CO2BLOCK Web Interface User Guide

This project provides a web interface for the CO2BLOCK tool, which estimates CO_2 storage capacity in saline aquifers. The interface allows users to input geological data, run the model online, and analyze different storage scenarios. The interface contains 5 modules, which are the map, inputs, model, optimization and the help modules. Each module is a single page with a unique route, navigated through React Router.

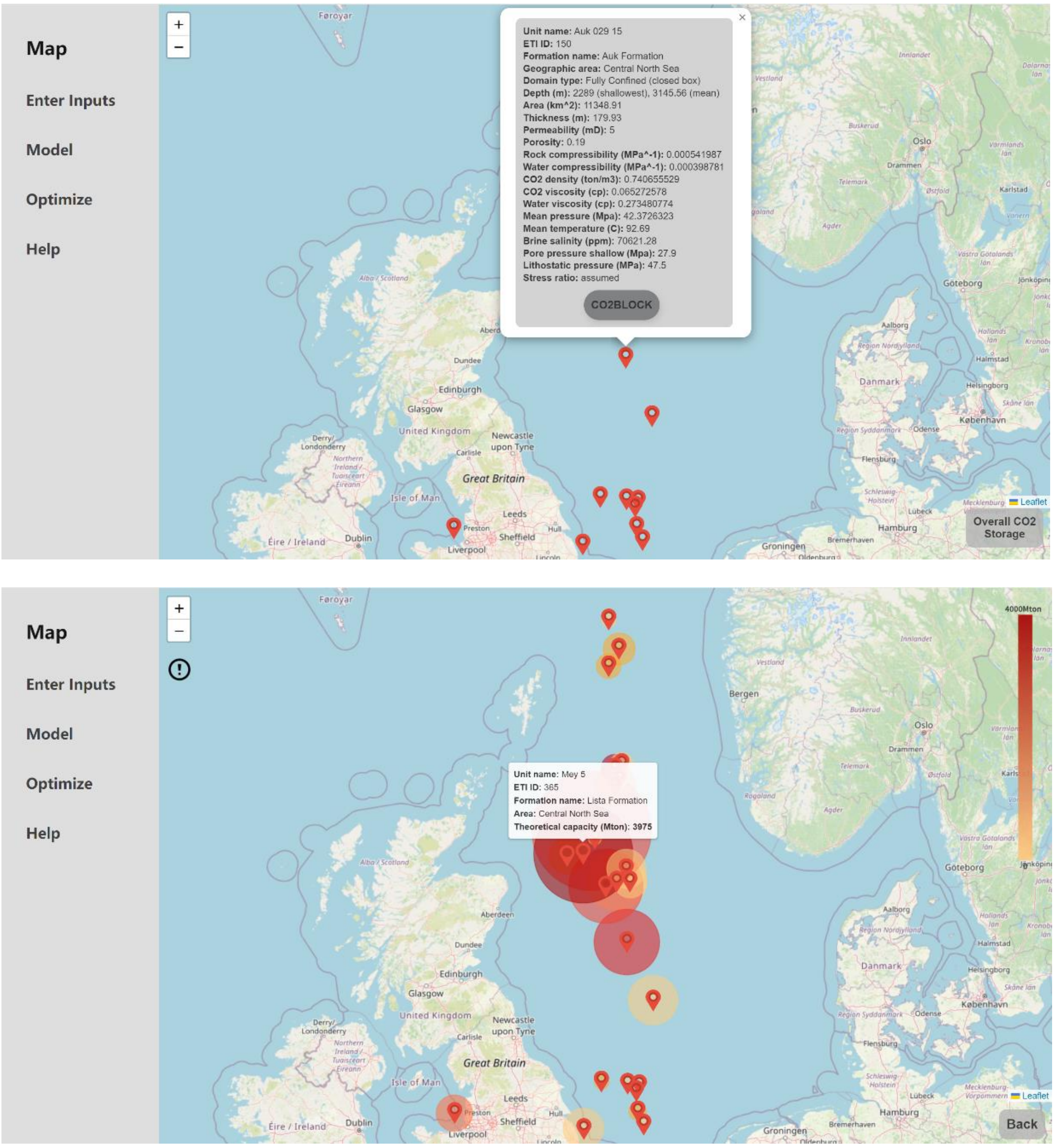
Map Module

Route: /map

As shown in Figure 1.a, markers representing different reservoir units are displayed on the map of the UK offshore area. The map is interactive, allowing users to drag, zoom in, and zoom out. When the user hovers over a marker, an overview of the reservoir unit will be shown. As illustrated in Figure 1.b, by clicking on a certain marker, the unit can be selected as the input of CO2BLOCK. The interface will navigate to the model module when the “CO2BLOCK” button is clicked.

Clicking the button at the bottom left displays a heat map of the theoretical CO_2 storage capacities of these reservoirs. The theoretical capacity is the volumetric capacity of a reservoir unit, calculated from reservoir area, height, and porosity. As shown in Figure 1.c, darker colors indicate larger theoretical capacities, while larger circle radii represent greater geological area sizes. The user can also see the overview and details of a certain unit, and go to the model page when the heat map is shown.

(a)



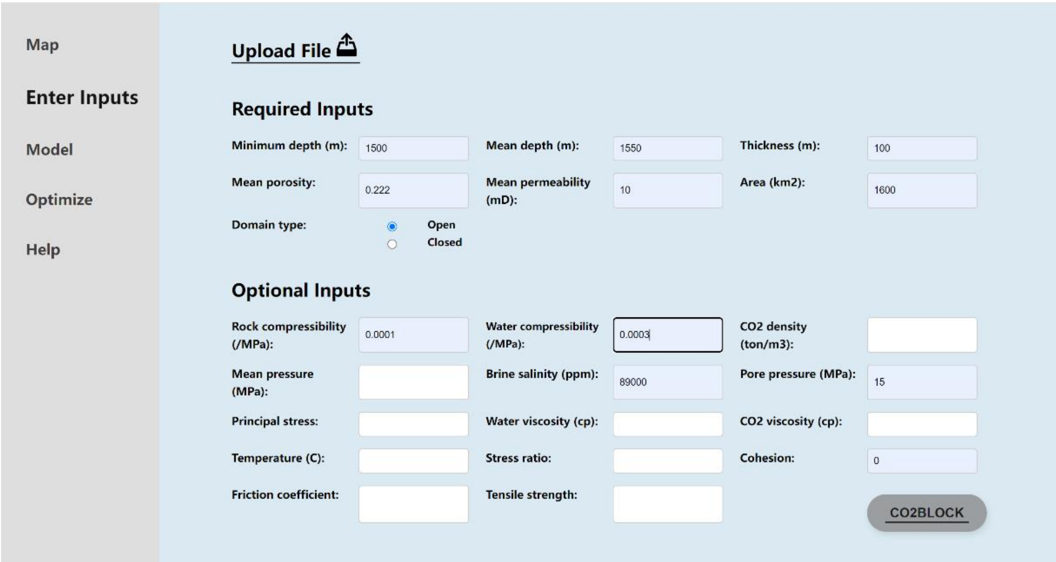
(b) (c)

Figure 1. (a) Initial page of the map module, with overview of a unit shown as the hover effect. (b) Unit details and “CO2BLOCK” button to go to the model page are displayed when a marker is clicked. (c) Heat map representing theoretical CO_2 storage capacities of reservoir sites.

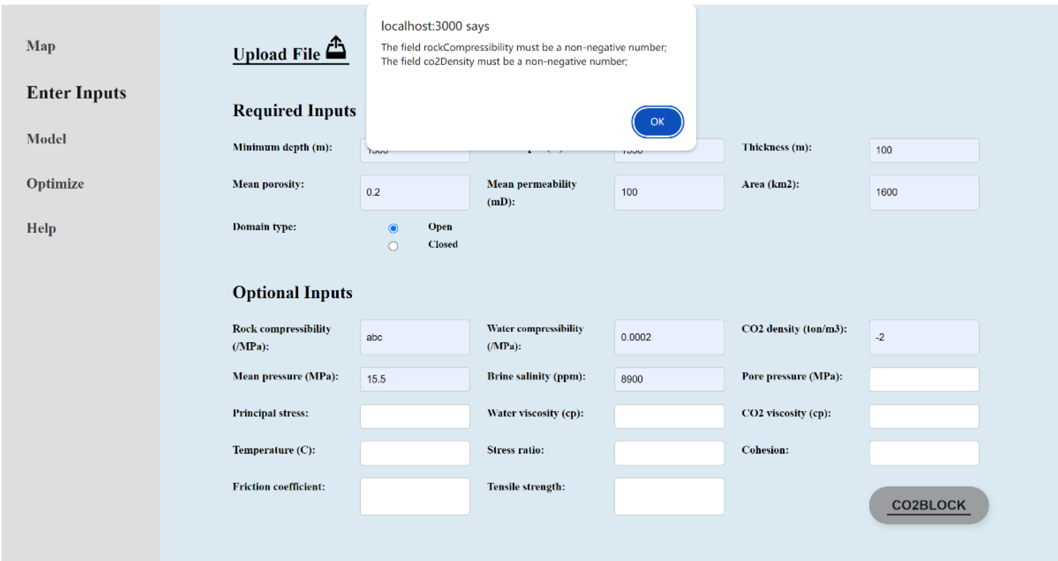
Inputs Module

Route: /enter-inputs

The interface also accepts manually entered model parameters. Required inputs are mean and minimum reservoir depth, mean porosity, mean permeability, reservoir thickness, reservoir or site area. The boundary condition of the unit also needs to be specified. Optional inputs include rock and water compressibility, CO_2 density and viscosity, water viscosity, pore pressure, mean pressure, mean temperature, brine salinity, maximum principal stress, the ratio of mean horizontal stress to vertical stress, the friction coefficient, the cohesion of reservoir rocks, and tensile strength. The system will alert messages when required parameters are not filled, or input data are not valid as displayed in Figure 2.b.



(a)



(b)

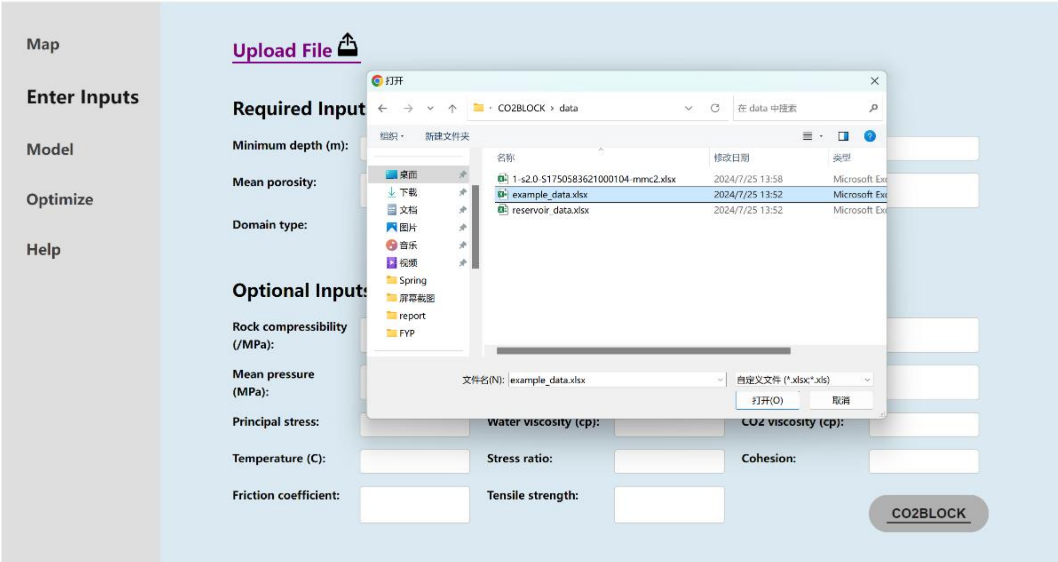
(c) 

Figure 2. (a) Manually enter inputs as model parameters. (b) Prompts displayed when the input type is incorrect (rock compressibility is not a number and CO_2 density is negative in this example). (c) Upload a local file as model inputs.

As shown in Figure 2.c, the user can also click “Upload” to choose a local file containing model parameters, and the file content will automatically fill the input boxes on the page. The uploaded file should be an Excel file with specific naming formats so that the system can correctly identify each parameter; these formats will be detailed on the help page. Clicking the button “CO2BLOCK” will navigate the interface to the model module.

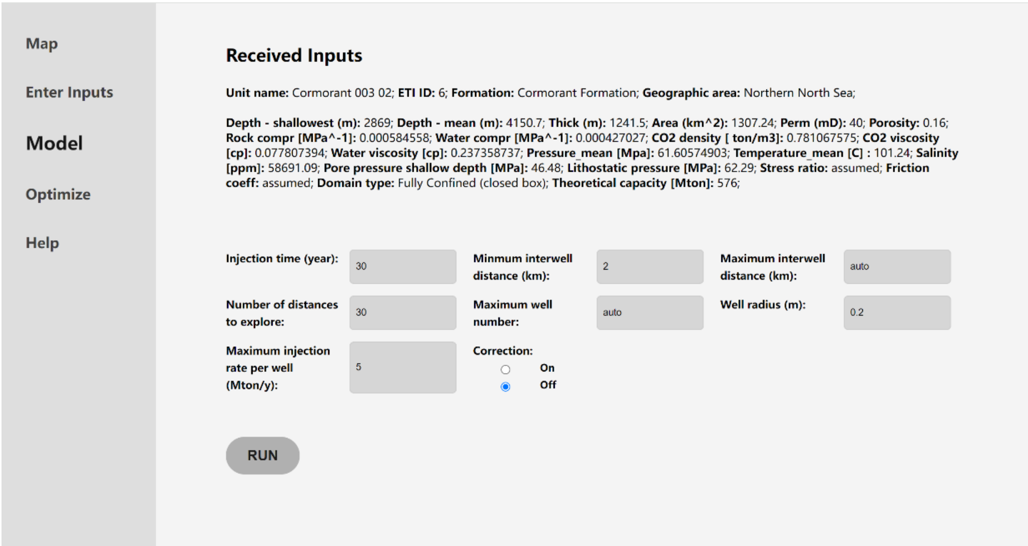
Model Module

Route: model/map/<site_id>

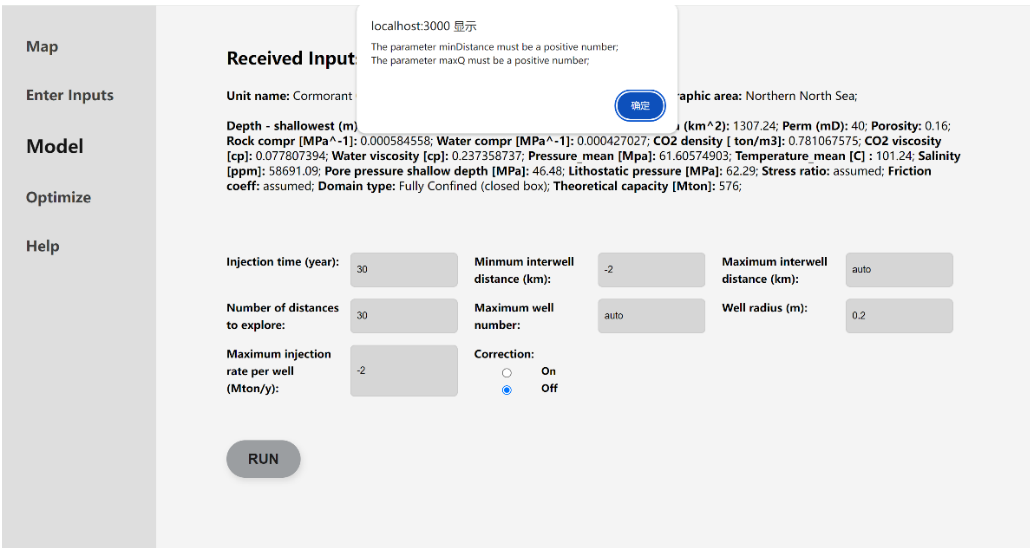
model/enter-inputs

The route of model module will be */model/map/<site_id>* if it is navigated from the map page, and */model/enter-inputs* if it is navigated from the inputs module. To run the model, the user must either select a unit on the map page or enter the parameters in the inputs module.

As shown in Figure 3.a, the received inputs are displayed on the page, and technical limit parameters can be specified in the input boxes. Any invalid technical limits will trigger an alert as shown in Figure 3.b. Maximum number of wells and maximum interwell distance can be set to “auto” for the model to explore. After clicking "Run", the backend will immediately launch the model. Once execution is complete, the plots of maximum flow rate per well and maximum sustainable storage will be presented on the page, as illustrated in Figure 3.c. Model outputs including plots and Excel files can be saved to local devices by clicking the download sign.

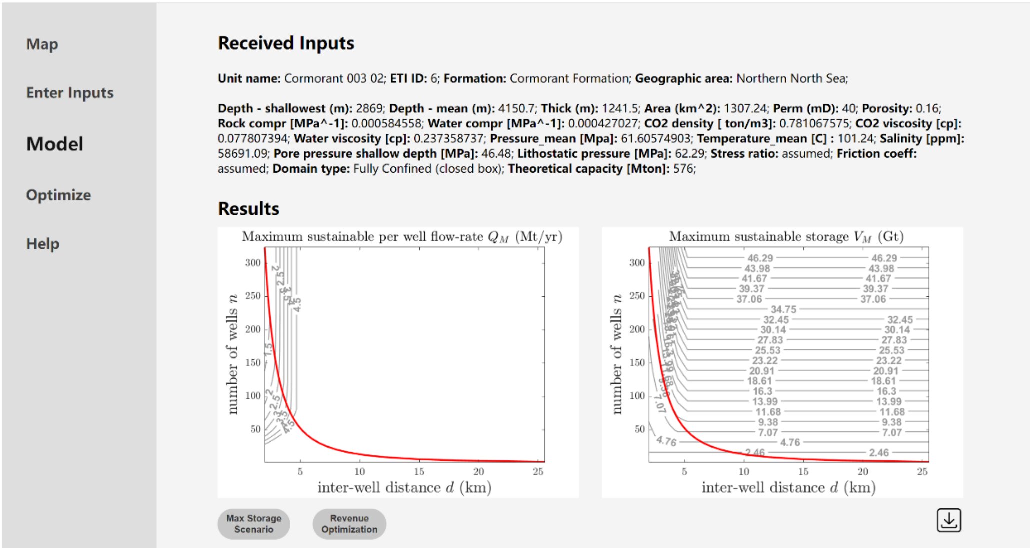


(a)



(b)

(c)



(d)

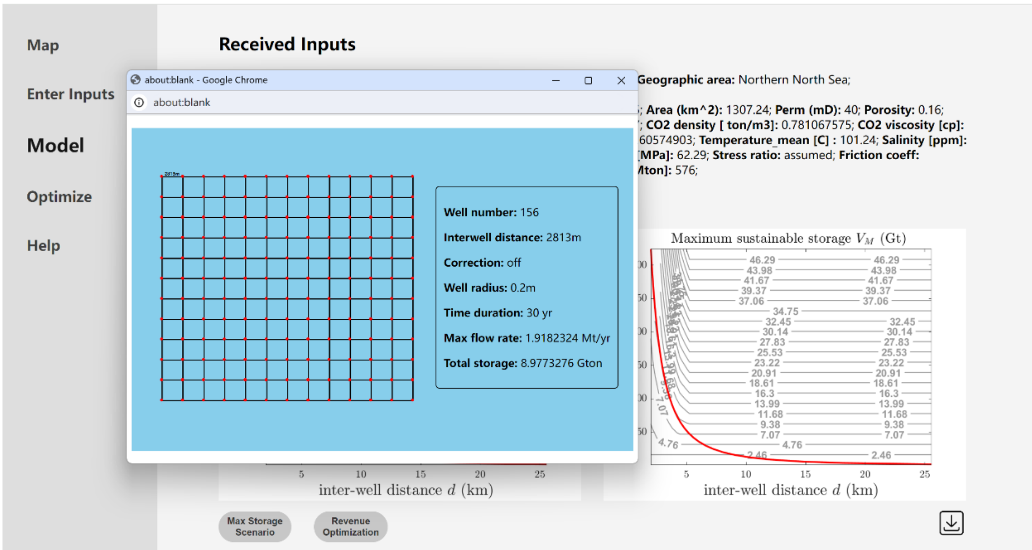


Figure 3. (a) Received inputs displayed, technical limits can be specified. (b) Alert message shown when technical limits are invalid (maximum well number and injection rate are negative in this example). (c) Display of output plots after the model finishes running. (d) Illustration of maximum storage scenario giving technical limits.

When clicking the button “Max Storage Scenario” at the bottom, the interwell distance and well number resulting in maximum storage will be visualized in a new window. Button “Revenue Optimization” will navigate the interface to the optimization page.

Optimization Module

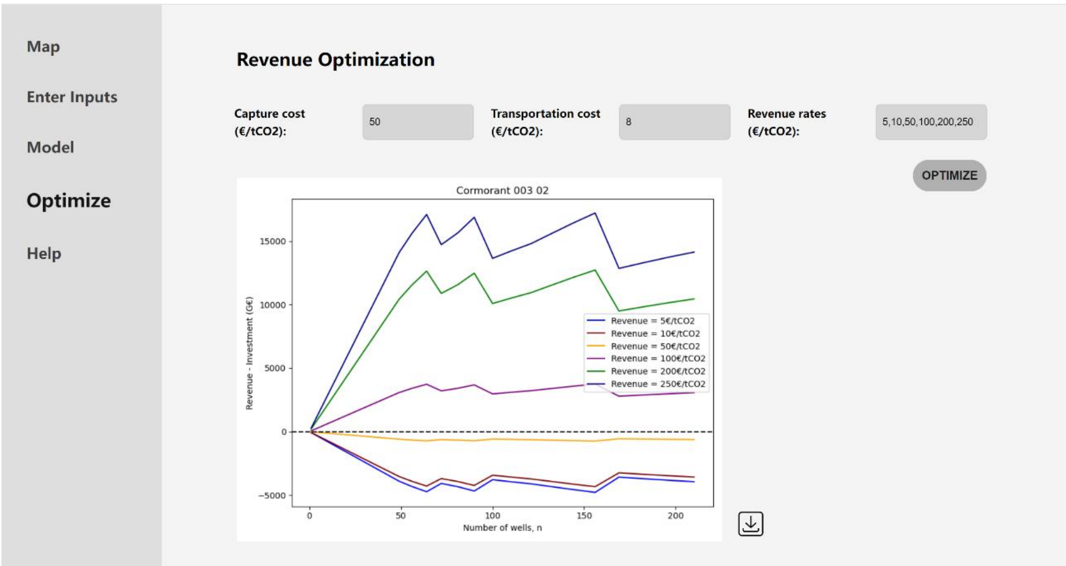
Route: /optimize/outputs

/optimize

The revenue optimization page reads the outputs from CO2BLOCK when the interface transitions from the model module to the optimization page, and the route will then be */optimize/outputs*. Before clicking “Optimize”, users can specify parameters including capture and transportation costs, as well as revenue rates. The interface will prompt users if any of the entered parameters are invalid. The net revenue is then calculated using a simplified economic analysis. As shown in Figure 4.a, once the backend completes calculation, a plot displaying net revenue across different rates is generated, which can be saved by clicking the download icon.

The user can also choose to upload an output file containing the maximum sustainable storage under different scenarios to compute the net revenue, as illustrated in Figure 4.b. The route will then be */optimize*. The uploaded file should be an Excel file with specific naming formats so that the system can correctly identify the values; these formats will be detailed on the help page.

(a)



(b)

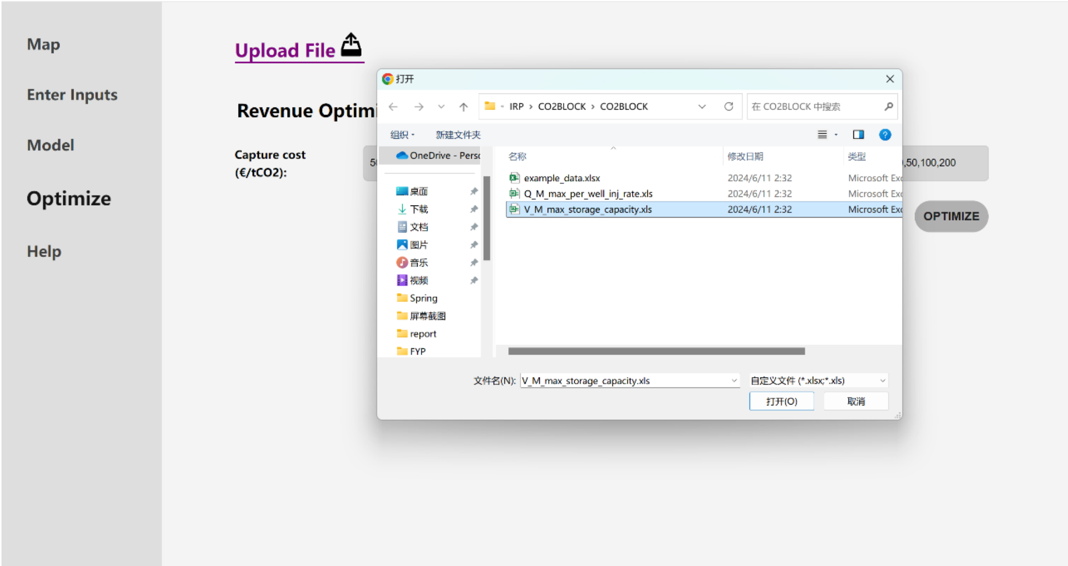


Figure 4. (a) Revenue calculation under different revenue rates based on model output. (b) Upload an output file for revenue optimization.

Help Module

Route: /help

As shown in Figure 5, the help page includes the description of the interface, with the link to user guide for installing the prerequisites provided. The user can also download the example files with sample column names for uploading. The navigation bar on the left side of the page allows users to switch between different modules.

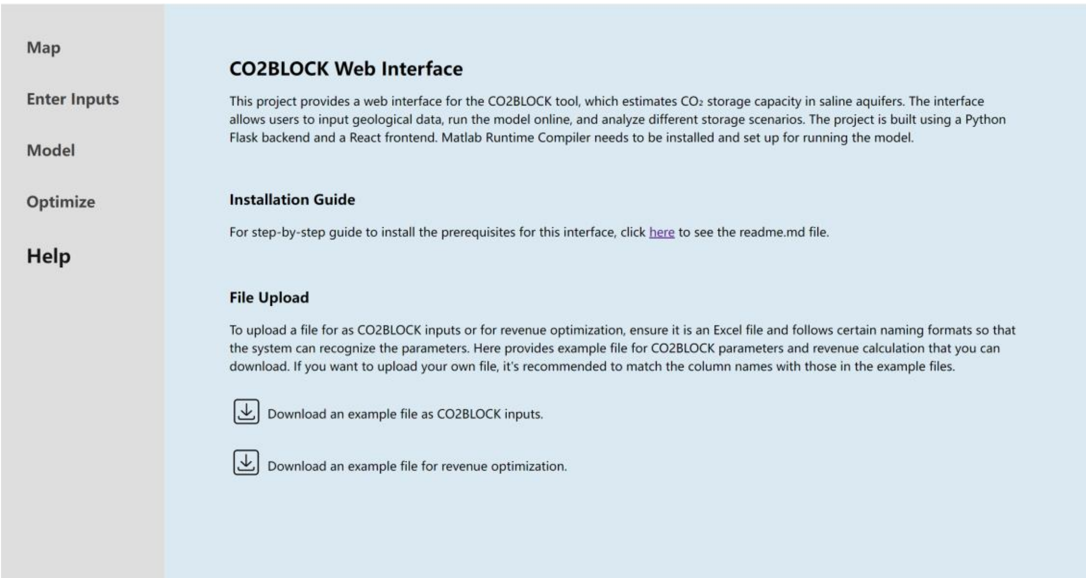


Figure 5. Help module with the description of the interface, link to the user guide, and example files.