

# Experiences

& challenges in the implementation  
of InfoWorks ICMlive for real time

surface water flood  
forecasting

in Leuven, Belgium



# Experiences & challenges

in the

implementation of

## InfoWorks ICMlive

for

## real time

surface water flood forecasting  
in Leuven, Belgium



# What is ICMlive?

**InfoWorks<sup>®</sup> CS**      collection systems

**+ InfoWorks<sup>®</sup> RS**      river systems

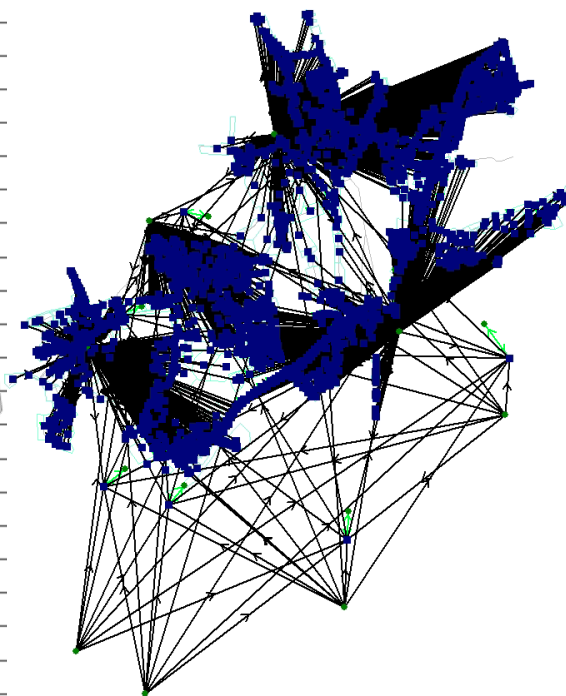
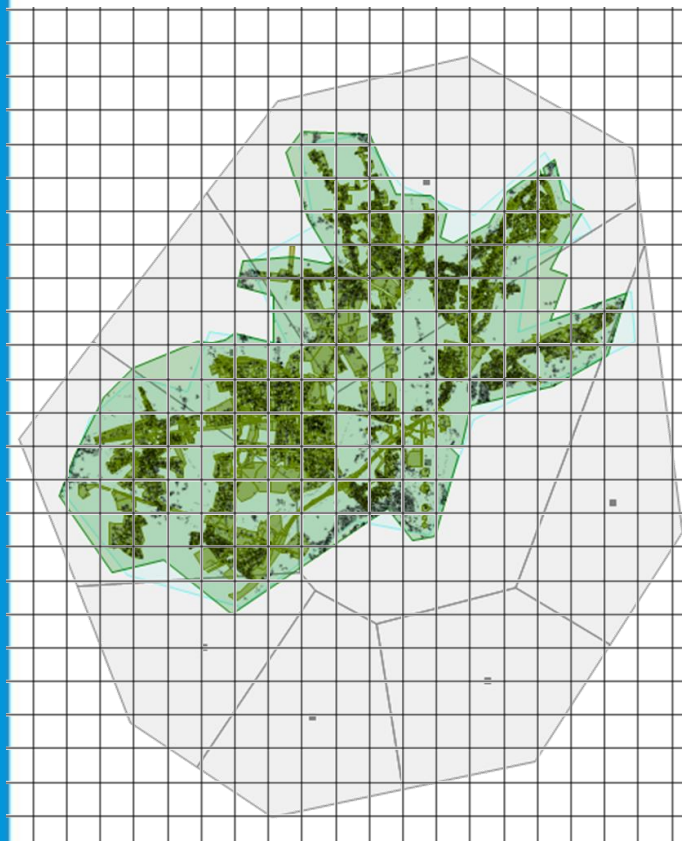
**= InfoWorks<sup>®</sup> ICM**

**+ ICM TSDB<sup>™</sup>**      real time data

**= ICMLive<sup>™</sup>**



# ICMlive = Floodworks = FEWS?



```
<?xml version="1.0" encoding="UTF-8"?>
<workflow xmlns="http://www.wldelft.nl/feWS" xmlns:xsi="http://www.w3.org/2001/XMLSchema"
xsi:schemaLocation="http://www.wldelft.nl/feWS
http://feWS.wldelft.nl/schemas/version1.0/workflow.xsd" version="1.1">
  <!--Run Rhein Interpolation -->
  <activity>
    <runIndependent>true</runIndependent>
    <workflowId>Rhein_Interpolate</workflowId>
  </activity>
  <!--Spatial interpolation from grid to HBV-centroids-->
  <activity>
    <runIndependent>true</runIndependent>
    <moduleId>Rhein_SpatialInterpolationCOSMO-LEPS</moduleId>
    <ensemble>
      <ensembleId>COSMO-LEPS</ensembleId>
      <runInLoop>true</runInLoop>
    </ensemble>
  </activity>
  <!--Aggregate forecast data for display -->
  <activity>
    <runIndependent>true</runIndependent>
    <moduleId>Rhein_AggregateForecast_COSMO-LEPS</moduleId>
    <ensemble>
      <ensembleId>COSMO-LEPS</ensembleId>
      <runInLoop>true</runInLoop>
    </ensemble>
  </activity>
  <!--Disaggregate timeseries at HBV-centroids -->
  <activity>
    <runIndependent>true</runIndependent>
    <moduleId>Rhein_DisaggregateSeriesCOSMO-LEPS</moduleId>
    <ensemble>
      <ensembleId>COSMO-LEPS</ensembleId>
      <runInLoop>true</runInLoop>
    </ensemble>
  </activity>
  <!--Merge timeseries from historical run and forecast run -->
  <activity>
    <runIndependent>true</runIndependent>
    <moduleId>HBV_Rhein_Merge_COSMO-LEPS</moduleId>
    <ensemble>
      <ensembleId>COSMO-LEPS</ensembleId>
      <runInLoop>true</runInLoop>
    </ensemble>
  </activity>
  <!--Aggregate inputs for display -->
  <activity>
    <runIndependent>true</runIndependent>
    <moduleId>HBV_Rhein_AggregateInputs_COSMO-LEPS</moduleId>
    <ensemble>
```

# Sewer network

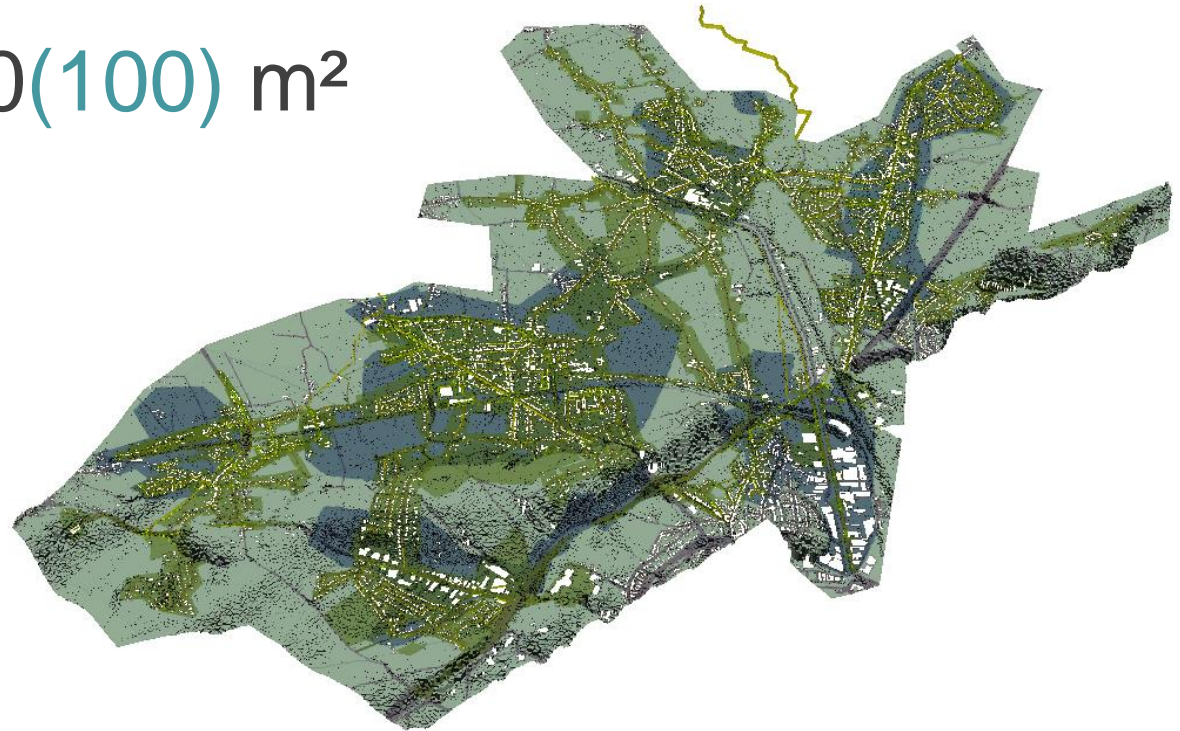
- continuously updated
- 3400 nodes
- 27 400 PE
- 1280 ha





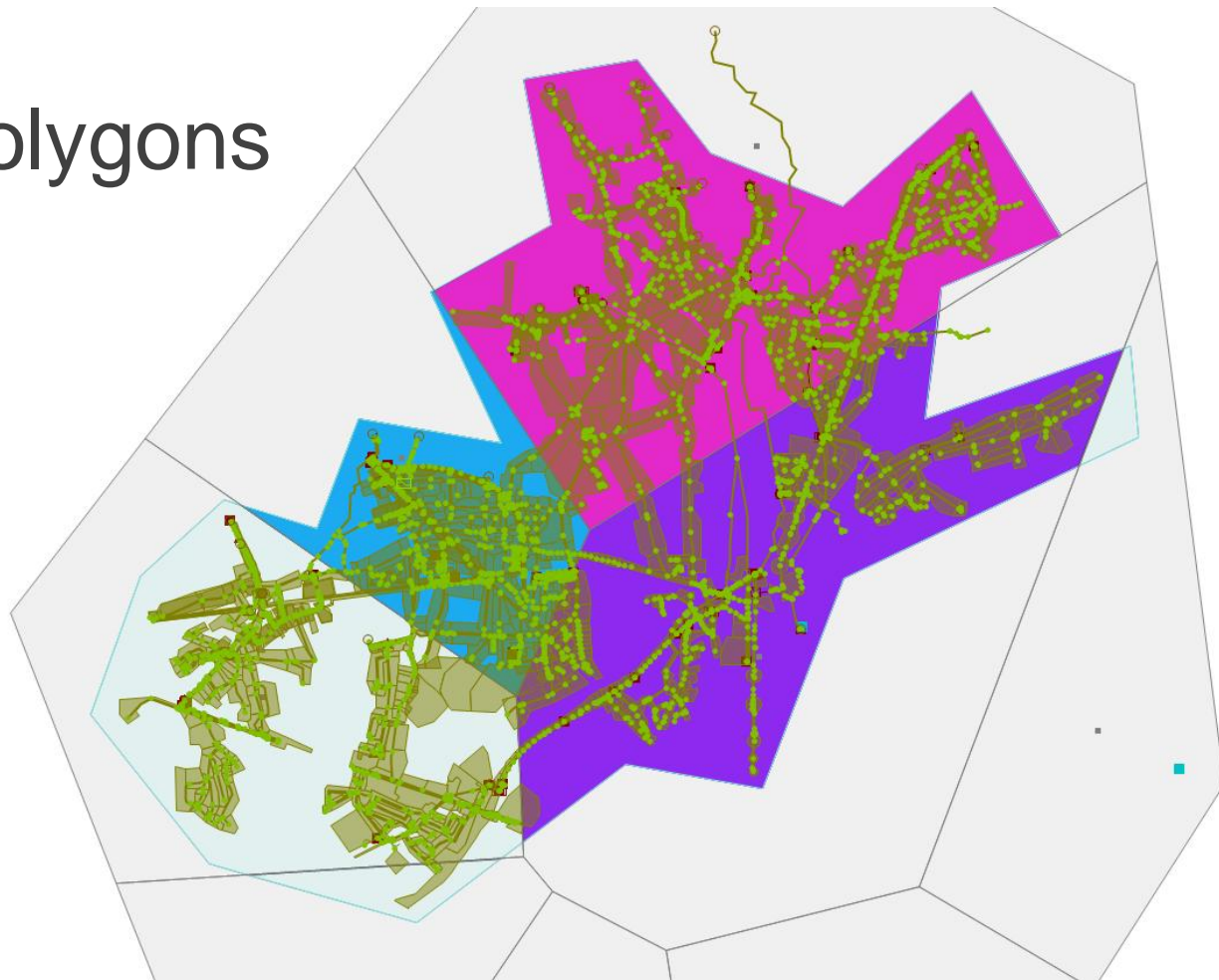
# Surface mesh

- 268 000 elements
- Max size 500(100) m<sup>2</sup>



# Rain gauges

- Thiessen polygons
- 4 (8)
- 12 mm/h
- 1 min
- 2 ... 6 km






# Rain gauges

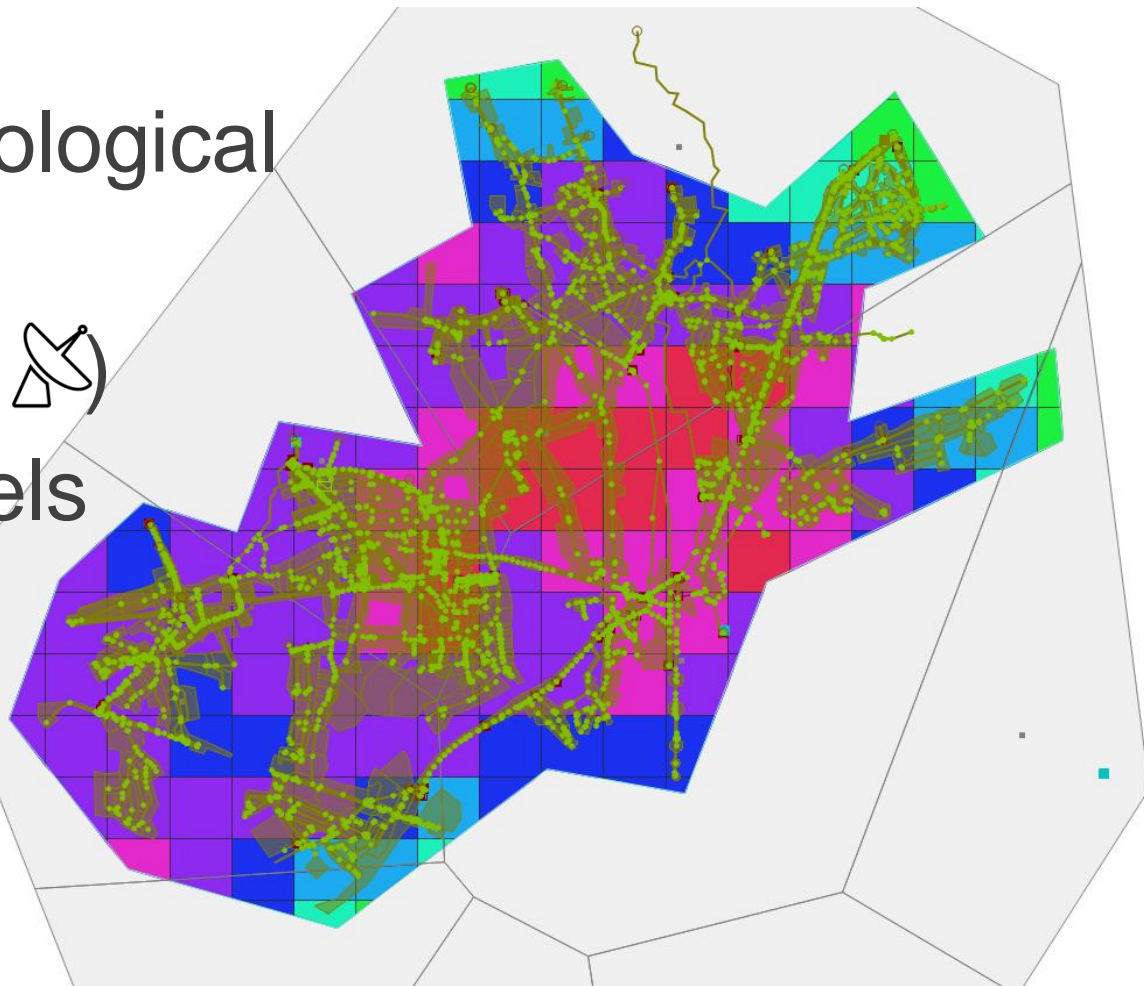
- GPRS
- Proprietary communication protocol & data server
- Data exchange via text files → delay!
- Storage on SQLServer for quick access





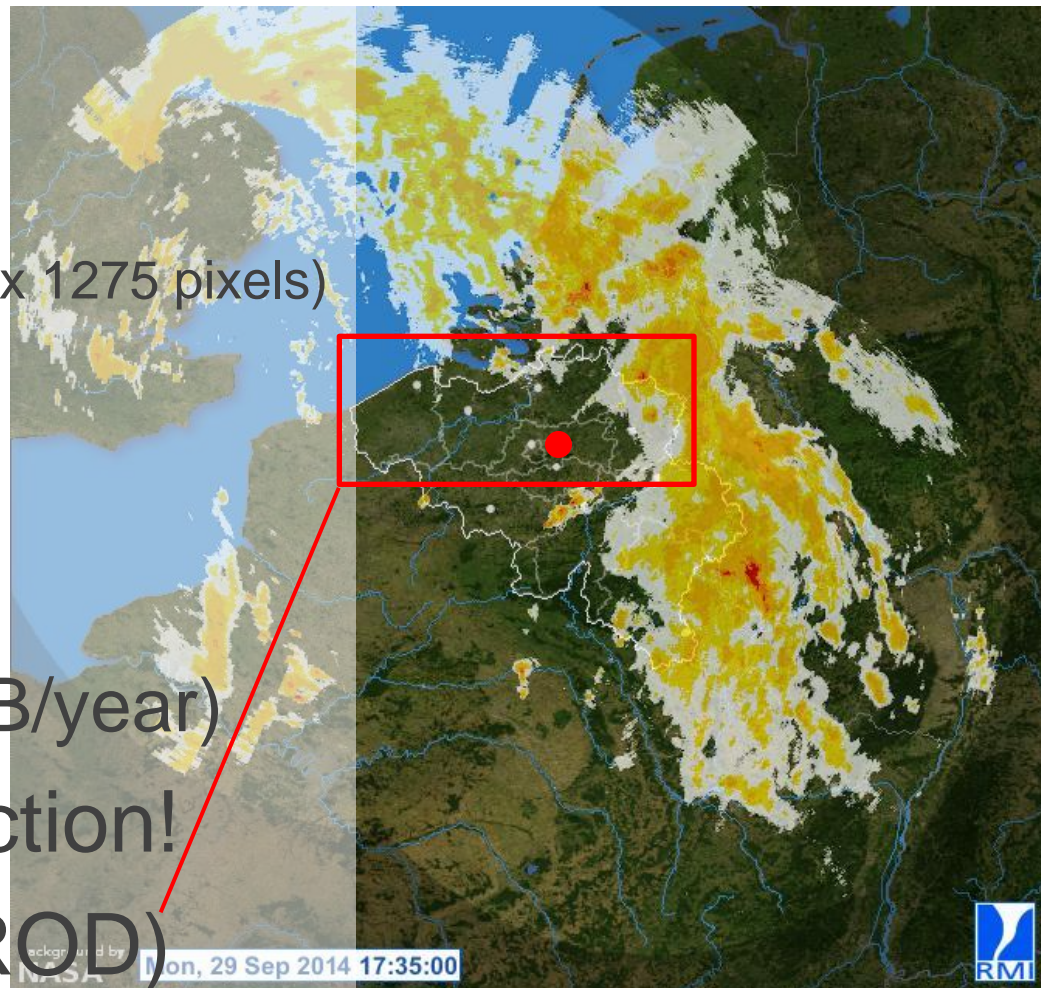
# C-band radar

- Royal Meteorological Institute
- Composite (3 )
- 147 (324) pixels
- 530 x 530 m
- 5 min



# C-band radar RMI

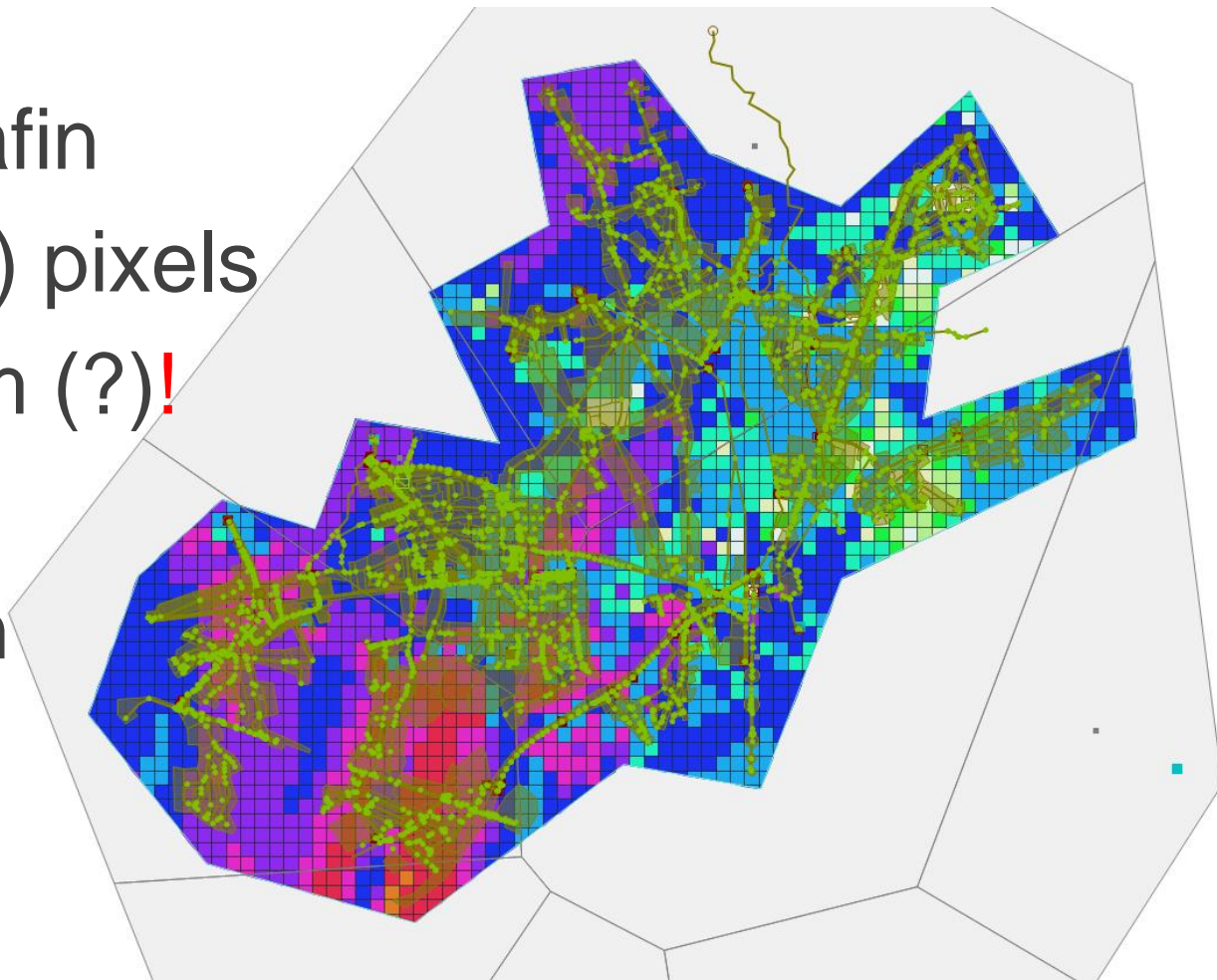
- RMI ftp server
- 700 x 675 km (1338 x 1275 pixels)
  - 180e9 pixels/year
  - 0.5 ... 2 TB/year
  - ~~SQL-Server~~
  - File system (20 GB/year)
- Time stamp correction!
- Conversion (NIMROD)





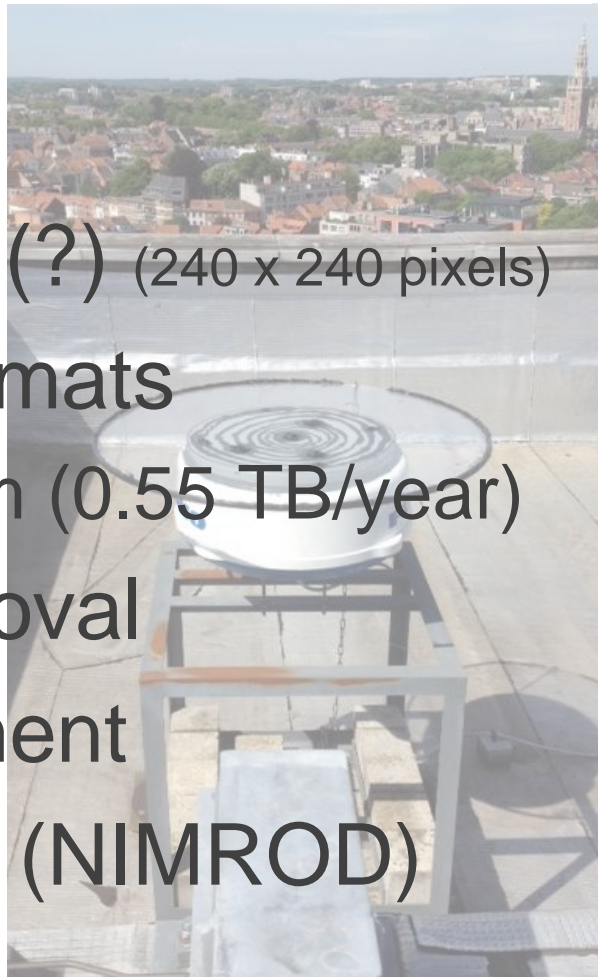
# X-band radar

- DHI & Aquafin
- 2015 (4940) pixels
- 125 x 125 m (?)!
- 1 min
- Every 5 min



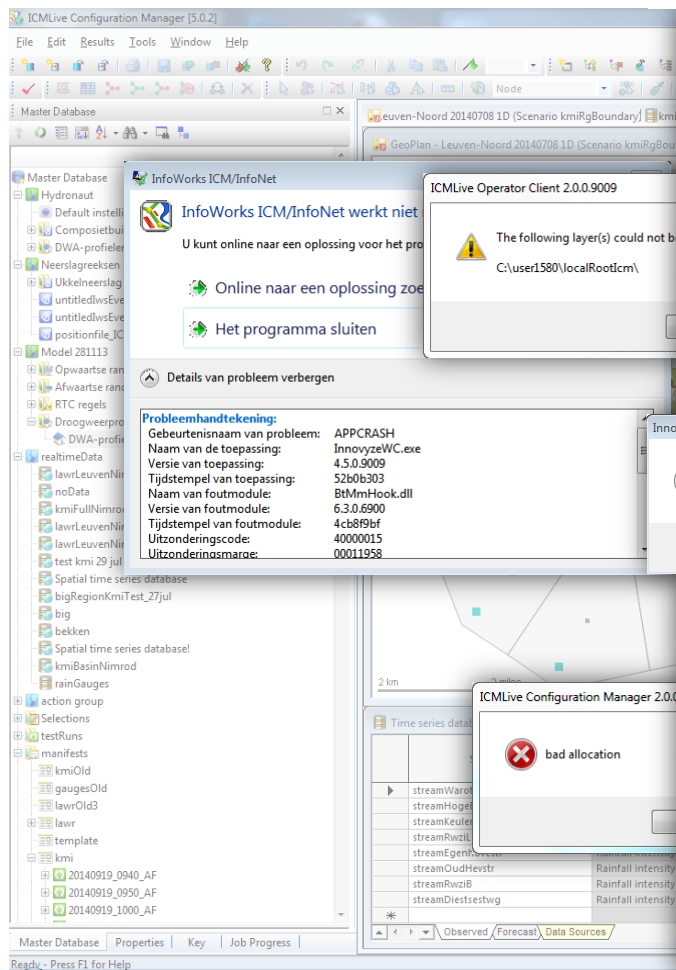
# X-band radar

- ftp server
- 30 x 30 km (?) (240 x 240 pixels)
- 6 binary formats
  - File system (0.55 TB/year)
- Clutter removal
- Data treatment
- Conversion (NIMROD)





# Implementation in ICMLive



ICMLive Configuration Manager [5.0.2]

File Edit Results Tools Window Help

Master Database

Hydronaut

Default instell

Compositieb

DWA-profiel

Neerslagreken

Ukkelneerslag

untitledlwsEve

untitledlwsEve

positionfile\_IC

Model 281113

Opwaartse ran

Afwaartse ran

RTC regels

Droogweerspro

DWA-profiel

realtimeData

lawrLeuvenNi

noData

kmiFullNimrod

lawrLeuvenNi

test kmi 29 jul

Spatial time series database

bigRegionKmiTest\_27jul

big

bekken

Spatial time series database

kmiBasinNimrod

rainGauges

action group

Selections

testRuns

manifests

kmiOld

gaugesOld

lawrOld3

lawr

template

kmi

20140919\_0940\_AF

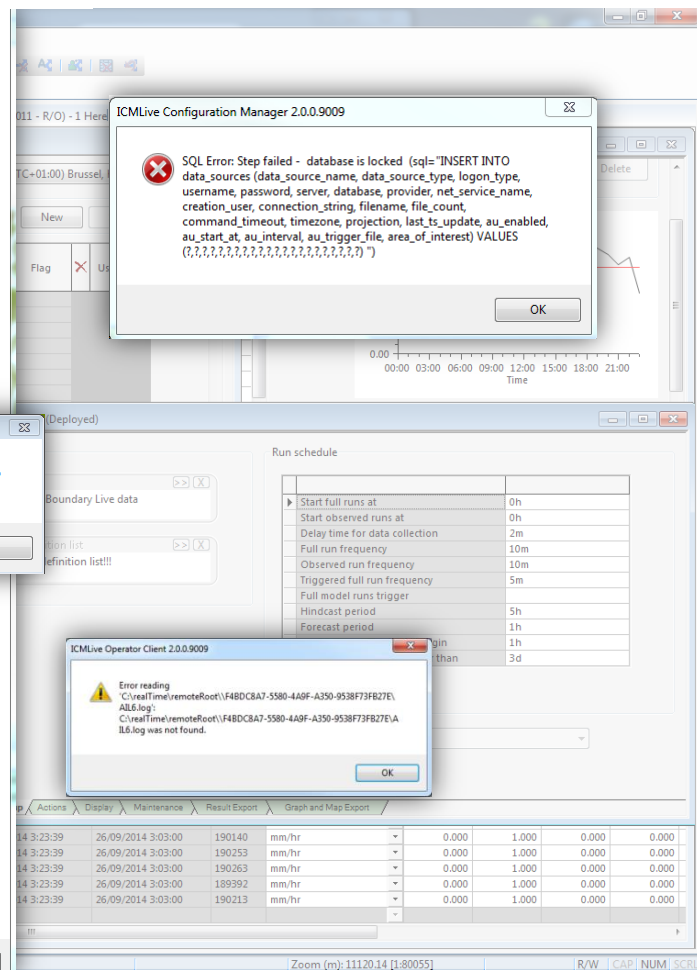
20140919\_0950\_AF

20140919\_1000\_AF

Master Database Properties Key Job Progress

Ready - Press F1 for Help

Added subtheme for Rainfall.  
 Replaced base theme for Ground Model.  
 Added subtheme for Flood.  
 Replaced base theme for Flood.  
 Added subtheme for Node.  
 Replaced base theme for Node.  
 Added subtheme Node Types to Node.  
 Replaced base theme for Conduit.  
 Replaced base theme for Flap valve.  
 Replaced base theme for Orifice.  
 Replaced base theme for Pump.  
 Replaced base theme for Sluice.  
 Replaced base theme for User control.  
 Replaced base theme for Weir.  
 Replaced base theme for Flume.  
 Replaced base theme for Siphon.  
 Replaced base theme for Screen.  
 Replaced base theme for Channel.  
 Replaced base theme for Culvert inlet.  
 Replaced base theme for Culvert outlet.  
 Replaced base theme for Irregular weir.  
 Replaced base theme for River reach.  
 Replaced base theme for Bridge.  
 Replaced base theme for Inline bank.  
 Replaced base theme for Subcatchment.  
 Added subtheme RAINFALL to Subcatchment.  
 Replaced base theme for Pruned link.



ICMLive Configuration Manager 2.0.0.9009

SQL Error: Step failed - database is locked (sql="INSERT INTO data\_sources (data\_source\_name, data\_source\_type, logon\_type, username, password, server, database, provider, net\_service\_name, creation\_user, connection\_string, filename, file\_count, command\_timeout, timezone, projection, last\_ts\_update, au\_enabled, au\_start\_at, au\_interval, au\_trigger\_file, area\_of\_interest) VALUES (?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?)")

OK

Run schedule

Start full runs at	Start observed runs at	Delay time for data collection	Full run frequency	Observed run frequency	Full model runs trigger	Hindcast period	Forecast period
0h	0h	2m	10m	10m	5m	5h	1h
						1h	1h
						3d	3d

Error reading 'C:\realTime\remoteRoot\F4BDC8A7-5580-4A9F-A350-9538F73F827E\AIB6.log'  
 'C:\realTime\remoteRoot\F4BDC8A7-5580-4A9F-A350-9538F73F827E\AIB6.log' was not found.

OK

Time	Date	Time	Flow	Unit	Flow	Unit	Flow	Unit
14 3:23:39	26/09/2014 3:03:00	190140	mm/hr	0.000	1.000	0.000	0.000	
14 3:23:39	26/09/2014 3:03:00	190253	mm/hr	0.000	1.000	0.000	0.000	
14 3:23:39	26/09/2014 3:03:00	190263	mm/hr	0.000	1.000	0.000	0.000	
14 3:23:39	26/09/2014 3:03:00	190392	mm/hr	0.000	1.000	0.000	0.000	
14 3:23:39	26/09/2014 3:03:00	190213	mm/hr	0.000	1.000	0.000	0.000	

Zoom (m): 11120.14 [1.80055] R/W CAP NUM SCR



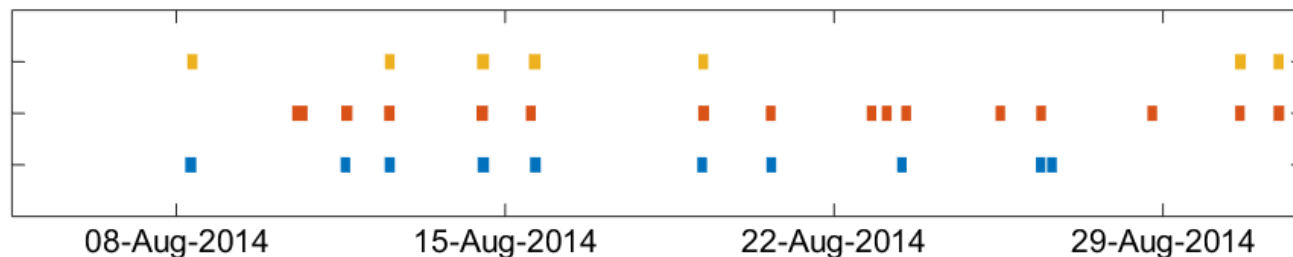
# ICMlive results



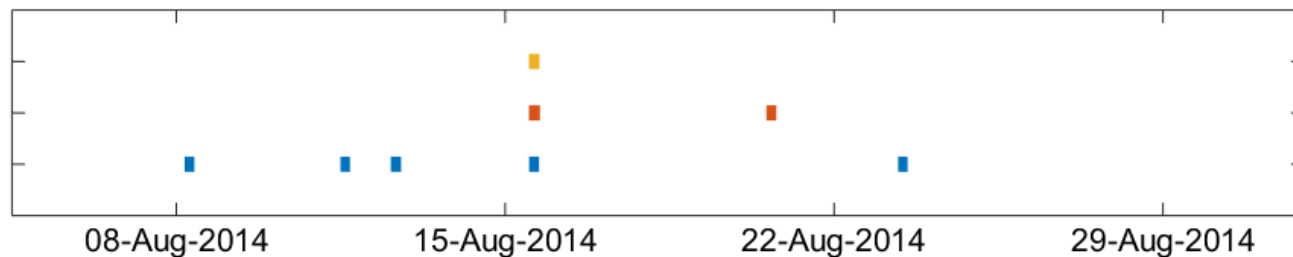
gauges  
C-band  
X-band



gauges  
C-band  
X-band



gauges  
C-band  
X-band



# Modelling issues

- Recalibration for different inputs?
- Simulation time (1D)
- Time zones & DST
- Software stability & flexibility
- No forecast yet (no forecast input)
- No 2D modeling yet (performance)



# Data issues

- Formats
  - Standards (.csv isn't one!)
  - Meta-data
  - Documentation (NIMROD)
  - Conversion
- Communication → reliability
- Storage







# Aquafin



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