# Toolkit-Based Modeling Workflow

Tutorial Data Here:

## <https://drive.google.com/drive/folders/1f2-Z9URwd0_Xp_QN0474n7Y9s9-RhADX?usp=drive_link>

## 1. Preparing the Elevation Data

1. Download the elevation data for the study site from the U.S. Geological Survey (USGS) website as a GeoTIFF file.
2. Use this file as a base approximation of the current-day conditions of the site. Keep in mind that data may be outdated depending on survey frequency.

## 2. Designing Interventions in Rhino

1. Open Rhino 8 and import a Google Earth satellite-view screenshot or an image of your bathymetric data.
2. Scale the image to 1:1 in model space.
3. Trace the edge of the coast for clarity.
4. Position breakwaters 400 ft away from the shoreline (adjust to meters as needed).
5. Set the shoreline trace to elevation 0 and raise the breakwater tops to an elevation of 2 ft.
6. Export the model as a .dxf file.

## 3. Aligning the Model in ArcGIS Pro

1. Load both the GeoTIFF and .dxf files into a new ArcGIS Pro project.
2. Check alignment: the USGS raster should geolocate correctly, but the Rhino model will not.
3. Run the Feature to Raster tool on the intervention file using the Polyline option.
4. Use the Georeferencing Toolkit to scale and align the intervention raster using control points and the shoreline trace as reference.
5. Combine the two rasters using Mosaic to New Raster, ensuring the intervention overwrites the underlying bathymetry where overlapping. Make sure to select 1 band, and 16-bit signed for the options.

## 4. Exporting the Bed File

1. Run Raster to Point with default settings.
2. Follow with Add XY Coordinates.
3. Export the resulting point grid as a .csv file containing POINT\_X, POINT\_Y, and grid\_code. They should be in the default export option in columns 3, 4, and 2, respectively. You don’t need to remove pointid.

## 5. Loading and Cleaning Data in MATLAB

1. Open MATLAB R2024a and load the .csv file.
2. Assign POINT\_X to x1, POINT\_Y to y1, and grid\_code to z1.
3. Use meshgrid to reconstitute the grid, and interpolate z1 with griddata using the 'cubic' option.
4. Set min and max equal to the USGS elevation range.

## 6. Visualizing Transects

1. Define a key list for transects and a structure of their endpoints.
2. Plot the model bed using pcolor and overlay each transect.
3. Save the plot as a PNG file for later reference.

## 7. Generating Input Files for XBeach

1. Loop through each transect.
2. Use linspace to generate evenly spaced x and y points between start and end.
3. Use interp2 to project elevation values onto the transect.
4. Plot the transect profile.
5. Create a folder named after the transect and save the profile image inside.
6. Define the simulation parameters, call create\_jonswap.m, run xb\_grid\_xgrid, write the parameter file, copy xbeach.exe and netcdf.dll into the folder, and start the simulation.

## 8. Running Multiple Simulations

1. Run multiple simulations in parallel—XBeach uses ~11% GPU, so up to 9 can run simultaneously with no slowdowns (depending on computer specs- use smaller batches as needed).
2. Test the setup with up to 5 simultaneous runs to confirm no performance drop.
3. Repeat simulations with alternate interventions and with no intervention as a control.

## 9. Analyzing Results

1. Let XBeach output NetCDF files containing water level, depth, wave height, and bed level over 2 hours, recorded every minute.
2. Use QUICKPLOT to animate water behavior and compare performance across interventions.