# **XBeachMI Documentation**

Release 0.1

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XBeach MI (Multiple Instances) is a Python wrapper for XBeach that allows the user to run multiple instances of XBeach simultaneously. Each instance can have its own settings. Possible applications are:

- 1. Running XBeach in stationairy and instationairy mode alternating depending on the wave conditions
- 2. Running XBeach with multiple wind conditions and averaging the result (MORMERGE)

A BMI-compatible version of XBeach is needed to use with the XBeach MI Python wrapper. The wrapper itself is also BMI compatible.

Contents:

#### Installation

This document describes the installation steps needed to get the XBeach MI (Multiple Instances) framework to work on a Windows machine (the screenshots may deviate slightly as they are from a Mac OS X machine). If you have a working XBeach installation you can skip step 1. If you have a working Python 2.7 installation with packages numpy, netCDF4, multiprocessing and mako installed, you can skip step 2.

### 1. Download XBeach

1. Go to http://xbeach.org.

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New XBeach 'Kingsday' release		Search January 26	assica Wilson's message board post, RE: Gett	ing Started Tutorial -

- 1. Choose Downloads and Releases and source.
- 1. Go to Daily builds and download XBeach rev. XXXX (with netCDF support). You need a recent version of XBeach (rev. >= 4748) that implements the Basic Model Interface (BMI).



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	XBeach is tested and validated automatically and also (almost) on a daily basis (	see Validation). F	or these tests, XBeach is	



#### 2. Download Python

- 1. Google for Python XY (or Anaconda).
- 1. Follow the instructions to download Python XY (or Anaconda).
- 1. Follow the instructions to install Python XY (or Anaconda). Do not forget to choose Full install and not the default installation configuration.

#### 3. Download BMI and XBeach MI

- 1. Go to http://github.com/openearth and search for bmi-python.
- 1. Choose Download ZIP.
- 1. Go back and search for xbeach-mi.
- 1. Choose Download ZIP.

#### 4. Install BMI and XBeach MI

- 1. Unzip the downloaded bmi-python and xbeach-mi packages.
- 2. Go to the command line (Start > cmd).
- 3. Go to the download directory of the bmi-python package.
- 4. Go to the directory that contains the setup.py file.







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5. Run the command python setup.py install.



- 1. Go to the download directory of the xbeach-mi package that contains the setup.py file.
- 2. Again, run the command python setup.py install.

#### 5. Test XBeach MI

- 1. Test the installation by running the command <code>xbeach-mi --help</code>.
- 1. Go to the example directory in the xbeach-mi download directory.
- 2. Run XBeach MI with the provided configuration file.
- 1. Details on configuring and running XBeach MI can be found on the documentation website: *Examples*





#### **Examples**

**Note:** In order to run XBeach MI you need a compiled XBeach library with BMI interface (bmi branch or trunk rev >= 4748) that is in your path.

Note: You can find the full examples described here in th GIT repository https://github.com/openearth/xbeach-mi/tree/master/example

For an XBeach MI run you need at least two files:

- 1. Regular params.txt file for XBeach
- 2. A XBeach MI JSON configuration file

In the following sections two example setups for XBeach MI are explained. The first is a sequential run in which multiple XBeach instances run in sequence (e.g. surfbeat for storm conditions and stationary for average conditions). The second is a parallel run in which multiple XBeach instances are run in parallel, while their bathymetry is averaged (MORMERGE). It is possible to combine both approaches in a single setup.

#### Sequential

The XBeach MI configuration file describes the communication between the different instances. It is in JSON format as shown below. Two sections are particularly important for a sequential run: scenario and exchange.

scenario describes what instances should be activated at what point in time. For a sequential run only one instance runs at a time. Note that it is possible to provide a list of instances, which would enable the parallel mode. Also note that all instances are activated by default at the start of the simulation.

exchange provides a list with all variables that are being exchanged between instances in case the model switches from one instance to another. For most sequential runs this list needs to contain the majority of the XBeach output variable for the best results as it ensures that the full model state is copied from one instance to another.

Note that the XBeach MI configuration file references a single params.txt file through the params\_file keyword. Consequently, all instances share the same params.txt file and no differences between the instances exist. Therefore, it is possible to add templating makers to the params.txt file to make it instance dependent. In the example below, the instance instat defines surfbeat boundary conditions, while the instance stat defines stationary boundary conditions. Please refer to the Mako templating engine for all the possible templating options.

**Note:** Note that the grids of all instances should be equal, so it is not allowed to define different values for nx and ny between instances.

## Parallel (MORMERGE)

For a parallel run instances don't need to be defined by a scenario (although it is possible), but can be defined by a simple list using the instances keyword. The exchange list is generally much smaller than for a sequential run and typically only holds the zb variable.

In addition, a keyword aggregate can be defined that specifies how data from the different instances need to be aggregated. The method keyword defines the methodology or a reference to a custom Python function. The options keyword holds key/value pairs that are passed as options to the aggregation function. The interval defined the interval in seconds when the data between instances should be aggregated and exchanged.

Also a parallel run uses a single params.txt file that uses Mako templating differentiate between instances. In this example both instances run in surfbeat mode, but with different boundary conditions.

## Nesting

Not supported.

CHAPTER 3

## Source code documentation

model

cmd

#### MPI

An MPI version of XBeach MI is being developed. This version can be ran within an MPICH2 or OpenMPI wrapper. Individual XBeach models can then be distributed over multiple cores for optimal performance.

The beta version of the MPI version can be found in a branch of the GitHub repository:

https://github.com/openearth/xbeach-mi/tree/mpi

## Examples

mpirun -n 8 xbeach-mi xbeachmi.json

### **Command-line tools**

The XB each MI wrapper can be executed from the command-line using the "xbeach-mi" command. See for more information the -help option.

## xbeach-mi

## Source code repository

The XBeach MI source code can be downloaded from the OpenEarth GitHub repository: https://github.com/openearth/xbeach-mi/.

CHAPTER 7

Indices and tables

- genindex
- modindex
- search