Report – Work Package 3

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RainGain Project Consortium Meeting, Exeter, 7th October 2014

WP3: Urban pluvial flood modelling and prediction

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

General Objective of WP3:

To implement rainfall data (WP2) into improved urban storm water models to enhance short term pluvial flood modelling and prediction

WP3 ACTIONS

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

Action WP3A10: Adoption, customisation and automatic linkage of rainfall forecasts to pluvial flood models.

Action WP3A11: Improvement and customisation of models for urban pluvial flood forecasting at fine scales in each of the pilot locations

Action WP3A12: Full-scale testing of the models for pluvial flood prediction at each of the pilot locations.

Action WP3A13: Development of guidelines and training material for capacity building and training of future end-users.

REVIEW - WP3 A10

A10: Linkage of local rainfall data to flood models

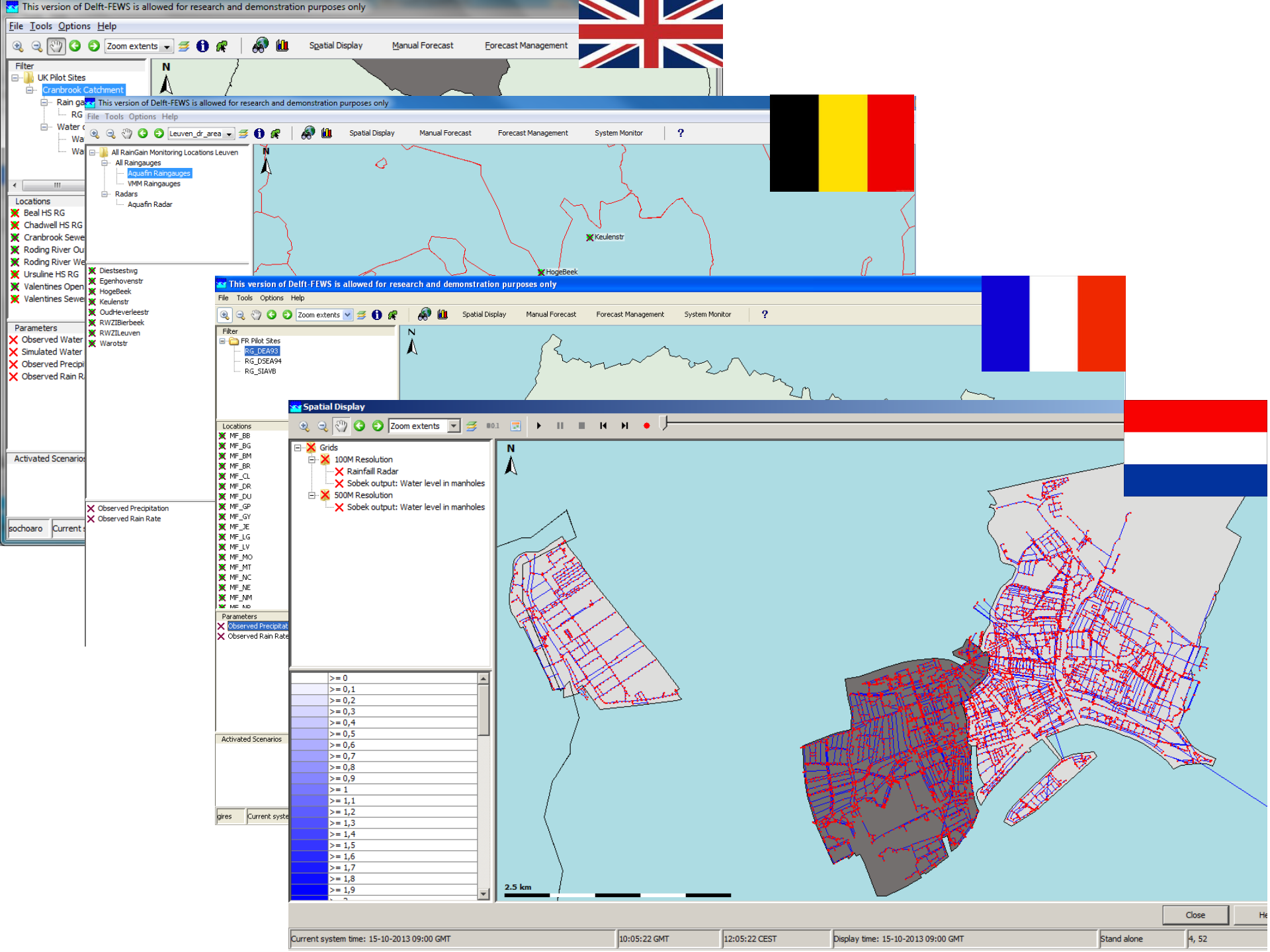
Output: protocols and software for automatic linkage of rainfall to models

SUMMARY OF PROGRESS TO DATE:

- Analysis of existing shells/platforms that allow automatic linkage of rainfall inputs & hydro models:

  In-house linkage of input data and models; UrbanFlood Common Information Space (CIS); Innovyze Floodworks & **ICM Live**; **Delft-FEWS**

- Agreement on adoption of Delft-FEWS platform as common 'core' (Jun 2012), definition of common rainfall formats for data exchange.
- Pilot Delft-FEWS platform implemented for UK pilot location (Oct 2012), basic version of Delft-FEWS platform implemented for BE, FR and NL pilot locations (Apr - Sep 2013)
- Training courses and documentation on use of the Delft-FEWS platform (Feb 2013, Aug 2013)
- Aquafin has progressed in the implementation of FloodWorks/InfoWorks ICM Live
- Through UK NOG meetings different forecasting systems have been analysed and recommendations have been made


This version of Delft-FEWS is allowed for research and demonstration purposes only
File Tools Options Help
Zoom extents
Spatial Display
Manual Forecast
Forecast Management
System Monitor
Filter
UK Pilot Sites
Cranbrook Catchment
Locations
Parameters
Activated Scenarios
Leuven_dr_area
All RainGain Monitoring Locations Leuven
All Raingauges
Aquafin Raingauges
VMM Raingauges
Radars
Aquafin Radar
Keulenstr
HogeBeek
FR Pilot Sites
RG_DEA93
RG_DSEA94
RG_SIAVB
Spatial Display
Grids
100M Resolution
Rainfaill Radar
Sobek output: Water level in manholes
500M Resolution
Sobek output: Water level in manholes
Observed Precipitation
Observed Rain Rate
>= 0
>= 0,1
>= 0,2
>= 0,3
>= 0,4
>= 0,5
>= 0,6
>= 0,7
>= 0,8
>= 0,9
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>= 1,6
>= 1,7
>= 1,8
>= 1,9
2.5 km
Close
Current system time: 15-10-2013 09:00 GMT
10:05:22 GMT
12:05:22 CEST
Display time: 15-10-2013 09:00 GMT
Stand alone

REVIEW - WP3 A10

A10: Linkage of local rainfall data to flood models

Output: protocols and software for automatic linkage of rainfall to models

CONCRETE OUTCOMES AND LESSONS LEARNT:

- From the testing of the Delft-FEWS, FloodWorks and InfoWorks ICM Live platforms we have learned about their advantages and disadvantages, bottlenecks for implementation of these systems, amongst others.

	+	-
Delft-FEWS	• Free • Multiple built-in tools • Widely used for national flood forecasting systems	• So far, it is not possible to link InfoWorks models to this platform
FloodWorks	• Tailored to work with InfoWorks CS, which is widely used operationally	• Limited data handling – e.g. limitation in the number of rainfall grids that one can use (hence limiting the use of high res rainfall estimates) • Commercial software: expensive and limited possibilities for customisation/improvement
InfoWorks ICM Live	• Tailored to work with InfoWorks ICM – one of the few (if not the only) relatively stable and operational 1D/2D models available	• Relatively new software - still suffers from a number of problems (inefficient data handling, only old fashioned radar data formats available, many bugs). • IW ICM 2D simulation times are currently still too high to allow frequent updating of the simulations. • Commercial software

REVIEW - WP3 A10

A10: Linkage of local rainfall data to flood models

Output: protocols and software for automatic linkage of rainfall to models

CONCRETE OUTCOMES AND LESSONS LEARNT:

- From the testing of the Delft-FEWS, FloodWorks and InfoWorks ICM Live platforms we have learned about their advantages and disadvantages, bottlenecks for implementation of these systems, amongst others.
- The main conclusions, lessons learnt and recommendations derived from our tests will be summarised in a short document.
- A paper has been produced which provides an overview of recent developments in surface water flood forecasting in England, as well as an assessment of the current service and recommendations for improvement – based upon survey amongst local authorities and discussions during UK NOG meetings.

REVIEW - WP3 A11

A11: Customisation of flood models

Output: Customised flood models for pilots

SUMMARY OF PROGRESS TO DATE:

- Models were implemented and have been continuously improved for all pilots, using the software package commonly used/readily available in each location:
  - UK: Infoworks CS & ICM
  - Belgium: Infoworks CS & ICM
  - Netherlands: Sobek
  - France: Canoe and Multi-Hydro
- Rainfall and flow/depth data have been continuously collected at pilot locations and are being used for model calibration and validation
- Lots of lessons learnt while implementing and improving models!

REVIEW - WP3 A11

A11: Customisation of flood models

Output: Customised flood models for pilots

SUMMARY OF PROGRESS TO DATE:

- In terms of modelling tools customisation and improvement:
  - Multi-Hydro has been continuously improved (a user friendly interface is being developed to handle data assimilation and visualisation, initial developments in innovative scaling analysis of outputs are underway)
  - Updated user guidelines and tutorial of AOFD were produced
  - Routines have been developed to aid implementation of fully-distributed models
- In terms of model structure comparison:
  - Comparison between semi-distributed and fully-distributed models (FR, UK)
  - Analysis of surface mesh resolution performance (BE)
  - Comparison between 1D/1D and 1D/2D models (BE, UK)

REVIEW - WP3 A11

A11: Customisation of flood models

Output: Customised flood models for pilots

CONCRETE OUTCOMES AND LESSONS LEARNT:

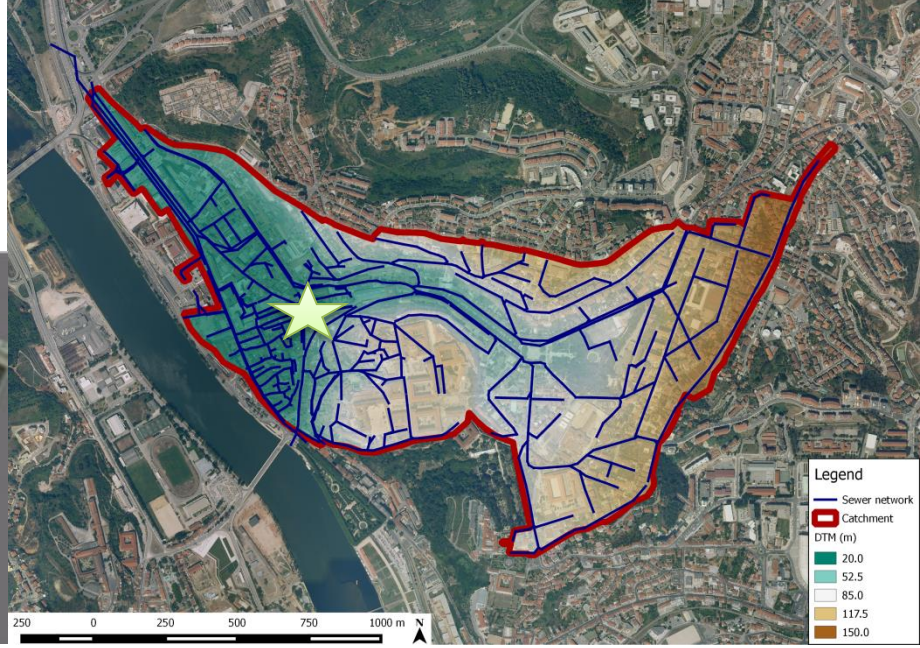
- In general, using fully distributed models in which rainfall is applied directly on a 2D model of the surface are deemed necessary to properly simulate urban pluvial flooding, given that it often happens before runoff reaches the sewer system.

- The use of fully distributed models requires far more detailed data than normally available (including high resolution DTMs, details of gully location and private sewer connections, proper modelling of gully inlet capacity) and imposes new challenges in terms of data processing and model implementation. Some tools to deal with these challenges have been developed - e.g.:

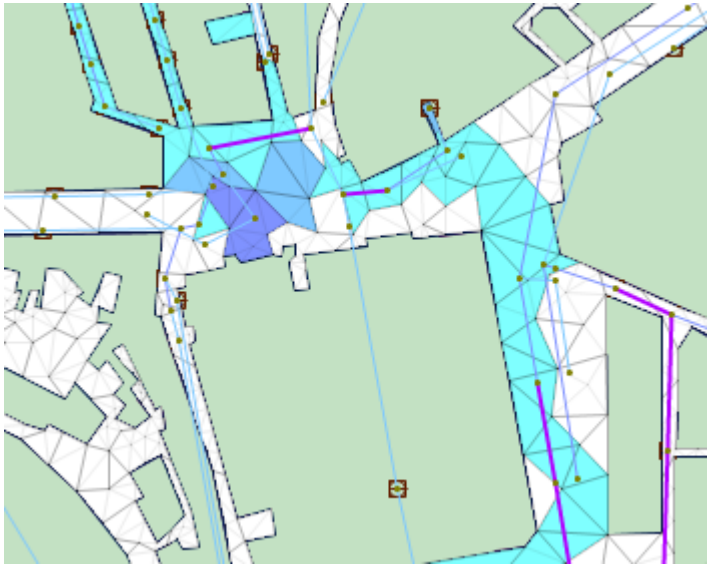
  - Simplification of bulding polygons (UK)
  - Automatic connection of gullies to main sewers (UK)
  - Strategies for better modelling inlet capacity (which is critical in 2D models) (UK)
  - We’re analysing how to deal with inconsistencies in DTM and with the modelling of open channels within 2D models (UK, FR)
  - User friendly interface for data preparation from commonly available GIS data (FR)

Coimbra results

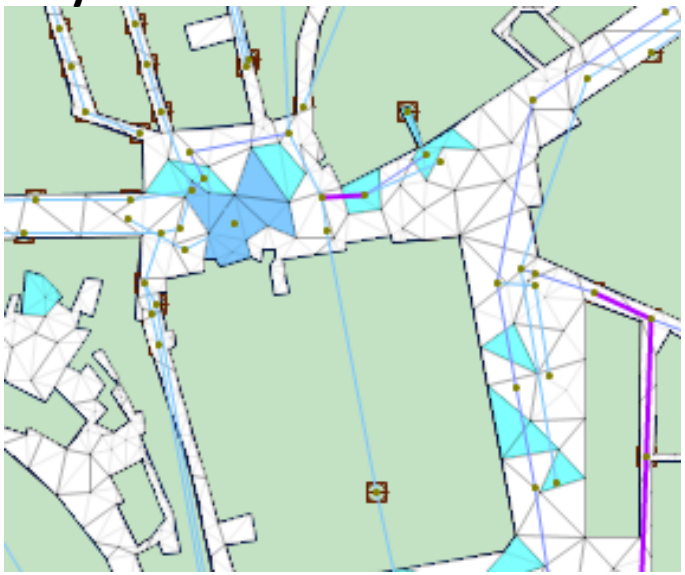
Flood registered on 9 June 2006



Semi-distributed model



Fully distributed model



REVIEW - WP3 A11

A11: Customisation of flood models

Output: Customised flood models for pilots

CONCRETE OUTCOMES AND LESSONS LEARNT:

- Run times of **operational** 2D models are still too long for RT simulations. Runtimes can be partially reduced, for example, through simplification of void polygons, through model hybridisation (use of meshes of different resolutions (BE), combination of 1D and 2D models of the surface (UK)) – but this may not fully solve the runtime problems and further optimisation of 2D routing algorithms is necessary.

- Currently, all operational and relatively stable 1D-2D modelling software are commercial, so possibility of improving them is limited

- Main conclusions will be summarised in WP3 review document

REVIEW - WP3 A12

A12: Full scale testing of pluvial flood models at pilot locations

Output: tested and implemented flood models for pilots + reports

SUMMARY OF PROGRESS TO DATE:

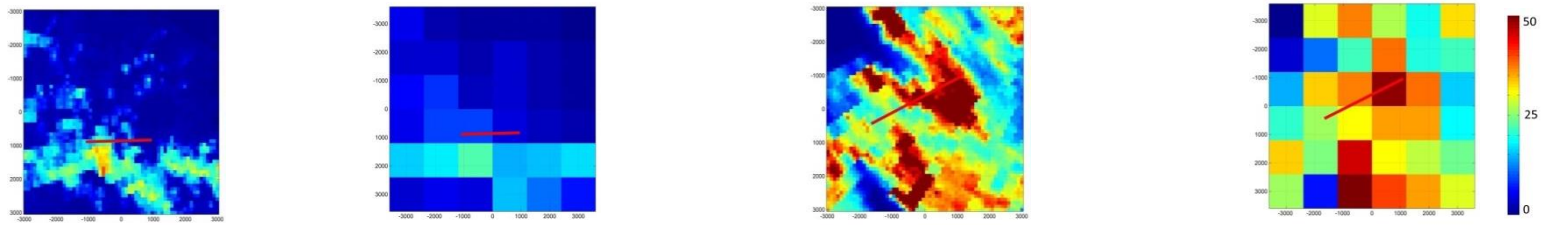
- Rainfall and depth/flow data have been continuously collected at the pilots
- Datasets to be used for testing of models were defined:
  - One common rainfall datasets for all pilots (for testing effects of resolution)
  - One specific data set of coincidental rainfall and hydro measurements for each pilot
- Comprehensive analysis of rainfall input resolution requirements using the common dataset is under way!
- Common methodology was implemented to characterise catchments and their representation with the help of fractal tools (tutorial at ENPC on June 2014)
- Further analysis will be carried out once new X-band radars are operational
- In UK the added value of the super-resolution radar product over London is being tested with the aid of hydraulic models of the pilots

Weather Radar and Hydrology joint paper

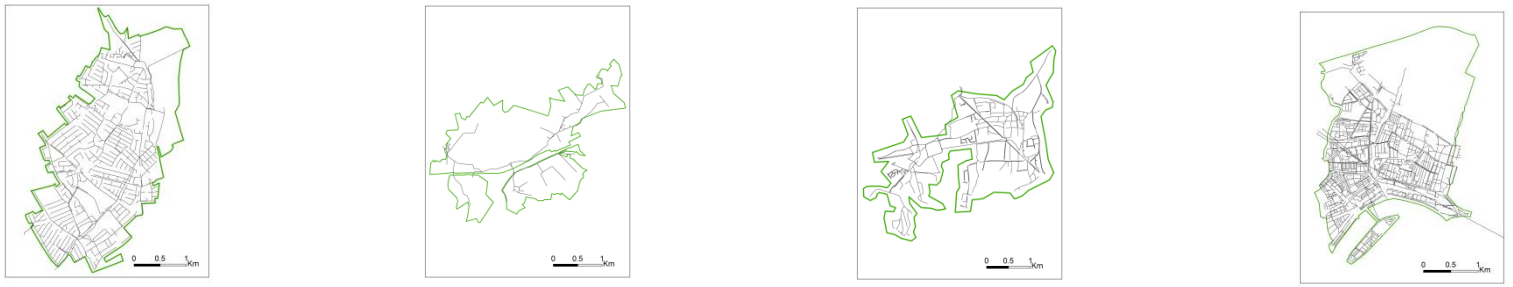
Multi-catchment analysis of the impact of rainfall input resolution on the hydraulic output of semi-distributed urban drainage models

Rainfall data of 2 spatial resolutions: 100 m and 1000 m

(a) Convective – 28/06/2011		(a) Stratiform – 29/10/2012	
(100 m resolution)	(1000 m resolution)	(100 m resolution)	(1000 m resolution)



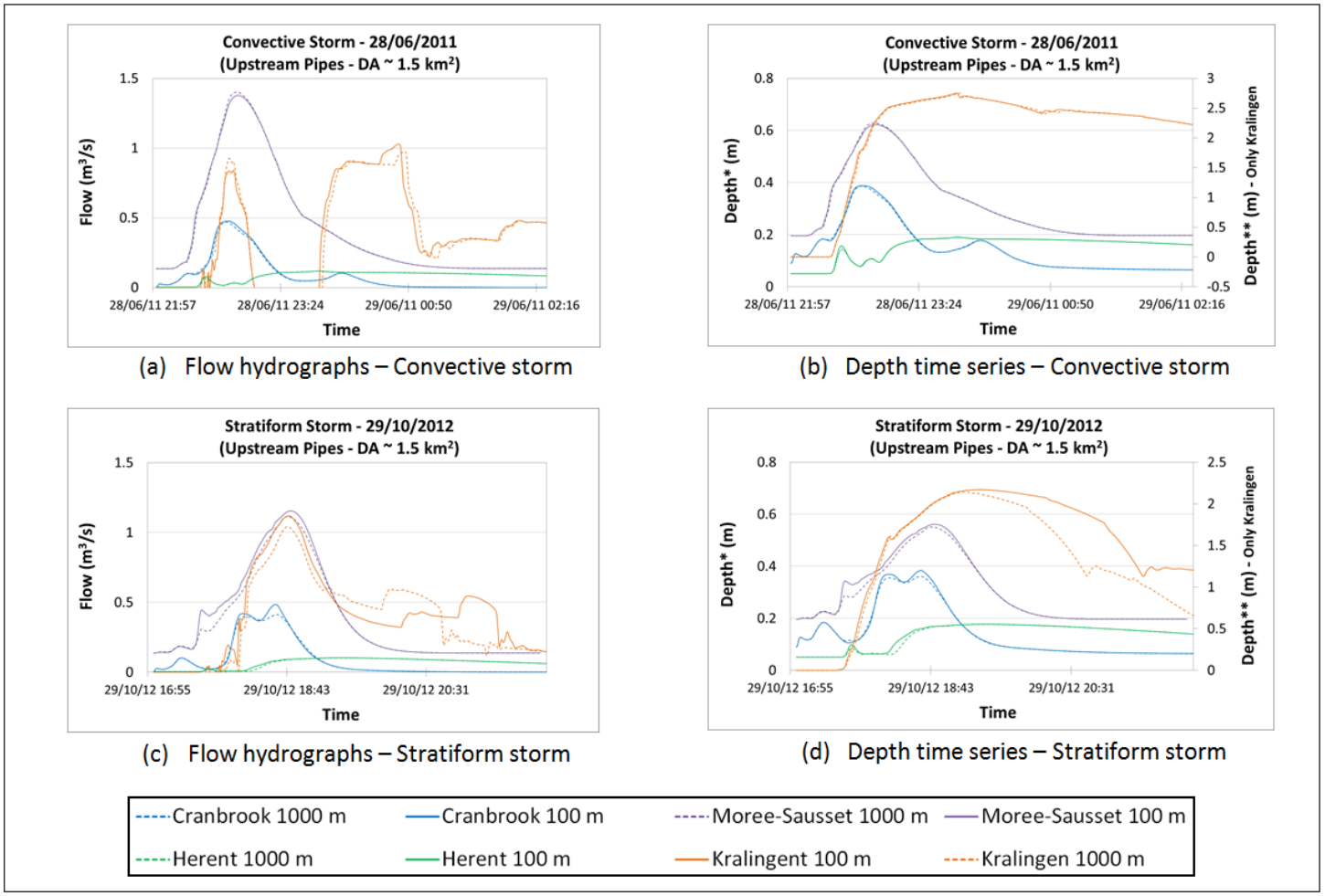
Semi-distributed urban drainage models of 4 RainGain pilot sites



Cranbrook (UK)	Morée-Sausset (FR)	Herent (BE)	Kralingen (NL)
Area: 8.65 km^2	Area: 5.60 km^2	Area: 4.75 km^2	Area: 6.70 km^2
Slope: 0.0093 m/m	Slope: 0.0029 m/m	Slope: 0.0220 m/m	Slope: 0.0003 m/m
SC Mean/STD: 0.49/0.71ha	SC Mean/STD: 11.92/10.34ha	SC Mean/STD: 0.71/1.27ha	SC Mean/STD: 1.20/1.33ha

Standardisation of results whenever possible: *relative storm alignment, catchment size, etc.*

Results



- Analysis at 3 points in each catchment (upstream, mid-stream, downstream)
- Not significant impact of rainfall input resolution is observed for two storms under consideration
- Work in progress!

REVIEW - WP3 A12

A12: Full scale testing of pluvial flood models at pilot locations

Output: tested and implemented flood models for pilots + reports

CONCRETE OUTCOMES AND LESSONS LEARNT:

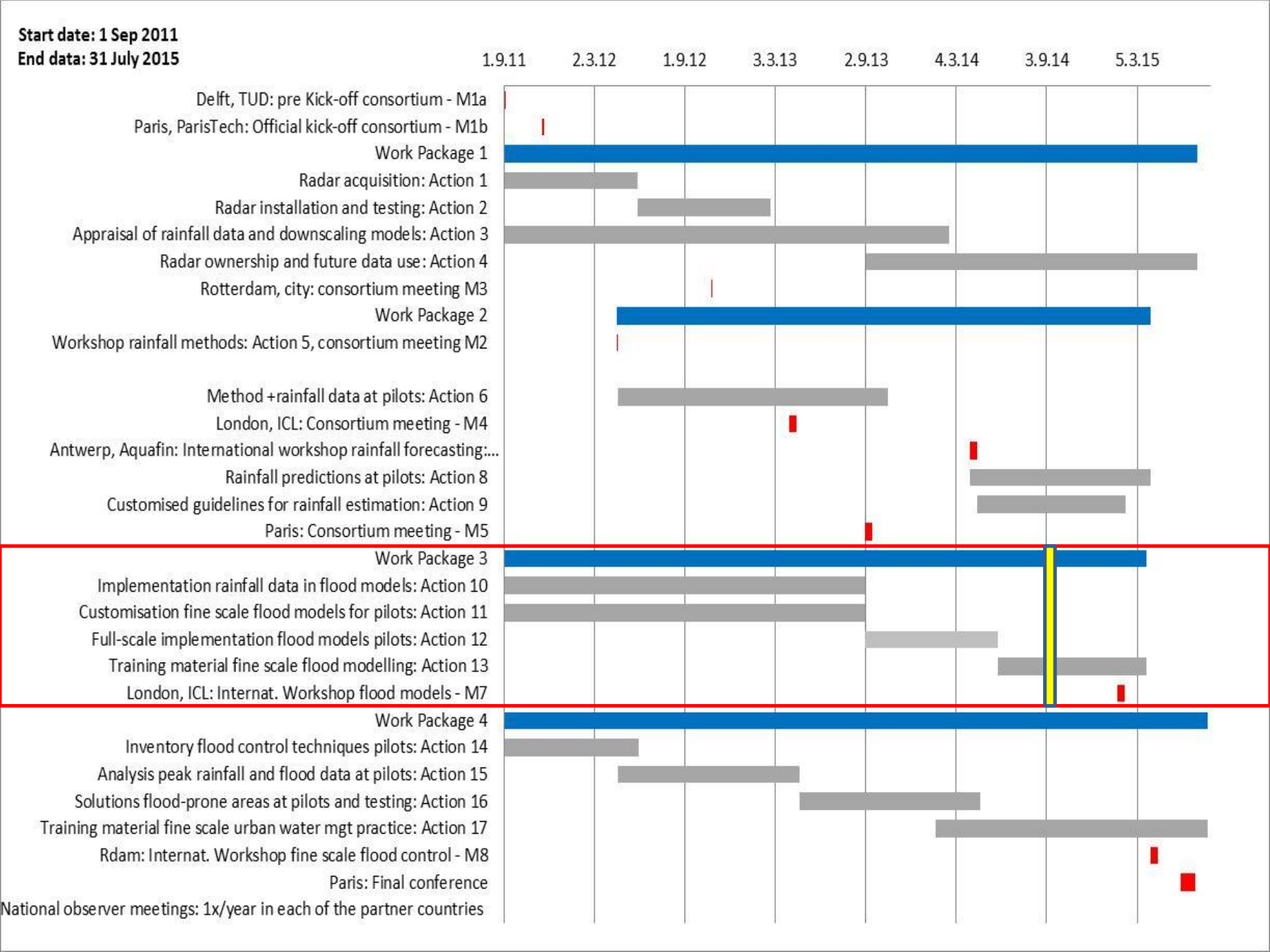
- Current results suggest that semi-distributed urban drainage models cannot take full advantage of higher resolution rainfall inputs; however, this doesn't mean that we should not measure rainfall at higher resolution (as measuring rainfall at higher resolution could improve accuracy too – but this is still under investigation!)
- Many more interesting outcomes are expected in what is left of the project – with on-going multi-catchment test, the new radars, the UKMO super-resolution product and the fully distributed models that are being implemented!
- The new results will be key for making decisions regarding the added value of higher resolution data – these will provide evidence to support/not support investment in radar technology (whether it is improvement of C-band radars or installation of X-band radars)

REVIEW - WP3 A13

A13: Training material and guidelines

Output: Training material and guidelines for pilots

- **PROGRESS TO DATE:**
  - ICL developed a workshop pack for engagement of stakeholders in local flood risk management.
  - Initial version of review document on urban pluvial flood models produced by ICL, with input from all partners involved in WP3. To be updated based upon results and conclusions drawn during the remainder of the project
  - Short document on recommendations about 'linking' platoforms, including compilation of Delft-FEWS documentation and training material
  - Tutorial of analysis of catchment features (sewer system, imperviousness) with the help of fractal tools has been developed


Start date: 1 Sep 2011
End data: 31 July 2015
1.9.11
2.3.12
1.9.12
3.3.13
2.9.13
4.3.14
3.9.14
5.3.15
Delft, TUD: pre Kick-off consortium - M1a
Paris, ParisTech: Official kick-off consortium - M1b
Work Package 1
Radar acquisition: Action 1
Radar installation and testing: Action 2
Appraisal of rainfall data and downscaling models: Action 3
Radar ownership and future data use: Action 4
Rotterdam, city: consortium meeting M3
Work Package 2
Workshop rainfall methods: Action 5, consortium meeting M2
Method +rainfall data at pilots: Action 6
London, ICL: Consortium meeting - M4
Antwerp, Aquafin: International workshop rainfall forecasting:...
Rainfall predictions at pilots: Action 8
Customised guidelines for rainfall estimation: Action 9
Paris: Consortium meeting - M5
Work Package 3
Implementation rainfall data in flood models: Action 10
Customisation fine scale flood models for pilots: Action 11
Full-scale implementation flood models pilots: Action 12
Training material fine scale flood modelling: Action 13
London, ICL: Internat. Workshop flood models - M7
Work Package 4
Inventory flood control techniques pilots: Action 14
Analysis peak rainfall and flood data at pilots: Action 15
Solutions flood-prone areas at pilots and testing: Action 16
Training material fine scale urban water mgt practice: Action 17
Rdam: Internat. Workshop fine scale flood control - M8
Paris: Final conference
National observer meetings: 1x/year in each of the partner countries

WP3 TEAM AT WORK!