

# Package ‘iRfcb’

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**Type** Package

**Title** Tools for Managing Imaging FlowCytobot (IFCB) Data

**Version** 0.5.1

**Description** A comprehensive suite of tools for managing, processing, and analyzing data from the IFCB. I R FlowCytobot ('iRfcb') supports quality control, geospatial analysis, and preparation of IFCB data for publication in databases like <https://www.gbif.org>, <https://www.obis.org>, <https://emodnet.ec.europa.eu/en>, <https://shark.smhi.se/>, and <https://www.ecotaxa.org>. The package integrates with the MATLAB 'ifcb-analysis' tool, which is described in Sosik and Olson (2007) [doi:10.4319/lom.2007.5.204](https://doi.org/10.4319/lom.2007.5.204), and provides features for working with raw, manually classified, and machine learning–classified image datasets. Key functionalities include image extraction, particle size distribution analysis, taxonomic data handling, and biomass concentration calculations, essential for plankton research.

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**Encoding** UTF-8

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**Note** This package includes code from <https://github.com/kudelalab/PSD> by kudela lab licensed under the MIT License.

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---

create\_package\_manifest

*Function to Create MANIFEST.txt*

---

## Description

This function generates a MANIFEST.txt file that lists all files in the specified paths, along with their sizes. It recursively includes files from directories and skips paths that do not exist. The manifest excludes the manifest file itself if present in the list.

## Usage

```
create_package_manifest(paths, manifest_path = "MANIFEST.txt", temp_dir)
```

## Arguments

paths	A character vector of paths to files and/or directories to include in the manifest.
manifest_path	A character string specifying the path to the manifest file. Default is "MANIFEST.txt".
temp_dir	A character string specifying the temporary directory to be removed from the file paths.

**Value**

This function does not return any value. It creates a `MANIFEST.txt` file at the specified location, which contains a list of all files (including their sizes) in the provided paths. The file paths are relative to the specified `temp_dir`, and the manifest excludes the manifest file itself if present.

---

ifcb\_adjust\_classes     *Adjust Classifications in Manual Annotations*

---

**Description**

This function adjusts the classifications in manual annotation files based on a class2use file. It loads a specified class2use file and applies the adjustments to all relevant files in the specified manual folder. Optionally, it can also perform compression on the output files. This is the R equivalent function of `start_mc_adjust_classes_user_training` from the `ifcb-analysis` repository (Sosik and Olson 2007).

**Usage**

```
ifcb_adjust_classes(class2use_file, manual_folder, do_compression = TRUE)
```

**Arguments**

`class2use_file` A character string representing the full path to the class2use file (should be a .mat file).

`manual_folder` A character string representing the path to the folder containing manual annotation files. The function will look for files starting with 'D' in this folder.

`do_compression` A logical value indicating whether to apply compression to the output files. Defaults to TRUE.

**Details**

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

**Value**

None

**References**

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

**See Also**

`ifcb_py_install` `ifcb_create_class2use` <https://github.com/hsosik/ifcb-analysis>

**Examples**

```

## Not run:
# Initialize a python session if not already set up
ifcb_py_install()

ifcb_adjust_classes("data/config/class2use.mat",
                  "data/manual/2014/")

## End(Not run)

```

---

ifcb\_annotate\_batch     *Annotate IFCB Images with Specified Class*

---

**Description**

This function creates or updates manual .mat classlist files with a user specified class in batch, based on input vector of IFCB image names. These .mat can be used with the code in the ifcb-analysis repository (Sosik and Olson 2007).

**Usage**

```

ifcb_annotate_batch(
  png_images,
  class,
  manual_folder,
  adc_files,
  class2use_file,
  manual_output = NULL,
  manual_recursive = FALSE,
  unclassified_id = 1,
  do_compression = TRUE,
  adc_folder = deprecated()
)

```

**Arguments**

png_images	A character vector containing the names of the PNG images to be annotated in the format DYYYYMMDDTHHMMSS_IFCBXXX_ZZZZZ.png, where XXX represent the IFCB number and ZZZZZ the roi number.
class	A character string or integer specifying the class name or class2use index to annotate the images with. If a string is provided, it is matched against the available classes in class2use_file.
manual_folder	A character string specifying the path to the folder containing the manual .mat classlist files.

adc_files	A character string specifying the path to the folder containing the raw data, organized in subfolders by year (YYYY) and date (DYYYYMMDD), or a vector with full paths to the .adc files. Each ADC file is used to determine the number of regions of interest (ROIs) for each sample when creating new manual .mat files.
class2use_file	A character string specifying the path to the .mat file containing class names and corresponding indices.
manual_output	A character string specifying the path to the folder where updated or newly created .mat classlist files will be saved. If not provided, the manual_folder path will be used by default.
manual_recursive	A logical value indicating whether to search recursively within manual_folder for .mat files. Default is FALSE.
unclassified_id	An integer specifying the class ID to use for unclassified regions of interest (ROIs) when creating new manual .mat files. Default is 1.
do_compression	A logical value indicating whether to compress the .mat file. Default is TRUE.
adc_folder	<b>[Deprecated]</b> Use adc_files instead.

### Details

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

If an image belongs to a sample that already has a corresponding manual .mat file, the function updates the class IDs for the specified regions of interest (ROIs) in that file. If no manual file exists for the sample, the function creates a new one based on the sample's ADC data, assigning unclassified IDs to all ROIs initially, then applying the specified class to the relevant ROIs.

The class parameter can be provided as either a string (class name) or an integer (class index). If a string is provided, the function will attempt to match it to one of the available classes in `class2use_file`. If no match is found, an error is thrown.

The function assumes that the ADC files are organized in subfolders by year (YYYY) and date (DYYYYMMDD) within `adc_folder`.

### Value

The function does not return a value. It creates or updates .mat files in the `manual_folder` to reflect the specified annotations.

### References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

### See Also

[ifcb\\_correct\\_annotation](#), [ifcb\\_create\\_empty\\_manual\\_file](#)

## Examples

```
## Not run:
# Initialize a python session if not already set up
ifcb_py_install()

# Annotate two png images with class "Nodularia_spumigena" and update or create manual files
ifcb_annotate_batch(
  png_images = c("D20230812T162908_IFCB134_01399.png",
                 "D20230714T102127_IFCB134_00069.png"),
  class = "Nodularia_spumigena",
  manual_folder = "path/to/manual",
  adc_files = "path/to/adc",
  class2use_file = "path/to/class2use.mat"
)

## End(Not run)
```

---

ifcb\_convert\_filenames

*Convert IFCB Filenames to Timestamps*

---

## Description

This function converts IFCB filenames to a data frame with separate columns for the sample name, full timestamp, year, month, day, time, and IFCB number. ROI numbers are included if available.

## Usage

```
ifcb_convert_filenames(filenamees, tz = "UTC")
```

## Arguments

filenamees	A character vector of IFCB filenames in the format "DYYYYMMDDTHH-MMSS_IFCBxxx" or "IFCBxxx_YYYY_DDD_HHMMSS". Filenames can optionally include an ROI number, which will be extracted if present.
tz	Character. Time zone to assign to the extracted timestamps. Defaults to "UTC". Set this to a different time zone if needed.

## Value

A tibble with the following columns:

- `sample`: The extracted sample name (character).
- `full_timestamp`: The full timestamp in "YYYY-MM-DD HH:MM:SS" format (POSIXct).
- `year`: The year extracted from the timestamp (integer).
- `month`: The month extracted from the timestamp (integer).

- day: The day extracted from the timestamp (integer).
- time: The extracted time in "HH:MM:SS" format (character).
- ifcb\_number: The IFCB instrument number (character).
- roi: The extracted ROI number if available (integer or NA).

If the roi column is empty (all NA), it will be excluded from the output.

### Examples

```
filenames <- c("D20230314T001205_IFCB134", "D20230615T123045_IFCB135")
timestamps <- ifcb_convert_filenames(filenames)
print(timestamps)
```

---

ifcb\_correct\_annotation

*Correct Annotations in MATLAB Classlist Files*

---

### Description

This function corrects annotations in MATLAB classlist files located in a specified manual folder, generated by the code in the ifcb-analysis repository (Sosik and Olson 2007). It replaces the class ID of specified regions of interest (ROIs) in the classlist files based on a correction file or a character vector.

### Usage

```
ifcb_correct_annotation(
    manual_folder,
    out_folder,
    correction = NULL,
    correct_classid,
    do_compression = TRUE,
    correction_file = deprecated()
)
```

### Arguments

- |               |   |
|---------------|---|
| manual_folder | A character string specifying the path to the folder containing the original MAT classlist files to be updated.   |
| out_folder    | A character string specifying the path to the folder where updated MAT classlist files will be saved.   |
| correction    | Either a character string specifying the path to the correction file, or a character vector containing image filenames to be corrected. If a file is provided, it should have a column named image_filename. If a character vector is provided, it will be treated as a direct list of image filenames. |



correct\_classid An integer specifying the class ID to use for corrections.

do\_compression A logical value indicating whether to compress the .mat file. Default is TRUE.

correction\_file **[Deprecated]** Use correction instead.

## Details

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

The correction file is expected to contain at least one column: `image_filename`, which includes the filenames of the images (with or without additional trailing information). The function processes each file, corrects the annotations, and saves the updated files in the output folder.

If a character vector is provided as `correction`, it will be used directly as a list of filenames for correction.

The correction is typically generated using a Shiny app that provides an interactive interface for browsing and managing IFCB (Imaging FlowCytobot) image galleries. This Shiny app can be initialized using the function `ifcb_run_image_gallery()`.

## Value

This function does not return any value; it updates the classlist files in the specified output directory.

## References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

## See Also

`ifcb_py_install` <https://github.com/hsosik/ifcb-analysis>

## Examples

```
## Not run:
# Initialize a python session if not already set up
ifcb_py_install()

# Correct class ID in .mat classlist files using a correction file
ifcb_correct_annotation("input/manual",
                        "output/manual",
                        "corrections.txt",
                        99)

# Correct class ID in .mat classlist files using a character vector of filenames
ifcb_correct_annotation("input/manual",
                        "output/manual",
                        c("D20230917T153755_IFCB134_01724.png",
                          "D20230917T110059_IFCB134_00380.png"),
                        99)
```

```
## End(Not run)
```

---

```
ifcb_count_mat_annotations
```

*Count IFCB Annotations from .mat Files*

---

### Description

This function processes .mat files, generated by the code in the ifcb-analysis repository (Sosik and Olson 2007), to count and summarize the annotations for each class based on the class2use information provided in a file.

### Usage

```
ifcb_count_mat_annotations(  
  manual_files,  
  class2use_file,  
  skip_class = NULL,  
  sum_level = "class",  
  mat_recursive = FALSE,  
  use_python = FALSE  
)
```

### Arguments

manual_files	A character string specifying the path to the .mat files or a folder containing .mat files.
class2use_file	A character string specifying the path to the file containing the class2use variable.
skip_class	A numeric vector of class IDs or a character vector of class names to be excluded from the count. Default is NULL.
sum_level	A character string specifying the level of summarization. Options: "sample", "roi" or "class" (default).
mat_recursive	Logical. If TRUE, the function will search for MATLAB files recursively when manual_files is a folder. Default is FALSE.
use_python	Logical. If TRUE, attempts to read the .mat file using a Python-based method. Default is FALSE.

### Details

If use\_python = TRUE, the function tries to read the .mat file using ifcb\_read\_mat(), which relies on SciPy. This approach may be faster than the default approach using R.matlab::readMat(), especially for large .mat files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using ifcb\_py\_install().

If use\_python = FALSE or if SciPy is not available, the function falls back to using R.matlab::readMat().

**Value**

A data frame with the total count of images per class, roi or per sample.

**References**

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

**Examples**

```
## Not run:
# Count annotations excluding specific class IDs
result <- ifcb_count_mat_annotations("path/to/manual_folder",
                                   "path/to/class2use_file",
                                   skip_class = c(99, 100))

print(result)

# Count annotations excluding a specific class name
result <- ifcb_count_mat_annotations("path/to/manual_folder",
                                   "path/to/class2use_file",
                                   skip_class = "unclassified")

print(result)

## End(Not run)
```

---

ifcb\_create\_class2use *Create a class2use .mat File*

---

**Description**

This function creates a .mat file containing a character vector of class names. A class2use file can be used for manual annotation using the code in the ifcb-analysis repository (Sosik and Olson 2007).

**Usage**

```
ifcb_create_class2use(classes, filename, do_compression = TRUE)
```

**Arguments**

**classes** A character vector of class names to be saved in the .mat file.  
**filename** A string specifying the output file path (with .mat extension).  
**do\_compression** A logical value indicating whether to compress the .mat file. Defaults to TRUE.

**Details**

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

**Value**

No return value. This function is called for its side effect of creating a .mat file.

**References**

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

**See Also**

`ifcb_py_install` `ifcb_adjust_classes` <https://github.com/hsosik/ifcb-analysis>

**Examples**

```
## Not run:
# Initialize a python session if not already set up
ifcb_py_install()

# Example usage:
classes <- c("unclassified", "Dinobryon_spp", "Helicostomella_spp")

ifcb_create_class2use(classes, "class2use_output.mat", do_compression = TRUE)

## End(Not run)
```

---

`ifcb_create_empty_manual_file`

*Create an Empty Manual Classification MAT File*

---

**Description**

Generates a MAT file for IFCB data with an empty manual classification structure using a specified number of ROIs, class names, and saves it to a specified output file. This function utilizes a Python script for creating the structure.

**Usage**

```
ifcb_create_empty_manual_file(  
  roi_length,  
  class2use,  
  output_file,  
  classlist = 1,  
  do_compression = TRUE,  
  unclassified_id = deprecated()  
)
```

**Arguments**

roi_length	Integer. The number of rows in the class list (number of ROIs).
class2use	Character vector. The names of the classes to include in the class2use_manual field of the MAT file.
output_file	Character. The path where the output MAT file will be saved.
classlist	Integer or numeric vector. Defines the values for the second column of the class list, typically representing the manual classification labels: <ul style="list-style-type: none"> <li>• If a single value is provided, all rows will be assigned this value. For example, all ROIs can be assigned to class index 1 (default), which typically represents the unclassified category.</li> <li>• If a numeric vector of the same length as roi_length is provided, the corresponding values will be used per row.</li> </ul>
do_compression	A logical value indicating whether to compress the .mat file. Default is TRUE.
unclassified_id	<b>[Deprecated]</b> ifcb_create_empty_manual_file now handles multiple classlist values. Use classlist instead.

**Details**

Python must be installed to use this function. The required python packages can be installed in a virtual environment using ifcb\_py\_install().

**Value**

No return value. This function is called for its side effects. The created MAT file is saved at the specified output\_file location.

**Examples**

```
## Not run:
# Initialize a python session if not already set up
ifcb_py_install()

# Create a MAT file with 100 ROIs, using a vector of class names, and save it to "output.mat"
ifcb_create_empty_manual_file(roi_length = 100,
                             class2use = c("unclassified", "Aphanizomenon_spp"),
                             output_file = "output.mat")

# Create a MAT file with 50 unclassified ROIs (1) and 50 Aphanizomenon_spp (2) ROIs
ifcb_create_empty_manual_file(roi_length = 100,
                             class2use = c("unclassified", "Aphanizomenon_spp"),
                             output_file = "output.mat",
                             classlist = c(rep(1, 50), rep(2, 50)))

## End(Not run)
```

---

ifcb\_create\_manifest    *Create a MANIFEST.txt File*

---

### Description

This function generates a MANIFEST.txt file listing all files in a specified folder and its subfolders, along with their sizes in bytes. The function can optionally exclude an existing MANIFEST.txt file from the generated list. A manifest may be useful when archiving images in data repositories.

### Usage

```
ifcb_create_manifest(  
    folder_path,  
    manifest_path = file.path(folder_path, "MANIFEST.txt"),  
    exclude_manifest = TRUE  
)
```

### Arguments

`folder_path`    A character string specifying the path to the folder whose files are to be listed.

`manifest_path`    A character string specifying the path and name of the MANIFEST.txt file to be created. Defaults to "folder\_path/MANIFEST.txt".

`exclude_manifest`    A logical value indicating whether to exclude an existing MANIFEST.txt file from the list. Defaults to TRUE.

### Value

No return value, called for side effects. Creates a MANIFEST.txt file at the specified location.

### Examples

```
## Not run:  
# Create a MANIFEST.txt file for the current directory  
ifcb_create_manifest(".")  
  
# Create a MANIFEST.txt file for a specific directory, excluding an existing MANIFEST.txt file  
ifcb_create_manifest("path/to/directory")  
  
# Create a MANIFEST.txt file and save it to a specific path  
ifcb_create_manifest("path/to/directory", manifest_path = "path/to/manifest/MANIFEST.txt")  
  
# Create a MANIFEST.txt file without excluding an existing MANIFEST.txt file  
ifcb_create_manifest("path/to/directory", exclude_manifest = FALSE)  
  
## End(Not run)
```

---

ifcb\_download\_dashboard\_data

*Download IFCB data files from an IFCB Dashboard*

---

## Description

This function downloads specified IFCB data files from a given IFCB Dashboard URL. It supports optional filename conversion and ADC file adjustments from the old IFCB file format.

## Usage

```
ifcb_download_dashboard_data(
  dashboard_url,
  samples,
  file_types,
  dest_dir,
  convert_filenames = FALSE,
  convert_adc = FALSE,
  parallel_downloads = 5,
  sleep_time = 2,
  multi_timeout = 120,
  max_retries = 3,
  quiet = FALSE
)
```

## Arguments

dashboard_url	Character. The base URL of the IFCB dashboard (e.g., "https://ifcb-data.whoj.edu"). If no subpath (e.g., /data/ or /mvco/) is included, /data/ will be added automatically. For the "features" and "autoclass" file_types, the dataset name needs to be included in the url (e.g. "https://ifcb-data.whoj.edu/mvco/").
samples	Character vector. The IFCB sample identifiers (e.g., "IFCB1_2014_188_222013" or "D20220807T025424_IFCB010").
file_types	Character vector. Specifies which file types to download. Allowed values: "blobs", "features", "autoclass", "roi", "zip", "hdr", "adc".
dest_dir	Character. The directory where downloaded files will be saved.
convert_filenames	Logical. If TRUE, converts filenames of the old format "IFCBxxx_YYYY_DDD_HHMMSS" to the new format (DYYYYMMDDTHHMMSS_IFCBXXX or IYYYYMMDDTHHMMSS_IFCBXXX). Default is FALSE. <b>[Experimental]</b>
convert_adc	Logical. If TRUE, adjusts .adc files from older IFCB instruments (IFCB1–6, with filenames in the format "IFCBxxx_YYYY_DDD_HHMMSS") by inserting four empty columns after column 7 to match the newer format. Default is FALSE. <b>[Experimental]</b>

parallel_downloads	Integer. The number of files to download in parallel per batch. This helps manage network load and system performance. Default is 5.
sleep_time	A numeric value indicating the number of seconds to wait between each batch of downloads. Default is 2.
multi_timeout	Numeric. The maximum time in seconds that the curl multi-download request will wait for a response before timing out. This helps prevent hanging downloads in case of slow or unresponsive servers. Default is 120 seconds.
max_retries	An integer specifying the maximum number of attempts to retrieve data in case the server is unable to handle the request. Default is 3.
quiet	Logical. If TRUE, suppresses messages about the progress and completion of the download process. Default is FALSE.

### Details

This function can download several files in parallel if the server allows it. The download parameters can be adjusted using the `parallel_downloads`, `sleep_time` and `multi_timeout` arguments.

If `convert_filenames = TRUE` [**Experimental**], filenames in the "IFCBxxx\_YYYY\_DDD\_HHMMSS" format (used by IFCB1-6) will be converted to IYYYYMMDDTHHMMSS\_IFCBXXX, ensuring compatibility with blob extraction in `ifcb-analysis` (Sosik & Olson, 2007), which identified the old .adc format by the first letter of the filename.

If `convert_adc = TRUE` [**Experimental**] and `convert_filenames = TRUE` [**Experimental**], the "IFCBxxx\_YYYY\_DDD\_HHMMSS" format will instead be converted to DYYYYMMDDTHHMMSS\_IFCBXXX. Additionally, .adc files will be modified to include four empty columns (PMT-A peak, PMT-B peak, PMT-C peak, and PMT-D peak), aligning them with the structure of modern .adc files for full compatibility with `ifcb-analysis`.

### Value

This function does not return a value. It performs the following actions:

- Downloads the requested files into `dest_dir`.
- If `convert_adc = TRUE`, modifies ADC files in place by inserting four empty columns after column 7.
- Displays messages indicating the download status.

### References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

### Examples

```
## Not run:
ifcb_download_dashboard_data(
  dashboard_url = "https://ifcb-data.whoi.edu/mvco/",
  samples = "IFCB1_2014_188_222013",
  file_types = c("blobs", "autoclass"),
  dest_dir = "data",
```



```
    convert_filenames = FALSE,  
    convert_adc = FALSE  
  )  
  
  ## End(Not run)
```

---

ifcb\_download\_test\_data

*Download Test IFCB Data*

---

## Description

This function downloads a zip archive containing MATLAB files from the iRfcb dataset available in the SMHI IFCB Plankton Image Reference Library (Torstensson et al. 2024), unzips them into the specified folder and extracts png images. These data can be used, for instance, for testing iRfcb and for creating the tutorial vignette using `vignette("a-general-tutorial", package = "iRfcb")`

## Usage

```
ifcb_download_test_data(  
  dest_dir,  
  figshare_article = "48158716",  
  max_retries = 5,  
  sleep_time = 10,  
  verbose = TRUE  
)
```

## Arguments

<code>dest_dir</code>	The destination directory where the files will be unzipped.
<code>figshare_article</code>	The file article number at the SciLifeLab Figshare data repository. By default, the iRfcb test dataset (48158716) from Torstensson et al. (2024) is used.
<code>max_retries</code>	The maximum number of retry attempts in case of download failure. Default is 5.
<code>sleep_time</code>	The sleep time between download attempts, in seconds. Default is 10.
<code>verbose</code>	A logical indicating whether to print progress messages. Default is TRUE.

## Value

No return value. This function is called for its side effect of downloading, extracting, and organizing IFCB test data.

## References

Torstensson, Anders; Skjjevik, Ann-Turi; Mohlin, Malin; Karlberg, Maria; Karlson, Bengt (2024). SMHI IFCB Plankton Image Reference Library. Version 3. SciLifeLab. Dataset. doi:10.17044/scilifelab.25883455.v3

## Examples

```
## Not run:  
# Download and unzip IFCB test data into the "data" directory  
ifcb_download_test_data("data")  
  
## End(Not run)
```

---

```
ifcb_download_who_i_plankton  
Download and Extract WHOI-Plankton Data
```

---

## Description

This function downloads WHOI-Plankton annotated plankton images (Sosik et al. 2015) for specified years from <https://hdl.handle.net/1912/7341>. The extracted .png data are saved in the specified destination folder.

## Usage

```
ifcb_download_who_i_plankton(  
  years,  
  dest_folder,  
  extract_images = TRUE,  
  max_retries = 10,  
  quiet = FALSE  
)
```

## Arguments

years	A vector of years (numeric or character) indicating which datasets to download. The available years are currently 2006 to 2014.
dest_folder	A string specifying the destination folder where the files will be extracted.
extract_images	Logical. If TRUE, extracts .png images from the downloaded archives and removes the .zip files. If FALSE, only downloads the archives without extracting images. Default is TRUE.
max_retries	An integer specifying the maximum number of attempts to retrieve data. Default is 10.
quiet	Logical. If TRUE, suppresses messages about the progress and completion of the download process. Default is FALSE.

**Value**

If `extract_images = FALSE`, returns a data frame containing metadata of downloaded image files. Otherwise, no return value; files are downloaded and extracted to `dest_folder`.

**References**

Sosik, H. M., Peacock, E. E. and Brownlee E. F. (2015), Annotated Plankton Images - Data Set for Developing and Evaluating Classification Methods. doi:[10.1575/1912/7341](https://doi.org/10.1575/1912/7341)

**Examples**

```
## Not run:  
# Download and extract images for 2006 and 2007 in the data folder  
ifcb_download_whoiplankton(c(2006, 2007),  
                           "data",  
                           extract_images = TRUE)  
  
## End(Not run)
```

---

ifcb\_extract\_annotated\_images

*Extract Annotated Images from IFCB Data*

---

**Description**

This function extracts labeled images from IFCB (Imaging FlowCytobot) data, annotated using the MATLAB code from the ifcb-analysis repository (Sosik and Olson 2007). It reads manually classified data, maps class indices to class names, and extracts the corresponding Region of Interest (ROI) images, saving them to the specified directory.

**Usage**

```
ifcb_extract_annotated_images(  
  manual_folder,  
  class2use_file,  
  roi_folders,  
  out_folder,  
  skip_class = NA,  
  verbose = TRUE,  
  manual_recursive = FALSE,  
  roi_recursive = TRUE,  
  overwrite = FALSE,  
  scale_bar_um = NULL,  
  scale_micron_factor = 1/3.4,  
  scale_bar_position = "bottomright",  
  scale_bar_color = "black",
```

```

old_adc = FALSE,
use_python = FALSE,
gamma = 1,
roi_folder = deprecated()
)

```

### Arguments

manual_folder	A character string specifying the path to the directory containing the manually classified .mat files.
class2use_file	A character string specifying the path to the file containing class names.
roi_folders	A character vector specifying one or more directories containing the ROI files.
out_folder	A character string specifying the output directory where the extracted images will be saved.
skip_class	A numeric vector of class IDs or a character vector of class names to be excluded from the count. Default is NULL.
verbose	A logical value indicating whether to print progress messages. Default is TRUE.
manual_recursive	Logical. If TRUE, the function will search for MATLAB files recursively within the manual_folder. Default is FALSE.
roi_recursive	Logical. If TRUE, the function will search for data files recursively within the roi_folder (if provided). Default is TRUE.
overwrite	A logical value indicating whether to overwrite existing PNG files. Default is FALSE.
scale_bar_um	An optional numeric value specifying the length of the scale bar in micrometers. If NULL, no scale bar is added.
scale_micron_factor	A numeric value defining the conversion factor from micrometers to pixels. Defaults to 1/3.4.
scale_bar_position	A character string specifying the position of the scale bar in the image. Options are "topright", "topleft", "bottomright", or "bottomleft". Defaults to "bottomright".
scale_bar_color	A character string specifying the scale bar color. Options are "black" or "white". Defaults to "black".
old_adc	A logical value indicating whether the adc file is of the old format (samples from IFCB1-6, labeled "IFCBxxx_YYYY_DDD_HHMMSS"). Default is FALSE.
use_python	Logical. If TRUE, attempts to read the .mat file using a Python-based method. Default is FALSE.
gamma	A numeric value for gamma correction applied to the image. Default is 1 (no correction). Values <1 increase contrast in dark regions, while values >1 decrease contrast.
roi_folder	<b>[Deprecated]</b> Use roi_folders instead.

## Details

If `use_python = TRUE`, the function tries to read the `.mat` file using `ifcb_read_mat()`, which relies on SciPy. This approach may be faster than the default approach using `R.matlab::readMat()`, especially for large `.mat` files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using `ifcb_py_install()`.

If `use_python = FALSE` or if SciPy is not available, the function falls back to using `R.matlab::readMat()`.

## Value

None. The function saves the extracted PNG images to the specified output directory.

## References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

## See Also

`ifcb_extract_pngs` `ifcb_extract_classified_images` <https://github.com/hsosik/ifcb-analysis>

## Examples

```
## Not run:
ifcb_extract_annotated_images(
  manual_folder = "path/to/manual_folder",
  class2use_file = "path/to/class2use_file.mat",
  roi_folders = "path/to/roi_folder",
  out_folder = "path/to/out_folder",
  skip_class = 1 # Skip "unclassified"
)

## End(Not run)
```

---

`ifcb_extract_biovolumes`

*Extract Biovolumes from IFCB Data and Compute Carbon Content*

---

## Description

This function reads biovolume data from feature files generated by the `ifcb-analysis` repository (Sosik and Olson 2007) and matches them with corresponding classification results or manual annotations. It calculates biovolume in cubic micrometers and determines if each class is a diatom based on the World Register of Marine Species (WoRMS). Carbon content is computed for each region of interest (ROI) using conversion functions from Menden-Deuer and Lessard (2000), depending on whether the class is identified as a diatom.

**Usage**

```

ifcb_extract_biovolumes(
    feature_files,
    mat_folder = NULL,
    custom_images = NULL,
    custom_classes = NULL,
    class2use_file = NULL,
    micron_factor = 1/3.4,
    diatom_class = "Bacillariophyceae",
    marine_only = FALSE,
    threshold = "opt",
    multiblob = FALSE,
    feature_recursive = TRUE,
    mat_recursive = TRUE,
    use_python = FALSE,
    verbose = TRUE
)

```

**Arguments**

<code>feature_files</code>	A path to a folder containing feature files or a character vector of file paths.
<code>mat_folder</code>	(Optional) Path to the folder containing class or manual annotation files.
<code>custom_images</code>	(Optional) A character vector of image filenames in the format DYYYYM-MDDTHHMMSS_IFCBXXX_ZZZZZ.png, where "XXX" represents the IFCB number and "ZZZZZ" represents the ROI number. These filenames should match the <code>roi_number</code> assignment in the <code>feature_files</code> and can be used as a substitute for MATLAB files.
<code>custom_classes</code>	(Optional) A character vector of corresponding class labels for <code>custom_images</code> .
<code>class2use_file</code>	A character string specifying the path to the file containing the <code>class2use</code> variable (default: NULL).
<code>micron_factor</code>	Conversion factor for biovolume to cubic micrometers. Default is 1 / 3.4.
<code>diatom_class</code>	A character vector specifying diatom class names in WoRMS. Default: "Bacillariophyceae".
<code>marine_only</code>	Logical. If TRUE, restricts the WoRMS search to marine taxa only. Default: FALSE.
<code>threshold</code>	Threshold for selecting classification information ("opt" for above-threshold classification, otherwise "all"). Default: "opt".
<code>multiblob</code>	Logical. If TRUE, includes multiblob features. Default: FALSE.
<code>feature_recursive</code>	Logical. If TRUE, searches recursively for feature files when <code>feature_files</code> is a folder. Default: TRUE.
<code>mat_recursive</code>	Logical. If TRUE, searches recursively for MATLAB files in <code>mat_folder</code> . Default: TRUE.
<code>use_python</code>	Logical. If TRUE, attempts to read .mat files using a Python-based method (SciPy). Default: FALSE.
<code>verbose</code>	Logical. If TRUE, prints progress messages. Default: TRUE.



```

# Using custom classification result:
class = c("Mesodinium_rubrum",
          "Mesodinium_rubrum")
image <- c("D20220522T003051_IFCB134_00002",
           "D20220522T003051_IFCB134_00003")

biovolume_df_custom <- ifcb_extract_biovolumes(feature_files,
                                                custom_images = image,
                                                custom_classes = class)

print(biovolume_df_custom)

## End(Not run)

```

---

```
ifcb_extract_classified_images
```

*Extract Taxa Images from MATLAB Classified Sample*

---

## Description

This function reads a MATLAB classified sample file (.mat) generated by the `start_classify_batch_user_training` function from the `ifcb-analysis` repository (Sosik and Olson 2007), extracts specified taxa images from the corresponding ROI files, and saves each image in a specified directory.

## Usage

```

ifcb_extract_classified_images(
  sample,
  classified_folder,
  roi_folder,
  out_folder,
  taxa = "All",
  threshold = "opt",
  overwrite = FALSE,
  scale_bar_um = NULL,
  scale_micron_factor = 1/3.4,
  scale_bar_position = "bottomright",
  scale_bar_color = "black",
  old_adc = FALSE,
  gamma = 1,
  use_python = FALSE,
  verbose = TRUE
)

```

## Arguments

`sample` A character string specifying the sample name.



classified_folder	A character string specifying the directory containing the classified files.
roi_folder	A character string specifying the directory containing the ROI files.
out_folder	A character string specifying the directory to save the extracted images.
taxa	A character string specifying the taxa to extract. Default is "All".
threshold	A character string specifying the threshold to use ("none", "opt", "adhoc"). Default is "opt".
overwrite	A logical value indicating whether to overwrite existing PNG files. Default is FALSE.
scale_bar_um	An optional numeric value specifying the length of the scale bar in micrometers. If NULL, no scale bar is added.
scale_micron_factor	A numeric value defining the conversion factor from micrometers to pixels. Defaults to 1/3.4.
scale_bar_position	A character string specifying the position of the scale bar in the image. Options are "topright", "topleft", "bottomright", or "bottomleft". Defaults to "bottomright".
scale_bar_color	A character string specifying the scale bar color. Options are "black" or "white". Defaults to "black".
old_adc	A logical value indicating whether the adc file is of the old format (samples from IFCB1-6, labeled "IFCBxxx_YYYY_DDD_HHMMSS"). Default is FALSE.
gamma	A numeric value for gamma correction applied to the image. Default is 1 (no correction). Values <1 increase contrast in dark regions, while values >1 decrease contrast.
use_python	Logical. If TRUE, attempts to read the .mat file using a Python-based method. Default is FALSE.
verbose	A logical value indicating whether to print progress messages. Default is TRUE.

### Details

If `use_python = TRUE`, the function tries to read the `.mat` file using `ifcb_read_mat()`, which relies on SciPy. This approach may be faster than the default approach using `R.matlab::readMat()`, especially for large `.mat` files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using `ifcb_py_install()`.

If `use_python = FALSE` or if SciPy is not available, the function falls back to using `R.matlab::readMat()`.

### Value

No return value, called for side effects. Extracts and saves taxa images to a directory.

### References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

**See Also**

`ifcb_extract_pngs ifcb_extract_annotated_images` <https://github.com/hsosik/ifcb-analysis>

**Examples**

```
## Not run:
# Define the parameters
sample <- "D20230311T092911_IFCB135"
classified_folder <- "path/to/classified_folder"
roi_folder <- "path/to/roi_folder"
out_folder <- "path/to/outputdir"
taxa <- "All" # or specify a particular taxa
threshold <- "opt" # or specify another threshold

# Extract taxa images from the classified sample
ifcb_extract_classified_images(sample, classified_folder, roi_folder, out_folder, taxa, threshold)

## End(Not run)
```

---

`ifcb_extract_pngs`

*Extract Images from IFCB ROI File*

---

**Description**

This function reads an IFCB (.roi) file and its corresponding .adc file, extracts regions of interest (ROIs), and saves each ROI as a PNG image in a specified directory. Optionally, you can specify ROI numbers to extract, useful for specific ROIs from manual or automatic classification results. Additionally, a scale bar can be added to the extracted images based on a specified micron-to-pixel conversion factor.

**Usage**

```
ifcb_extract_pngs(
  roi_file,
  out_folder = dirname(roi_file),
  ROInumbers = NULL,
  taxaname = NULL,
  gamma = 1,
  overwrite = FALSE,
  scale_bar_um = NULL,
  scale_micron_factor = 1/3.4,
  scale_bar_position = "bottomright",
  scale_bar_color = "black",
  old_adc = FALSE,
  verbose = TRUE
)
```

**Arguments**

<code>roi_file</code>	A character string specifying the path to the <code>.roi</code> file.
<code>out_folder</code>	A character string specifying the directory where the PNG images will be saved. Defaults to the directory of the ROI file.
<code>ROInumbers</code>	An optional numeric vector specifying the ROI numbers to extract. If NULL, all ROIs with valid dimensions are extracted.
<code>taxaname</code>	An optional character string specifying the taxa name for organizing images into subdirectories. Defaults to NULL.
<code>gamma</code>	A numeric value for gamma correction applied to the image. Default is 1 (no correction). Values $<1$ increase contrast in dark regions, while values $>1$ decrease contrast.
<code>overwrite</code>	A logical value indicating whether to overwrite existing PNG files. Default is FALSE.
<code>scale_bar_um</code>	An optional numeric value specifying the length of the scale bar in micrometers. If NULL, no scale bar is added.
<code>scale_micron_factor</code>	A numeric value defining the conversion factor from micrometers to pixels. Defaults to 1/3.4.
<code>scale_bar_position</code>	A character string specifying the position of the scale bar in the image. Options are "topright", "topleft", "bottomright", or "bottomleft". Defaults to "bottomright".
<code>scale_bar_color</code>	A character string specifying the scale bar color. Options are "black" or "white". Defaults to "black".
<code>old_adc</code>	A logical value indicating whether the adc file is of the old format (samples from IFCB1-6, labeled "IFCBxxx_YYYY_DDD_HHMMSS"). Default is FALSE.
<code>verbose</code>	A logical value indicating whether to print progress messages. Default is TRUE.

**Value**

This function is called for its side effects: it writes PNG images to a directory.

**See Also**

[ifcb\\_extract\\_classified\\_images](#) for extracting ROIs from automatic classification.

[ifcb\\_extract\\_annotated\\_images](#) for extracting ROIs from manual annotation.

**Examples**

```
## Not run:
# Convert ROI file to PNG images
ifcb_extract_pngs("path/to/your_roi_file.roi")

# Extract specific ROI numbers from ROI file
ifcb_extract_pngs("path/to/your_roi_file.roi", "output_directory", ROInumbers = c(1, 2, 3))
```

```
# Extract images with a 5 micrometer scale bar
ifcb_extract_pngs("path/to/your_roi_file.roi", scale_bar_um = 5)

## End(Not run)
```

---

```
ifcb_get_ecotaxa_example
```

*Get EcoTaxa Column Names*

---

## Description

This function reads an example EcoTaxa metadata file included in the `iRfcb` package.

## Usage

```
ifcb_get_ecotaxa_example(example = "ifcb")
```

## Arguments

example	A character string specifying which example EcoTaxa metadata file to load. Options are: <b>"minimal"</b> Loads a minimal example, for fully manual entry. <b>"full_unknown"</b> Loads a full featured example, with unknown objects only. <b>"full_classified"</b> Loads a full featured example, with already classified objects. <b>"ifcb"</b> (Default) Loads a full IFCB-specific dataset used for EcoTaxa submissions.
---------	---

## Details

This function loads different types of EcoTaxa metadata examples based on the user's need. The examples include a minimal template for manual data entry, as well as fully featured datasets with or without classified objects. The default is an IFCB-specific example, originating from <https://github.com/VirginieSonnet/IFCBdatabaseToEcotaxa>. The example headers can be used when submitting data from Imaging FlowCytobot (IFCB) instruments to EcoTaxa at <https://ecotaxa.obs-vlfr.fr/>.

## Value

A data frame containing EcoTaxa example metadata.

## Examples

```
ecotaxa_example <- ifcb_get_ecotaxa_example()

# Print the first five columns
dplyr::tibble(ecotaxa_example)
```

---

ifcb\_get\_ferrybox\_data

*Retrieve Ferrybox Data for Specified Timestamps*


---

### Description

This internal SMHI function reads .txt files from a specified folder containing Ferrybox data, filters them based on a specified ship name (default is "SveaFB" for R/V Svea), and extracts data (including GPS coordinates) for timestamps (rounded to the nearest minute) falling within the date ranges defined in the file names.

### Usage

```
ifcb_get_ferrybox_data(
    timestamps,
    ferrybox_folder,
    parameters = c("8002", "8003"),
    ship = "SveaFB",
    latitude_param = "8002",
    longitude_param = "8003"
)
```

### Arguments

timestamps	A vector of POSIXct timestamps for which GPS coordinates and associated parameter data are to be retrieved.
ferrybox_folder	A string representing the path to the folder containing Ferrybox .txt files.
parameters	A character vector specifying the parameters to extract from the Ferrybox data. Defaults to c("8002", "8003").
ship	A string representing the name of the ship to filter Ferrybox files. The default is "SveaFB".
latitude_param	A string specifying the header name for the latitude column in the Ferrybox data. Default is "8002".
longitude_param	A string specifying the header name for the longitude column in the Ferrybox data. Default is "8003".

### Details

The function extracts data from files whose names match the specified ship and fall within the date ranges defined in the file names. The columns corresponding to latitude\_param and longitude\_param will be renamed to gpsLatitude and gpsLongitude, respectively, if they are present in the parameters argument.

The function also handles cases where the exact timestamp is missing by attempting to interpolate the data using floor and ceiling rounding methods. The final output will ensure that all specified parameters are numeric.

**Value**

A data frame containing the input timestamps and corresponding data for the specified parameters. Columns include 'timestamp', 'gpsLatitude', 'gpsLongitude' (if applicable), and the specified parameters.

**Examples**

```
## Not run:
ferrybox_folder <- "/path/to/ferrybox/data"
timestamps <- as.POSIXct(c("2016-08-10 10:47:34 UTC",
                           "2016-08-10 11:12:21 UTC",
                           "2016-08-10 11:35:59 UTC"))

result <- ifcb_get_ferrybox_data(timestamps, ferrybox_folder)
print(result)

## End(Not run)
```

---

ifcb\_get\_mat\_names      *Get Variable Names from a MAT File*

---

**Description**

This function reads a .mat file generated the ifcb-analysis repository (Sosik and Olson 2007) and retrieves the names of all variables stored within it.

**Usage**

```
ifcb_get_mat_names(mat_file, use_python = FALSE)
```

**Arguments**

mat_file	A character string specifying the path to the .mat file.
use_python	Logical. If TRUE, attempts to read the .mat file using a Python-based method. Default is FALSE.

**Details**

If use\_python = TRUE, the function tries to read the .mat file using ifcb\_read\_mat(), which relies on SciPy. This approach may be faster than the default approach using R.matlab::readMat(), especially for large .mat files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using ifcb\_py\_install().

If use\_python = FALSE or if SciPy is not available, the function falls back to using R.matlab::readMat().

**Value**

A character vector of variable names.

**References**

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

**See Also**

`ifcb_get_mat_variable` <https://github.com/hsosik/ifcb-analysis>

**Examples**

```
# Example .mat file included in the package
mat_file <- system.file("exdata/example.mat", package = "ifcb")

# Get variable names from a MAT file
variables <- ifcb_get_mat_names(mat_file)
print(variables)
```

---

`ifcb_get_mat_variable` *Get Classes from a MAT File*

---

**Description**

This function reads a specified variable from a `.mat` file generated by the `ifcb-analysis` repository (Sosik and Olson 2007). It can be used, for example, to extract lists of classes from the file.

**Usage**

```
ifcb_get_mat_variable(
  mat_file,
  variable_name = "class2use",
  use_python = FALSE
)
```

**Arguments**

<code>mat_file</code>	A character string specifying the path to the <code>.mat</code> file containing the class information.
<code>variable_name</code>	A character string specifying the variable name in the <code>.mat</code> file that contains the class information. The default is "class2use". Other examples include "class2use_manual" from a manual file, or "class2use_auto" for a class list used for automatic assignment. You can find available variable names using the function <code>ifcb_get_mat_names</code> .
<code>use_python</code>	Logical. If TRUE, attempts to read the <code>.mat</code> file using a Python-based method. Default is FALSE.

### Details

If `use_python = TRUE`, the function tries to read the `.mat` file using `ifcb_read_mat()`, which relies on SciPy. This approach may be faster than the default approach using `R.matlab::readMat()`, especially for large `.mat` files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using `ifcb_py_install()`.

If `use_python = FALSE` or if SciPy is not available, the function falls back to using `R.matlab::readMat()`.

### Value

A character vector of class names.

### References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

### See Also

`ifcb_get_mat_names` <https://github.com/hsosik/ifcb-analysis>

### Examples

```
# Example .mat file included in the package
mat_file <- system.file("exdata/example.mat", package = "iRfcb")

# Get class names from a class2use file
classifier_name <- ifcb_get_mat_variable(mat_file, "classifierName")
print(classifier_name)

# Get class names from a classifier file
class2useTB <- ifcb_get_mat_variable(mat_file, "class2useTB")
print(class2useTB)
```

---

ifcb\_get\_runtime

*Read IFCB Header File and Extract Runtime Information*

---

### Description

This function imports an IFCB header file (either from a local path or URL), extracts specific target values such as runtime and inhibititime, and returns them in a structured format (in seconds). This is the R equivalent function of `IFCBxxx_readhdr` from the `ifcb-analysis` repository (Sosik and Olson 2007).

### Usage

```
ifcb_get_runtime(hdr_file)
```



**Arguments**

hdr\_file            A character string specifying the full path to the .hdr file or URL.

**Value**

A list (hdr) containing runtime, inhibittime, and runType (if available) extracted from the header file.

**References**

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

**See Also**

<https://github.com/hsosik/ifcb-analysis>

**Examples**

```
## Not run:  
# Example: Read and extract information from an IFCB header file  
hdr_info <- ifcb_get_runtime("path/to/IFCB_hdr_file.hdr")  
  
print(hdr_info)  
  
## End(Not run)
```

---

ifcb\_get\_shark\_colnames

*Get Shark Column Names*

---

**Description**

This function reads SHARK column names from a specified tab-separated values (TSV) file included in the package. These columns are used for submitting IFCB data to <https://shark.smhi.se/>.

**Usage**

```
ifcb_get_shark_colnames(minimal = FALSE)
```

**Arguments**

minimal            A logical value indicating whether to load only the minimal set of column names required for data submission to SHARK. Default is FALSE.

**Details**

For a detailed example of a data submission, see [ifcb\\_get\\_shark\\_example](#).

**Value**

An empty data frame containing the SHARK column names.

**See Also**

[ifcb\\_get\\_shark\\_example](#)

**Examples**

```
shark_colnames <- ifcb_get_shark_colnames()
print(shark_colnames)

shark_colnames_minimal <- ifcb_get_shark_colnames(minimal = TRUE)
print(shark_colnames_minimal)
```

---

ifcb\_get\_shark\_example

*Get Shark Column Example*

---

**Description**

This function reads a SHARK submission example from a file included in the package. This format is used for submitting IFCB data to <https://shark.smhi.se/>.

**Usage**

```
ifcb_get_shark_example()
```

**Value**

A data frame containing example data following the SHARK submission format.

**See Also**

[ifcb\\_get\\_shark\\_colnames](#)

**Examples**

```
shark_example <- ifcb_get_shark_example()

# Print example as tibble
dplyr::tibble(shark_example)
```

---

ifcb\_get\_trophic\_type *Get Trophic Type for a List of Plankton Taxa*

---

## Description

This function matches a specified list of taxa with a summarized list of trophic types for various plankton taxa from Northern Europe (data sourced from SMHI Trophic Type).

## Usage

```
ifcb_get_trophic_type(taxa_list = NULL, print_complete_list = FALSE)
```

## Arguments

`taxa_list` A character vector of scientific names for which trophic types are to be retrieved.  
`print_complete_list` Logical, if TRUE, prints the complete list of summarized trophic types.

## Details

If there are multiple trophic types for a scientific name (i.e. AU and HT size classes), the summarized trophic type is "NS".

## Value

A character vector of trophic types corresponding to the scientific names in `taxa_list`, or a data frame containing all taxa and trophic types available in the SMHI Trophic Type list. The available trophic types are autotrophic (AU), heterotrophic (HT), mixotrophic (MX) or not specified (NS).

## Examples

```
# Example usage:
taxa_list <- c("Acanthoceras zachariasii",
              "Nodularia spumigena",
              "Acanthoica quattrosipina",
              "Noctiluca",
              "Gymnodiniales")

ifcb_get_trophic_type(taxa_list)
```

---

`ifcb_is_diatom`*Identify Diatoms in Taxa List*

---

### Description

This function takes a list of taxa names, cleans them, retrieves their corresponding classification records from the World Register of Marine Species (WoRMS), and checks if they belong to the specified diatom class. The function only uses the first name (genus name) of each taxa for classification.

### Usage

```
ifcb_is_diatom(  
  taxa_list,  
  diatom_class = "Bacillariophyceae",  
  max_retries = 3,  
  sleep_time = 10,  
  marine_only = FALSE,  
  fuzzy = deprecated(),  
  verbose = TRUE  
)
```

### Arguments

<code>taxa_list</code>	A character vector containing the list of taxa names.
<code>diatom_class</code>	A character string or vector specifying the class name(s) to be identified as diatoms, according to WoRMS. Default is "Bacillariophyceae".
<code>max_retries</code>	An integer specifying the maximum number of attempts to retrieve WoRMS records in case of an error. Default is 3.
<code>sleep_time</code>	A numeric value indicating the number of seconds to wait between retry attempts. Default is 10 seconds.
<code>marine_only</code>	Logical. If TRUE, restricts the search to marine taxa only. Default is FALSE.
<code>fuzzy</code>	<b>[Deprecated]</b> The fuzzy argument is no longer available
<code>verbose</code>	A logical indicating whether to print progress messages. Default is TRUE.

### Value

A logical vector indicating whether each cleaned taxa name belongs to the specified diatom class.

### See Also

<https://www.marinespecies.org/>

## Examples

```
## Not run:
taxa_list <- c("Nitzschia_sp", "Chaetoceros_sp", "Dinophysis_norvegica", "Thalassiosira_sp")
ifcb_is_diatom(taxa_list)

## End(Not run)
```

---

ifcb_is_in_basin	<i>Check if Points are in a Specific Sea Basin</i>
------------------	--

---

## Description

This function checks if vectors of latitude and longitude points are within a user-supplied sea basin. The Baltic Sea basins are included as a pre-packaged shapefile in the `iRfcb` package.

## Usage

```
ifcb_is_in_basin(latitudes, longitudes, plot = FALSE, shape_file = NULL)
```

## Arguments

latitudes	A numeric vector of latitude points.
longitudes	A numeric vector of longitude points.
plot	A boolean indicating whether to plot the points and the sea basin. Default is FALSE.
shape_file	The absolute path to a custom polygon shapefile in WGS84 (EPSG:4326) that represents the specific sea basin. Default is a land-buffered shapefile of the Baltic Sea basins, included in the <code>iRfcb</code> package.

## Details

This function reads a pre-packaged shapefile of the Baltic Sea Basin from the `iRfcb` package by default, or a user-supplied shapefile if provided. It sets the CRS, transforms the CRS to WGS84 (EPSG:4326) if necessary, and checks if the given points fall within the specified sea basin. Optionally, it plots the points and the sea basin polygons together.

## Value

A logical vector indicating whether each point is within the specified sea basin, or a plot with the points and basins if `plot = TRUE`.

**Examples**

```
# Define example latitude and longitude vectors
latitudes <- c(55.337, 54.729, 56.311, 57.975)
longitudes <- c(12.674, 14.643, 12.237, 10.637)

# Check if the points are in the Baltic Sea Basin
points_in_the_baltic <- ifcb_is_in_basin(latitudes, longitudes)
print(points_in_the_baltic)

# Plot the points and the basin
ifcb_is_in_basin(latitudes, longitudes, plot = TRUE)
```

---

```
ifcb_is_near_land      Determine if Positions are Near Land
```

---

**Description**

Determines whether given positions are near land based on a land polygon shape file. The Natural Earth 1:10m land vectors are included as a default shapefile in `iRfcb`.

**Usage**

```
ifcb_is_near_land(
  latitudes,
  longitudes,
  distance = 500,
  shape = NULL,
  source = "ne",
  crs = 4326,
  remove_small_islands = TRUE,
  small_island_threshold = 2e+06,
  plot = FALSE,
  utm_zone = deprecated()
)
```

**Arguments**

<code>latitudes</code>	Numeric vector of latitudes for positions.
<code>longitudes</code>	Numeric vector of longitudes for positions. Must be the same length as <code>latitudes</code> .
<code>distance</code>	Buffer distance (in meters) from the coastline to consider "near land." Default is 500 meters.
<code>shape</code>	Optional path to a shapefile ( <code>.shp</code> ) containing coastline data. If provided, this file will be used instead of the default Natural Earth 1:10m land vectors. A high-resolution shapefile can improve the accuracy of buffer distance calculations. Alternatively, you can retrieve a more detailed European coastline automatically by setting the <code>source</code> argument to <code>"eea"</code> .

source	Character string indicating which default coastline source to use when shape = NULL. Options are "ne" (Natural Earth, default) and "eea" (European Environment Agency). Ignored if shape is provided.
crs	Coordinate reference system (CRS) to use for input and output. Default is EPSG code 4326 (WGS84).
remove_small_islands	Logical indicating whether to remove small islands from the coastline. Useful in archipelagos. Default is TRUE.
small_island_threshold	Area threshold in square meters below which islands will be considered small and removed, if remove_small_islands is set to TRUE. Default is 2 square km.
plot	A boolean indicating whether to plot the points, land polygon and buffer. Default is FALSE.
utm_zone	<b>[Deprecated]</b> This argument is deprecated. UTM zones are now determined automatically based on the longitude of the input positions.

## Details

This function calculates a buffered area around the coastline using a polygon shapefile and determines if each input position intersects with this buffer or the landmass itself. By default, it uses the Natural Earth 1:10m land vector dataset.

The EEA shapefile is downloaded from <https://www.eea.europa.eu/data-and-maps/data/eea-coastline-for-analysis-2/gis-data/eea-coastline-polygon> when source = "eea".

## Value

If plot = FALSE (default), a logical vector is returned indicating whether each position is near land or not, with NA for positions where coordinates are missing. If plot = TRUE, a ggplot object is returned showing the land polygon, buffer area, and position points colored by their proximity to land.

## Examples

```
# Define coordinates
latitudes <- c(62.500353, 58.964498, 57.638725, 56.575338)
longitudes <- c(17.845993, 20.394418, 18.284523, 16.227174)

# Call the function
near_land <- ifcb_is_near_land(latitudes, longitudes, distance = 300, crs = 4326)

# Print the result
print(near_land)
```

---

ifcb\_match\_taxa\_names *Retrieve WoRMS Records with Retry Mechanism*

---

## Description

This function attempts to retrieve WoRMS records using the provided taxa names. It retries the operation if an error occurs, up to a specified number of attempts.

## Usage

```
ifcb_match_taxa_names(  
  taxa_names,  
  best_match_only = TRUE,  
  max_retries = 3,  
  sleep_time = 10,  
  marine_only = FALSE,  
  return_list = FALSE,  
  verbose = TRUE,  
  fuzzy = deprecated()  
)
```

## Arguments

taxa_names	A character vector of taxa names to retrieve records for.
best_match_only	A logical value indicating whether to automatically select the first match and return a single match. Default is TRUE.
max_retries	An integer specifying the maximum number of attempts to retrieve records.
sleep_time	A numeric value indicating the number of seconds to wait between retry attempts.
marine_only	Logical. If TRUE, restricts the search to marine taxa only. Default is FALSE.
return_list	A logical value indicating whether to return the output as a list. Default is FALSE, where the result is returned as a dataframe.
verbose	A logical indicating whether to print progress messages. Default is TRUE.
fuzzy	<b>[Deprecated]</b> The fuzzy argument is no longer available

## Value

A data frame (or list if return\_list is TRUE) of WoRMS records or NULL if the retrieval fails after the maximum number of attempts.



## Examples

```
## Not run:
# Example: Retrieve WoRMS records for a list of taxa names
taxa <- c("Calanus finmarchicus", "Thalassiosira pseudonana", "Phaeodactylum tricornutum")

# Call the function
records <- ifcb_match_taxa_names(taxa_names = taxa,
                                max_retries = 3,
                                sleep_time = 5,
                                marine_only = TRUE,
                                verbose = TRUE)

print(records)

## End(Not run)
```

---

ifcb\_merge\_manual      *Merge IFCB Manual Classification Data*

---

## Description

This function merges two sets of manual classification data by combining and aligning class labels from a base set and an additional set of classifications. The merged .mat data can be used with the code in the ifcb-analysis repository (Sosik and Olson 2007).

## Usage

```
ifcb_merge_manual(
  class2use_file_base,
  class2use_file_additions,
  class2use_file_output = NULL,
  manual_folder_base,
  manual_folder_additions,
  manual_folder_output,
  do_compression = TRUE,
  temp_index_offset = 50000,
  skip_class = NULL,
  quiet = FALSE
)
```

## Arguments

class2use\_file\_base

Character. Path to the class2use file of the base manual classifications. The base set contains the original manual classifications list that form the foundation for merging.

<code>class2use_file_additions</code>	Character. Path to the <code>class2use</code> file of the additions manual classifications. The additions set contains additional classifications that need to be merged with the base set. Class labels from the <code>class2use_file_additions</code> that are not already included in the <code>class2use_file_base</code> will be added to generate the <code>class2use_file_output</code> .
<code>class2use_file_output</code>	Character. Path where the merged <code>class2use</code> file will be saved. If NULL, the merged file will be stored in the same directory as <code>class2use_file_base</code> . Default is NULL.
<code>manual_folder_base</code>	Character. Path to the folder containing the base set of manual classification <code>.mat</code> files.
<code>manual_folder_additions</code>	Character. Path to the folder containing the additions set of manual classification <code>.mat</code> files.
<code>manual_folder_output</code>	Character. Path to the output folder where the merged classification files will be stored.
<code>do_compression</code>	A logical value indicating whether to compress the <code>.mat</code> file. Defaults to TRUE.
<code>temp_index_offset</code>	Numeric. A large integer used to generate temporary indices during the merge process. Default is 50000.
<code>skip_class</code>	Character. A vector of class names to skip from the <code>class2use_file_additions</code> during the merge process. Default is NULL.
<code>quiet</code>	Logical. If TRUE, suppresses output messages. Default is FALSE.

### Details

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

The **base** set consists of the original classifications that are used as a reference for the merging process. The **additions** set contains the additional classifications that need to be merged with the base set. When merging, unique class names from the additions set that are not present in the base set are appended.

The function works by aligning the class labels from the additions set with those in the base set, handling conflicts by using a temporary index system. It copies `.mat` files from both the base and additions folders into the output folder, while adjusting indices and and class names for the additions.

Note that the maximum limit for `uint16` is 65,535, so ensure that `temp_index_offset` remains below this value.

### Value

No return value. Outputs the combined `class2use` file in the same folder as `class2use_file_base` is located or at a user-specified location, and merged `.mat` files into the output folder.

## References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

## See Also

`ifcb_py_install` <https://github.com/hsosik/ifcb-analysis>

## Examples

```
## Not run:
ifcb_merge_manual("path/to/class2use_base.mat", "path/to/class2use_additions.mat",
                 "path/to/class2use_combined.mat", "path/to/manual/base_folder",
                 "path/to/manual/additions_folder", "path/to/manual/output_folder",
                 do_compression = TRUE, temp_index_offset = 50000, quiet = FALSE)

## End(Not run)
```

---

ifcb\_prepare\_who\_i\_plankton

*Download and Prepare WHOI-Plankton Data*

---

## Description

This function downloads manually annotated images from the WHOI-Plankton dataset (Sosik et al. 2015) and generates manual classification files in `.mat` format that can be used to train an image classifier using the `ifcb-analysis` MATLAB package (Sosik and Olson 2007).

## Usage

```
ifcb_prepare_who_i_plankton(
  years,
  png_folder,
  raw_folder,
  manual_folder,
  class2use_file,
  skip_classes = NULL,
  dashboard_url = "https://ifcb-data.who_i.edu/mvco/",
  extract_images = FALSE,
  download_blobs = FALSE,
  blobs_folder = NULL,
  download_features = FALSE,
  features_folder = NULL,
  parallel_downloads = 5,
  sleep_time = 2,
  multi_timeout = 120,
```

```

    convert_filenames = TRUE,
    convert_adc = TRUE,
    quiet = FALSE
)

```

## Arguments

years	Character vector. Years to download and process. For available years, see <a href="https://hdl.handle.net/1912/7341">https://hdl.handle.net/1912/7341</a> or <a href="#">ifcb_download_who_i_plankton</a> .
png_folder	Character. Directory where .png images will be stored.
raw_folder	Character. Directory where raw files (.adc, .hdr, .roi) will be stored.
manual_folder	Character. Directory where manual classification files (.mat) will be stored.
class2use_file	Character. File path to .mat file to store the list of available classes.
skip_classes	Character vector. Classes to be excluded during processing. For example images, refer to <a href="https://whoigit.github.io/who_i-plankton/">https://whoigit.github.io/who_i-plankton/</a> .
dashboard_url	Character. URL for the IFCB dashboard data source (default: "https://ifcb-data.who_i.edu/mvco/").
extract_images	Logical. If TRUE, extracts .png images from the downloaded archives and removes the .zip files. If FALSE, only downloads the archives without extracting images. Default is FALSE.
download_blobs	Logical. Whether to download blob files (default: FALSE).
blobs_folder	Character. Directory where blob files will be stored (required if download_blobs = TRUE).
download_features	Logical. Whether to download feature files (default: FALSE).
features_folder	Character. Directory where feature files will be stored (required if download_features = TRUE).
parallel_downloads	Integer. Number of parallel IFCB Dashboard downloads (default: 5).
sleep_time	Numeric. Seconds to wait between download requests (default: 2).
multi_timeout	Numeric. Timeout for multiple requests in seconds (default: 120).
convert_filenames	Logical. If TRUE (default), converts filenames of the old format "IFCBxxx_YYYY_DDD_HHMSS" to the new format (DYYYYMMDDTHHMSS_IFCBXXX). <b>[Experimental]</b>
convert_adc	Logical. If TRUE (default), adjusts .adc files from older IFCB instruments (IFCB1–6, with filenames in the format "IFCBxxx_YYYY_DDD_HHMSS") by inserting four empty columns after column 7 to match the newer format. <b>[Experimental]</b>
quiet	Logical. Suppress messages if TRUE (default: FALSE).

## Details

This function requires a python interpreter to be installed. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

This is a wrapper function for the `ifcb_download_who_i_plankton`, `ifcb_download_dashboard_data` and `ifcb_create_empty_manual_file` functions and used for downloading, processing, and converting IFCB data. Please note that this function downloads and extracts large amounts of data, which can take considerable time.

The training data prepared from this function can be merged with an existing training dataset using the `ifcb_merge_manual` function.

To exclude images from the training dataset, either exclude the class completely with the `skip_classes` argument, or set `extract_images = TRUE` and manually delete specific .png files from the `png_folder` and rerun `ifcb_prepare_who_i_plankton`.

If `convert_filenames = TRUE` [**Experimental**], filenames in the "IFCBxxx\_YYYY\_DDD\_HHMSS" format (used by IFCB1-6) will be converted to IYYYYMMDDTHHMSS\_IFCBXXX, ensuring compatibility with blob extraction in `ifcb-analysis` (Sosik & Olson, 2007), which identified the old .adc format by the first letter of the filename.

If `convert_adc = TRUE` [**Experimental**] and `convert_filenames = TRUE` [**Experimental**], the "IFCBxxx\_YYYY\_DDD\_HHMSS" format will instead be converted to DYYYYMMDDTHHMSS\_IFCBXXX. Additionally, .adc files will be modified to include four empty columns (PMT-A peak, PMT-B peak, PMT-C peak, and PMT-D peak), aligning them with the structure of modern .adc files for full compatibility with `ifcb-analysis`.

## Value

This function does not return a value but downloads, processes, and stores IFCB data.

## References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

Sosik, H. M., Peacock, E. E. and Brownlee E. F. (2015), Annotated Plankton Images - Data Set for Developing and Evaluating Classification Methods. doi:10.1575/1912/7341

## See Also

<https://hdl.handle.net/1912/7341>, [https://whoigit.github.io/who-i-plankton/ifcb\\_merge\\_manual](https://whoigit.github.io/who-i-plankton/ifcb_merge_manual)  
[ifcb\\_download\\_who\\_i\\_plankton](#) [ifcb\\_download\\_dashboard\\_data](#)

## Examples

```
## Not run:
# Download and prepare WHOI-Plankton for the years 2013 and 2014
ifcb_prepare_who_i_plankton(
  years = c("2013", "2014"),
  png_folder = "who_i_plankton/png",
  raw_folder = "who_i_plankton/raw",
  manual_folder = "who_i_plankton/manual",
  class2use_file = "who_i_plankton/config/class2use_whoiplankton.mat"
)
```

```
## End(Not run)
```

---

```
ifcb_psd
```

```
Plot and Save IFCB PSD Data
```

---

### Description

This function generates and saves data about a dataset's Particle Size Distribution (PSD) from Imaging FlowCytobot (IFCB) feature and hdr files, which can be used for data quality assurance and quality control.

### Usage

```
ifcb_psd(
  feature_folder,
  hdr_folder,
  save_data = FALSE,
  output_file = NULL,
  plot_folder = NULL,
  use_marker = FALSE,
  start_fit = 10,
  r_sqr = 0.5,
  beads = NULL,
  bubbles = NULL,
  incomplete = NULL,
  missing_cells = NULL,
  biomass = NULL,
  bloom = NULL,
  humidity = NULL,
  micron_factor = 1/3.4
)
```

### Arguments

<code>feature_folder</code>	The absolute path to a directory containing all of the v2 feature files for the dataset.
<code>hdr_folder</code>	The absolute path to a directory containing all of the hdr files for the dataset.
<code>save_data</code>	A boolean indicating whether to save data to CSV files. Default is FALSE.
<code>output_file</code>	A string with the base file name for the .csv to use (including path). Set to NULL to not save data (default).
<code>plot_folder</code>	The folder where graph images for each file will be saved. Set to NULL to not save graphs (default).
<code>use_marker</code>	A boolean indicating whether to show markers on the plot. Default is FALSE.
<code>start_fit</code>	An integer indicating the start fit value for the plot. Default is 10.

r_sqr	The lower limit of acceptable R <sup>2</sup> values (any curves below it will be flagged). Default is 0.5.
beads	The maximum multiplier for the curve fit. Any files with higher curve fit multipliers will be flagged as bead runs. If this argument is included, files with "runBeads" marked as TRUE in the header file will also be flagged as a bead run. Optional.
bubbles	The minimum difference between the starting ESD and the ESD with the most targets. Any files with a difference higher than this threshold will be flagged as mostly bubbles. Optional.
incomplete	A tuple with the minimum volume of cells (in c/L) and the minimum mL analyzed for a complete run. Any files with values below these thresholds will be flagged as incomplete. Optional.
missing_cells	The minimum image count to trigger count ratio. Any files with lower ratios will be flagged as missing cells. Optional.
biomass	The minimum number of targets in the most populated ESD bin for any given run. Any files with fewer targets will be flagged as having low biomass. Optional.
bloom	The minimum difference between the starting ESD and the ESD with the most targets. Any files with a difference less than this threshold will be flagged as a bloom. Will likely be lower than the bubbles threshold. Optional.
humidity	The maximum percent humidity. Any files with higher values will be flagged as high humidity. Optional.
micron_factor	The conversion factor to microns. Default is 1/3.4.

### Details

The PSD function originates from the PSD python repository (Hayashi et al. in prep), which can be found at <https://github.com/kudelalab/PSD>.

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

The function requires v2 features generated by the `ifcb-analysis` MATLAB package (Sosik and Olson 2007) found at <https://github.com/hsosik/ifcb-analysis>.

### Value

A list with data, fits, and flags DataFrames if `save_data` is FALSE; otherwise, NULL.

### References

Hayashi, K., Walton, J., Lie, A., Smith, J. and Kudela M. Using particle size distribution (PSD) to automate imaging flow cytobot (IFCB) data quality in coastal California, USA. In prep. Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

### See Also

`ifcb_py_install` <https://github.com/kudelalab/PSD> <https://github.com/hsosik/ifcb-analysis>

**Examples**

```

## Not run:
# Initialize the python session if not already set up
ifcb_py_install()

ifcb_psd(
  feature_folder = 'path/to/features',
  hdr_folder = 'path/to/hdr_data',
  save_data = TRUE,
  output_file = 'psd/svea_2021',
  plot_folder = 'psd/plots',
  use_marker = FALSE,
  start_fit = 13,
  r_sqr = 0.5,
  beads = 10 ** 9,
  bubbles = 150,
  incomplete = c(1500, 3),
  missing_cells = 0.7,
  biomass = 1000,
  bloom = 5,
  humidity = NULL,
  micron_factor = 1/3.0
)

## End(Not run)

```

---

ifcb\_psd\_plot

*Generate PSD Plot for a Given Sample*


---

**Description**

This function generates a plot for a given sample from Particle Size Distribution (PSD) data and fits from Imaging FlowCytobot (IFCB). The PSD data and fits can be generated by `ifcb_psd` (Hayashi et al. in prep).

**Usage**

```
ifcb_psd_plot(sample_name, data, fits, start_fit)
```

**Arguments**

<code>sample_name</code>	The name of the sample to plot in DYYYYMMDDTHHMMSS.
<code>data</code>	A data frame containing the PSD data (data output from <code>ifcb_psd</code> ), where each row represents a sample and each column represents different particle sizes in micrometers.
<code>fits</code>	A data frame containing the fit parameters for the power curve (fits output from <code>ifcb_psd</code> ), where each row represents a sample and the columns include the parameters <code>a</code> , <code>k</code> , and <code>R2</code> .



`start_fit` The x-value threshold below which data should be excluded from the plot and fit.

### Value

A ggplot object representing the PSD plot for the sample.

### References

Hayashi, K., Walton, J., Lie, A., Smith, J. and Kudela M. Using particle size distribution (PSD) to automate imaging flow cytobot (IFCB) data quality in coastal California, USA. In prep.

### See Also

`ifcb_psd` <https://github.com/kudelalab/PSD>

### Examples

```
## Not run:
#' # Initialize a python session if not already set up
ifcb_py_install()

# Analyze PSD
psd <- ifcb_psd(feature_folder = 'path/to/features',
               hdr_folder = 'path/to/hdr_data',
               save_data = TRUE,
               output_file = 'psd/svea_2021',
               plot_folder = NULL,
               use_marker = FALSE,
               start_fit = 13,
               r_sqr = 0.5,
               beads = 10 ** 9,
               bubbles = 150,
               incomplete = c(1500, 3),
               missing_cells = 0.7,
               biomass = 1000,
               bloom = 5,
               humidity = NULL)

# Plot PSD of the first sample
plot <- ifcb_psd_plot(sample_name = "D20230316T101514",
                    data = psd$data,
                    fits = psd$fits,
                    start_fit = 10)

# Inspect plot
print(plot)

## End(Not run)
```

---

ifcb_py_install	<i>Install iRfcb Python Environment</i>
-----------------	---

---

### Description

This function sets up the Python environment for iRfcb. By default, it creates and activates a Python virtual environment (venv) named "iRfcb" and installs the required Python packages from the "requirements.txt" file. Alternatively, users can opt to use the system Python instead of creating a virtual environment by setting `use_venv = FALSE` (not recommended).

### Usage

```
ifcb_py_install(  
  envname = "~/virtualenvs/iRfcb",  
  use_venv = TRUE,  
  packages = NULL  
)
```

### Arguments

<code>envname</code>	A character string specifying the name of the virtual environment to create. Default is <code>~/virtualenvs/iRfcb</code> .
<code>use_venv</code>	Logical. If TRUE (default), a virtual environment is created. If FALSE, the system Python is used instead, and missing packages are installed globally for the user.
<code>packages</code>	A character vector of additional Python packages to install. If NULL (default), only the packages from "requirements.txt" are installed.

### Details

This function requires Python to be available on the system. It uses the `reticulate` package to manage Python environments and packages.

The `USE_IRFCB_PYTHON` environment variable can be set to automatically activate an installed Python venv named `iRfcb` when the `iRfcb` package is loaded. Ensure that the `iRfcb` venv is installed in `reticulate::virtualenv_root()` and available via `reticulate::virtualenv_list()` (see examples). You can set `USE_IRFCB_PYTHON` to `"TRUE"` in your `.Renviro` file to enable automatic setup. For more details, see the package README at <https://europeanifcbgroup.github.io/iRfcb/#python-dependency>.

### Value

No return value. This function is called for its side effect of configuring the Python environment.

## Examples

```
## Not run:
# Define the name of the virtual environment in your virtual_root directory
envpath <- file.path(reticulate::virtualenv_root(), "iRfcb")

# Install the iRfcb Python venv in your virtual_root directory
ifcb_py_install(envname = envpath)

# Install the iRfcb Python environment with additional packages
ifcb_py_install(envname = envpath, packages = c("numpy", "plotly"))

# Use system Python instead of a virtual environment
ifcb_py_install(envname = envpath, use_venv = FALSE)

## End(Not run)
```

---

ifcb\_read\_features      *Read Feature Files from a Specified Folder or File Paths*

---

## Description

This function reads feature files from a given folder or a specified set of file paths, optionally filtering them based on whether they are multiblob or single blob files.

## Usage

```
ifcb_read_features(feature_files = NULL, multiblob = FALSE, verbose = TRUE)
```

## Arguments

**feature\_files**      A path to a folder containing feature files or a character vector of file paths.  
**multiblob**            Logical indicating whether to filter for multiblob files (default: FALSE).  
**verbose**             Logical. Whether to display progress information. Default is TRUE.

## Value

A named list of data frames, where each element corresponds to a feature file read from `feature_files`. The list is named with the base names of the feature files.

## Examples

```
## Not run:
# Read feature files from a folder
features <- ifcb_read_features("path/to/feature_folder")

# Read only multiblob feature files
multiblob_features <- ifcb_read_features("path/to/feature_folder", multiblob = TRUE)
```

```
# Read feature files from a list of file paths
features <- ifcb_read_features(c("path/to/file1.csv", "path/to/file2.csv"))

## End(Not run)
```

---

ifcb\_read\_hdr\_data      *Reads HDR Data from IFCB HDR Files*

---

### Description

This function reads all IFCB instrument settings information files (.hdr) from a specified directory.

### Usage

```
ifcb_read_hdr_data(
  hdr_files,
  gps_only = FALSE,
  verbose = TRUE,
  hdr_folder = deprecated()
)
```

### Arguments

hdr_files	A character string specifying the path to hdr files or a folder path.
gps_only	A logical value indicating whether to include only GPS information (latitude and longitude). Default is FALSE.
verbose	A logical value indicating whether to print progress messages. Default is TRUE.
hdr_folder	<b>[Deprecated]</b> Use <code>hdr_files</code> instead.

### Value

A data frame with sample names, GPS latitude, GPS longitude, and optionally timestamps.

### Examples

```
## Not run:
# Extract all HDR data
hdr_data <- ifcb_read_hdr_data("path/to/data")
print(hdr_data)

# Extract only GPS data
gps_data <- ifcb_read_hdr_data("path/to/data", gps_only = TRUE)
print(gps_data)

## End(Not run)
```

---

`ifcb_read_mat`*Read a MATLAB .mat File in R*

---

**Description**

This function reads a MATLAB .mat file using a Python function via reticulate.

**Usage**

```
ifcb_read_mat(file_path)
```

**Arguments**

`file_path`      A character string representing the full path to the .mat file.

**Details**

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

This function requires a python interpreter to be installed. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

**Value**

A list containing the MATLAB variables.

**See Also**

[ifcb\\_py\\_install](#)

**Examples**

```
## Not run:
# Initialize Python environment and install required packages
ifcb_py_install()

# Example .mat file included in the package
mat_file <- system.file("exdata/example.mat", package = "iRfcb")

# Read mat file using Python
data <- ifcb_read_mat(mat_file)

## End(Not run)
```

---

ifcb\_read\_summary      *Read and Summarize Classified IFCB Data*


---

### Description

This function reads a MATLAB `.mat` file containing aggregated and classified IFCB (Imaging FlowCytobot) data generated by the `countcells_allTbnew_user_training` function from the `ifcb-analysis` repository (Sosik and Olson 2007), or a list of classified data generated by `ifcb_summarize_class_counts`. It returns a data frame with species counts and optionally biovolume information based on specified thresholds.

### Usage

```
ifcb_read_summary(
  summary,
  hdr_directory = NULL,
  biovolume = FALSE,
  threshold = "opt",
  use_python = FALSE
)
```

### Arguments

<code>summary</code>	A character string specifying the path to the <code>.mat</code> summary file or a list generated by <code>ifcb_summarize_class_counts</code> .
<code>hdr_directory</code>	A character string specifying the path to the directory containing header ( <code>.hdr</code> ) files. Default is <code>NULL</code> .
<code>biovolume</code>	A logical indicating whether the file contains biovolume data. Default is <code>FALSE</code> .
<code>threshold</code>	A character string specifying the threshold type for counts and biovolume. Options are "opt" (default), "ad hoc", and "none".
<code>use_python</code>	Logical. If <code>TRUE</code> , attempts to read the <code>.mat</code> file using a Python-based method. Default is <code>FALSE</code> .

### Details

If `use_python = TRUE`, the function tries to read the `.mat` file using `ifcb_read_mat()`, which relies on SciPy. This approach may be faster than the default approach using `R.matlab::readMat()`, especially for large `.mat` files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using `ifcb_py_install()`.

If `use_python = FALSE` or if SciPy is not available, the function falls back to using `R.matlab::readMat()`.

### Value

A data frame containing the summary information including file list, volume analyzed, species counts, optionally biovolume, and other metadata.

## References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

## See Also

<https://github.com/hsosik/ifcb-analysis>

## Examples

```
mat_file <- system.file("exdata/example_summary.mat", package = "iRfcb")

summary_data <- ifcb_read_summary(mat_file, biovolume = FALSE, threshold = "opt")
print(summary_data)
```

---

ifcb\_replace\_mat\_values

*Replace Values in MATLAB Classlist*

---

## Description

This function replaces a target class ID with a new ID in MATLAB classlist files, generated by the code in the ifcb-analysis repository (Sosik and Olson 2007).

## Usage

```
ifcb_replace_mat_values(
  manual_folder,
  out_folder,
  target_id,
  new_id,
  column_index = 1,
  do_compression = TRUE
)
```

## Arguments

manual_folder	A character string specifying the path to the folder containing MAT classlist files to be updated.
out_folder	A character string specifying the path to the folder where updated MAT classlist files will be saved.
target_id	The target class ID to be replaced.
new_id	The new class ID to replace the target ID.
column_index	An integer value specifying which classlist column to edit. Default is 1 (manual).
do_compression	A logical value indicating whether to compress the .mat file. Default is TRUE.

**Details**

Python must be installed to use this function. The required python packages can be installed in a virtual environment using `ifcb_py_install()`.

**Value**

This function does not return any value; it updates the classlist files in the specified directory.

**References**

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

**See Also**

`ifcb_py_install` <https://github.com/hsosik/ifcb-analysis>

**Examples**

```
## Not run:  
# Initialize a python session if not already set up  
ifcb_py_install()  
  
# Replace class ID 99 with 1 in .mat classlist files  
ifcb_replace_mat_values("output/manual", "output/manual", 99, 1, column_index = 1)  
  
## End(Not run)
```

---

`ifcb_run_image_gallery`

*Run IFCB Image Gallery*

---

**Description**

Launches a Shiny application that provides an interactive interface for browsing and managing IFCB (Imaging FlowCytobot) image galleries.

**Usage**

```
ifcb_run_image_gallery()
```

**Details**

Users can specify a folder containing .png images, navigate through the images, select and unselect images, and download a list of selected images. This feature is particularly useful for quality control of annotated images. A downloaded list of images from the app can also be uploaded to filter and view only the selected images.



**Value**

No return value. This function launches a Shiny application for interactive image browsing and management.

**Examples**

```
## Not run:  
# Run the IFCB image gallery Shiny app  
ifcb_run_image_gallery()  
  
## End(Not run)
```

---

ifcb\_summarize\_biovolumes

*Summarize Biovolumes and Carbon Content from IFCB Data*

---

**Description**

This function calculates aggregated biovolumes and carbon content from Imaging FlowCytobot (IFCB) samples based on biovolume information from feature files. Images are grouped into classes either based on MATLAB classification, manually annotated files, or a user-supplied list of images and their corresponding class labels (e.g. from a CNN model).

**Usage**

```
ifcb_summarize_biovolumes(  
  feature_folder,  
  mat_folder = NULL,  
  class2use_file = NULL,  
  hdr_folder = NULL,  
  custom_images = NULL,  
  custom_classes = NULL,  
  micron_factor = 1/3.4,  
  diatom_class = "Bacillariophyceae",  
  marine_only = FALSE,  
  threshold = "opt",  
  feature_recursive = TRUE,  
  mat_recursive = TRUE,  
  hdr_recursive = TRUE,  
  use_python = FALSE,  
  verbose = TRUE  
)
```

**Arguments**

`feature_folder` Path to the folder containing feature files (e.g., CSV format).

<code>mat_folder</code>	(Optional) Path to the folder containing MATLAB classification or manual annotation files.
<code>class2use_file</code>	(Optional) A character string specifying the path to the file containing the <code>class2use</code> variable (default NULL). Only needed when summarizing manual MATLAB results.
<code>hdr_folder</code>	(Optional) Path to the folder containing HDR files. Needed for calculating cell, biovolume and carbon concentration per liter.
<code>custom_images</code>	(Optional) A character vector of image filenames in the format <code>DYYYYMMD-DTHHMMSS_IFCBXXX_ZZZZZ</code> , where "XXX" represents the IFCB number and "ZZZZZ" represents the ROI number. These filenames should match the <code>roi_number</code> assignment in the <code>feature_files</code> and can be used as a substitute for MATLAB files.
<code>custom_classes</code>	(Optional) A character vector of corresponding class labels for <code>custom_images</code> .
<code>micron_factor</code>	Conversion factor from microns per pixel (default: 1/3.4).
<code>diatom_class</code>	A string vector of diatom class names in the World Register of Marine Species (WoRMS). Default is "Bacillariophyceae".
<code>marine_only</code>	Logical. If TRUE, restricts the WoRMS search to marine taxa only. Default is FALSE.
<code>threshold</code>	Threshold for classification (default: "opt").
<code>feature_recursive</code>	Logical. If TRUE, the function will search for feature files recursively within the <code>feature_folder</code> . Default is TRUE.
<code>mat_recursive</code>	Logical. If TRUE, the function will search for MATLAB files recursively within the <code>mat_folder</code> . Default is TRUE.
<code>hdr_recursive</code>	Logical. If TRUE, the function will search for HDR files recursively within the <code>hdr_folder</code> (if provided). Default is TRUE.
<code>use_python</code>	Logical. If TRUE, attempts to read the <code>.mat</code> file using a Python-based method. Default is FALSE.
<code>verbose</code>	A logical indicating whether to print progress messages. Default is TRUE.

## Details

This function performs the following steps:

1. Extracts biovolumes and carbon content from feature and classification results using `ifcb_extract_biovolumes`.
2. Optionally incorporates volume data from HDR files to calculate volume analyzed per sample.
3. Computes biovolume and carbon content per liter of sample analyzed.

The MATLAB classification or manual annotation files are generated by the `ifcb-analysis` repository (Sosik and Olson 2007). Users can optionally provide a **custom classification** by supplying a vector of image filenames (`custom_images`) along with corresponding class labels (`custom_classes`). This allows summarization of biovolume and carbon content without requiring MATLAB classification or manual annotation files (e.g. results from a CNN model).

Biovolumes are converted to carbon according to Menden-Deuer and Lessard 2000 for individual regions of interest (ROI), applying different conversion factors to diatoms and non-diatom protists.

If provided, the function also incorporates sample volume data from HDR files to compute biovolume and carbon content per liter of sample.

If `use_python = TRUE`, the function tries to read the `.mat` file using `ifcb_read_mat()`, which relies on SciPy. This approach may be faster than the default approach using `R.matlab::readMat()`, especially for large `.mat` files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using `ifcb_py_install()`.

### Value

A data frame summarizing aggregated biovolume and carbon content per class per sample. Columns include 'sample', 'classifier', 'class', 'biovolume\_mm3', 'carbon\_ug', 'ml\_analyzed', 'biovolume\_mm3\_per\_liter', and 'carbon\_ug\_per\_liter'.

### References

Menden-Deuer Susanne, Lessard Evelyn J., (2000), Carbon to volume relationships for dinoflagellates, diatoms, and other protist plankton, *Limnology and Oceanography*, 3, doi: 10.4319/lo.2000.45.3.0569.

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

### Examples

```
## Not run:
# Example usage:
ifcb_summarize_biovolumes("path/to/features", "path/to/mat", hdr_folder = "path/to/hdr")

# Using custom classification result:
images <- c("D20220522T003051_IFCB134_00002",
           "D20220522T003051_IFCB134_00003")
classes = c("Mesodinium_rubrum",
           "Mesodinium_rubrum")

ifcb_summarize_biovolumes(feature_folder = "path/to/features",
                          hdr_folder = "path/to/hdr",
                          custom_images = images,
                          custom_classes = classes)

## End(Not run)
```

---

```
ifcb_summarize_class_counts
```

*Count Cells from TreeBagger Classifier Output*

---

### Description

This function summarizes class results for a series of classifier output files and returns a summary data list.

**Usage**

```
ifcb_summarize_class_counts(
  classpath_generic,
  hdr_folder,
  year_range,
  use_python = FALSE
)
```

**Arguments**

<code>classpath_generic</code>	Character string specifying the location of the classifier output files. The path should include 'xxxx' in place of the 4-digit year (e.g., 'classxxxx_v1/').
<code>hdr_folder</code>	Character string specifying the directory where the data (hdr files) are located. This can be a URL for web services or a full path for local files.
<code>year_range</code>	Numeric vector specifying the range of years (e.g., 2013:2014) to process.
<code>use_python</code>	Logical. If TRUE, attempts to read the .mat file using a Python-based method. Default is FALSE.

**Details**

If `use_python = TRUE`, the function tries to read the .mat file using `ifcb_read_mat()`, which relies on SciPy. This approach may be faster than the default approach using `R.matlab::readMat()`, especially for large .mat files. To enable this functionality, ensure Python is properly configured with the required dependencies. You can initialize the Python environment and install necessary packages using `ifcb_py_install()`.

If `use_python = FALSE` or if SciPy is not available, the function falls back to using `R.matlab::readMat()`.

**Value**

A list containing the following elements:

<code>class2useTB</code>	Classes used in the TreeBagger classifier.
<code>classcountTB</code>	Counts of each class considering each target placed in the winning class.
<code>classcountTB_above_optthresh</code>	Counts of each class considering only classifications above the optimal threshold for maximum accuracy.
<code>ml_analyzedTB</code>	Volume analyzed for each file.
<code>mdateTB</code>	Dates associated with each file.
<code>filelistTB</code>	List of files processed.
<code>classpath_generic</code>	The generic classpath provided as input.
<code>classcountTB_above_adhocthresh</code> (optional)	Counts of each class considering only classifications above the adhoc threshold.
<code>adhocthresh</code> (optional)	The adhoc threshold used for classification.

**Examples**

```
## Not run:
ifcb_summarize_class_counts('path/to/class/classxxx_v1/',
                           'path/to/data/', 2014)

## End(Not run)
```

---

```
ifcb_summarize_png_counts
```

*Summarize Image Counts by Class and Sample*

---

**Description**

This function summarizes the number of images per class for each sample and timestamps, and optionally retrieves GPS positions, and IFCB information using `ifcb_read_hdr_data` and `ifcb_convert_filenames` functions.

**Usage**

```
ifcb_summarize_png_counts(
  png_folder,
  hdr_folder = NULL,
  sum_level = "sample",
  verbose = TRUE
)
```

**Arguments**

<code>png_folder</code>	A character string specifying the path to the main directory containing subfolders (classes) with <code>.png</code> images.
<code>hdr_folder</code>	A character string specifying the path to the directory containing the <code>.hdr</code> files. Default is <code>NULL</code> .
<code>sum_level</code>	A character string specifying the level of summarization. Options: "sample" (default) or "class".
<code>verbose</code>	A logical indicating whether to print progress messages. Default is <code>TRUE</code> .

**Value**

If `sum_level` is "sample", returns a data frame with columns: `sample`, `ifcb_number`, `class_name`, `n_images`, `gpsLatitude`, `gpsLongitude`, `timestamp`, `year`, `month`, `day`, `time`, `roi_numbers`. If `sum_level` is "class", returns a data frame with columns: `class_name`, `n_images`.

**See Also**

[ifcb\\_read\\_hdr\\_data](#) [ifcb\\_convert\\_filenames](#)

**Examples**

```
## Not run:
# Example usage:
# Assuming the following directory structure:
# path/to/png_folder/
# |- class1/
# |   |- sample1_00001.png
# |   |- sample1_00002.png
# |   |- sample2_00001.png
# |- class2/
# |   |- sample1_00003.png
# |   |- sample3_00001.png

png_folder <- "path/to/png_folder"
hdr_folder <- "path/to/hdr_folder" # This folder should contain corresponding .hdr files

# Summarize by sample
summary_sample <- ifcb_summarize_png_counts(png_folder,
                                           hdr_folder,
                                           sum_level = "sample",
                                           verbose = TRUE)

print(summary_sample)

# Summarize by class
summary_class <- ifcb_summarize_png_counts(png_folder,
                                           hdr_folder,
                                           sum_level = "class",
                                           verbose = TRUE)

print(summary_class)

## End(Not run)
```

---

```
ifcb_summarize_png_metadata
```

*Summarize PNG Image Metadata*

---

**Description**

This function processes IFCB data by reading images, matching them to the corresponding header and feature files, and joining them into a single dataframe. This function may be useful when preparing metadata files for an EcoTaxa submission.

**Usage**

```
ifcb_summarize_png_metadata(
  png_folder,
  feature_folder = NULL,
  hdr_folder = NULL
)
```

**Arguments**

png\_folder      Character. The file path to the folder containing the PNG images.  
feature\_folder   Character. The file path to the folder containing the feature files (optional).  
hdr\_folder      Character. The file path to the folder containing the header files (optional).

**Value**

A dataframe that joins image data, header data, and feature data based on the sample and roi number.

**Examples**

```
## Not run:  
png_folder <- "path/to/pngs"  
feature_folder <- "path/to/features"  
hdr_folder <- "path/to/hdr_data"  
result_df <- ifcb_summarize_png_metadata(png_folder, feature_folder, hdr_folder)  
  
## End(Not run)
```

---

ifcb\_volume\_analyzed    *Estimate Volume Analyzed from IFCB Header File*

---

**Description**

This function reads an IFCB header file to extract sample run time and inhibit time, and returns the associated estimate of sample volume analyzed (in milliliters). The function assumes a standard IFCB configuration with a sample syringe operating at 0.25 mL per minute. For IFCB instruments after 007 and higher (except 008). This is the R equivalent function of IFCB\_volume\_analyzed from the ifcb-analysis repository (Sosik and Olson 2007).

**Usage**

```
ifcb_volume_analyzed(hdr_file, hdrOnly_flag = FALSE, flowrate = 0.25)
```

**Arguments**

hdr\_file      A character vector specifying the path(s) to one or more .hdr files or URLs.  
hdrOnly\_flag   An optional flag indicating whether to skip ADC file estimation (default is FALSE).  
flowrate      Milliliters per minute for syringe pump (default is 0.25).

**Value**

A numeric vector containing the estimated sample volume analyzed for each header file.

## References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

## See Also

<https://github.com/hsosik/ifcb-analysis>

## Examples

```
## Not run:  
# Example: Estimate volume analyzed from an IFCB header file  
hdr_file <- "path/to/IFCB_hdr_file.hdr"  
ml_analyzed <- ifcb_volume_analyzed(hdr_file)  
print(ml_analyzed)  
  
## End(Not run)
```

---

ifcb\_volume\_analyzed\_from\_adc

*Estimate Volume Analyzed from IFCB ADC File*

---

## Description

This function reads an IFCB ADC file to extract sample run time and inhibit time, and returns the associated estimate of sample volume analyzed (in milliliters). The function assumes a standard IFCB configuration with a sample syringe operating at 0.25 mL per minute. For IFCB instruments after 007 and higher (except 008). This is the R equivalent function of IFCB\_volume\_analyzed\_fromADC from the *ifcb-analysis* repository (Sosik and Olson 2007).

## Usage

```
ifcb_volume_analyzed_from_adc(adc_file)
```

## Arguments

`adc_file` A character vector specifying the path(s) to one or more .adc files or URLs.

## Value

A list containing:

- **ml\_analyzed**: A numeric vector of estimated sample volume analyzed for each ADC file.
- **inhibit\_time**: A numeric vector of inhibit time values extracted from ADC files.
- **runtime**: A numeric vector of runtime values extracted from ADC files.



## References

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216.

## See Also

<https://github.com/hsosik/ifcb-analysis>

## Examples

```
## Not run:
# Example: Estimate volume analyzed from an IFCB ADC file
adc_file <- "path/to/IFCB_adc_file.adc"
adc_info <- ifcb_volume_analyzed_from_adc(adc_file)
print(adc_info$ml_analyzed)

## End(Not run)
```

---

ifcb_which_basin	<i>Determine if Points are in a Specified Sea Basin</i>
------------------	---

---

## Description

This function identifies which sub-basin a set of latitude and longitude points belong to, using a user-specified or default shapefile. The default shapefile includes the Baltic Sea, Kattegat, and Skagerrak basins and is included in the `iRfcb` package.

## Usage

```
ifcb_which_basin(latitudes, longitudes, plot = FALSE, shape_file = NULL)
```

## Arguments

latitudes	A numeric vector of latitude points.
longitudes	A numeric vector of longitude points.
plot	A boolean indicating whether to plot the points along with the sea basins. Default is FALSE.
shape_file	The absolute path to a custom polygon shapefile in WGS84 (EPSG:4326) that represents the sea basin. Defaults to the Baltic Sea, Kattegat, and Skagerrak basins included in the <code>iRfcb</code> package.

## Details

This function reads a pre-packaged shapefile of the Baltic Sea, Kattegat, and Skagerrak basins from the `iRfcb` package by default, or a user-supplied shapefile if provided. The shapefiles originate from SHARK (<https://shark.smhi.se/>). It sets the CRS, transforms the CRS to WGS84 (EPSG:4326) if necessary, and checks if the given points fall within the specified sea basin. Optionally, it plots the points and the sea basin polygons together.

**Value**

A vector indicating the basin each point belongs to, or a ggplot object if `plot = TRUE`.

**Examples**

```
# Define example latitude and longitude vectors
latitudes <- c(55.337, 54.729, 56.311, 57.975)
longitudes <- c(12.674, 14.643, 12.237, 10.637)

# Check in which Baltic sea basin the points are in
points_in_the_baltic <- ifcb_which_basin(latitudes, longitudes)
print(points_in_the_baltic)

# Plot the points and the basins
ifcb_which_basin(latitudes, longitudes, plot = TRUE)
```

---

`ifcb_zip_matlab`*Create a Zip Archive of Manual MATLAB Files*

---

**Description**

This function creates a zip archive containing specified files and directories for manually annotated IFCB images, organized into a structured format suitable for distribution or storage. The MATLAB files are generated by the `ifcb-analysis` repository (Sosik and Olson 2007). The zip archive can be used to submit IFCB data to repositories like in the SMHI IFCB Plankton Image Reference Library (Torstensson et al., 2024).

**Usage**

```
ifcb_zip_matlab(
  manual_folder,
  features_folder,
  class2use_file,
  zip_filename,
  data_folder = NULL,
  readme_file = NULL,
  matlab_readme_file = NULL,
  email_address = "",
  version = "",
  print_progress = TRUE,
  feature_recursive = TRUE,
  manual_recursive = FALSE,
  data_recursive = TRUE,
  quiet = FALSE
)
```

**Arguments**

manual_folder	The directory containing .mat files to be included in the zip archive.
features_folder	The directory containing .csv files, including subfolders, to be included in the zip archive.
class2use_file	The path to the file (class2use_file) that will be renamed and included in the 'config' directory of the zip archive.
zip_filename	The filename for the zip archive to be created.
data_folder	Optionally, the directory containing additional data files (.roi, .adc, .hdr) to be included in the zip archive.
readme_file	Optionally, the path to a README file that will be updated with metadata and included in the zip archive.
matlab_readme_file	Optionally, the path to a MATLAB README file whose content will be appended to the end of the README file in the zip archive.
email_address	The email address to be included in the README file for contact information.
version	Optionally, the version number to be included in the README file.
print_progress	A logical value indicating whether to print progress bar. Default is TRUE.
feature_recursive	Logical. If TRUE, the function will search for feature files recursively within the feature_folder. Default is TRUE.
manual_recursive	Logical. If TRUE, the function will search for MATLAB files recursively within the manual_folder. Default is FALSE.
data_recursive	Logical. If TRUE, the function will search for data files recursively within the data_folder (if provided). Default is TRUE.
quiet	Logical. If TRUE, suppresses messages about the progress and completion of the zip process. Default is FALSE.

**Details**

This function performs the following operations:

- Lists .mat files from manual\_folder.
- Lists .csv files from features\_folder (including subfolders).
- Lists .roi, .adc, .hdr files from data\_folder if provided.
- Copies listed files to temporary directories (manual\_dir, features\_dir, data\_dir, config\_dir).
- Renames and copies class2use\_file to config\_dir as class2use.mat.
- Updates readme\_file with metadata (if provided) and appends PNG image statistics and MATLAB README content.
- Creates a manifest file (MANIFEST.txt) listing all files in the zip archive.
- Creates a zip archive (zip\_filename) containing all copied and updated files.
- Cleans up temporary directories after creating the zip archive.

**Value**

No return value. This function creates a zip archive containing the specified files and directories.

**References**

Sosik, H. M. and Olson, R. J. (2007), Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. *Limnol. Oceanogr: Methods* 5, 204–216. Torstensson, Anders; Skjevik, Ann-Turi; Mohlin, Malin; Karlberg, Maria; Karlson, Bengt (2024). SMHI IFCB Plankton Image Reference Library. SciLifeLab. Dataset. doi:10.17044/scilifelab.25883455

**See Also**

`ifcb_zip_pngs` <https://github.com/hsosik/ifcb-analysis>

**Examples**

```
## Not run:
ifcb_zip_matlab("path/to/manual_files", "path/to/feature_files",
               "path/to/class2use.mat", "output_zip_archive.zip",
               data_folder = "path/to/data_files",
               readme_file = system.file("exdata/README-template.md", package = "iRfcb"),
               matlab_readme_file = system.file("inst/exdata/MATLAB-template.md",
                                                package = "iRfcb"),
               email_address = "example@email.com",
               version = "1.0")

## End(Not run)
```

---

ifcb\_zip\_pngs

*Zip PNG Folders*

---

**Description**

This function zips directories containing .png files and optionally includes README and MANIFEST files. It can also split the resulting zip file into smaller parts if it exceeds a specified size. The zip archive can be used to submit IFCB data to repositories like in the SMHI IFCB Plankton Image Reference Library (Torstensson et al., 2024).

**Usage**

```
ifcb_zip_pngs(
  png_folder,
  zip_filename,
  readme_file = NULL,
  email_address = "",
  version = "",
  print_progress = TRUE,
```

```

    include_txt = FALSE,
    split_zip = FALSE,
    max_size = 500,
    quiet = FALSE
  )

```

### Arguments

png_folder	The directory containing subdirectories with .png files.
zip_filename	The name of the zip file to create.
readme_file	Optional path to a README file for inclusion in the zip package.
email_address	Optional email address to include in the README file.
version	Optional version information to include in the README file.
print_progress	A logical value indicating whether to print progress bar. Default is TRUE.
include_txt	A logical value indicating whether to include text (.txt, .tsv and .csv) files located in the subdirectories. Default is FALSE.
split_zip	A logical value indicating whether to split the zip file into smaller parts if its size exceeds max_size. Default is FALSE.
max_size	The maximum size (in MB) for the zip file before it gets split. Only used if split_zip is TRUE. Default is 500 MB.
quiet	Logical. If TRUE, suppresses messages about the progress and completion of the zip process. Default is FALSE.

### Value

This function does not return any value; it creates a zip archive and optionally splits it into smaller files if specified.

### References

Torstensson, Anders; Skjevik, Ann-Turi; Mohlin, Malin; Karlberg, Maria; Karlson, Bengt (2024). SMHI IFCB Plankton Image Reference Library. SciLifeLab. Dataset. doi:10.17044/scilifelab.25883455

### See Also

[ifcb\\_zip\\_matlab](#)

### Examples

```

## Not run:
# Zip all subdirectories in the 'images' folder with a README file
ifcb_zip_pngs("path/to/images",
              "images.zip",
              readme_file = system.file("exdata/README-template.md", package = "iRfcb"),
              email_address = "example@example.com",
              version = "1.0")

# Zip all subdirectories in the 'images' folder without a README file

```

```
ifcb_zip_pngs("path/to/images", "images.zip")  
## End(Not run)
```

---

process\_ifcb\_string    *Process IFCB String*

---

## Description

This helper function processes IFCB (Imaging FlowCytobot) filenames and extracts the date component in YYYYMMDD format. It supports two formats:

- IFCB1\_2014\_188\_222013: Extracts the date using year and day-of-year information.
- D20240101T120000\_IFCB1: Extracts the date directly from the timestamp.

## Usage

```
process_ifcb_string(ifcb_string, quiet = FALSE)
```

## Arguments

ifcb_string	A character vector of IFCB filenames to process.
quiet	A logical indicating whether to suppress messages for unknown formats. Defaults to FALSE.

## Value

A character vector containing extracted dates in YYYYMMDD format, or NA for unknown formats.

## Examples

```
# Example 1: Process a string in the 'IFCB1_2014_188_222013' format  
process_ifcb_string("IFCB1_2014_188_222013")  
  
# Example 2: Process a string in the 'D20240101T120000_IFCB1' format  
process_ifcb_string("D20240101T120000_IFCB1")  
  
# Example 3: Process an unknown format  
process_ifcb_string("UnknownFormat_12345")
```

---

read_hdr_file	<i>Function to Read Individual Files and Extract Relevant Lines</i>
---------------	---

---

**Description**

This function reads an HDR file and extracts relevant lines containing parameters and their values.

**Usage**

```
read_hdr_file(file)
```

**Arguments**

file                    A character string specifying the path to the HDR file.

**Value**

A data frame with columns: parameter, value, and file.

---

split_large_zip	<i>Split Large Zip File into Smaller Parts</i>
-----------------	--

---

**Description**

This helper function takes an existing zip file, extracts its contents, and splits it into smaller zip files without splitting subfolders.

**Usage**

```
split_large_zip(zip_file, max_size = 500, quiet = FALSE)
```

**Arguments**

zip\_file                The path to the large zip file.  
max\_size                The maximum size (in MB) for each split zip file. Default is 500 MB.  
quiet                    Logical. If TRUE, suppresses messages about the progress and completion of the zip process. Default is FALSE.

**Value**

This function does not return any value; it creates multiple smaller zip files.

## Examples

```
## Not run:  
# Split an existing zip file into parts of up to 500 MB  
split_large_zip("large_file.zip", max_size = 500)  
  
## End(Not run)
```

---

summarize\_TBclass      *Summarize TreeBagger Classifier Results*

---

## Description

This function reads a TreeBagger classifier result file (.mat format) and summarizes the number of targets in each class based on the classification scores and thresholds.

## Usage

```
summarize_TBclass(classfile, adhocthresh = NULL)
```

## Arguments

classfile	Character string specifying the path to the TreeBagger classifier result file (.mat format).
adhocthresh	Numeric vector specifying the adhoc thresholds for each class. If NULL (default), no adhoc thresholding is applied. If a single numeric value is provided, it is applied to all classes.

## Value

A list containing three elements:

classcount	Numeric vector of counts for each class based on the winning class assignment.
classcount_above_optthresh	Numeric vector of counts for each class above the optimal threshold for maximum accuracy.
classcount_above_adhocthresh	Numeric vector of counts for each class above the specified adhoc thresholds (if provided).



---

vol2C_lgdiatom	<i>Convert Biovolume to Carbon for Large Diatoms</i>
----------------	--

---

**Description**

This function converts biovolume in microns<sup>3</sup> to carbon in picograms for large diatoms (> 2000 micron<sup>3</sup>) according to Menden-Deuer and Lessard 2000. The formula used is:  $\log \text{pgC cell}^{-1} = \log a + b * \log V \text{ (um}^3\text{)}$ , with  $\log a = -0.933$  and  $b = 0.881$  for diatoms > 3000 um<sup>3</sup>.

**Usage**

```
vol2C_lgdiatom(volume)
```

**Arguments**

volume            A numeric vector of biovolume measurements in microns<sup>3</sup>.

**Value**

A numeric vector of carbon measurements in picograms.

**Examples**

```
# Volumes in microns^3
volume <- c(5000, 10000, 20000)

# Convert biovolume to carbon for large diatoms
vol2C_lgdiatom(volume)
```

---

vol2C_nondiatom	<i>Convert Biovolume to Carbon for Non-Diatom Protists</i>
-----------------	--

---

**Description**

This function converts biovolume in microns<sup>3</sup> to carbon in picograms for protists besides large diatoms (> 3000 micron<sup>3</sup>) according to Menden-Deuer and Lessard 2000. The formula used is:  $\log \text{pgC cell}^{-1} = \log a + b * \log V \text{ (um}^3\text{)}$ , with  $\log a = -0.665$  and  $b = 0.939$ .

**Usage**

```
vol2C_nondiatom(volume)
```

**Arguments**

volume            A numeric vector of biovolume measurements in microns<sup>3</sup>.

**Value**

A numeric vector of carbon measurements in picograms.

**Examples**

```
# Volumes in microns^3
volume <- c(5000, 10000, 20000)

# Convert biovolume to carbon for non-diatom protists
vol2C_nondiatom(volume)
```

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