

# MIKE Cloud Execution

Updated June 2024

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# 1 Introduction

The following sections describes how to access MIKE Cloud and run simulations in MIKE Cloud for MIKE+, MIKE Zero and FEFLOW, respectively.

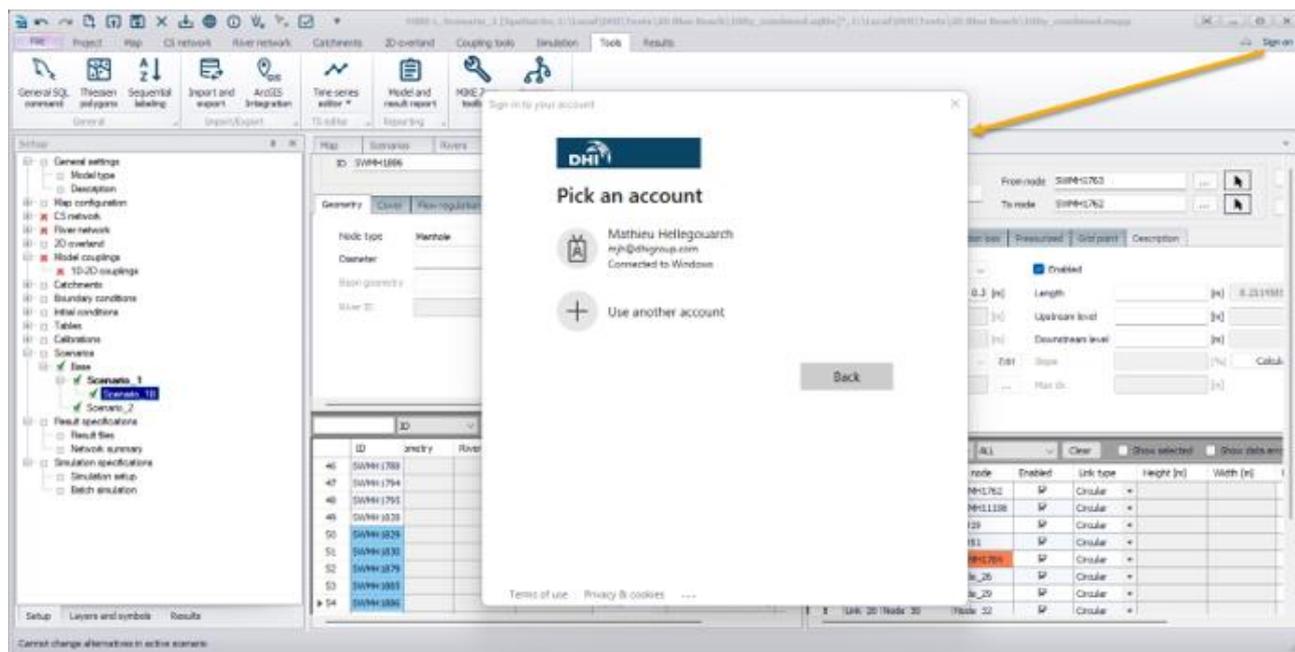
## 2 Get started with Cloud Execution

### 2.1 Obtain MIKE Cloud Account

You will need access to a MIKE Cloud Account to be able to use Cloud Execution. To run models using the MIKE Cloud Execution, you need credits that can be purchased separately as 'Credit Bundles'.

### 2.2 Login to MIKE Cloud

This step is done directly in your desktop software (option at the uppermost right corner). Logging in takes you to the Data Admin section of MIKE Cloud, where you can create project workspaces, upload and store files and see your Cloud Execution credit balance.



### 2.3 Available VM configurations

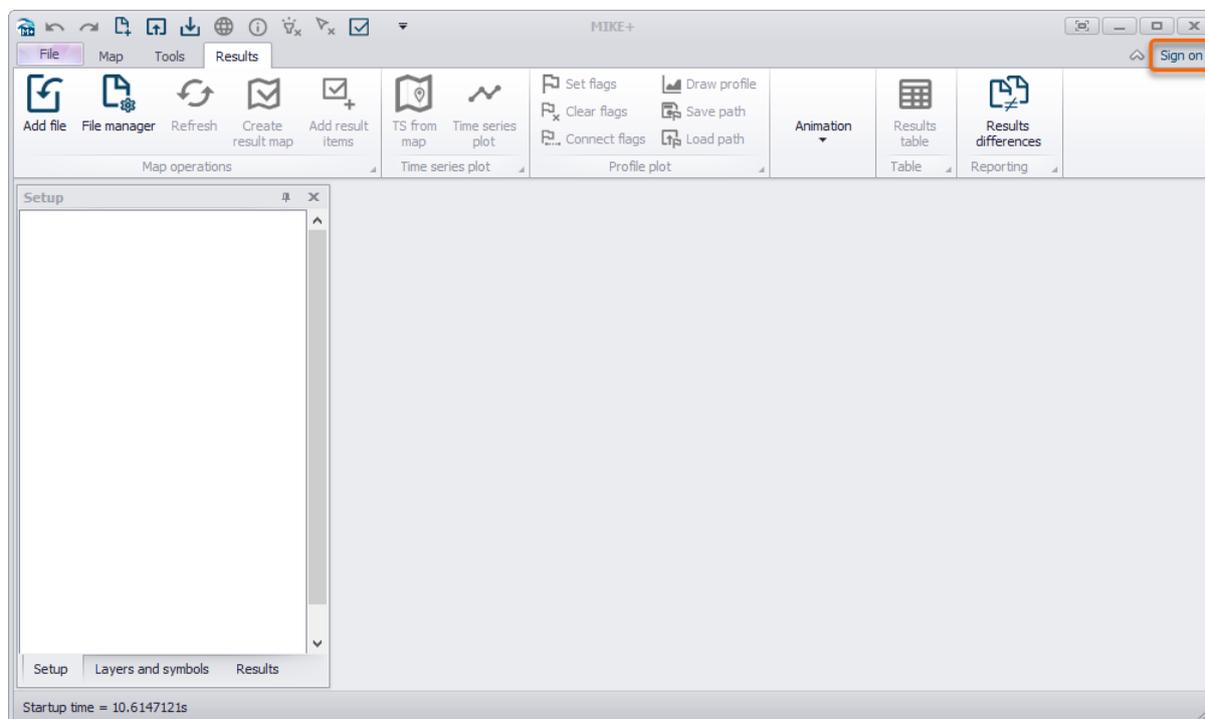
In the Cloud Simulation panel (FEFLOW) and Simulation Launcher (MIKE Zero and MIKE+), choose from six Virtual Machine (VM) configurations with varying credit consumption rates

VM Names	Specifications	Azure VM	Credits per hour	Example usage
VM-S-5	7GB RAM 2 CPU cores No GPU	DS2 v2	0.4	<b>General purpose:</b> Initial model testing & validation

VM-S-40	32GB RAM 16 CPU cores No GPU	F16s v2	2	<b>Compute optimised:</b> <input type="checkbox"/> 1-dimensional river and pipe flow models (MIKE+) <input type="checkbox"/> A single FEFLOW model run
VM-H-60	352GB RAM 44CPU cores No GPU	HC44rs	8	<b>High performance compute:</b> <input type="checkbox"/> 3D Navier-Stokes based models (MIKE 3 Flow Model FM and MIKE 3 Wave Model FM) <input type="checkbox"/> Several FEFLOW model runs in parallel <input type="checkbox"/> A highly-parallelised FePEST run
VM-S-100	128GB RAM 64 CPU cores No GPU	F64s v2	8	<b>Compute optimised:</b> <input type="checkbox"/> Complex 1D-2D coupled models (MIKE+) <input type="checkbox"/> Several FEFLOW model runs in parallel <input type="checkbox"/> A highly-parallelised FePEST run
VM-G-5	112GB RAM 6 CPU cores 1 Tesla V100 GPU	NC6s v3	6	<b>GPU accelerated compute:</b> Dedicated for PETSc GPU-accelerated solver in FEFLOW for very large groundwater models (e.g. >1-2 million elements)
VM-G40	224GB RAM 12 CPU cores 2 Tesla V100 GPUs	NC12s v3	10	<b>GPU accelerated compute:</b> Very large 2D inundation models (MIKE 21 Flow Model FM)

### 3 Working with MIKE Cloud in MIKE+

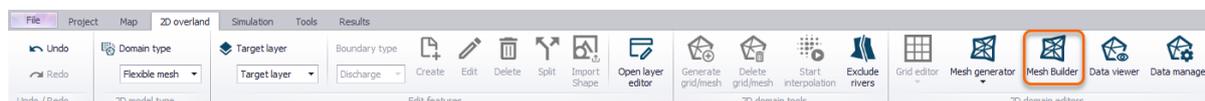
MIKE Cloud offers online applications and cloud-based services to boost modelling in MIKE+. To take advantage of MIKE Cloud, you must first sign into your MIKE Cloud account. If not already signed on, use the 'Sign on' option in the upper right corner of the MIKE+ window.



After clicking 'Sign on', you will be prompted to select a MIKE Cloud account. If you do not have a MIKE Cloud account yet, please reach out to your local DHI sales representative.

Once signed on, the user account will be shown in the upper right corner of the MIKE+ window. The drop-down menu next to this user account allows you to sign out, or to open the MIKE Cloud home page which will bring you to the MIKE Data Admin page where your project files can be stored.

Once signed into MIKE Cloud, it is also possible to access the Mesh Builder application to create 2D meshes for use in the 2D overland model. Click the 'Mesh Builder' button from the '2D overland' tab in the ribbon, to open the application.



For the working mode 'Rivers, collection system and overland flows', it is now also possible to execute simulations on MIKE Cloud to benefit from a selection of powerful virtual machines on demand. As a prerequisite, your account must be credited in order to be able to execute simulations.

**Note:** From July 1<sup>st</sup> 2024 it is only possible to use Cloud Execution with MIKE+ Version 2024 Update 1. This restriction will be changed with Release 2025.

### 3.1 Running MIKE+ simulations on MIKE Cloud

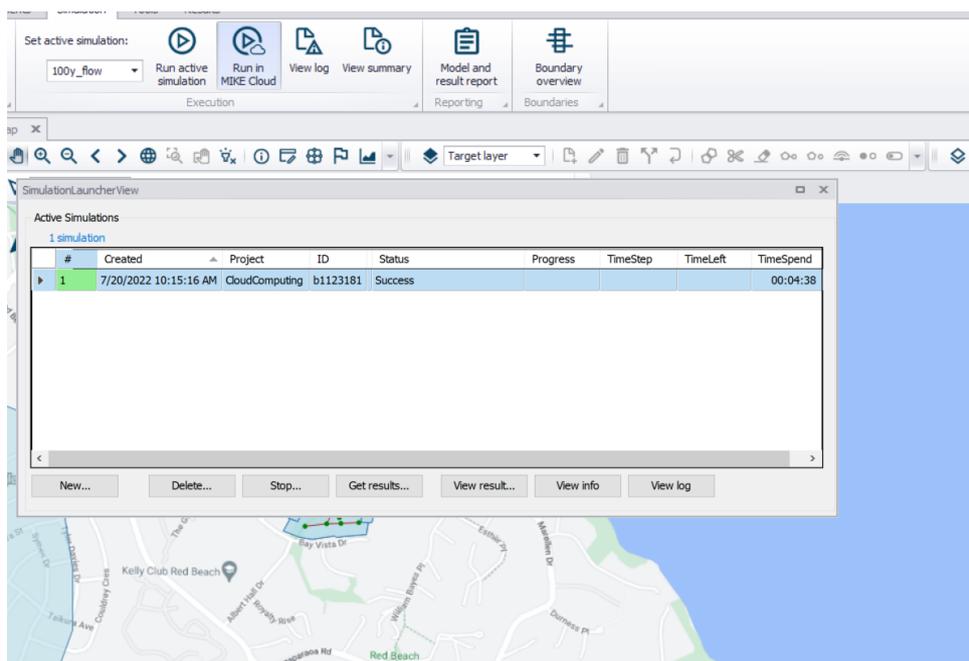
In the MIKE+ Model Manager manual, [MIKE+ Model Manager](#), you can read about MIKE Cloud in Section 2.13. Engines MIKE 1D (for pipes and rivers) and MIKE21 FM (for 2D Overland) are supported in MIKE Cloud (DHI EPANET, SWMM or Water Hammer engines are not supported). It is also recognized that we need to expand the documentation in MIKE+, but there is also reference to the MIKE Zero manual for more details.

The following workflow utilises the 2D Blue Beach example model that is installed with MIKE+.

From the 'Simulation' tab in the ribbon, select the simulation ID to be executed from the 'Set active simulation' drop-down list



Click 'Run in MIKE Cloud' → this will create the simulation files automatically, and then open the 'Simulation Launcher' window with this created simulation file pre-selected.



The user just needs to adjust the other settings (parallelization options, option to download or not the result files) and click Launch.

All functionalities within Simulation Launcher are the same as when executed from MIKE Zero. All files are saved to Data Admin, including the result files. So if the user doesn't click on "Download results automatically" prior to execution, then the results files can be downloaded manually from the MIKE Cloud Data Admin environment.

## 4 Working with MIKE Cloud in MIKE Zero

The MIKE Zero modelling framework has been extended to include a number of MIKE Cloud applications (for example, Mesh Builder). To take advantage of MIKE Cloud, you will need to secure a MIKE Cloud account.

To use MIKE Cloud applications or features, MIKE Zero must be signed on to you MIKE Cloud account. If not already signed on, use the 'Sign on' option in the upper right corner of the MIKE Zero interface.

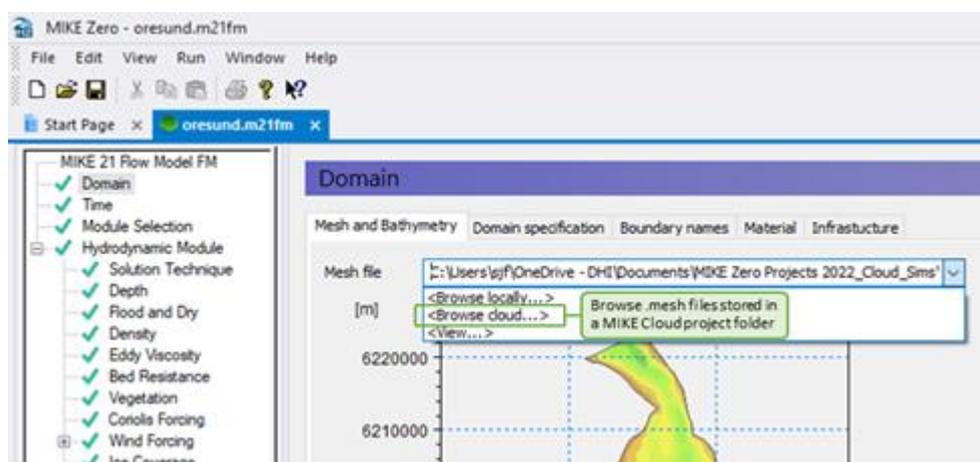


After clicking 'Sign on', you will be prompted to select a MIKE Cloud account. Once signed on, the named user account will be shown in the upper right corner of the MIKE Zero interface. Clicking on the named user again will allow you to sign out.

Links to available MIKE Cloud applications are available from the MIKE Zero Start Page (see below)



In addition to engine execution in the cloud, additional cloud-enhanced functionality includes the ability to browse .mesh files stored in your MIKE Cloud project folder.

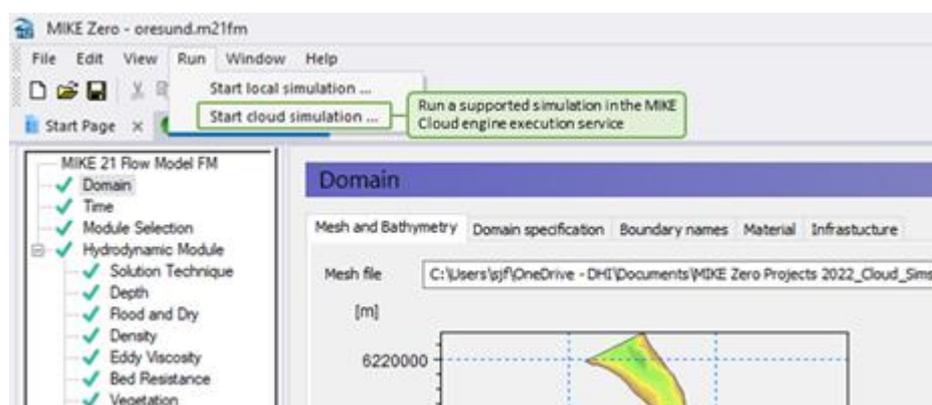
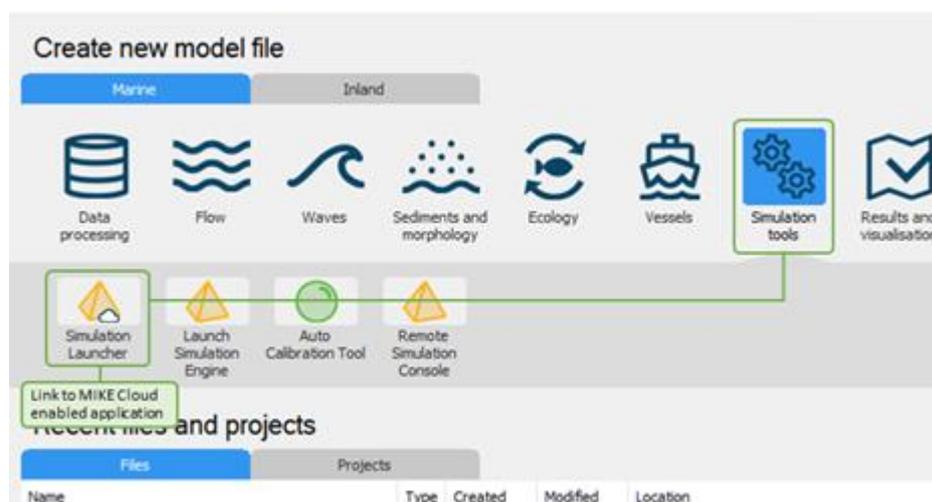


**Note:** From July 1<sup>st</sup> 2024 it is only possible to use Cloud Execution with MIKE Zero Version 2024 Update 1. This restriction will be changed with Release 2025.

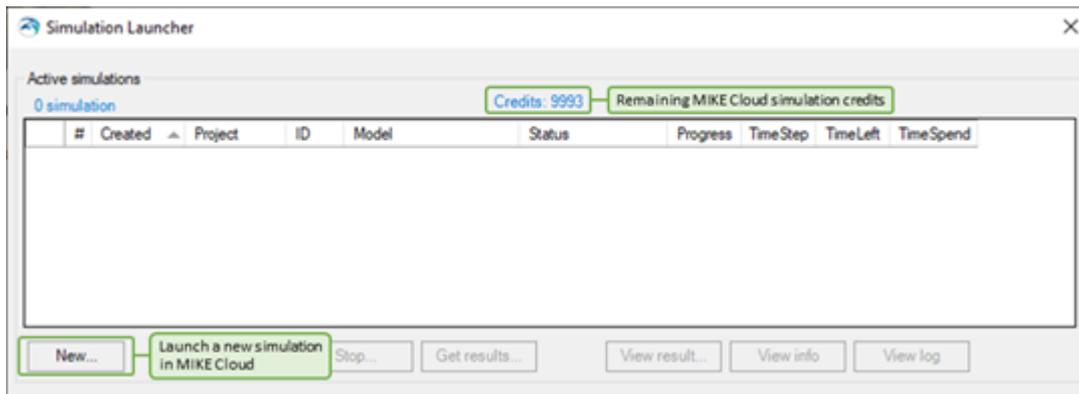
## 4.1 Running MIKE Zero simulations on MIKE Cloud

When MIKE Zero is signed on to your MIKE Cloud account, it is possible to execute simulations from the MIKE Zero interface to a selection of cloud-based virtual machines on demand via the Simulation Launcher. As a prerequisite, your MIKE Cloud account must be credited to be able to execute cloud simulations.

There are two methods to access the Simulation Launcher and thus execute simulations in the cloud; from a link on the MIKE Zero Start Page, and from the Run menus of individual setup editors

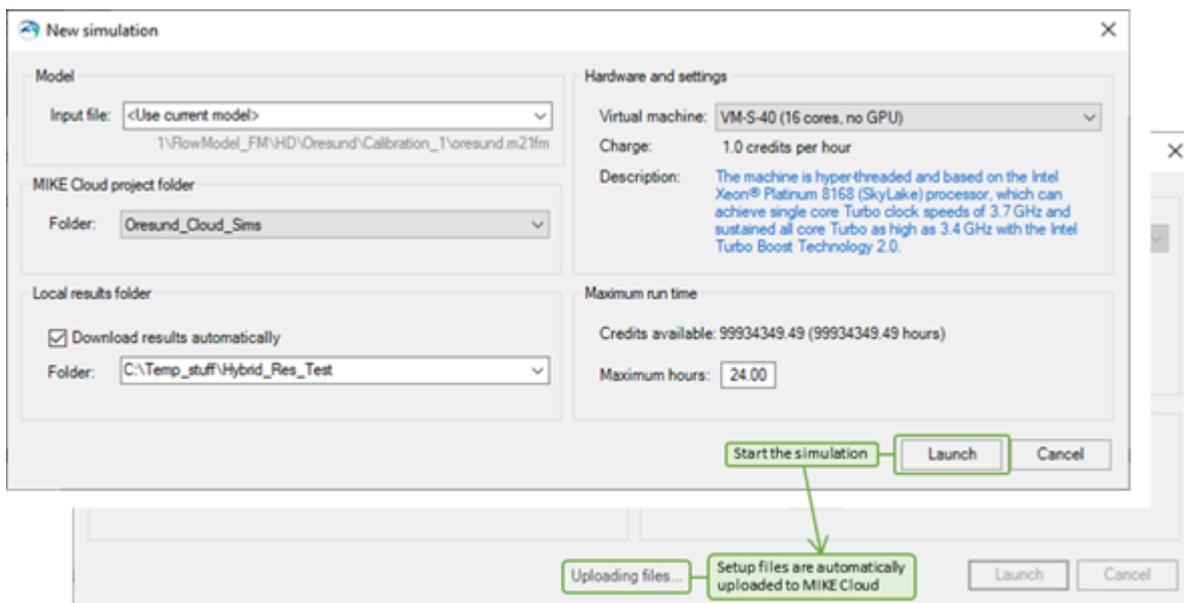


The Simulation Launcher displays a counter showing available simulation credits, a list of previous and current simulations, and various simulation controls and information options. To begin a new simulation in the cloud, click 'New...'



Upon clicking 'New...', a 'New simulation' window will open. Here, you can specify the model setup file (usually the current model), an existing MIKE Cloud project folder (refer to separate Data Admin documentation), the local results folder, the virtual machine you wish to use, and the maximum simulation time after which the simulation will terminate (this feature is included to allow you to better control credit use and associated costs).

When 'Launch' is clicked, relevant setup files will be uploaded from your local computer to the MIKE Cloud project folder, the 'New simulation' window will close, and the cloud simulation process will start.



## 5 Working with MIKE Cloud in FEFLOW

The present document is a condensed documentation of the use of MIKE Cloud in FEFLOW. The full documentation is available in the official [FEFLOW Online Help](#) and [FePEST Online Help](#) systems.

FEFLOW model run (s) can be executed in DHI MIKE Cloud infrastructure. The deployment of the model run (s) is a “*One-click solution*” approach directly from FEFLOW and/or FePEST graphical interfaces. DHI MIKE Cloud offers a variety of virtual machines, which are intended to cover several modelling applications.

### Technical requirements

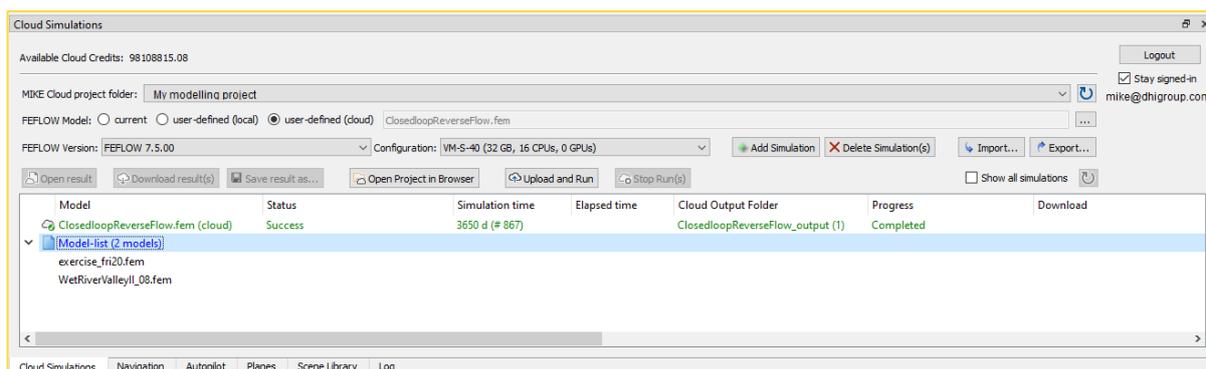
Accessing cloud resources through FEFLOW and FePEST GUIs requires:

- At least the installation of FEFLOW 8.1.3 (Update 3),
- the installation of .NET Desktop Runtime 6.x and
- access to company subscription to the MIKE Cloud with valid credits.

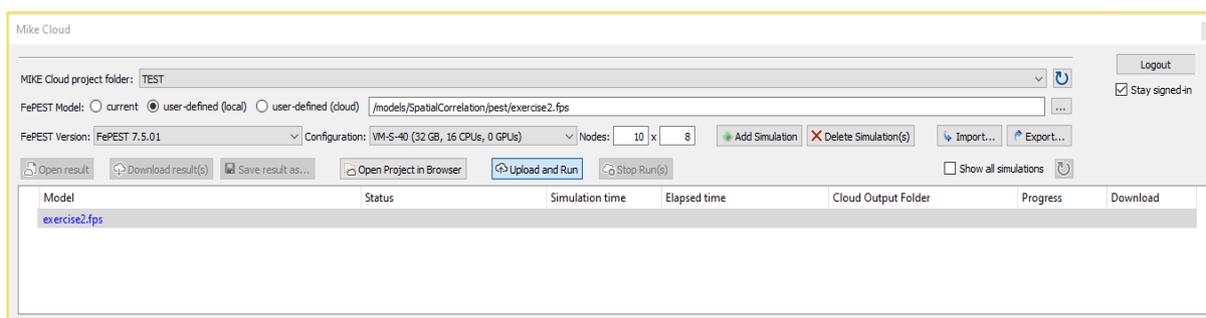
### Overview of functionalities

In FEFLOW, the new **Cloud Simulations** panel is activate / deactivate as any other GUI panel through the menu **View - Panels**. Cloud simulations can be executed individually, i.e., one simulation instance per virtual machine (VM), or several FEFLOW models within one VM.

The initial mandatory step is to log-in to MIKE Cloud. This step is done directly in the panel (option at the uppermost right corner). The log-in operation can only be done through a company email address linked to the MIKE Cloud subscription.



Cloud Simulations panel in FEFLOW GUI.



Cloud Simulations panel in FePEST GUI.

### Model list and multiple job execution

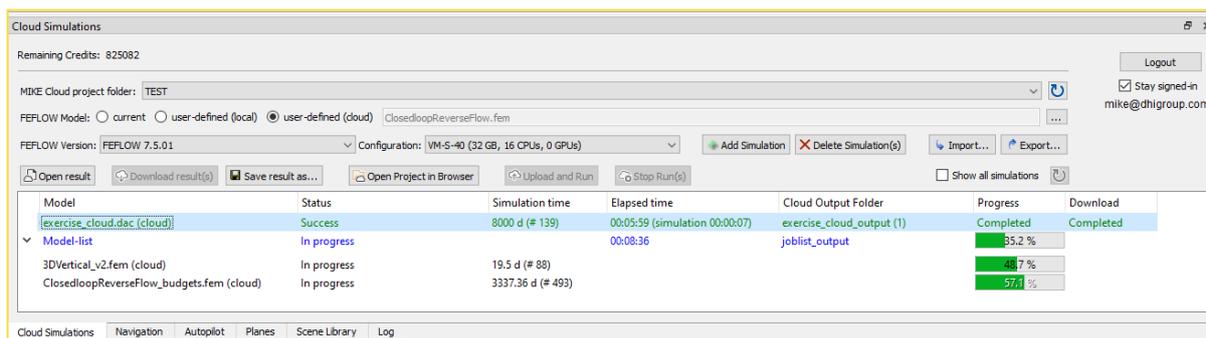
By right-clicking on the model list in the **Cloud Simulations** panel, several advanced options are offered (see picture below). The user can create a **Model List**, which is a list of several FEFLOW models to be executed within the same virtual machine.

Here several model runs are executed within the same virtual machine and the user may want to define the **Number of Threads** per simulation. This is recommended to achieve a proper CPU balance in between

all the jobs. The default number of threads is automatic, which means that the maximum available thread at the chosen configuration is taken. This approach is analogue to the default option in the FEFLOW Global Settings in the case of a local model run.

In the case of a model list, the progress of the simulation shown in the **Cloud Simulations** panel is a function of all the FEFLOW models linked to the job. The panel also presents **Simulation time** and the **Elapsed Time** for each model independently.

Option in panel	Description
MIKE Cloud project folder	User-defined project in DHI's Data Admin (cloud storage) to upload a chosen FEFLOW *.fem and *.dac files. For every cloud run, a result folder within the selected MIKE Cloud project folder is created.
FEFLOW model	A FEFLOW model to be used for the cloud execution: <ul style="list-style-type: none"> <li>• Current: The actual document opened in the FEFLOW GUI.</li> <li>• User-defined (local): A *.fem document located in a local directory.</li> <li>• User-defined (cloud): A *.fem document previously uploaded to the cloud and within the selected MIKE Cloud project folder.</li> </ul>
FEFLOW Version	We support only cloud simulations using the FEFLOW version 8.1.3 engine. This will change in future releases.
Configuration	The Configuration list indicates the virtual machine where the FEFLOW model will run. There are several configurations available and suitable for both FEFLOW and FePEST.
Add / Delete simulations	A Simulation is defined by the combination of a FEFLOW *.fem / *.dac file, a FEFLOW Version and a Configuration. Simulations can be created by pressing the Add Simulation button. Simulations are not started immediately. The simulation begins only after pressing the Upload and Run button. Simulations can be also eliminated after selecting their names from the model list and pressing the Delete Simulations button.
Import/Export from/to file	A JSON file can be imported/exported with the cloud configurations.
Upload and run	Button to upload the model input files (*.fem and *.dac) to the corresponding MIKE Cloud project. After the upload operation successes, the simulation starts.
Open result	The option requires a single simulation record to be selected from the job list and that the result file (*.dac) has been previously downloaded. The Open result button will automatically load the FEFLOW *.dac file in the FEFLOW GUI.
Download result (s)	After pressing the button, FEFLOW starts downloading all selected (completed) records to a local temporary file.
Save result as	The button Save result as downloads the result to a user-defined path/location or copies/renames the temporally created file to the user-defined path/location, if the result has been already downloaded.
Show all completed simulations	The option adds all completed simulations in the list (together with "current" simulations which are always shown).



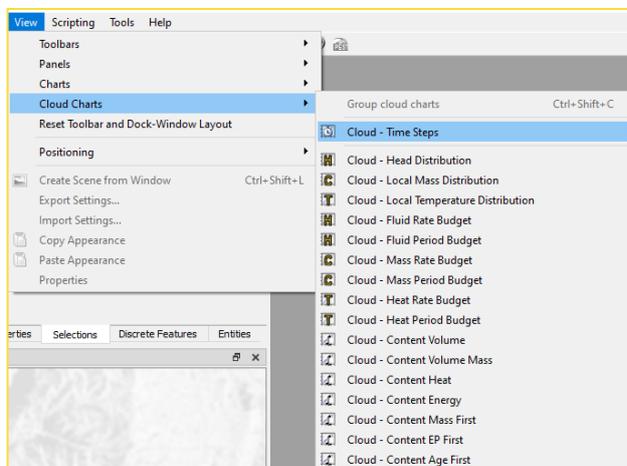
Example of model list with two cloud runs within the same virtual machine.

### Real-time result monitoring

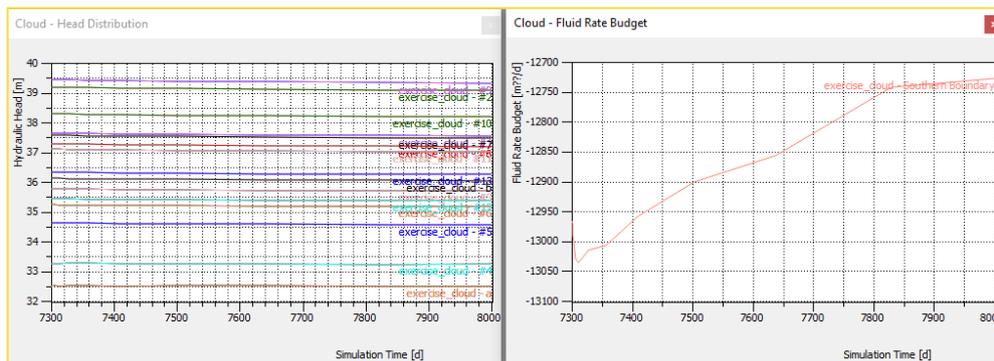
The user can monitor the **Status** of the model run (e.g., Success or In Progress), the Simulation time (**Time step number** and **Absolute Simulation time**) and the **Elapsed Time**. All this information is continuously updated during the model run. Especially, the **Elapsed Time** can be used to partially understand the model runtime. However, the preparation of a VM after the Upload and Run button has been used, could cost additional time (in minutes) before the FEFLOW run really starts. Therefore, the Elapsed Time may not necessary always reflect the total duration of the job.

FEFLOW model results can be monitored during the cloud run without the need of downloading the FEFLOW results \*.dac file. As in any local FEFLOW simulation, the user can follow partial results through a set of charts. In the case of cloud model runs, the possibility to review model results is done though the new **Cloud Charts**. These charts are also accessible through the menu **View**.

In the case multiple simulations are in progress, the **Cloud Charts** content reflects the selected simulation from the model list. The content of the chart will be automatically updated as soon as another simulation record is selected in the **Cloud Simulations** panel.



List of Cloud Charts available in the FEFLOW GUI.



Example of Cloud Charts (Head Distribution and Fluid Rate Budget) in the FEFLOW GUI.

### Final recommendations

- A larger VM configuration would not necessary speed-up the model simulations. The final model runtime depends on the model Problem Settings such as Problem Class (e.g., linear or nonlinear problems), Solver settings, among others. Configurations with more than 16 CPUs are intended for cases, where more than one FEFLOW run is executed in parallel. For example, in a FePEST parallelization, the VM could host several FEFLOW runs in parallel, thus the CPUs could be entirely occupied. A configuration supporting GPU is only relevant for FEFLOW models with the Algebraic Multigrid option under the PETSc solver.
- VM configurations with larger number of CPUs (and with GPU) will reflect a high consumption of MIKE credits. If you are not sure available your billability and costs, you can contact the general support hotline ([mike@dhigroup.com](mailto:mike@dhigroup.com)) to ask such details. FEFLOW GUI offers you the current available credits.
- The user is fully responsible of the content of the model files to be uploaded and subsequently used for the cloud execution. There is a minimum level of comparison to assess whether a file has been already uploaded into the cloud storage portal (so-called MD5 checksum). The difference between two identical file names with almost the same model content (e.g., just a change in a FEFLOW parameter) would probably not be recognized. Especially in those cases where files are several GBs, it is strongly recommended to verify the file content before uploading.