Imperial College London

MULTI-SCALE RADAR DATA ANALYSIS

Optimisation of Urban Rainfall Estimates

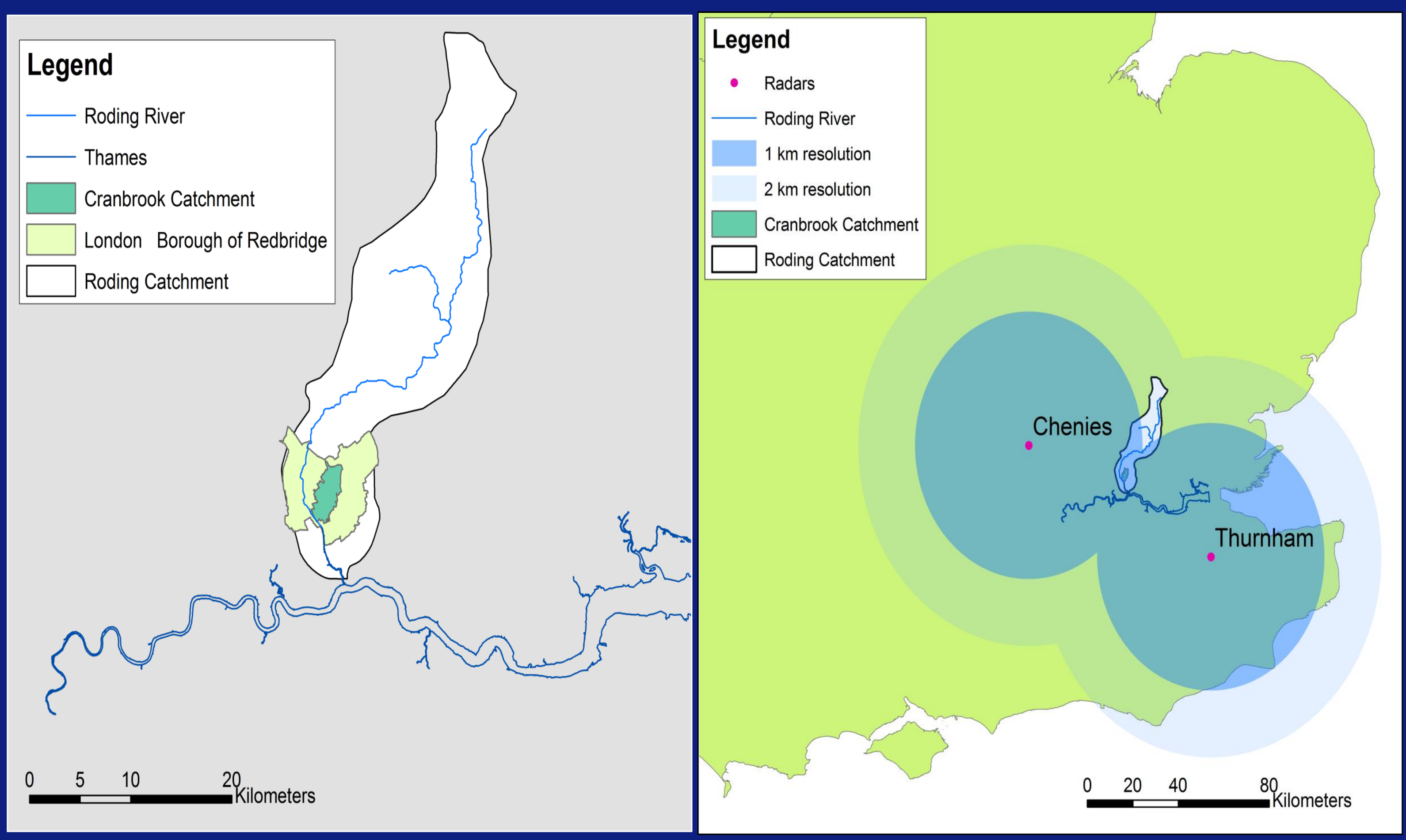
Zigang Bill Guo Supervised by Dr. Christian Onof, Dr. Lipen Wang

Department of Civil and Environmental Engineering, South Kensington Campus, Imperial College London

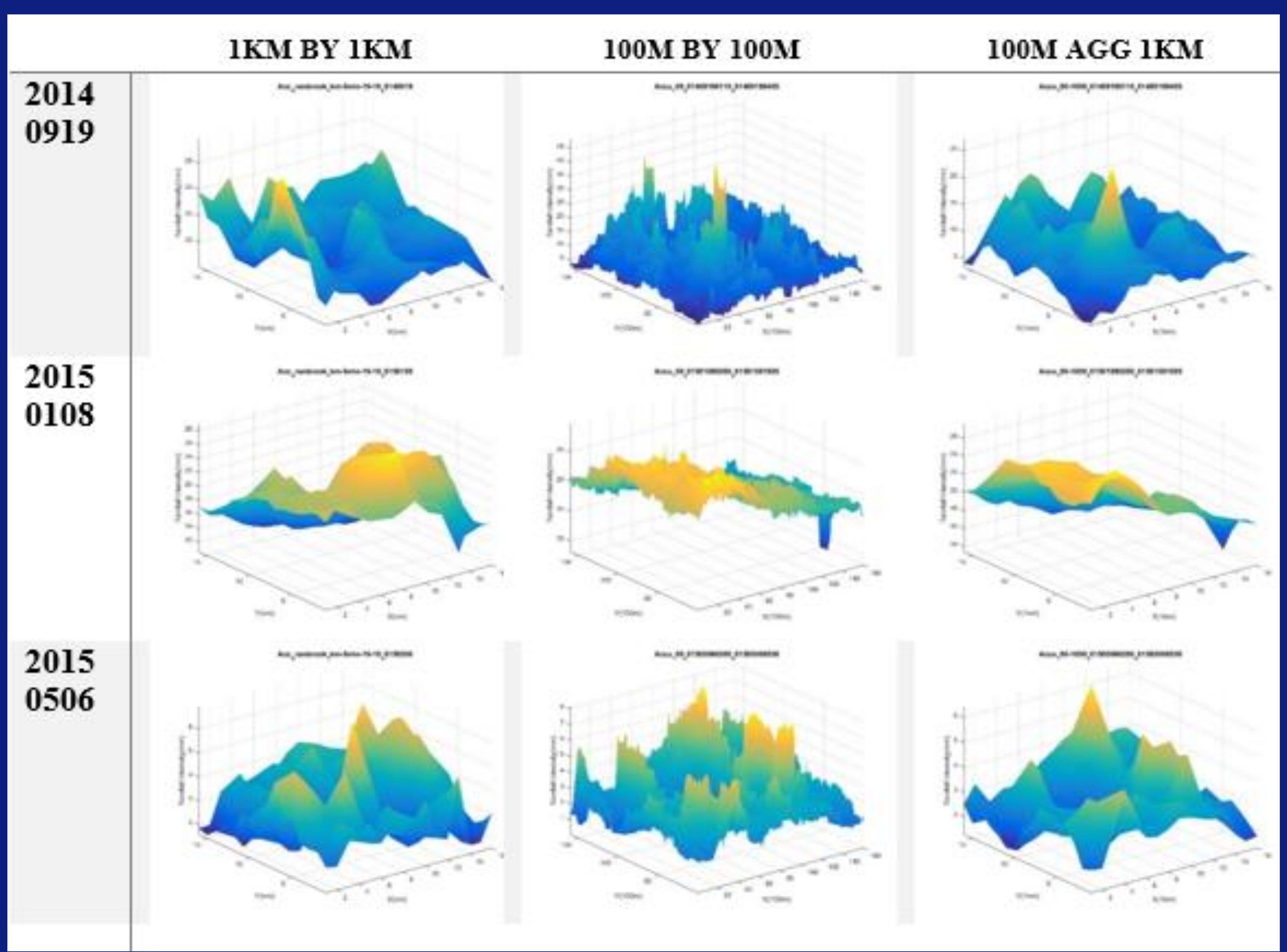
INTRODUCTION

Pluvial flooding has been the main cause of significant damaging events in urban areas in Europe and the UK. Modelling and forecasting detailed and realistic rainfall with high accuracy are the key to mitigate this type of flooding. The use of radar rainfall estimates for this has recently draw great attention due to their realistic description of spatial and temporal characteristics of rainfall. However, the currently available radar rainfall estimates are still of insufficient accuracy and resolution. The application of geo-statistical concepts called multifractal variogram model has been proven useful in this project in improving the deficiencies of radar data by multi-scale extrapolation techniques.

CRANBROOK CATCHMENT AND RADAR COVERAGE



The Cranbrook catchment (on the left) is a predominantly urban region within the London Borough of Redbridge, of residential and commercial character over an area of 8.65 km^2. It is covered by two radar products provided by UK Met Office (on the right) with 1km and 100m resolution respectively.

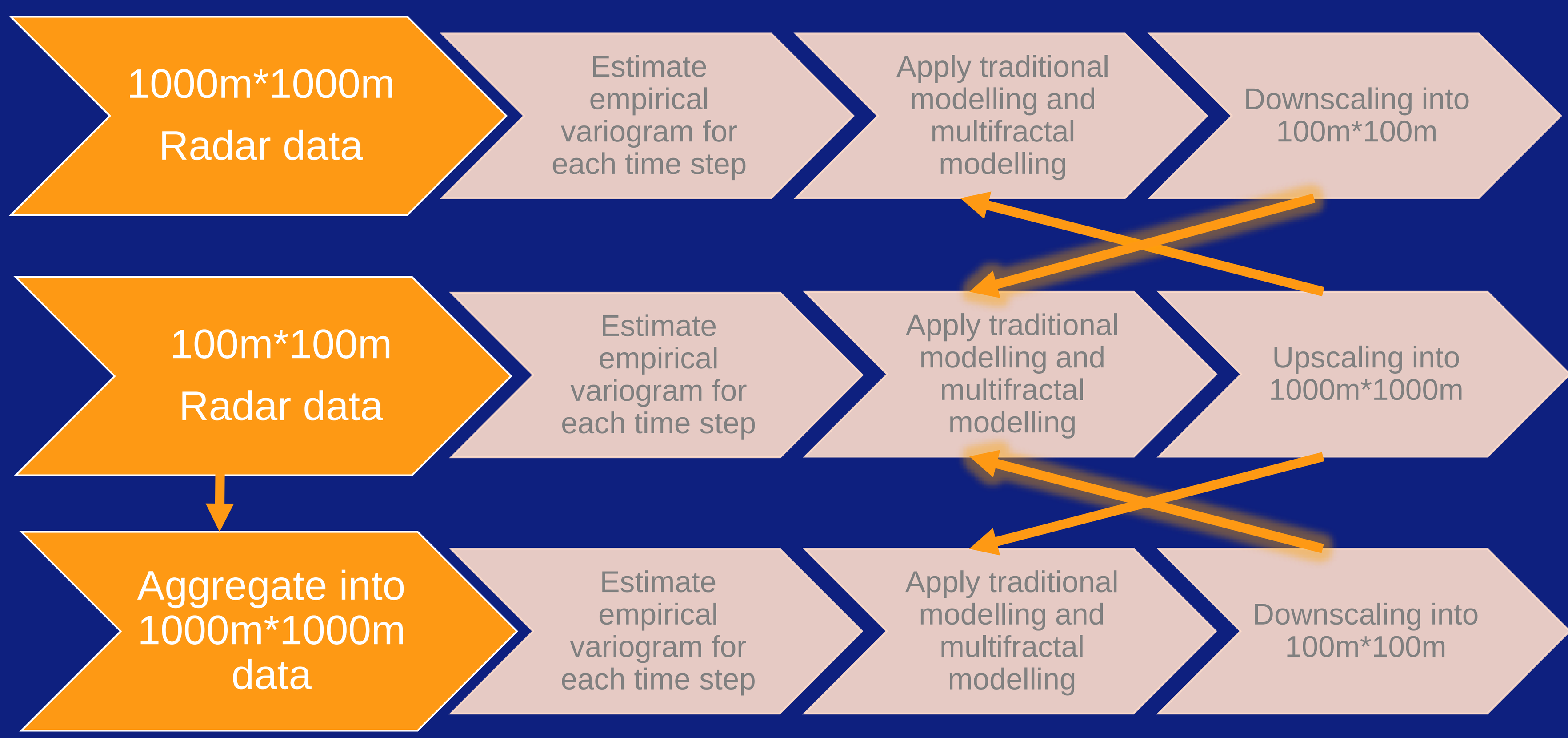


The figures above show the accumulated rainfall intensity of the three rainfall events that are recorded by the two radar products within Cranbrook catchment. These three rainfall events happened on 19th Sep. 2014, 8th Jan. 2015 and 6th May 2015 respectively.

ACKNOWLEDGEMENTS

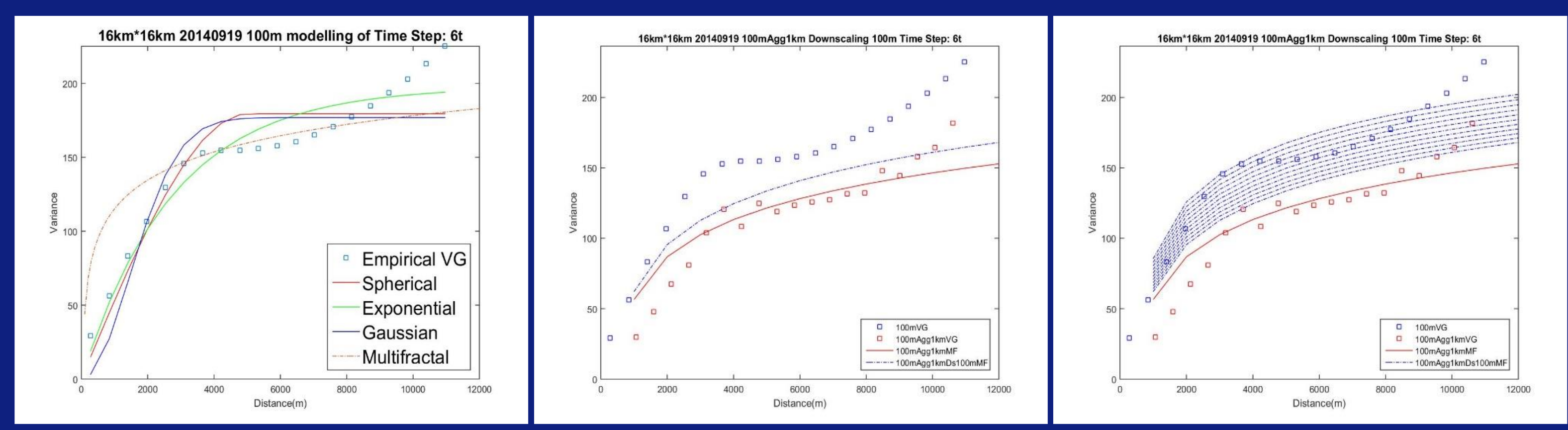
I would like to express my sincere gratitude to my academic supervisors, Dr. Onof and Dr. Wang, for time and effort they have dedicated to my work and for continually being a tremendous support.

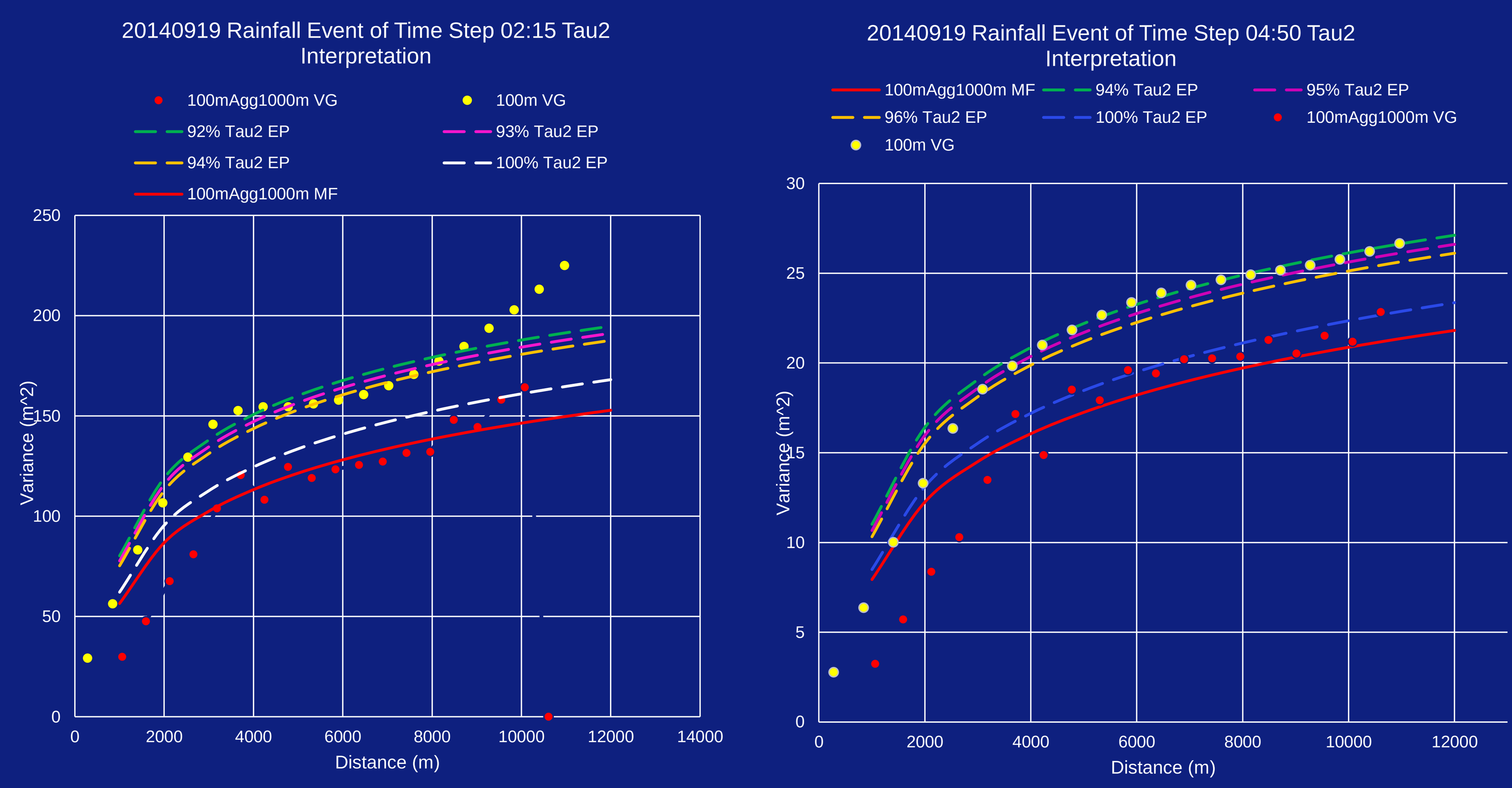
METHODOLOGY



100m and 1000m (both raw and aggregated) radar data are processed through both traditional and multifractal variogram modelling, and extrapolated through upscaling or downscaling for comparisons. The key is to compare the downscaled data with the raw 100m radar data (glowing arrow) in order to investigate the reliability of the downscaling technique.

RESULTS





- Both traditional and multifractal variogram models provide good fits to the empirical variograms.
- Some examples show deficiencies of the downscaling techniques in fitting the original 100m resolution data.
- Errors are mainly cause by the radar indirect detection process and estimation error of second order mass exponent $\tau(2)$
- The reliability of the extrapolation technique can be controlled within 5% standard deviation of $\tau(2)$

CONCLUSION

The project firstly used geo-statistical tool (i.e. variogram) to provide a 2nd order approximation of the spatial structure of rainfall at a given scale. Then by integrating with the theory of multifractals, the multifractal variogram model can be derived. This model enables the extrapolation of multi-scale spatial structures of rainfall data. In terms of perspective of this study, the developed downscaling technique can be further applied in order to achieve multi-scale data merging technique, which enables further optimised rainfall estimates.