Package 'kelpdecline'

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Type Package

Title Estimate kelp decline from historical baseline of Landsat estimated kelp biomass

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Description Estimates proportion of Landsat pixels with kelp biomass in decline when compared to historical baseline.
The proportions are given for quarter degree cells in Central, Southern and Baja California.

Imports ncdf4, sp, raster

License GPL (>=2)

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

R topics documented:

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kelpdecline-package   *Estmates kelp biomass decline relative to a historical baseline*

Description

Estimates proportion of Landsat pixels with kelp biomass in decline when compared to a historical baseline. The proportions are given for 0.25 x 0.25 degree, lat x long, cells in Central, Southern and Baja California.

Details

The nc_convert function first converts the nc file curated by the SBC-LTER project to a data.frame with kelp biomass by Landsat pixel and quarter. Then the decline_finder function estimates if individual Landsat pixels (30x30 m) are declining or not when compared to a historical baseline (also estimated internally). The function then calculates the proportion of pixels in decline inside larger areas of 0.25 by 0.25 degree (lat and long). This function produces an array that can be useful to map out kelp in decline. The function can also produce an output table with summary statistics for each region (0.25 by 0.25 degree scale).

Author(s)

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References

Tennies, N., Alberto, F. (in prep) A tool for detecting giant kelp canopy biomass decline in the Californias.

Bell, T, K. Cavanaugh, D. Siegel. (2023) SBC LTER: Time series of quarterly NetCDF files of kelp biomass in the canopy from Landsat 5, 7 and 8, since 1984 (ongoing) ver 19. Environmental Data Initiative. https://doi.org/10.6073/pasta/630565d6a8bf54c7cbce6802284dd431. Accessed 2023-02-22.

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decline_finder   *The main function estimating proportion of Landsat pixels with kelp biomass in decline.*

Description

The function first estimates if individual Landsat pixels (30x30 m) are declining or not when compared to a historical baseline (also estimated internally). Then calculates the proportion of pixels in decline inside larger areas of 0.25 x0.25 degree (lat and long). The function produces an array that can be useful to map out kelp in decline. The function can also produce an output table with summary statistics for each region (0.25 x 0.25 degree scale).

Usage

```
decline_finder(data, baseline_threshold = 0.1, scarce_cutoff = 0.6, present_window = 16,
hist_period = 100, window_lag = 0, lat_min = 27.01, lat_max = 37.5, lon_min = -123.5,
        lon_max = -114, table_name = NULL)
```

Arguments

data	A data frame of temporal variation of kelp biomass per Landsat pixel, as produced by nc_convert.
baseline_threshold	
	A proportion of the average historical biomass (per pixel) below which all quarters in present_window period, for the same pixel, are required to be for the pixel to be classified as in decline. Defaults conservatively to 0.1, i.e., 10 percent of the historical average.
scarce_cutoff	The proportion of quarters with kelp biomass in the time series of length hist_period needs to be larger than this cutoff value for the pixel to be included in the analysis. Defaults to 0.4.
present_window	The duration of the current period, in number of quarters, used to characterize present biomass status.
hist_period	Number of quarters, counting back from the present, used to calculate hist_biomass. Defaults to 100 quarters.
window_lag	How many quarters from the most recent quarter in the time series should present_window slide back. This allows to estimate how kelp in decline was classified for periods in the past. It defaults to zero.
lat_min	Used to limit the extent of the output files and maps by providing the minimum latitude in decimal degrees. Defaults to 27.01, the edge of the data in the SBC-LTER file in 2022.
lat_max	Used to limit the extent of the output files and maps by providing the maximum latitude in decimal degrees. Defaults to 37.05, the edge of the data in the SBC-LTER file in 2022.
lon_min	Used to limit the extent of the output files and maps by providing the minimum longitude in decimal degrees. Defaults to -123.5, the edge of the data in the SBC-LTER file in 2022.
lon_max	Used to limit the extent of the output files and maps by providing the maximum longitude in decimal degrees. Defaults to -114, the edge of the data in the SBC-LTER file in 2022.
table_name	A string with the name of the output file recording summary statistics for each 0.25 x 0.25 degree region in the study extent. This defaults to NULL, so be sure to replace with a quoted file name (string) here if you want a detailed output written to the working directory.

Details

The function offers several arguments that allow for flexible definition of the periods used for charactherizing historical and present times and to control overall functionality. The flexibility allows for an easy implementation of sensitivity analysis of the effect of these arguments to the characterization of kelp decline. Examples are given in a package vignette.

Value

A raster file with the proportion of Landsat pixels in decline for each 0.25 x 0.25 degree region in the study extent. This raster can be easily plotted to map out regions of kelp in decline (see examples in package vignette). To get an optional summary statistic file written to the working directory be sure to supply a name to argument table_name.

Author(s)

Nathaniel Tennies and Filipe Alberto

References

Tennies, N., Alberto, F. (in prep) A tool for detecting giant kelp canopy biomass decline in the Californias.

Bell, T, K. Cavanaugh, D. Siegel. (2023) SBC LTER: Time series of quarterly NetCDF files of kelp biomass in the canopy from Landsat 5, 7 and 8, since 1984 (ongoing) ver 19. Environmental Data Initiative. https://doi.org/10.6073/pasta/630565d6a8bf54c7cbce6802284dd431. Accessed 2023-02-22.

See Also

nc_convert occupancy_trend

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nc_convert   *Convert nc input to a data.frame with kelp biomass variation*

Description

The function converts the external file in nc format to a data.frame with the time series of kelp biomass.

Usage

```
nc_convert(nc_data_location)
```

Arguments

nc_data_location

A string with the name of the nc file file containing kelp biomass temporal variation, curated by the SBC-LTER team.

Value

A data frame with kelp biomass recorded for each 30 x 30m Landsat pixel areas in the study extent (Central to Baja California). Each pixel with kelp is a row in the data frame, whereas columns contain temporal variation recorded by quarter.

Author(s)

Nathaniel Tennies and Filipe Alberto

References

Tennies, N., Alberto, F. (in prep) A tool for detecting giant kelp canopy biomass decline in the Californias.

Bell, T, K. Cavanaugh, D. Siegel. (2023) SBC LTER: Time series of quarterly NetCDF files of kelp biomass in the canopy from Landsat 5, 7 and 8, since 1984 (ongoing) ver 19. Environmental Data Initiative. https://doi.org/10.6073/pasta/630565d6a8bf54c7cbce6802284dd431. Accessed 2023-02-22.

See Also

decline_finder

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occupancy_trend	*Estimate trend of kelp canopy by comparing present with historical pixel occupancy.*

Description

The function estimates a trend of kelp canopy by comparing present (yearly only) and historical occupancies. Results are summarized at the 0.25 x 0.25 degree (regions) scale.

Usage

```
occupancy_trend(data,present_year=2022,outFile="Out.DF.txt",test=FALSE,npermuts=1000)
```

Arguments

data	A data frame of temporal variation of kelp biomass per Landsat pixel, as produced by `nc_convert`.
present_year	The year used to characterize the period used to estimate a trend.
outFile	The name for the tab-delimited output file written to the working directory. Defaults to Out.DF.txt.
test	A logical to decide if significance tests should be run. Defaults to FALSE.
npermuts	Number of randomizations used in the significance test.

Details

Pixel occupancy in a given reference year (present_year) is compared to the long-run proportion of years occupied across the entire time series to determine a trend (recovery, decline, no significant change). Landsat pixel data (30 x 30 m) kelp yearly occupancy is first converted to an annual, binomial series of pixel occupancy. If at least one quarter in a given year has non-zero biomass, the pixel is considered occupied during the year. Next, long-term probability of yearly pixel occupancy (LTPYPO) is subtracted from the reference year pixel occupancy RYPO (1 or 0), RYPO-LTPYPO. This simple statistic, which ranges from -1 to 1, is a good weight of the importance of the change relative to the long-term occupancy history. For example, an occupied pixel (RYPO of 1) with a LTPYPO of 0.8 produces a 0.2 deficit, whereas if LTPYPO is only 0.1, the deficit is 0.9. Pixel deficits are averaged for all pixels in a region of 0.25 x 0.25 degrees to produce a single trend value at this scale. A significance test is available, where randomized RYPO values are sampled with LTPYPO chances. The procedure is repeated npermuts times to generate a randomized distribution for the region deficit trend under the null hypothesis that pixel occupancy follows LTPYPO. The test does not integrate the autoregressive nature of kelp occupancy (the effect of the previous year's occupancy) and should be improved in the future.

Value

A raster file with the trend deficit per region 0.25 x 0.25 degree region. A summary statistic file is also written to the working directory. table_name.

Author(s)

Filipe Alberto and Nathaniel Tennies

References

Tennies, N., Alberto, F. (in prep) A tool for detecting giant kelp canopy biomass decline in the Californias.

Bell, T, K. Cavanaugh, D. Siegel. (2023) SBC LTER: Time series of quarterly NetCDF files of kelp biomass in the canopy from Landsat 5, 7 and 8, since 1984 (ongoing) ver 19. Environmental Data Initiative. https://doi.org/10.6073/pasta/630565d6a8bf54c7cbce6802284dd431. Accessed 2023-02-22.

See Also

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