Temporal interpolation of radar rainfall images

Performance assessment across spatial scales

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Investing in Opportunities

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INTERREG IVB

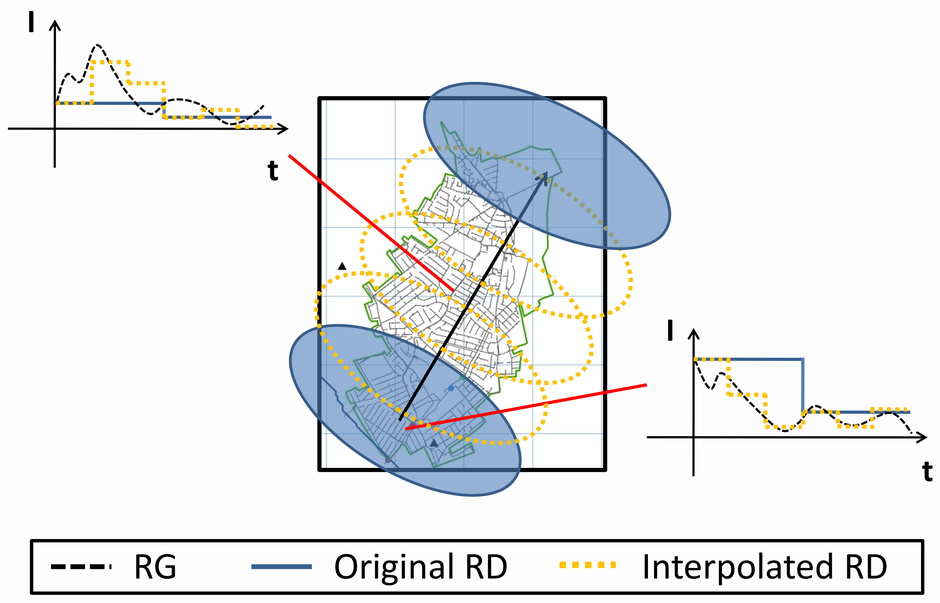
INTRODUCTION

An advection-based temporal interpolation method, based upon the multi-scale variational optical flow technique, is proposed to generate high temporal-resolution radar QPEs **[1]**. The proposed method was used to generate radar QPEs at 1-min temporal resolutions from UK Met Office C-band radar QPEs originally at 5-min temporal resolution and varying spatial resolutions of 1 km, 500 m and 100 m. The performance of the temporally-interpolated radar QPEs, across a range of spatial resolutions, was assessed through comparison against local rain gauge records and through hydrological verification using as case study 3 storm events observed in a small urban catchment (~865 ha) in London for which dense rain gauge and sewer flow records, as well as a recently-calibrated high-resolution urban drainage model were available.

METHODOLOGY

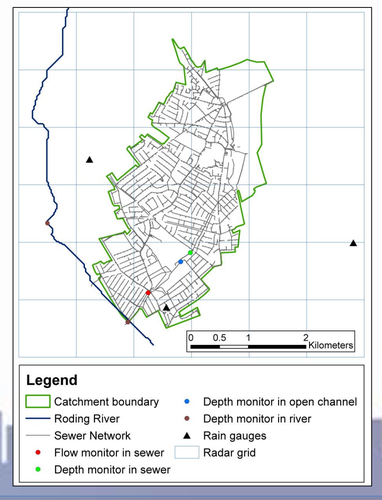
1. Estimate storm velocity from two successive radar images using a multi-scale variation optical flow technique **[2]**, and assume the velocity remains invariant within short time period.

2. Interpolate intermediate images using bi-directional velocities **[3]** and occlusion reasoning algorithm.



PILOT LOCATION

- Cranbrook, NE London, UK
- Drainage area: ~8.5 km^2 (52 % impervious)
- InfoWorks ICM semi-distributed sewer model
- 5 sensors monitoring the water levels and/or flow records (1-2 min resolution)



RAINFALL DATA SETS

- Rain gauge network: 1 min data from 3-4 gauging site;
- Radar data: Composite rain rate from UKMO C-band radars at 5-min temporal resolution and at 1 km, 500 m (Long Pulse) and 100 m (Short Pulse) spatial resolutions.

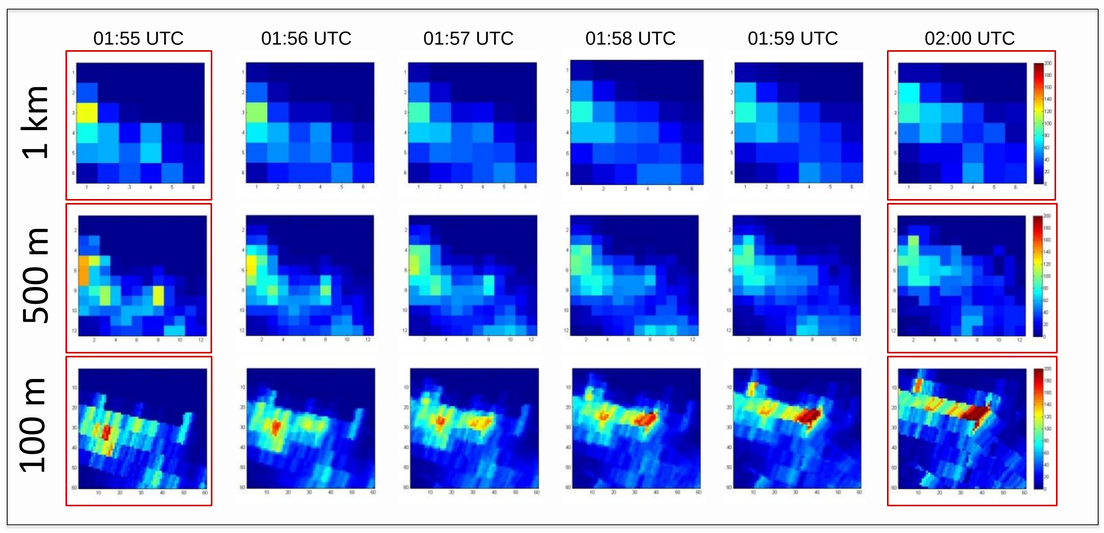


FIG 1: Snapshots of the original (images with red outlines) and the interpolated RD estimates at peak intensity period (01:55 - 02:00) for the event on 19th Sep 2014.

RESULTS & DISCUSSION

- Variation in spatial details is found to be more significant in the interpolated 100-m radar images than others (see **FIG 1**).
- Temporally-interpolated RD estimates, at all analysing spatial scales, can better replicate the dynamics shown in local rain gauge profile (see **FIG 2**) and generally result in improved hydraulic outputs, which is particularly evident in capturing the timing for peak flow depths (see **FIG 3**).

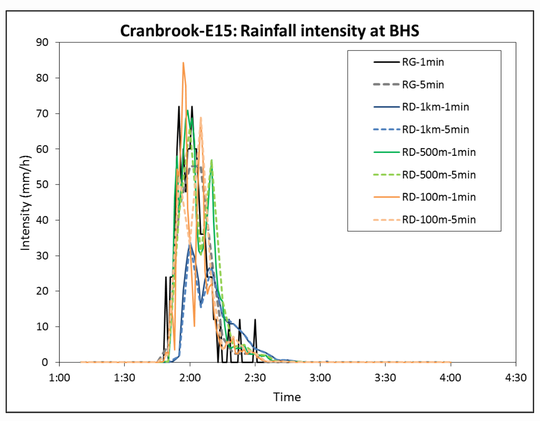


FIG 2: Comparisons of RG and RD estimates (at different spatial and temporal resolutions) at the Beal High School gauging site.

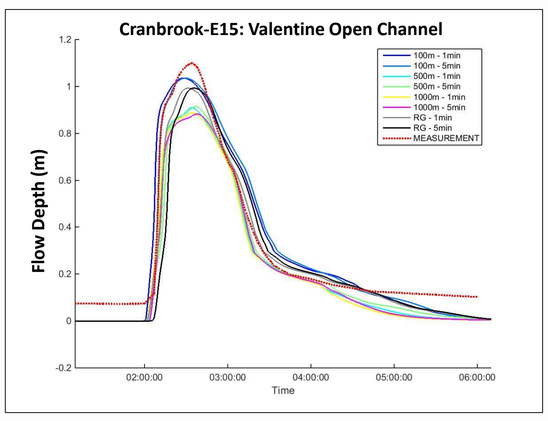


FIG 3: Comparisons of the observed and the simulated flow depth hydrographs at Valentine Open Channel gauging site for the event on 19th Sep 2014.

CONCLUDING REMARKS

1. The proposed temporal interpolation technique can effectively improve the applicability of the radar rainfall estimates (at different spatial scales) to urban hydrology, through producing the intermediate rainfield estimates.

2. The impact of temporal interpolation is found to increase as higher spatial-resolution radar data are used.

[1] Wang, L.-P., et al., 2015. Enhancement of radar rainfall estimates for urban hydrology through optical flow temporal interpolation and Bayesian gauge-based adjustment, Journal of Hydrology. In press.

[2] Brox, T., et al., 2004. High Accuracy Optical Flow Estimation Based on a Theory for Warping, in: Pajdla, T., Matas, J. (Eds.), Computer Vision - ECCV 2004 SE - 3, Springer Berlin Heidelberg, pp. 25–36.

[3] Thorndahl, S., et al., 2014. Bias adjustment and advection interpolation of long-term high resolution radar rainfall series. Journal of Hydrology. 508, 214–226.