Package ‘dilp’

May 8, 2026

Title Reconstruct Paleoclimate and Paleoecology with Leaf Physiognomy

Version 1.1.0

Description Use leaf physiognomic methods to reconstruct mean annual temperature (MAT), mean annual precipitation (MAP), and leaf dry mass per area (Ma), along with other useful quantitative leaf traits. Methods in this package described in Lowe et al. (in review).

License GPL (>= 3)

URL https://github.com/mjbutrim/dilp, https://mjbutrim.github.io/dilp/

BugReports https://github.com/mjbutrim/dilp/issues

Depends R (>= 2.10)

Imports dplyr, ggplot2, ggrepel, grDevices, magrittr, rlang, stats, stringr, tidyr, utils, vegan

Encoding UTF-8

LazyData true

RoxygenNote 7.3.1

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Author Matthew J. Butrim [aut, cre, cph],
Alexander J. Lowe [aut],
Andrew G. Flynn [aut],
Aly Baumgartner [aut],
Daniel J. Peppe [aut],
Dana L. Royer [aut]

Maintainer Matthew J. Butrim <mbutrim@uwyo.edu>

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`calc_lma` *Generate leaf mass per area results*

Description

`calc_lma()` will typically only be called internally by `lma()`. It provides the flexibility to use custom regression parameters to calculate leaf mass per area (LMA).

Usage

```
calc_lma(data, params, resolution = "species")
```

Arguments

`data` Must include "petiole metric" or some combination of columns to calculate petiole metric such as "Blade Area", "Petiole Area", and "Petiole Width", or "Leaf Area" and "Petiole Width". If calculating morphospecies-mean LMA, must include "Site" and "Morphotype" columns. If calculating species-mean LMA, only needs to include a "Site' column.

`params` A list of regression parameters. Must contain "stat" (= "mean" or = "variance"), "regression_slope", "y_intercept", "unexplained_mean_square", "sample_size_calibration" "mean_log_petiole_metric_calibration", "sum_of_squares_calibration", and "critical_value".

Pre-loaded sets of parameters:

"royer_species_mean_ma":
- stat = "mean",
- regression_slope = 0.382,
- y_intercept = 3.070,
- unexplained_mean_square = 0.032237,
- sample_size_calibration = 667,

- mean_log_petiole_metric_calibration = -3.011,
- sum_of_squares_calibration = 182.1,
- critical_value = 1.964

"royer_site_mean_ma":
- stat = "mean",
- regression_slope = 0.429,
- y_intercept = 3.214,
- unexplained_mean_square = 0.005285,
- sample_size_calibration = 25,
- mean_log_petiole_metric_calibration = -2.857,
- sum_of_squares_calibration = 5.331,
- critical_value = 2.069

"lowe_site_mean_ma":
- stat = "mean",
- regression_slope = 0.345,
- y_intercept = 2.954,
- unexplained_mean_square = 0.01212861,
- sample_size_calibration = 70,
- mean_log_petiole_metric_calibration = -2.902972,
- sum_of_squares_calibration = 1.154691,
- critical_value = 1.995469

"lowe_site_variance_ma":
- stat = "variance",
- regression_slope = 0.302,
- y_intercept = 5.028,
- unexplained_mean_square = 0.1713672,
- sample_size_calibration = 70,
- mean_log_petiole_metric_calibration = -5.97104,
- sum_of_squares_calibration = 5.085184,
- critical_value = 1.995469

`resolution` Either "species" or "site". Informs whether the function should calculate morphospecies-mean LMA values ("species") or site-mean/site- variance LMA values ("site"). If resolution = "site", data must already be in the form of species-mean LMA.

Value

A table with LMA results

References

- Royer, D. L., L. Sack, P. Wilf, C. H. Lusk, G. J. Jordan, Ulo Niinemets, I. J. Wright, et al. 2007. Fossil Leaf Economics Quantified: Calibration, Eocene Case Study, and Implications. Paleobiology 33: 574–589
- Lowe, A. J., D. L. Royer, D. J. Wieczynski, M. J. Butrim, T. Reichgelt, L. Azevedo-Schmidt, D. J. Peppe, et al. 2024. Global patterns in community-scale leaf mass per area distributions of woody non-monocot angiosperms and their utility in the fossil record. In review.

Examples

```
# Calculate morphospecies-mean LMA values with the parameters from Royer et al. (2007)
results <- calc_lma(McAbeeExample,
  params = list(
    stat = "mean",
    regression_slope = 0.382,
    y_intercept = 3.070,
    unexplained_mean_square = 0.032237,
    sample_size_calibration = 667,
    mean_log_petiole_metric_calibration = -3.011,
    sum_of_squares_calibration = 182.1,
    critical_value = 1.964
  ),
  resolution = "species"
)
results

# Calculate site-mean LMA values with the parameters from Lowe et al. (2024) entered from scratch
site_results <- calc_lma(results,
  params = list(
    stat = "mean",
    regression_slope = 0.345,
    y_intercept = 2.954,
    unexplained_mean_square = 0.01212861,
    sample_size_calibration = 70,
    mean_log_petiole_metric_calibration = -2.902972,
    sum_of_squares_calibration = 1.154691,
    critical_value = 1.995469
  ),
  resolution = "site"
)
site_results
```

`climate_calibration_data` *Climate Calibration Data*

Description

Temperature and precipitation data associated with the modern localities used to calibrate the DiLP model

Usage

```
climate_calibration_data
```

Format

`climate_calibration_data`**:**

A data frame with 92 rows and 3 columns:

Site Locality name

MAT Mean Annual Temperature (celsius)

MAP Mean Annual Precipitation (mm)

Source

Peppe et al. 2011

References

- Peppe, D.J., Royer, D.L., Cariglino, B., Oliver, S.Y., Newman, S., Leight, E., Enikolopov, G., Fernandez-Burgos, M., Herrera, F., Adams, J.M., Correa, E., Currano, E.D., Erickson, J.M., Hinojosa, L.F., Hoganson, J.W., Iglesias, A., Jaramillo, C.A., Johnson, K.R., Jordan, G.J., Kraft, N.J.B., Lovelock, E.C., Lusk, C.H., Niinemets, Ü., Peñuelas, J., Rapson, G., Wing, S.L. and Wright, I.J. (2011), Sensitivity of leaf size and shape to climate: global patterns and paleoclimatic applications. New Phytologist, 190: 724-739. https://doi.org/10.1111/j.1469-8137.2010.03615.x

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`dilp` *Generate DiLP results*

Description

`dilp()` processes raw leaf physiognomic data, checks for common errors/outliers, and returns the processed data, keys to finding potential errors or outliers, and paleoclimate reconstructions.

Usage

```
dilp(specimen_data, params = "PeppeGlobal", subsite_cols = NULL)
```

Arguments

`specimen_data` A data frame containing specimen level leaf physiognomic data. See Lowe et al. 2024 for more information on how to collect this data. A good reference for how to put together the data: `McAbeeExample`

Required columns:

- site
- specimen_number
- morphotype
- margin
- feret
- blade_area

- raw_blade_perimeter
- internal_raw_blade_perimeter
- length_of_cut_perimeter
- no_of_primary_teeth
- no_of_subsidiary_teeth

Recommended columns:

- petiole_width
- petiole_area
- blade_perimeter
- minimum_feret
- raw_blade_area
- internal_raw_blade_area

`params` Either a string referring to one of two preloaded parameter sets of a list of custom parameters (same format as the list below).

Preloaded parameter sets are "PeppeGlobal" and "PeppeNH" which are calibrated based on global and northern hemisphere data respectively. Allen et al. (2020) illustrates a situation in which the northern hemisphere parameters may be preferable. The "PeppeNH" parameters only estimate MAT. Use "PeppeGlobal" for all MAP estimates. Defaults to "PeppeGlobal" as follows (Peppe et al. 2011):

- MAT.MLR.M = 0.21,
- MAT.MLR.FDR = 42.296,
- MAT.MLR.TC.IP = -2.609,
- MAT.MLR.constant = -16.004,
- MAT.MLR.error = 4,
- MAT.SLR.M = 0.204,
- MAT.SLR.constant = 4.6,
- MAT.SLR.error = 4.9,
- MAP.MLR.LA = 0.298,
- MAP.MLR.TC.IP = 0.279,
- MAP.MLR.PR = -2.717,
- MAP.MLR.constant = 3.033,
- MAP.MLR.SE = 0.6,
- MAP.SLR.LA = 0.283,
- MAP.SLR.constant = 2.92,
- MAP.SLR.SE = 0.61

`subsite_cols` A vector or list of columns present in `specimen_data` to calculate paleoclimate estimates for. A completely optional parameter - allows different groupings of specimens to be tested, or comparisons of paleoclimate estimates at different levels of grouping. Adds additional estimates to $results.

Value

A list of tables that includes all pertinent DiLP information:

- processed_leaf_data: the full set of cleaned and newly calculated leaf physiognomic data that is necessary for DiLP analysis. See `dilp_processing()` for more information.
- processed_morphotype_data: morphospecies-site pair means for all leaf physiognomic data.
- processed_site_data: site means for all leaf physiognomic data.
- errors: lists any specimens that may be causing common errors in DiLP calculations. See `dilp_errors()` for more information.
- outliers: flags outliers in variables used for DiLP analysis that may represent incorrect data. See `dilp_outliers()` for more information.
- results: climate reconstructions of MAT and MAP using single and multi-linear regressions.

References

- Allen, S. E., Lowe, A. J., Peppe, D. J., & Meyer, H. W. (2020). Paleoclimate and paleoecology of the latest Eocene Florissant flora of central Colorado, USA. Palaeogeography, Palaeoclimatology, Palaeoecology, 551, 109678.
- Peppe, D.J., Royer, D.L., Cariglino, B., Oliver, S.Y., Newman, S., Leight, E., Enikolopov, G., Fernandez-Burgos, M., Herrera, F., Adams, J.M., Correa, E., Currano, E.D., Erickson, J.M., Hinojosa, L.F., Hoganson, J.W., Iglesias, A., Jaramillo, C.A., Johnson, K.R., Jordan, G.J., Kraft, N.J.B., Lovelock, E.C., Lusk, C.H., Niinemets, Ü., Peñuelas, J., Rapson, G., Wing, S.L. and Wright, I.J. (2011), Sensitivity of leaf size and shape to climate: global patterns and paleoclimatic applications. New Phytologist, 190: 724-739. https://doi.org/10.1111/j.1469-8137.2010.03615.x
- Lowe. A.J., Flynn, A.G., Butrim, M.J., Baumgartner, A., Peppe, D.J., and Royer, D.L. (2024), Reconstructing terrestrial paleoclimate and paleoecology with fossil leaves using Digital Leaf Physiognomy and leaf mass per area. JoVE.

Examples

```
dilp_results <- dilp(McAbeeExample)
dilp_results$processed_leaf_data
dilp_results$processed_morphotype_data
dilp_results$processed_site_data
dilp_results$errors
dilp_results$outliers
dilp_results$results
```

`dilp_cca` *Test if site leaf physiognomy falls within the physiognomic space of the DiLP calibration dataset*

Description

dilp_cca plots a canonical correspondence analysis (CCA) ordination of the leaf physiognomic space represented in the calibration dataset of Peppe et al. (2011). The fossil sites being tested are placed along the CCA axes. If a fossil site falls outside of the plotted calibration space, paleoclimate reconstructions for that fossil site should be treated with caution.

Usage

```
dilp_cca(
  dilp_table,
  physiognomy_calibration = physiognomyCalibration,
  climate_calibration = climateCalibration
)
```

Arguments

`dilp_table` The results of a call to `dilp()`

`physiognomy_calibration`
A physiognomic calibration dataset. Defaults to an internal version of `physiognomy_calibration_data`.

`climate_calibration`
A climate calibration dataset. Defaults to an internal version of `climate_calibration_data`.

Value

A ggplot2 plot

References

- Peppe, D.J., Royer, D.L., Cariglino, B., Oliver, S.Y., Newman, S., Leight, E., Enikolopov, G., Fernandez-Burgos, M., Herrera, F., Adams, J.M., Correa, E., Currano, E.D., Erickson, J.M., Hinojosa, L.F., Hoganson, J.W., Iglesias, A., Jaramillo, C.A., Johnson, K.R., Jordan, G.J., Kraft, N.J.B., Lovelock, E.C., Lusk, C.H., Niinemets, Ü., Peñuelas, J., Rapson, G., Wing, S.L. and Wright, I.J. (2011), Sensitivity of leaf size and shape to climate: global patterns and paleoclimatic applications. New Phytologist, 190: 724-739. https://doi.org/10.1111/j.1469-8137.2010.03615.x

Examples

```
results <- dilp(McAbeeExample)
dilp_cca(results)
```

dilp_errors — *Check for common errors in DiLP measurements*

Description

dilp_errors() will typically only be called internally by dilp(). However, it can be used on its own to evaluate errors that commonly occur during the data collection and processing steps. A dilp_errors() call will nearly always follow a dilp_processing() call. Returns a data frame.

Usage

```
dilp_errors(specimen_data)
```

Arguments

specimen_data	Processed specimen level leaf physiognomic data. The structure should match the structure of the output from dilp_processing()

Value

A 7 by X data frame. Each row shows a common error, and which specimens from the input dataset are tripping it.

Examples

```
# Check for errors in the provided McAbeeExample dataset.
dilp_dataset <- dilp_processing(McAbeeExample)
dilp_errors <- dilp_errors(dilp_dataset)
dilp_errors
```

dilp_outliers — *Identify outlier specimens*

Description

dilp_outliers() will typically only be called internally by dilp(). However, it can be used on its own to locate specimens that may have been misreported or measured incorrectly. dilp_outliers() returns a data frame listing specimens that have unusually high or low values for the four key parameters used in DiLP analyses. If flagged, it may be worth taking a look at the raw measurements and evaluating if the specimen should be used.

Usage

```
dilp_outliers(specimen_data)
```

Arguments

`specimen_data` Processed specimen level leaf physiognomic data. The structure should match the structure of the output from `dilp_processing()`

Value

A 4 by X data frame. Each row represents one of the DiLP parameters, and the specimens that are outliers for that parameter.

Examples

```
# Check for outliers in the provided McAbeeExample dataset. Each
# of these outliers has been manually re-examined and was found acceptable.
dilp_dataset <- dilp_processing(McAbeeExample)
dilp_outliers <- dilp_outliers(dilp_dataset)
dilp_outliers
```

---

dilp_processing *Process raw leaf physiognomic data*

Description

`dilp_processing()` will typically only be called internally by `dilp()`. However, it can be used on its own to generate and view a processed DiLP dataset that includes raw and derived physiognomic values useful for DiLP and other physiognomic analyses. Returns a data frame.

Usage

```
dilp_processing(specimen_data)
```

Arguments

`specimen_data` A data frame containing specimen level leaf physiognomic data. A good reference for how to put together the data: `McAbeeExample`

Value

A data frame containing cleaned and processed specimen level leaf physiognomic data. New variables calculated are:

- Leaf area
- Feret diameter
- Feret diameter ratio (FDR)
- Raw blade perimeter corrected (Raw blade perimeter - length of cut perimeter)
- Internal raw blade perimeter corrected (Internal raw blade perimeter - length of cut perimeter)
- Total tooth count

- Total tooth count : internal perimeter (TC:IP)
- Perimeter ratio
- Petiole metric
- Aspect ratio
- Shape factor
- Compactness
- Tooth area
- Tooth area : perimeter (TA:P)
- Tooth area: internal perimeter (TA:IP)
- Tooth area : blade area (TA:BA)
- Average primary tooth area (Avg TA)
- Tooth count : blade area (TC:BA)
- Tooth count : perimeter (TC:P)

Examples

```
dilp_dataset <- dilp_processing(McAbeeExample)
dilp_dataset
```

`lma` *Generate a suite of leaf mass per area results*

Description

`lma()` takes either raw or processed leaf physiognomic data and returns leaf mass per area (LMA) reconstructions of species-mean, site-mean, and site- variance.

`lma()` calls `calc_lma()` multiple times with different sets of parameters. See `calc_lma()` for more control over LMA reconstructions.

Usage

```
lma(specimen_data)
```

Arguments

`specimen_data` A table that must include "Site", "Morphotype", and either "Petiole Metric", or "Blade Area", "Petiole Area", and "Petiole Width".

Value

A list of tables containing leaf mass per area reconstructions.

- species_mean_lma contains the average LMA for each morphospecies-site pair. Values calculated using the regression from Royer et al. (2007).
- royer_site_mean_lma contains the average LMA for each site. Values calculated using the regression from Royer et al. (2007)
- lowe_site_lma contains the average LMA for each site. Values calculated using the regression from Lowe et al. (2024)
- lowe_variance contains the variance in LMA for each site. Values calculated using the regression from Lowe et al. (2024)

References

- Royer, D. L., L. Sack, P. Wilf, C. H. Lusk, G. J. Jordan, Ulo Niinemets, I. J. Wright, et al. 2007. Fossil Leaf Economics Quantified: Calibration, Eocene Case Study, and Implications. Paleobiology 33: 574–589
- Lowe, A. J., D. L. Royer, D. J. Wieczynski, M. J. Butrim, T. Reichgelt, L. Azevedo-Schmidt, D. J. Peppe, et al. 2024. Global patterns in community-scale leaf mass per area distributions of woody non-monocot angiosperms and their utility in the fossil record. In review.

Examples

```
results <- lma(McAbeeExample)
results
```

McAbeeExample *McAbee Example Data*

Description

Leaf physiognomic data of specimens collected from the McAbee Fossil Beds in British Columbia, Canada (Lowe et al. 2018).

Usage

```
McAbeeExample
```

Format

`McAbeeExample`**:**

A data frame with 192 rows and 18 columns:

Site Stratigraphic layer or locality

Specimen Number Repository number for individual specimen

Morphotype Morphotype the specimen belongs to

Measurer comments Additional notes about the specimen or its measurements

Margin Whether the margin is toothed (0) or entire (1)

Petiole Width The width of the petiole at the basalmost point of insertion into the leaf lamina

Blade area The reconstructed area of the leaf lamina, not including the petiole

Blade perimeter The length of the perimeter of the leaf lamina, not including the petiole

Feret The diameter of a circle with the same area as the leaf lamina, not including the petiole

Minimum Feret The longest line that can be drawn between two points on the perimeter of a selection that is perpendicular to Feret length. Approximates blade width.

Raw blade area The area of a leaf prepared for tooth measurements that still has its teeth.

Raw blade perimeter The perimeter of a leaf prepared for tooth measurements that still has its teeth.

Internal raw blade area The area of a leaf prepared for tooth measurements with teeth digitally removed.

Internal raw blade perimeter The perimeter of a leaf prepared for tooth measurements with teeth digitally removed.

Length of cut perimeter The total length of all segments of leaf removed from the leaf blade while removing damage during preparation of the leaf.

no. of primary teeth The number of primary teeth along the undamaged perimeter

no. of secondary teeth The number of secondary teeth along the undamaged perimeter

Source

Lowe et al. 2018

References

- Lowe, A. J., D. R. Greenwood, C. K. West, J. M. Galloway, M. Sudermann, and T. Reichgelt. 2018. Plant community ecology and climate on an upland volcanic landscape during the Early Eocene Climatic Optimum: McAbee Fossil Beds, British Columbia, Canada. Palaeogeography, Palaeoclimatology, Palaeoecology 511: 433–448.

`physiognomy_calibration_data`

Physiognomy Calibration Data

Description

Leaf physiognomic data taken from the modern localities used to calibrate the DiLP model

Usage

```
physiognomy_calibration_data
```

Format

`physiognomy_calibration_data`:

A data frame with 92 rows and 12 columns:

Site Locality name

Leaf.area Average leaf area at site

FDR Feret diameter:Feret length. Describes leaf linearity compared to a circle

Perimeter.ratio Ratio - Raw blade perimeter:Internal raw blade perimeter

TC.P Ratio - Tooth count:Perimeter

TC.IP Ratio - Tooth count:Internal perimeter

Avg.TA Average area of a primary tooth

TA.BA Ratio - Tooth area:Blade area

TA.P Ratio - Tooth area:Perimeter

TA.IP Ratio - Tooth area:Internal perimeter

TC.BA Ratio - Tooth count:Blade area

Margin Percentage of untoothed species at the site

Source

Peppe et al. 2011

References

- Peppe, D.J., Royer, D.L., Cariglino, B., Oliver, S.Y., Newman, S., Leight, E., Enikolopov, G., Fernandez-Burgos, M., Herrera, F., Adams, J.M., Correa, E., Currano, E.D., Erickson, J.M., Hinojosa, L.F., Hoganson, J.W., Iglesias, A., Jaramillo, C.A., Johnson, K.R., Jordan, G.J., Kraft, N.J.B., Lovelock, E.C., Lusk, C.H., Niinemets, Ü., Peñuelas, J., Rapson, G., Wing, S.L. and Wright, I.J. (2011), Sensitivity of leaf size and shape to climate: global patterns and paleoclimatic applications. New Phytologist, 190: 724-739. https://doi.org/10.1111/j.1469-8137.2010.03615.x

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`precip_slr` *Estimate precipitation with simple linear regression*

Description

`precip_slr()` will produce estimates of mean annual precipitation and standard error using leaf area analysis.

Usage

```
precip_slr(
  data,
  regression = "Peppe2018",
  slope = NULL,
  constant = NULL,
  error = NULL
)
```

Arguments

`data`	A data frame that must include the columns "morphotype", "leaf_area", and "specimen_number". Must be species level data.
`regression`	A string representing one of the following pre-loaded regressions: • "Peppe2018" - for global precipitation estimates • "Peppe2011" - The Americas, Japan, and Oceania • "Jacobs2002" - Africa • "Wilf1998" - The Americas and Africa
`slope`	Slope, if using a custom regression
`constant`	Constant, if using a custom regression
`error`	Standard error, if using a custom regression

Value

A table with MAP estimates for each site

References

- Peppe, D. J., Baumgartner, A., Flynn, A., & Blonder, B. (2018). Reconstructing paleoclimate and paleoecology using fossil leaves. Methods in paleoecology: Reconstructing Cenozoic terrestrial environments and ecological communities, 289-317.
- Peppe, D.J., Royer, D.L., Cariglino, B., Oliver, S.Y., Newman, S., Leight, E., Enikolopov, G., Fernandez-Burgos, M., Herrera, F., Adams, J.M., Correa, E., Currano, E.D., Erickson, J.M., Hinojosa, L.F., Hoganson, J.W., Iglesias, A., Jaramillo, C.A., Johnson, K.R., Jordan, G.J., Kraft, N.J.B., Lovelock, E.C., Lusk, C.H., Niinemets, Ü., Peñuelas, J., Rapson, G., Wing, S.L. and Wright, I.J. (2011), Sensitivity of leaf size and shape to climate: global patterns and paleoclimatic applications. New Phytologist, 190: 724-739. https://doi.org/10.1111/j.1469-8137.2010.03615.x
- Jacobs, B. F. (2002). Estimation of low-latitude paleoclimates using fossil angiosperm leaves: examples from the Miocene Tugen Hills, Kenya. Paleobiology, 28, 399–421.
- Wilf, P. (2008). Fossil angiosperm leaves: paleobotany’s difficult children prove themselves. Paleontological Society Papers, 14, 319–333.

Examples

```
precip_slr(McAbeeExample, regression = "Peppe2011")
```

temp_slr *Estimate temperature with simple linear regression*

Description

`temp_slr()` will produce estimates of mean annual temperature and standard error using leaf margin analysis.

Usage

```
temp_slr(
  data,
  regression = "Peppe2018",
  slope = NULL,
  constant = NULL,
  error = NULL
)
```

Arguments

`data`	A data frame that must include the columns "morphotype" and "margin". Can be species or site level data.
`regression`	A string representing one of the following pre-loaded regressions: • "Peppe2018" - for global temperature estimates • "Peppe2011" - The Americas, Japan, and Oceania • "Peppe2011NH" - Peppe 2011 (Northern Hemisphere only) • "Miller2006" - North and Central America • "WingGreenwood" - East Asia - original leaf margin analysis regression • "Wilf1997" - The Americas
`slope`	Slope, if using a custom regression
`constant`	Constant, if using a custom regression
`error`	Standard error, if using a custom regression

Value

A table with MAT estimates for each site

References

- Miller, I. M., Brandon, M. T., & Hickey, L. J. (2006). Using leaf margin analysis to estimate mid-Cretaceous (Albian) paleolatitude of the Baja BC block. Earth and Planetary Science Letters, 245, 95–114.
- Peppe, D. J., Baumgartner, A., Flynn, A., & Blonder, B. (2018). Reconstructing paleoclimate and paleoecology using fossil leaves. Methods in paleoecology: Reconstructing Cenozoic terrestrial environments and ecological communities, 289-317.

- Peppe, D.J., Royer, D.L., Cariglino, B., Oliver, S.Y., Newman, S., Leight, E., Enikolopov, G., Fernandez-Burgos, M., Herrera, F., Adams, J.M., Correa, E., Currano, E.D., Erickson, J.M., Hinojosa, L.F., Hoganson, J.W., Iglesias, A., Jaramillo, C.A., Johnson, K.R., Jordan, G.J., Kraft, N.J.B., Lovelock, E.C., Lusk, C.H., Niinemets, Ü., Peñuelas, J., Rapson, G., Wing, S.L. and Wright, I.J. (2011), Sensitivity of leaf size and shape to climate: global patterns and paleoclimatic applications. New Phytologist, 190: 724-739. https://doi.org/10.1111/j.1469-8137.2010.03615.x
- Wing, S., & Greenwood, D. R. (1993). Fossils and fossil climate: the case for equable continental interiors in the Eocene. Philosophical Transactions of the Royal Society of London Series B, 341, 243–252.
- Wilf, P. (1997). When are leaves good thermometers? A new case for leaf margin analysis. Paleobiology, 23, 373–390.

Examples

```
temp_slr(McAbeeExample, regression = "Peppe2011")
```

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view_regressions   *View preloaded regressions*

Description

View preloaded regressions

Usage

```
view_regressions(type)
```

Arguments

type	Must be either "dilp", "lma", temp", or "precip".

Value

A data frame containing the parameters for each available regression of the selected type.

Examples

```
view_regressions("dilp")
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