Package 'aermod'

October 23, 2021

Title Work with AERMOD POST files

Version 0.0.1.0

Description Convert Fortran Unformatted I/O format POST files to/from R matrix. Convert 1-hr SO2 NAAQS Design value for linear combination of matrices. Developed for running Monte Carlo simulations for SO2 SIP Attainment Demonstration Modeling.

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Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

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Suggests testthat (>= 3.0.0)

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Imports magrittr,
dplyr,
purrr,
stringr,
tidyselect,
tidyr,
tibble,
lubridate

R topics documented:

blend *Blend two impact matrices together.*

Description

The blend operation inserts rows from a source impact matrix (typically corresponding to an impact matrix for a non-continuous source) into a target impact matrix (typically corresponding to a continuous source that does not operate at the same time as the non-continuous source). Blend also generates an impact matrix which is a zero matrix of the same dimensions as the source matrix, except for the selected rows.

Usage

```
blend(src, indices, target)
```

Arguments

src	Matrix corresponding to source group for which intermittent operation is simulated.
indices	Hours of operation (integer vector). Typically generated with hrs_rand
target	Matrix representing source group that does *not* operate when intermittent source does. By default this is the zero matrix (i.e., intermittent source may operate at same time as all other sources).

Details

Indices are intended to be a set of randomly generated operating hours created by hrs_rand (which may be created via make_simplan).

Value

Blended matrix. Has an attribute listing all of the hours for which a substitution was made. Existing attributes are carried over from target.

fast_so2_dv *Calculate 2010 SO2 design values using base functions only*

Description

Calculate 2010 SO2 design values using base functions only

Usage

```
fast_so2_dv(mat, sumfn = identity)
```

Arguments

mat	An impact matrix over five years of met data
sumfn	Use max for max DV at any receptor, default is identity (DV at each receptor, in order).

Value

A vector of design values.

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get_dv *Calculate SO2 Design value*

Description

Calculate the 2010 SO2 NAAQS design value for an impact matrix. The impact matrix should have rows corresponding to the number of hours in a five-year meteorological database (e.g., 43848 hours for 2016–2020). The number of receptors (columns) can be arbitrary.

Usage

```
get_dv(mat, diag = FALSE)
```

Arguments

mat	An impact matrix, typically a linear combination of impact matrices, which may be the result of a Monte Carlo simulation.
diag	Do not report full calculation. Instead, output a tibble giving the top four daily highs at each receptor x year.

Details

Per EPA's 2014 guidance (pp. A-24–A-25), the calculation is carried out as follows:

1. At each receptor, for each hour of the modeled period, calculate a total concentration across all sources including backgro1md concentrations if applicable. This can be done in AERMOD using SRCGROUP ALL or by adding individual source groups outside of AERMOD, using hourly POSTFILEs. If the user is totaling the concentrations outside of AERMOD, the source groups used in the calculations need to be mutually exclusive, i.e. no one source should be in multiple source groups.
2. From the total concentrations calculated in step 1, obtain the 1-hr maximum concentration at each receptor for each modeled day.
3. From the output of step 2, for each year modeled, calculate the 99th percentile (4th highest) daily maximum 1-hour concentration at each receptor. If modeling 5 years of meteorological data, this results in five 99th percentile concentrations at each receptor.
4. Average the 99th percentile (or 4th highest) concentrations across the modeled years to obtain a design value at each receptor.

5. Modeled source contributions to a NAAQS violation can be determined by analyzing the hourly concentrations from the individual source groups POSTFILES corresponding to the same hour as the 4th daily maximum 1-hour concentration from each year. See 75 FR at 35540.

Value

A double corresponding to the calculated design value.

`hrs_rand` *Generate random hours of operation*

Description

Generate random hours of operation over the meteorological database. Hours within each meteorological year are randomly sampled (without replacement). Random sampling can consider blocks of consecutive hours, or individual hours (block length of 1).

Usage

```
hrs_rand(
  yrspan = 2016L:2020L,
  nblock = 6L,
  blocklen = 1L,
  which_filter = 1L,
  units = c("hours", "days"),
  emis_scale = 1
)
```

Arguments

`yrspan`	Calendar years for which operating hours are to be generated. A numeric vector
`nblock`	Number of blocks of consecutive hours.
`blocklen`	Number of hours in each block. Default is 1.
`which_filter`	Integer specifying special filters on the random number generation. Default is 1 (no filter). 2 is case where nblock = 1 and blocks in successive years must be spaced at least 365 days apart.
`units`	for `blocklen`, either `"hours"` (default) or `"days"`. Return value is always vector of hours.
`emis_scale`	, for binned randomized emission rates, a vector of emission scalars of length `blocklen`. Default is 1 (no binning).

Value

An integer vector of operating hours, which may be used to index rows in an impact matrix.

`make_simplan` *Generate a list of random operating hours, along with the PRNG seeds needed to recreate them.*

Description

Generate a list of random operating hours, along with the PRNG seeds needed to recreate them.

Usage

```
make_simplan(N_sim = 5, ...)
```

Arguments

`N_sim`	The number of sets of operating hours to generate.
`...`	Input parameters for call to `hrs_rand`.

Value

a nested list of N_sim elements, each of which is a list with elements `seed` and `hrs`

`scan_postfile` *Scan POST file*

Description

Reads Fortran unformatted I/O POSTFILE and conver to matrix. Hours are not written individually, nor are source groups as they are saved as attributes of the matrix.

Usage

```
scan_postfile(f, ...)
```

Arguments

`f`	path to an unformatted Fortran I/O binary POST file generated by AERMOD.
`...`	arguments passed thru to `readBin`. Primary use is to specify endianness in case POST file was generated on a machine with different endianness from your own.

Details

The AERMOD user's guide (3-186–3-187) describes the format of the file as follows:

"... the resulting unformatted file includes a constant-length record for each of the selected averaging periods calculated during the model run. The first variable of each record is an integer variable (4 bytes) containing the ending date (YYMMDDHH) for the averages on that record. The second variable for each record is an integer variable (4 bytes) for the number of hours in the averaging period. The third variable for each record is a character variable of length eight containing the source group ID. The remaining variables of each record contain the calculated average concentration values for all receptors, in the order in which they were defined in the input runstream."

The records themselves are delimited by 4 byte integers (at the start and end of each record) giving the size (in bytes of the record). There is some predictability in the data: As generated by AERMOD, all records have an equal number of bytes. Additionally, the hours are numbered sequentially, without gaps, and the source group and averaging time are the same for each record. Therefore, the only information that needs to be stored at the record level is the ordered tuple of concentrations at each receptor for the particular hour and source group. `scan_postfile` stores this information as a matrix, and stores the starting hour, averaging period, and source group name as attributes of the matrix, rather than repeating the information with each row.

Value

An impact matrix with attributes `srcgrp` and `hrbaseline` (first hour). The number of hours and number of receptors can be accessed by calling the built-in `dim` function on the matrix.

`serialize_post` *Serialize impact matrix*

Description

Serialize impact matrix to AERMOD unformatted binary POST file.

Usage

```
serialize_post(mat, fname, srcgrp)
```

Arguments

`mat`	matrix
`fname`	character
`srcgrp`	character

Value

logical

sher_lambda *Report Lambda Values for State Health Effects Review*

Description

Generates various statistics used in TCEQ Toxicology Tier III RFC reviews. If the impact matrix covers more than one year of met data, only the first year is used.

Usage

```
sher_lambda(mat, esl)
```

Arguments

mat	An impact matrix over one year of met data
esl	an esl against which to report lambda values

Value

A list of various data tables useful for running Monte Carlo simulations, or reporting unadjusted lambda values.

sher_monte_carlo *Generate 99.9 percentile value of total exceedances (10,000 Monte Carlo trials) for State Health Effects review, given table of exceedances.*

Description

Generates various statistics used in TCEQ Toxicology Tier III RFC reviews. If the impact matrix covers more than one year of met data, only the first year is used.

Usage

```
sher_monte_carlo(lambda, nhr, nsim = 10000L)
```

Arguments

lambda	A lambda object generated by the sher_lambda function
nhr	A proposed limit on hr/yr of operatoin.

Value

A table of 99.9% percentile exceedance figures for different window sizes and ESL thresholds (2xESL, 4xESL)

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