



**DAFNI: a computational platform to support infrastructure systems research.**

*Dr Brian Matthews*

*DAFNI Project Lead, Scientific Computing Department,  
Science and Technology Facilities Council*

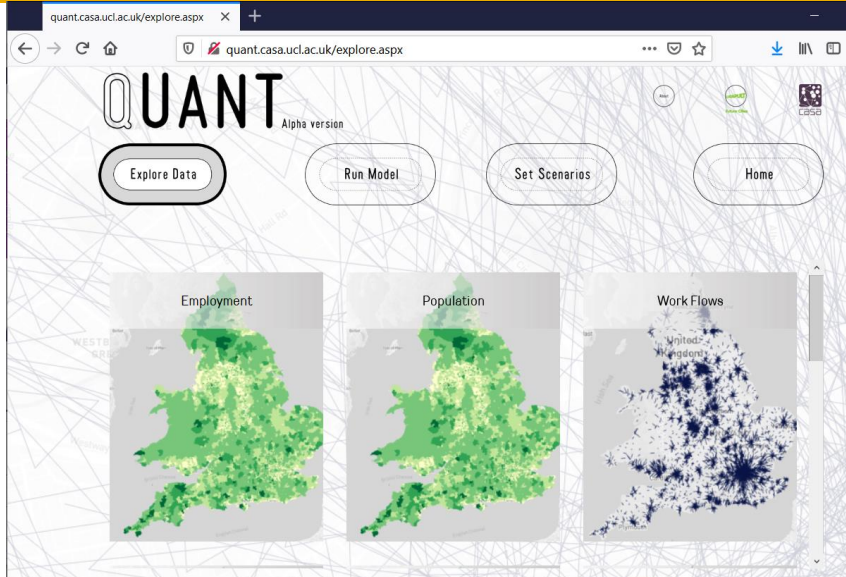


[www.dafni.ac.uk](http://www.dafni.ac.uk)

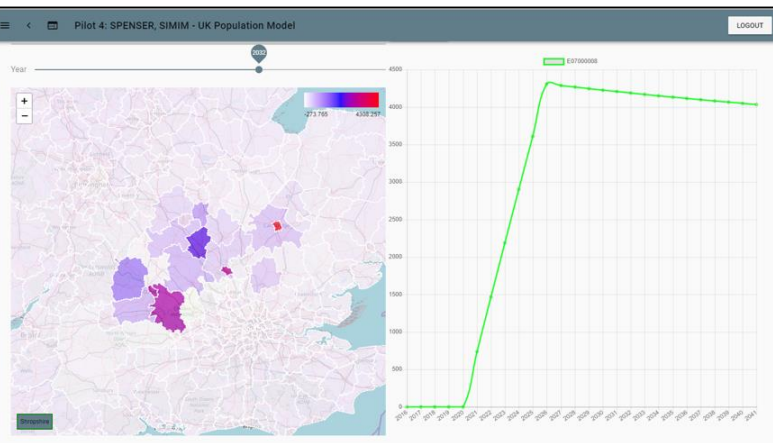
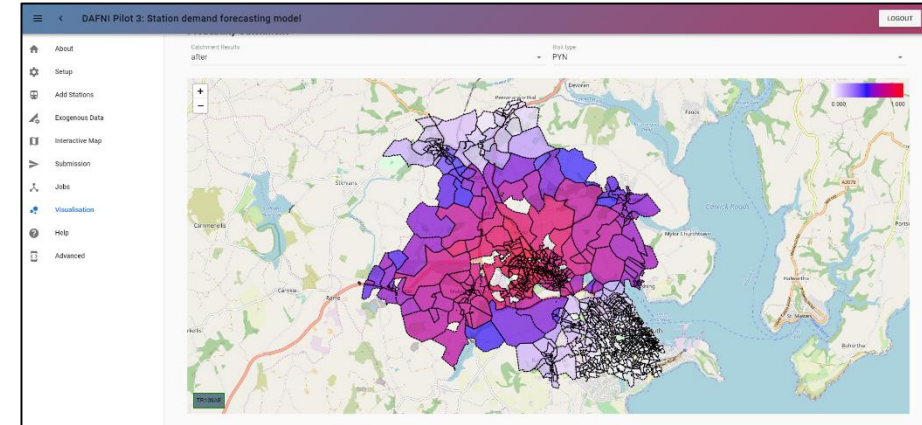


# Why DAFNI?





## Station demand model, University of Southampton

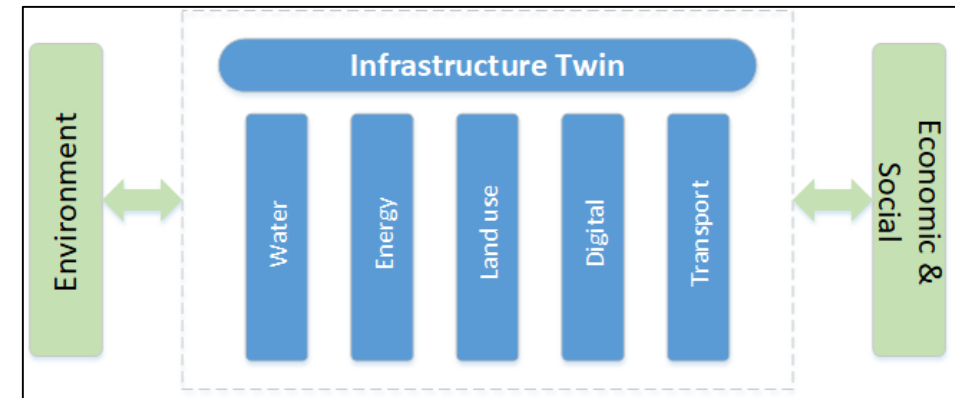


## SIMIM, University of Leeds

- Scaling up
  - More data, Higher resolution
  - Performant computing hard to access
- Integration between models
  - Across scales
  - Across sectors
- Data integration and exchange.
  - Share data between infrastructure models
  - Security respected
  - Common standards for interchange and interoperation



*Integration across scales*



*Integration across sectors*

**Infrastructure Systems Research is Multi-disciplinary by its very nature**



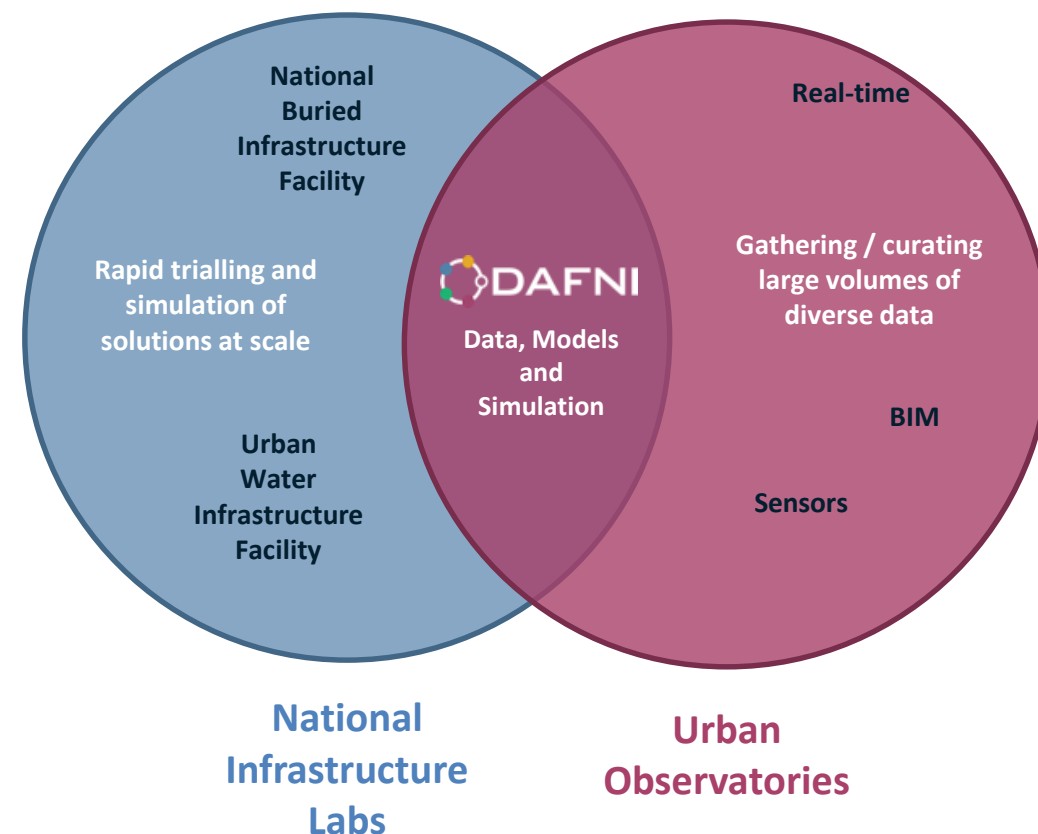
- **A Place for sharing and combining data and models**
  - A hybrid high-performance computing platform
  - A secure repository for national infrastructure data and models
- **A Place to support collaborations and deploy applications**
  - A collaborative platform to research multi-system models of infrastructure
- **A Place as a legacy**
  - A place to make data and models available for the long-term

## Data and Analytics Facilities for National Infrastructure

Providing a computing platform for research into decision making for national infrastructure

£8M investment 2017-2021 under the UK Collaboratorium for Research on Infrastructure and Cities

Towards Partnerships between Academia, Government, Industry





**Prof. Jim Hall**  
Uni. of Oxford



**Prof. Stephen Hallett**  
Cranfield Uni.



**Dr. Theo Tryfonas**  
Uni. of Bristol.



**Prof. Nigel Cassidy**  
Uni. of Birmingham



**Dr. Aruna Sivakumar**  
Imperial College



**Prof. Daniel Coca**  
Uni. of Sheffield



**Dr. Peter Oliver**  
STFC



**Dr. Nik Lomax**  
Uni. of Leeds



**Prof. Liz Varga**  
UCL



**Prof. Julien Harou**  
Uni. of Manchester



**Dr. Simon Blainey**  
Uni. of Southampton



**Dr. Luke Smith**  
Uni. of Newcastle



**Prof. Mike Batty**  
UCL



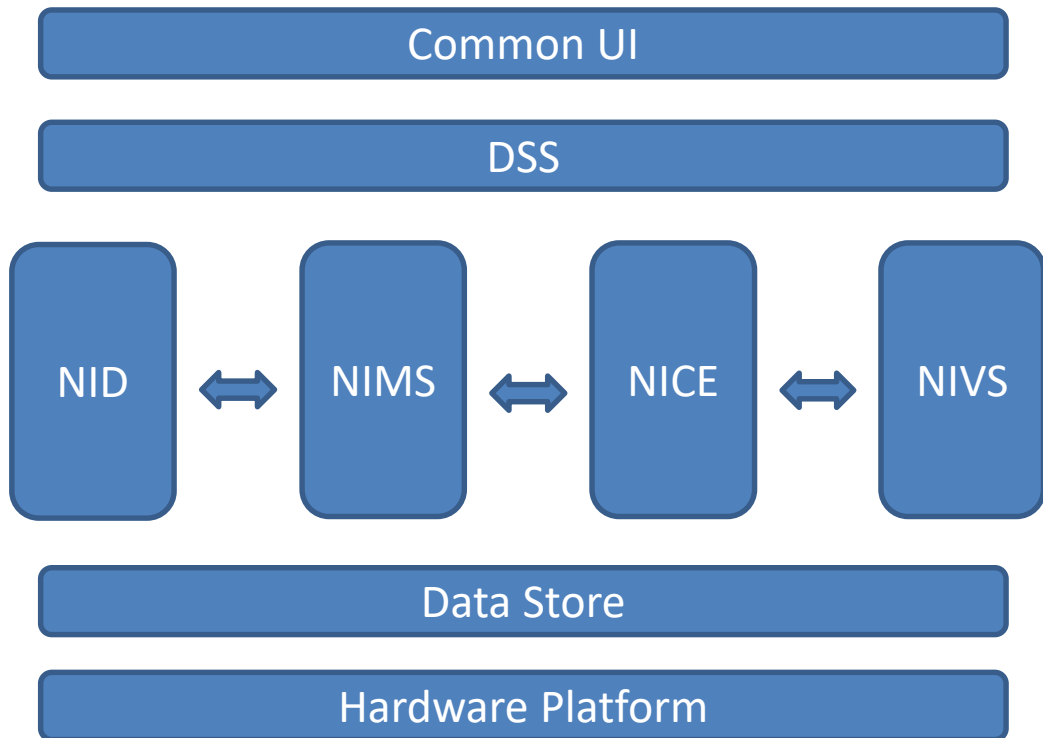
**Dr. Ruchi Choudhary**  
Uni. of Cambridge

**A Partnership of 12 universities and + STFC as development and hosting partner**



# The DAFNI Platform





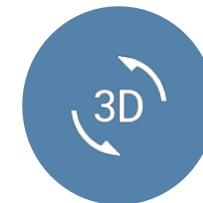
**National Infrastructure Database (NID)**



**National Infrastructure Modelling Service (NIMS)**



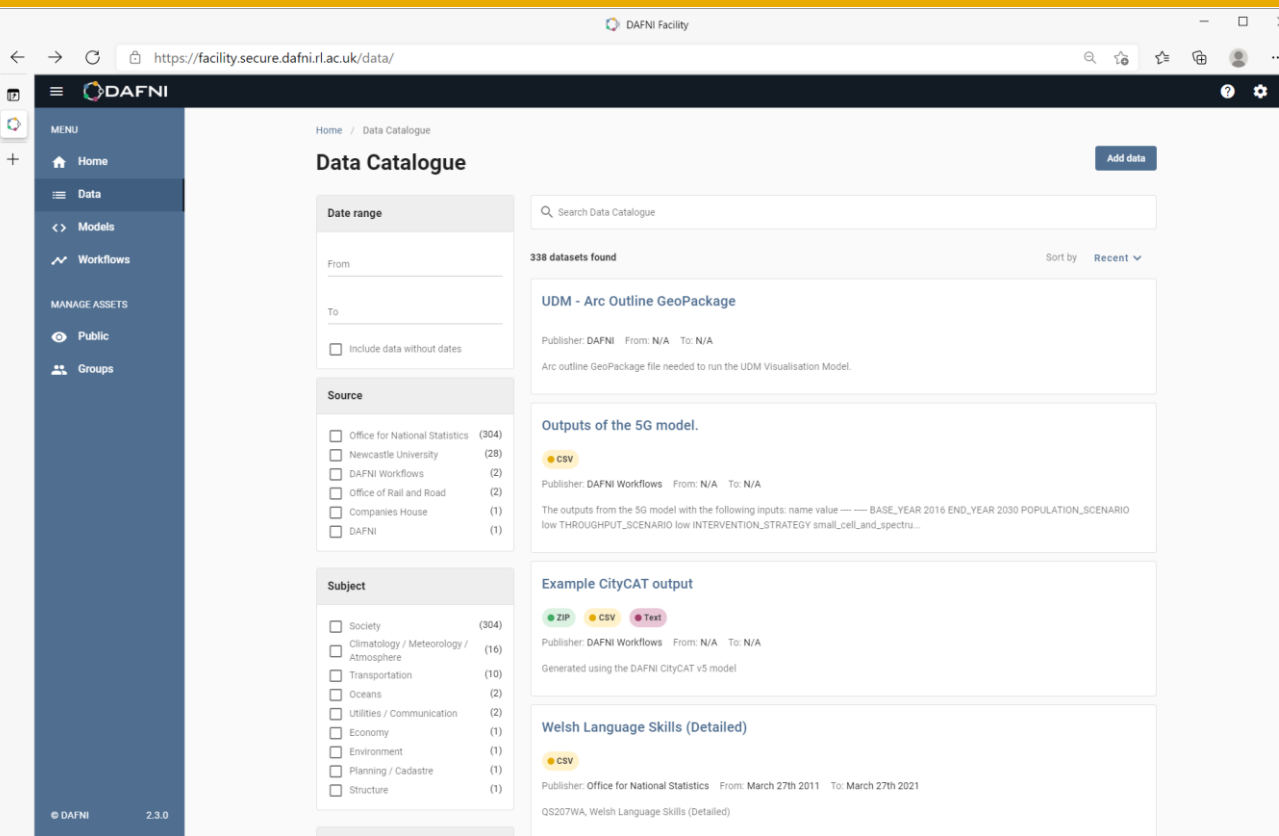
**National Infrastructure Cloud Environment (NICE)**



**National Infrastructure Visualisation Suite (NIVS)**



**DAFNI Security Service (DSS)**



Home / Data Catalogue

## Data Catalogue

Search Data Catalogue

338 datasets found

Sort by Recent

**UDM - Arc Outline GeoPackage**

Publisher: DAFNI From: N/A To: N/A

Arc outline GeoPackage file needed to run the UDM Visualisation Model.

**Outputs of the 5G model.**

CSV

Publisher: DAFNI Workflows From: N/A To: N/A

The outputs from the 5G model with the following inputs: name value --- BASE\_YEAR 2016 END\_YEAR 2030 POPULATION\_SCENARIO low THROUGHPUT\_SCENARIO low INTERVENTION\_STRATEGY small\_cell\_and\_spectru...

**Example CityCAT output**

ZIP CSV Text

Publisher: DAFNI Workflows From: N/A To: N/A

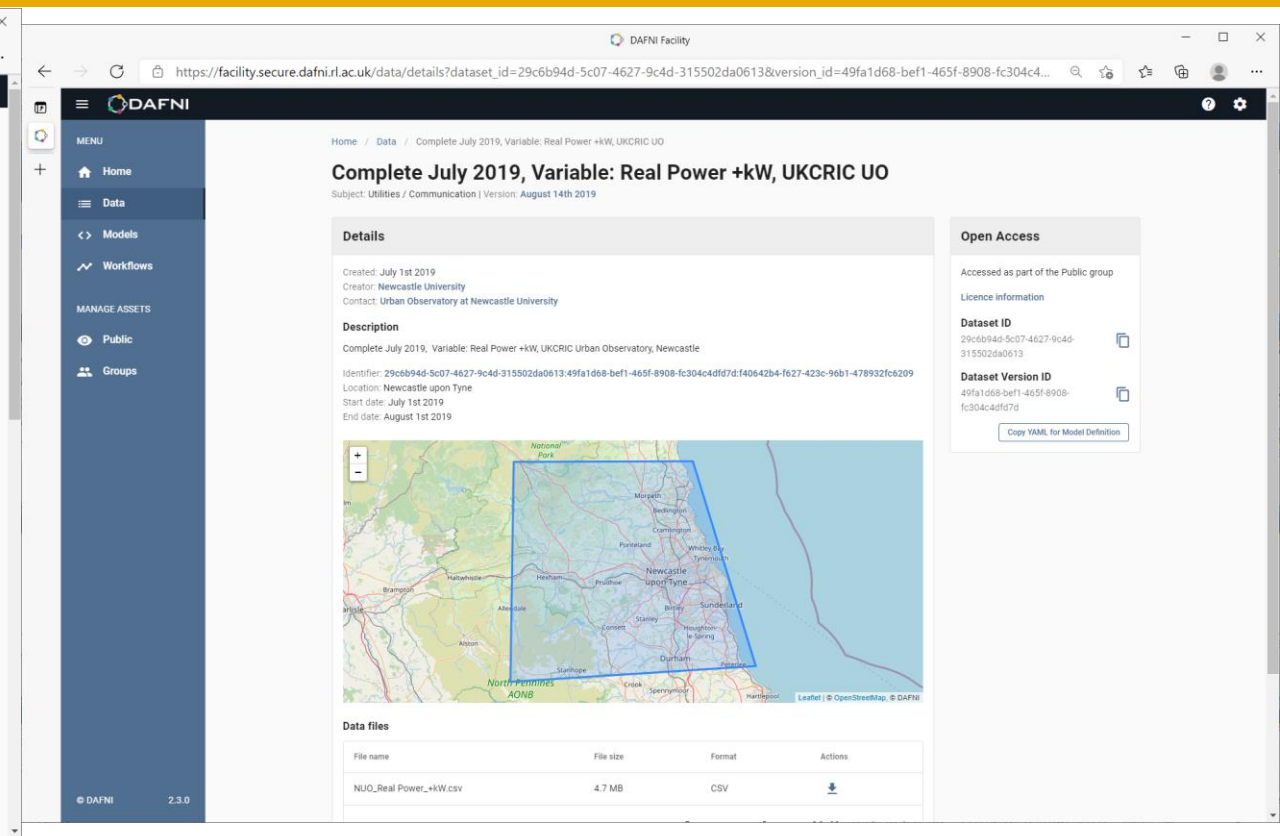
Generated using the DAFNI CityCAT v5 model

**Welsh Language Skills (Detailed)**

CSV

Publisher: Office for National Statistics From: March 27th 2011 To: March 27th 2021

QS207WA, Welsh Language Skills (Detailed)



Home / Data / Complete July 2019, Variable: Real Power +kW, UKCRIC UO

## Complete July 2019, Variable: Real Power +kW, UKCRIC UO

Subject: Utilities / Communication | Version: August 14th 2019

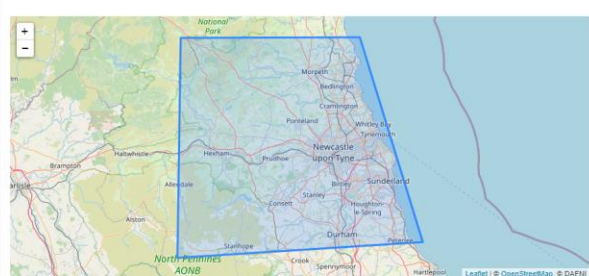
**Details**

Created: July 1st 2019  
 Creator: Newcastle University  
 Contact: Urban Observatory at Newcastle University

**Description**

Complete July 2019, Variable: Real Power +kW, UKCRIC Urban Observatory, Newcastle

Identifier: 29c6b94d-5c07-4627-9c4d-315502da0613:49fa1d68-bef1-465f-8908-fc304c4df67d:4f0842b4-f627-423c-96b1-478932fc6209  
 Location: Newcastle upon Tyne  
 Start date: July 1st 2019  
 End date: August 1st 2019



**Open Access**

Accessed as part of the Public group


License information

**Dataset ID**  
 29c6b94d-5c07-4627-9c4d-315502da0613

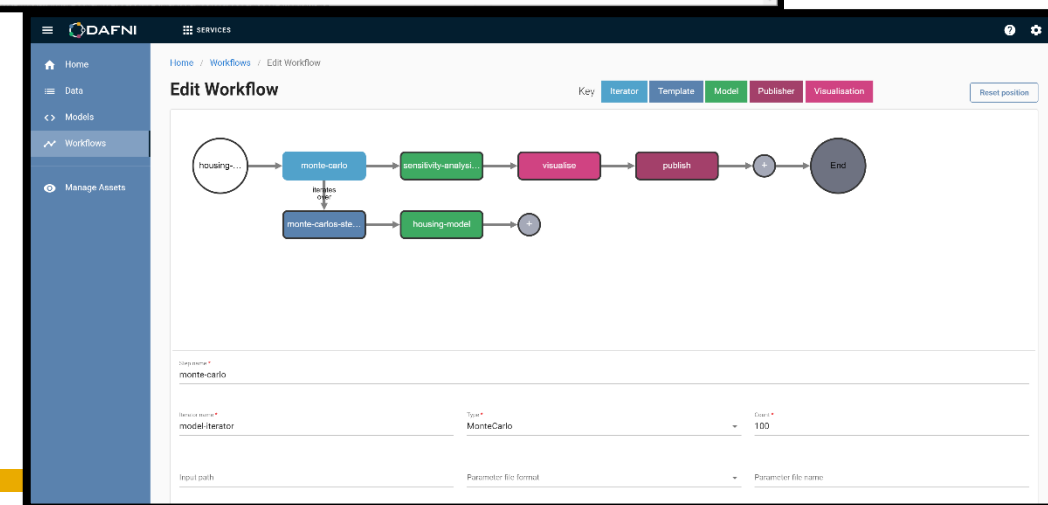
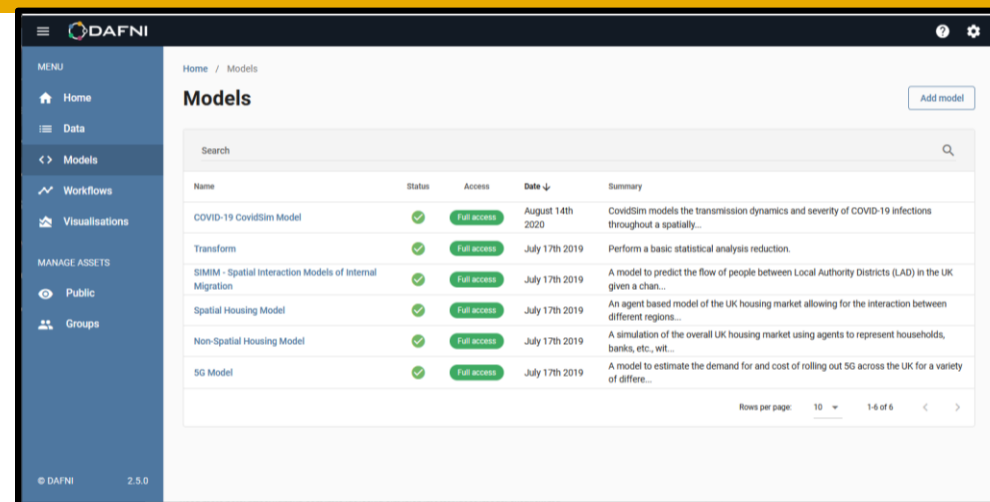
**Dataset Version ID**  
 49fa1d68-bef1-465f-8908-fc304c4df67d

Copy YAML for Model Definition

**Data files**

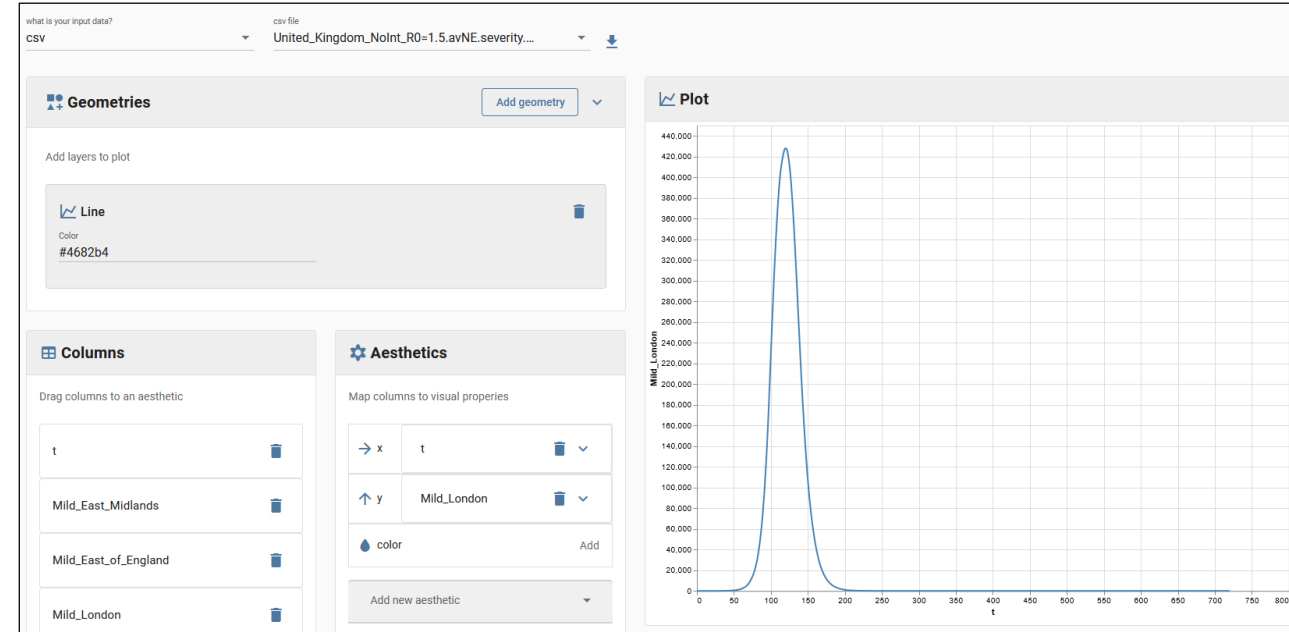
File name	File size	Format	Actions
NJO_Real Power_+kW.csv	4.7 MB	CSV	

- Upload models from anywhere into a model repository
  - Models “containerised” using Docker
  - Independent of code and operating systems
  - Sharing models
  - Within the same security framework
- Models can then be run on the HTC cluster
  - Kubernetes orchestration of containers
  - Scale up models for more compute
  - Access to data in the NID
  - Access to visualisations
- The NIMS allows workflows to be constructed
  - Coupling models together
- Key feature of providing an Infrastructure Ecosystem
  - Across different sectors
  - Across different scales
- A repository of models and workflow
  - Sharing models
  - Within the same security framework





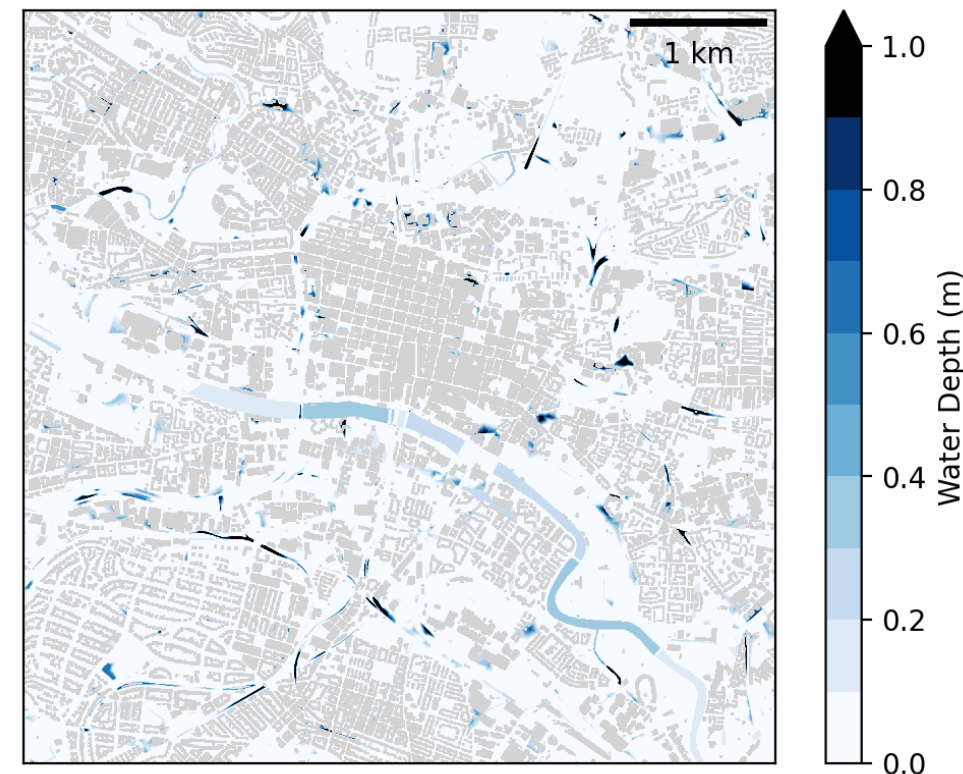
- The National Infrastructure Visualisation Service
  - Build visualisations from workflow output
- Two ways
  - Drag and drop tool
  - Jupyter Notebooks



# How is DAFNI being used?



- NERC project
  - led by University of East Anglia
  - Aug 20 – Nov 22
- Assess the risk of climate change
  - Flooding
  - Health risk from extreme heat
  - Agriculture and biodiversity
- Affect of approaches to adaptation
  - Bio-adaptation
  - Case studies in the Clyde Catchment, Norfolk Broads
  - Towards CCRA4
- Multi-systems modelling approach
- Working with DAFNI to provide
  - A framework for combining models together
  - A place where users can go to access and run workflows
  - A legacy where models can be accessed for the long-term



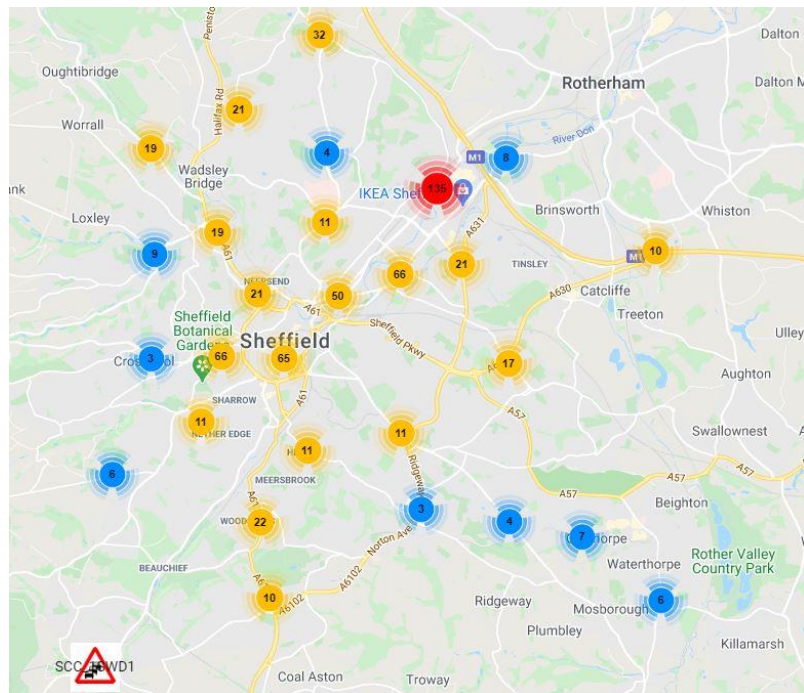
*Flood event impact on Central Glasgow, CityCat model, University of Newcastle*

<https://www.tyndall.ac.uk/OpenCLIM>

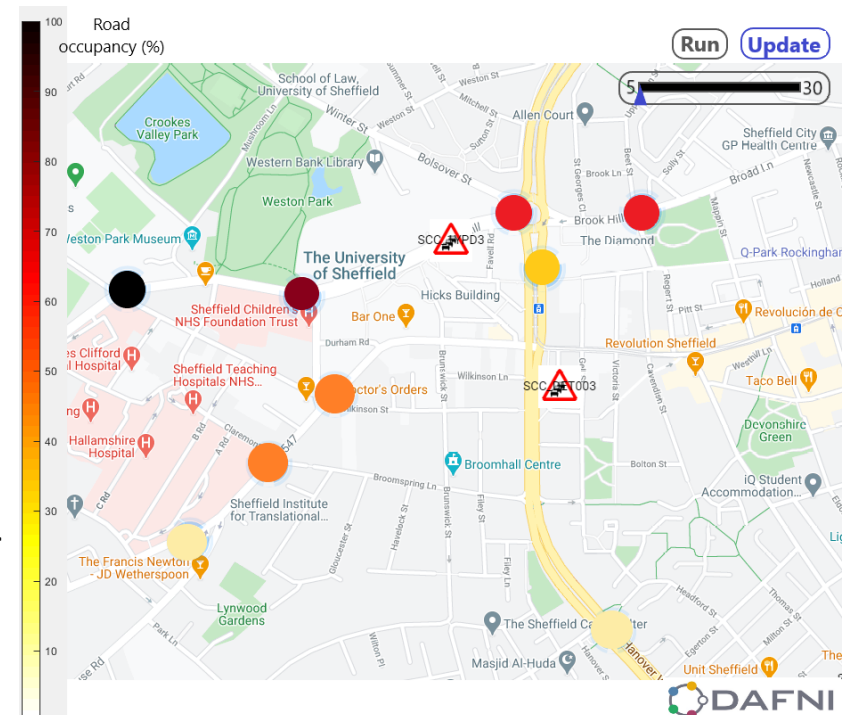




# Pilot study - Traffic Digital Twin in Sheffield



- Traffic data from the Sheffield Urban Observatory
  - 640 sensors that report traffic flow (no. of cars/min)
  - Time resolution: 5 min
- Build AI-based model
  - updates in real-time for each sensor
  - predicts evolution of traffic (ex: 30 min ahead)
- A digital replica of the Sheffield traffic
- Identify areas where congestion will occur



### Use cases:

- Traffic monitoring system that predicts congested areas
- Real-time traffic flow optimization



The University Of Sheffield.

**Christian Genes,  
Daniel Coca**



# What next for DAFNI?

## DAFNI-ROSE

A grant under EPSRC's Resource-Only Strategic Equipment programme

July 2021-June 2023

- A production platform
  - With an enriched collection of data and models
- Developing the User Base
  - Research users
  - Working with CDTs for early careers researchers
- Looking towards further development:
  - Digital Twins:
  - Information Integration infrastructure
- Forming Multi-disciplinary partnerships
  - With academia, government and Industry

**Please talk to us!**

[info@dafni.ac.uk](mailto:info@dafni.ac.uk)

[www.dafni.ac.uk](http://www.dafni.ac.uk)





**Thank You**

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