

# Package: glscalibrator (via r-universe)

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**Type** Package

**Title** Automated Calibration and Analysis of GLS (Global Location Sensor) Data

**Version** 0.1.0

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**Description** Provides a fully automated workflow for calibrating and analyzing light-level geolocation (GLS) data from seabirds and other wildlife. The package auto-discovers birds from directory structures, automatically detects calibration periods from the first days of deployment, processes multiple individuals in batch mode, and generates standardized outputs including position estimates, diagnostic plots, and quality control metrics. Implements the established threshold workflow internally, following the methods described in SGAT, GeoLight, and TwGeos.

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**Encoding** UTF-8

**LazyData** false

**RoxygenNote** 7.3.3

**Depends** R (>= 4.1.0)

**Imports** magrittr, maps, dplyr, lubridate, stringr, utils, grDevices, graphics, stats

**Suggests** knitr, rmarkdown, testthat (>= 3.0.0)

**VignetteBuilder** knitr

**URL** <https://github.com/fabbiologia/glscalibrator>

**BugReports** <https://github.com/fabbiologia/glscalibrator/issues>

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**Repository** <https://fabbiologia.r-universe.dev>

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auto\_detect\_calibration

*Automatically Detect Calibration Period*

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### Description

Automatically detects a suitable calibration period from the beginning of the light data. This assumes the bird was at a known location (typically the colony) at the start of deployment.

### Usage

```
auto_detect_calibration(
  light_data,
  colony_lat,
  colony_lon,
  threshold = 2,
  min_twilights = 2
)
```

### Arguments

light_data	A data.frame with columns Date and Light
colony_lat	Numeric latitude of known calibration location
colony_lon	Numeric longitude of known calibration location
threshold	Light threshold for twilight detection (default: 2)
min_twilights	Minimum number of twilights required (default: 2)

**Details**

The function tries calibration periods of different lengths (2, 3, 1, 4, 5 days) and returns the first period that yields sufficient twilights with both sunrise and sunset events.

**Value**

A list with:

start	POSIXct start of calibration period
end	POSIXct end of calibration period
twilights	Number of twilights detected
duration_days	Duration in days

**Examples**

```
# Auto-detect calibration from example data (requires SGAT)
example_file <- gls_example("W086")
light_data <- read_lux_file(example_file)
calib <- auto_detect_calibration(light_data,
                               colony_lat = 27.85,
                               colony_lon = -115.17)

print(calib)
```

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calibrate\_gls\_batch    *Batch Calibration of Multiple GLS Devices*

---

**Description**

Main function for automated batch processing of GLS data. Auto-discovers all birds in a directory, detects calibration periods, performs an internal gamma-style sun elevation calibration, and generates standardized outputs.

**Usage**

```
calibrate_gls_batch(  
  data_dir,  
  output_dir,  
  colony_lat,  
  colony_lon,  
  light_threshold = 2,  
  exclude_equinoxes = NULL,  
  min_positions = 10,  
  create_plots = TRUE,  
  verbose = TRUE  
)
```

## Arguments

<code>data_dir</code>	Character path to directory containing .lux files
<code>output_dir</code>	Character path for output files
<code>colony_lat</code>	Numeric latitude of colony/capture location
<code>colony_lon</code>	Numeric longitude of colony/capture location
<code>light_threshold</code>	Numeric light threshold in lux (default: 2)
<code>exclude_equinoxes</code>	List of date ranges to exclude (optional)
<code>min_positions</code>	Minimum number of valid positions required (default: 10)
<code>create_plots</code>	Logical, whether to create diagnostic plots (default: TRUE)
<code>verbose</code>	Logical, print progress messages (default: TRUE)

## Details

This function implements a complete automated workflow:

1. Auto-discovers .lux files in the data directory
2. For each bird:
  - Reads light data
  - Auto-detects calibration period
  - Detects and filters twilights
  - Learns a sun elevation angle directly from the calibration data
  - Calculates positions using threshold method
  - Generates diagnostic plots
3. Combines results into standardized formats
4. Creates summary statistics and quality control metrics

## Value

A list containing:

<code>summary</code>	data.frame with calibration summary for all birds
<code>results</code>	List of position estimates for each bird
<code>processing_log</code>	Detailed processing log

## Examples

```
## Not run:  
# Basic usage  
results <- calibrate_gls_batch(  
  data_dir = "data/raw/birds",  
  output_dir = "data/processed/calibration",  
  colony_lat = 27.85178,  
  colony_lon = -115.17390
```

```
)  
  
# With equinox exclusions  
equinoxes <- list(  
  c("2024-08-24", "2024-10-23"),  
  c("2024-02-19", "2024-04-19")  
)  
results <- calibrate_gls_batch(  
  data_dir = "data/raw/birds",  
  output_dir = "data/processed/calibration",  
  colony_lat = 27.85,  
  colony_lon = -115.17,  
  exclude_equinoxes = equinoxes  
)  
  
## End(Not run)
```

---

convert\_to\_glsmerge     *Convert to GLSmerge Format*

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## Description

Converts calibrated position data to the standard GLSmerge format used by many researchers and analysis tools.

## Usage

```
convert_to_glsmerge(results, bird_id, zenith)
```

## Arguments

results	data.frame of position estimates
bird_id	Character ID of the bird
zenith	Numeric zenith angle used for calibration

## Value

data.frame in GLSmerge format

---

detect\_twilights      *Detect Twilight Times from Light Data*

---

### Description

Detects sunrise and sunset times from light intensity data using a threshold-crossing method. This is a proven, simple approach that identifies transitions between day and night.

### Usage

```
detect_twilights(light_data, threshold = 2)
```

### Arguments

light\_data      A data.frame with columns Date (POSIXct) and Light (numeric)  
 threshold      Numeric light threshold in lux for day/night distinction (default: 2)

### Value

A data.frame with columns:

Twilight      POSIXct datetime of twilight event  
 Rise          Logical, TRUE for sunrise, FALSE for sunset

### Examples

```
# Detect twilights from example data
example_file <- gls_example("W086")
light_data <- read_lux_file(example_file)
twilights <- detect_twilights(light_data, threshold = 2)
head(twilights)
```

---

estimate\_sun\_elevation      *Estimate the sun elevation angle for a known site*

---

### Description

Uses observed calibration twilights at a known location to learn the sun elevation angle required by the threshold method. The calculation minimizes the median absolute difference between observed and predicted twilights using the NOAA solar equations.

### Usage

```
estimate_sun_elevation(twilight, rise, lon, lat, interval = c(-12, 2))
```

**Arguments**

twilight	POSIXct vector of twilight times from the calibration period.
rise	Logical vector marking whether each event is a sunrise (TRUE) or sunset (FALSE).
lon, lat	Numeric longitude and latitude of the calibration site.
interval	Numeric length-two vector giving the search interval (in degrees) for the sun elevation.

**Value**

Named numeric vector containing the inferred zenith angle ('z1'), the sun elevation ('degElevation'), and the objective value.

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filter_twilights	<i>Filter and Clean Twilight Data</i>
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**Description**

Applies quality filters to twilight data to remove spurious detections caused by shading, logger malfunction, or other artifacts.

**Usage**

```
filter_twilights(twilights, light_data = NULL, threshold = 2, strict = TRUE)
```

**Arguments**

twilights	A data.frame with columns Twilight and Rise
light_data	The original light data (optional, for quality checks)
threshold	Light threshold used for twilight detection
strict	Logical, if TRUE applies stricter filtering (default: TRUE)

**Details**

Filters applied:

- Remove twilights too close together (< 1-2 hours)
- Remove twilights with unusual intervals (far from 12 or 24 hours)
- Optionally check light quality around twilight (if light\_data provided)

**Value**

A filtered data.frame of twilights

## Examples

```
# Filter twilights from example data
example_file <- gls_example("W086")
light_data <- read_lux_file(example_file)
twilights <- detect_twilights(light_data, threshold = 2)
twilights_clean <- filter_twilights(twilights, light_data, threshold = 2)
nrow(twilights_clean)
```

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gls\_example

*Get Path to Example Data*

---

## Description

Helper function to get the path to example .lux files included with the package. Three example files are available and their metadata is exposed via `glscalibrator_example_metadata`.

## Usage

```
gls_example(which = "all")
```

## Arguments

which	Character string specifying which example file: <ul style="list-style-type: none"><li>• "W086" - See metadata for details</li><li>• "W592" - See metadata for details</li><li>• "synthetic" - See metadata for details</li><li>• "all" - Returns paths to all example files (default)</li></ul>
-------	---

## Value

Character vector of file path(s) to example data

## Examples

```
# Inspect available example datasets
list_gls_examples()

# Read the bundled W086 seabird deployment
light_data <- read_lux_file(gls_example("W086"))

# Run calibration on the synthetic dataset (quick demo)
synt_path <- gls_example("synthetic")
synthetic_data <- read_lux_file(synt_path)
twl <- detect_twilights(synthetic_data, threshold = 2)
```

---

`glscalibrator_example_metadata`*Metadata for the bundled GLS example datasets*

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## Description

The package ships with three light-level geolocation (.lux) files that are used throughout the documentation, vignettes, and tests. This metadata table records their origin and recommended use so that analysts can reference the contents programmatically.

Named character vector of the filenames stored in `inst/extdata/`, keyed by the identifiers recognised by `gls_example()`.

## Usage

`glscalibrator_example_metadata``glscalibrator_example_files`

## Format

A data frame with 3 rows and 7 variables:

**name** Short identifier used by `gls_example()`

**file** Filename stored under `inst/extdata/`

**type** "real" or "synthetic" dataset

**description** Summary of the dataset contents

**duration\_days** Approximate deployment duration represented

**size\_kb** Approximate file size in kilobytes

**notes** Additional guidance for analysis and demonstrations

A data frame (tibble) with metadata for each example dataset.

Named character vector. Use with `system.file("extdata", ...)`.

## Details

All files are plain-text .lux exports that can be read directly with `read_lux_file()`. Real datasets were collected from tropical seabirds breeding near 27.85°N, 115.17°W and are approved for demonstration and teaching purposes. The synthetic dataset contains idealised sunrise/sunset curves for rapid testing.

## See Also

`gls_example()`, `list_gls_examples()`

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list_gls_examples	<i>List Available Example Datasets</i>
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**Description**

Shows information about example datasets included with the package.

**Usage**

```
list_gls_examples()
```

**Value**

A data.frame with columns: name, file, type, description, duration\_days, size\_kb, notes

**Examples**

```
list_gls_examples()
```

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plot_calibration	<i>Plot Calibration Diagnostics</i>
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**Description**

Creates diagnostic plots showing light data and detected twilights during the calibration period.

**Usage**

```
plot_calibration(light_data, twilights, threshold, bird_id, output_dir)
```

**Arguments**

light_data	data.frame with Date and Light columns
twilights	data.frame with Twilight and Rise columns
threshold	Numeric light threshold
bird_id	Character ID for plot title
output_dir	Directory to save plot

**Value**

NULL (creates PNG file)

---

plot_track	<i>Plot Bird Track</i>
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**Description**

Creates a map showing the estimated movement track of a bird

**Usage**

```
plot_track(  
  results,  
  colony_lat,  
  colony_lon,  
  bird_id,  
  output_dir,  
  hemisphere = ""  
)
```

**Arguments**

results	data.frame with Latitude and Longitude columns
colony_lat	Numeric latitude of colony
colony_lon	Numeric longitude of colony
bird_id	Character ID for plot title
output_dir	Directory to save plot
hemisphere	Character hemisphere check result

**Value**

NULL (creates PNG file)

---

read_lux_file	<i>Read Light Data from .lux Files</i>
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**Description**

Reads and parses light intensity data from .lux files generated by geolocation loggers. Handles various formats and automatically detects the start of data.

**Usage**

```
read_lux_file(file_path)
```

**Arguments**

`file_path`      Character string specifying the path to the .lux file

**Value**

A data.frame with columns:

<code>Date</code>	POSIXct datetime in UTC
<code>Light</code>	Numeric light intensity in lux

**Examples**

```
# Read example data included with package
example_file <- gls_example("W086")
light_data <- read_lux_file(example_file)
head(light_data)
```

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