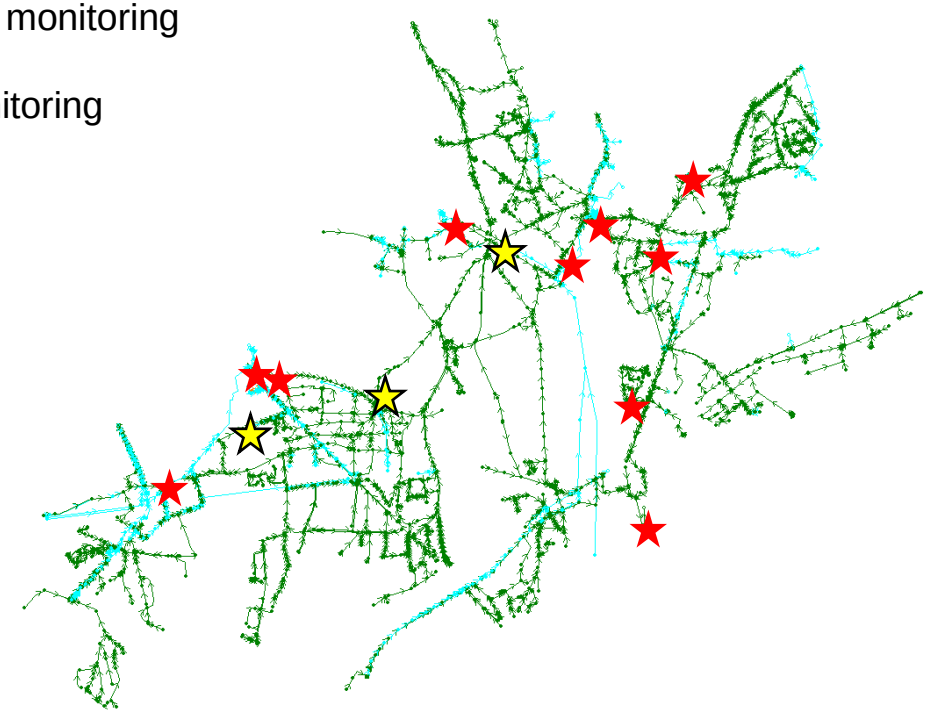
Monitoring campaigns

- Northern part
  - Monitoring at certain locations since 2005
    - Flow, depth, CSO spills, pump operation
  - Most data not available in realtime
    - Used for historic model verification
- Southern part
  - Very little monitoring at present
  - RTC pilot implementation underway in Kessel-Lo area (close to WWTP)

Monitoring in northern part

☆ Flow and depth monitoring

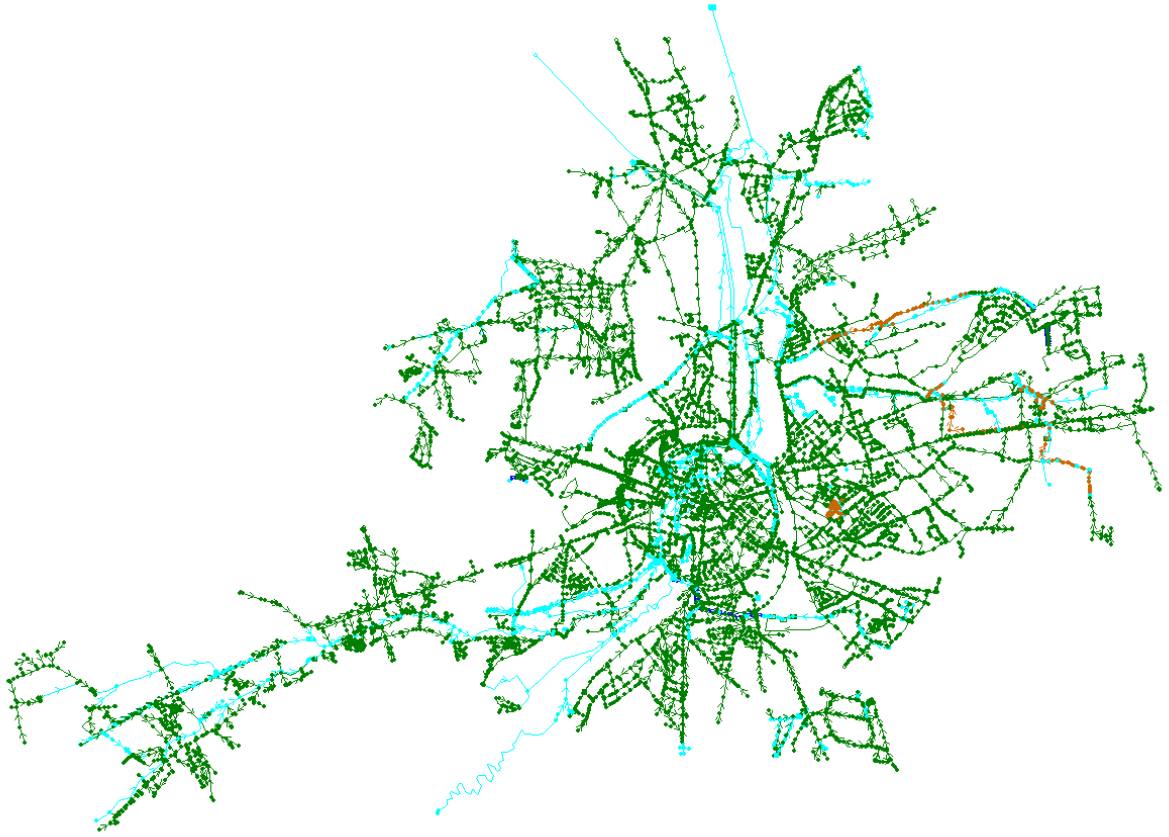
★ Depth only monitoring



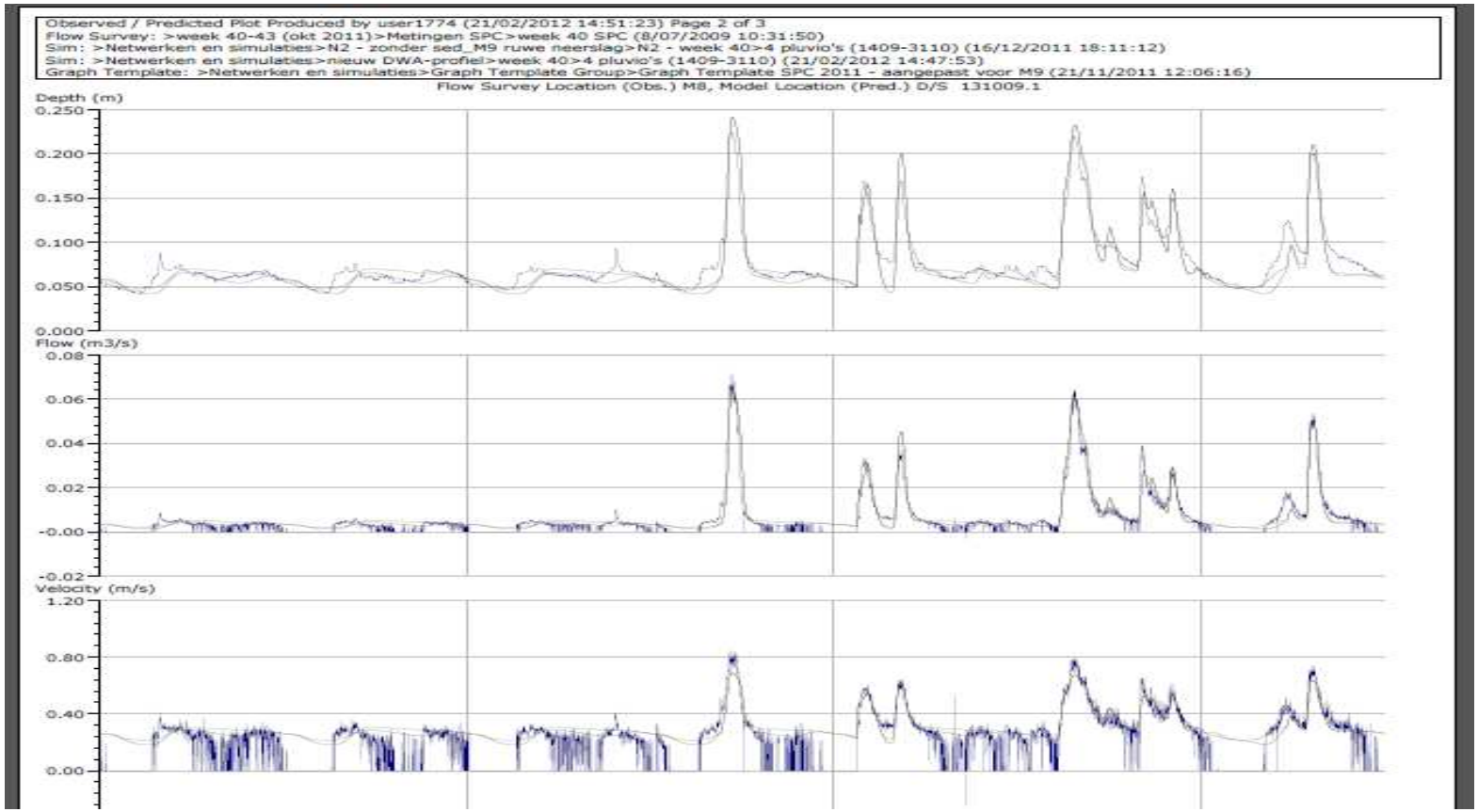
Sewer modelling

- Existing model
  - Detailed models available for almost all of the area (InfoWorks CS)
  - Not all areas equally up-to-date
    - Recent local sewer projects to be obtained from various municipalities
    - Contributing areas to be checked
  - Model verification for some areas (especially in southern part) almost 10 years old

Existing model



Recent model verification (raingauges only)



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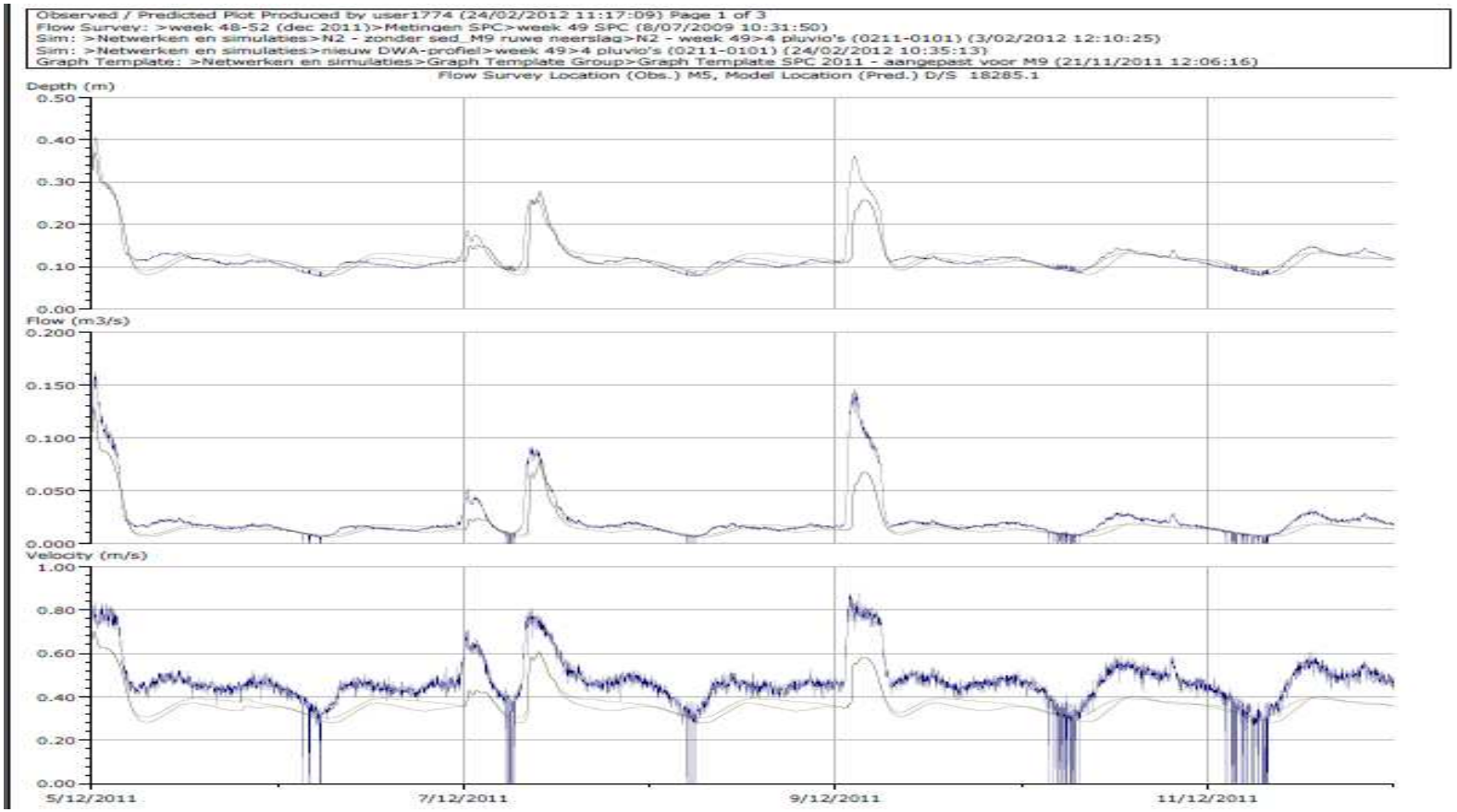
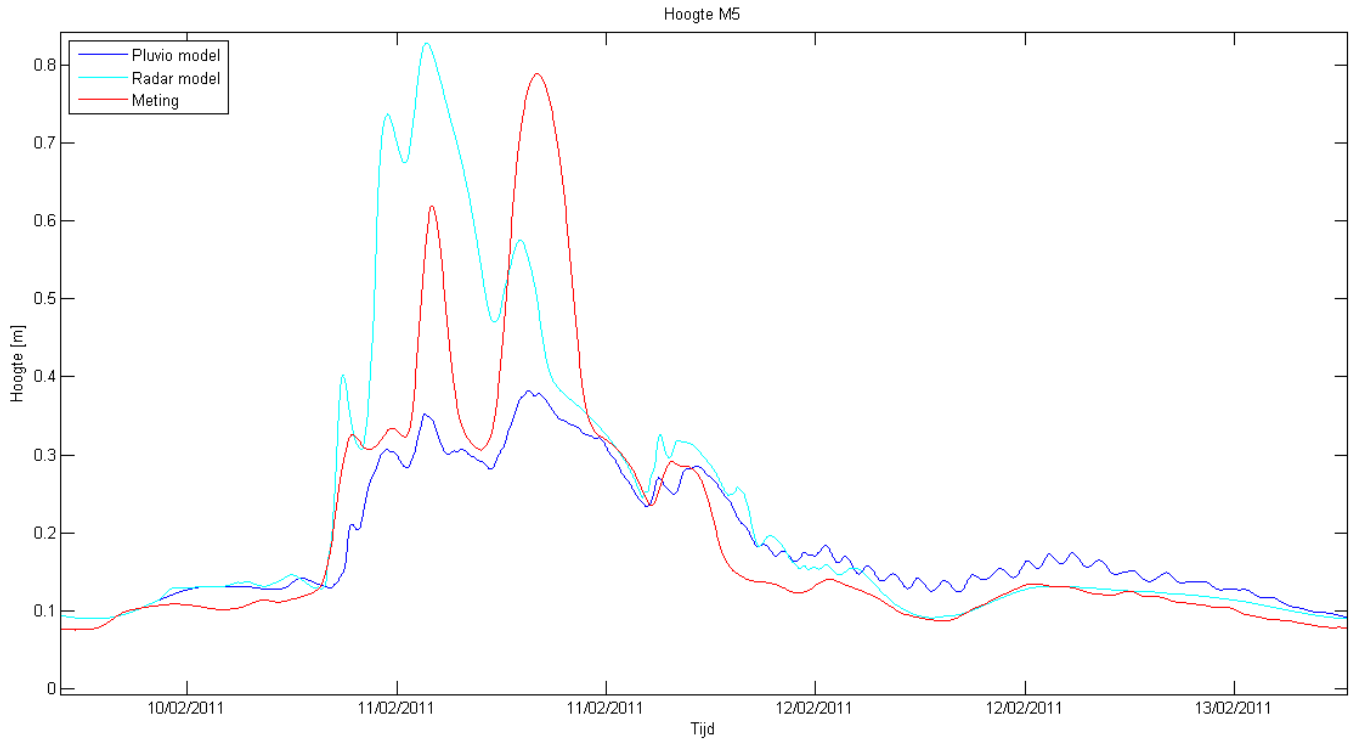


Comparison radar vs. raingauges input



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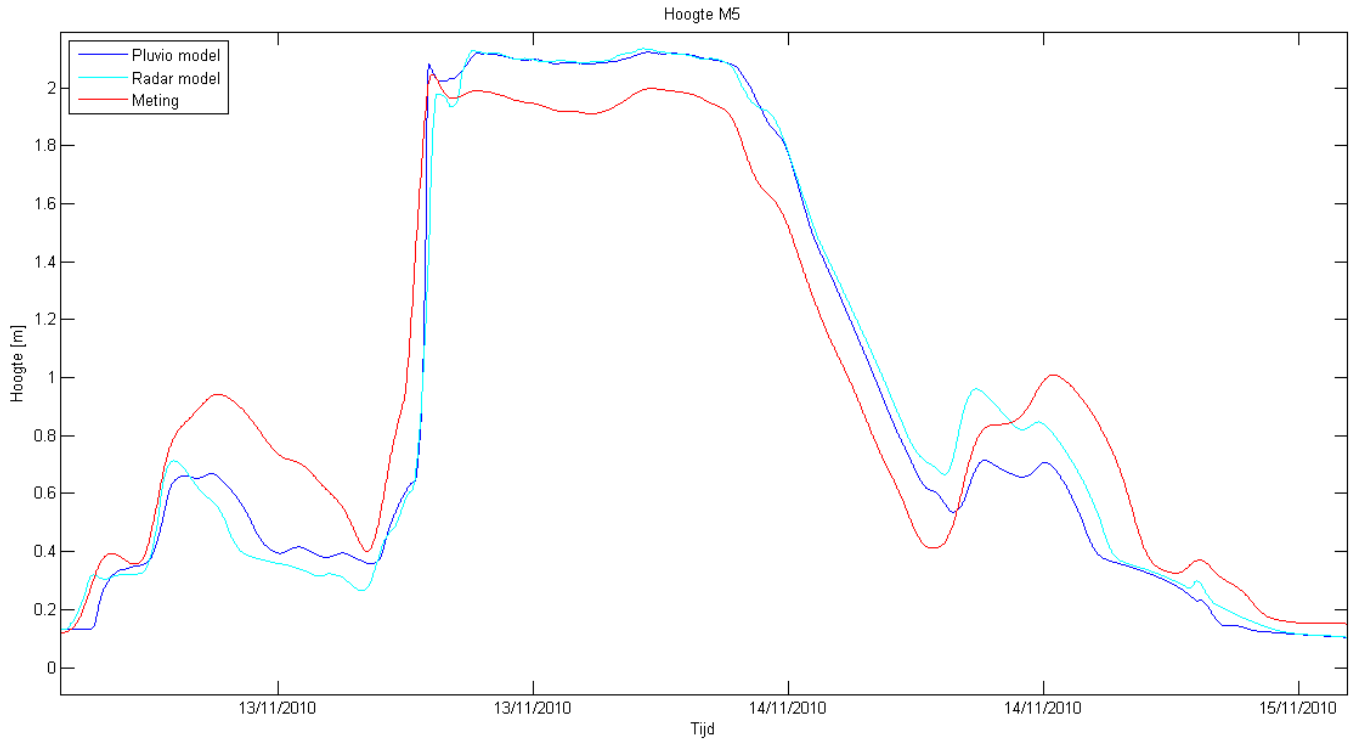

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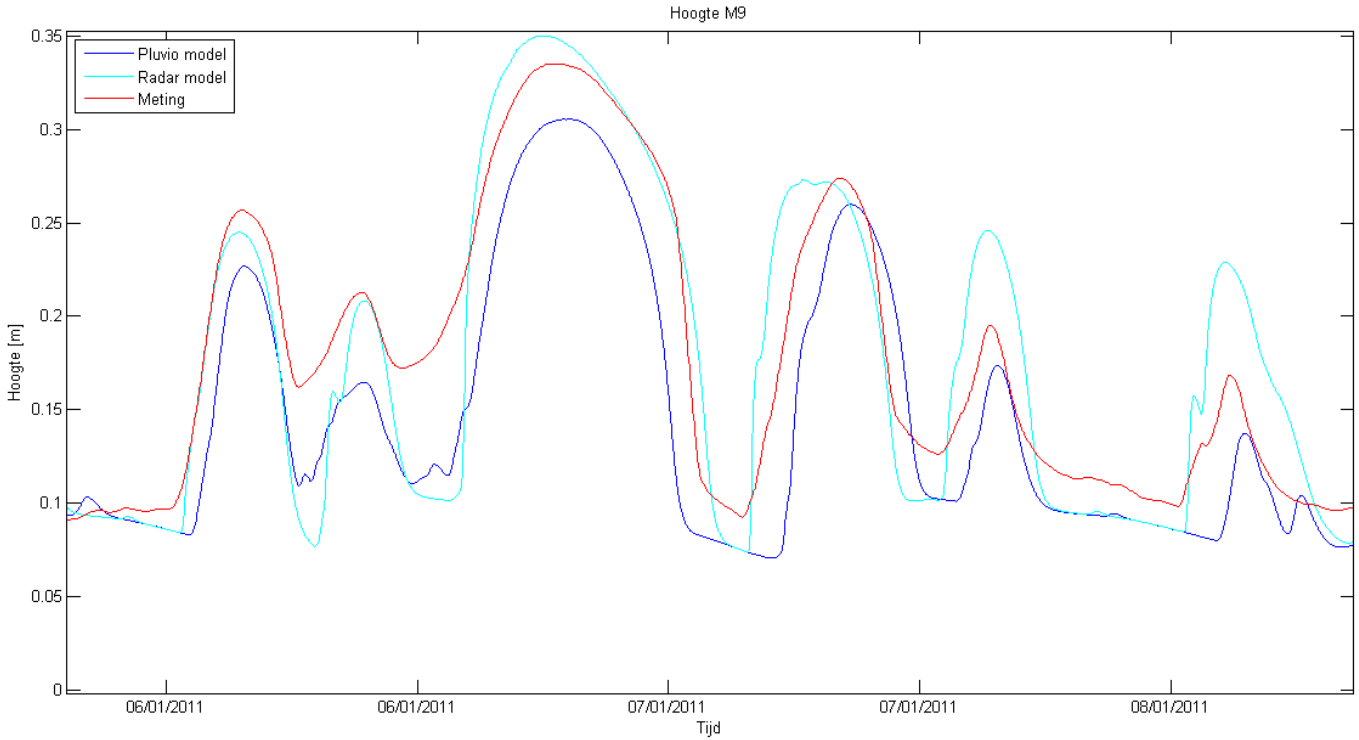

Main issues in the area

- List of problem areas (flooding) discussed with Herent and Leuven
  - Some typical urban floods
    - Due to sewer undercapacity, interaction with (small) receiving watercourses
  - Some locations due to pervious area runoff
    - Overland runoff from agricultural areas etc. drains to sewer
    - Highly dependent on seasonal variations (soil wetness, …)
  - Sewer / watercourse interaction important to take into account
    - Obtain and integrate real time predictions from VMM ?
- CSO spill reduction
  - Second priority after flood prevention
  - To be optimised by using RTC
- PS optimisation
  - Make sure all pumping stations are conform with minimal operational performance requirements

Planned activities for next 6 months

- WP1
  - Install new raingauges and telemetry system
  - Write and test scripts for realtime radar data retrieval and processing
  - Create first prototype of radar web viewer (limited access)
- WP2
  - Improve radar calibration
  - Additional raingauge calibration
- WP3
  - Continue detailed validation of northern part based on permanent monitoring
  - Extend (parts of) existing model with 2D data (DTM, detailed background map)
  - Try out various approaches of flood modelling
  - First trials with FloodWorks (forecast model)
- WP4
  - Follow up actions from first NOG meeting