## NAME

**mbotps** − Predicts tides using the OSU Tidal Prediction Software (OTPS) distribution.

## VERSION

Version 5.0

## SYNOPSIS

**mbotps**
[
**--input**=*datalist* {**-I***datalist*}
**--format**=*format_id* {**-F***format_id*}
**--use-mbprocess** {**-M**}
**--skip-existing** {**-S**}
**--tide-output**=*file* {**-O***output*}
**--tide-position**=*lon/lat* {**-R***lon/lat*}
**--tide-format**=*format_id* {**-A***tideformat*}
**--interval**=*interval* {**-D***interval*}
**--start-time**=*year/month/day/hour/minute/second* {**-B***year/month/day/hour/minute/second*}
**--end-time**=*year/month/day/hour/minute/second* {**-E***year/month/day/hour/minute/second*}
**--tide-station-file**=*file* {**-N***tidestationfile*}
**--tide-station-position**=*lon/lat {***-U***lon/lat}*
**--tide-station-format**=*format_id {***-C***tidestationformat}*
**--otps-model**=*model_name {***-T***model}*
**--otps-path**=*path {***-P***path}*
**--help** *{***-H***}*
**--verbose** *{***-V***}*
*]*

## DESCRIPTION

**MBotps** is a utility that predicts tides using software and global tidal models available from Gary Egbert and Svetlana Erofeeva of Oregon State University (OSU) at:

https://www.tpxo.net In order for **mbotps** to function, users must separately obtain and install the OSU Tidal Prediction Software (OTPS) and the associated TPXO tidal models. Both software and models are made available at no cost for academic, research or other noncommercial use, but must be licensed for a fee for commercial use. Instructions (current as of 2024) are given below for installing the software and a model.

**MBotps** can be operated in two modes. First, users may use the **−R**, **−B**, and **−E** options to specify a location and the beginning and end times of a tidal model for that location. The **−D** option sets the time interval of values in the output tidal model, and the **−O** option sets the output tidal model filename.

Alternatively, instead of specifying a place and time range, the user may specify one or more swath data files using the **−I** option. A tidal model is produced for each swath file in which tidal values are calculated using the sonar navigation locations at intervals specified with the **−D** option, and if the **−M** option is specified, the swath file's processing parameter file is modified so that **mbprocess** applies the tidal model during processing.

The **−C***tidestationformat*, **−N***tidestationfile*, and **−U***tidestationlon/tidestationlat* commands together allow users to input observations from a tide station; these observations can be used to calculate corrections to tidal model values in the vicinity of the tide station. If tide station data are specified, then **MBotps** calculates the difference between the observed and modeled tide at that station for each data point in the input tide station data. This difference time series is then used as a correction to the output tide models, whether

at a location specified with the **−R***lon/lat* option or for swath data specified with the **−I***datalist* option.

## OBTAINING AND INSTALLING OTPS AND TXPO MODELS

The OSU Tidal Prediction Software (OTPS) can be downloaded from

https://www.tpxo.net/otps

Three versions of the software are available, the first of which consists of Fortran 90 programs that work with OTPS binary model files, the second of which is a **MATLAB** package also working with the binary model files, and the third of which is Fortran 90 programs that work with netCDF format model files. These instructions discuss only the first binary file case that has been tested with **MB-System**, and present only one of many possible installation scenarios (but this case fits MB-System default settings).

On the OTPS web page, use the "Download OTPS" button to download the OTPS software distribution in the form of a file named "OTPS.tar.Z". The MB-System default settings include locating the OTPS installation in the directory /usr/local/src/ . Move the distribution file to this directory:

```
mv OTPS.tar.Z /usr/local/src
```

If the user does not have write privileges in /usr/local/src, then it may be necessary to operate in "sudo" mode (which assumes the user is a system administrator):

```
sudo mv OTPS.tar.Z /usr/local/src
```

Move to /usr/local/src and unpack the distribution:

```
cd /usr/local/src
gunzip OTPS.tar.Z
tar xvf OTPS.tar or
uncompress OTPS.tar.Z
tar xvf OTPS.tar
```

This will unpack a directory called OTPS. Moving into the directory and listing the contents:

```
cd OTPS
ls
```

yields:

```
COPYRIGHT               makefile*
DATA/                   matlab/
README                  predict_tide.f90
constit.h*              predict_tide_sample_out
dumsetup                setup.atl
extract_HC.f90*         setup.inp
extract_HC_sample_out   setup.local
extract_local_model.f90 subs.f90
lat_lon                 time
lat_lon_time
```

The component of OTPS that is required for **mbotps** is the program predict_tide, which must be compiled from the Fortran 90 source file predict_tide.f90.

On a Linux computer with the GCC compiler suite installed, the gfortran program (a Fortran compiler) is already available, or can be easily installed via apt on Debian and Ubuntu or via yum on CentOs or Red Hat:

```
sudo apt install gfortran
```

or

```
sudo yum install gcc-gfortran
```

On a Mac, the LLVM compiler suite installed with the XCode development tools does not include a Fortran compiler, and so it is necessary to install GCC as well. Assuming that a Mac user is already installing prerequisite packages for **MB-System** using the MacPorts package manager, then **gfortran** can be installed via

the commands:

```
sudo port install gcc14 +gfortran
sudo port select --set gcc mp-gcc14
sudo ln -s /opt/local/bin/gfortran-mp-14 gfortran
```

Note that the version of GCC will continue to increment over time, and so may no longer be GCC 14. The last command links the installed Fortran compiler to the name "gfortran" (to allow the use of the OTPS makefile without modification).

In the OTPS directory, apply the Fortran compiler using the make utility:

```
sudo make predict_tide
```

The program predict_tide now exists in a location known to **mbotps**.

The OTPS directory described above includes a directory named DATA, which has the following contents:

```
HAW/                    Model_tpxo9.v2
Model_Hawaii            Model_tpxo9_atlas_v5
Model_tpxo10.v2         load_file
Model_tpxo10_atlas
```

Here the files with names beginning with "Model_" describe different available tidal models, each of which consists of a directory containing many model files. In order to install a tidal model, the associated directory and files must be obtained and placed inside the DATA directory. We recommend use of the TPXO10-atlas-v2 bin model, which combines a global model with higher resolution local models for many coastal areas. This is described in the Model_tpxo10_atlas file.

The tidal model must be obtained from OSU via instructions on the web pages:

```
https://www.tpxo.net/global
https://www.tpxo.net/tpxo-products-and-registration
```

Basically, one must request access to a model via email. If approved, you will receive a link to download a directory named TPXO10_atlas_v2 which contains the following files:

```
grid_tpxo10_atlas_30_v2     u_2n2_tpxo10_atlas_30_v2
h_2n2_tpxo10_atlas_30_v2    u_k1_tpxo10_atlas_30_v2
h_k1_tpxo10_atlas_30_v2     u_k2_tpxo10_atlas_30_v2
h_k2_tpxo10_atlas_30_v2     u_m2_tpxo10_atlas_30_v2
h_m2_tpxo10_atlas_30_v2     u_m4_tpxo10_atlas_30_v2
h_m4_tpxo10_atlas_30_v2     u_mf_tpxo10_atlas_30_v2
h_mf_tpxo10_atlas_30_v2     u_mm_tpxo10_atlas_30_v2
h_mm_tpxo10_atlas_30_v2     u_mn4_tpxo10_atlas_30_v2
h_mn4_tpxo10_atlas_30_v2    u_ms4_tpxo10_atlas_30_v2
h_ms4_tpxo10_atlas_30_v2    u_n2_tpxo10_atlas_30_v2
h_n2_tpxo10_atlas_30_v2     u_o1_tpxo10_atlas_30_v2
h_o1_tpxo10_atlas_30_v2     u_p1_tpxo10_atlas_30_v2
h_p1_tpxo10_atlas_30_v2     u_q1_tpxo10_atlas_30_v2
h_q1_tpxo10_atlas_30_v2     u_s1_tpxo10_atlas_30_v2
h_s1_tpxo10_atlas_30_v2     u_s2_tpxo10_atlas_30_v2
h_s2_tpxo10_atlas_30_v2
```

Move the directory TPXO10_atlas_v2 to /usr/local/src/OTPS/DATA/ :

```
mv TPXO10_atlas_v2 /usr/local/src/OTPS/DATA/
```

The tidal model should now be installed, and **mbotps** should access it successfully. This can be tested by running **mbotps** with the −−help option:

```
Program mbotps
MB-system Version 5.8.3beta03
```

MBotps predicts tides using methods and data derived from the OSU Tidal Prediction Software (OTPS)

distributions.

usage: mbotps
[
--input=datalist {-Idatalist}
--format=format_id {-Fformat_id}
--use-mbprocess {-M}
--skip-existing {-S}
--tide-output=file {-Ooutput}
--tide-position=lon/lat {-Rlon/lat}
--tide-format=format_id {-Atideformat}
--interval=interval {-Dinterval}
--start-time=year/month/day/hour/minute/second {-Byear/month/day/hour/minute/second}
--end-time=year/month/day/hour/minute/second {-Eyear/month/day/hour/minute/second}
--tide-station-file=file {-Ntidestationfile}
--tide-station-position=lon/lat {-Ulon/lat}
--tide-station-format=format_id {-Ctidestationformat}
--otps-model=model_name {-Tmodel}
--otps-path=path {-Ppath}
--help {-H}
--verbose {-V}
]

Checking for available OTPS tide models
OTPS location: /usr/local/src/otps
Default OTPS model name: tpxo10_atlas
Specified OTPS model name:
Possible OTPS tidal models:
tpxo10_atlas <installed>
Number of available OTPS tide models: 1

Using OTPS tide model: tpxo10_atlas

The output of **mbotps** indicates that the desired tidal model is available.

## MB-SYSTEM AUTHORSHIP

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−−**input**=*datalist*
Sets the input filename. If *format* > 0 (set with the −−**format** option) then the swath sonar data contained in *infile* is read and processed. If *format* < 0, then *infile* is assumed to be an ascii file containing a list of the input swath sonar data files to be processed and their formats. The program will read the data in each one of these files. In the *infile* file, each data file should be followed by a data format identifier, e.g.:
datafile1 11
datafile2 24

This program uses the **MBIO** library and will read or write any swath sonar format supported by **MBIO**. A list of the swath sonar data formats currently supported by **MBIO** and their identifier values is given in the **MBIO** manual page. Default: *infile* = "stdin".

**−−format=***format_id*
Sets the data format of the input swath data file specified with the **−I** option. If *format* < 0, then the input file specified with the **−I** option will actually contain a list of input swath sonar data files. This program uses the **MBIO** library and will read any swath sonar format with timestamps supported by **MBIO**. A list of the swath sonar data formats currently supported by **MBIO** and their identifier values is given in the **MBIO** manual page. The default format is set using **mbdefaults**.

**−−use-mbprocess**
If the **−I** option has been used so that tidal models are created for swath files, then this option causes each swath file's parameter file to be modified so that **mbprocess** will read and apply the ancillary tidal model file created by **mbotps**.

**−−skip-existing**
If tide models are being generated for swath files specified using the **-I** option, then skip files that already have an existing tide model.

**−−tide-output=***file*
Sets the filename of the tidal model output.

**−−tide-position=***lon/lat*
Sets the longitude and latitude position at which the tidal model will be calculated.

**−−tide-format=***format_id*
This option sets the format of the tide station data in the file specified using the **-N***tidestationfile* option. The tide station data may be in one of four ASCII, space delimited, table formats:
*tidestationformat*=1: format is <time_d tide>
*tidestationformat*=2: format is <yr mon day hour min sec tide>
*tidestationformat*=3: format is <yr jday hour min sec tide>
*tidestationformat*=4: format is <yr jday daymin sec tide>
Note that in format 1 the value time_d = decimal seconds since 1/1/1970 and that format 4 the value daymin = decimal minutes since the start of day.

**−−interval**=*interval*
This option sets the time interval between tidal model values in seconds. Default: 60 seconds.

**−−start-time**=*year/month/day/hour/minute/second*
This option sets the starting time for for the output tidal model.

**−−end-time**=*year/month/day/hour/minute/second*
This option sets the ending time for the output tidal model

**−−tide-station-file**=*file*
Sets the filename of the tide station data file used to correct the output tide model.

**−−tide-station-position**=*lon/lat*
Sets the longitude and latitude position of the tide station from which the data specified with the **\-−tide-station-file**=*flTidestationfile*.

**−−tide-station-format**=*format_id*
This option sets the format of the tide station data in the file specified using the **-N***tidestationfile* option. The tide station data may be in one of four ASCII, space delimited, table formats:
*tidestationformat*=1: format is <time_d tide>
*tidestationformat*=2: format is <yr mon day hour min sec tide>
*tidestationformat*=3: format is <yr jday hour min sec tide>
*tidestationformat*=4: format is <yr jday daymin sec tide>
Note that in format 1 the value time_d = decimal seconds since 1/1/1970 and that format 4 the value daymin = decimal minutes since the start of day.

**−−otps-model**=*model_name*
Sets the name of the OTPSnc tidal model to be used. This model must be part of the local OTPSnc installation. Examples include "tpxo7.2" and "altas". Default: "tpxo10_atlas"

**−−otps-path**=*path*
Sets the path to the local installation of OTPS, which in turn defines the location of the program **predict_tide** called by **mbotps** and the tide model to be used by **predict_tide**.

**−−help**
This "help" flag cause the program to print out a description of its operation and then exit immediately.

**−−verbose**
Increases the verbosity of **mbotps**.

## EXAMPLES

Suppose one wishes to obtain a tidal model for the location 121W 36N extending at 60 second intervals over the day February 21, 2009. The following will suffice:

```
mbotps −−tide-position=125/36 −−start-time=2009/02/21/00/00/00 \
                    −−end-time=2009/02/21/23/59/59 −−verbose
```

The shell output looks like:

```
Program mbotps
MB-system Version 5.8.3beta03

Checking for available OTPS tide models
 OTPS location: /usr/local/src/otps
 Default OTPS model name: tpxo10_atlas
 Specified OTPS model name:
 Possible OTPS tidal models:
  tpxo10_atlas <installed>
 Number of available OTPS tide models: 1

Using OTPS tide model:  tpxo10_atlas
Running: cd /usr/local/src/otps; ./predict_tide

 Lat/Lon/Time file:/Users/caress/t30135.txt
 Predict OCEAN tide
 DATA/TPXO10_atlas_v2/h_m2_tpxo10_atlas_30_v2
 Model:       src/otps/DATA/Model_tpxo10_atlas
 Lat limits:     -90.0166702       90.0166702
 Lon limits:      1.66666675E-02   360.016663
 Constituents: m2  s2  k1  o1  n2  p1  k2  q1  2n2 mf  mm  m4  ms4 mn4 s1
 Predict elevations (m)
 Constituents to include: m2  s2  k1  o1  n2  p1  k2  q1  2n2 mf  mm  m4  ms4 mn4 s1
 Infer minor constituents except those listed above.
 The grid bathymetry defined in z, u, v - nodes
 Bathymetry at u/v nodes is used to calculate currents
Opening atlas files:m2  s2  k1  o1  n2  p1  k2  q1  2n2 mf  mm  m4  ms4 mn4 s1   done
 Results are in /Users/caress/u30135.txt

Results are really in tide_model.txt
```

The output tidal model is in the file tide_model.txt, which includes data that look like:

```
# Tide model generated by program mbotps
```

```
# MB-System Version: 5.8.3beta03
# Tide model generated by program mbotps
# which in turn calls OTPS program predict_tide obtained from:
#     http://www.coas.oregonstate.edu/research/po/research/tide/
#
# OTPSnc tide model:
#      tpxo10_atlas
# Output format:
#      year month day hour minute second tide
# where tide is in meters
# Run by user <caress> on cpu <RAITT-1121.local> at <Tue Nov 19 21:36:30 2024>
# Model:        src/otps/DATA/Model_tpxo10_atlas
# Constituents included: m2  s2  k1  o1  n2  p1  k2  q1  2n2 mf  mm  m4  ms4 mn4 s1
2009 02 21 00 00 00   -0.6780
2009 02 21 00 01 00   -0.6760
2009 02 21 00 02 00   -0.6730
2009 02 21 00 03 00   -0.6710
2009 02 21 00 04 00   -0.6680
2009 02 21 00 05 00   -0.6650
2009 02 21 00 06 00   -0.6630
2009 02 21 00 07 00   -0.6600
2009 02 21 00 08 00   -0.6580
2009 02 21 00 09 00   -0.6550
2009 02 21 00 10 00   -0.6520
2009 02 21 00 11 00   -0.6490
2009 02 21 00 12 00   -0.6470
2009 02 21 00 13 00   -0.6440
 ..................
2009 02 21 23 54 00   -0.7900
2009 02 21 23 55 00   -0.7890
2009 02 21 23 56 00   -0.7870
2009 02 21 23 57 00   -0.7860
2009 02 21 23 58 00   -0.7840
2009 02 21 23 59 00   -0.7820
```

Now, suppose that one wants to apply tide corrections directly to a set of EM3002 data in GSF format. First, execute **mbotps** with the datalist for the swath data specified as input:

```
mbotps −−input=datalist.mb-1 −−verbose
```

The resulting shell output looks like:

```
Program mbotps
MB-system Version 5.8.3beta03

Checking for available OTPS tide models
 OTPS location: /usr/local/src/otps
 Default OTPS model name: tpxo10_atlas
 Specified OTPS model name:
 Possible OTPS tidal models:
        tpxo10_atlas <installed>
 Number of available OTPS tide models: 1

Using OTPS tide model:  tpxo10_atlas
Running: cd /usr/local/src/otps; ./predict_tide

 ----------------------------------------
```

```
Processing tides for himbb05291.d23.mb121

35602 records read from himbb05291.d23.mb121.fnv

 Lat/Lon/Time file:tmp_mbotps_llt_7413.txt
 Constituents to include: m2  s2  n2  k2  k1  o1  p1  q1
 Predict OCEAN tide
 Interpolate minor constituents

 DATA/TPXO10_atlas_v2/h_m2_tpxo10_atlas_30_v2
 Model:       src/OTPS/DATA/Model_tpxo10_atlas
 Model is on grid uniform in lat,lon
 Lat limits:    -90.125 90.125
 Lon limits:    0.125 360.125
Constituents: m2  s2  k1  o1  n2  p1  k2  q1  2n2 mf  mm  m4  ms4 mn4 s1
 Predict elevations (m)
 Constituents to include: m2  s2  k1  o1  n2  p1  k2  q1  2n2 mf  mm  m4  ms4 mn4 s1
 Infer minor constituents except those listed above.
 The grid bathymetry defined in z, u, v - nodes
 Bathymetry at u/v nodes is used to calculate currents
Opening atlas files:m2  s2  k1  o1  n2  p1  k2  q1  2n2 mf  mm  m4  ms4 mn4 s1   done
 Results are in tmp_mbotps_llttd_7413.txt

Results are really in himbb05291.d23.mb121.tde
```

The output tide files have the same structure shown above:

```
# Tide model generated by program mbotps
# MB-System Version: 5.8.3beta03
# Tide model generated by program mbotps
# which in turn calls OTPS program predict_tide obtained from:
#     http://www.coas.oregonstate.edu/research/po/research/tide/
#
# OTPSnc tide model:
#      tpxo10_atlas
# Output format:
#      year month day hour minute second tide
# where tide is in meters
# Run by user <caress> on cpu <deitz> at <Tue Nov 19 17:53:22 2024>
# Model:       src/OTPS/DATA/Model_tpxo10_atlas
# Constituents included: m2  s2  n2  k2  k1  o1  p1  q1  mf  mm  m4  ms4 mn4
2005 10 18 19 01 36    0.0800
2005 10 18 19 02 36    0.0790
2005 10 18 19 03 36    0.0770
2005 10 18 19 04 36    0.0760
2005 10 18 19 05 37    0.0750
2005 10 18 19 06 37    0.0730
2005 10 18 19 07 37    0.0720
2005 10 18 19 08 37    0.0710
2005 10 18 19 09 37    0.0700
```

In addition to generating *.tde files for each swath file referenced by the input datalist structure, when the **--use-mbprocess** option is specified, **mbotps** modifies the parameter file associated with each swath file (creating it if necessary) so that tide correction is enabled using the *.tde file and tide format 2. When

**mbprocess** is run on the same datalist, the files will be reprocessed, and the processing will include the application of the tide correction to all bathymetry.

## SEE ALSO

**mbsystem**(1), **mbprocess**, **mbset**

## BUGS

Installing the OTPS package from OSU is not excessively easy.