Data Assimilation for REsilient City (DARE): urban flooding

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Motivation

Urban and rural flooding can result from intense rainfall, flash floods, coastal floods or river floods. However, in cities, unlike in rural areas, there is very little open soil available for water storage and most floodwater is transported to surface water or the sewage system. Also, since most large cities are situated near water bodies, floods due to climate changes are more likely to occur in a near future.

Today, 54% of the world's population lives in urban areas, a proportion that is expected to increase to 66% by 2050 [1]. Thus, early and accurate urban flood forecasts are very important to minimise social and financial damage as well as potential loss of life.

What is data assimilation?

Data assimilation (DA) is an emerging mathematical technique for improving predictions from large and complex forecasting models by combining uncertain model predictions with a diverse set of observational data in a dynamic feedback loop.
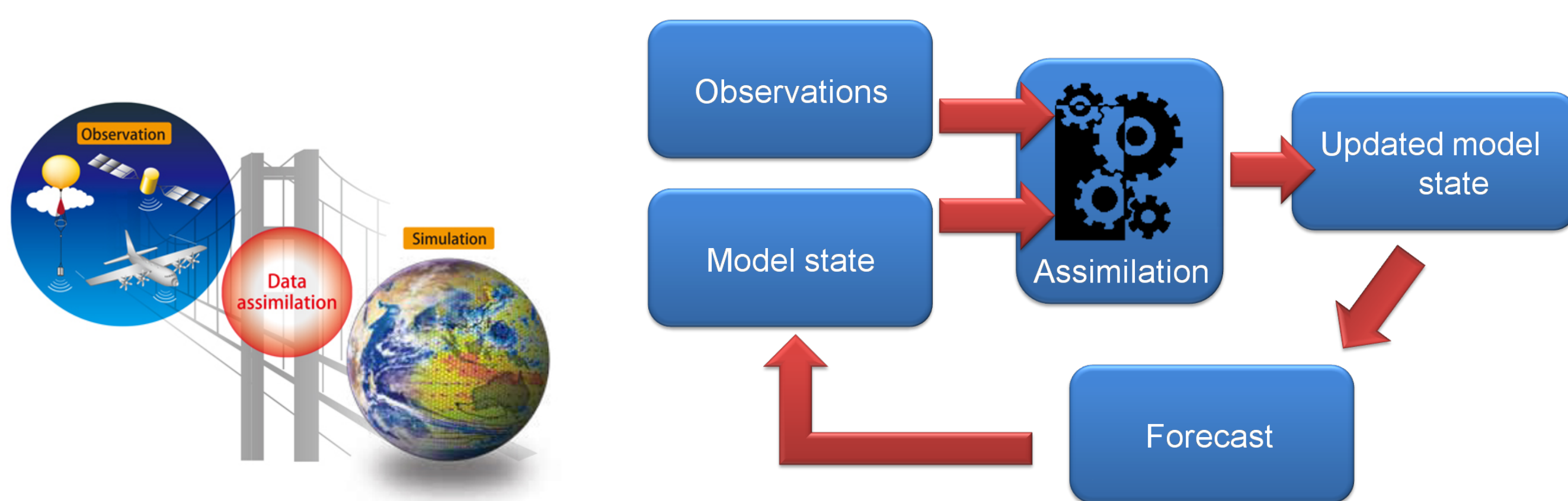

Figure 1: Data assimilation concept.

There are many DA methods, each with its benefits and applications; in this project we will be using ensemble data assimilation (EnDA) methods since these stochastic methods produce both the 'best analysis' of the forecast along with a confidence of the forecast. Additionally, EnDA methods are easy to implement.

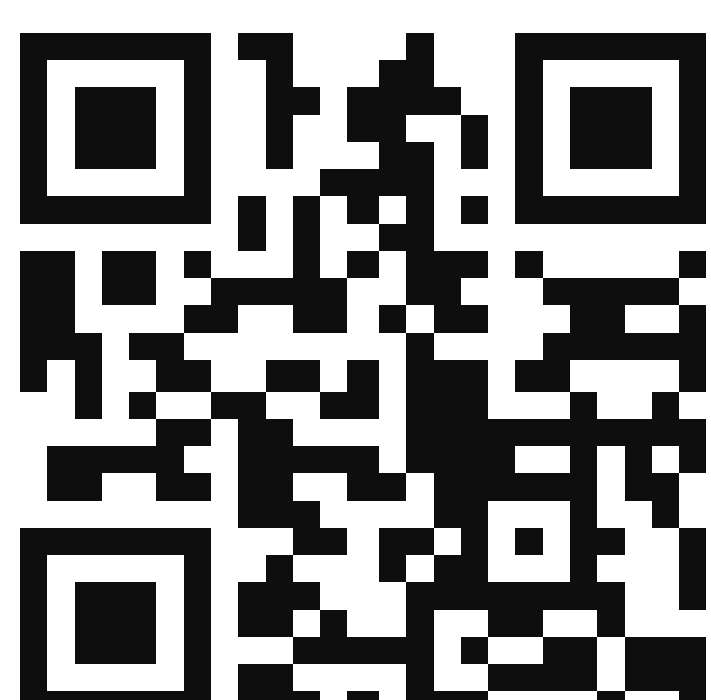## Cities considered in the project

Our project relies on having enough observations in cities, thus we choose to work with cities where we think there would be good cover of observations available, e.g. from CCTV cameras.
Cities we are currently working with are: London, Bristol, Exeter, Glasgow, Leeds and Tewkesbury.

Acknowledgements

Contact Information

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Project aims

The aim of the project is to produce a step-change in the forecast skill for urban flood forecasting through:
  ► advancement in data assimilation techniques applied to urban flooding prediction;
  ► use of novel observations such CCTV and SAR satellite images of floods in cities.

Project partners

Use of novel observations

We will use a variety of observations available such as water height from river gauge data but we will also make use of abundance of 'city smart' data such as images of CCTV cameras in cities. This information would allow us to assimilate water height in rivers as well as flooded roads.
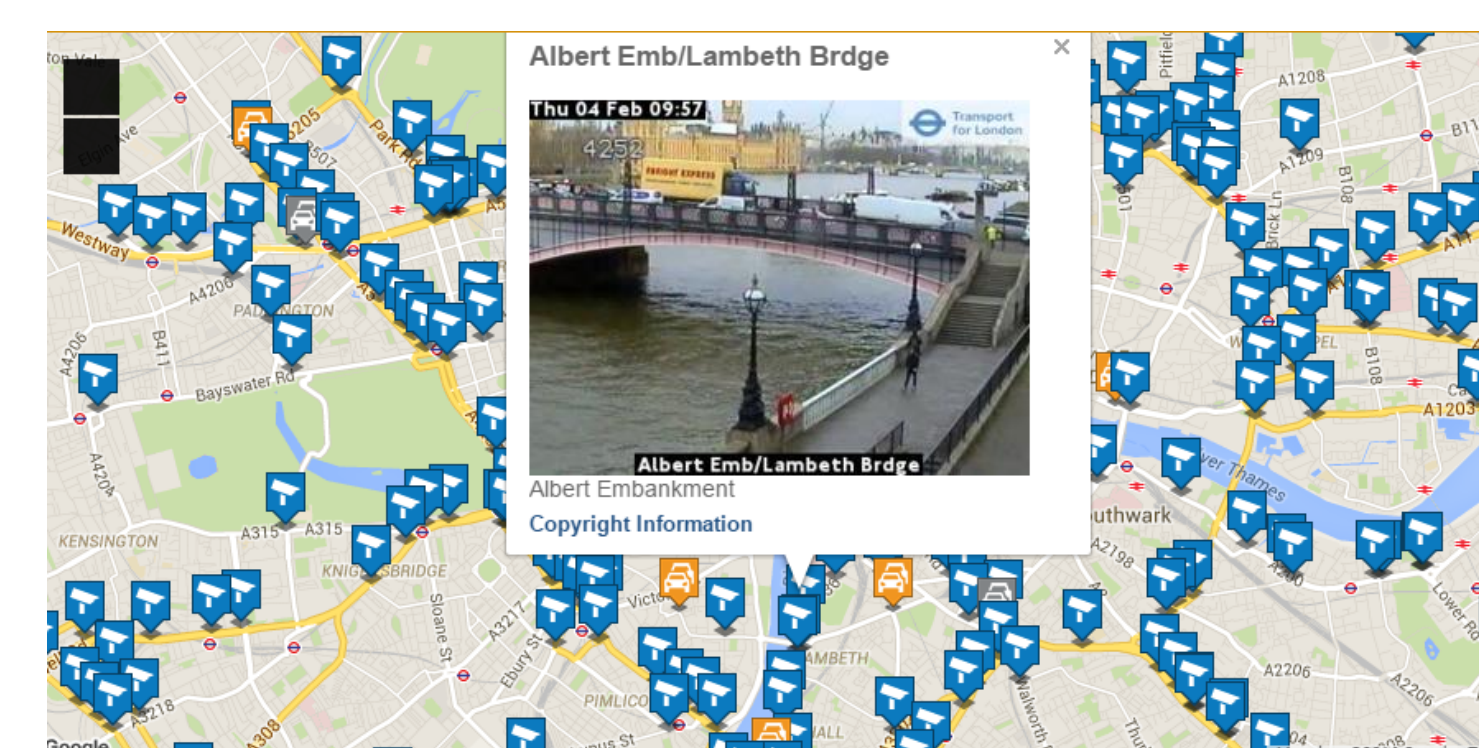

Figure 2: In the project we will assimilate new opportunity data sets from urban areas such as London traffic CCTV camera images of floods (a subset of Transport For London cameras).

Part of the project also will look into developing an algorithm to extract water extent from SAR images for cities and once completed such satellite observations (where available) will also be used in the data assimilation system.
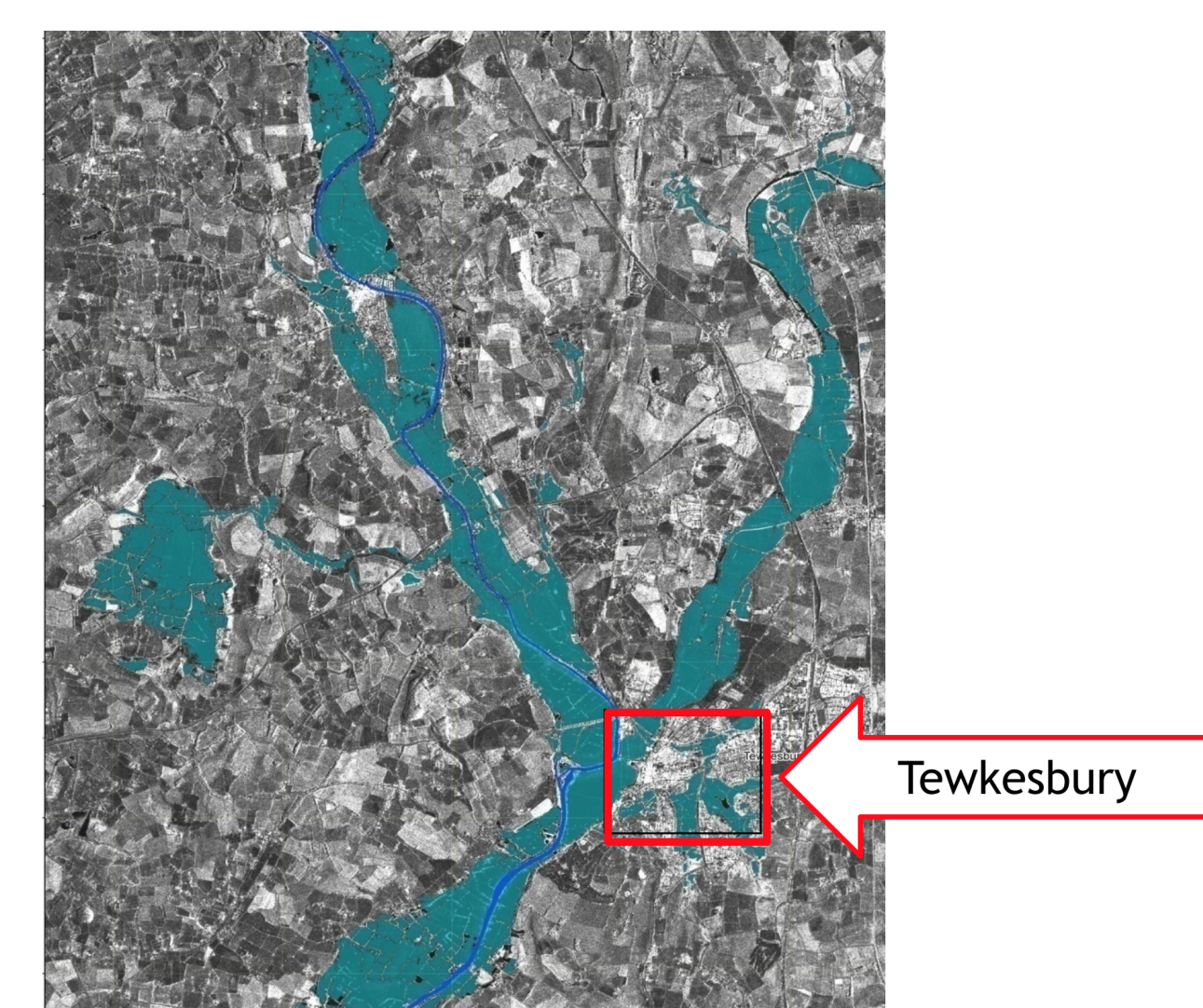

Figure 3: TerraSAR-X image of the lower Severn July 2007 flood, with derived flood extent (blue) overlain (DLR 2007).

References

[1] 2014 revision of world urbanization prospects. http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html. Accessed: 2017-04-24.

[2] J. Garcia-Pintado, D. Mason, S.L. Dance, H. Cloke, J.C. Neal, J. Freer, and P.D. Bates. Satellite-supported flood forecasting in river networks: a real case study. *Journal of Hydrology*, 523:706 − 724, 2015.