# BRIE user guide v1.0

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# Overview

The Barrier Inlet Environment (BRIE) model simulates barrier island transgression during sea-level rise. It explicitly simulates the effect of tidal inlets on barrier island morphodynamics. The model is written for MatLab.

# Files

Three files are necessary for BRIE, located in a folder accessible to MatLab. Aside from the three model files, you will also need a matlab function called v2struct, which can be found online.

*initialize\_barrier\_model.m* generates initial and boundary conditions for the model. Output is a matlab data structure with model settings.

*barrier\_model.m* contains the model, input is a data structure generated by *initialize\_barrier model.m*

*run\_barrier\_model.m* allows the user to run the model automatically for sets of parameters such as sea-level rise rates or wave heights.

# Starting a run

There are two options for starting a model run:

*barrier\_model(initialize\_barrier\_model)* will run the model with the settings described in initialize\_barrier model

*run\_barrier\_model* will run the model with a series of parameters described in run\_barrier model.

# Input conditions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **parameter** | **Model default** | **units** | **note** | **Ref.** |
| name | 'Example' |  |  |  |
| barrier\_model\_on | true |  | Flag to turn the overwash and shoreface formulations on or off |  |
| ast\_model\_on | true |  | Flag to turn alongshore transport on or off |  |
| inlet\_model\_on | true |  | Flag to turn inlets on or off |  |
| make\_gif | false |  | Flag to make a gif of the model run |  |
| plot\_on | true |  | Flag to plot during the model run |  |
| sedstrat\_on | false |  | Flag to generate stratigraphy at a certain location |  |

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| **general parameters** | | | | |
| rho\_w | 1025 | kg/m3 | Density of water |  |
| g | 9.81 | m/s2 | Gravity |  |
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| **wave climate parameters** | | | | |
| wave\_height | 1 | m | Mean offshore significant wave height |  |
| wave\_period | 10 | s | Mean wave period |  |
| wave\_asym | 0.8 |  | Fraction of waves approaching from the left looking offshore | 1 |
| wave\_high | 0.2 |  | Fraction of waves approaching at angles higher than 45 degrees from shore normal | 1 |
| wave\_climl | 180 |  | resolution of possible wave approach angles (1 per degree, easy math) |  |
| AngArray | linspace(-0.5\*pi,0.5\*pi,wave\_climl)' |  | Wave approach angles |  |
| k | 5.3e-6\*1050\*(g^1.5)\*(0.5^1.2)\*(sqrt(g\*0.78)/(2\*pi))^0.2 |  | correct k for alongshore transport | 2 |

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| **barrier model parameters** | | | | |
| slr | 2.00E-03 | m/yr | sea-level rise rates |  |
| s\_background | 1.00E-03 |  | background cross-shore slope | 3 |
| w\_b\_crit | 200 | m | critical barrier width | 3 |
| h\_b\_crit | 2 | m | critical barrier height | 3 |
| Qow\_max | 20 | m3/m/yr | max overwash flux | 3 |
| z | 10 | m | initial sea level |  |
| bb\_depth | 3 | m | back barrier depth |  |
| grain\_size | 2.00E-04 | m | Median grain size of the shoreface |  |
| R | 1.65 |  | relative density of sand |  |
| e\_s | 0.01 |  | suspended sediment transport efficiency factor | 4 |
| c\_s | 0.01 |  | Shoreface transport friction factor | 4 |

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| **alongshore grid setup** | | | | |
| dy | 100 | m | length of each alongshore section (m) |  |
| ny | 1000 |  | number of alonghsore sections |  |

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| **timestepping** | | | | |
| dt | 0.05 | years | Timestep of the numerical model |  |
| nt | 1.00E+05 |  | number of timesteps |  |
| dtsave | 1.00E+03 |  | save spacing |  |

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| **Inlet** | | | | |
| Jmin | 10000 | m | minimum inlet spacing | 5 |
| a0 | 0.5 | m | amplitude of tide |  |
| omega0 | 1.40E-04 | rad/s | tidal frequency |  |
| inlet\_asp | sqrt(0.005) |  | aspect ratio inlet | 6 |
| man\_n | 0.05 | s m-1/3 | bulk manning n of the lagoon (vegetated stream) | 6 |
| u\_e | 1 | m/s | inlet equilibrium velocity | 6 |
| inlet\_max | 100 |  | maximum number of inlets (debugging) |  |
| marsh\_cover | 0.5 |  | percentage of backbarrier covered by marsh and therefore does not contribute to tidal prism |  |

# Output files

The barrier model generates a matlab data structure upon completion.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable name** | **Variable size** | **units** | **note** |
| Qoverwash | [nt×1single] | m3/yr | Total overwash flux through time |
| x\_t\_save | [ny×nt/dtsaveint32] | m | Position of the shoreface toe |
| x\_s\_save | [ny×nt/dtsaveint32] | m | Position of the shoreline |
| x\_b\_save | [ny×nt/dtsaveint32] | m | Position of the back barrier shoreline |
| h\_b\_save | [ny×nt/dtsavesingle] | m | Height of the barrier |
| s\_sf\_save | [ny×nt/dtsavesingle] |  | Shoreface slope |
| z0 | [1×1] | m | Minimum integration depth for the shoreface flux |
| d\_sf | [1×1] | m | Shoreface depth |
| k\_sf | [1×1] | m3/m/yr | Shoreface flux |
| s\_sf\_eq | [1×1] |  | Equilibrium shoreface slope |
| inlet\_age | [x×2int32] |  | Inlet position (col 1 is time, col 2 is alongshore location) |
| inlet\_nr | [1×nt/dtsaveuint16] |  | Number of inlets active through time |
| inlet\_migr | [1×nt/dtsaveint16] | m/yr | Average rate of inlet migration through time |
| inlet\_ai | [1×nt/dtsaveint32] |  | Average inlet cross-sectional area through time |
| inlet\_alpha | [1×nt/dtsavesingle] |  | Average alpha fraction for each inlet through time |
| inlet\_beta | [1×nt/dtsavesingle] |  | Average beta fraction for each inlet through time |
| inlet\_delta | [1×nt/dtsavesingle] |  | Average delta fraction for each inlet through time |
| inlet\_Qs\_in | [1×nt/dtsavesingle] | m3/yr | Average sediment flux into inlets through time |
| Qinlet | [nt×1single] | m3/yr | Total transgressive inlet flux through time |

# References

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