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SAM - System based analysis and management of urban flood risks

Keighley Pilot Study

Overview

- Keighley catchment
- Stochastic spatial time series rainfall
- Risk tool – Hydraulic Incapacity
 - Use
 - Run Times
 - Results
 - Comparisons

Study area

- Keighley – North West of Bradford, West Yorks
- Population ~ 87,000
- Catchment area ~ 1,300 Ha
- Total asset length (not inc S24) = 353 km
- InfoWorks modelled length = 153 km
- Detailed model – 27 nodes / 1000 population
- InfoWorks model developed for AMP3 CSO aesthetics so any flood risk prediction results can not be relied upon as a true representation of reality

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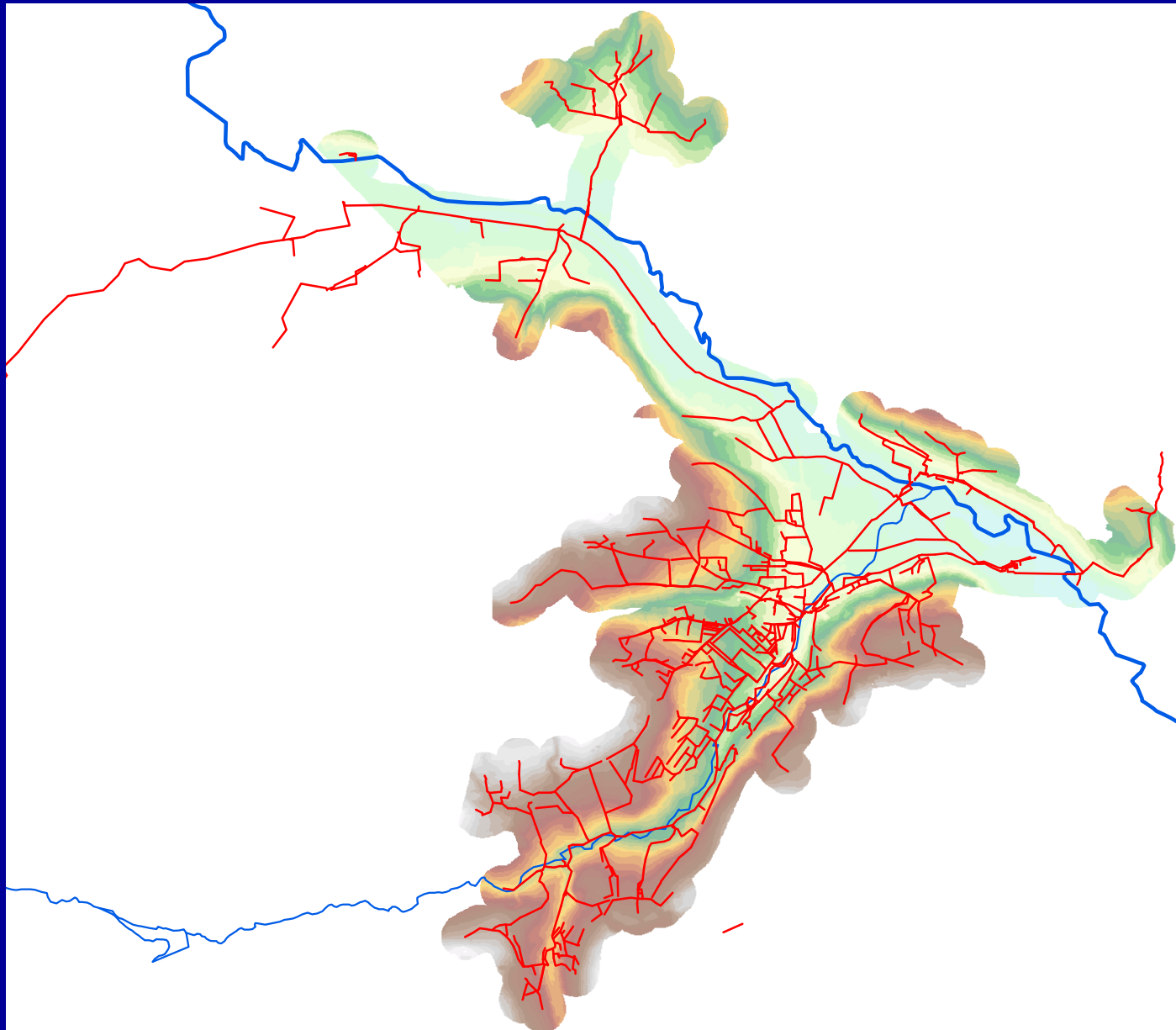
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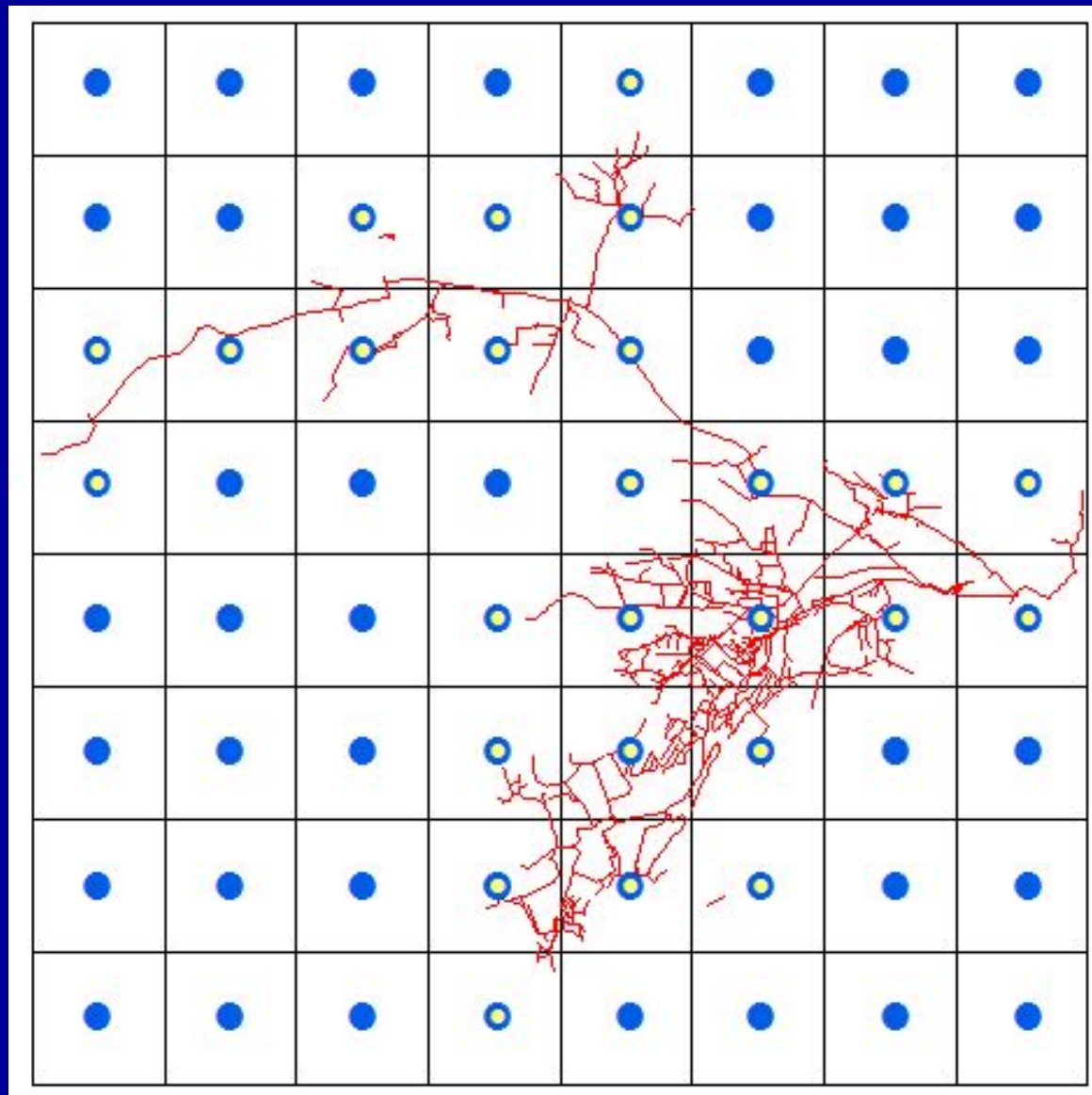
Sewered area and topography



Stochastic spatial rainfall

- 100 year Synthetic 2D rainfall time series produced for Keighley case study area.
- 8x8 Grid – 64 cells.

Spatial rainfall grid



Rainfall tool GUI

DTI SAM - Events Management

Project Menu ▾ Statistics ▾

Select/Edit Simulation control file (.sam)

Project Title

Control file

Database

Database OK

Data From 2001 To 2100

Comments

Rainfall events files

Output rainfall events folder

Prefix File name Format .RED .CSV

Selection Criteria

General

Dates: FROM TO

Selection criteria: Single Cell Study Area whole catchment

Single Cell

Min Duration in Study Area

Inter-event Dry Period in Whole Catchment

Threshold Intensity over

Study Area

Min Duration

Inter-event Dry Period

Threshold Intensity over

Whole Catchment

Min Duration

Inter-event Dry Period

Threshold Intensity over

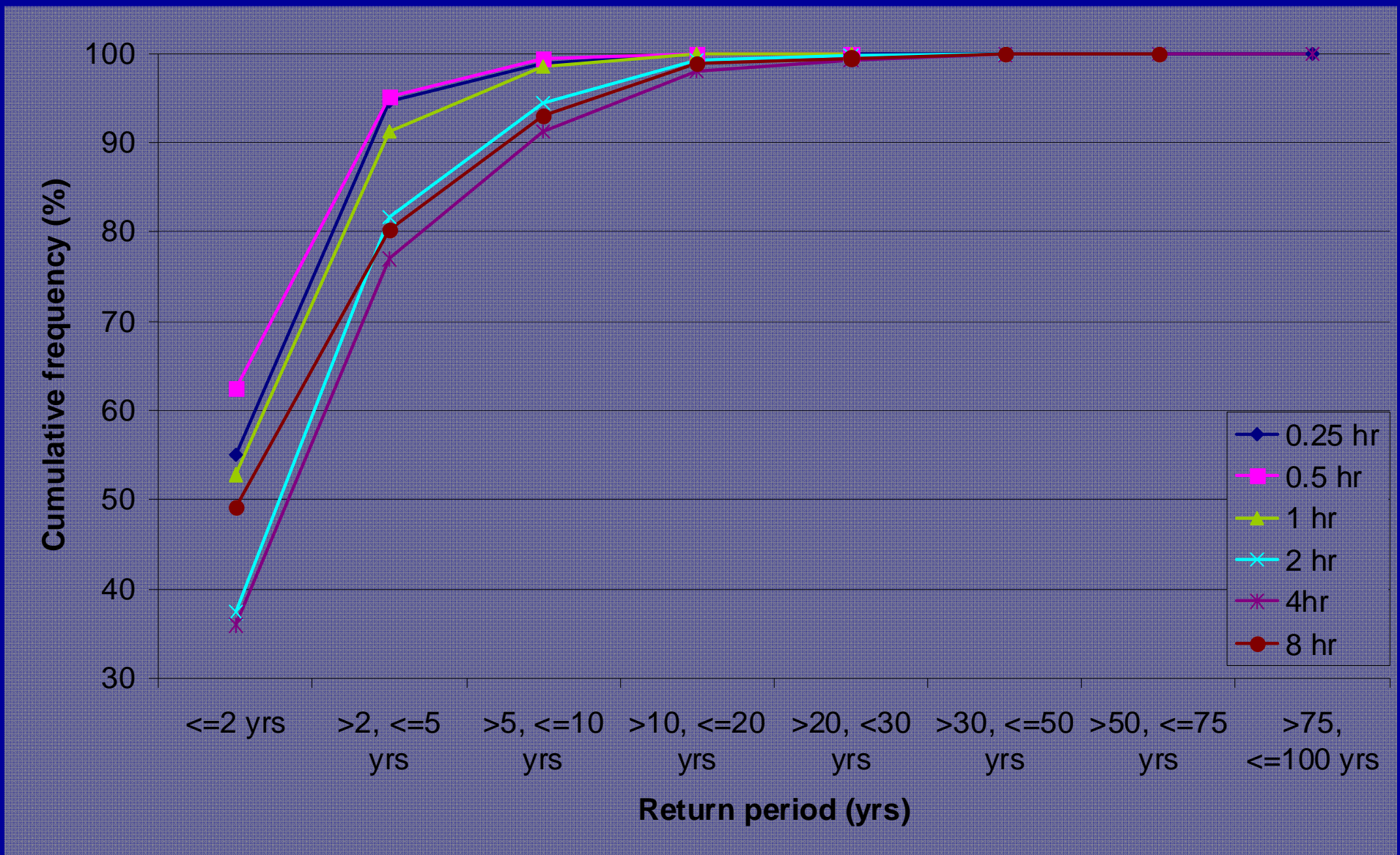
Rainfall tool

- Tool interrogates database to find events given set criteria. (Minimum Duration, Inter-event Dry Period, Threshold depth and duration). Either based on single cell rainfall or whole catchment.
- Also possible to output annual maxima for given duration.

Rainfall analysis

- FEH return period analysis on annual maxima.
- Comparisons with radar data inconclusive due to short (3.5 yr) data availability – radar data tendency for higher proportion of long return period events.

Annual maxima return periods



SAM-UMC / Risk tool

Hydraulic Incapacity

- Function of tool is to calculate flood depths and damages in the catchment
 1. Input rainfall events run through InfoWorks network
 2. RFSM uses InfoWorks flood volumes to calculate depths in the catchment
 3. Risk tool calculates and aggregates damage costs.

SAM-UMC / Risk tool GUI

DTI - SAM Risk Analysis

General

Model name: M1POT_100yr_c

Description: TS rainfall, catch, M1POT depths for 30, 60, 120, 240 and 480 minutes from 2001 to 2100. Repeats removed.

Run control

1D Rainfall events

IW specific parameters

Dry period length: 240

Parameters

Min no. of runs: 250

Max no. of runs: 10000

Convergence criteria: 0.01

Input

Rainfall events: C:\DTI_SAM\Rainfall_for_IW\ Browse Edit

Control file: C:\DTI_SAM\RiskTool_Mar0 Browse

Output files directory: C:\DTI_SAM\RiskTool_Mar0 Browse

Base IW CS model: C:\DTI_SAM\Keighley_IW_V Browse

Specific data

N event per year: 100 Time serie length: 100

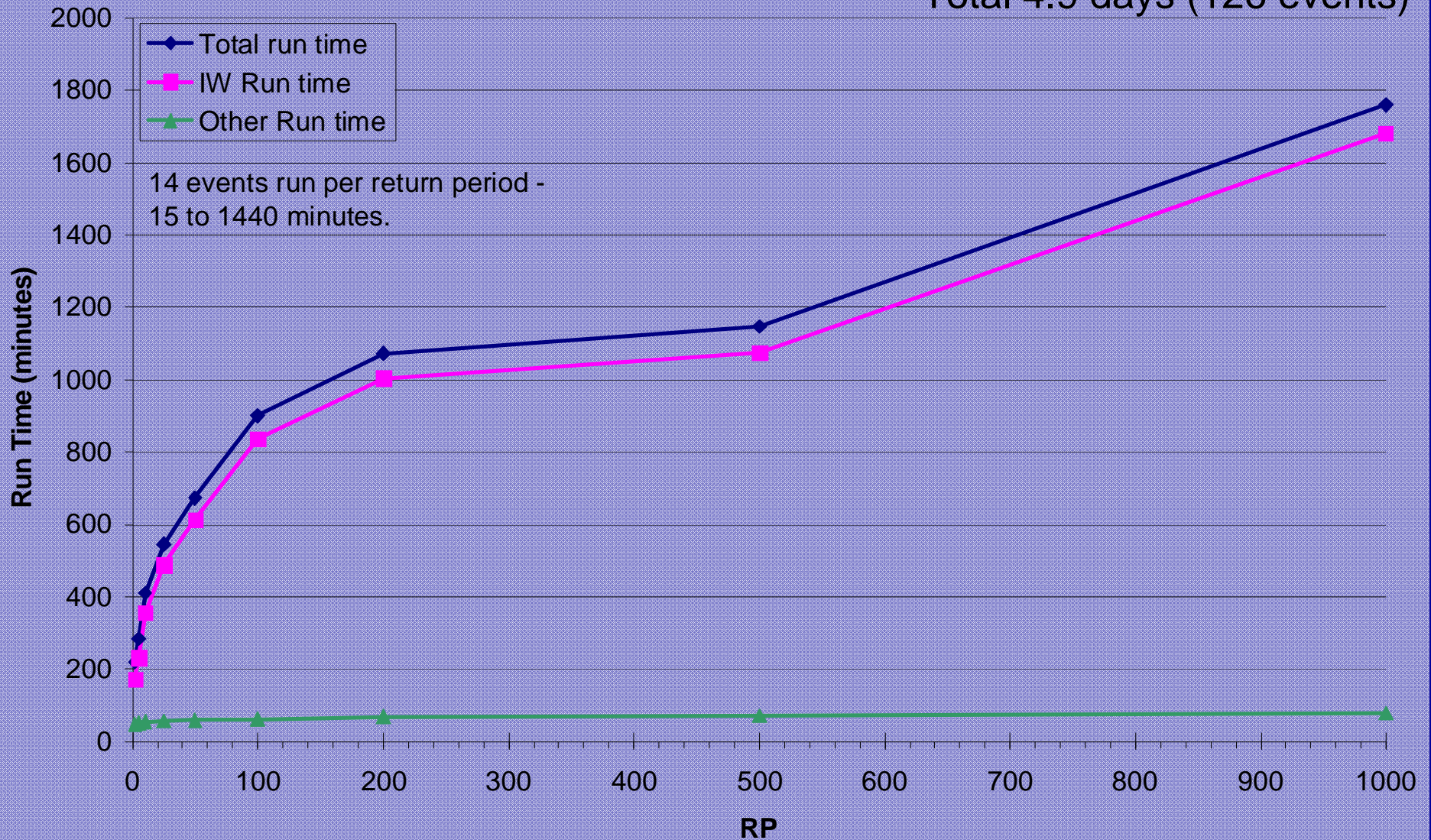
Run Close

Application

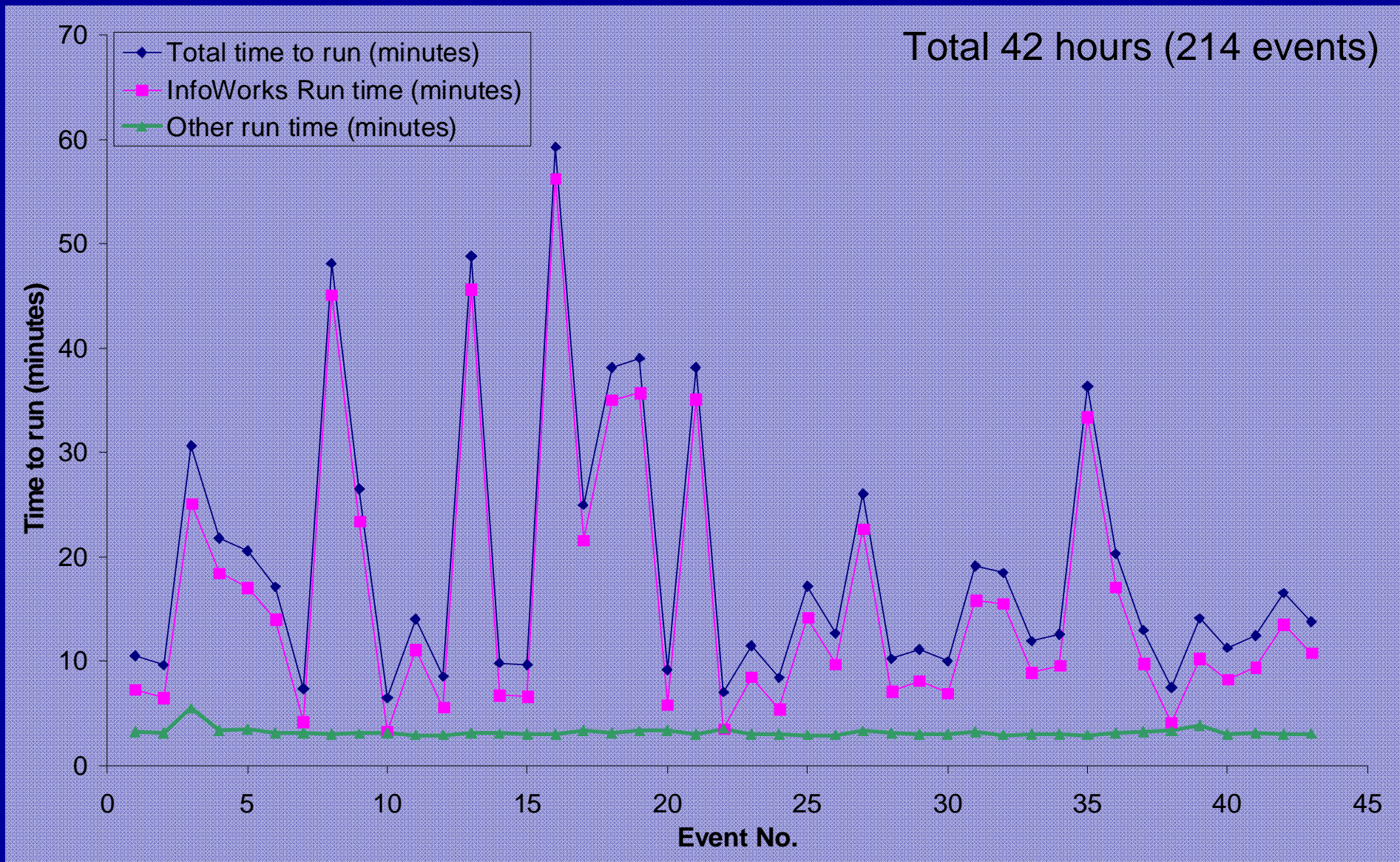
- Use existing InfoWorks network.
- Convert flood types to 'Lost'.
- Set up empty rainfall and run groups.
- Produce rainfall (.red) files – either design or using rainfall tool.
- Setup .csv file listing events, return period (or frequent/extreme if time series data), duration.
- Run tool

Run times for design rainfall

Total 4.9 days (126 events)



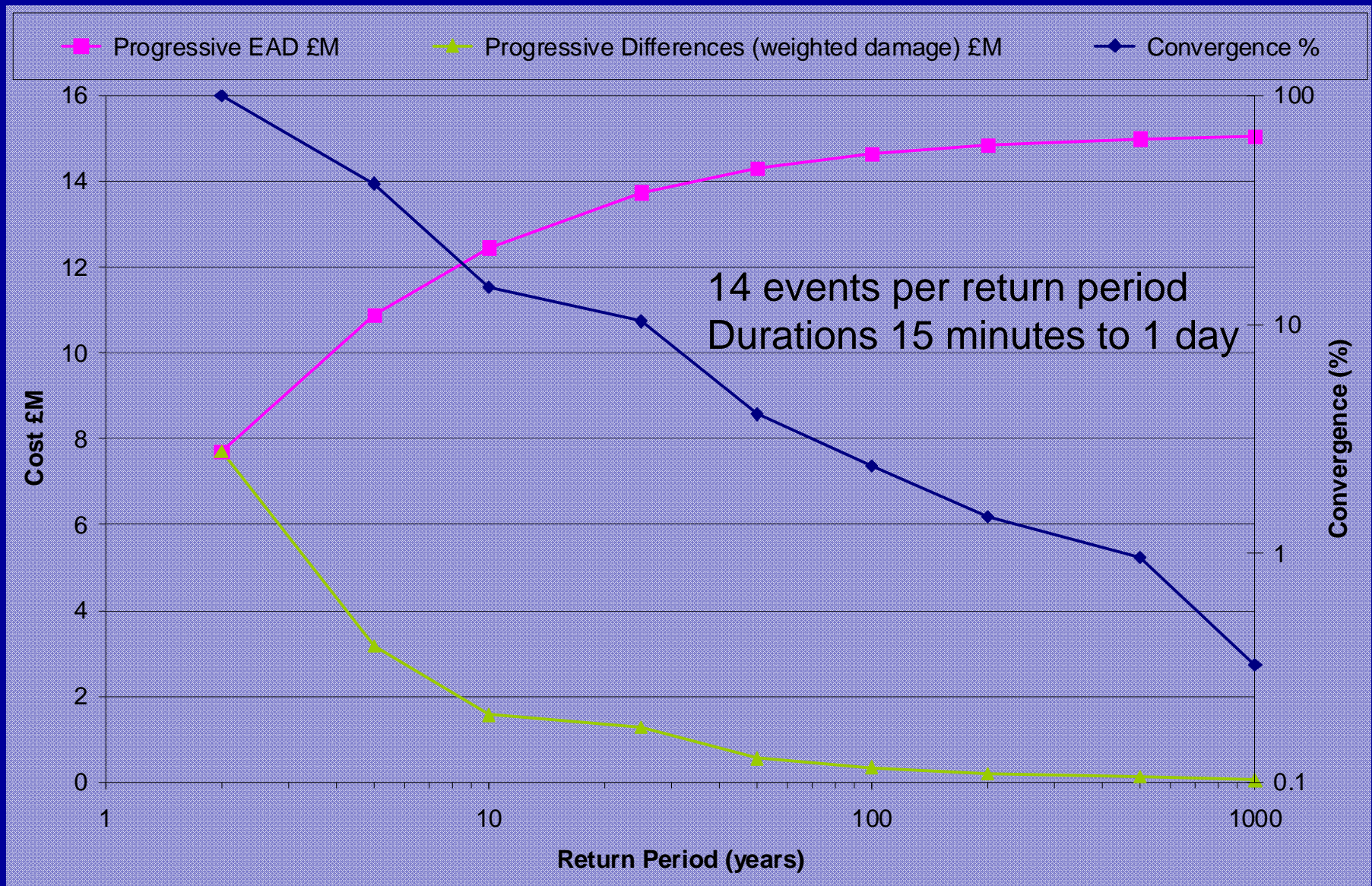
Run times for time series rainfall



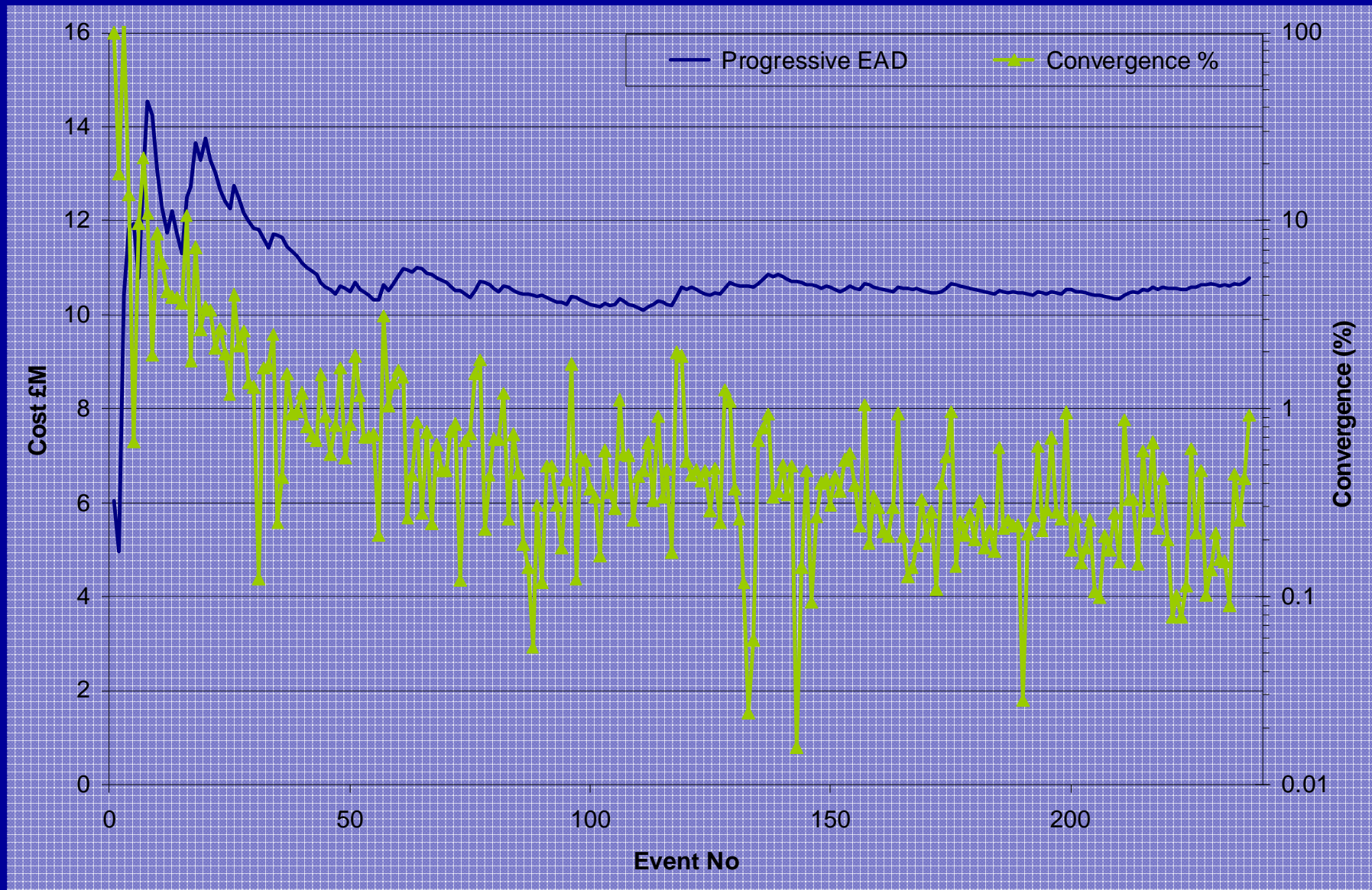
Outputs

- Currently outputs are in the form of .csv type text files.
- Data includes Expected Annual Damage, Damages and Depths based on InfoWorks Nodes and RFSM impact zones.
- Summary data can easily be processed in Excel, or used in GIS.

EAD - Design Rainfall



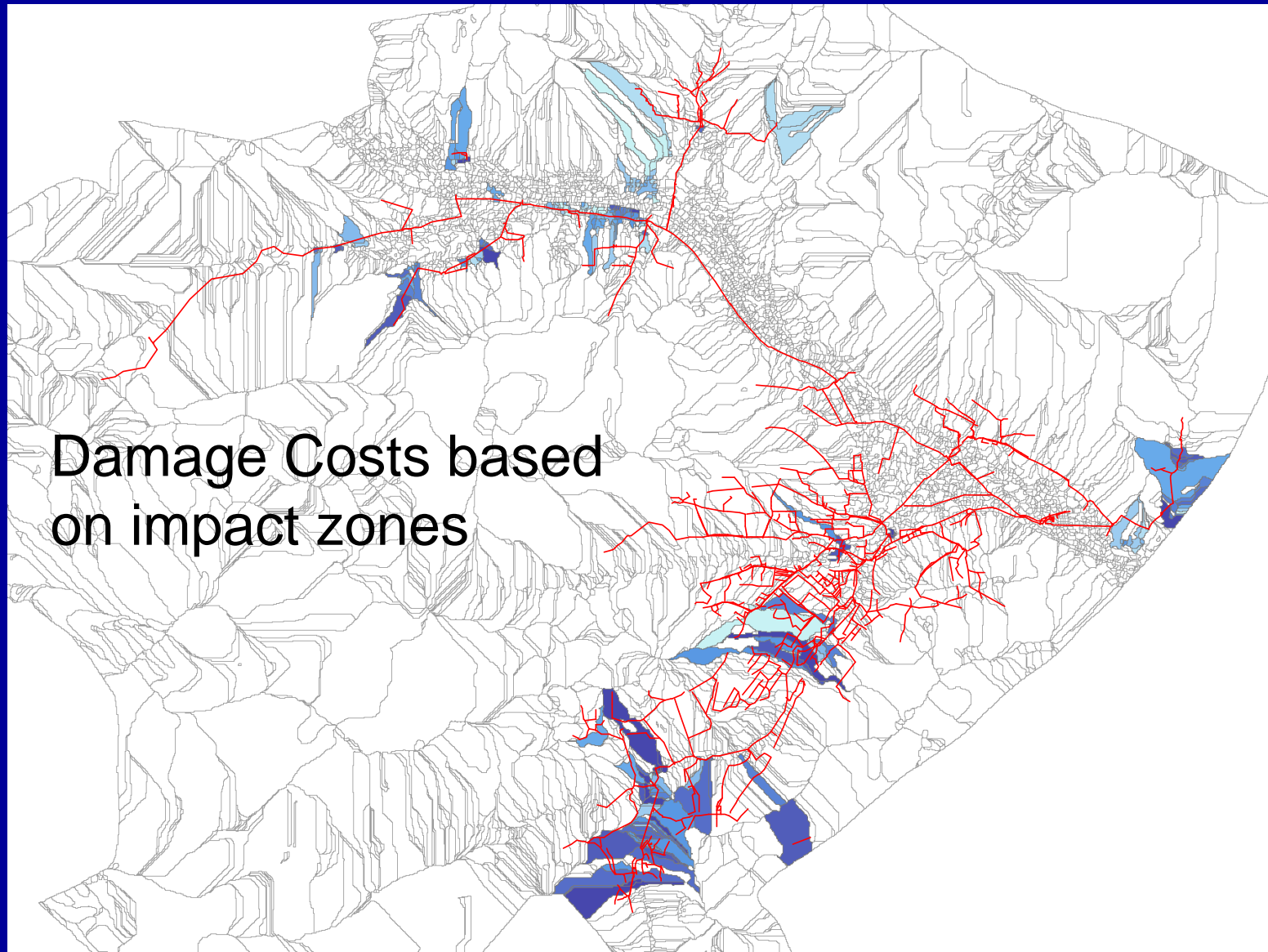
EAD – Time series Rainfall



EAD Summary

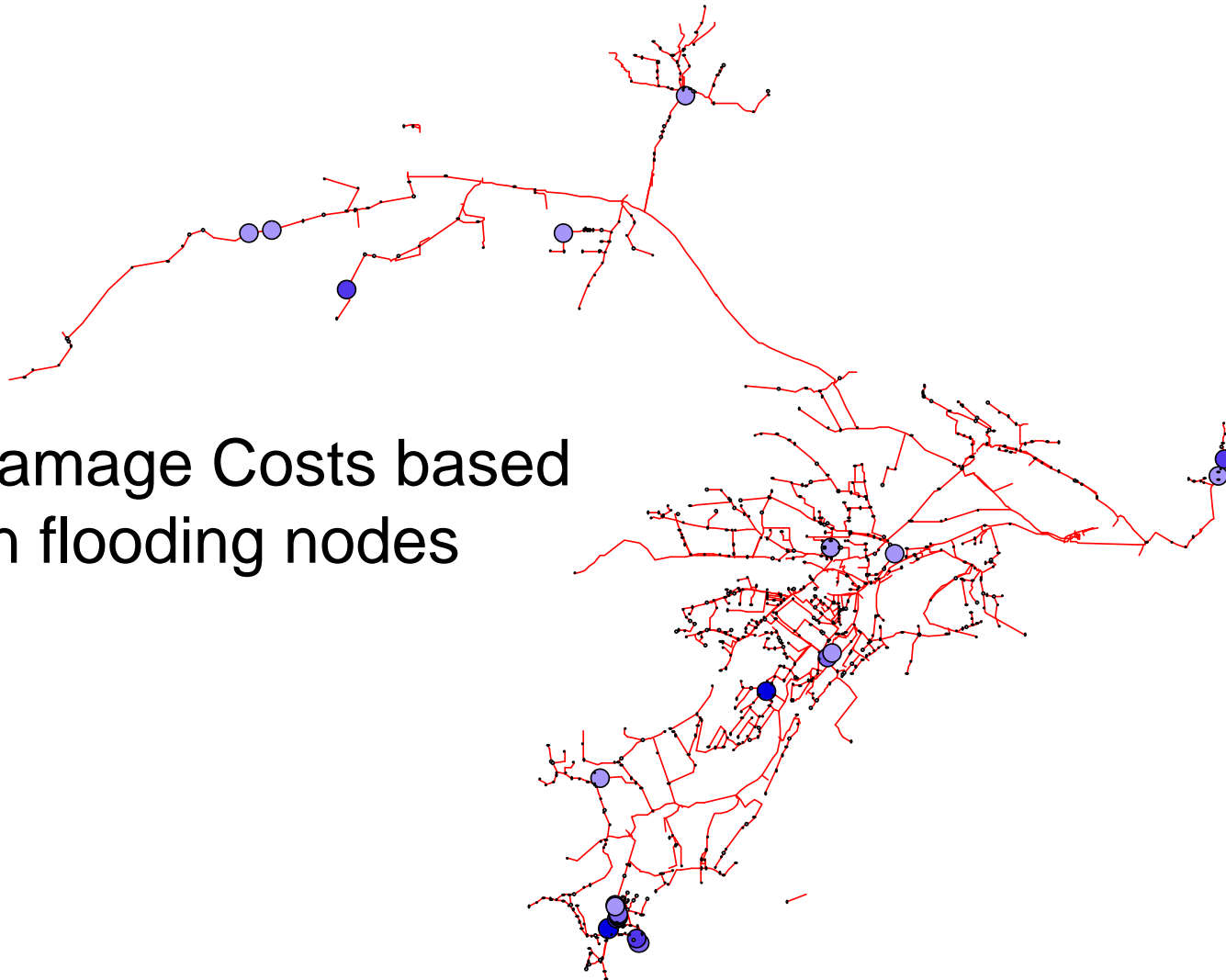
Run details	EAD (£M)	Convergence (%)
Design events M2-M1000	15.0	0.3
Time series 2001 - 2010	13.5	1.2
Time series 2011 - 2020	6.4	0.9
Time series 2001 - 2020	10	0.7
Time series 2001 – 2100	10.8	0.9

Outputs to GIS



Outputs to GIS

Damage Costs based
on flooding nodes

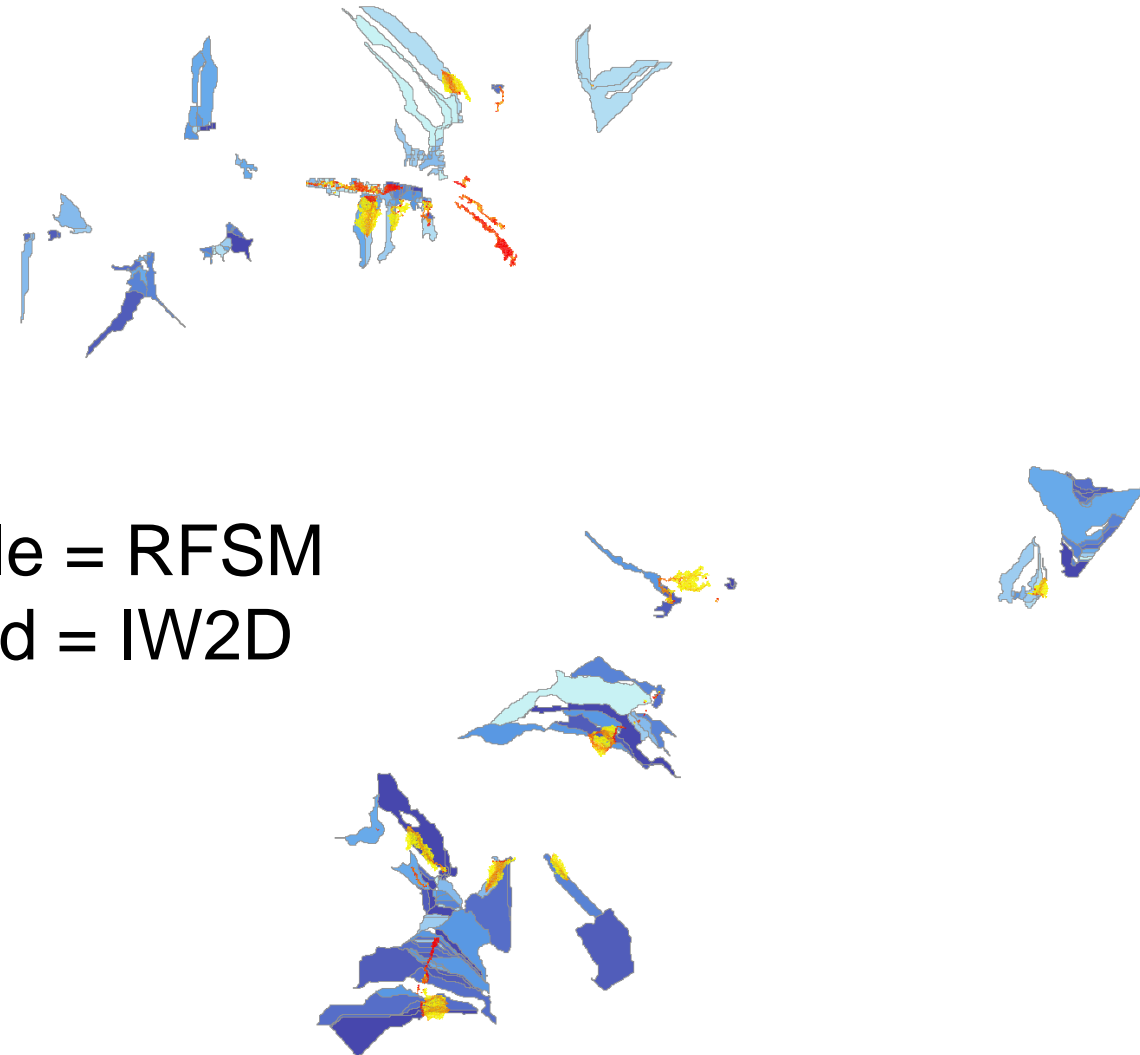


Comparison to InfoWorks 2D

- Set up InfoWorks model with 1m (horizontal resolution) Lidar data.
- Standard parameters – cells 25 to 100 m² – total 420,000 cells. (RFSM has 1.5 million in 8340 impact zones, but spread over 328 Km² rather than 26Km²)
- Ran for limited number of events.
- Run times longer than RFSM e.g M2-1440 34 minutes risk tool (IW 1D sim plus RFSM) IW2D run 67 minutes.
- Compared flooding areas.

2D depth comparison

Blue/Purple = RFSM
Yellow/Red = IW2D



Conclusions

- Useful methodologies and tools developed.
- Potential to further develop tools into distributable software.
- Rainfall database / tool easy to use and stochastic dataset is good given length of calibration data.
- Risk tool straightforward to use with low and stable run times.