Report – Work Package 3

By Susana Ochoa-Rodriguez

RainGain Project Meeting, Paris, 21st October 2013

WP3: Urban pluvial flood modelling and prediction

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 & OUTPUTS

WP3	A10 Linkage of local rainfall data to flood models	A11 Customisation of flood models for rainfall input	A12 Full scale testing of pluvial flood models at pilot locations	A13 Training material and guidelines
	Output: platform for automatic linkage	Output: Customised flood models for pilots	Output: tested and implemented flood models for pilots + reports	Output: Training material and guidelines for pilots

REVIEW - WP3 A10

A10: Linkage of local rainfall data to flood models

Output: platform for automatic linkage

PROGRESS TO DATE:

- Agreement on adoption of Delft-FEWS platform as common 'core' (Jun 2012)

- Pilot Delft-FEWS platform implemented for UK pilot location (Oct 2012)

- Training course on use of the Delf-FEWS platform (Feb 2013)

- First version of Delft-FEWS platform implemented for BE and FR pilot locations (Apr 2013)

- First version of Delft-FEWS platform implemented for NL locations (Sep 2013)

- Tutorial and training material was carried out/developed by ICL for (Aug 2013):

  - Clarifying modular structure of platform and thus facilitate implementation

  - Creation of new instances of existing modules (training material includes example for creating an instance to import and visualise Nimrod data in Delft-FEWS)

  - Linkage of external algorithms to the platform

File Tools Options Help

Zoom extents

Spatial Display   Manual Forecast   Forecast Management

Filter
UK Pilot Sites
Cranbrook Catchment
Rain ga
RG
Water

Locations
Beal HS RG
Chadwell HS RG
Cranbrook Sewe
Roding River Ou
Roding River We
Ursuline HS RG
Valentines Open
Valentines Sewe

Parameters
Observed Water
Simulated Water
Observed Precipi
Observed Rain R

Activated Scenario

sochoaro   Current s

File Tools Options Help

Leuven_dr_area

Spatial Display   Manual Forecast   Forecast Management   System Monitor   ?

All RainGain Monitoring Locations Leuven
All Raingauges
Aquafin Raingauges
VMM Raingauges
Radars
Aquafin Radar

Diestsestwg
Egenhovenstr
HogeBeek
Keulenstr
OudHeverleestr
RWZIBierbeek
RWZILeuven
Warotstr

Keulenstr
HogeBeek

Observed Precipitation
Observed Rain Rate

File Tools Options Help

Zoom extents

Spatial Display   Manual Forecast   Forecast Management   System Monitor   ?

Filter
FR Pilot Sites
RG_DEA93
RG_DSEA94
RG_SIAVB

Locations
MF_BB
MF_BG
MF_BM
MF_BR
MF_CL
MF_DR
MF_DU
MF_GP
MF_GY
MF_JE
MF_LG
MF_LV
MF_MO
MF_MT
MF_NC
MF_NE
MF_NM

Parameters
Observed Precipitati
Observed Rain Rate

Activated Scenarios

gires   Current syste

Spatial Display

Zoom extents   ■0.1

Grids
100M Resolution
Rainfaill Radar
Sobek output: Water level in manholes
500M Resolution
Sobek output: Water level in manholes

>= 0
>= 0,1
>= 0,2
>= 0,3
>= 0,4
>= 0,5
>= 0,6
>= 0,7
>= 0,8
>= 0,9
>= 1
>= 1,1
>= 1,2
>= 1,3
>= 1,4
>= 1,5
>= 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 | 4, 52

REVIEW - WP3 A10

AQUAFIN FORECASTING SYSTEM FRAMEWORK
(using FloodWorks – InfoWorks ICM Live)

Network (done by Mieke & Mieke)
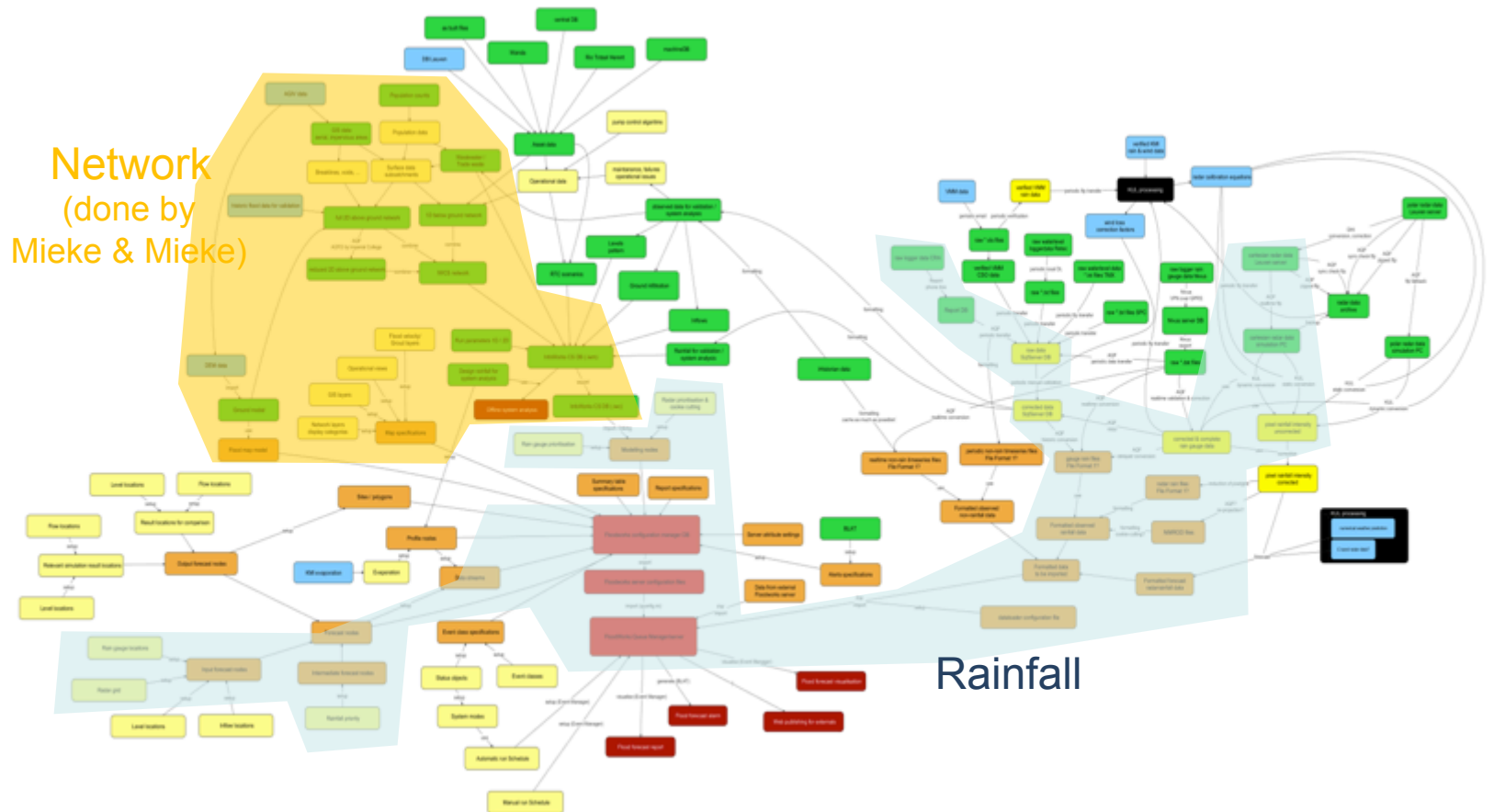
Rainfall

REVIEW - WP3 A10

NEXT STEPS:

- **OCT 2013 – Project Meeting (FR):**

  - Definition of standard formats for rainfall data exchange amongst partners

  - Definition of algorithms to be shared amongst partners through the Delft-FEWS platform

  - Selection of rainfall datasets for initial testing of models and initial assessment of impact of resolution

- **APR2014 – Project Meeting:**

  - Completion of data format exchange functionalities

  - Incorporation of first algorithms in the Delft-FEWS platform

  - Initial testing of models with selected common datasets (ideally, having established standard data formats and having implemented data conversion functionalities in the Delft-FEWS platform should help in this process)

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

REVIEW - WP3 A11

A11: Customisation of flood models for rainfall input

Output: Customised flood models for pilots

PROGRESS TO DATE:

- It has been agreed that at each pilot location the software package commonly used/readily available would continue to be used for the implementation of urban pluvial flood models in the RainGain project (Jun 2012)

    - UK: Infoworks

    - Belgium: Infoworks

    - Netherlands: Sobek

    - France: Canoe and Multi-Hydro

- Initial models implemented for all pilot locations

- Rainfall and flow/depth data have been continuously collected at pilot locations and are being used for model calibration and validation

COUNTRY	PILOT SITE	PILOT LEADER	DRAINAGE AREA (km²)	MAIN CHARACTERISTICS	HYDRAULIC MODEL	RAINFALL DATA AVAILABLE	MAIN OBJECTIVES
NL	Spaanse Polder (Rotterdam District 12)	Guenda Bruni	1.9 km²	Industrial area, highly impervious	Sewer system only, semi-distributed, Sobek-Urban	New polarimetric X-band radar, rain gauges	Mainly urban planning (analysis of water storage tank, water squares, further optimisation of real time control elements, green roofs)
NL	Kralinger – Crooswijk (Rotterdam District 10)	Guenda Bruni	8 km²	Residential & industrial	Sewer system only, semi-distributed, Sobek-Urban	New polarimetric X-band radar, rain gauges	Mainly urban planning (analysis of water storage tank, water squares, further optimisation of real time control elements, green roofs)
NL	Rotterdam-Centre (Rotterdam District 9)	Guenda Bruni	3.7 km²	Residential area with 2 urban parks	Sewer system only, semi-distributed, Sobek-Urban	New polarimetric X-band radar, rain gauges	Mainly urban planning (analysis of water storage tank, water squares, further optimisation of real time control elements, green roofs)
FR	Morée-Sausset, of which Kodak is a subcatchment (Seine-Saint-Denis, Paris)	Auguste Gires	Morée-Sausset: 34 km² Kodak: 1.44 km²	Highly urbanised, rather flat. Several retention basins for flood control.	Canoe model for whole catchment; Dual-drainage, fully distributed, Muli-Hydro for Kodak	Raingauges, C-band and new polarimetric X-band radar	Optimisation of real time control elements
FR	Jouy-en-Josas (Seine-Saint-Denis County, Paris)	Auguste Gires	2.5 km²	Steep slopes, combination of land uses. Several storm water retention basins	Dual-drainage, fully distributed, Muli-Hydro	Raingauges, C-band and new polarimetric X-band radar	Optimisation of real time control elements
FR	Sucy-en-Brie (Val de Marne County, Paris)	Abdellah Ichiba	2.69 km²	New retention basin (interest on RT control of it)	Currently CANOE model (only sewer system), Multi-Hydro is being implemented. Also, CALAMAR system for RT calibration	Raingauges, C-band and new polarimetric X-band radar	Optimisation of real time control elements

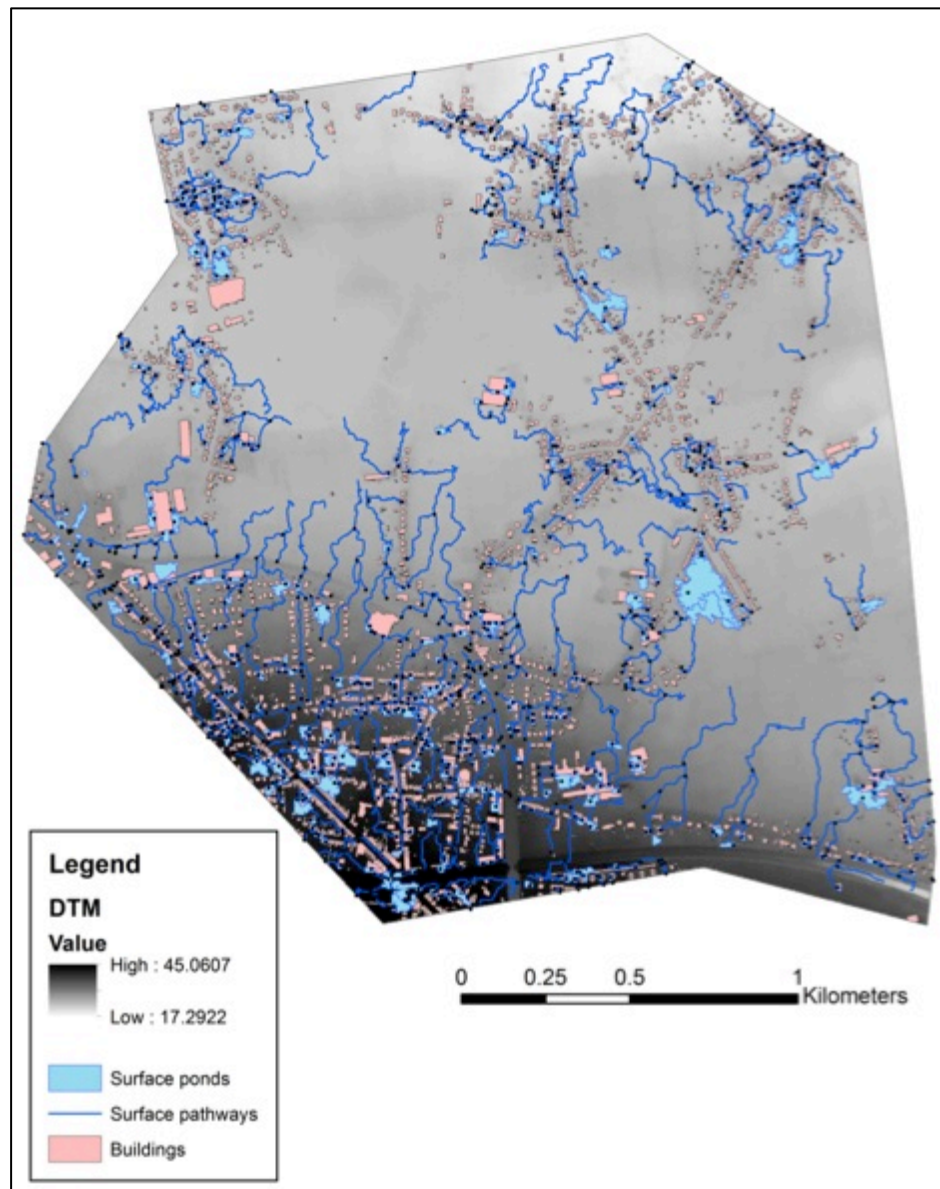| COUNTRY	PILOT SITE	PILOT LEADER	DRAINAGE AREA (km²)	MAIN CHARACTERISTICS	HYDRAULIC MODEL	RAINFALL DATA AVAILABLE	MAIN OBJECTIVES
BE	Northern part of Leuven (Herent)	Johan Van Assel	30 km²	Occasional pluvial flooding in centre of Herent	Currently 1D InfoWorks. Both full 2D and dual system (1D/2D) foreseen to be implemented	Previously acquired X-band radar and 8 operational raingauges	Flood modelling, RT flood forecasting and warning. General optimisation of pumping stations and CSOs Identify and solve problems of rural overland inflow to sewer system
BE	Full Leuven area	Johan Van Assel	120 km²	Highly urbanised city centre with risk of coincidental fluvial and pluvial flooding (although nothing serious has happened in recent years). Occasional pluvial flooding in low areas near WWTP.	Currently 1D InfoWorks, to be extended for flood modelling. Full 2D implementation unlikely to be feasible within project.	Previously acquired X-band radar and 8 operational raingauges	Same as above. Use RTC for realtime flood and storage control near WWTP.
BE	Ghent: area Oostakker - Sint-Amandsberg	Patrick Willems		Regular flooding	Dual-drainage, semi-distributed, Infoworks	Rain gauge data to be collected; additional gauges will be installed by TMVW (sewer system manager)	Climate adaptation planning Flood nowcasting system (RainGain & PLURISK projects)
UK	Cranbrook catchment, London Borough of Redbridge	Susana Ochoa	9 km²	Highly urbanised, coincidental fluvial and pluvial flooding	Dual-drainage (1D/1D and 1D/2D), semi-distributed, InfoWorks	Upgraded C-band radar, raingauges and possibly X-band radar	Urban planning and RT forecasting and warning
UK	Torquay Town Centre, Devon Borough of Torbay	Susana Ochoa	14.6 km²	Coastal city, steep slopes drain to natural depression, flooding exacerbated by high tides	Dual-drainage, semi-distributed, Infoworks	Upgraded C-band radar, raingauges and possibly X-band radar	Optimisation of real time control elements
UK	Purley Area, London Borough of Croydon	Susana Ochoa	6.5 km²	Highly urbanised, great density of receptors, slopes drain to natural depression	Sewer system only, semi-distributed InfoWorks	Upgraded C-band radar and raingauges	Urban planning and RT forecasting and warning

REVIEW - WP3 A11

PROGRESS TO DATE:

Recent developments in Automatic Overland Flow Delineation (AOFD) Tool by ICL (Apr – Oct 2013):

– This tool facilitates creation of 1D models of the surface, which are less detailed than 2D models, but computationally more efficient

– AOFD tool users manual was updated (Jul 2013)

– Tutorial on the use of the AOFD tool given by ICL to partners from BE and NL interested in using it (Aug 2013)

– Initial test for Leuven pilot location done by ICL

– KUL partners currently using AOFD for implementing 1D surface models in their pilot locations

Test:

1D model of subarea of Leuven generated with AOFD

Legend

DTM
Value
High : 45.0607
Low : 17.2922

Surface ponds
Surface pathways
Buildings

0   0.25   0.5   1
Kilometers

But operational 1D model may not be implemented due to GIS software constraints (for running AOFD tool) and time required for implementation of another model (in addition to 2D one)

REVIEW - WP3 A11

PROGRESS TO DATE:

Recent developments in Leuven (BE) pilot location (Apr – Oct 2013):

- 1D sewer system model structure completed for subarea of Leuven, verification yet to be done

- Initial 2D model of the surface implemented (without voids)

- Initial tests of 2D model of the surface with voids, bottle necks are being identified, several problems have arisen and decisions have been made as a result:

    - Too many mesh elements which may exceed capacity of InfoWorks CS software

    - Ways of reducing mesh elements are being sought

    - Given limitations of InfoWorks CS, Aquafin partners have recently decided to use InfoWorks ICM (+ ICM Live) instead of IW CS (+ FloodWorks)
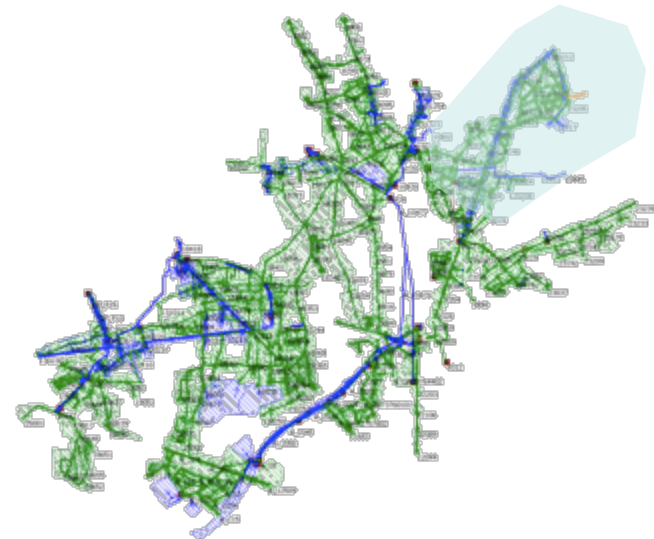
REVIEW - WP3 A11

PROGRESS TO DATE:

Recent developments in Ghent (BE) pilot location (Apr – Oct 2013):

- 1D model of sewer system has been implemented

- 1D model of the surface is being developed with the AOFD tool and InfoWorks CS tools

- Future activities :

  - Create 1D-1D dual drainage models

  - Compare AOFD and InfoWorks CS generated 1D-1D models

  - Implement 1D/2D model for the city of Gent (high resolution DTM 1x1m maps)

  - Implementation of hybrid models

  - Comparison of model structures
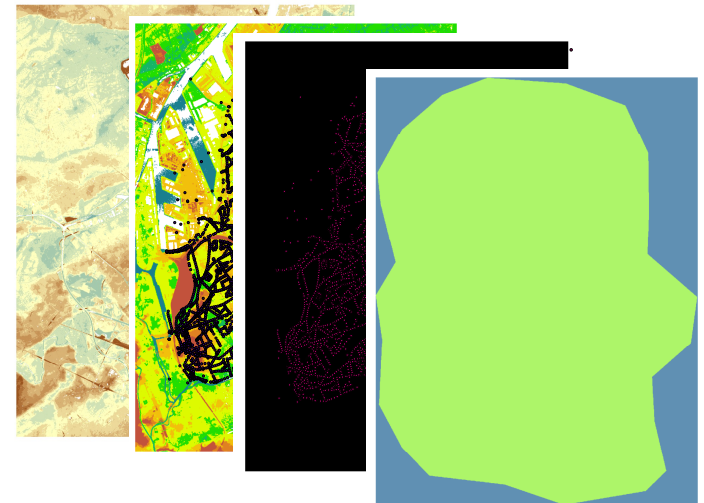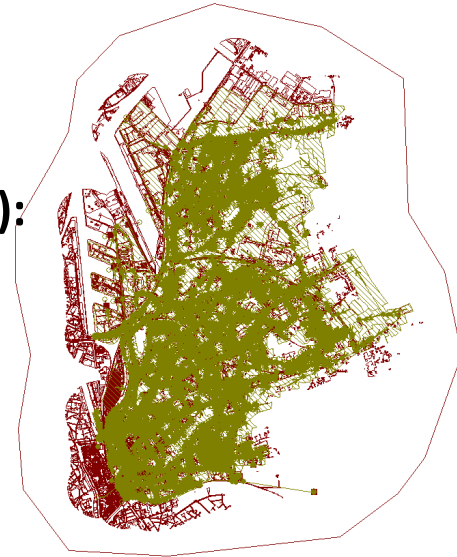
REVIEW - WP3 A11

PROGRESS TO DATE:

Recent developments in NL pilot locations (Apr – Oct 2013):

–   Initial tests for implementing a Multi-Hydro model of two areas in Rotterdam: the Spaanse Polder and Centrum districts. This has been done in collaboration between TU Delft and ENPC.

–   Two problems encountered with the implementation of the Multi-Hydro model, mainly related to special characteristics of Dutch flat catchments:

   –   Multi-Hydro does not yet include ancillary structures (pumps, weirs, etc.), of which there are lots in the Rotterdam sewer systems due to the flatness of the area

   –   Multi-Hydro requires definition of an outflow point for the catchment, while in a flat catchment the flow direction is not 'predefined' and may even change during a storm event.

REVIEW - WP3 A11

Recent developments in NL pilot locations (Apr – Oct 2013):

Land Use (MH)
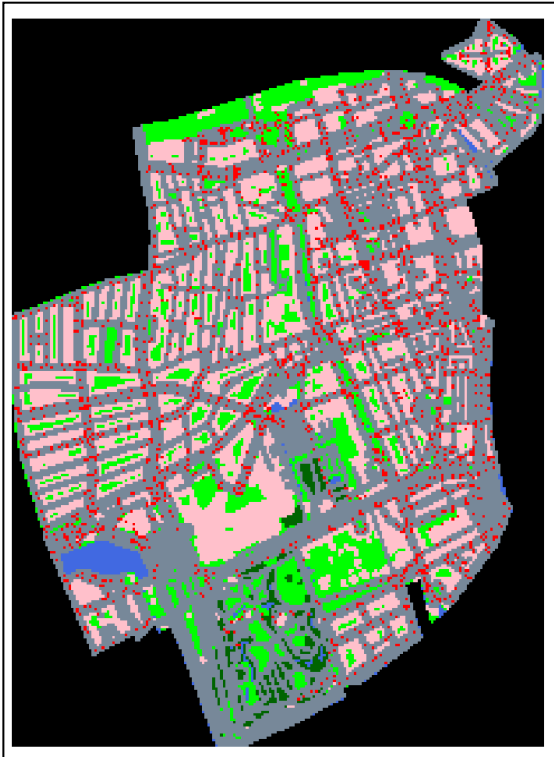
Elevation (MH)

Sewer System (SWMM/MH)

REVIEW - WP3 A11

PROGRESS TO DATE:

Recent developments in FR pilot locations (Apr – Oct 2013):

- Significant upgrade of the in-house developed Multi-Hydro model. The interactions between surface and sewer flow are now correctly handled when sewers are overflowing.

- **Loup catchment** (upstream of Morée-Sausset pilot site): validation of Multi-Hydro model using 4 heavy rainfall events (WP3 A11 & 12)

- **Sucy-en-Brie:** Multi-Hydro models of different resolutions have been implemented for this pilot area. Canoe model was already in place and has been further validated using 'virtual X-band radar data' (WP3 A11 & 12)

Canoe

MH 10m

MH 3m

MH 5m
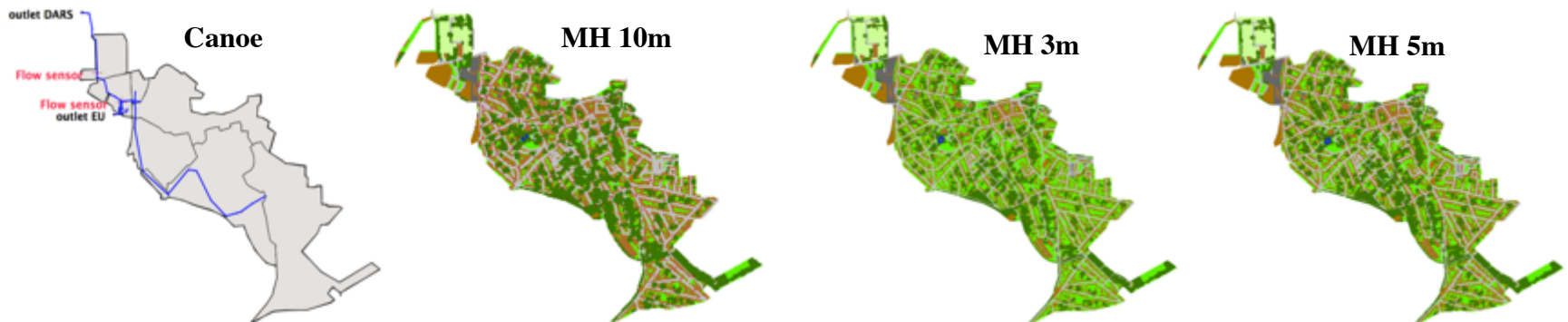
REVIEW - WP3 A11

- **NEXT STEPS:**

  – Models of all pilot locations will continue to be improved as the project progresses and monitoring data becomes available.

  – Throughout the project the different software packages and modelling approaches will be discussed and compared, partners will share experiences and expertise, and recommendations regarding the suitability of the different models will be made.

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

REVIEW - WP3 A12

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

Output: tested and implemented flood models for pilots + reports

PROGRESS TO DATE:

– Data for testing of models are being collected

– The datasets to be used for testing of models have been agreed upon (Feb 2013) – these will come from WP2

– **Recent developments in The Netherlands:**

  – Analysis of the impact of spatial and temporal resolution of rainfall estimates on the outputs of the hydraulic model of Rotterdam Centrum District (using data from Cabauw X-band radar)

  – Not much impact was observed

  – Interesting discussion about these results took place during technical meeting in Leuven (Aug 2013)

1 min

2012-01-03 14:41, rainfall rate (mm/h)

5 min

2012-01-03 14:44, rainfall rate (mm/h)

10 min

2012-01-03 14:49, rainfall rate (mm/h)
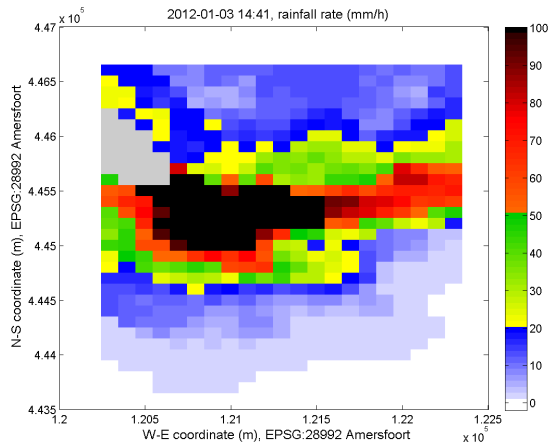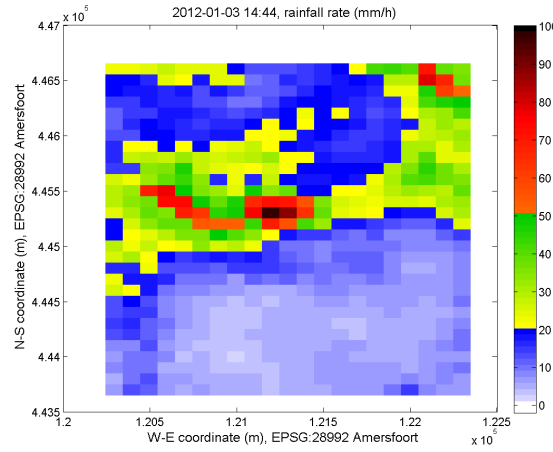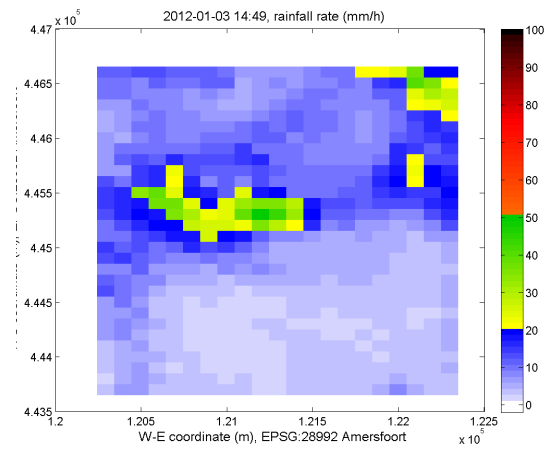
Moderate yet highly-localised event, with a small, approximately 1-2 km² storm cell moving over the catchment in just a few minutes

Location 1

WL@900585 Δt= 10 min, 5 min, 1 min

Location 2

WL@901676 Δt= 10 min, 5 min, 1 min

Location 3

WL@northern area Δt= 10 min, 5 min, 1 min
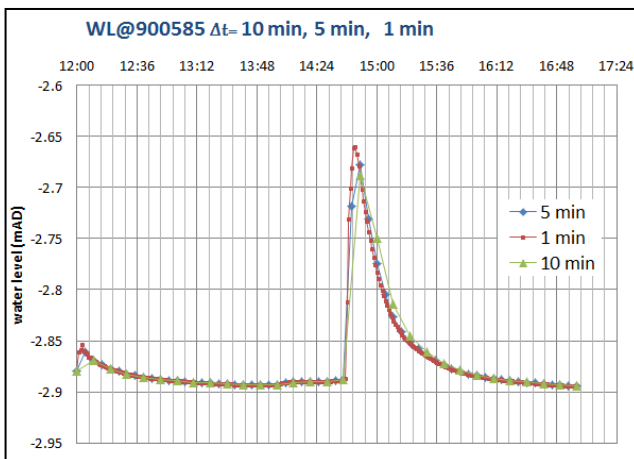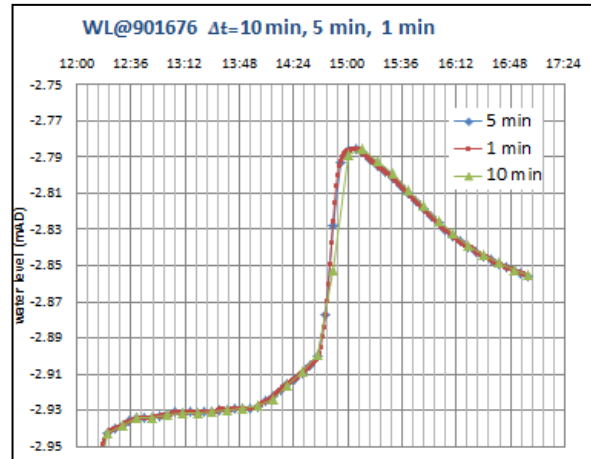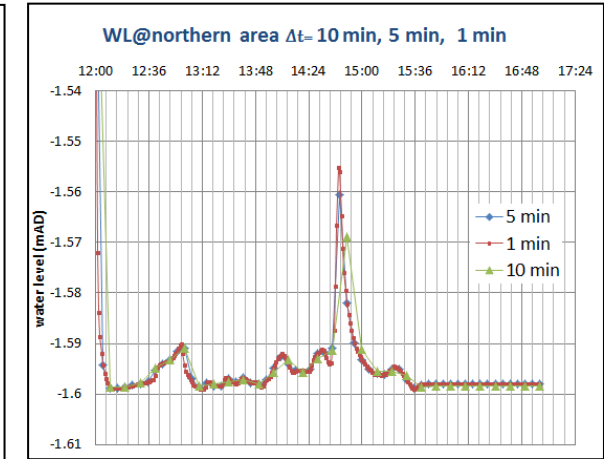
REVIEW - WP3 A12

- **PROBLEMS / PARTICULAR ISSUES:**

  – Collection of data for model testing is delayed as a result of delays in WP1

- **NEXT STEPS:**

  – **Oct 2013:** initial datasets will be selected for testing of models and assessment of the impact of rainfall data resolution

  – **Feb 2014:** collaborative paper will be submitted to Weather Radar and Hydrology Symposium

  – Data collection will continue at all pilot locations

  – Looking forward to rainfall data from new radars

Datasets to be used for model testing:

– One common rainfall dataset will be applied to models of all pilot locations. This dataset will include: C-band and/or X-band radar data, raingauge data, merged radar-raingauge data, downscaled radar data. This would enable drawing conclusions regarding the effect of different rainfall inputs on different models.

– Complete dataset specific to each pilot location, comprising rainfall as well as water depth/flow measurements. This would enable assessing the performance of the model.

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

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 (Feb 2013).

  - Updates to workshop pack have been made following comments from Greater London Authority

  - 'Dynamic' interactions around the WP3 Review Document:

    - Useful comments and inputs received from partners from all countries

    - Interesting discussions around document

    - Document has been updated accordingly and a new version will be available soon
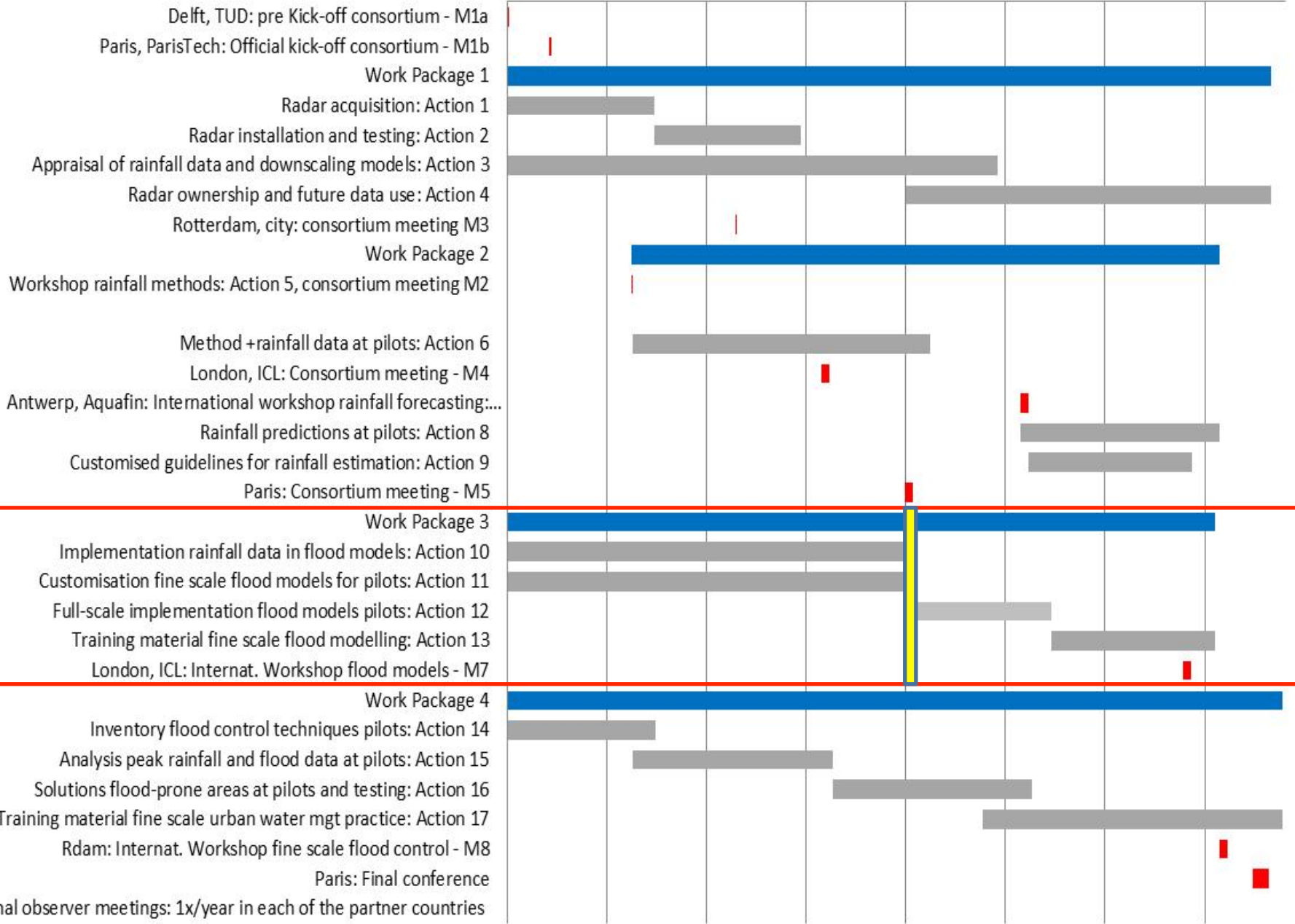
REVIEW - WP3 A13

- **NEXT STEPS:**

    - As more results become available from pilot locations, general conclusions will be drawn and will be included in the WP3 review document

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

OVERALL PROGRESS

- In general, progress according to proposed timeline

- Permanent (and very useful) consultation and discussion with partners on forecasting platform, urban pluvial flood modelling approaches and modelling results