Minutes of the Second RainGain National Observers Group Meeting (UK)

Prepared by Susana Ochoa Rodríguez and Laurie Thraves

Date: Tuesday 16th April 2013, from 09:30 to 16:00

Venue: London City Hall, The Queens Walk, London, SE1 2AA

Purpose of the meeting:

- To introduce the RainGain project to a group of national observers comprising specialists, practitioners, academics and local and central government policy-makers
- To present the first results of the RainGain project and the activities planned for the remainder of the project
- To promote interaction between urban pluvial flood risk managers from the four RainGain partner countries and jointly discuss key aspects of the management of this type of flooding
- To give the observers the possibility of getting involved in the RainGain project

Present:

NAME	ORGANISATION
Andy Palmer	AECOM
Peter Dunlop	Anglian Water Services Ltd
Ian Sivyer	Atkins
Robert J. Moore	Centre for ECology & Hydrology
Roger Thomas	Chairman, LGA Coastal SIG
Brian Richards	Dorset County Council
Chris Janes	Environment Agency
Ian Joyner	Environment Agency
Richard Cross	Environment Agency
Tim Harrison	Environment Agency
Andrew Lane	Environment Agency (Flood Forecasting Centre)
Alex Nickson	Greater London Authority
Andrew Walker	Innovyze Ltd
Ian Ringer	JBA Consulting
Lachlan Attwooll	London Borough of Redbridge (Emergency Planning)
Joseph Okai	London Borough of Southwark
Priscilla Mumby	Medway Unitary Authority
Alys Bishop (on behalf of Mark Henderson)	Norfolk County Council
Richard Allitt	Richard Allitt Associates Ltd
Monika Pfeifer	Selex Systems Integration
John Kissi	Southwark Council
Patricia Cuervo	The Royal Borough of Kensington and Chelsea

NAME	ORGANISATION
David Stewart	Torbay Council
Catherine Muller	University of Birmingham
Alma Schellart	University of Bradford
Antonio Patania	University of Bradford
Dr. Anna Romanova	University of Bradford
Paolo Leorin	University of Bradford
Nanding	University of Bristol
Johan Van Assel	Aquafin NV
STANCIC Natalija	Conseil Général de la Seine Saint Denis
ICHIBA Abdellah	Conseil Général du Val-de-Marne
BOMPARD Philippe	Conseil Général du Val-de-Marne
Rosa Vicari	ENPC
Gires Auguste	ENPC
Li-Pen Wang	Imperial College London
Susana Ochoa Rodriguez	Imperial College London
Chris Onof	Imperial College London
Cedo Maksimovic	Imperial College London
Patrick Willems	KU Leuven
Laurens Cas Decloedt	KU Leuven
Laurie Thraves	LGIU/Local Government Flood Forum
Andy Johnston	LGIU/Local Government Flood Forum
Barry O'Brien	LGIU/Local Government Flood Forum
Patricia MacKenzie	Met Office
Timothy Darlington	Met Office
Jacqueline Sugier	Met Office
Sharon Jewell	Met Office
Daniel Goedbloed	Municipality of Rotterdam
Tirza Molegraaf	Provincie of Zuid-Holland
Erik de Haan	Provincie of Zuid-Holland
Alwin Wink	TU Delft
Guendalina Bruni	TU Delft
Marie-claire ten Veldhuis	TU Delft
Ricardo Reinoso Rondinel	TU Delft
Regina Edoo	TU Delft

Minutes - First RainGain National Observers Group meeting (UK)

1. Opening of the meeting

Opening and welcome by Laurie Thraves (Local Government Flood Forum). Laurie welcomed and thanked attendees for their participation and provided a brief overview of the RainGain project, including details of the context and objectives of the project, as well as of the partnership.

2. Presentations: Surface water flood risk management in the UK

Presentations were given by four guest speakers from UK organisations dealing with different aspects of urban pluvial flood risk management. Speakers included:

- Andy Johnston (Chief Operating Officer, Local Government Information Unit (LGIU)/ Local Government Flood Forum (LGFF))
- Andrew Lane (Senior Hydrometeorologist – Leader of Surface Water Flood Forecasting, UK National Flood Forecasting Centre)
- Alex Nickson (Policy and Programmes Manager for Climate Change, Adaption, Water, Green Infrastructure and Air Quality, Greater London Authority)
- David Stewart (Service Manager Engineer, Torbay Council)

The presentations were followed by questions/answers session**. These presentations will be circulated** amongst attendees. A brief summary of the main points of each of the presentations is provided.

2.1. Presentation by Dr Andy Johnston (LGIU/LGFF): "An overview of surface water flood risk management in the UK"

- The UK led the way in privatisation of water companies. This is unusual even in the UK. In Scotland the water company is in public ownership and in Northern Ireland water is still run by the state. In England and Wales, private business runs the drinking water and wastewater. This has several implications:
    - Ownership of water companies is now largely with non-UK based companies and non-publicly listed companies so it is hard to get information out as this info is commercially sensitive, key investment decisions in infrastructure are governed by a process between the private company and the regulator OFWAT, and the companies are heavily indebted as they borrow to invest
    - There is a real democratic deficit in the way water is managed in the UK as it is fully privatised. The only small concession is that in theory local elections could decide the shape of surface water schemes

- The water companies are regulated by Ofwat and EA
- There was massive flooding in the UK in summer 2007. A large proportion of flooding came from surface water rather than rivers. At that point there were no warnings or emergency plans in place for dealing with surface water flooding. These events revealed that there was a gap in the structures that manage water: no one was responsible for surface water flooding
- During the 2007 floods the emergency services and local authorities stepped in to provide support. This was all done in the back of goodwill and the fact that there was an emergency which needed to be dealt with
- The summer 2007 floods led to the Pitt Review ("Learning lessons from the 2007 floods") and the 2010 Flood and Water Management Act which made local authorities responsible for surface water flooding. The review recognised that, because of the unique characteristics of this type of flooding, local authorities are best placed to take over management of surface water flooding
- New regional structures were created which integrate surface and other sources of flooding in particular coastal flooding. A gap still exists in governance and knowledge when it comes to groundwater flooding
- Surface water management plans and strategic flood plans are being prepared
- A lot of progress has been made in short time but two big issues are yet to be resolved:
    - SuDS (Sustainable Urban Drainage Systems): We know we need smarter ways for managing surface water flooding. However, maintenance is an issue. There is a lack of political will and incentives to make SuDS happen at present.
    - Insurance: One of the unique elements is that in the UK flood insurance is linked to property insurance (it is a relatively small part of property insurance). There was an agreement that as long as the government invested enough money on reducing flood risk insurance companies would subsidise insurance premiums. However, this agreement is coming to an end in 2013 and the insurers and government are unwilling to renew it. If an agreement cannot be reached, this may result homeowners become 'self-insured'. Other potential solutions include a levy on every policy that is purchased that is placed in a common pot and used to subsidise properties at high risk or reduction of the cost of insurance by implementing property level flood protection measures.
- Better information and improved flood forecasting would enable better management of flood events. This could also reduce the risks of insurance "blackspots" being created. As project partners from NL pointed out, flood risk and price of insurance premiums are defined in the UK by postcode and previous claims. This is overly simplistic.

2.2. Presentation by Dr Andrew Lane (Flood Forecasting Centre): "Surface water flood forecasting and guidance in the UK: theory, performance and outlook"

- Andrew introduced the Flood Forecasting Centre (FFC) and described the services it provides and the progress made in the last few years with regard to surface water flood forecasting. The FFC is a successful partnership between the Met Office and the Environment Agency. It was

established in April 2009 following the recommendations of the Pitt Review. The FFC aims to provide earlier flood warnings in England and Wales for all sources of flooding

- The services provided by the FFC include: local flood advisory services, flood guidance statements, and hydrometeorological services for the Environment Agency
- Their main FFC product is the Flood Guidance Statement (FGS). This provides a daily flood risk assessment for government and emergency responders to assist with tactical planning decisions. This assessment includes **all types of natural flood risk** (i.e. river, coastal, groundwater and **surface water flooding**) and is issued at county level across England and Wales and provides information over five days. The risk of each type of flooding is estimated using a matrix which combines likelihood (i.e. hazard) and potential impacts
- The FFC has strived to improve the forecasting of surface water flooding. The first step in this process was the 1st Generation Extreme Rainfall Alerts (2008-2011) which were based on 1 in 30 year return period rainfall depth-duration thresholds (which were considered likely to lead to surface flooding in urban areas). These alerts did not consider potential impacts or other hydrological parameters. These alerts were superseded by the 2nd Generation Surface Water Flooding Decision Support Tool (SWFDST) launched in 2011 and developed in collaboration with Halcrow. This tool links rainfall thresholds with parameters on the ground including antecedent precipitation conditions and blue square maps of potential impacts. This tool has continued to be improved and refined using data from recent flood events
- Areas for improvement of the current service provided by the FFC include: more geographically targeted flood risk assessment and warning, improved visualisation, and higher accuracy. In order to improve the current flood risk assessment, the FFC is working in collaboration with the Centre for Ecology and Hydrology to link rainfall forecasts to a grid-to-grid distributed hydrological model of the UK. This model will be used to define the hazard footprint, which will afterwards be translated into impact
- The FFC will continue to be a national service and, in spite of the improvements, it is unlikely that it can deal with the very fine detail of small urban catchments.

2.3. Presentation by Alex Nickson (Greater London Authority): "Surface water flood risk management in London"

- Alex provided an overview of what the Greater London Authority (GLA) is and how it is coordinating the management of surface water flood risk in London through the Drain London Project. The GLA is the regional government for London and comprises an elected Mayor and an elected London Assembly. It is responsible for the well-being of Londoners.
- Drain London Project:
    - Drain London was initiated in early 2007 just before the major flood events of summer 2007. At that time the risk of surface water flooding in London had been identified as a potential threat and the lack of an adequate strategy for managing it had been

recognised: there was no ownership of risk, no map of where it might "get wet", fragmented responsibility for delivery, and a low skills base outside consultancies

- Before Drain London, London had 33 boroughs with 33 ways of working. It was acknowledged that doing things for the whole of London would be more efficient than doing it for each of the boroughs
- Key activities of the Drain London Project include: raising awareness, mapping flood risk, building capacity, identifying priorities, piloting approaches, developing and delivering programmes and monitoring their performance. Details of each of these activities can be found in the power point presentation
- Engaging communities has proven to be one of the most difficult tasks. A key in this process is to contact community leaders who can champion the implementation of surface water flood risk reduction measures in their local areas.

- Future challenges: given increased urbanisation, and the effects of climate change, surface water flood risk in London is at the boundary of an acceptable to an unacceptable risk. The challenge will be to close the adaption gap through interventions including: increasing the drainage capacity, absorbing and retaining rainfall, improving maintenance, implementing local resilience measures, and accepting the increasing surface water flood risk

2.4. Presentation by David Stewart (Torbay Council): "Flood risk management in Torbay"

- David provided an overview of flood risk in Torbay with an emphasis on Torquay Town Centre as this area is a RainGain case study. He also provided an overview of the roles of the different stakeholders involved in flood risk management in Torbay, how responsibilities and flood risk management strategies have evolved over time, the actions implemented so far and next steps for reducing flood risk in the area
- Torbay is located in the south west of UK and comprises the towns of Torquay, Paignton and Brixham. One of the major flooding locations is the town centre of Torquay which has a high density of commercial properties. The sewer system of this area is predominantly combined and the main sewer corresponds to the former River Fleet (the river discharges into the combined sewer system in the upper part of Torquay Town Centre)
- Flooding mechanisms in Torbay are complex with flood water from a variety of sources including: combined sewers, main rivers, ordinary watercourses, surface water runoff, highway drainage, the sea, and groundwater. Torquay Town Centre is mainly susceptible to surface water and sewer flooding (sewer surcharge may occur as a result of heavy rainfall and of high flows of the River Fleet which discharges into the sewer system). There are some emergency CSOs which discharge into the sea however, when the tide is high, the discharge capacity of the CSOs is reduced and this may exacerbate surface water and sewer flooding
- The responsibilities for flood risk management in Torbay fall across a range of stakeholders including individual property owners, water companies, highway authorities, local authorities and riparian owners

- Torbay Council is one of the few authorities in the UK that is still doing hydraulic modelling (most local authorities stopped doing so when water companies were privatised and took over the control of water supply and sewage systems). Moreover, the authority works closely with the water company of the area (South West Water)
- A number of regulations have come into force in the last decades which have significantly changed the role that local authorities play in flood risk management. The latest regulation is the 2010 Flood and Water Management Act which designated local authorities as lead local flood authorities responsible for managing local flood risk, including surface water flooding, and required them to: investigate local flooding, create local flood risk management strategies, maintain an asset register, and designate flood risk protection assets. Fulfilling these requirements has not been less challenging for Torbay Council compared to other local authorities in the UK as Torbay Council has continued to manage their sewer system and kept their expertise in this area
- A number of actions have been implemented in Torquay over the last few years aimed at reducing the risk of flooding. These include: construction of attenuation tanks, the Making Space for Water pilot study, the Torquay Flood Study, Level 1 and 2 Strategic Flood Risk Assessments, surface water flood risk mapping, installation of depth monitors and raingauges, and Torquay town centre highway scheme. The funding for most of these comes from the local council
- Future measures to reduce flood risk include: encouraging use of sustainable drainage schemes in future developments, implementation of Torquay flood management plans, implementation of Torquay town centre flood alleviation scheme, and educating the public (the authority has recently been awarded a Defra grant for carrying out a flood resilience community pathfinder).

3. Presentations: Surface water flood risk management in RainGain partner countries

Presentations were given by three guest speakers from the RainGain partner countries:

- Daniel Goedbloed (Strategic Development Advisor, Province Holland Zuid, The Netherlands)
- Philippe Bompard and Natalija Stancic (Conseil général du Val-de-Marne & Conseil général de la Seine-Saint-Denis, France)
- Johan Van Assel (Senior Research Engineer, Aquafin NV, Belgium)

The speakers provided an overview of how urban water, more specifically urban pluvial flooding, is being managed in their respective countries, including their experiences to date, on-going work and challenges. The presentations were followed by a question/answer session**. These presentations will be circulated** amongst attendees. A brief summary of the main points of each of the presentations is provided below.

3.1. Presentation by Daniel Goedbloed (Province Holland Zuid, NL): "Urban water management in the Netherlands"

- A major part of The Netherlands is below sea level. There is therefore a great need for good water management
- The Netherlands is split into **12 provinces** each of which is responsible for regional spatial planning, facilitation of economic development and management of nature and landscape. In turn, each province comprises several **municipalities** and **water boards**. The former are responsible for local spatial planning, sewerage systems and drainage and the latter are responsible for managing local water bodies, dike construction and treatment of wastewater
- Daniel works for the Province of South Holland which is a highly urbanised area comprising the cities of Rotterdam, The Hague, Delft and Leiden. Daniel's presentation focused on the city of Rotterdam. Rotterdam is a harbour city and its challenges include heavy storms, CSO discharges into the canal system, sea level rises, changing river discharges, and high groundwater levels
- Rotterdam's spatial development strategy 2030 focuses on integrating water safety, water quantity and water quality criteria into new urban water planning in order to connect water with opportunities and create an attractive and economically strong city. In connection with this, Rotterdam has a climate proof programme the aim of which is to have a 100% climate change proof city by 2025 while making it attractive and economically strong. This programme includes long-term as well as short-term actions
- One of the main actions is to make more space for water as there is need for more storage inside the city. Different schemes are being implemented to achieve this, for example, underground storage tanks, urban flood plains along urban channels, water squares
- The aim of the water squares is to create additional storage in a way that is aesthetically attractive and which can bring multiple benefits. The local communities play a crucial role in the implementation of these squares as they must support them. To achieve this, participatory approaches have been successfully implemented that identify what people want for their square and design the square so that people's interests as well as storage goals are fulfilled
- Other actions include the implementation of green roofs and porous pavements. Green roofs are partly subsidised by the government and the aim is to make the city adaptive as well as attractive. Porous pavements are being installed alongside maintenance of streets and sewer systems in order to minimise costs and maximise benefits
- Another action is investing in knowledge and development. An example of this is the recent purchase of an X-band radar for the city of Rotterdam as part of the RainGain project (of which the Provice Holland Zuid is a partner).

3.2. Presentation by Philippe Bompard & Natalija Stancic (Conseil général du Val-de-Marne & Conseil général de la Seine-Saint-Denis, France): "Surface water flood risk management in the parisian agglomeration: The cases of Seine-Saint-Denis and Val-de-Marne"

- Seine-Saint-Denis and Val-de-Marne are two counties of Paris. In both counties water management objectives include management of the quantity as well as of the quality of water
- Seine-Saint-Denis County is 236 km^2 with 1.5 million inhabitants. It is relatively flat and highly urbanised. Former rivers have been culverted and have become part of the sewer system. The county has a **real time operation system** comprising 142 remote local control systems including storm water basins, pumping stations, rain gauges, flow gauges, siphons and gates. A decision-making support system was implemented in the 90's which assists the operator in selecting the appropriate remote control strategy to apply. The system is based on a rain-type catalogue and corresponding pre-established control strategies scenarios based on hydraulic simulations and local expertise. Initial alerts are received by the operator once > 5 mm rainfall is observed at at least 2 raingauges
- Val-de-Marne County is 245 km^2 with 1.35 million inhabitants. Real-time control elements include storage basins, pumping stations, flow/level gauges and raingauges. A forecasting system (Calamar) is in place which enables real time operation of storage basins (based on the rainfall forecast).

3.3. Presentation by Johan Van Assel (Aquafin NV, Belgium): "(Urban) flood management in Flanders ,Belgium"

- Aquafin is the wastewater company for the Flanders region of Belgium
- The main sources of flooding in Flanders are tidal, fluvial and pluvial/sewer flooding. Different organisations are in charge of the different sources of flooding, however, there is significant interaction between the different types of flooding and, therefore, flood risk management in Flanders is complex. In general, the Department of Mobility and Public Works (MOW) is in charge of tidal flooding and motorway drainage (which is related to surface water and sewer flooding), the Flemish Environment Agency (VMM) is in charge of main 1st category rivers, provinces are in charge of 2nd category rivers, Aquafin is in charge of trunk sewers and local sewer operators and municipalities are in charge of minor 3rd category rivers, local sewers, ditches and SuDS
- There are good early warning systems in place for fluvial flooding but not for pluvial flooding. The latter has much shorter response time, and is localised, so forecasting it is more difficult
- Sewerage design codes in Belgium have evolved in the last two decades. A new code came into force in 2013 which focuses more on sustainable urban drainage elements and has updated design storms based on more recent rainfall statistics
- Building regulations in Belgium are complex and people used to build anywhere they wanted. New regulations have also come into force in recent years which are stricter and require

implementation of source control measures in new development. Most new houses have rainwater harvesting systems in place

- Urban flood modelling has also evolved over the last decades going from traditional approaches where only the sewer system is modelled and dummy flood cones are used to represent flooding to dual-drainage and more integrated approaches
- Aquafin aims to implement an urban flood early warning system (EWS) in the near future. This system will be based on the same concepts of fluvial flooding EWS. However, the shorter response times and small spatial scales of urban flooding make the forecasting and event reconstruction more challenging. Aquafin has chosen the FloodWorks software package for the implementation of the EWS as all of their urban drainage models were already setup in InfoWorks CS and the fluvial flood EWS is in FloodWorks as well (so both EWS could be easily linked in the future). In addition, Aquafin has recently purchased an X-band radar which is expected to provide rainfall estimates and forecasts with better accuracy and resolution that are suitable for urban hydrological applications
- Remaining challenges in the management and modelling of urban flooding in Flanders include the development of integrated storm water management plans in collaboration with all authorities involved, implementation of adaptive measures for coping with the increasing effects of climate change, use of real time control measures to prevent flooding in the most sensitive areas, implementation of EWS to improve preparedness and response to inevitable flooding, improvement, verification and assessment of the performance of urban flood models and optimisation of models that are sufficiently fast to run the EWS.

4. Presentations: Progress to date and next steps for the RainGain Project (UK Project Partners):

Presentations were given by the following representatives of UK RainGain partner organisations:

- Introduction by Prof. Čedo Maksimović, Imperial College London
- Susana Ochoa, Imperial College London
- Jacqueline Sugier & Timothy Darlington, Met Office

The speakers provided an overview of the progress to date and of the activities planned for the remainder of the RainGain project. The presentations were followed by a questions/answer session**. These presentations will be circulated** amongst attendees. A brief summary of the main points of each of the presentations is provided below.

4.1. Introduction by Prof. Čedo Maksimović (Imperial College London)

- Prof. Maksimovic explained the concept and characteristics of surface water/pluvial flooding and the challenges associated to its modelling and forecasting. He introduced the work currently underway in the RainGain project which aims at tackling the challenges imposed by this type of flooding
- Surface/pluvial flooding is caused by intense storms during which the capacity of the sewer network and of the urban surface is exceeded. This type of flooding takes place quickly and at small temporal and spatial scales and, therefore, the flood models and the rainfall estimates and forecast must be rapid and accurate
- Accurately modelling the "urban jungle" is a difficult task and there will always be a trade-off between accuracy and run times. Moreover, the lack of complete urban pluvial flood records and the dynamic nature of urban catchments lead to high uncertainty in the models of this type flooding which hinders decision-making
- The public is often the first responder as a result of the rapid onset of urban pluvial flooding. Nonetheless, local residents have low awareness of the risk of urban pluvial flooding and are not willing to take part in its management. Coordinating activities between the different stakeholders involved and engaging the general public in the management of this type of flooding remains a big challenge
- Budget reductions to local government make managing this type of flooding even more challenging.

4.2. Presentation by Susana Ochoa Rodriguez (Imperial College London)

- Susana provided an overview of the work that has been done at Imperial College London (ICL) since the beginning of the RainGain project in September 2011 and described the activities envisaged for the remainder of the project
- Three urban catchments have been adopted as pilot sites and will be used for demonstration of the technologies developed throughout the RainGain project. These are: the Cranbrook catchment (London Borough of Redbridge), the Purley area (London Borough of Croydon) and Torquay town centre (Torbay District Council, Devon). For each of these catchments the relevant data has been collected and processed, monitoring systems have been implemented and the flooding mechanisms and flood risk management objectives have been investigated
- To improve the quality of rainfall estimates and forecasts in support of urban pluvial flood modelling and forecasting the following has been carried out:
    - Techniques for adjusting radar rainfall estimates based on raingauge measurements have been reviewed and tested. It has been possible to significantly improve the accuracy of rainfall estimates while preserving the spatial structure captured by radar. The improved rainfall estimates have been fed into urban drainage models and the results show substantial improvement in the simulated flow depths (as compared to flow depth measurements). In addition, the possibility of calibrating urban drainage models using adjusted rainfall estimates has been explored and promising results have been obtained

so far. Lastly, the possibility of improving radar-based nowcastings (i.e. radar-based short-term rainfall forecasts) by improving the original radar estimates (which are the starting point of the rainfall forecast) has started to be explored

- An X-band radar was installed in London in April 2013. The radar was obtained on loan from radar manufacturer Selex and will be operating in London for 6 months. The smaller wavelengths at which X-band radars operate make them more sensitive (than C-band radars) and able to detect smaller particles (e.g. drizzle, light snow). In addition, because the radar is closer to the ground, it is expected to provide better rainfall estimates for London. The performance of this radar and its relative merits (in comparison with the C-band radars operated by the Met Office) will be assessed throughout the project. A website for displaying real time and historical data collected by the X-band radar is being developed. The link to the website will be circulated to attendees of this meeting.

- To support the modelling of urban pluvial flooding the following activities are underway and will continue to be developed throughout the project: improved calibration of dual-drainage models based on monitoring data and improved rainfall estimates, overall estimation of the uncertainty associated to urban pluvial flood models, analysis and definition of local pluvial flood triggers (which enable more localised flood warnings), and benchmarking of models of different levels of complexity (based upon which recommendations will be made on the suitability of different models for specific applications)
- To support urban pluvial flood forecasting a pilot forecasting system has initially been implemented using the open shell Delft-FEWS system (the same system currently used for fluvial flood forecasting in the UK). This system will be continued to be developed and improved throughout the project
- In addition to the technical work above, to support improved flood risk management the following activities have been carried out with the purpose of improving flood risk management:
  - A workshop pack for engaging community members in local flood risk management was developed by ICL in collaboration with the GLA and LGFF
  - Meetings such as this one will continue to be organised in order to communicate and discuss our progress with the potential end users and ensure that the technologies developed throughout this project meet the needs of the users and are adopted.

4.3. Presentation by Jacqueline Sugier (Met Office): "Upgrading the UK weather radar network"

- Jacqueline introduced the existing radar network of the UK Met Office and explained the upgrade project that is underway which includes upgrading of all radars to dual polarisation. The Met Office radar network includes 15 C-band radars, 2 of which already have dual polarisation capability. Dual polarisation radars transmit and receive signals in both vertical and horizontal polarisation and the small differences between the two signals provide information about the shape of the target and its composition. It is therefore expected that the dual polarisation

capability will allow more accurate radar rainfall products that will improve short-range forecasts, particularly for severe weather

- The new radar systems and software that are being used in the upgrade project have been developed 'in-house' in collaboration with academic and industrial partners from the UK and, therefore, the Met Office has complete control over the signal processing and will be able to optimise radar products.

4.4. Presentation by Timothy Darlington (Met Office): "High resolution radar rainrate products"

- Timothy explained the work that is being done at the Met Office in collaboration with ICL aimed at refining the resolution of radar rainfall estimates for urban applications whilst maintaining and improving quality. The goal is to produce 100 m or better resolution radar products over Central London by 2014
- The methods that are being explored for obtaining finer resolution estimates in azimuth and range include azimuth sharpening and range oversampling. The azimuth sharpening is implemented by weighting values in azimuth in order to recover some of the angular resolution while range oversampling improves resolution in range (called Retro de-convolution method) and for reducing measurement variance (called whitening transformation)
- Development of high-resolution products has already started. Preliminary tests have been conducted and a formal trial will start in May 2013 at Wardon Hill radar site. The evaluation of the performance of the different techniques will include comparison against raingauges

5. Breakout Session

A key aim of this year's NOG meeting was to bring together rainfall experts, urban drainage modelling experts and flood risk managers to discuss the way forward for the implementation of surface water flood forecasting and warning systems in the UK and for enhancing the resilience of local communities to surface water flooding. To guide this discussion, a set of 6 questions was prepared. The audience was split into 4 groups, each comprising rainfall experts, urban flood modellers and flood risk managers. Each group was asked to answer a set of questions prepared in advance by project partners. The discussion at each group was led by a UK RainGain partner. After the group discussion, the chair of each breakout group presented a summary of the main conclusions reached by each group to the audience. **The summary of these conclusions is provided in a separate file**.

6. Closing

Closing by Laurie Thraves

Laurie concluded by thanking attendees for their participation and by thanking the Greater London Authority for letting us use their premises for this event. Laurie also provided details on how to get involved in the project. Please contact Laurie Thraves on 020 7445 2845 and laurie.thraves@lgiu.org.uk or Susana Ochoa-Rodriguez on s.ochoa-rodriguez@imperial.ac.uk.