

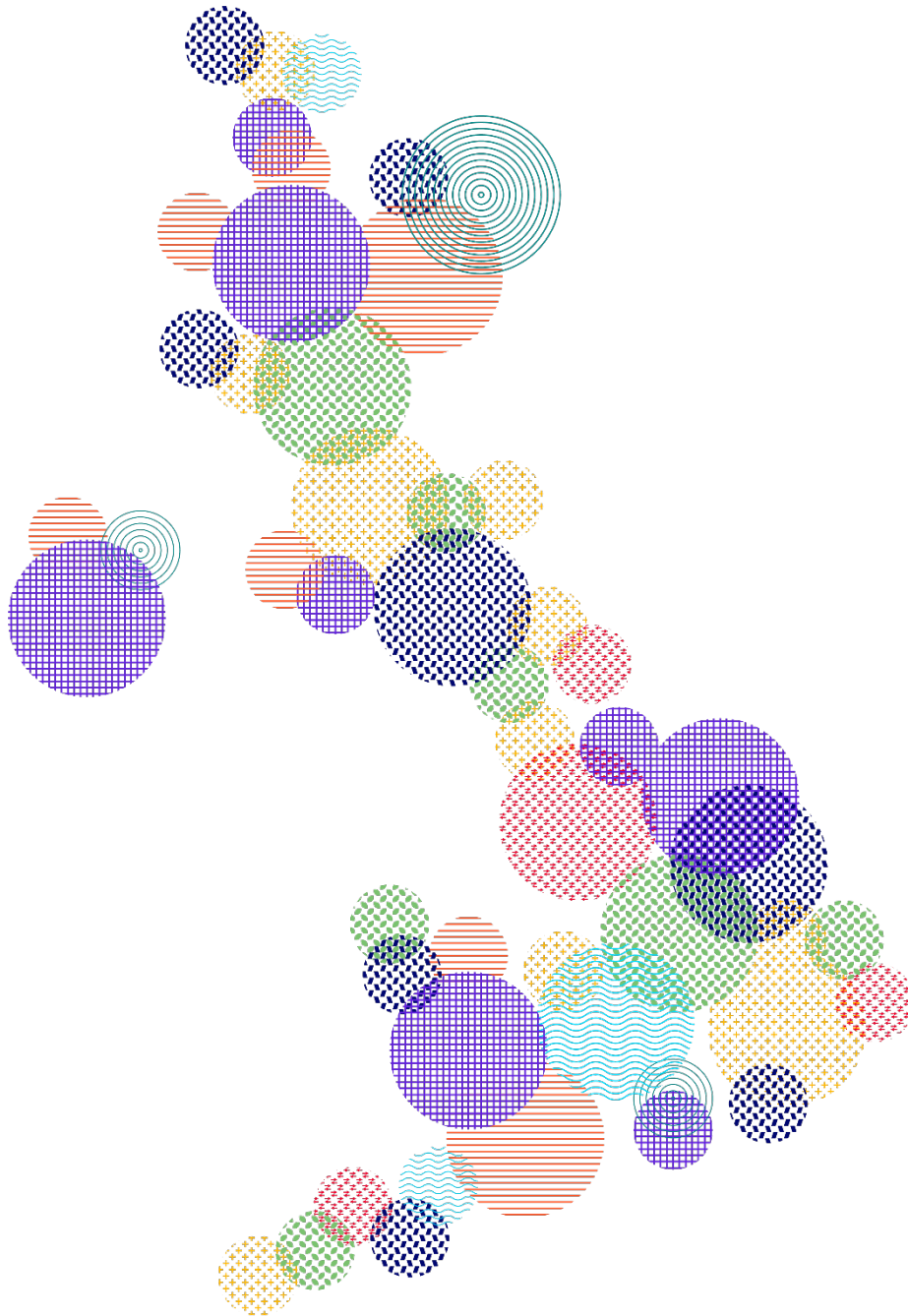


NATIONAL  
DIGITAL TWIN  
PROGRAMME

CReDo  
Climate Resilience Demonstrator

# Using CReDo on DAFNI

March 2022



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## Introduction

The Data and Analytics Facility for National Infrastructure (DAFNI) provided storage and computing capabilities via their public portal, and a secure private development environment to enable collaboration on sensitive data across the distributed team.

The version of the CReDo model hosted on DAFNI is designed to be used with data stored on the platform and provides users the opportunity to run the visualisations with their own data, or to integrate with an alternative analysis pipeline.

## Signing up to DAFNI

Sign up to the DAFNI platform: <https://dafni.ac.uk/accessing-dafni/>

Once approved, you should be able to log into the DAFNI platform:  
<https://dafni.ac.uk/dafnILogin/>

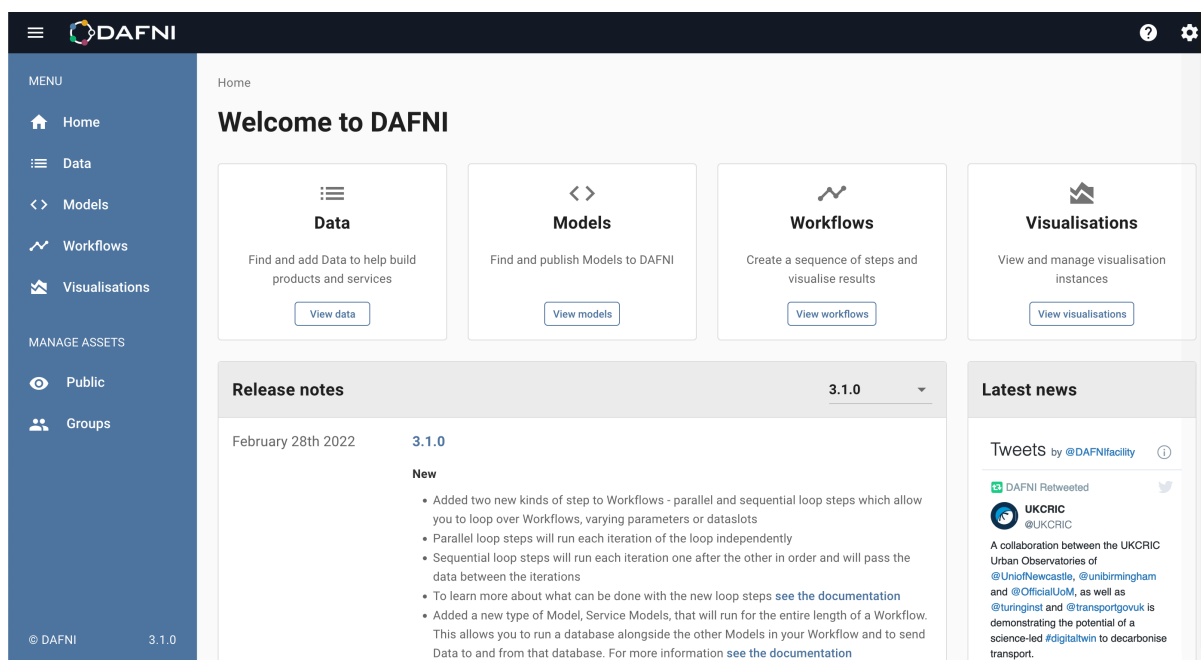


Figure 1 DAFNI Welcome page

Once you log in, you will see something similar to Figure 1. For general guidance on using DAFNI, see their documentation: <https://docs.secure.dafni.rl.ac.uk/>.

# How to use CReDo on the DAFNI platform

The left hand menu on the DAFNI Welcome page, Figure 1 shows the key components of software run on DAFNI – Data, Models, Workflows and visualisations. We utilise each of these in the CReDo pipeline.

**Data** allows us to upload datasets useful for analysis, from flooding simulation outputs and asset infrastructure configurations, through to writing the final outputs back to the database for storage for later analysis.

**Models** contains the components which perform specific tasks, such as the asset failure model. Models are core components of the DAFNI platform and refer to their help pages for guidance on the format required for model specification and upload.

**Workflows** consist of several model components chained together to form a series of instructions.

**Visualisations** contains all visualisation instances.

## View previous CReDo outputs

Outputs from previous runs of the CReDo twin have been stored on DAFNI and can be visualised from the browser. The custom visualisation tools developed in the CReDo project have been integrated into the DAFNI platform and can be generated on demand. To do this, navigate to the **Data** section of the DAFNI platform. This will contain a list of all datasets available to you as a user. Outputs from CReDo will be publicly available, such as those in the screenshot below. To visualise the output, select the tick box next to the data to view and click the **Visualise** button also shown in the screenshot, Figure 2.

The screenshot shows the DAFNI Data Catalogue interface. On the left is a sidebar menu with options: Home, Data, Models, Workflows, Visualisations, and Manage Assets (Public, Groups). The main area is titled 'Data Catalogue' and includes a search bar, a 'Visualise' button, and a list of datasets. The first dataset is 'CReDo digital twin output (hipims\_case\_100RP6h25u)' with a description of a HIPIMS simulation and download options (MD, CSV, JSON, GeoJSON, ZIP). The second dataset is 'CReDo digital twin output (hipims\_case\_100RP8h45u)' with a description of a HIPIMS simulation and download options (MD, CSV, JSON, GeoJSON, ZIP). The third dataset is 'CReDo digital twin output (hipims\_case\_100RP8h45u)'.

Figure 2 Screenshot of Data section in DAFNI

Clicking on **Visualise** will produce a new screen allowing you to name and specify the form of visualisation to produce.

Figure 3 Create visualisation screen in DAFNI

Selecting the drop down menu under **Type** will produce the option of “CMCL Vis App”, amongst others. This is the option to use to specify using the CReDo visualisation tool. Once you have completed the necessary fields, click **Create**. This will then send a request for the necessary resources on the DAFNI platform.

Visualisation instances can be viewed under the **Visualisations** tab, and clicking on a specific visualisation's name will take you to it. Downloaded and initialising the visualisation will take several minutes, so some errors may appear in the browser if it is accessed before it is ready.

## Using the CReDo workflow

Once familiar with the CReDo tools, it is hoped that users will want to build upon the outputs from the project. This section details how you can run the workflow on user specified data, or how to alter the workflow for new applications in the future.

Many models were created during the CReDo project, detailed in the CReDo Technical Reports. These were combined into two main workflows – the modular and the information cascade. The modular workflow has been designed with interoperability in mind, allowing the asset failure and systems impact models designed in [CReDo Technical Report 3: Assessing asset failure](#) and [4: Modelling system impact](#) to be integrated. The information cascade model follows the methodology described in [CReDo Technical Report 1: Building a cross-sector digital twin](#).

Within each workflow, there is a “time step loop” – the time step loop is required because of the several time steps within a flooding simulation. We want outputs monitoring the impact for each stage in the flood, so the workflows need to iterate over each time step in the flood. The necessary stages to run at each time step are contained within this timestep loop, which is

then embedded in a longer workflow which prepares the databases and ingests the data specifying the environment.

For the information cascade model, the time step loop is called **CReDo timestep loop (information cascade model only)** and the full workflow is called **CReDo workflow (information cascade model only)**. For the modular workflow, the time step loop is called **CReDo timestep loop (individual asset failure and system-wide impact models)** and the whole workflow is called **CReDo workflow (individual asset failure and system-wide impact models)**. Clicking on a workflow provides more information and allows it to be customised.

When a workflow is selected, they can be altered by either changing parameters or the workflow itself. Figure 4, below shows the screen for a single workflow produced during the CReDo project.

The screenshot shows the DAFNI interface for a CReDo workflow. The left sidebar contains a menu with options: Home, Data, Models, Workflows (selected), Visualisations, and Manage Assets (Public, Groups). The main content area is titled 'CReDo workflow (individual asset failure and system-wide impact models)' and shows it is the latest version, accessed as the owner of the asset with full access. Below this, there are tabs for 'Versions' (View all, No default, Go to latest) and buttons for 'Make Default' and 'Deprecate'. The workflow details section includes the publisher 'CMCL Innovations', the date 'March 25th 2022 - 18:27', the ID 'd3b45c20-9cfb-4d24-a5c9-36bf1185979c', and the parent ID '0456ec48-da64-4ef1-9358-f8f75c0069f4'. It also shows a version message 'replicating 0.6m cut', a summary 'CReDo workflow - run this to run the CReDo digital twin', and a description 'Workflow to run CReDo digital twin. This workflow uses the individual asset failure and system-wide impact models to resolve failures within the asset networks.' The parameter sets section lists four different parameter sets that can be run with this workflow, each with a name, published by, date published, and actions (edit and play buttons).

Name	Published by	Date published	Actions
1:100 yr, 6 hr, 20% uplift	CMCL Innovations	March 25th 2022	[Edit] [Play]
1:100 yr, 6 hr, 45% uplift	CMCL Innovations	March 25th 2022	[Edit] [Play]
1:100 yr, 3 hr, 40% uplift	CMCL Innovations	March 25th 2022	[Edit] [Play]
1:100 yr, 3 hr, 25% uplift	CMCL Innovations	March 25th 2022	[Edit] [Play]

Figure 4 Screenshot of a single workflow produced during CReDo

Parameter sets contain the parameters which specify a run – presets can be rerun by clicking the **Play** button next to a given parameter set, or they can be edited by clicking on the pencil icon. Clicking on edit will take the user to the visualisation of the workflow, and clicking on different sections of the workflow will show the parameters set for each stage, as shown in Figure 5 below.

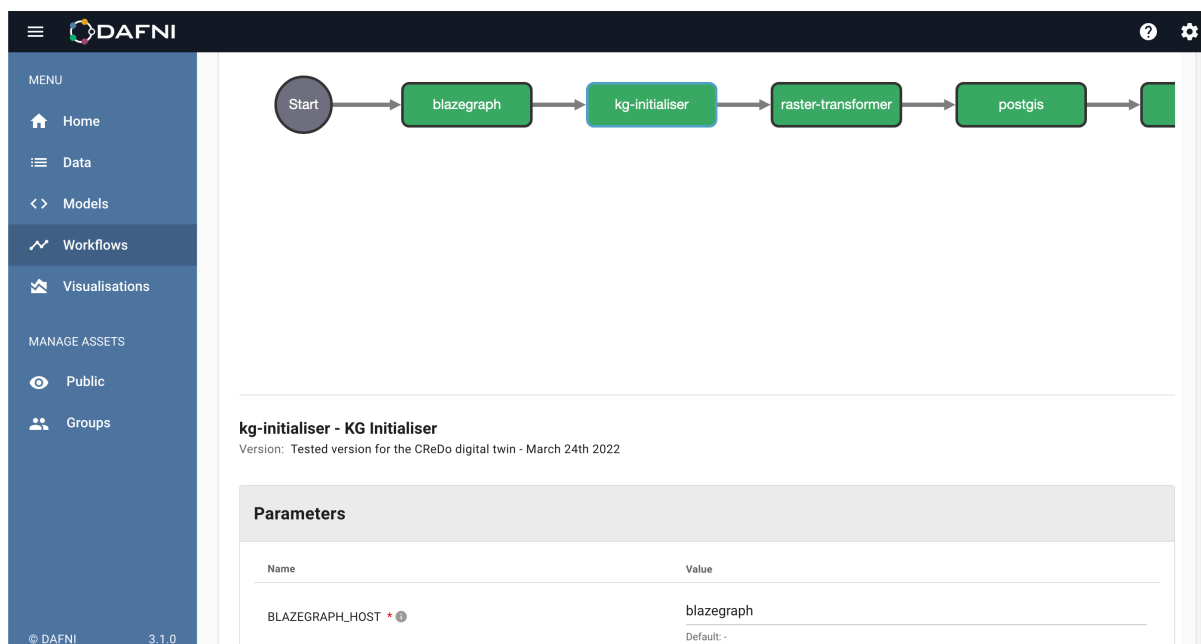




Figure 5 Screenshot showing the different sections of the workflow

Datasets are also specified in this section, with specific datasets able to be loaded to each relevant part of the pipeline.

The screenshot shows the DAFNI interface with a workflow description and its parameter sets. The workflow is titled 'Published by: CMCL Innovations' and was published on March 25th 2022 at 18:25. The 'Version message' states 'Reproducing 0.6m cut'. The 'Summary' section mentions 'CReDo timestep loop - do not directly run this workflow'. The 'Description' section explains that the workflow is used within the CReDo workflow as a loop, and the current timestep should be passed via the 'SIMULATION\_TIMES' parameter of the timestep-initialiser step.

The 'Parameter sets' section shows a table of parameter sets that can be run with this workflow:

Name	Published by	Date published ↓	Actions
Default set	CMCL Innovations	March 25th 2022	 

The 'Instances' section shows a table of workflow instances:

Workflow version	Parameter set	Started	Finished ↓	Status
No instances available for this Workflow				

The interface also includes a sidebar menu with options like Home, Data, Models, Workflows, Visualisations, and Manage Assets.

Figure 6 Screenshot showing the parameter sets and Instances for this part of the workflow

Once a workflow has been set running, it will appear under the “Instances” section of its page. The status alongside it can be Pending, for a job yet to run; Running, for a job in process; Error, for if it has failed; and Succeeded, for when it has completed. Variables, such as specifications for the output files, are included as parameters in the workflow. The results will be saved back to the DAFNI data store, and able to be visualised using the approach above.

To edit a workflow and include user specified models, select the **Edit Workflow** button on the workflow’s description page (as shown in Figure 4). After inputting version information, you will

be presented with a view of the workflow. Selecting a component in the workflow shows the current model loaded at that stage, and can be replaced with the “Change model” button.

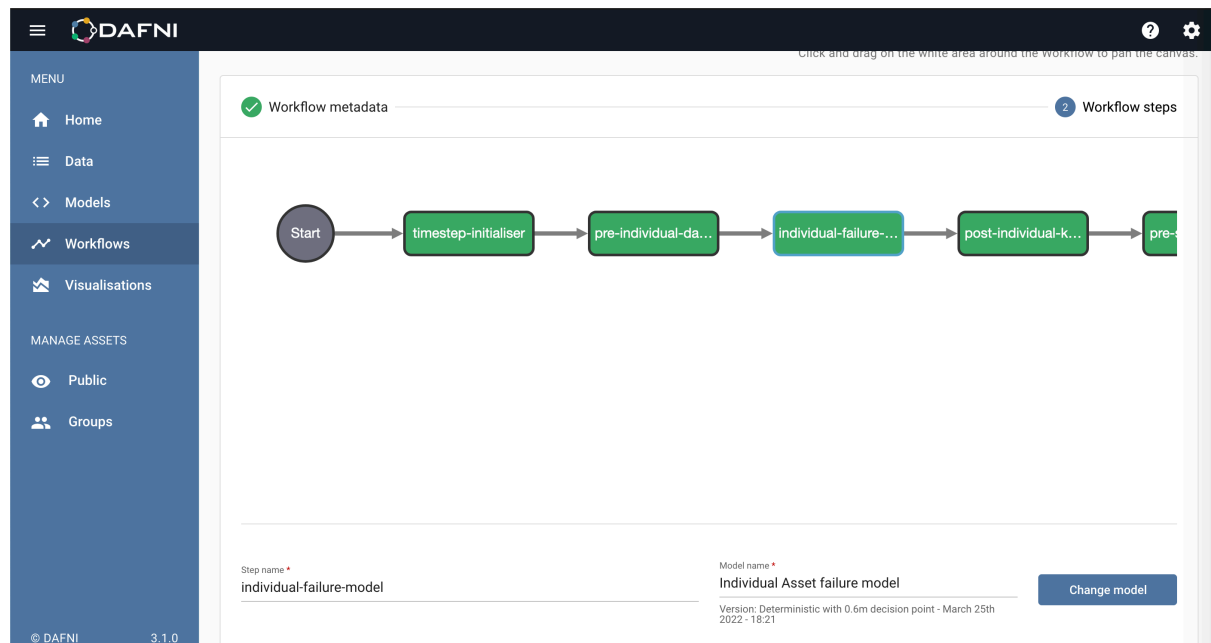


Figure 7 Screenshot of Workflow view, selecting a component to view the model for that stage.

Alternatively, new components can be added by the + icon on the workflow

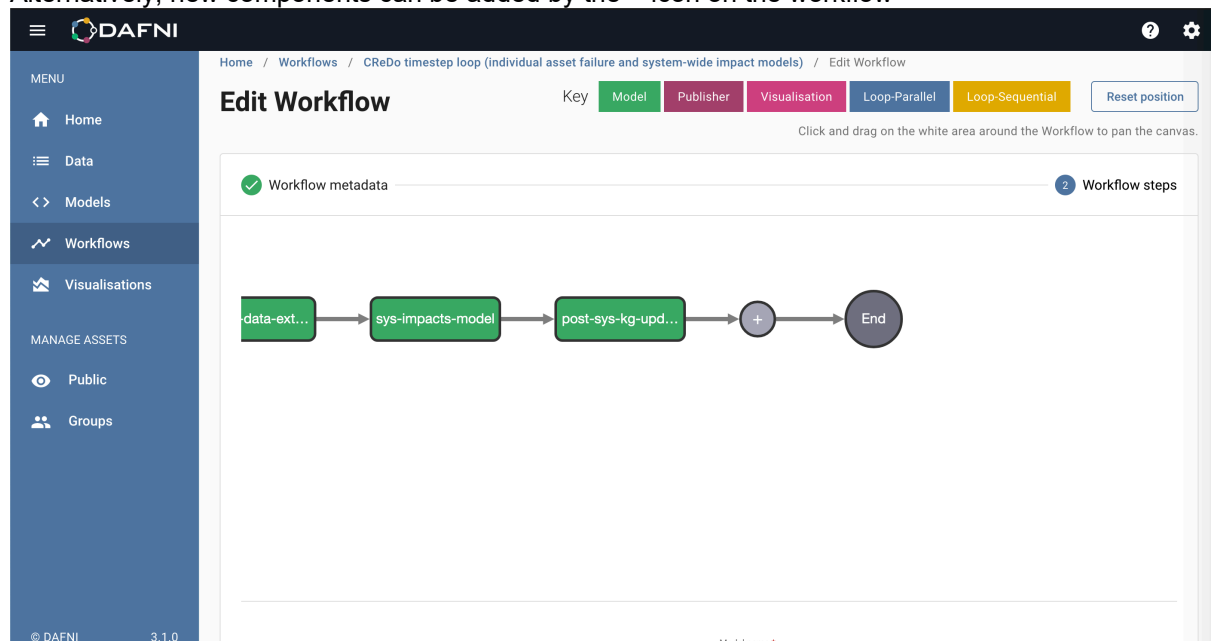


Figure 8 Screenshot showing the add new component icon.

For further information on using the DAFNI platform, contact them directly at [info@dafni.ac.uk](mailto:info@dafni.ac.uk). For further information on the components in the CReDo project, please visit the [Digital Twin Hub](https://www.digitaltwinhub.co.uk).



