Constrain the flux: Robust groundwater models to assess groundwater flooding

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1. Introduction - Research gap

The estimation of groundwater fluxes in urban areas is inherently complex, due to the concentration of human activities. The difficulty in urban groundwater modelling is further reinforced by the scarcity of appropriate urban groundwater data – a gap that could be filled through remote sensing. Remotely sensed data in groundwater modelling have mainly been used in large, rural and ungauged areas to overcome the difficulties of the lack of field observations. However, the possibility of using remotely sensed data to constrain groundwater fluxes has not been fully explored. Recent advances in modelling techniques (i.e., FloPy: a Python-based framework for creating, running and post-processing MODFLOW-based models) allow for more versatility in applying groundwater modelling. Modelling the interactions between groundwater and surface water in urban areas is key to understanding the risks that groundwater flooding poses to flood resilience.

2. Aims

- Provide a framework for assimilating remotely sensed data into groundwater modelling
- Assess the model's performance to simulate groundwater dynamics that represent regions of groundwater flooding

3. Objectives

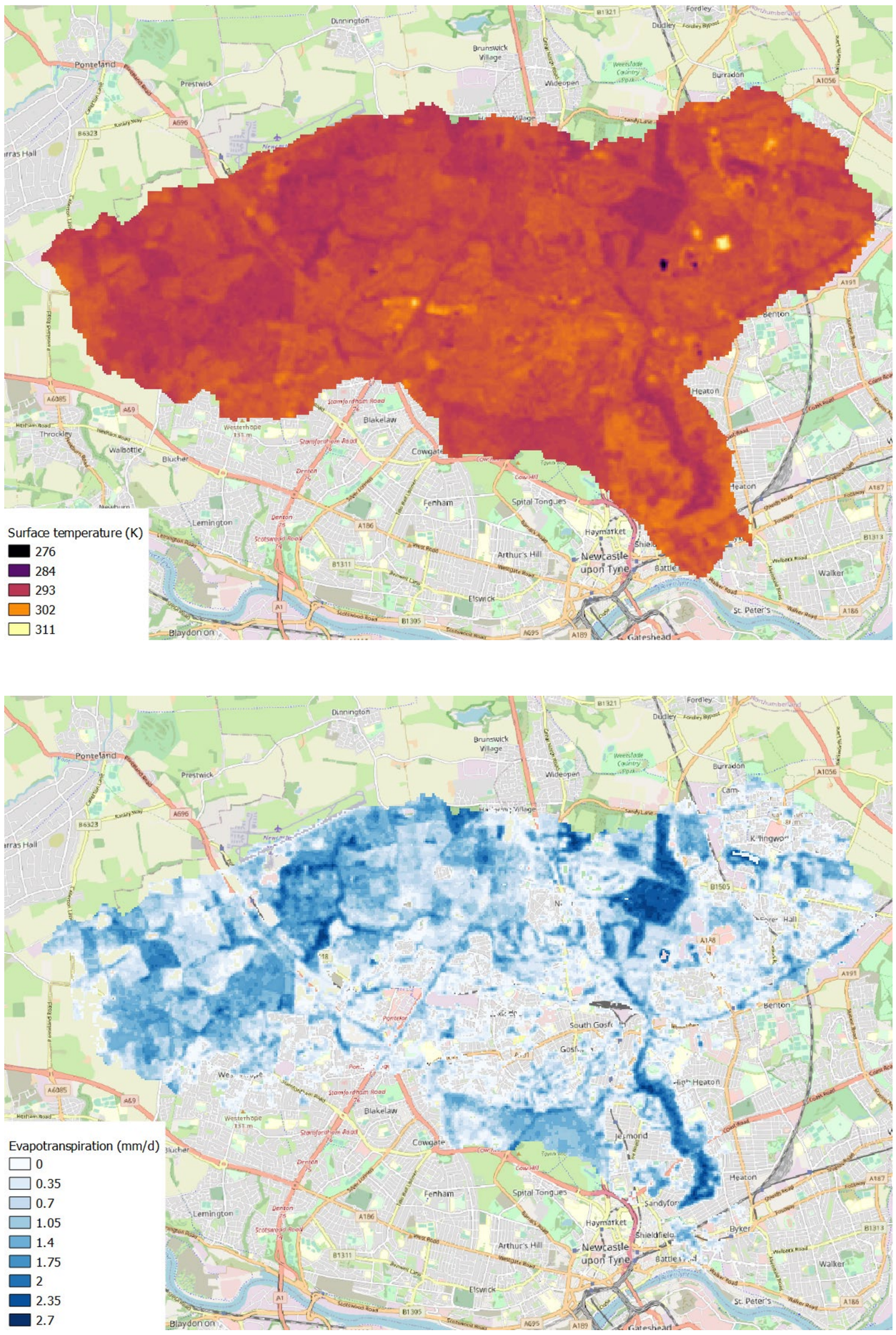
- Develop a framework for assimilating remotely sensed data into MODFLOW. Use the information provided by the remotely sensed data to constrain model parameters.
- Utilise the flexibility of the Python environment to perform advanced calibration and validation techniques
- Estimate the uncertainty in model performance by using the flexibility of the Python environment and the information from remote sensing

4. Methodology

- Use the flexibility of FloPy to develop a framework for assimilating remotely sensed data into an urban groundwater model and the freedom of the Python environment to perform advance calibration and validation techniques and sensitivity analysis.
- Use Machine Learning to test the information content within the variables (e.g. ET, vegetation health, temperature, etc.) and identify variables that can be constrained using remotely sensed data.
- Produce ensembles of model formulations and use performance metrics to evaluate model performance.

5. Outcomes

- Identify urban areas and infrastructure prone to groundwater flooding
- Develop a tool to better inform water management decisions in terms of groundwater flooding protection – Application by Newcastle City Council



Surface temperature (top) and actual evapotranspiration (bottom) at the Ouseburn watershed on 11/09/2002

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