



# Stakeholders' Presentations







# **Robert Moore**

### Head of the Hydrological Modelling & Forecasting Group, Centre for Ecology & Hydrology

#### Stakeholder Forum

# **RainGain and CEH**

### **Robert Moore**

Centre for Ecology & Hydrology, Wallingford, UK

RainGain Observers Group Meeting 11 September 2015, Imperial College, London, UK



# CEH and my role

- Centre for Ecology & Hydrology: the NERC centre for integrated research covering terrestrial and freshwater ecosystems and their interaction with the atmosphere
  - Natural Hazards Science Area: developing the science associated with prediction of hydro-meteorological, biological and air quality hazards
    - Hydrological Modelling & Forecasting Group
      - Flood forecasting
      - Forecasting fluvial and surface flood risk & impact
      - Rainfall estimation using radar & raingauge data





# Countrywide flood guidance with G2G model



- Uses spatial datasets on terrain, soil/geology, land-cover
- Responds to spatial variation of rainfall input
- Used operationally across Britain at a 1km, 15 min resolution

Moore et al., IAHS Publ. 305 (2006)

Price *et al.;* Cranston & Tavendale, Water Management (2012)

### Forecasting surface water flooding impact







Impact

& Risk

#### Glasgow 2014 Commonwealth Games real-time pilot

Moore et al. (2015) Surface water flood forecasting for urban communities, www.crew.ac.uk/publications

### Hyrad system and radar rainfall rarity

#### Hyrad system for rainfall display & analysis

💦 Nimrod products - Scotland 1/2/5km composite QC - Hyrad

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Nimrod products - Scotland 1/2/5km composite QC

Select point and

boundary of

interest

File

For Hel



15:00 14-Aug-200°

16:00 14-Aug 2008

17:00 14-Aug 2008

12:00 14-Aug-2008 13:00 14-Aug 2008 Scottish
Water

15:00 14-Aug-2008

16:00 14-Aug-2008 17:00 14-Aug-2008

14-Aug-2008

14:00

14-Aug-2008 14-Aug 2008

12:00 14-Aug-2008

14-Aug 2008

Cole et al. (2012), IAHS Publ. 351, 644-649

# **Relevance of RainGain to CEH**

- Inter-Agency Committee on the Hydrological use of Weather Radar: biannual reporting on UK progress in R&D, operations and opportunities. CEH provides representation & Technical Secretary. www.iac.rl.ac.uk
- Evidence & guidance on improving estimation, resolution and coverage of radar rainfall (super-resolution dualpolarisation C-band, local X-band)
- Improved estimation methods for gridded rainfall using raingauge and weather radar with case study evaluation at urban scale (singularity-sensitive merging)
- Relevance to hydrological application across scales







# Johan Verlinde

### Water Asset Manager, City of Rotterdam



Johan Verlinde – Water Department City of Rotterdam

### The Netherlands The Dutch Delta in NW Europe

DES

#### DEVELOPMENTS





Welke **İMPBC**<sup>L</sup> heeft de 3e Industriële Revolutie op uw bedrijf?



#### Rotterdam climate change adaptation strategy

#### **Effects of Climate Change**



Sea level rise



Low river discharges



Long periods of heat



More intense rain events



High river discharges





#### **Rotterdam Climate Change Adaptation Strategy**



#### Core of the RAS

- 1. Robust system: Maintain and strengthen
- 2. Adaptation: use of the urban space
- 3. Working together & Linking in
- 4. Create added value for environment, society, ecology & society



#### RAINGAIN RADAR AND 3Di



















#### **Cumulative Socio-Political Drivers**



#### WATER SENSITIVE CITY FRAMEWORK

### Rotterdam climate change adaptation strategy

#### Perspective for the climate resilient delta city

Illustrative reproduction of the possibilities for climate adaptation for different types of city districts

- What measures could we apply here?
- Which stakeholders are important to play a role?
- What value is added by those measures?
- Which stakeholders profit?



Compacte stad



Binnendijkse stadswijken



Naoorlogse wijken en buitengebieden



Buitendijkse stadswijken



n Havens



Stadshavens



2









#### Dagelijks gebruik buitenruimte

te gebruiken als tribune

sen Zadkine







Grote bassin ingericht op actief gebruik toor verschillende groepen

Afbeeldingen: De Urbanisten

UNDANISTEN

#### **PRIVATE AND PUBLIC**

#### Create water awareness





#### **INNOVATIONS AND DEVELOPMENT**



#### **From grey to green** Soft forms of storage – Sponge concepts



#### **REDEN 5: INNOVATIES EN ONTWIKKELING**



#### From small to big Upscaling of storage system

DE URBANISTEN

#### **REDEN 5: INNOVATIES EN ONTWIKKELING**



#### **REDEN 5: INNOVATIES EN ONTWIKKELING**



Form coalitions, working together

**DE URBANISTEN** 



Water sensitive Rotterdam Innovation Agenda



#### WE'RE NOT READY FOR THE FUTURE

60



#### GOOD MEASURES NEED MEASURING & MODELLING







# **Graham Squibbs**

#### Independent Consultant, G. Squibbs Consultancy

#### Representative of CIWEM Urban Drainage Group

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### **CIWEM UDG AND RAINGAIN.**

**Graham Squibbs** 

G. Squibbs Consultancy



### Introduction to CIWEM UDG

- Started in 1984 as WaPUG (Wallingford Procedure User Group).
- Continued as WaPUG but changed emphasis to Wastewater Planning User Group)
- In 2009 joined CIWEM to become a knowledge group of CIWEM, CIWEM Urban Drainage Group.
- Celebrated 30 years at our Autumn 2014 Conference.



### **Aims and Objectives**

- Aims and objectives are aligned with CIWEM's Royal Charter.
- Advance the science and practice of urban drainage management for the public benefit
- Promote education, training, study and research in urban drainage management and to publish the results of such research
- Establish and maintain appropriate standards of competence for urban drainage management professionals



### What we do

#### Amongst other things

- We organise a programme of conferences and workshops which enable professionals to network, share good practice, debate topical issues, socialise and receive training.
- We support a programme of industry facing research and development to define and promote good practice.
- We share outcomes through a series of publications made available through the CIWEM website.
- We establish, maintain and promote a competency framework to support professionals develop their careers and skills in urban drainage management
- We maintain a leadership committee which is representative of all UK regions and sectors of the urban drainage community. This includes water company representatives, EA, SEPA, local authorities, academics and consultants.



### **Publications**

- Hydraulic Modelling Code of Practice
- Modelling Guides
  - Rainfall Guide (to be published November 2015)
  - Integrated Urban Drainage Modelling Guide
  - Design of CSO chambers with screens
  - Quality Modelling of Sewer Systems
  - River data Collection Guide (for UPM studies)
  - River Modelling Guide (for UPM studies)
- Competency Framework for Wastewater Planners



### Where does RainGain fit in?

- All aspects of the RainGain project are relevant to the work of CIWEM UDG.
- My main interest is rainfall and modelling
- Development of Rainfall Guide identified the following significant unresolved issues
  - What to do if the radar data and raingauge data don't match
  - How do we calibrate radar data with locally collected raingauge data



### **Recent comparison study**

- 2 catchments in the North of England
- Both catchments close enough to Radar site to provide good resolution radar data.
- Standard Met Office provided 1km radar data at 5 minute intervals.
- Comparison made between radar data and raingauge data, and both datasets run through hydraulic models.



### **Comparison Plots**







### Conclusion

- Variances in maximum intensities may be down to differences in temporal resolution
- My own personal views
  - Use of radar data is being held back by perceived issues over accuracy.
  - Calibration against local raingauge data and improved temporal resolution are of greater benefit than obtaining higher resolution spatial data as modelling is less accurate the smaller the catchment size, and hence 100m resolution radar could be a higher resolution than necessary at the current time.







# **David Stewart**

### Service Manager for Engineering, Torbay Council



### RAINGAIN

### **Torbay Council**

#### **Dave Stewart – Flood Risk Manager**

11<sup>th</sup> September 2015



### **Overview**

- Introduction to Torbay Council
- Flooding Issues in Torbay
- Defra Community Engagement Pathfinder
- Future Measures to Improve Local Flood Warnings

# Introduction to Torbay Council

#### Location of Torbay





# **Flooding Issues in Torbay**

### **Source of Flooding in Torbay: Combined Sewers** Main Rivers **Ordinary Watercourses** Surface Water Run Off Highway Drainage The Sea Groundwater

# **Flooding Issues in Torbay**

- Flooding mechanisms are complex with floodwater from a variety of sources.
- Responsibilities fall across a range of stakeholders:
  - Individual Property Owners
  - Water Companies
  - Highway Authority
  - Local Authority
  - Riparian Owners

# Defra Community Engagement Pathfinder

- Production of community flood plans
- Automated raingauges in Torquay, Paignton & Brixham
- Depth monitors in critical flood risk areas
- Local flood warnings issued based on realtime rainfall and depth data
- Information available online to local community

# Defra Community Engagement Pathfinder

#### **Timeview Telemetry** receiving and forwarding time series data and alarms Logout Change Password User Guide Sep 02 2015 13:45 GMT Torbay View ✓ 5 Days ✓ Sort by Latest Checkin ✓ 20 🗸 Items per Page Icon Display Yes 🗸 List Stations - Torbay Council All Groups List Latest Map View Group 5 Davs Group 5 Davs Alarms TORBAY OCCOMBE VALLEY TORBAY ELLACOMBE PARK i3.8V i4.7V List Stations e0.0V 1.6mA h3.8V COUNCIL e0.0V 1.3m/ h3.6V COUNCIL Stage Depth Timeview DBi (0.401V) 2015-08-29 00:00:00 2015-09-02 08:50:30 Temp 11.84Deg0 **Overdue Checkins** 2015-08-29 00:00:00 2015-09-02 08:56:00 TORBAY TEMPLER ROAD TORBAY MANOR CRESCENT i3.8V i3.8V e0.0V 0.4mA e0.0V 1.3mA h3.6V COUNCIL COUNCIL Stage RAINFALL 10.4mm 2015-08-29 00:00:00 2015-09-02 08:45:28 Temp 13.67DegC 2015-08-29 00:00:00 2015-09-02 08:05:30 TORBAY VICTORIA PARK TORBAY **TOWN HALL RG 1** i3.8V e0.0V 1.2mA h3.6V e0.0V 0.3mA h3.7V COUNCIL COUNCIL RAINFALL Stage 0.523m 10.6mm νυννανα . . . m31 2015-08-29 00:00:00 2015-09-02 07:50:52 Temp 12.85DeaC mAOD 2015-08-29 00:00:00 2015-09-02 07:53:02 TORBAY COCKINGTON TORBAY LAYWELL RESERVOIR RG i3.9V 3.8V COUNCIL COUNCIL Road RAINFALL 3.0mA 0.4m/ h3.6V 0m 22mm . . . h . h 2015-08-29 00:00:00 2015-09-02 07:12:48 Temp 12.189Deg Stage Temp 12.89DeaC 2015-08-29 00:00:00 2015-09-02 07:15:32

# **Future Measures to Improve Local Flood Warnings**

- Installation of additional depth monitors to increase coverage of flood warning system
- Investigate use of a local rainfall radar to provide improved flood warnings
- Real-time modelling of system using InfoWorks ICM Live

### **RAINGAIN – Torbay Council**

# Any Questions?





# Michael Cranston

### Manager of the Flood Forecasting and Warning Unit, Scottish Environment Protection Agency (SEPA)

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# Urban flood early warning systems in Scotland



Scottish Flood Forecasting Service

Michael Cranston RainGain National Observers UK Meeting

# **Flood Forecasting Service Aims**



Working with the Met Office, SEPA will develop approaches in forecasting pluvial flooding





#### **BBC** NEWS

Met Office

England N Ireland Scotland Wales	track	IEWS
Politics Business Entertainment Science/Nature Technology	News Front Page World UK England	You are in: Scotland Wednesday, 31 July, 2002, 04:29 GMT 05:29 Homes evacuated after flooding
Health Education Talking Point	N Ireland Scotland Wales Politics	
Country Profiles In Depth	Ser Entertainment Science/Nature	
Programmes	op raii Education	
BBC SPORT	Em RC Talking Point	

# Summer flooding in Glasgow

July 2002, June 2007, August 2011, July 2012, July 2013

July 2013

### **Urban Flood Early Warning Systems**



**Surface water** (pluvial) flood forecasting remains one of the biggest challenges for our community. Developments to date include precipitation forecasts linked to known flood depth-duration



**Risk-based hydrometeorological** approach that links 24-hour ensemble rainfall forecasts (MOGREPS-UK) through a hydrological model (Grid-to-Grid) to a library of flood hazard impact assessments.







### **Urban Flood Early Warning Systems**



# **Urban Flood Early Warning Systems**



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**Communication of risk** through a bespoke surface water flood forecast based on emergency responder requirements – during 2014 Commonwealth Games



**New approach** in the UK for forecasting and alerting surface water flood hazard















Scottish Flood Forecasting Service





Deltares



### **Urban Flood Early Warning** What challenges remain?



Scottish Flood Forecasting Service

lood Guidance Statement 10:30hrs 05 July 2011

dwy flood risk in Scotland is below. This statement is

General Overview of Flood Ris RATTER OF COMMENT

Scottish Flood Forecasting Service Working in partnership Met Office

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### #1 Scale of real-time QPE



**X-Band radar.** Can local X-band radars fill the 'gaps' in the UK network where estimates of rainfall can be poor?

**Low-cost solution.** Do they represent a solution where the cost-benefit does not favour the installation of C-Band installations?

**Uncertainty**. As forecasters should we get better at dealing with managing uncertainties in radar rainfall estimates?







### #2 Scale of our short-range rainfall forecasts



**Nowcast.** Provides useful radar extrapolation forecasts blended with high resolution NWP yet provides the greatest source of error in flood forecasting.

**STEPS.** Used in the Glasgow pilot, short term ensemble prediction system offers useful nowcast for use in hydrological applications.

**Scale**. What scale can we usefully apply short-range rainfall forecasts if the skill of the NWP is limited to 25km at >6 hours and can high resolution radar QPE assimilated in the Nowcast improve skill?

SEE PART Scottish Flood Forecasting Service

UKPP rainfall products - STEPS fcst rainrate 15min



10:00 GMT Sun 27-Jul-2014 (09:45+00:15)

oodforecastingservice.net

### #3 Scale of our hydrological applications



**Flood Hazard.** We have a good appreciation of the surface water flood hazard footprint in Scotland.

Local scale vs national scale. Whilst the Glasgow pilot delivered a new method for linking rainfall forecasts to real time 1km gridded impacts; should we deliver a two-tiered approach with nested real time hydrological applications.



oodforecastingservice.net

SEE DEATH Scottish Flood Forecasting Service

# Summary

- The Glasgow pilot has delivered a new approach for urban flood early warning in Scotland
- However there remain some significant science and application challenges



#### More information available:

SFFS Blog: <u>www.floodforecastingservice.net</u> Final research report: <u>http://www.crew.ac.uk/publications/</u> Journal Paper: submitted to Journal of Flood Risk Management (Speight *et al.*)

Email: michael.cranston@sepa.org.uk









