# Package 'SeaGraphs'

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**Type** Package

**Title** Sea Currents to Connectivity Transformation

**Version** 0.1.3

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**Description** Transformation of sea currents to connectivity data. Two files of horizontal and vertical currents flows are transformed into connectivity data in the form of 'sfnetwork', shapefile, edge list and adjacency matrix. An application example is shown at Nagkoulis et al. (2025) <doi:10.1016/j.dib.2024.111268>.

**License** GPL-3

**Encoding** UTF-8

**URL** https://github.com/cadam00/SeaGraphs, https://cadam00.github.io/SeaGraphs/

**BugReports** https://github.com/cadam00/SeaGraphs/issues

**Imports** sfnetworks, sf, terra, leaflet, leaflet.minicharts, leaflet.extras2, methods, stats

**Depends** R (>= 4.1.0)

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

**Config/testthat/edition** 3

**VignetteBuilder** knitr, rmarkdown

**NeedsCompilation** no

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**Repository** CRAN

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`antpath_sfn` *Antpath plot*

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## Description

Antpath plot of connections

## Usage

```
antpath_sfn(result, lowcut = NULL, uppcut = NULL)
```

## Arguments

| | |
|---|---|
| `result` | `SeaGraph` object (i.e. output of seagraph) or `sfnetwork` or `sf` object containing 'from', 'to' and 'weight' column names. |
| `lowcut` | Optional percentile of threshold for not plotting connections below this value. |
| `uppcut` | Optional percentile of threshold for not plotting connections above this value. |

## Value

A leaflet antmap map output.

## Examples

```
graph_result <- seagraph(component_u    = get_component_u(),
                         component_v    = get_component_v(),
                         mask_shapefile = NULL,
                         k_neighbors    = 7)

antpath_sfn(graph_result)

antpath_sfn(graph_result, lowcut = 0.1, uppcut = 0.9)
```

## flows_sfn *Flow plot*

### Description

Flow plot of connections

### Usage

```
flows_sfn(result, lowcut = NULL, uppcut = NULL)
```

### Arguments

| | |
|---|---|
| result | SeaGraph object (i.e. output of seagraph) or sfnetwork or sf object containing 'from', 'to' and 'weight' column names. |
| lowcut | Optional percentile of threshold for not plotting connections below this value. |
| uppcut | Optional percentile of threshold for not plotting connections above this value. |

### Value

A leaflet flow map output.

### Examples

```
graph_result <- seagraph(component_u    = get_component_u(),
                         component_v    = get_component_v(),
                         mask_shapefile = NULL,
                         k_neighbors    = 7)

flows_sfn(graph_result)

flows_sfn(graph_result, lowcut = 0.1, uppcut = 0.9)
```

## get_component_u *Example component u*

### Description

Example horizontal direction raster.

### Usage

```
get_component_u()
```

## Details

Example of input component_u used for functions. It is a cropped area of yearly aggregated and normalized horizontal component at Black Sea.

## Value

SpatRaster object.

## References

Lima, L., Aydogdu, A., Escudier, R., Masina, S., Ciliberti, S. A., Azevedo, D., Peneva, E. L., Causio, S., Cipollone, A., Clementi, E., Cretí, S., Stefanizzi, L., Lecci, R., Palermo, F., Coppini, G., Pinardi, N., and Palazov, A. (2020). Black Sea Physical Reanalysis (CMEMS BS-Currents) (Version 1) [Data set]. Copernicus Monitoring Environment Marine Service (CMEMS). doi:10.25423/CMCC/BLKSEA_MULTIYEAR_PHY_007_004. Last Access: 07/11/2024.

Schulzweida, U. (2023). CDO User Guide (23.0). Zenodo. doi:10.5281/zenodo.10020800.

## See Also

get_component_v,get_mask_shapefile

## Examples

```
component_u <- get_component_u()
terra::plot(component_u)
```

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# get_component_v *Example component v*

---

## Description

Example vertical direction raster.

## Usage

```
get_component_v()
```

## Details

Example of input component_v used for functions. It is a cropped area of yearly aggregated and normalized vertical component at Black Sea.

## Value

SpatRaster object.

## References

Lima, L., Aydogdu, A., Escudier, R., Masina, S., Ciliberti, S. A., Azevedo, D., Peneva, E. L., Causio, S., Cipollone, A., Clementi, E., Cretí, S., Stefanizzi, L., Lecci, R., Palermo, F., Coppini, G., Pinardi, N., and Palazov, A. (2020). Black Sea Physical Reanalysis (CMEMS BS-Currents) (Version 1) [Data set]. Copernicus Monitoring Environment Marine Service (CMEMS). doi:10.25423/CMCC/BLKSEA_MULTIYEAR_PHY_007_004. Last Access: 07/11/2024.

Schulzweida, U. (2023). CDO User Guide (23.0). Zenodo. doi:10.5281/zenodo.10020800.

## See Also

`get_component_u`,`get_mask_shapefile`

## Examples

```
component_v <- get_component_v()
terra::plot(component_v)
```

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`get_mask_shapefile` *Example mask shapefile*

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## Description

Example mask shapefile.

## Usage

```
get_mask_shapefile()
```

## Details

Example of input `mask_shapefile` used for functions. It is a bounding box subset of get_component_u and get_component_v `SpatRaster` objects.

## Value

`sf` and `data.frame` object.

## Examples

```
mask_shapefile <- get_mask_shapefile()
plot(mask_shapefile)
```

seagraph *Sea Currents To Connectivity Transformation*

## Description

Sea Currents To Connectivity Transformation

## Usage

```
seagraph(component_u, component_v, mask_shapefile = NULL, k_neighbors = 7L)
```

## Arguments

| | |
|---|---|
| component_u | SpatRaster object with horizontal direction. |
| component_v | SpatRaster object with vertical direction. |
| mask_shapefile | Optional sf or SpatVector object for masking component_u and component_v SpatRaster objects. The default value is NULL, indicating that no mask is performed. |
| k_neighbors | integer object with the number $k$ of nearest neighbors to use. The default is 7L. |

## Details

Sea currents data of the input are transformed into weighted directed graph connectivity data. Each centroid of component_u and component_v is considered as a separate graph node. These connectivity data are provided in sfnetwork, sf, edge list and adjacency matrix form. An additional data.frame with correspondence between indices and coordinates for edge list and adjacency matrix is returned as well. The weights in all outputs are minmax-scaled in $[0 - 1]$.

Extent, resolution and coordinate system of both must have the same for both component_u and component_v; otherwise an error stops the function's execution. In case that a mask_shapefile is provided, then it is internally assured that it has the same resolution or coordinates with component_u and a warning is prompted.

## Value

SeaGraph object, which is a list containing the following elements:

- sfnetwork: sfnetwork object representing both graph and coordinates of the connectivity map.
- sf: sf and data.frame object representing 'LINESTRING' rows of connections between nodes.
- edge_list: matrix object representing the edge list, where source ('from'), destination ('to') and weight ('weight') for each connection are returned.
- adj_mat: matrix object representing the weighted adjacency matrix of the nodes.
- ID_coords: data.frame object with the correspondence between indices and coordinates for edge list (edge_list) and adjacency matrix (adj_mat).

## References

Nagkoulis, N., Adam, C., Mamoutos, I., Katsanevakis, S., and Mazaris, A. D. (2025). An ecological connectivity dataset for Black Sea obtained from sea currents. *Data in Brief*, *58*, 111268. doi:10.1016/j.dib.2024.111268

## See Also

antpath_sfn,flows_sfn

## Examples

```
graph_result <- seagraph(component_u    = get_component_u(),
                         component_v    = get_component_v(),
                         k_neighbors    = 7)
## Example of mask usage
masked_result <- seagraph(component_u    = get_component_u(),
                          component_v    = get_component_v(),
                          mask_shapefile = get_mask_shapefile(),
                          k_neighbors    = 7)
```

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