Flood Modeller essentials

Getting started guide

Flood Modeller

Jacobs

This guide covers everything you need to know before you start using Flood Modeller. Ideal for beginners, but also highly recommended for those with prior modelling knowledge, you will learn terminology commonly-used in the software. Some of the functionality and capabilities of Flood Modeller are shown, and you will see how easy your modelling can be in the intuitive graphical user interface.

This guide is part one of a four-part tutorial on getting started with Flood Modeller.

Introduction

In this guide, we will cover a selection of "need to know" items, necessary as a starting point before you progress further using Flood Modeller.

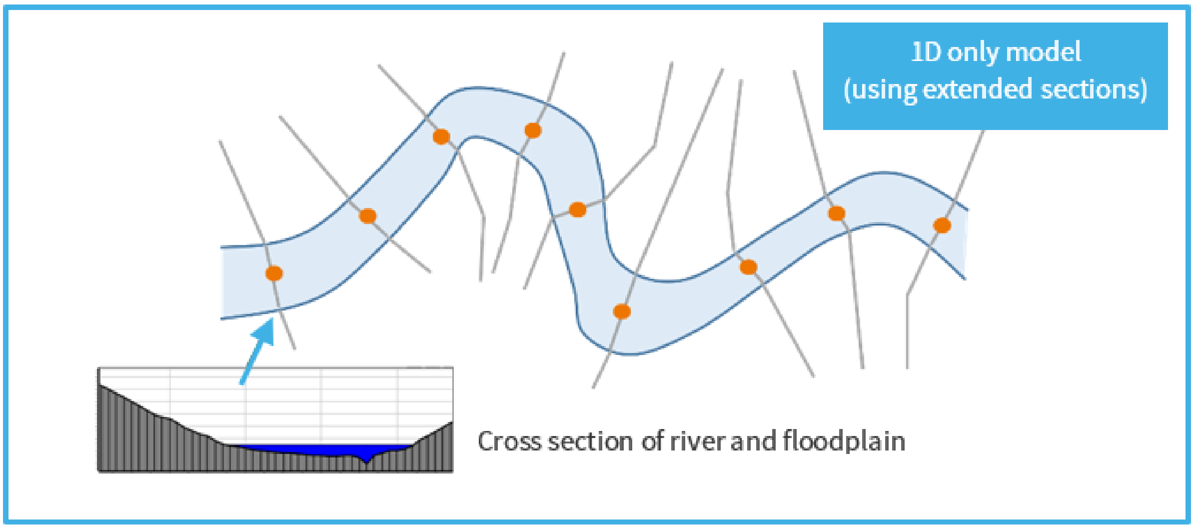
Please note that this guide is intended to introduce users to terminology used in Flood Modeller and provide an overview of functionality available. As such, we mention commonly-used approaches only; there are a multitude of caveats and alternatives, and the list of processes and functionality presented here is by no means exhaustive.

What is a simulation?

We want to use Flood Modeller to model a (potential) flood. We want to consider multiple scenarios, for example, the affect from different storms, different defence designs, and/or different initial water levels. Simulations will be run for each scenario.

The area of interest could be modelled in 1D, 2D or both. Flood Modeller offers all three options and the decision on which option to select will depend upon multiple aspects, including available data for the site and available time to run simulations. The required outputs from the modelling, i.e. levels of detail and data types (for example, flood maps, animations, etc.), should also be taken into consideration.

1D modelling is most effective in channels or pipes and so river networks are often modelled in 1D; nodes specify the underlying river bed geometry and roughness, plus other features such as structures (bridges, culverts, etc.). It can also be applied to flows on the floodplain. However, the nature of a 1D model, i.e. averaging hydraulic properties across each section, means that although this type of model can define volumes of floodplain flow, it won't detail the pathways taken by these flows.

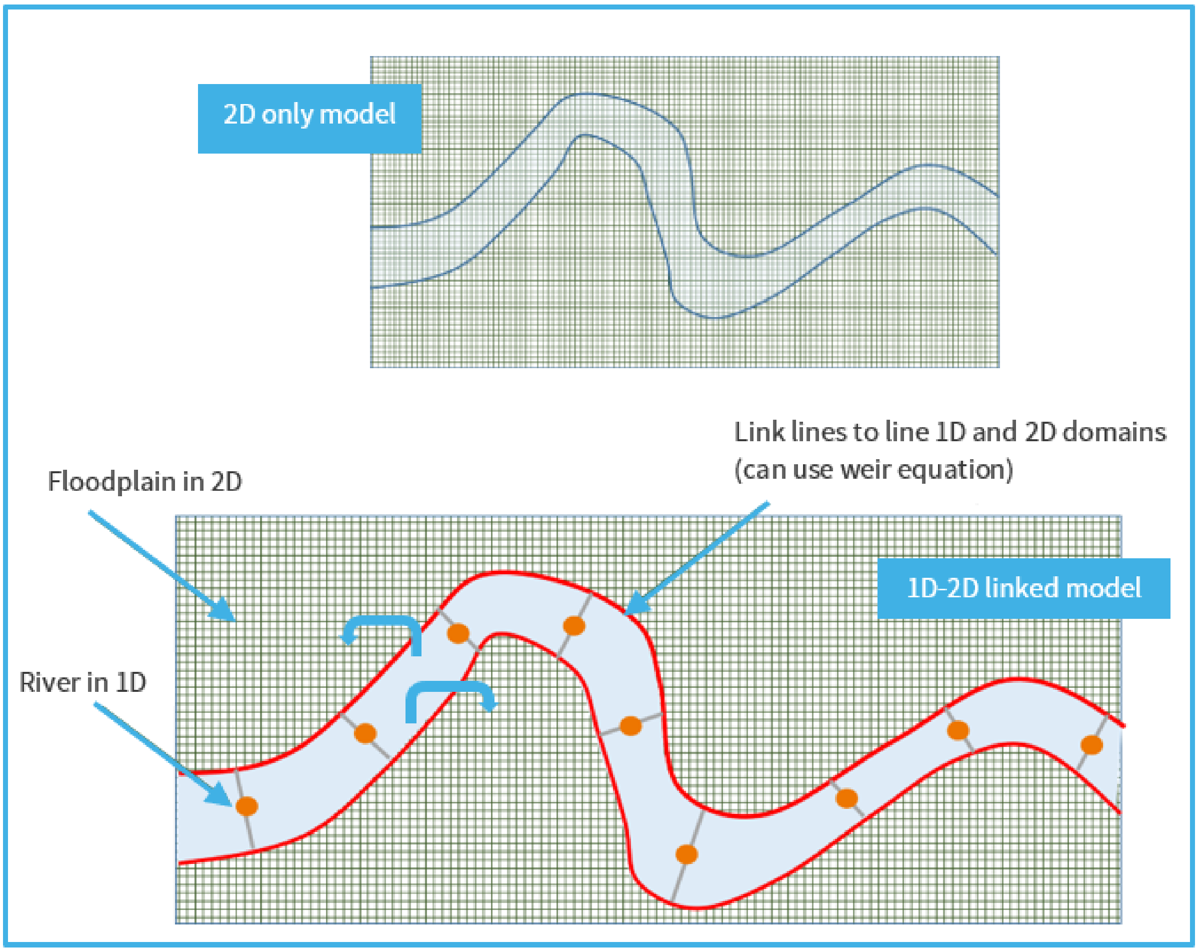


If the flow pathways and full flood animations are desired, the floodplain may be better modelled in 2D; spatial datasets specify the underlying ground elevation, topographic features such as areas of high ground or pathways between buildings and any variations in land use (defined by changes in roughness coefficient). However, 2D models are used less often for modelling of in-bank flows. This is usually because raster ground survey data for the in-bank portions of rivers are a lot less available.

To run a 1D only simulation (for example, if modelling a river network in 1D) the user provides details such as the flow entering the river (e.g. from a design storm) and a timestep. Based on this information and the specified initial water level in the river, the software calculates the new water level (stage) and flow, at all the nodes, at each requested timestep.

To run a 2D only simulation (for example, if modelling a floodplain in 2D) the user provides details such as the flow entering the floodplain (e.g. overtopped from a river) and a timestep. Based on this information and the specified calculation area (active area), the software calculates water levels and flows at each grid cell within the active area, at each requested timestep.

Integrated modelling incorporates both 1D and 2D model components with additional linking elements to enable them to exchange information dynamically as a simulation runs. This enables a model to take advantage of the best aspects of each model type, i.e. 1D modelling the in-bank flows and 2D modelling flow paths across the floodplain (when flows go out of bank).



What is needed to run a 1D simulation?

A 1D simulation requires a network to represent the 1D components. If modelling a river, a 1D river network describes the river itself.

A river network consists of multiple 1D units, or nodes, to provide the physical properties of the river – geometry and roughness of the river bed in river sections, details of boundaries to describe how water enters and leaves the system, and, if present within the modelled reach, details of other structures and features (bridges, culverts, reservoirs, etc.).

Background mapping can also be added for visualisation purposes.

Initial conditions are also required for a 1D simulation. These provide the initial water level throughout the network. If these are not defined realistically the model may become unstable and fail.

When setting up a 1D simulation, details of your network and initial conditions must be provided, alongside timing and run options (whether the simulation is steady-state or unsteady). Multiple parameters can be calculated in a 1D simulation; flow, stage, velocity, total energy, channel conveyance and average shear stress, among others.

What is needed to run a 2D simulation?

A 2D simulation requires details about the 2D domain (the area to be modelled).

A ground elevation grid provides the underlying elevation data of the area; most commonly a Digital Terrain Model (DTM) or Digital Elevation Model (DEM) is used. The roughness of the area, alongside other topographic features such as areas of high ground, can be specified in additional datasets.

An active area must be defined, within which the calculations are performed.

A 2D simulation also requires boundary information to detail the flow entering / leaving the system. The location of the boundary line(s) and the flow data itself are both necessary.

When setting up a 2D simulation, the timing and simulation type must be provided, alongside the domain and boundary details. By default, depth, elevation, flow and velocity data are all calculated and additional outputs are also available.

What is needed to run an integrated simulation?

An integrated simulation involves both 1D and 2D modelling components. So-called “link lines” linking the 1D network(s) and the 2D domain(s) must also be specified.

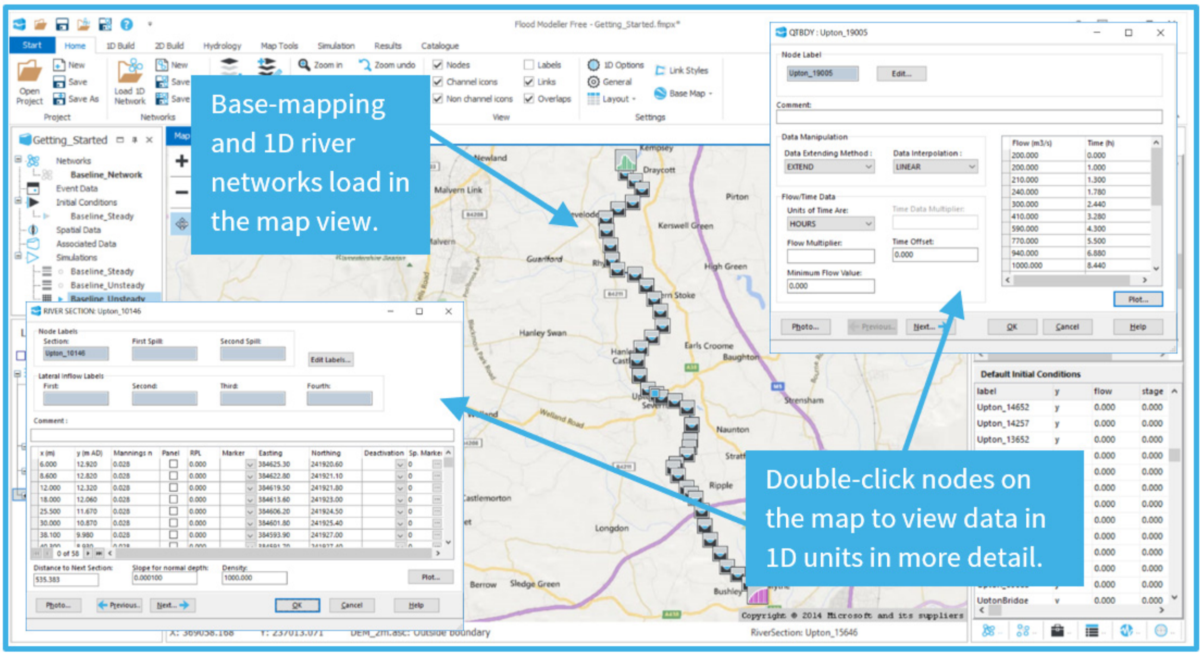
Flood Modeller provides functionality to allow you to draw these link lines directly onto your map view. The simulation then accounts for flows in both directions; allowing water to flow from the 1D network to the 2D domain and vice versa.

When setting up a linked simulation, a 1D simulation must be referenced within the 2D model, alongside details of the 2D active areas and link lines. As with 2D only simulations, depth, elevation, flow and velocity data are calculated by default, with additional outputs also available.

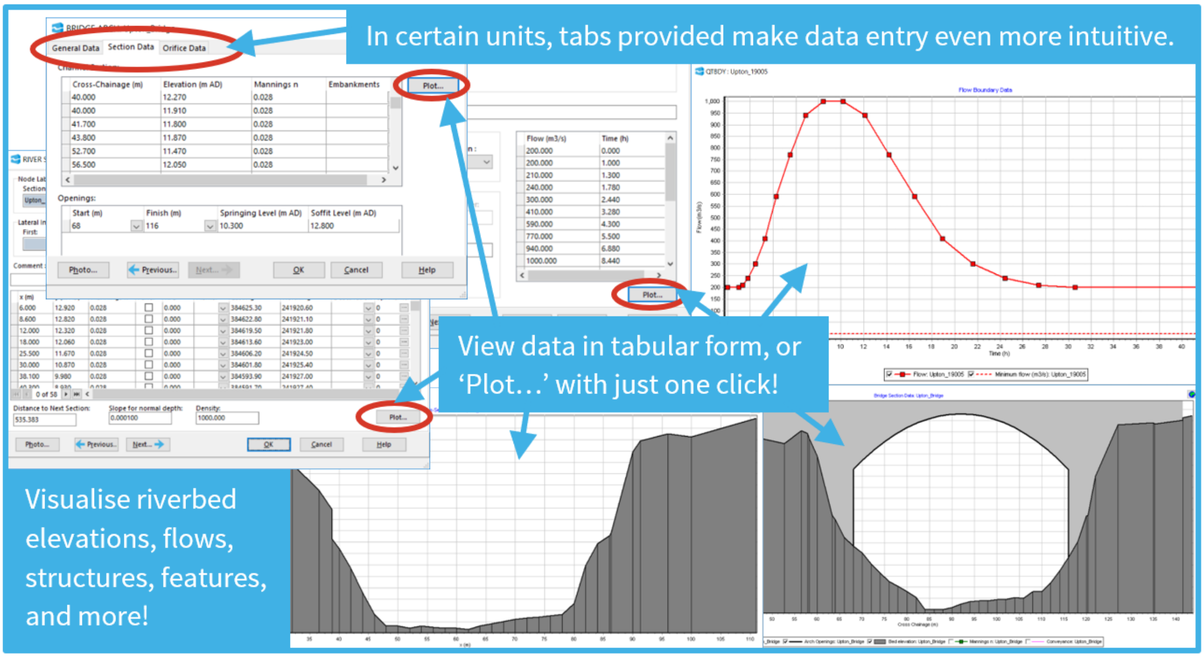
What can I visualise from a simulation?

Flood Modeller's graphical interface provides the ideal platform for visualising all aspects of your model, both throughout the build process, and for result analysis and processing.

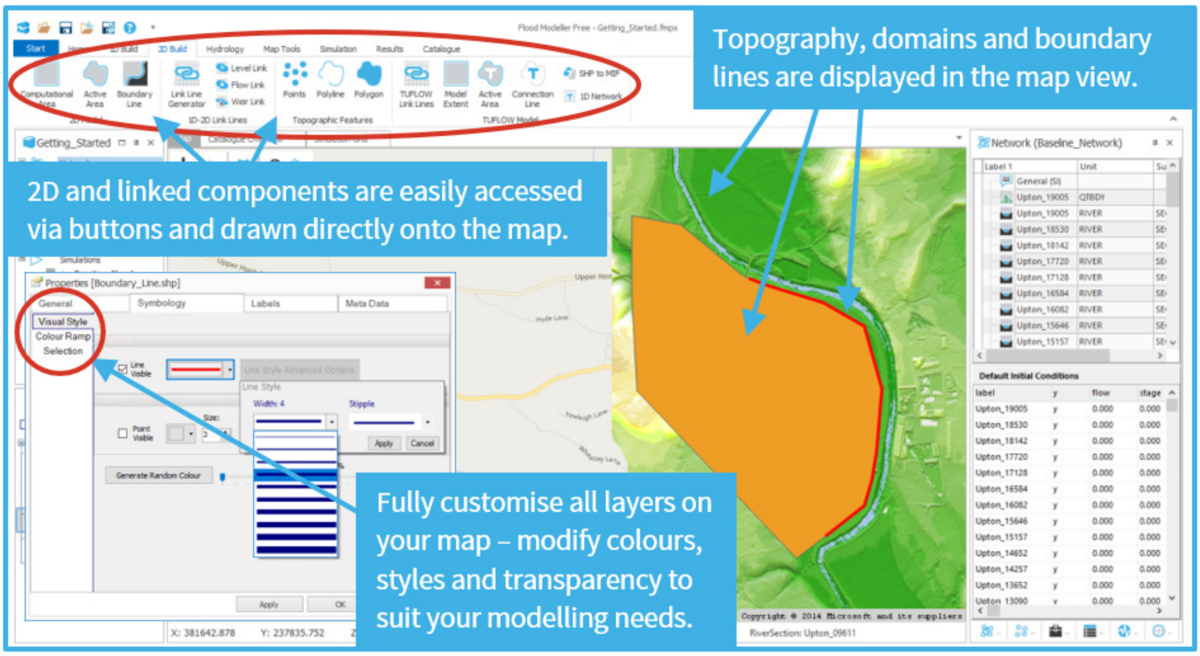
Prior to running a simulation, the map view allows visualisation of all modelling components, together with background mapping. For 1D river networks, this consists of unique icons identifying each node of the river itself, together with links showing the connectivity of the network.



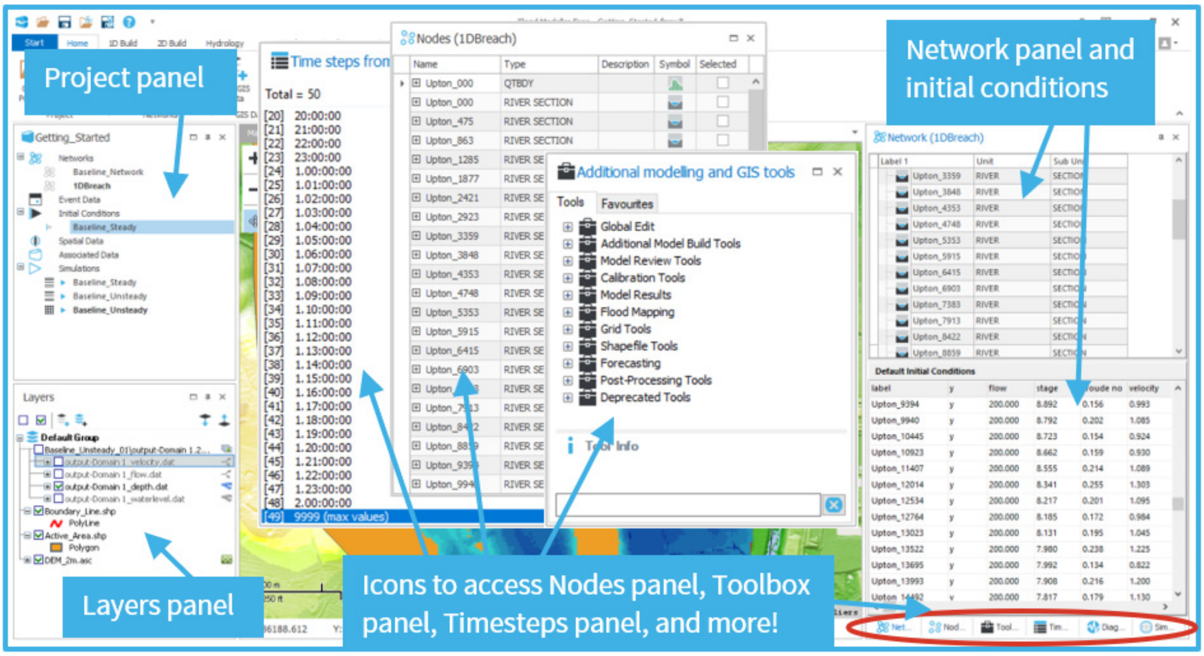
Each node then has further visualisation options; buttons are provided to plot cross-sections and long sections from your river data, and inflows can be viewed in tabular or graphical form, for example.



In 2D, the map view is crucial for viewing all model components, including topography, domains and boundary lines. These, together with any lines linking 1D and 2D modelling components (link lines), are drawn and edited directly on the map view.

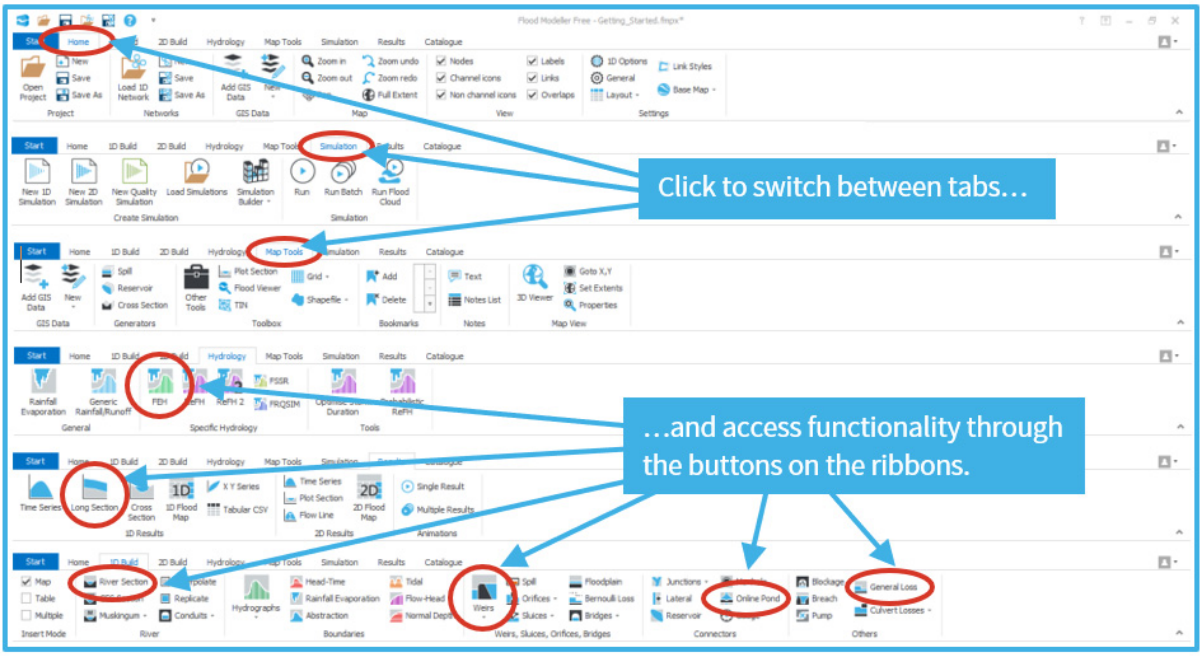


Alongside the map view, a variety of panels allow for further opportunities to visualise modelling components – for example, the network panel shows the currently active network in tabular form together with initial conditions; the layers panel shows all loaded GIS data and shapefiles; and the project panel lists all files currently loaded, sorted by type.

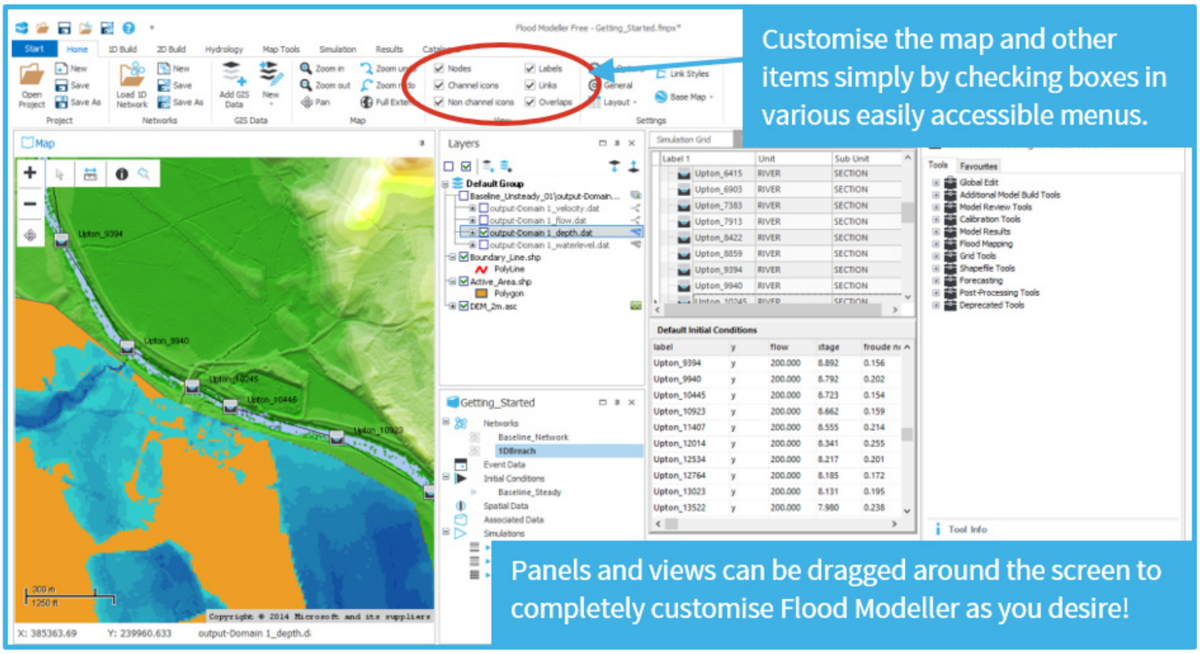


A selection of tabs enables users to quickly switch between ribbons showing a multitude of commonly-used functionality, categorised to assist through the model build, simulation run, and results viewing processes. Unique, clear icons are provided along each ribbon, together with user-friendly pop-up “tool tips” further clarifying the function of each button.

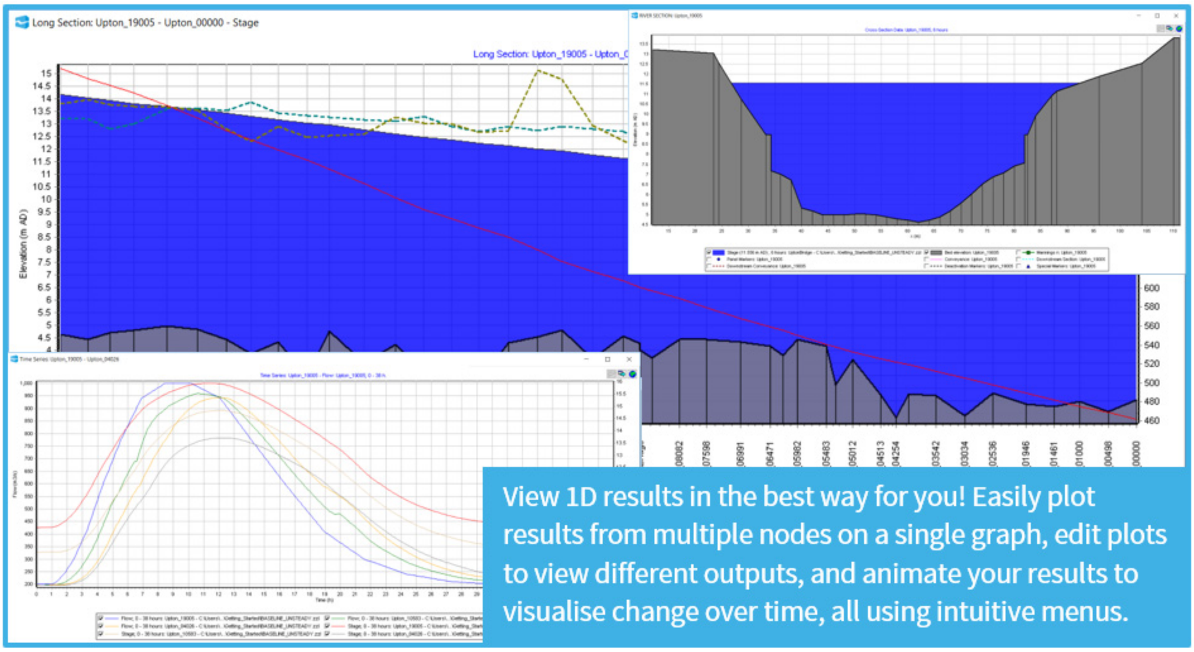
Tip: You can hit the F1 key at any location in the interface to access further guidance on any function or tool!



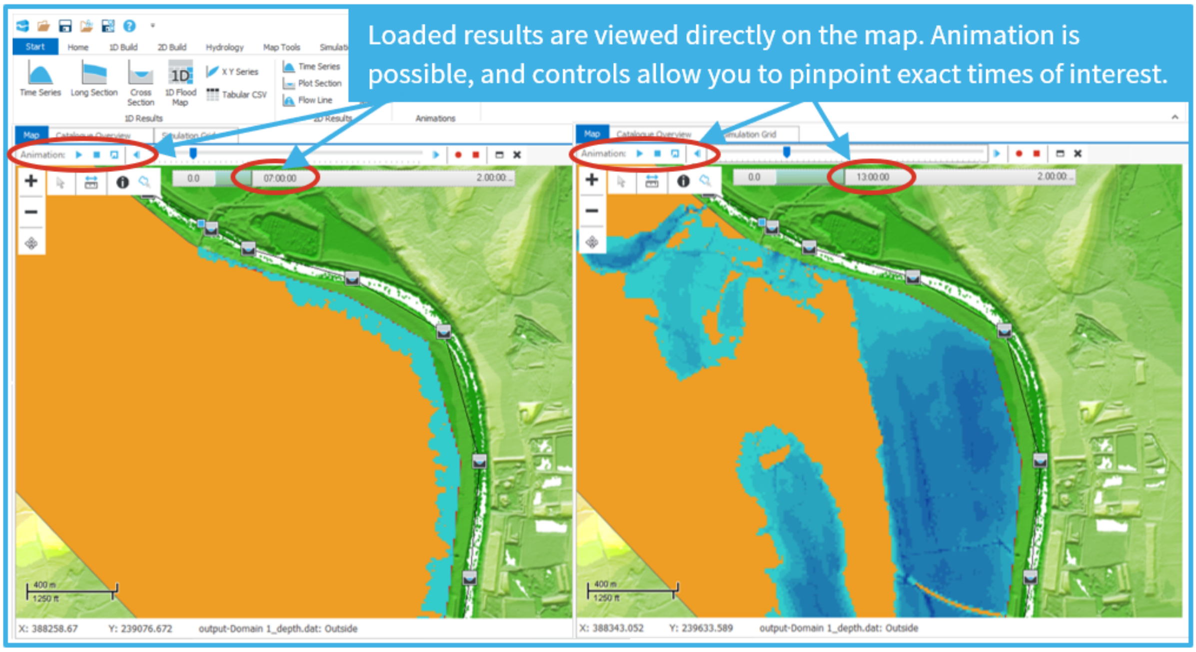
To further enhance the modeller's experience, these aspects are all fully customisable. On the map view, labels, icons and layers can be hidden from view simply by checking boxes provided, and menus allow for changes to all line styles and colours. Panels can be moved around, resized, or hidden from view altogether to give an interface that suits your modelling needs.



The results from a 1D simulation can be viewed in cross section plots (showing a cross-sectional "slice" of the river at a certain time) and time-series plots (showing changes in the water level over time at a node). Long section plots show the water level along the river from upstream to downstream and can be animated to see this change over time. Tools are also provided in the interface to post-process model outputs to generate data such as flood maps and animated maps.



For visualising 2D results, Flood Modeller's map view again provides the ideal solution. Depth, velocity, flow and water level are all calculated by default for any 2D or 1D-2D linked simulation. Once loaded, flood data maps for each of these outputs can be viewed on the map. These also can be visualised as animations, with controls provided to select the exact timestep of interest.



Summary

You now have had an initial overview of what we mean by a 'simulation' and understand the importance of selecting to model components in 1D, 2D, or both. You have seen what is required to run a simulation and have been introduced to various terminology along the way. You have also seen how all aspects of the modelling process can be visualised through the graphical user interface, from building and editing modelling components through to plotting and animating the computed outputs of simulations.

What's next?

Now you're ready to tackle the next of our "Getting Started" guides:

Flood Modeller essentials - This guide covers everything you need to know before you start using Flood Modeller. Ideal for beginners, but also highly recommended for those with prior modelling knowledge, you will learn terminology commonly-used in the software. Some of the functionality and capabilities of Flood Modeller are shown, and you will see how easy your modelling can be in the intuitive graphical user interface.

Running and visualising a 1D simulation – This guide introduced 1D river modelling. You will load a river network and learn how to setup and run 1D simulations. We will explore a selection of the multiple ways Flood Modeller allows us to visualise the results from this.

Building, running and visualising a 2D simulation –In this guide, we saw results where our water levels exceeded the river bank. In this guide we consider the simplest approach to investigate how this affects the floodplain; using a 2D only simulation. You will build all necessary 2D modelling components, setup and run a 2D simulation, and visualise the results from this, all in just ten simple steps!

Integrating, running and visualising a linked simulation– Taking the results from a 1D simulation and manually using these as an input to a 2D simulation provides quick and easy results, as we saw in the previous guide. A more dynamic approach is to consider the full interaction between the river and floodplain (i.e. flows going in both directions, rather than just flooding from river to floodplain). This is known as integrated modelling. In this guide, you will revisit your original river network and, using the 2D modelling components from the previous guide, build a model that incorporates both the 1D river network and 2D floodplain.