Delft-FEWS platform application for first UK pilot site

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RainGain Project Meeting

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CONTENTS

1. Why we need a platform?

- Because we promised:

  A10: Adoption, customisation and automatic linkage of rainfall forecasts to pluvial flood models

- Because it would facilitate testing of models and rainfall processing/forecasting methodologies

  A12: Full-scale testing of the models for pluvial flood prediction in each of the pilot locations

- Because it would facilitate knowledge sharing amongst partners

2. Some existing Flood Forecasting Platforms
(Flood Early Warning Systems - FEWS)

- In-house linkage of input data and models - Tailored for particular needs, research projects
- UrbanFlood Common Information Space (CIS): open platform for Early Warning Systems (EWS)
- Innovyze Floodworks
- Delft-FEWS
- …

All have similar structure, the final purpose is the same

3. Proposed platform: Delft-FEWS

- **Open Source, Open shell** system for managing forecasting processes and/or handling time series data
- Collection of modules designed for building a hydrological forecasting system customised to the specific requirements of an individual organisation
- User-friendly GIS interface, wide range of tools for visualisation, analysis and handling of data
- Provides open interface to any external forecasting model and/or data handling routine

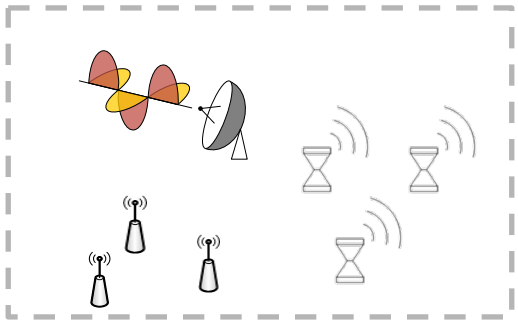
Why Delft-FEWS?

- Open Source
- Flexible, extensible modular structure
- Used for simple as well as complex applications
- Supports wide range of standard formats
- Built-in tools
- Has been widely tested – operationally used in more than 20 countries: US, UK, Taiwan, NL, Singapore, etc.
- Complete documentation
- User forum
- We have some expertise and help from Deltares

More about Delft-FEWS

- Developed using Java
- Fully configurable through open XML formatted configuration files
- Data are imported using standard interchange formats (XML, CSV, GRIBB, ASCII, etc.)
- Also supports import of ensemble weather predictions

Delft-FEWS Modular System



FEWS database

Database Module

External Data Folder

Import Module

Validation Module

Interpol. Module

Transform . Module

Adapter Module

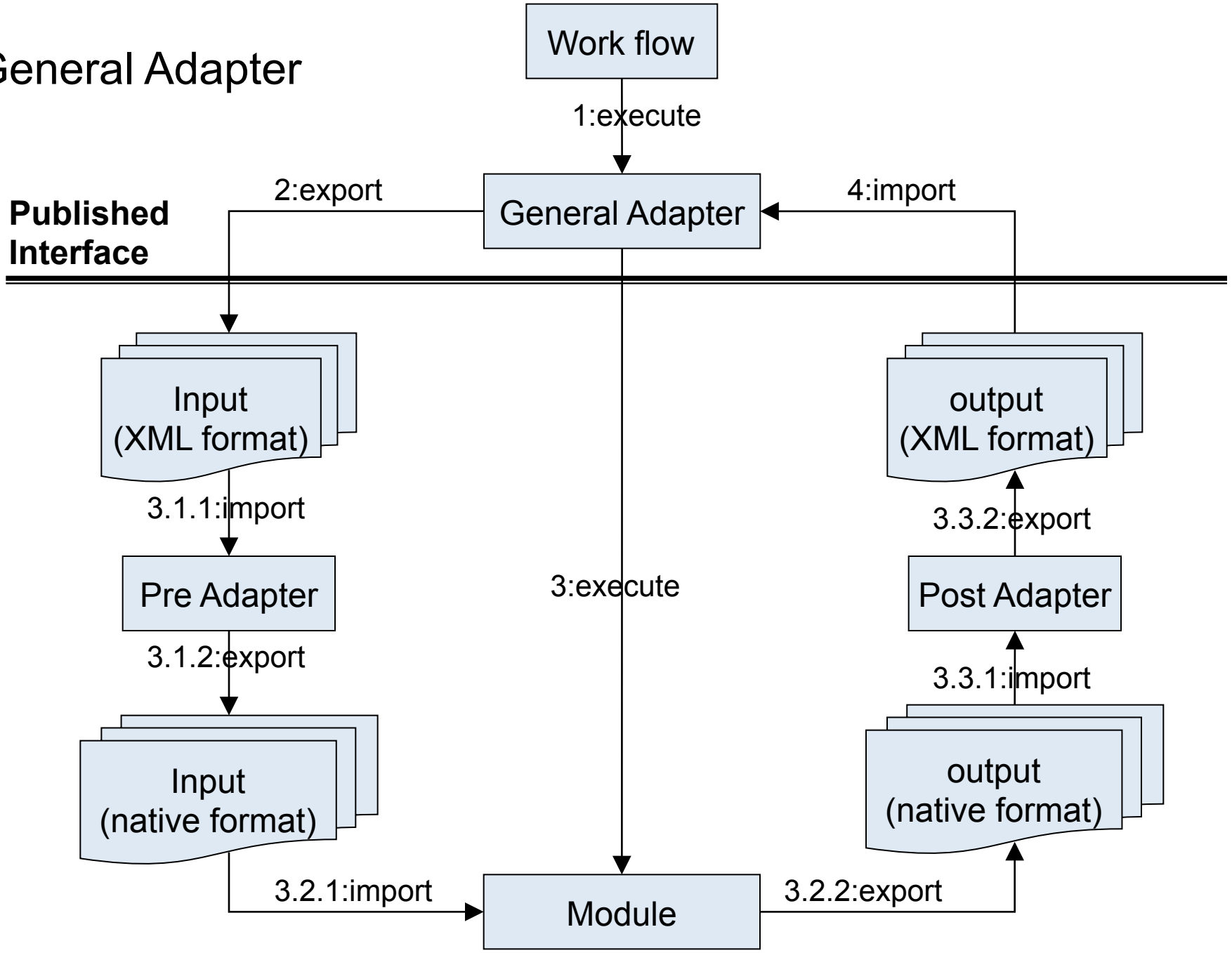
Mapping Module

Report Module

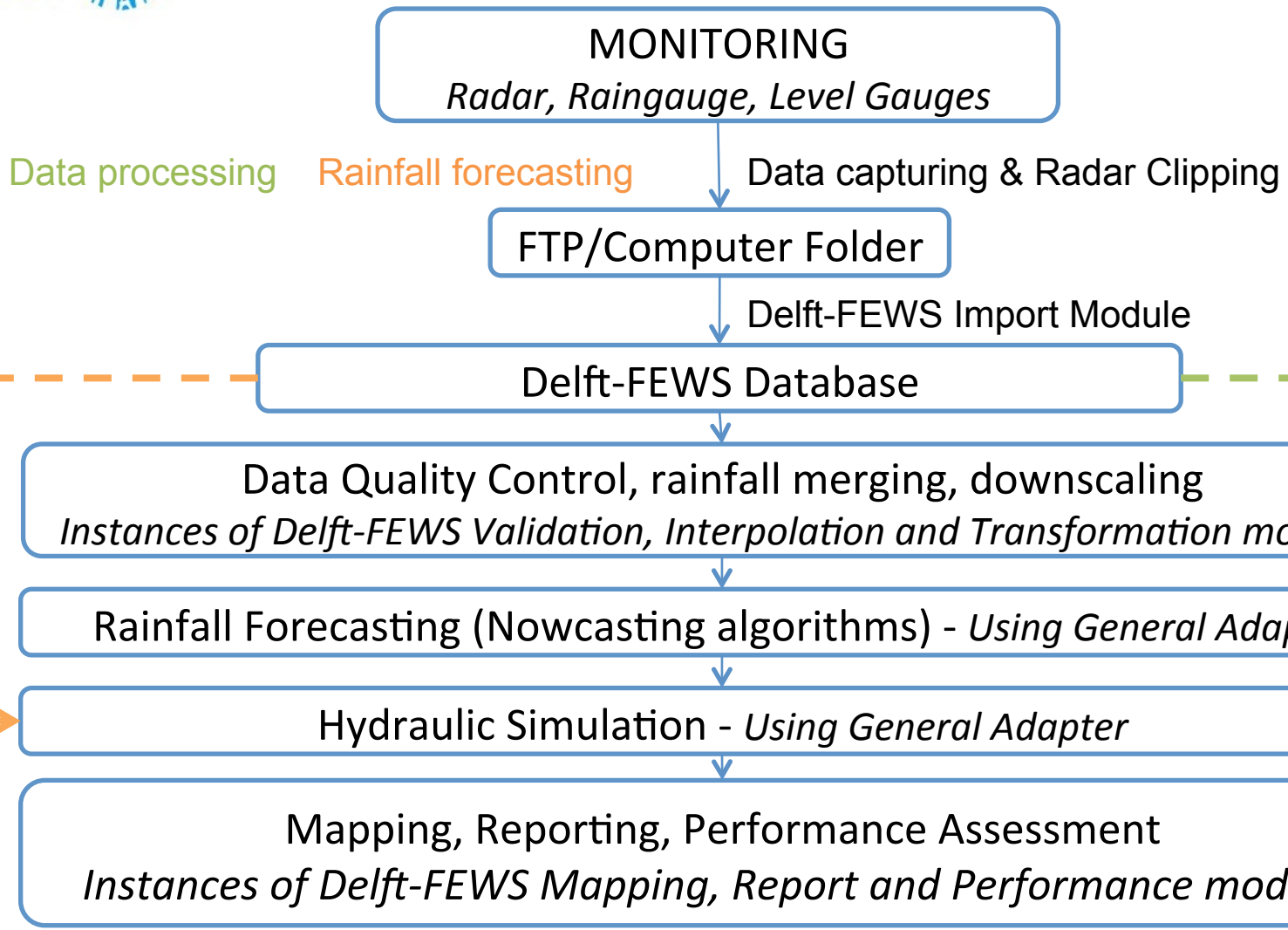
Perform. Module

User Interface

General Adapter



4. Workflow


MONITORING
Radar, Raingauge, Level Gauges
Data processing
Rainfall forecasting
Data capturing & Radar Clipping
FTP/Computer Folder
Delft-FEWS Import Module
Delft-FEWS Database
Data Quality Control, rainfall merging, downscaling
Instances of Delft-FEWS Validation, Interpolation and Transformation modules
Rainfall Forecasting (Nowcasting algorithms) - Using General Adapter
Hydraulic Simulation - Using General Adapter
Mapping, Reporting, Performance Assessment
Instances of Delft-FEWS Mapping, Report and Performance modules

5. Proposed Setup

- Delft-FEWS can be run in two ways:
  - As a self-contained (standalone) manually driven forecasting system operation on a normal desktop computer
  - As a fully automated distributed client-server application

- Proposed setup:
  - Standalone version installed on a desktop computer located in pilot leaders' workplace
  - In this way we avoid confidentiality and communication issues

6. Delft-FEWS platform application for first UK pilot site

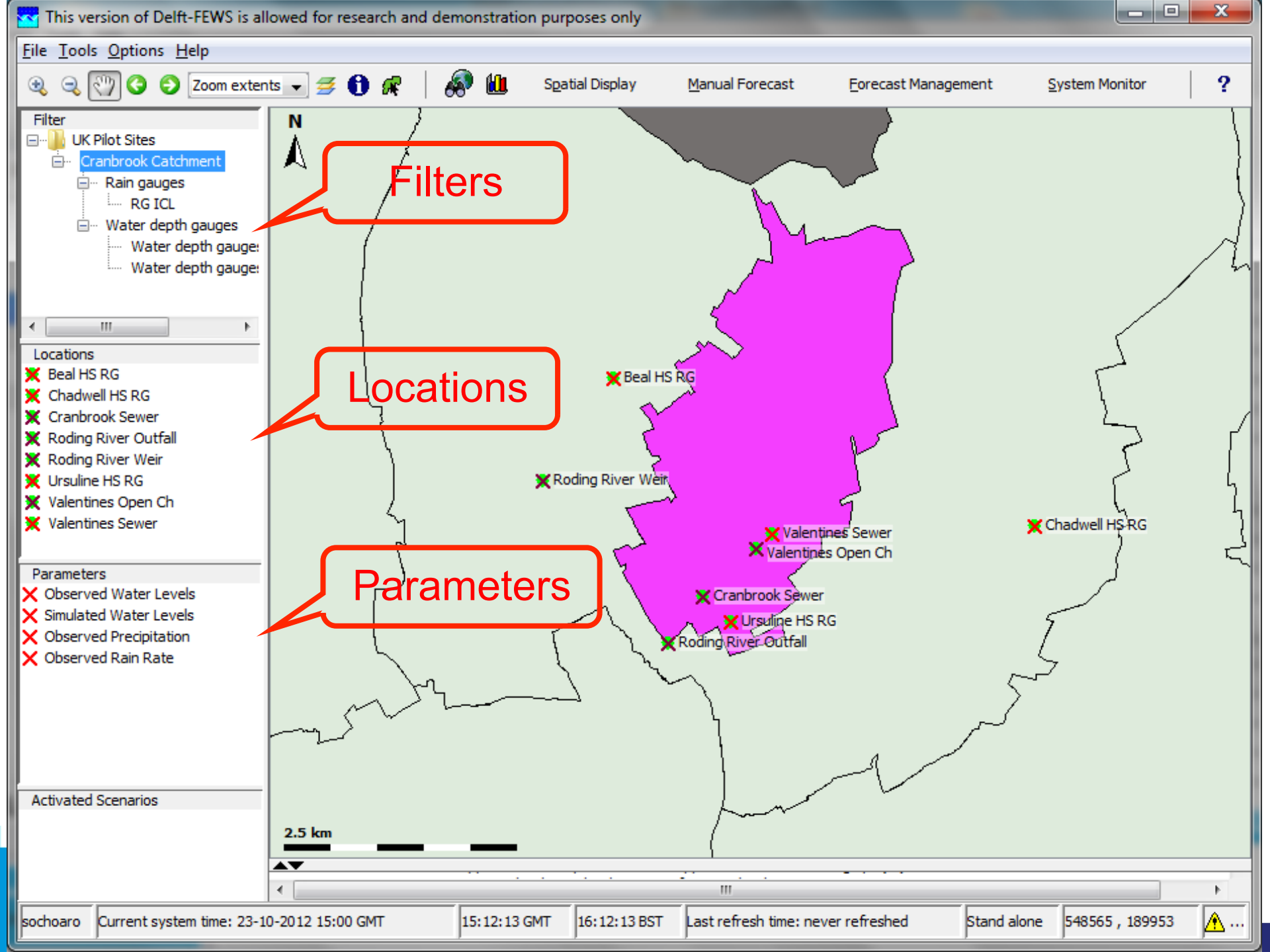
ACTIVITIES TO DATE:

- Installation of Delft-FEWS
- Set up of maps, locations and filters
- Import and display of telemetry data (raingauge and water depth observations)
- Linkage and running of hydraulic model (SWMM)
- Import and visualisation of radar data (grid display)

- Installation of Delft-FEWS
  - Received installation files and tutorial from Deltares in mid July
  - Files include executable for installation of Java platform, in addition to java classes and regional/application specific configuration files

bin	This folder contains the actual Delft-FEWS software.
jre	This folder contains the Java Runtime Environment
FEWS_SA	In this folder the files for a separate application are stored. There can be multiple application folders next to the bin and jre folder

- Setup of maps, locations and filters:
  - **Maps:** with shapefiles (FEWS_SA\Config\MapLayerFiles), need to customise display (FEWS_SA\Config\SystemConfigFiles\Explorer.xml)
  - **Point locations:** can be defined using shapefiles or specifying coordinates (FEWS_SA\Config\RegionConfigFiles\LocationSets.xml; FEWS_SA\Config\RegionConfigFiles\Locations.xml)
  - **Filters:** allow choosing what you want to display and how you want to group your locations in the display. Some locations may be declared, but through filters you choose if you want to display them or not and you can also assign the parameters that will be associated to each specific location. (FEWS_SA\Config\RegionConfigFiles\Filters.xml)


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
Rain gauges
RG ICL
Water depth gauges
Water depth gauge
Water depth gauge
Filters
Locations
Beal HS RG
Chadwell HS RG
Cranbrook Sewer
Roding River Outfall
Roding River Weir
Ursuline HS RG
Valentines Open Ch
Valentines Sewer
Locations
Parameters
Observed Water Levels
Simulated Water Levels
Observed Precipitation
Observed Rain Rate
Parameters
Activated Scenarios
N
Beal HS RG
Roding River Weir
Valentines Sewer
Valentines Open Ch
Chadwell HS RG
Cranbrook Sewer
Ursuline HS RG
Roding River Outfall
2.5 km
sochoaro
Current system time: 23-10-2012 15:00 GMT
15:12:13 GMT
16:12:13 BST
Last refresh time: never refreshed
Stand alone
548565 , 189953

```
<locationSet id="Total_Sensors" name="Total Sensors">
    <esriShapeFile>
        <file>All_Sensors.shp</file> <!-- I loaded the shp conta
        <geoDatum>Ordnance Survey Great Britain 1936</geoDatum>
        <id>%ID_NEW%</id>
        <name>%NAME%</name>
        <description>%DESCRIPT%</description>
        <shortName>%SHORTNAME%</shortName>
        <x>%XCOORD%</x>
        <y>%YCOORD%</y>
        <z>%ZCOORD%</z>
        <attribute id="TYPE">
            <text>%TYPE%</text>
        </attribute>
        <attribute id="SYSTEM">
            <text>%SYSTEM%</text>
        </attribute>
        <attribute id="Cranbrook">
            <text>%Cranbrook%</text>
        </attribute>
        <attribute id="Purley">
            <text>%Purley%</text>
        </attribute>
        <attribute id="Torquay">
            <text>%Torquay%</text>
        </attribute>
    </esriShapeFile>
</locationSet>
```

Mapping between shp and FEWS locations

Attributes to be used for filtering later on

Shapefile: Need to think of attributes that will allow filtering in the future

All_Sensors

FID	Shape *	ID	ID_NEW	NAME	DESCRIPT	SHORTNAME	XCOORD	YCOORD	ZCOORD	TYPE	SYSTEM	Cranbrook	Purley	Torquay
0	Point	RG_00	Ascot_Berkshire	Ascot_Berkshire	RG	Ascot_Berkshire	492414.97	167281.853	0	RG	LGfL	0	0	0
1	Point	RG_00	Ashford_Kent	Ashford_Kent	RG	Ashford_Kent	599952.604	141746.819	0	RG	LGfL	0	0	0
2	Point	RG_00	Atomwide_Orpington_S	Atomwide_Orpington_S	RG	Atomwide_Orpington_S	546772.207	167554.175	0	RG	LGfL	0	0	0
3	Point	RG_00	Aylesbury_Buckingham	Aylesbury_Buckingham	RG	Aylesbury_Buckingham	481744.744	211706.987	0	RG	LGfL	0	0	0
4	Point	RG_00	Bedfont_W_London	Bedfont_W London	RG	Bedfont_W_London	509106.765	174286.627	0	RG	LGfL	0	0	0
5	Point	RG_00	Belmont_S_London	Belmont_S London	RG	Belmont_S_London	525318.663	162309.107	0	RG	LGfL	0	1	0
6	Point	RG_00	BETT_Olympia_London	BETT Olympia_London	RG	BETT_Olympia_London	524354.039	178975.595	0	RG	LGfL	0	0	0
7	Point	RG_00	Bodmin_Cornwall	Bodmin_Cornwall	RG	Bodmin_Cornwall	207676.312	65649.348	0	RG	LGfL	0	0	0
8	Point	RG_00	Bow_London	Bow_London	RG	Bow_London	536960.307	182860.526	0	RG	LGfL	0	0	0

- Import and display of telemetry data (raingauge and water depth observations):
  - Using CSV format supported by Delft-FEWS (using existing class)
  - Need to create new instance of existing module (FEWS_SA\Config\ModuleConfigFiles)
  - Need to "register" new instance (FEWS_SA\Config\RegionConfigFiles\ModuleInstanceDescriptors.xml)
  - Map system variables vs file variables (FEWS_SA\Config\IdMapFiles)
  - Make sure filters will show the imported data (FEWS_SA\Config\RegionConfigFiles\Filters.xml)
  - Define workflow (create new one or add activity to existing workflow) (FEWS_SA\Config\WorkflowFiles)
  - Register your workflow (FEWS_SA\Config\RegionConfigFiles\WorkflowDescriptors .xml)

CSV format

```
Location Names,Beal_HS_RG,Ursuline_HS_RG,Chadwell_HS_RG
Location Ids,Beal_HS_RG,Ursuline_HS_RG,Chadwell_HS_RG
Time,Rain Rate[mm/h],Rain Rate[mm/h],Rain Rate[mm/h]
2010-08-22 18:00:00,0,0,0
2010-08-22 18:05:00,0,0,0
2010-08-22 18:10:00,0,0,0
2010-08-22 18:15:00,0,0,0
2010-08-22 18:20:00,0,0,0
2010-08-22 18:25:00,0,0,0
2010-08-22 18:30:00,0,0,0
2010-08-22 18:35:00,0,0,0
2010-08-22 18:40:00,0,0,0
2010-08-22 18:45:00,0,0,0
2010-08-22 18:50:00,0,0,0
2010-08-22 18:55:00,0,0,0
2010-08-22 19:00:00,0,0,0
2010-08-22 19:05:00,0,0,0
2010-08-22 19:10:00,0,0,0
2010-08-22 19:15:00,0,0,0
2010-08-22 19:20:00,0,0,0
2010-08-22 19:25:00,0,0,0
2010-08-22 19:30:00,0,0,0
2010-08-22 19:35:00,0,0,0
2010-08-22 19:40:00,0,0,0
2010-08-22 19:45:00,0,2.4,0
2010-08-22 19:50:00,2.4,0,0
2010-08-22 19:55:00,0,0,2.4
2010-08-22 20:00:00,0,2.4,0
2010-08-22 20:05:00,2.4,0,0
```

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!--NFFS Midlands region-->
<timeSeriesImportRun xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/
  <import>
  <general>
      <importType>CSV</importType>
      <folder>$IMPORT_CSV_FOLDER$</folder>
      <failedFolder>$IMPORT_FAILED_FOLDER$</failedFolder>
      <backupFolder>$BACKUP_CSV_FOLDER$</backupFolder>
      <idMapId>IdImportCSV</idMapId>
      <unitConversionsId>ImportUnitConversions</unitConversionsId>
      <importTimeZone>
        <timeZoneOffset>-23:00</timeZoneOffset>
      </importTimeZone>
      <dataFeedId>CSV</dataFeedId>
    </general>
    <timeSeriesSet>
      <moduleInstanceId>ImportCSV</moduleInstanceId>
      <valueType>scalar</valueType>
      <parameterId>RR.obs</parameterId>
      <locationSetId>RG_ICL_Cranbrook</locationSetId>
      <timeSeriesType>external historical</timeSeriesType>
      <timeStep unit="minute" multiplier="5"/> <!--Temporal resolution-->
      <readWriteMode>read only</readWriteMode>
      <synchLevel>1</synchLevel>
    </timeSeriesSet>
    <timeSeriesSet>
      <moduleInstanceId>ImportCSV</moduleInstanceId>
      <valueType>scalar</valueType>
```

New module instance for importing CSV files

IdMapping for new CSV import instance

```xml
<?xml version="1.0" encoding="UTF-8"?>
<idMap xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocat
  <!-- these are the parameters -->
  <parameter internal="P.obs" external="Rainfall"/> <!--External is the name to be included in the CSV file-->
  <parameter internal="RR.obs" external="Rain Rate"/>
  <parameter internal="H.obs" external="Water Depth"/>
  <!-- these are the locations - So far I have only included the locations of Cranbrook ICL sensors-->
  <location internal="Beal_HS_RG" external="Beal_HS_RG"/>
  <location internal="Ursuline_HS_RG" external="Ursuline_HS_RG"/>
  <location internal="Chadwell_HS_RG" external="Chadwell_HS_RG"/>
  <location internal="Valentines_Sewer" external="Valentines_Sewer"/>
  <location internal="Valentines_OpenC" external="Valentines_OpenC"/>
  <location internal="Cranbrook_Sewer" external="Cranbrook_Sewer"/>
  <location internal="Roding_Outfall" external="Roding_Outfall"/>
  <location internal="Roding_River" external="Roding_River"/>
</idMap>
```

eInstanceDescriptors 1.02 default.xml | Explorer 1.00 default.xml | LocationSets 1.00 default.xml | ImportCSVTelemetry 1.00 default.xml

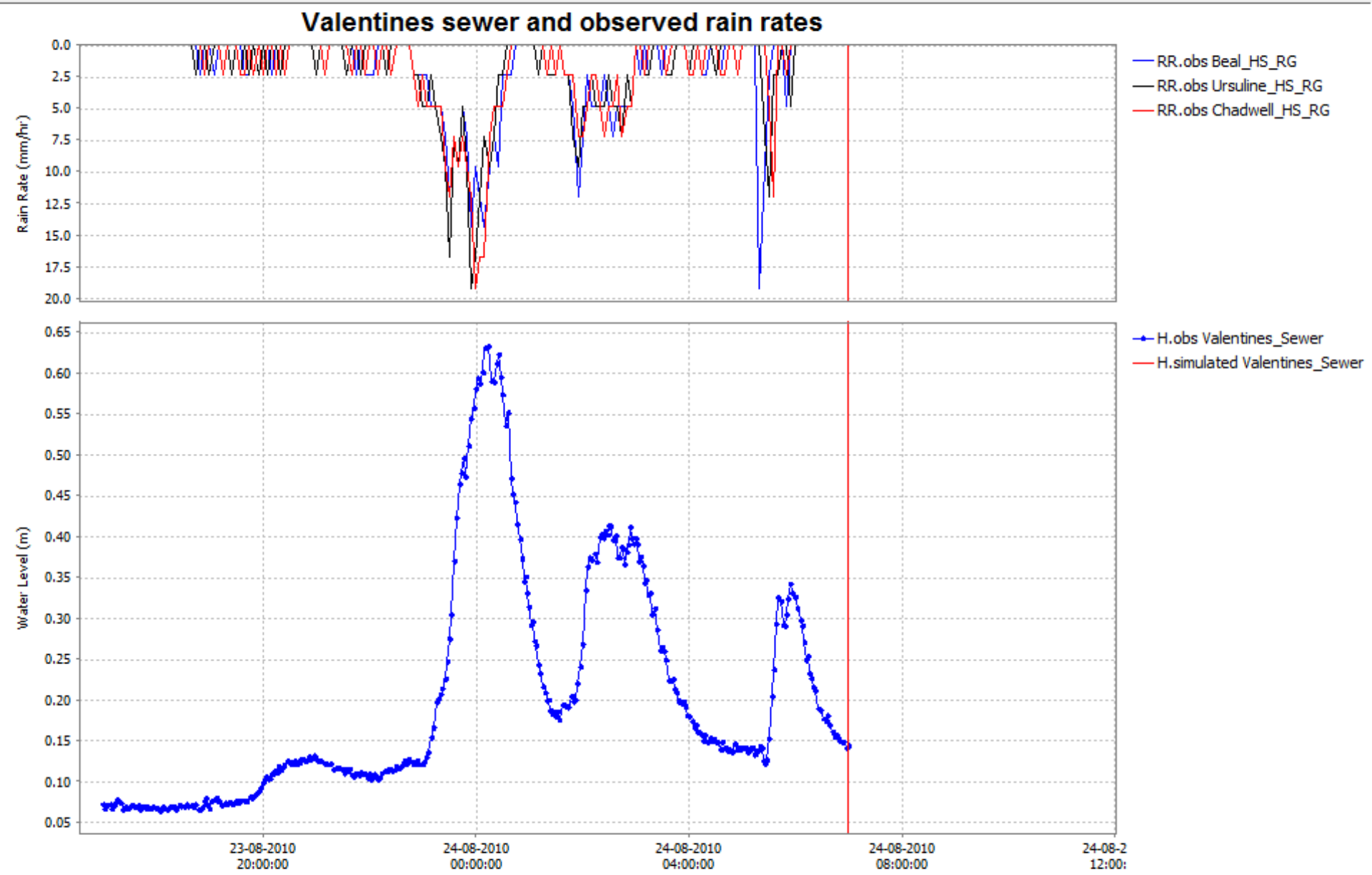
```
<?xml version="1.0" encoding="UTF-8"?>
<workflow xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLS

  <!--Import CSV Time Series from Telemetry-->
  <activity>
    <runIndependent>true</runIndependent>
    <moduleInstanceId>ImportCSV</moduleInstanceId>
  </activity>
</workflow>
```

New workflow

Registration of new workflow

eInstanceDescriptors 1.02 default.xml | Explorer 1.00 default.xml | LocationSets 1.00 default.xml | ImportCSVTelemetry 1.00 default.xml | WorkflowDescriptors 1.00 default.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<workflowDescriptors xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLSchema-i
  <workflowDescriptor id="ImportExternal" visible="true" forecast="false">
    <description>Import external data</description>
  </workflowDescriptor>
  <workflowDescriptor id="RunSwmm" visible="true" forecast="false">
    <description>Run SWMM</description>
  </workflowDescriptor>
  <workflowDescriptor id="ImportCSVTelemetry" visible="true" forecast="false">
    <description>Import rainfall telemetry</description>
  </workflowDescriptor>
</workflowDescriptors>
```

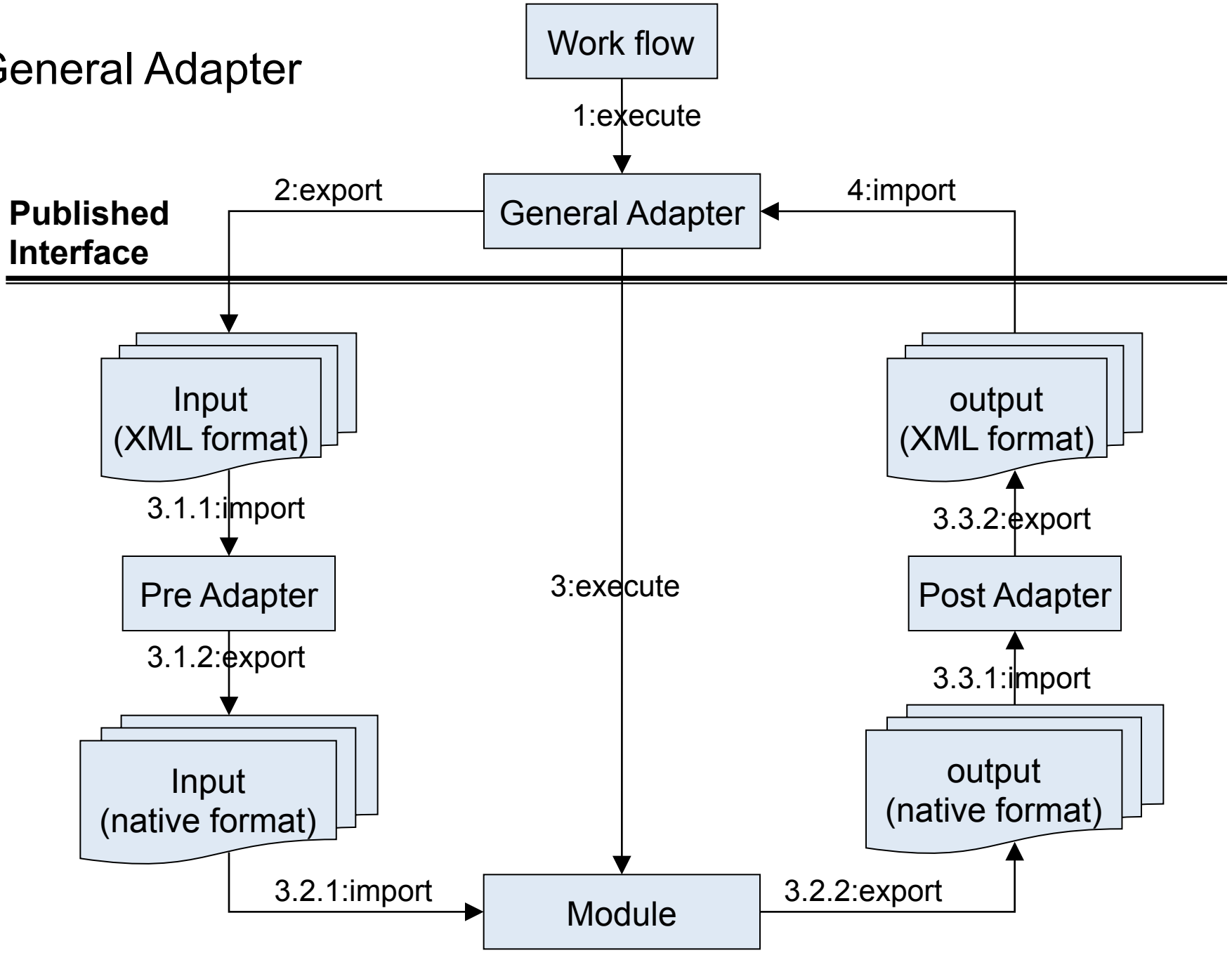


Close Help

21:11:52 GMT | 22:11:52 BST | Display time: 24-08-2010 07:00 GMT | Stand alone | Local Datum

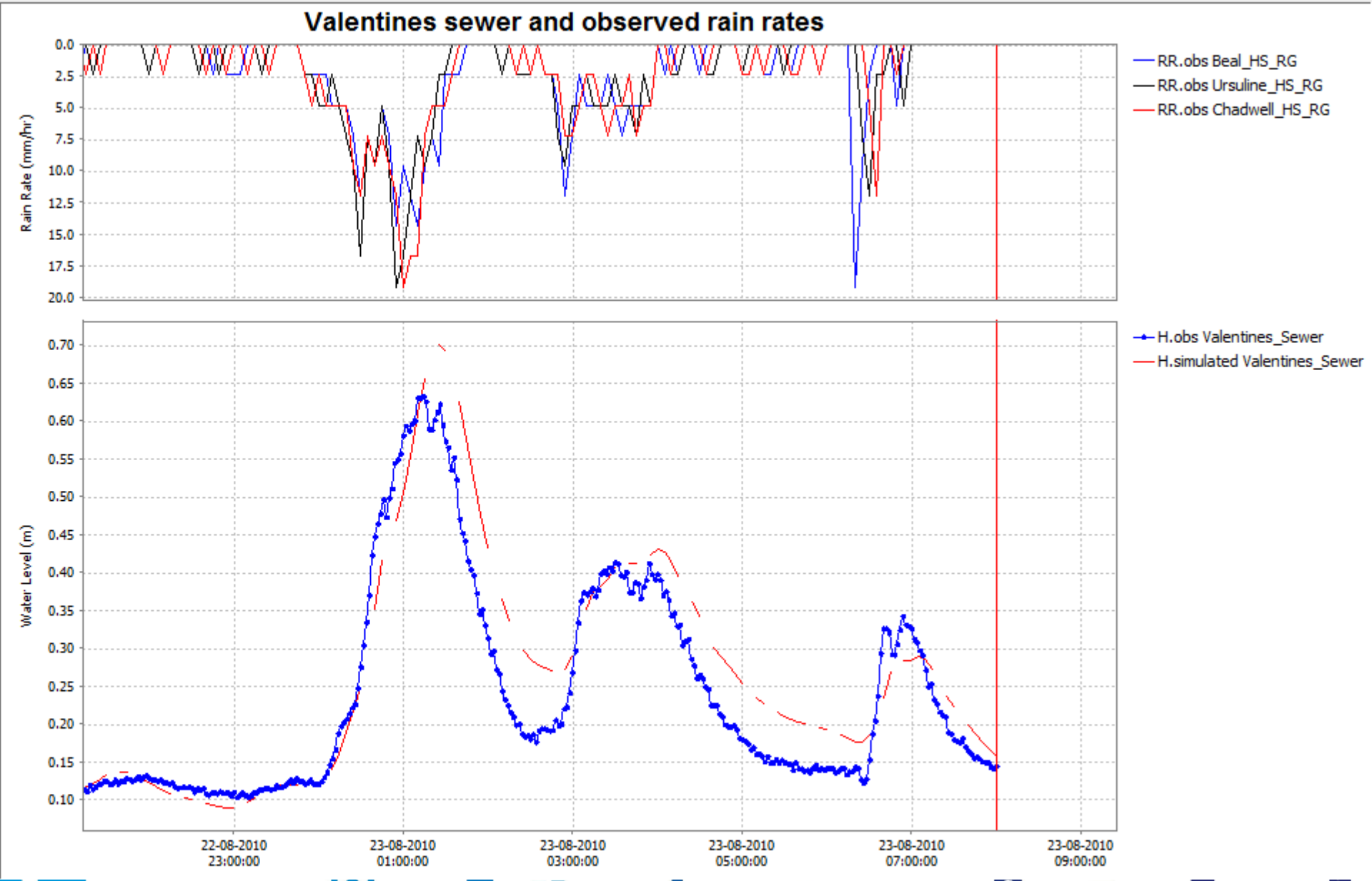
- Linkage and running of hydraulic model (SWMM)
  - Used computing engine (.exe) of SWMM
  - Used “General Adapter” – created new instance of “General Adapter” called “swmm”, which “calls” the computing engine of SWMM and runs it.
  - The detailed activities required for linking and running SWMM are the following:
    - *Pre-adapter:* Transformation of data into SWMM format
    - *Main instance:* Running of SWMM (FEWS_SA\Modules\swmm) (FEWS_SA\ModuleConfigFiles\swmm)
    - *Post-adapter:* Parsing of SWMM output and converting to CSV (an .exe was created for this) (FEWS_SA\ModuleConfigFiles\swmm_output)
    - Importing CSV output back to SWMM (using same module instance used for importing telemetry data)
  - The new instances must be registered and included in a workflow, as was done with the CSV import instance.

General Adapter



Display 1.00 Default.xml | Explorer 1.00 default.xml | TimeSeriesDisplayConfig 1.02 default.xml | swmm 1.00 default.xml | swmm_outp

```
<?xml version="1.0" encoding="UTF-8"?>
<workflow xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/200
  <!--Interpolate Hydro1 and Hydro2        -->
  <activity>
    <runIndependent>true</runIndependent>
    <moduleInstanceId>ImportCSV</moduleInstanceId>
  </activity>
  <activity>
    <runIndependent>true</runIndependent>
    <moduleInstanceId>ExportCSV</moduleInstanceId>
  </activity>
  <activity>
    <runIndependent>true</runIndependent>
    <moduleInstanceId>swmm</moduleInstanceId>
  </activity>
  <activity>
    <runIndependent>false</runIndependent>
    <moduleInstanceId>swmm_output</moduleInstanceId>
  </activity>
  <activity>
    <runIndependent>false</runIndependent>
    <moduleInstanceId>ImportSwmmCSV</moduleInstanceId>
  </activity>
</workflow>
```


Valentines sewer and observed rain rates
Rain Rate (mm/hr)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
RR.obs Beal_HS_RG
RR.obs Ursuline_HS_RG
RR.obs Chadwell_HS_RG
Water Level (m)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
H.obs Valentines_Sewer
H.simulated Valentines_Sewer
22-08-2010 23:00:00
23-08-2010 01:00:00
23-08-2010 03:00:00
23-08-2010 05:00:00
23-08-2010 07:00:00
23-08-2010 09:00:00

In the same way we ran SWMM, any other *.exe programme can be linked to Delft-FEWS in the future

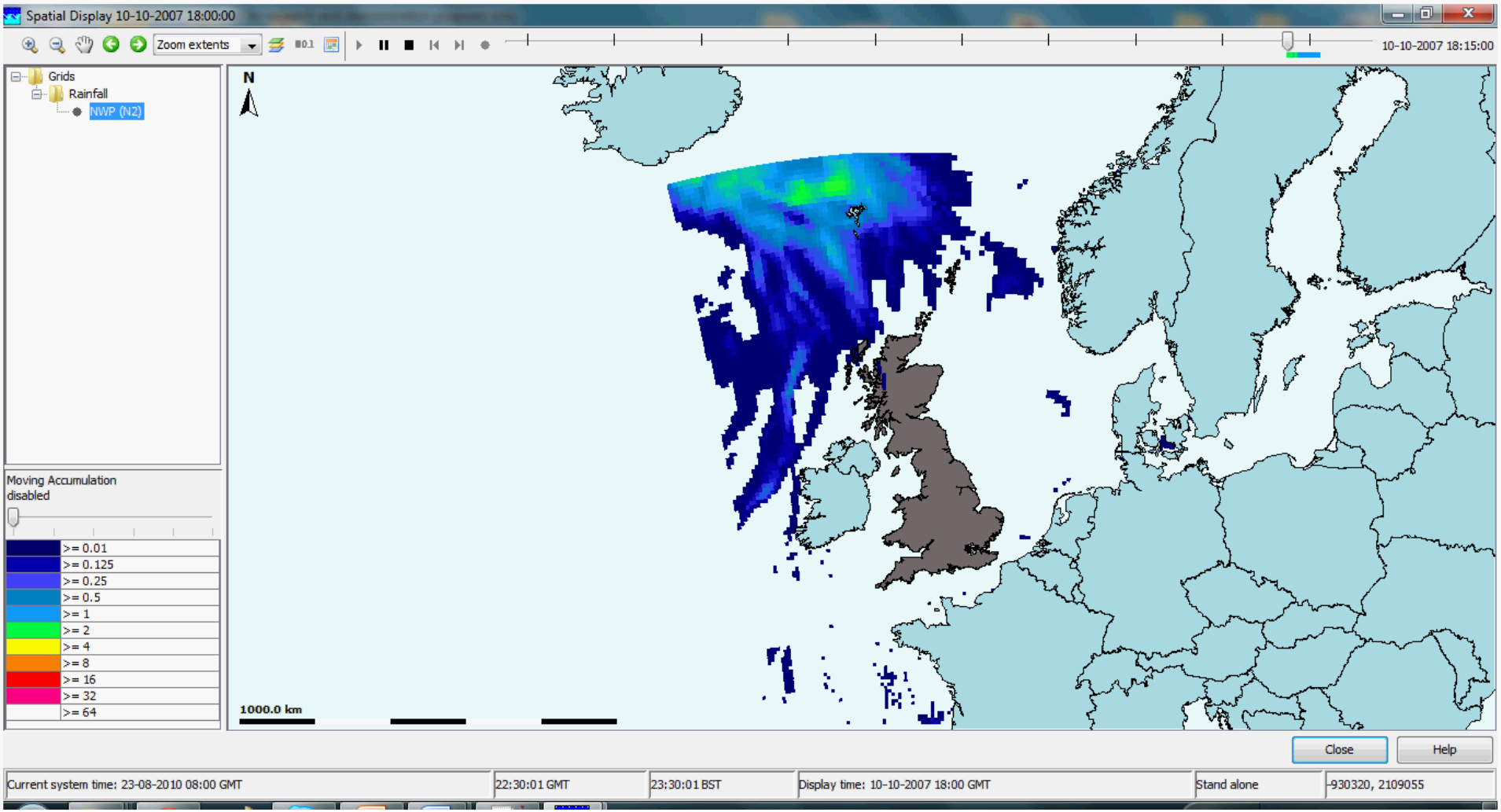
- Import and visualisation of radar data (grid display):
  - Using Import Nimrod routines supported by Delft-FEWS (using existing class)
  - Need to create new instance of existing module (FEWS_SA\Config\ModuleConfigFiles)
  - Need to “register” new instance (FEWS_SA\Config\RegionConfigFiles\ModuleInstanceDescriptors.xml)
  - Map system variables vs file variables (FEWS_SA\Config\IdMapFiles)
  - Configure grid display (FEWS_SA\Config\DisplayConfigFiles\SpatialDisplay 1.00 Default.xml)
  - Define workflow (create new one or add activity to existing workflow) (FEWS_SA\Config\WorkflowFiles)
  - Register your workflow (FEWS_SA\Config\RegionConfigFiles\WorkflowDescriptors .xml)

Rain Gain

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB



7. Topics for discussion

- **Use of platform:** testing of algorithms for rainfall processing/forecasting
- **Platform setup (agreed upon in June 2012):** one forecasting system installed/customised at each pilot location, managed by pilot leaders
- Models to be used at each pilot location:
  - InfoWorks?
  - Will we be able of implementing more than one type of model per location?
  - Semidistributed vs fully-distributed models
  - Would be ideal to compare different model structures within RainGain

7. Topics for discussion

- Who will do what? Who will develop adapters?
- Possibility of sharing of algorithms (knowledge sharing!)
  - Are partners willing to share algorithms?
  - We don't need to share source codes! We can simply work with .exe files
  - Outputs for Interreg: potentially .exe files + FEWS adapters + "metadata" (including description of the algorithm and the way in which it should be cited)
- Other technical issues: information flow, data formats, data storage
- General views on the proposed platform
- Potential barriers for implementation
- Case specific requirements

8. Revision of Actions and Time Frame

1. **AUG 2012:** Model data collection & setup?
2. **OCT 2012 (project meeting):** first UK pilot forecasting platform will be presented – discussion about design and implementation in other locations can take place during project meeting
3. **APR 2013:** Platform & models implemented for all case studies (these may be improved later, but we need to have models and platform up and running)
4. **SEP 2013:** Finished / tested forecasting platform & first results using fine-scale rainfall in case studies

Start date: 1 Sep 2011
End data: 31 July 2015