Package ‘earhtide’

March 13, 2020

Type Package

Title Parallel Implementation of 'ETERNA 3.40' for Prediction and Analysis of Earth Tides

Version 0.0.10

Maintainer Jonathan Kennel <jkennel@uoguelph.ca>

Description This is a port of 'Fortran ETERNA 3.4'
<http://igets.u-strasbg.fr/soft_and_tool.php> by H.G. Wenzel for calculating synthetic Earth tides using the
Hartmann and Wenzel (1994) <doi:10.1029/95GL03324> or

BugReports https://github.com/jkennel/earhtide/issues

URL https://github.com/jkennel/earhtide

License GPL-3

Depends R (>= 3.4.0)

Imports Rcpp (>= 1.0.0), RcppParallel (>= 4.4.2), R6 (>= 2.3.0)

LinkingTo Rcpp (>= 1.0.0), RcppParallel (>= 4.4.2), RcppArmadillo (>= 0.9.200.7.0), BH (>= 1.69.0-1)

Suggests testthat (>= 2.1.0), knitr, rmarkdown

RoxygenNote 6.1.1

VignetteBuilder knitr

Encoding UTF-8

LazyData TRUE

NeedsCompilation yes

SystemRequirements C++11

Author Jonathan Kennel [aut, cre, trl],
Beth Parker [ths],
Wenzel Hans-Georg [ctb]

Repository CRAN

Date/Publication 2020-03-13 18:10:03 UTC
R topics documented:

earthtide-package ................................................. 2
calc_earthtide .................................................... 3
Earthtide ........................................................... 4
eterna_wavegroups .............................................. 7
get_iers ............................................................. 7
get_main_frequency .............................................. 8

Index

earthtide-package

earthtide: R port of the earth tide processing package ETERNA (by Hans-Georg Wenzel) including the Kudryavtsev wave catalog.

Description

The goal of this package is to generate synthetic earth tides for use in the R programming language and in particular environmental models. Code was parallized and refactored to minimize duplication, and to allow for future improvements.

Details

You can learn about the earthtide package in the vignettes: browseVignettes(package = "earthtide")

Author(s)

Maintainer: Jonathan Kennel <jkenelle@uoguelph.ca> [translator]

Other contributors:

• Beth Parker <bparker@uoguelph.ca> [thesis advisor]
• Wenzel Hans-Georg [contributor]

References


See Also

Useful links:

• https://github.com/jkennel/earthtide
• Report bugs at https://github.com/jkennel/earthtide/issues
Description

This is a wrapper to the Earthtide R6 class for the prediction of Earth tides. This function is provided for users who would prefer a more typical R function.

Usage

calc_earthtide(utc, do_predict = TRUE, method = "gravity",
astro_update = 1, latitude = 0, longitude = 0, elevation = 0,
azimuth = 0, gravity = 0, earth_radius = 6378136.3,
earth_eccen = 0.0066943979514, cutoff = 1e-06, wave_groups = NULL,
catalog = "ksm04", eop = NULL, return_matrix = FALSE,
scale = TRUE, ...)

Arguments

utc            The date-time in UTC (POSIXct vector).
do_predict    run in predict or analyze mode
method        One or more of "gravity", "tidal_potential", "tidal_tilt", "vertical_displacement",
              "horizontal_displacement", "n_s_displacement", "e_w_displacement", "vertical_strain",
              "areal_strain", "volume_strain", "horizontal_strain", or "ocean_tides", "pole_tide",
              "lod_tide". The pole tide and lod_tide are used in predict mode even if do_predict
              is FALSE. More than one value can only be used if do_predict == TRUE.
astro_update  Integer that determines how often to phases are updated in number of samples.
              Defaults to 1 (every sample), but speed gains are realized with larger values.
              Typically updating every hour will have speed gains and keep precision (ie 3600
              for one second data, 60 for minute data, 1 for hourly data).
latitude      The station latitude (numeric) defaults to 0.
longitude     The station longitude (numeric) defaults to 0.
elevation     The station elevation (m) (numeric) defaults to 0.
avimuth       Earth azimuth (numeric) defaults to 0.
gravity       Gravity at the station (m/s^2) (numeric) 0 to estimate gravity from elevation
              and latitude.
earth_radius  Radius of earth (m) (numeric) defaults to 6378136.3
earth_eccen   Eccentricity of earth (numeric) defaults to 6.69439795140e-3
cutoff        Cutoff amplitude for constituents (numeric) defaults to 1e-6.
wave_groups   Two column data.frame having start and end of frequency groups (data.frame).
              This data.frame must have two columns with the names 'start', and 'end' signi-
              fying the start and end of the wave groupings. An optional third column 'mul-
              tiplier' can be provided to scale the particular wave group. If column names do
              no match, the inferred column positions are start, end, multiplier.
Earthtide

<table>
<thead>
<tr>
<th>catalog</th>
<th>Use the &quot;hw95s&quot; catalog or &quot;ksm04&quot; catalog (character).</th>
</tr>
</thead>
<tbody>
<tr>
<td>eop</td>
<td>User defined Earth Orientation Parameter (EOP) data.frame with the following columns: datetime, ddt, ut1_utc, lod, x, y, dx, dy</td>
</tr>
<tr>
<td>return_matrix</td>
<td>Return a matrix of tidal values instead of data.frame. The datetime column will not be present in this case (logical).</td>
</tr>
<tr>
<td>scale</td>
<td>Scale results when do_predict is FALSE</td>
</tr>
<tr>
<td>...</td>
<td>Currently not used.</td>
</tr>
</tbody>
</table>

Value

data.frame of tidal results

Examples

tms <- as.POSIXct('1990-01-01', tz = 'UTC') + c(0, 3600)
wave_groups = data.frame(start = 0, end = 8, multiplier = 1.5)
et <- calc_earthtide(utc = tms,
do_predict = TRUE,
method = c('tidal_potential', 'lod_tide', 'pole_tide'),
astro_update = 1,
latitude = 52.3868,
longitude = 9.7144,
elevation = 110,
gravity = 9.8127,
cutoff = 1.0e-5,
catalog = 'ksm04',
wave_groups = wave_groups)

Earthtide

Earthtide class

Description

Earthtide class

Class to generate synthetic earthtide signals.

Format

An R6Class generator object
Usage

et <- Earthtide$new(
et = as.POSIXct("2017-01-01", tz = "UTC") + 0:(24 * 7) * 3600,
latitude = 52.3868,
longitude = 9.7144,
catalog = "ksm04",
wave_groups = data.frame(start = 0.0, end = 6.0))
et$predict(method = "gravity", astro_update = 1)
et$analyze(method = "gravity", astro_update = 1)
et$lod_tide()
et$pole_tide()
et$tide()
et$print()

Arguments

Earthtide$new

- et: An Earthtide object.
- utc: The date-time in UTC (POSIXct vector).
- latitude: The station latitude (numeric) defaults to 0.
- longitude: The station longitude (numeric) defaults to 0.
- elevation: The station elevation (m) (numeric) defaults to 0.
- azimuth: Earth azimuth (numeric) defaults to 0 (degrees)
- gravity: Gravity at the station (m/s^2) (numeric) 0 to estimate gravity from elevation and latitude.
- earth_radius: Radius of earth (m) (numeric) defaults to 6378136.3
- earth_eccen: Eccentricity of earth (numeric) defaults to 6.69439795140e-3
- cutoff: Cutoff amplitude for constituents (numeric) defaults to 1e-6
- wave_groups: Two column data.frame having start and end of frequency groups (data.frame).
  This data.frame must have two columns with the names 'start', and 'end' signifying the start and end of the wave groupings. An optional third column 'multiplier' can be provided to scale the particular wave group. If column names do no match, the inferred column positions are start, end, multiplier.
- catalog: Use the "hw95s" catalog or "ksm04" catalog (character).
- eop: User defined Earth Orientation Parameter (EOP) data.frame with the following columns: datetime, ddt, ut1_utc, lod, x, y, dx, dy
- ...: Currently not used.

Earthtide$predict, Earthtide$analyze

- method: For predict and analyze. One of "gravity", "tidal_potential", "tidal_tilt", "vertical_displacement", "horizontal_displacement", "n_s_displacement", "e_w_displacement", "vertical_strain", "areal_strain", "volume_strain", "horizontal_strain" or "ocean_tides".
• astro_update: For predict and analyze. Integer that determines how often to phases are updated in number of samples. Defaults to 1 (every sample), but speed gains are realized with larger values. Typically updating every hour will have speed gains and keep precision (i.e. 3600 for one second data, 60 for minute data, 1 for hourly data).

• return_matrix: For predict and analyze. Return a matrix of tidal values instead of data.frame. The datetime column will not be present in this case (logical).

Details

$new(utc, latitude, longitude, elevation, azimuth, gravity, earth_radius, earth_eccen, cutoff, wave_groups, catalog, ...)
create a new Earthtide object and initialize catalog, station and times.

$predict(method, astro_argument, return_matrix) generate a combined synthetic Earth tide.

$analyze(method, astro_argument, return_matrix, scale) generate components of the Earth tide for analysis.

$lod_tide() generate components of the LOD (Length Of Day) tide.

$pole_tide() generate components of the pole tide.

$tide() get the tide data.frame.

$print() print the Earthtide object.

References


Examples

et <- Earthtide$new(
  utc = as.POSIXct("2017-01-01", tz = "UTC") + 0:(24 * 7) * 3600,
  latitude = 52.3868,
  longitude = 9.7144,
  catalog = "ksm04",
  wave_groups = data.frame(start = 0.0, end = 6.0))

et$predict(method = "gravity", astro_update = 1)

plot(gravity~datetime, et$tide(), type='l')
**eterna_wavegroups**

**Hartmann and Wenzel (1995) (ETERNA 3.4) wavegroups**

**Description**

This data.frame contains wavegroups for different data time spans. The wavegroups should be subset prior to use and the 'time' column provides guidelines based on your input time span.

**Usage**

eterna_wavegroups

**Format**

A data.frame. The columns are:

- **name**: wave group name
- **start**: lowest frequency of the wave group
- **end**: highest frequency of the wave group
- **time**: applicable to data of what length

**Examples**

utils::data(eterna_wavegroups)

---

**get_iers**

**get_iers**

**Description**

get_iers returns a data.frame of earth orientation parameters from (1962-present). This function requires an active internet connection. Bulletins A and B are combined giving precedence to B. The following datasets are downloaded (~ 7 MB):

- ftp://cddis.gsfc.nasa.gov/pub/products/iers/tai-utc.dat

**Usage**

get_iers()
get_main_frequency

Value
data.frame of earth orientation parameters with the following columns: datetime, ddt, ut1_utc, lod, x, y, dx, dy.

Examples

## Not run:
eop <- get_iers()

## End(Not run)

get_main_frequency get_main_frequency

Description

Get the frequency of the wave with the maximum amplitude in a range.

Usage

get_main_frequency(start, end)

Arguments

start the starting frequency in cycles per day (numeric)
end the ending frequency in cycles per day (numeric)

Value

the main frequency between start and end
Index

*Topic **datasets**
  eterna_wavegroups, 7
  _PACKAGE (earthtide-package), 2

calc_earthtide, 3

Earthtide, 4
Earthtide-class (Earthtide), 4
earthtide-package, 2
eterna_wavegroups, 7

get_iers, 7
get_main_frequency, 8

R6Class, 4