Imperial College London

International Research on Flood Resilience at Imperial College London

- Crue Era-Net **DIANE-CM** Project: **D**ecentralised **I**ntegrated **AN**alysis and **E**nhancement of Awareness through **C**ollaborative **M**odelling and Management of Flood Risk
- NWE Interreg IVB **RainGain** Project: Advanced observation and rainfall prediction for urban pluvial flood management
- Climate KIC **Blue Green Dream** Project: Integrating Blue and Green Urban Assets for the City of Tomorrow

Susana Ochoa Rodríguez and Prof. Čedo Maksimović

BRE & SMARTeST Seminar: Building Flood Resilient Communities

BRE, Garston, Watford, 14th June 2012

Flood Risk Management Via Collaborative Modelling

DIANE-CM PROJECT

Decentralised **I**ntegrated **AN**alysis and **E**nhancement of Awareness through **C**ollaborative **M**odelling and Management of Flood Risk

(Jan 2010 – Oct 2011)

Project Partners

Leuphana University of Lüneburg (Germany)

Imperial College London (United Kingdom)

UNESCO-IHE Institute for Water Education (The Netherlands)

Contents

- Objectives and methodology
- Case studies
- Implementation: UK case study
- Conclusions

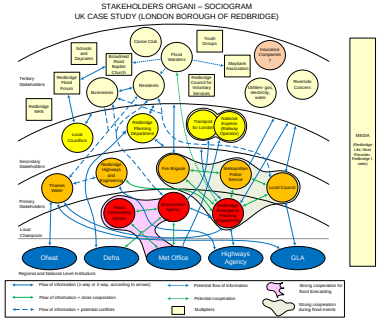
Main objectives

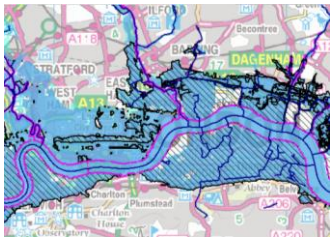
- To enhance flood risk awareness and capacity through collaborative modelling and social learning
- Supported by improved flood modelling and mapping techniques and by web-based decision support making tools

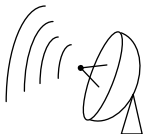
Enhance **resilience** of local communities to flooding

Goals and Working Steps

1. Stakeholder identification and analysis







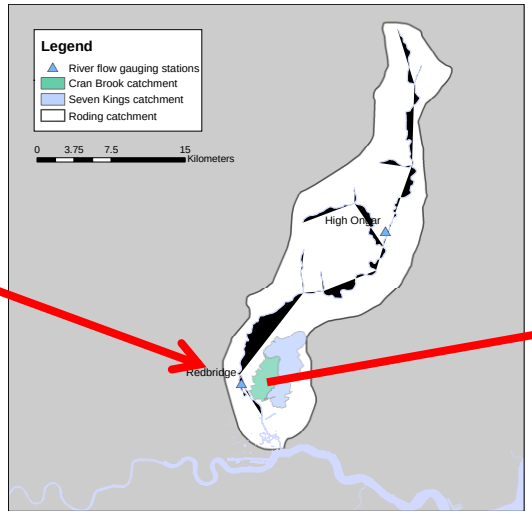
2. Improvement of flood modelling, mapping and Near-Real-Time flood forecast

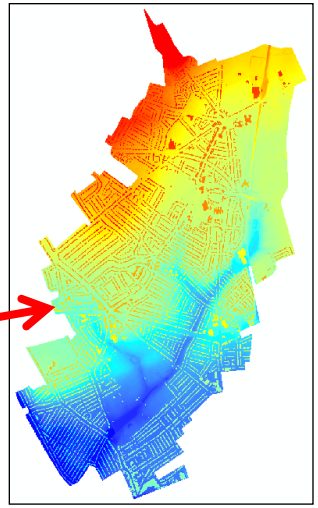
3. Collaborative Modelling for participatory and improved flood risk management

4. Enhancing resilience through training, awareness raising and dissemination

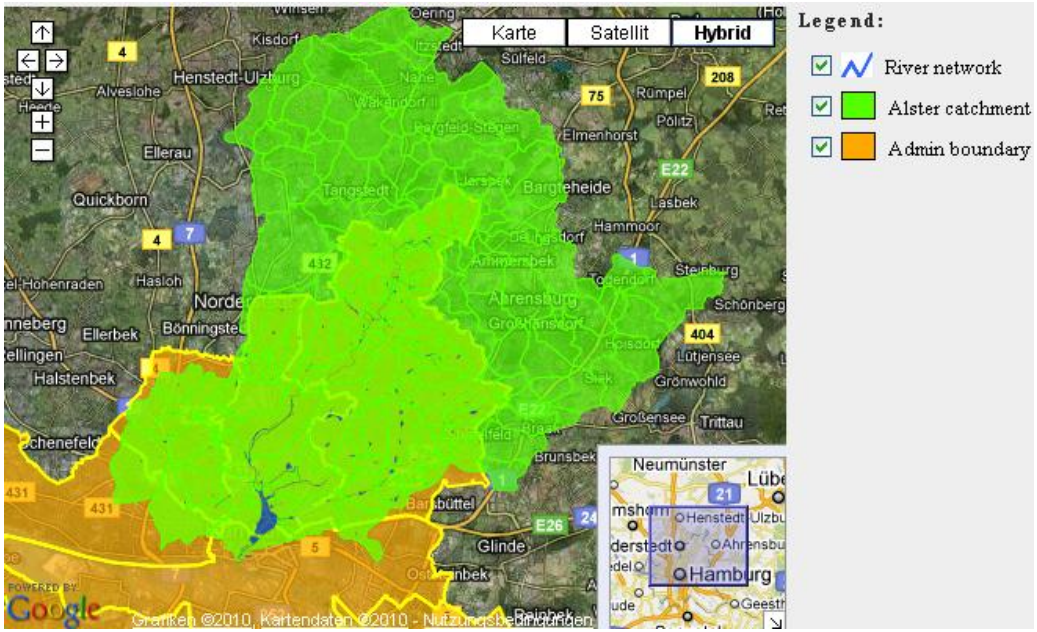
UK Case Study: Cranbrook catchment

- Focus: **surface flooding**
- Area: approx. 9 km^2, predominantly urbanised
- Located within the London Borough of Redbridge (NE of London)
- Subcatchment of Roding River catchment





German Case Study: Alster river catchment



- **Focus: fluvial flooding**
- L= 56 km, A = 587 km^2.
- Tributary of Elbe river
- High damage potential
- Natural and canalised parts, dammed lakes

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UK CASE STUDY

Focus on **surface** flooding

- Focus on flood risk and event management
- Planning issues with GE support

GERMAN CASE STUDY

- Focus on **fluvial** flooding
- Surface flooding with UK support

Focus on planning issues

Supported by web-based tools (**UNESCO-IHE**) and experiences of **Dutch experts** in planning and flood risk management

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Implementation: UK Case Study

Step 1: Stakeholder Analysis

Objectives:

- To identify relevant stakeholders
- To understand interrelations between them
- To understand current situation and needs regarding FRM in the study area

Methodology

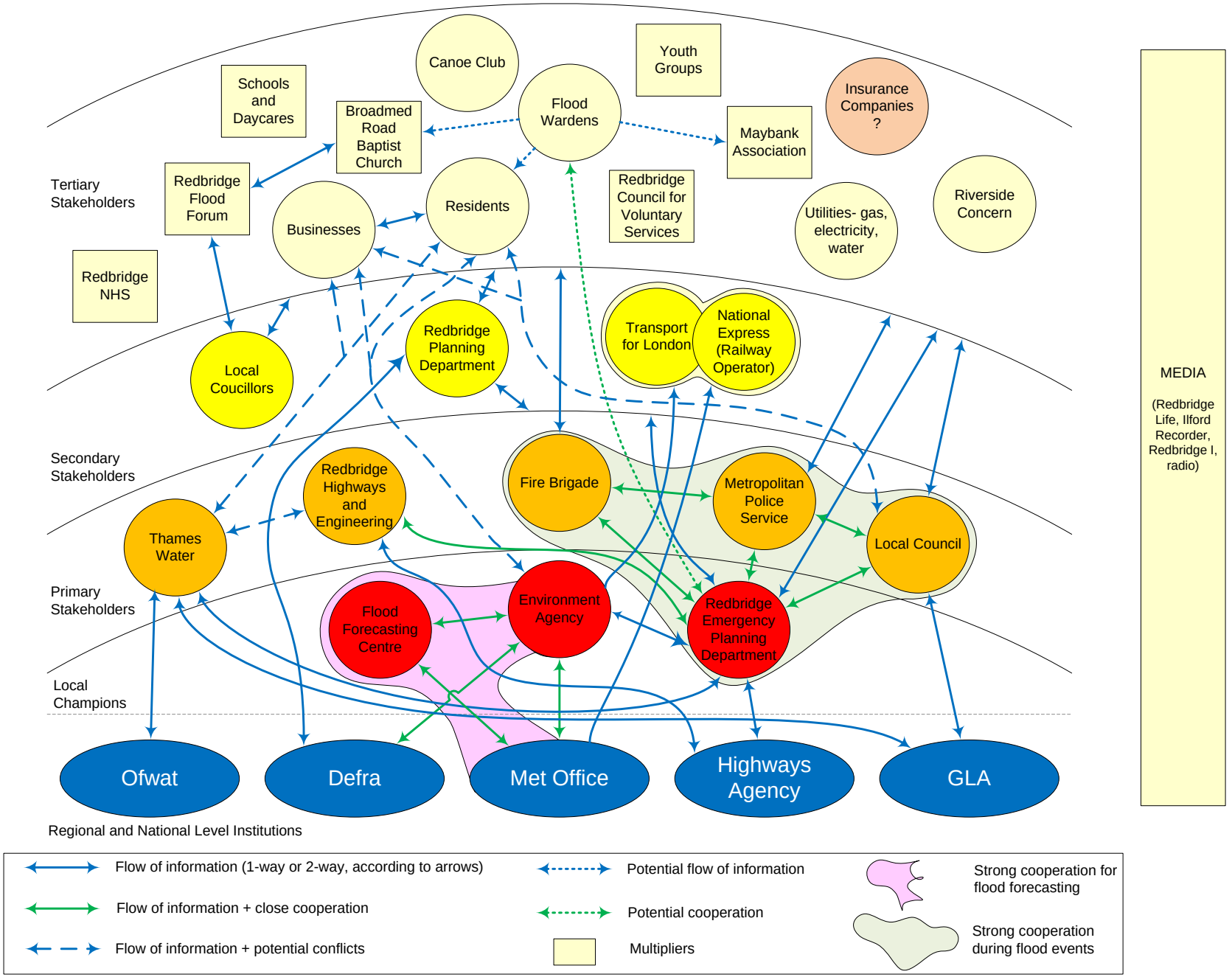
- A **common framework** for the stakeholder analysis was developed and used for both case study areas to ensure **comparability**
- Brainstorming session
- 10 structured interviews
- Summary of information in parameter table
- Categorisation of stakeholders through MCA (*Multi-Criteria Analysis*)
- Elaboration of organi and sociogram
- Flood risk awareness evaluation

Categorisation of stakeholders

(Through Multi-Criteria Analysis)

Criteria taken into account: role in FRM, responsibilities, available resources, available information, willingness to cooperate, confidentiality issues, etc.

According to their role in FRM and their activities	According to their relevance in FRM and their role in the project
▪ Flood management professionals ▪ Emergency managers ▪ Planners ▪ General public	▪ Local Champions ▪ Primary stakeholders ▪ Secondary stakeholders ▪ Tertiary stakeholders


Canoe Club
Youth Groups
Schools and Daycares
Flood Wardens
Insurance Companies ?
Broadmed Road Baptist Church
Maybank Association
Tertiary Stakeholders
Redbridge Flood Forum
Residents
Redbridge Council for Voluntary Services
Riverside Concern
Businesses
Utilities- gas, electricity, water
Redbridge NHS
Transport for London
National Express (Railway Operator)
Redbridge Planning Department
Local Coucillors
Secondary Stakeholders
Redbridge Highways and Engineering
Fire Brigade
Metropolitan Police Service
Thames Water
Local Council
Primary Stakeholders
Flood Forecasting Centre
Environment Agency
Redbridge Emergency Planning Department
Local Champions
Ofwat
Defra
Met Office
Highways Agency
GLA
Regional and National Level Institutions
MEDIA
(Redbridge Life, Ilford Recorder, Redbridge I, radio)
Flow of information (1-way or 2-way, according to arrows)
Potential flow of information
Strong cooperation for flood forecasting
Flow of information + close cooperation
Potential cooperation
Strong cooperation during flood events
Flow of information + potential conflicts
Multipliers

Flood Risk Awareness Assessment

- Access to results of survey previously conducted by the Local Council (in 2007)
- 10 flood risk assessment questionnaires submitted online

Main findings - Flood Risk Awareness Assessment

- High turnover rate
- New residents are of particular concern; they were found to have little or no knowledge of flood risk.
- Old residents are aware of flood risk, but have not adopted self-protection measures
- The public wishes for structural measures, limited recognition for self-resilience measures

Main findings - Flood Risk Awareness Assessment

- Flooding vulnerable residents have not taken any precautions to protect their properties.
- Lack of knowledge regarding whether they live in a flood risk area
- Insufficient information and training concerning what to do in case of flooding, in spite of significant efforts of Local Council
- Misunderstanding regarding the roles of the different authorities (e.g. Local Council, Police, Fire Brigade, Environment Agency)
- Flood warden scheme is considered to be a good option for improving event management
- Participants would be willing to use internet web based tools.

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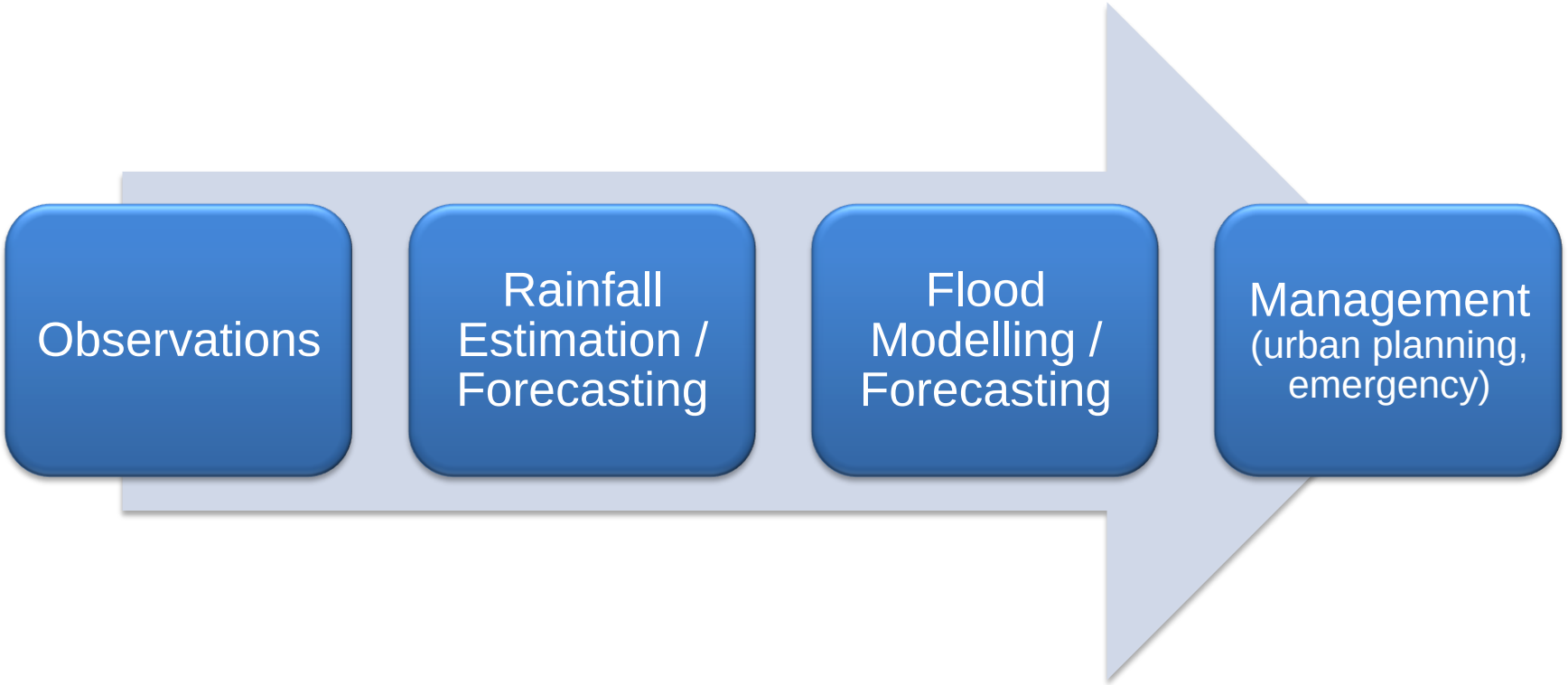
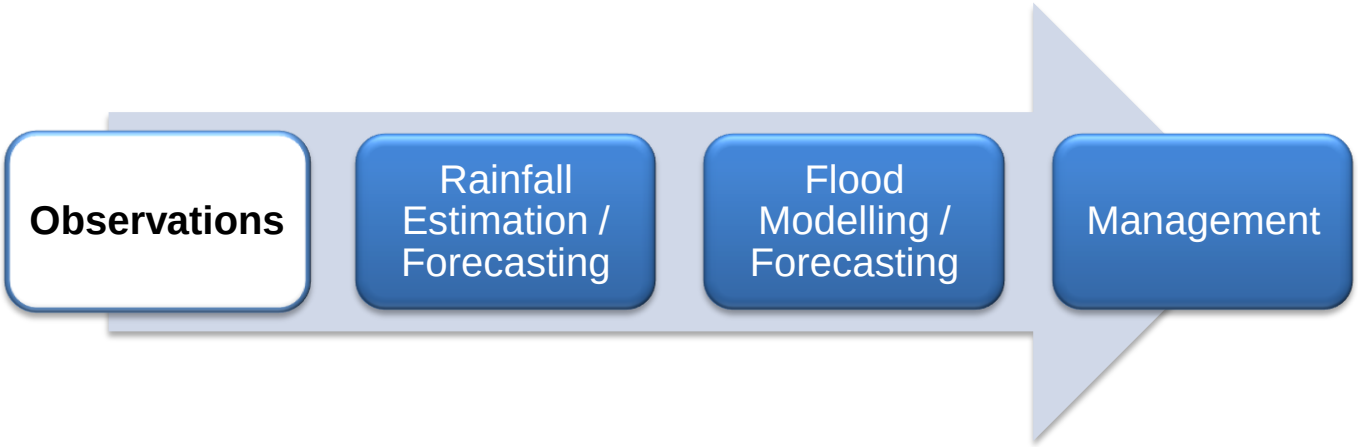
Step 2: Improved flood modelling

UK Case Study: focus on pluvial flooding

Extreme rainfall events exceed the capacity of the drainage system!

Model Assembly for Pluvial Flood Modelling, Forecasting and Management



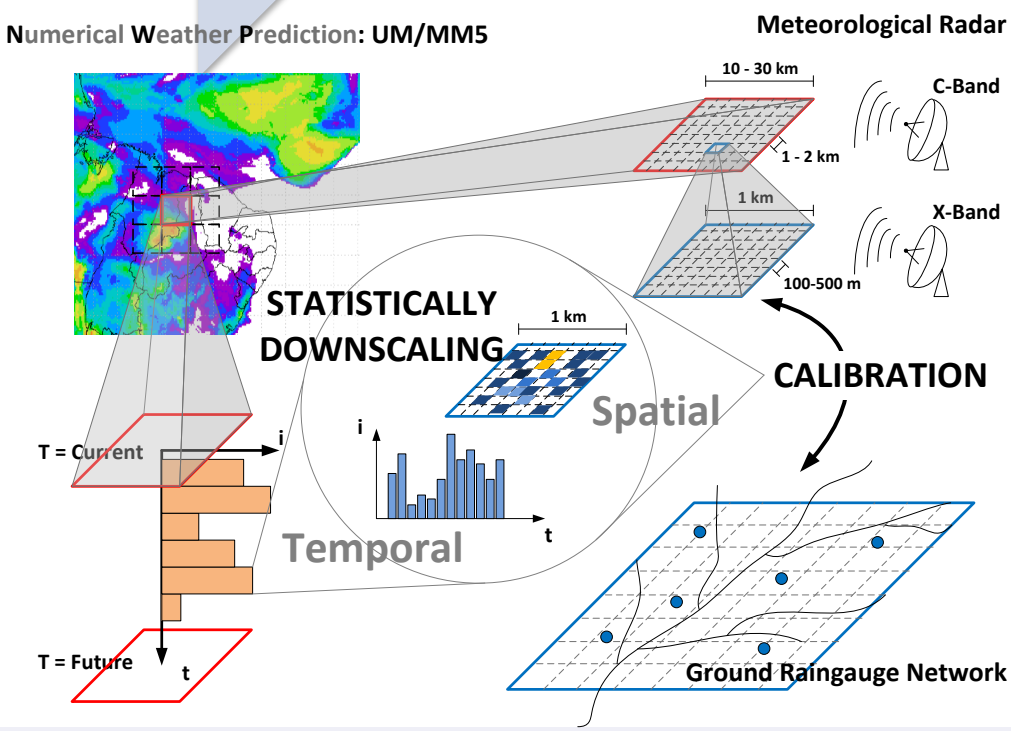


Deployment of monitoring system with Real-Time transmission



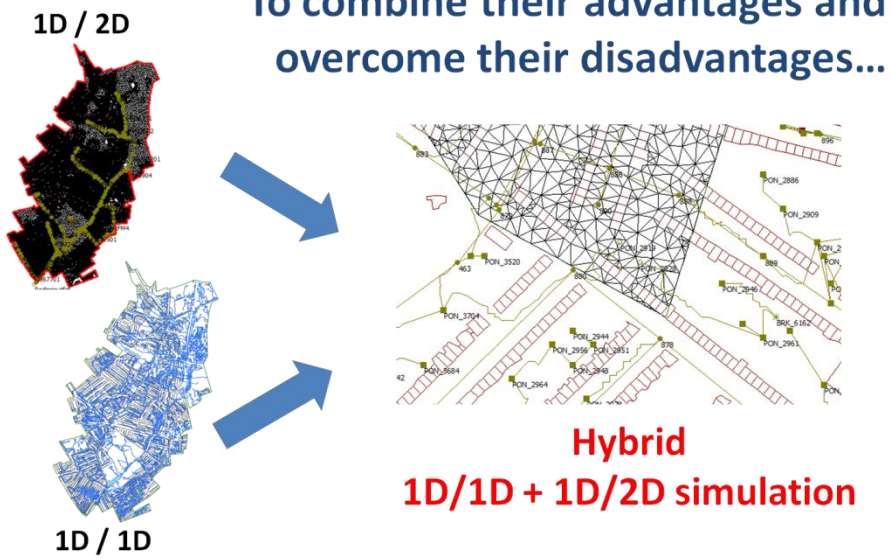

Observations → Rainfall Estimation / Forecasting → Flood Modelling / Forecasting → Management

- Improvement of rainfall estimates through combination of raingauge and radar data
- Development of new temporal and spatial downscaling techniques



Observations → Rainfall Estimation / Forecasting → Flood Modelling / Forecasting → Management

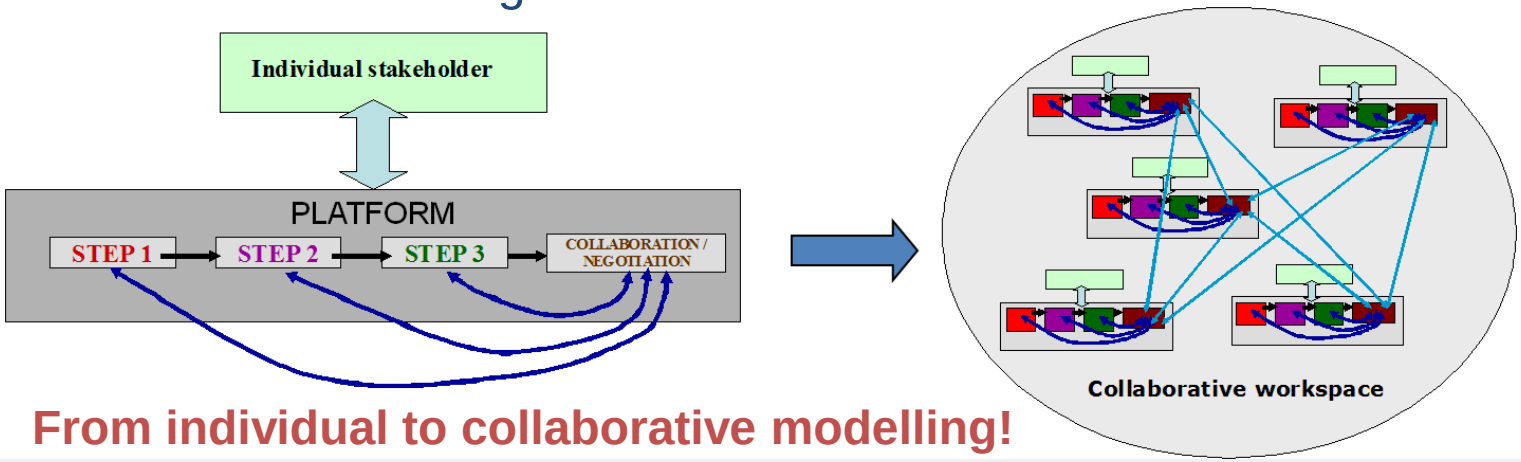
- Setup of 1D/2D and 1D/1D models
- Development of hybrid models



Step 3: Collaborative Modelling for participatory flood risk management

COLLABORATIVE PLATFORM

- Online platform whereby information about flood risk in the study area is provided and discussed amongst participants and feedback can be provided
- Supports development of shared understanding of current flood risk
- Supports collaborative ranking of alternatives for FRM



From individual to collaborative modelling!

Collaborativ
Cranbrook catch
United Kingdom

Collaborative r
Cranbrook catchme
United Kingdom

Collaborative mode
Cranbrook catchment, Lon
United Kingdom

Collaborative mo
Cranbrook catchment,
United Kingdom

Collaborative modelling in flood risk management
Cranbrook catchment, London Borough of Redbridge,
United Kingdom

DIANE-CM

INTRODUCTION | CRANBROOK AREA | FLOOD RISK FRAMEWORK | FLOOD RISK MANAGEMENT | STAKEHOLDERS | COLLABORATIVE MODELLING

Introducti

Welcome to the

Why is flood pr

Collaborative

Who are we?

Read more >>

Cranbrook are

The Cranbrook

Framework for mar

Step 0

System Definition

Study area and identification of flood related problems

Surface Flooding related Legislation

STEP 4:

Stages of stakehol

Step 0 - Flood rel

Because your opinion and comments are important to us in order to improve the collaborative platform and the modelling process, please give us your feedback about the following topics:

Flood Risk Awareness Questionnaire

Flood risk awareness is a critical component of flood risk management and is essential for reducing the vulnerability of local communities to flooding. A more informed society is better prepared to absorb and reduce flood impact and, therefore, it is less vulnerable to it.

That is why one of the priorities of the DIANE-CM Project is to enhance flood risk awareness and to better inform people about flood risk. To do this and to optimise the resources and activities of the DIANE-CM Project, **we need to know what you think and what you know about flood risk in Redbridge.** For this reason, if you are a resident of Redbridge we cordially invite you to complete a questionnaire by **clicking here.**

Answering the questions takes about 20 minutes. Thanks in advance for your valuable contribution!

Feedback about platform design, objectives, scenarios and measures

The main topic of the first workshop is the definition of the objectives, scenarios and flood hotspots. In this stage your opinion is vital to us; it constitutes the main input for improving the platform and making the best out of it!

Let us know what you think about:

- The overall design of the Collaborative Platform. **Click here.**
- The **Objectives, Scenarios** and **Measures. Click here.**

Thanks in advance for your valuable contribution!

Discussion Forum:

Feedback:

Steps for Collaborative Modelling (supported by platform):

1. System definition

2. Identification of flood risk management objectives

Obj_1	Obj_2	Obj_3	Obj_4	Obj_5
To reduce the magnitude of surface flooding	To minimise the damage to properties	To minimise damage to critical infrastructure	To maximise the opportunity of salvaging belongings	To maximise ease and feasibility of implementation

3. Definition of flood scenarios

- 30 years return period + lower level at the Roding River
- 30 years return period + high level at the Roding River
- 200 years return period + high level at the Roding River
- 200 years return period + high level at the Roding River (base case for the CME)

4. Identification of alternatives for FRM

- **A1 (base case):** Do nothing
- **A2:** Rainwater harvesting
- **A3**: Improved and targeted maintenance regimes for the sewer system
- **A4:** Improved resistance for preventing water from entering properties
- **A5:** Improved rainfall and flood forecasting and warning

5. Joint / collaborative ranking of alternatives

5. Collaborative Modelling Exercise for Joint Ranking of Alternatives for FRM

- Developed through three modules:

  -MODULE 1: Individual module
    - Weighting of objectives
    - Evaluation of alternatives
    - Ranking (TOPSIS)

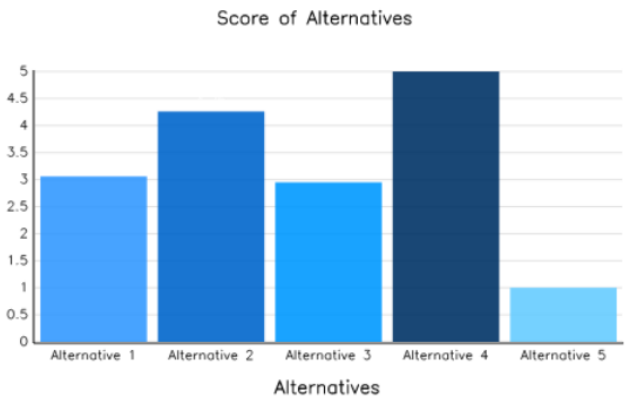
  -MODULE 2: Group module

  -MODULE 3: Collaborative module and negotiation stage

Stakeholder name: Mike Nye

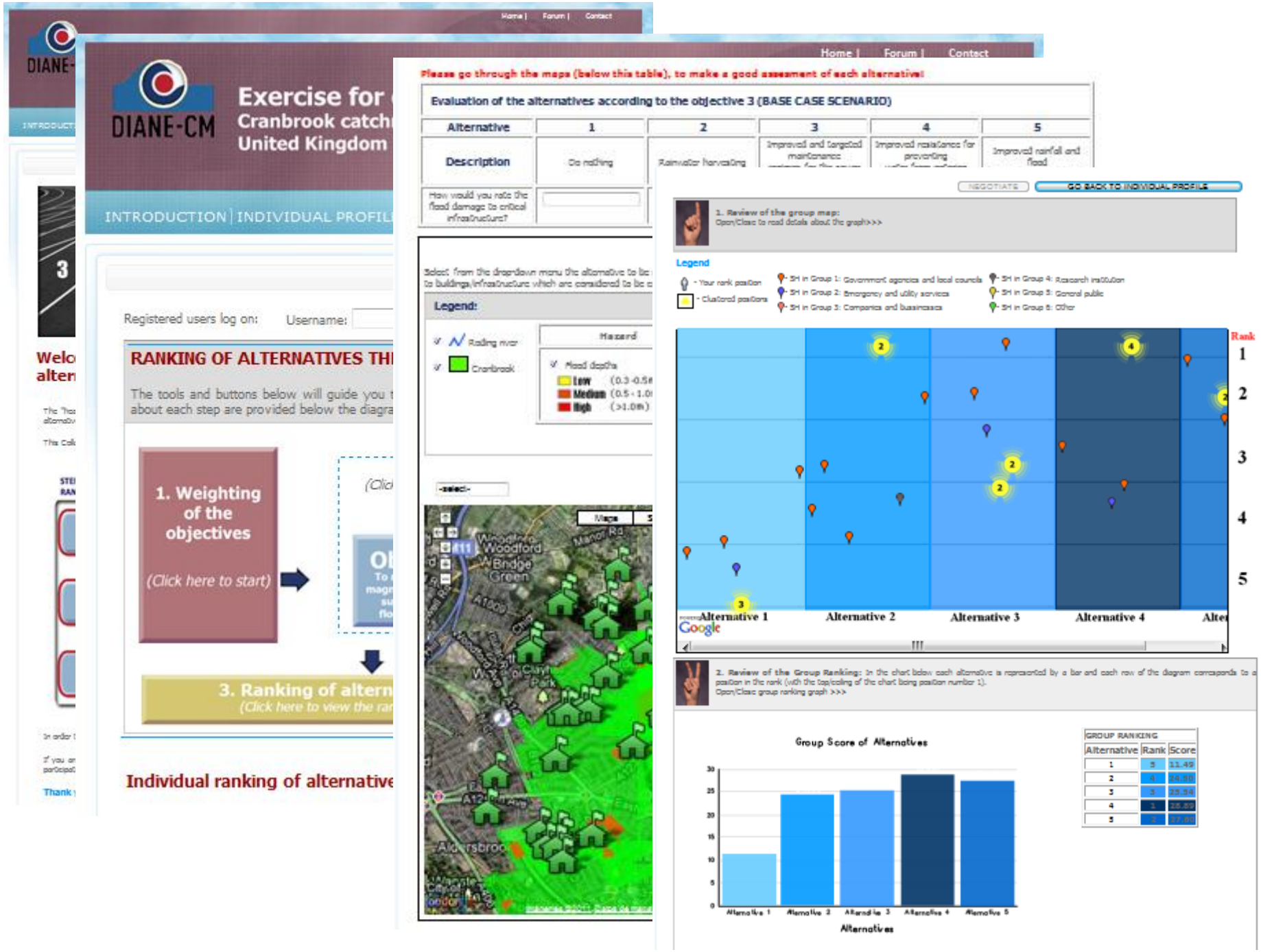
DECISION MATRIX						
OBJECTIVES (INDICATOR)/ ALTERNATIVES	Obj 1: Magnitude of surface flooding (Flooded hectares)	Obj 2: Damage to properties (Number of properties flooded)	Obj 3: Damage to critical infrastructure (Damage to critical infrastructure)	Obj 4: To salvage belongings inside properties and businesses (Opportunity of salvaging belongings)	Obj 5: To select FRM alternatives easy and feasible to implement (Feasibility of implementation in Redbridge)	RANKING OF ALT.
Alternative 1	28.02	987	Medium damage	Very low opportunity	Very high feasibility	3
Alternative 2	24.06	816	Medium damage	Very low opportunity	Low feasibility	2
Alternative 3	25.8	904	Medium damage	Very low opportunity	Medium feasibility	4
Alternative 4	28.02	535	Medium damage	Very low opportunity	Low feasibility	1
Alternative 5	28.02	987	Medium damage	Very low opportunity	Low feasibility	5
GOAL OF THE OBJECTIVE	*Minimised*	*Minimised*	*Minimised*	*Maximised*	*Maximised*	Sum objectives' weight
WEIGHT OF THE OBJECTIVE	0	45	45	5	5	100

Graph of Ranking:



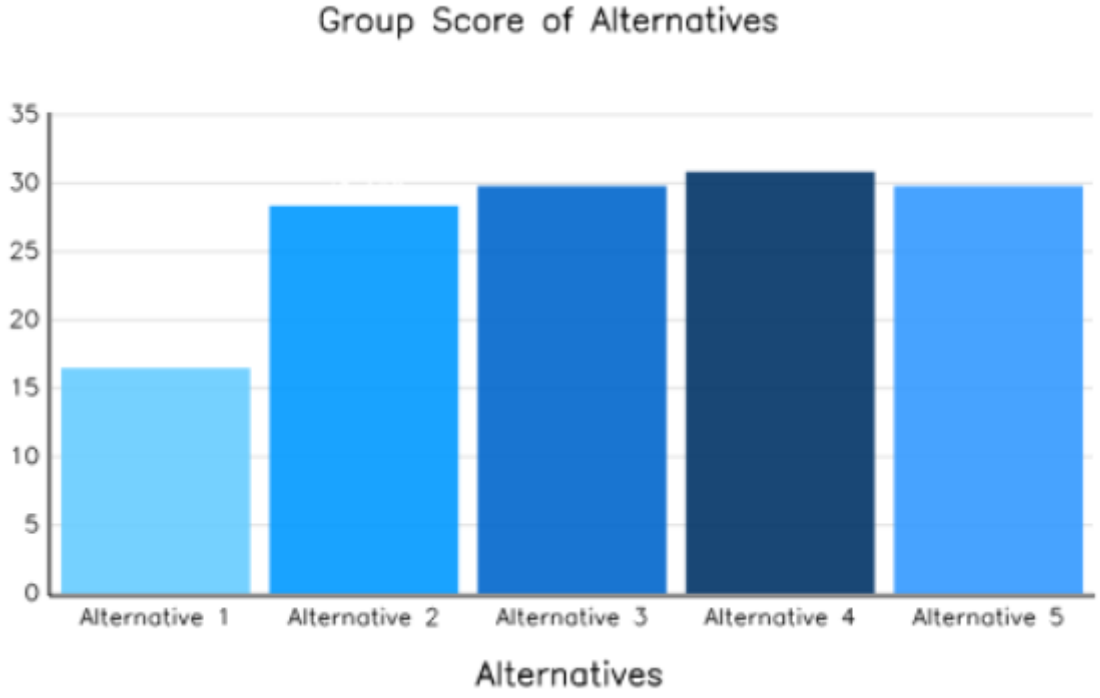
Reason of selection:

Most of the responsibility for property level flood protection falls on the property owner - for flooding in any form. Rainwater harvesting scores well, but the feasibility of installation everywhere is highly doubtful. Improved warning and forecasting (to 30 minute lead time) will likely not have a significant effect in terms of property damage limitation - almost everyone will seek to confirm the warning through an alternative source, which will decrease the effective lead time. Also assumes warning recipients are in the property and able to act.

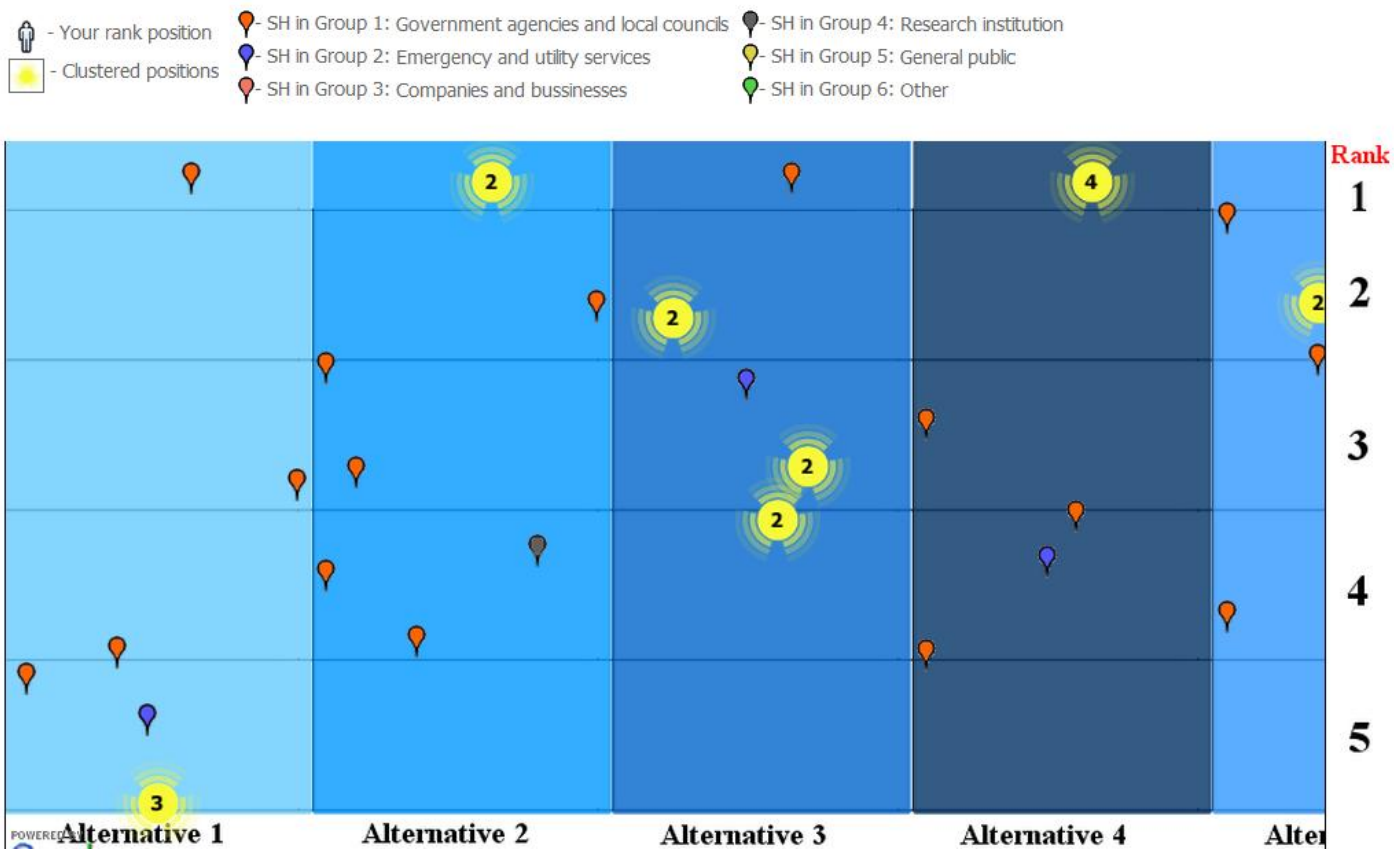

Home | Forum | Contact
DIANE-CM
Exercise for
Cranbrook catch
United Kingdom
INTRODUCTION | INDIVIDUAL PROFIL
Registered users log on:
Username:
RANKING OF ALTERNATIVES TH
The tools and buttons below will guide you
about each step are provided below the diagra
1. Weighting of the objectives
(Click here to start)
3. Ranking of altern
(Click here to view the ra
Individual ranking of alternative
Please go through the maps (below this table), to make a good assesment of each alternative!
Evaluation of the alternatives according to the objective 3 (BASE CASE SCENARIO)
Alternative
1
2
3
4
5
Description
Do nothing
Rainwater harvesting
Improved and targeted maintenance
Improved resistance for preventing
Improved rainfall and flood
How would you rate the flood damage to critical infrastructure?
Legend:
Riding river
Cranbrook
Hazard
Flood depths
Low
Medium
High
-select-
Maps
Woodford Bridge
Green
Clay Hill Park
Aldersbrook
NEGOTIATE
GO BACK TO INDIVIDUAL PROFILE
1. Review of the group map:
Open/Close to read details about the graph>>>
Legend
Your rank position
Clustered positions
SH in Group 1: Government agencies and local councils
SH in Group 2: Emergency and utility services
SH in Group 3: Companies and businesses
SH in Group 4: Research institution
SH in Group 5: General public
SH in Group 6: Other
Rank
1
2
3
4
5
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Google
2. Review of the Group Ranking: In the chart below each alternative is represented by a bar and each row of the diagram corresponds to a position in the rank (with the top/ceiling of the chart being position number 1).
Open/Close group ranking graph >>>
Group Score of Alternatives
Alternatives
GROUP RANKING
Alternative
Rank
Score

Group Results for the UK Case Study:

- **A1 (base case):** Do nothing
- **A2:** Rainwater harvesting
- **A3**: Improved and targeted maintenance regimes for the sewer system
- **A4:** Improved resistance for preventing water from entering properties
- **A5:** Improved rainfall and flood forecasting and warning



GROUP RANKING		
Alternative	Rank	Score
1	5	16.49
2	4	28.35
3	2	29.80
4	1	30.83
5	3	29.79



GROUP ASSESSMENT								
SH's Group	Initials	Name	Log in/out	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
SH	LE	Lucy Evans	In	1.78	2.45	5.00	3.47	4.84
SH	AN	Andy Naish	In	1.19	3.15	2.93	5.00	4.39
SH	JM	John Martin	In	1.95	2.02	4.32	5.00	3.90
SH	MO	Mark OBrien	In	1.51	5.00	3.73	2.56	4.44
SH	LEd	Laura Edwards	In	1.00	5.00	3.27	2.86	4.39
SH	FA	Fuad Ali	In	1.00	2.62	3.34	5.00	4.64
SH	MN	Mike Nye	In	3.06	4.26	2.95	5.00	1.00
SH	SM	Stephen Arundell	In	5.00	3.84	4.26	1.93	2.19
Group score				16.4878	28.3451	29.7959	30.8268	29.7929
Group rank				5	4	2	1	3

CONCLUSIONS

- The developed tools proved to be useful for promoting interaction between stakeholders, developing shared knowledge, carrying out collaborative modelling and achieving social acceptance of new technologies for flood risk management.
- Engaging a wide variety of stakeholders in the decision-making process for flood risk management proved to make them more aware of the situation and increased their personal responsibility towards this issue
- Having case studies of different magnitudes allowed drawing conclusions and recommendations for replication in other areas.

CONCLUSIONS

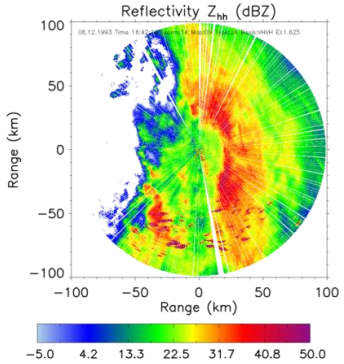
Some barriers for wider stakeholder involvement remain:

- Lack of knowledge and motivation
- Language barriers
- High residential turnover rate
- Apathy to taking part in flood risk management and towards self-resilience measures

RainGain Project:

Advanced observation and rainfall prediction for urban pluvial flood management

(Sep 2011 – Jul 2015)



RAINGAIN
Project Objective

To improve fine-scale measurement and prediction of rainfall and to enhance urban pluvial flood prediction in order to enable urban water managers to adequately cope with intense storms, so that the vulnerability of populations and critical infrastructure can be reduced.

Project Partners

1) TU Delft (NL)
2) Zuid-Holland Province (NL)
3) Gemeentewerken Rotterdam (NL)
4) KU Leuven (B)
5) Aquafin NV (B)
6) Ecole des Ponts ParisTech (F)
7) Marne-la-Vallée (F)
8) Seine-St.-Denis (F)
9) Météo France (F)
10) Imperial College London (UK)
11) Met Office (UK)
12) Local Government Flood Forum (UK)
13) Véolia (F)

Work Packages

- **WP1:** Acquisition, installation and testing of X-band radars and high-quality radar protocols in pilot locations.
  Lead: ParisTech, Daniel Schertzer

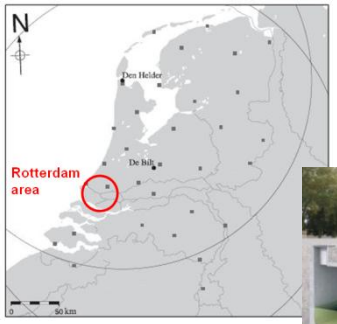
- **WP2:** Acquisition of rainfall data at the detailed time and spatial scales that are essential for urban rainfall and flooding prediction
  Lead: KU Leuven, Patrick Willems

- **WP3:** Implementation of rainfall data in existing urban water models to enhance short term pluvial flood modelling and prediction
  Lead: Imperial College of London, Cedo Maksimovic

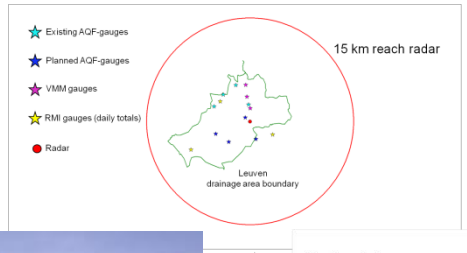
- **WP4:** Implementation of detailed rainfall data and flood modelling results into enhanced urban water management strategies at the short and long term
  Lead: TU Delft, Marie-claire ten Veldhuis

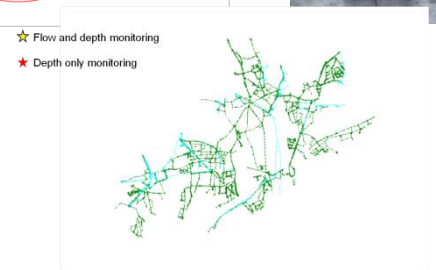
Pilot Sites

Rotterdam (NL)

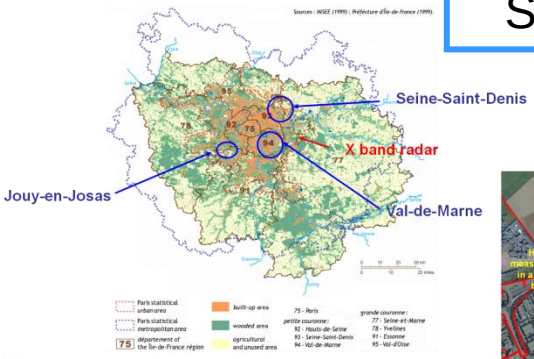


Leuven (BE)

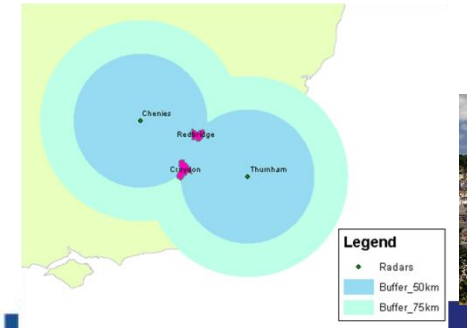




Marne-la-Vallée (FR)
Seine-St.-Denis (FR)



Croydon (UK)
Redbridge (UK)
Torbay (UK)



Cooperative Work

- Knowledge exchange between partners
- Field visits pilot locations
- Workshops on development of common methods and training for practical application
- Demonstration tools (radar, flood model), applications (radar results, model results), solutions (early warning systems, operational control, storage basins) to other partners

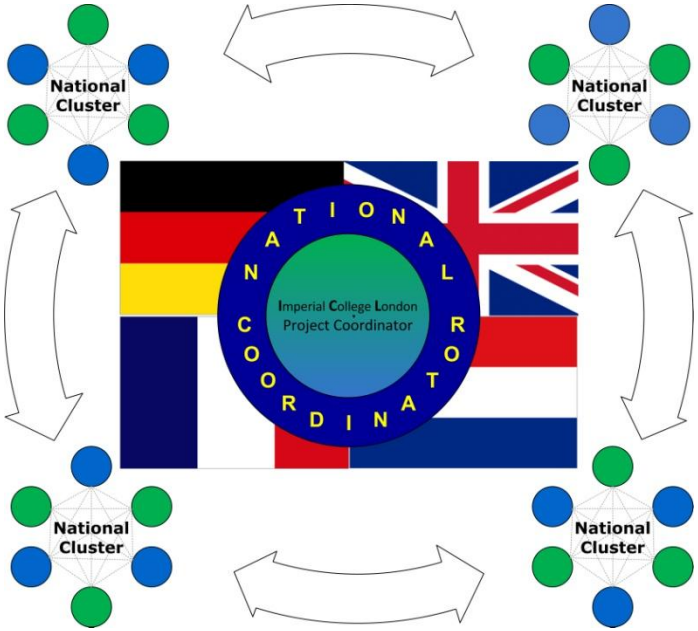
Blue Green Dream

Integrating Blue and Green Urban Assets for the City of Tomorrow

eit Knowledge & Innovation Community
Climate-KIC

Blue Green Dream

- Led by Urban Water Research Group of ICL
- 4 EU countries
- 14 partners and 24 supporters from academia, businesses (including SMEs) and local, regional and national governments



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Thank you

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