Package ‘footprint’
January 6, 2021

Title Calculate Air Travel Emissions
Version 0.1
Description A handy tool to calculate carbon footprints from air travel based on three-letter International Air Transport Association (IATA) airport codes or latitude and longitude. footprint first calculates the great-circle distance between departure and arrival destinations. It then uses the Department of Environment, Food & Rural Affairs (DEFRA) greenhouse gas conversion factors for business air travel to estimate the carbon footprint. These conversion factors consider trip length, flight class (e.g. economy, business), and emissions metric (e.g. carbon dioxide equivalent, methane).

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URL https://github.com/acircleda/footprint

BugReports https://github.com/acircleda/footprint/issues

Depends R (>= 3.5.0)
Imports airportr, dplyr, magrittr, rlang
Suggests devtools, knitr, rmarkdown, testthat (>= 2.1.0), tibble, covr

VignetteBuilder knitr

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

NeedsCompilation no

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**airport_footprint**

**Description**

A function that calculates emissions per flight based on pairs of three-letter airport codes, flight classes, and emissions metrics. Emissions are returned in kilograms of the chosen metric.

**Usage**

```
airport_footprint(departure, arrival, flightClass = "Unknown", output = "co2e")
```

**Arguments**

- **departure**
  a character vector naming one or more three-letter IATA (International Air Transport Association) airport codes for outbound destination

- **arrival**
  a character vector naming one or more three-letter IATA (International Air Transport Association) airport codes for inbound destination

- **flightClass**
  a character vector naming one or more flight class categories. Must be of the following "Unknown", "Economy", "Economy+", "Business" or "First". If no argument is included, "Unknown" is the default and represents the average passenger.

- **output**
  a single character argument naming the emissions metric of the output. For metrics that include radiative forcing, one of
  - "co2e" (carbon dioxide equivalent with radiative forcing) - default
  - "co2" (carbon dioxide with radiative forcing)
  - "ch4" (methane with radiative forcing)
  - "n2o" (nitrous oxide with radiative forcing)
  - Metrics without radiative forcing: "co2e_norf", "co2_norf", "ch4_norf", or "n2o_norf".

**Details**

Distances between airports are based on the Haversine great-circle distance formula, which assumes a spherical earth. They are calculated using the `airportr` package. The carbon footprint estimates are derived from the Department for Environment, Food & Rural Affairs (UK) 2019 Greenhouse Gas Conversion Factors for Business Travel (air): https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019

**Value**

a numeric value expressed in kilograms of chosen metric
Examples

```r
# Calculations based on individual flights
airport_footprint("LAX", "LHR")
airport_footprint("LAX", "LHR", "First")
airport_footprint("LAX", "LHR", "First", "ch4")
airport_footprint("LAX", "LHR", output = "ch4")

# Calculations based on a data frame of flights
library(dplyr)
library(tibble)

travel_data <- tribble(~name, ~from, ~to, ~class,
                        "Mike", "LAX", "PUS", "Economy",
                        "Will", "LGA", "LHR", "Economy+",
                        "Elle", "TYS", "TPA", "Business")

travel_data %>%
  rowwise() %>%
mutate(emissions = airport_footprint(from, to,
                                        flightClass = class,
                                        output="co2e"))
```

latlong_footprint

*Calculate flight emissions based on longitude and latitude pairs*

**Description**

A function that calculates emissions per flight based on longitude and latitude, flight classes, and emissions metrics. Emissions are returned in kilograms of the chosen metric.

**Usage**

```r
latlong_footprint(
  departure_lat,
  departure_long,
  arrival_lat,
  arrival_long,
  flightClass = "Unknown",
  output = "co2e"
)
```

**Arguments**

- `departure_lat` a numeric vector of one or more latitudes for departure location
- `departure_long` a numeric vector of one or more longitudes for outbound location
- `arrival_lat` a numeric vector of one or more latitudes for arrival location
arrival_long  a numeric vector of one or more longitudes for arrival location

flightClass a character vector naming one or more flight class categories. Must be of the following "Unknown", "Economy", "Economy+", "Business" or "First". If no argument is included, "Unknown" is the default and represents the average passenger.

output character emissions metric of the output. For metrics that include radiative forcing, one of

- "co2e" (carbon dioxide equivalent with radiative forcing) - default
- "co2" (carbon dioxide with radiative forcing)
- "ch4" (methane with radiative forcing)
- "n2o" (nitrous oxide with radiative forcing)
- Metrics without radiative forcing: "co2e_norf", "co2_norf", "ch4_norf", or "n2o_norf".

Details

Value
a numeric value expressed in kilograms of chosen metric

Examples
# Calculations based on individual flights
latlong_footprint(34.052235, -118.243683, 35.179554, 129.075638)
latlong_footprint(34.052235, -118.243683, 35.179554, 129.075638, "First")
latlong_footprint(34.052235, -118.243683, 35.179554, 129.075638, "First", "ch4")
latlong_footprint(34.052235, -118.243683, 35.179554, 129.075638, output = "ch4")

# Calculations based on a data frame of flight
library(dplyr)
library(tibble)

travel_data <- tribble(~name, ~departure_lat, ~departure_long, ~arrival_lat, ~arrival_long,
  # Los Angeles -> Busan
  "Mike", 34.052235, -118.243683, 35.179554, 129.075638,
  # New York -> London
  "Will", 40.712776, -74.005974, 51.52, -0.10)

travel_data %>%
  rowwise() %>%
  mutate(emissions = latlong_footprint(departure_lat, departure_long, arrival_lat,)

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arrival_long,
output="co2e")


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