Diversity II – Preliminary Dryland Products

Booklet for Test Site 10 Southern Europe

Team

European Space Agency

Project requirement definition; user interface; EO data provision; project control

Brockmann Consult GmbH, Germany

Prime contractor; project management; algorithms for preprocessing including atmospheric correction over land and lakes; software and production

GeoVille, Austria

Drylands requirements analysis; algorithms for drylands; software and production

Brockmann Geomatics AB, Sweden

Biodiversity and user interface; algorithms for in-water retrieval and lake indicators; website, web GIS, communication and outreach

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Requirements engineering, validation

Consultants

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Table of Content

Introduction

With the Diversity II project (http://www.diversity2.info/) ESA aims at contributing with EO based methods to the strategic goals of the Convention on Biological Diversity (CBD), especially the supportive goal E: Enhance implementation through participatory planning, knowledge management and capacity building. Besides the CBD and other interested parties, also the UN Convention to Combat Desertification (UNCCD) is a major relevant and interested stakeholder and participating in the User Requirement compilations. The specific aim of this project is to set up an EO-based monitoring scheme for assessment of status, changes and trends of biodiversity and ecosystem NPP (Net Primary Production) in global drylands using moderate resolution EO data. The project is based on Envisat MERIS data and comprises a period of analysis from 2002-2012. Figure 1 gives an overview of the dry land sites which have been selected in the Diversity II project.

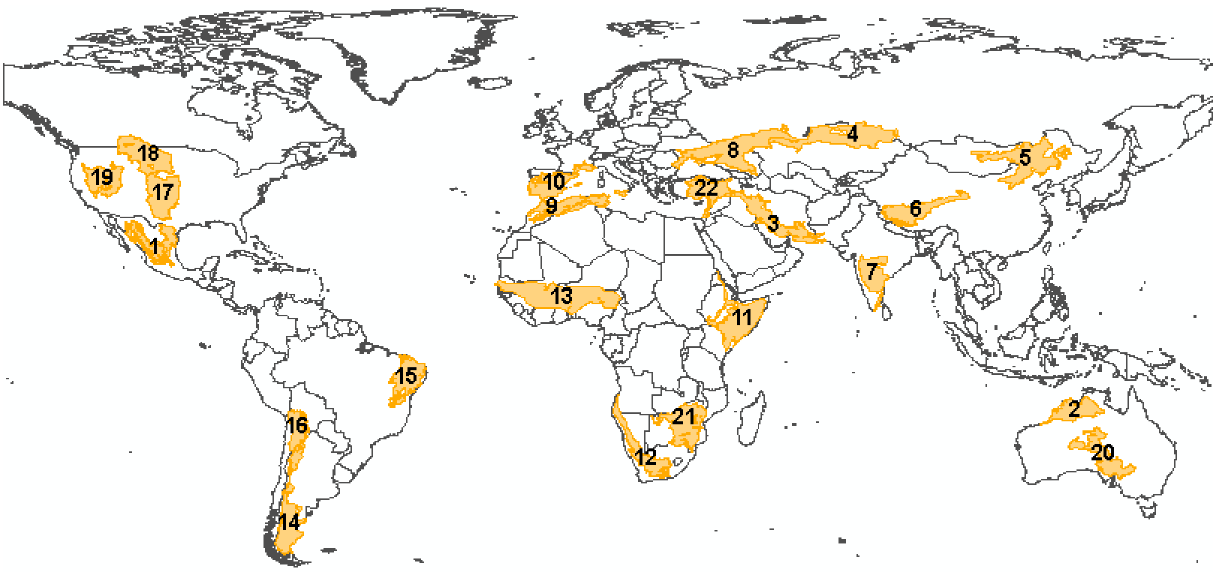


Figure 1: Distribution of global Diversity II dry land sites

Scope of the Preliminary Booklet

This booklet presents NPP proxy and Rain Use Efficiency (RUE) status, change and trend maps for study site 10, Southern Europe along with some basic background information. The booklet is in a preliminary stage and may be changed upon user request to include further or different results of the analyses. The booklets can be downloaded on http://www.diversity2.info/testsites/ppd/.

However, the focus of the booklet is on the most significant and important results of the studies, while complete documentations of methods, techniques and all results will be subject of the project reports. The presented maps can be downloaded via FTP (see page 10 for FTP access).

Up to now, only so-called "Level one" products are shown, i.e. descriptive maps of status and trends of NPP proxies and RUE. They will be supplemented with level-two products, which are currently under development and aim to present the results in more abstract and synthesised ways.

The booklet serves not only to present methods and results in a compact way to users, but also to elicit user feedback. At the end of the booklet (page 32), a short questionnaire is included, aiming at structuring the feedback along some general lines. However, for convenience we recommend to use the on-line questionnaire on http://www.diversity2.info/testsites/ppd/uq/.

Overview of Test Site

The map in Figure 2 presents an overview of the study site 10 in the South Western part of Europe. The map on the top shows the GlobCover v. 2.3 2009 data, which were derived (http://due.esrin.esa.int/globcover/) based on ENVISAT MERIS FR (300m) reflectance data. It depicts a rather diverse pattern of vegetation mostly dominated by agriculturally influenced land cover types.

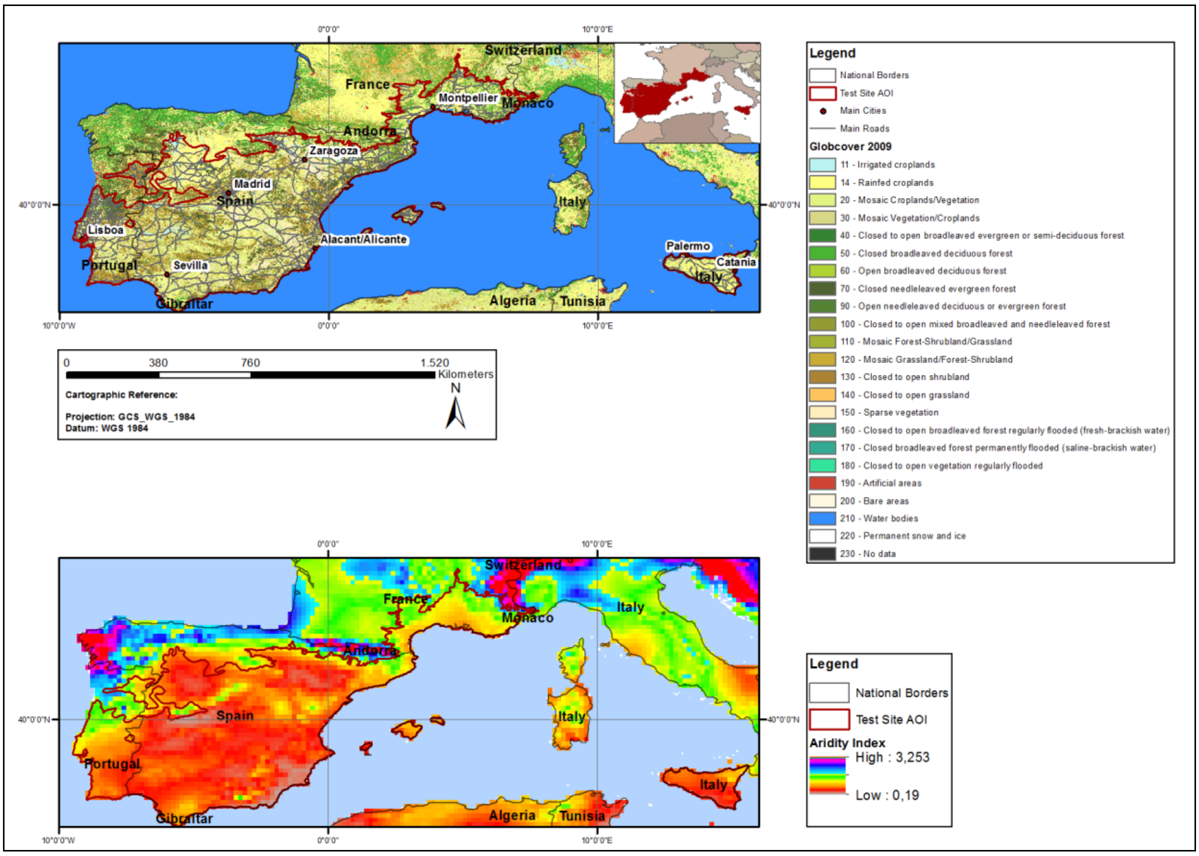


Figure 2: Overview of test site 10, Southern Europe, showing land cover from the GlobCover 2009 data set on the left-hand side and an aridity index map on the right-hand side derived from the CGIAR-CSI global aridity data base

In the entire region, commonalities of the land cover patterns with those of the aridity index derived from the CGIAR-CSI global aridity data base (Zomer et. al, 2007, Zomer et. al, 2008) can be observed, e.g. with the forest distribution linked to more humid areas. Within the actual test area the land cover patterns, which include many of the "mosaic" classes, cannot be as clearly related to the rather homogeneous aridity pattern. The aridity index is depicted on the bottom of Figure 2. The CGIAR-CSI global aridity index is computed as ratio of mean annual precipitation and mean annual potential evapotranspiration. Note that declining values indicate increasing aridity. The southern European test site comprises aridity values between 0,19 – 1.5 with the majority ranging between 0,2 and 0,5 (following the CGIAR-CSI classification scheme this corresponds to arid conditions).

Figure 3 shows two climographs of central Portugal and central Spain, respectively. Both climographs exhibit a similar seasonal behavior. However, the climate station in central Spain shows a less pronounced seasonal pattern characterized by rainfall bimodality with peaks in spring and fall.

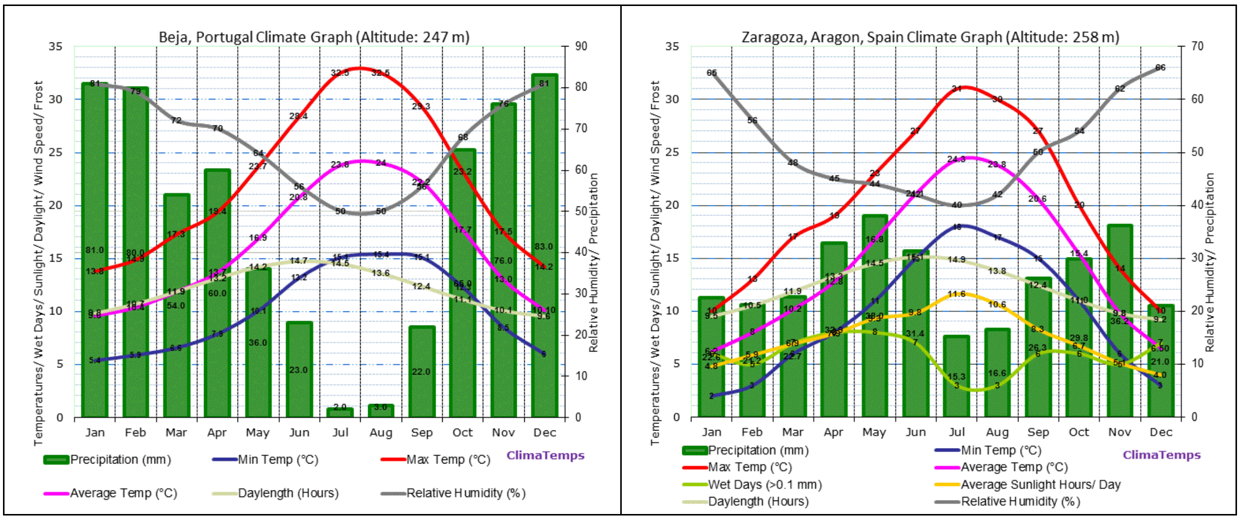


Figure 3: Climographs of Beja (Central Portugal) and Zaragoza (Central Spain), sources: http://www.beja.climatemps.com/graph.php, http://www.aragon.climatemps.com/graph.php

Vegetation and Biophysical Time Series

The seasonal behaviour of the vegetation greenness and important water related parameters are shown in Figure 5. Figure 4 presents the locations of the time series data in all diagrams derived for test site 10, of which time series for location 5 and 7 are presented in Figure 5.

As NPP proxy the NOAA AVHRR GIMMS NDVI (http://gcmd.nasa.gov/records/GCMD_GLCF_GIMMS.html)were used, along with the corresponding rainfall (http://disc.sci.gsfc.nasa.gov/precipitation/documentation/TRMM_README/TRMM_3B42_readme.shtml), CCI soil moisture (http://www.esa-soilmoisture-cci.org/) and MODIS evapotranspiration (http://modis.gsfc.nasa.gov/data/dataprod/dataproducts.php?MOD_NUMBER=16) time series data. All these global data sets are available on the internet free of charge.

The two diagrams shown give an impression of both the spatial and the temporal variability of rainfall and subsequently of soil moisture and vegetation. MODIS evapotranspiration generally follows this temporal pattern.

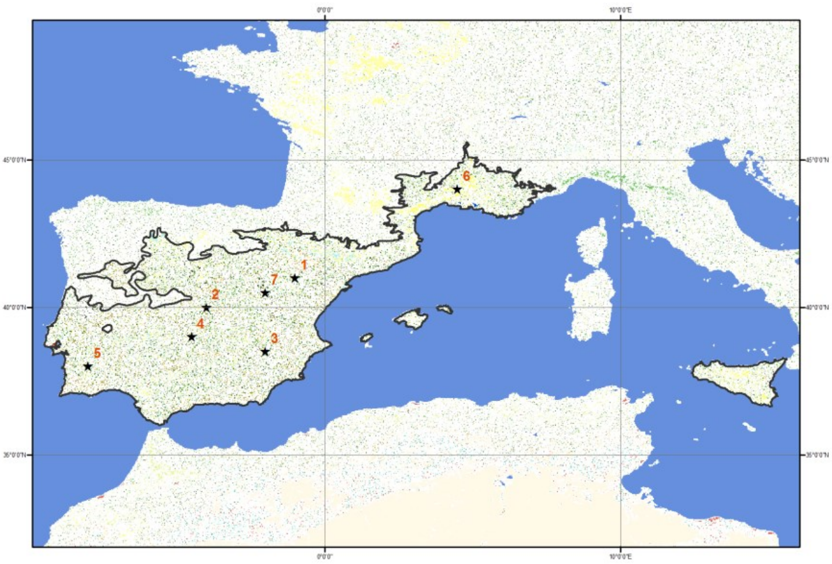


Figure 4: Locations of derived time series diagrams

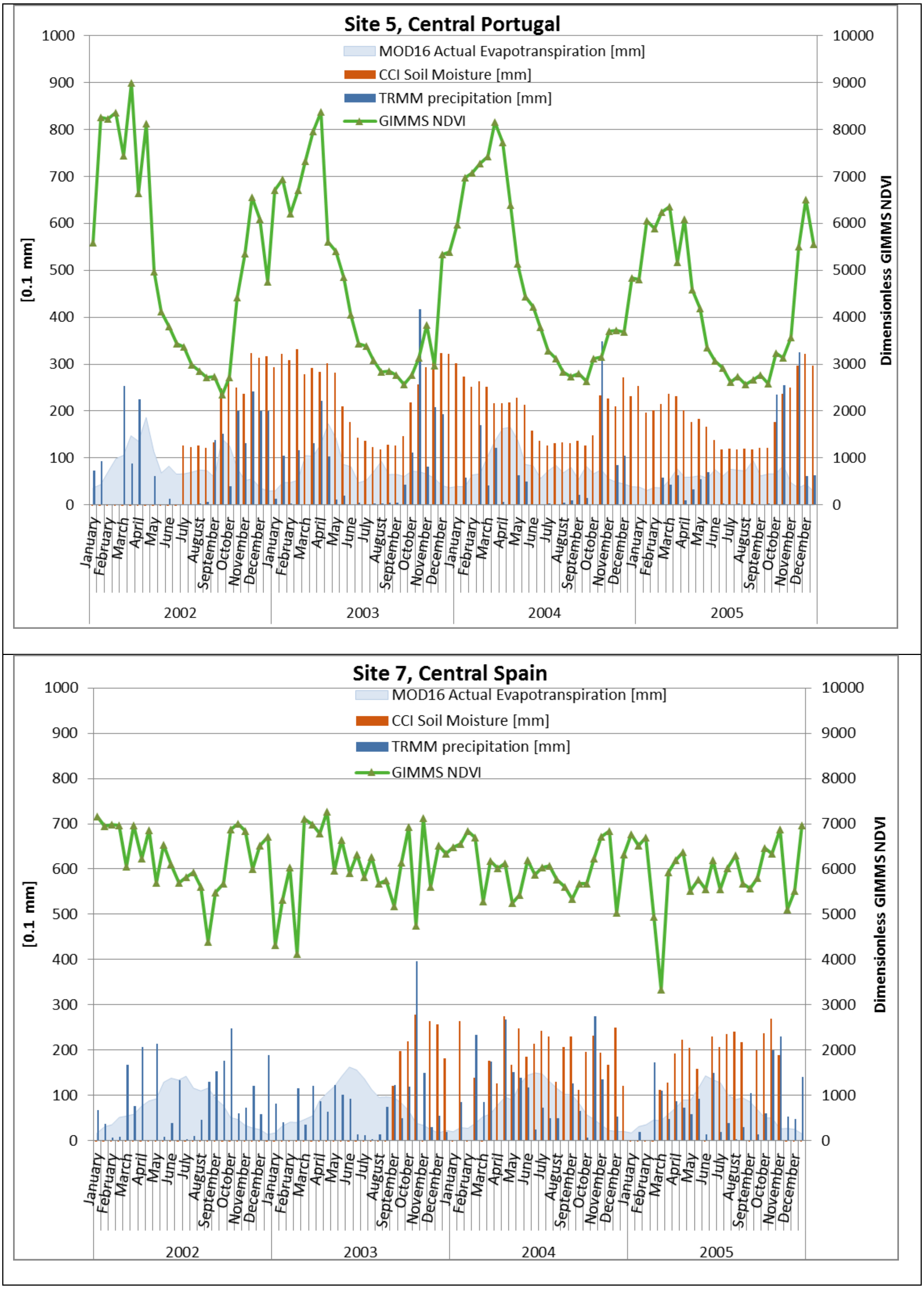


Figure 5: Time series diagrams for locations 5 and 7 in Figure 4

Underlying Data of the Generated Indicators

Based on ENVISAT MERIS FR (Full Resolution) data with a ground resolution of 300m, all NPP proxies presented here and the indicators derived therefrom originate from the fraction of absorbed photosynthetically active radiation (fAPAR) computed according to Gobron et al. 1999. The fAPAR values are compiled on a bi-weekly basis, resulting in time series data with 24 values per calendar year. In addition, TRMM 3b42 rainfall data were used to relate the productivity data to precipitation.

Generation of NPP-Proxies

In a first step, phenological descriptors and periods are derived individually for each year, as shown in Figure 6. The diagram in Figure 6 shows the temporal course of the NPP proxy data (here NOAA GIMMS NDVI) during a 3-years periods and the subdivision into different seasonal periods. The vegetation year includes the full yearly vegetation cycle starting at the end of the preceding dry season and ending at the end of the following dry season – or in case of several green seasons during a year – at or before the begin of the (statistically) dominant green season. The vegetation year length of a given year varies with possible shifts of the green season start time.

The ***vegetation year*** can be subdivided into different periods, limited by defined starting and ending points in time. The ***growing season*** includes ascending (green segment of the curve) and descending parts (brown part) and starts once a selected greenness threshold is surpassed on the way from the start of the vegetation year to the green peak. The brown part of the curve demarcates the ***senescence period***, which ends again once a defined lower fAPAR threshold is passed. The thresholds depend on the ranges between the fAPAR minima before and after the green peak, respectively, and the peak fAPAR value. Here, 10 percent of these ranges added to the respective minima define the thresholds. The ochre part of the vegetation curve constitutes the "***dry season***".

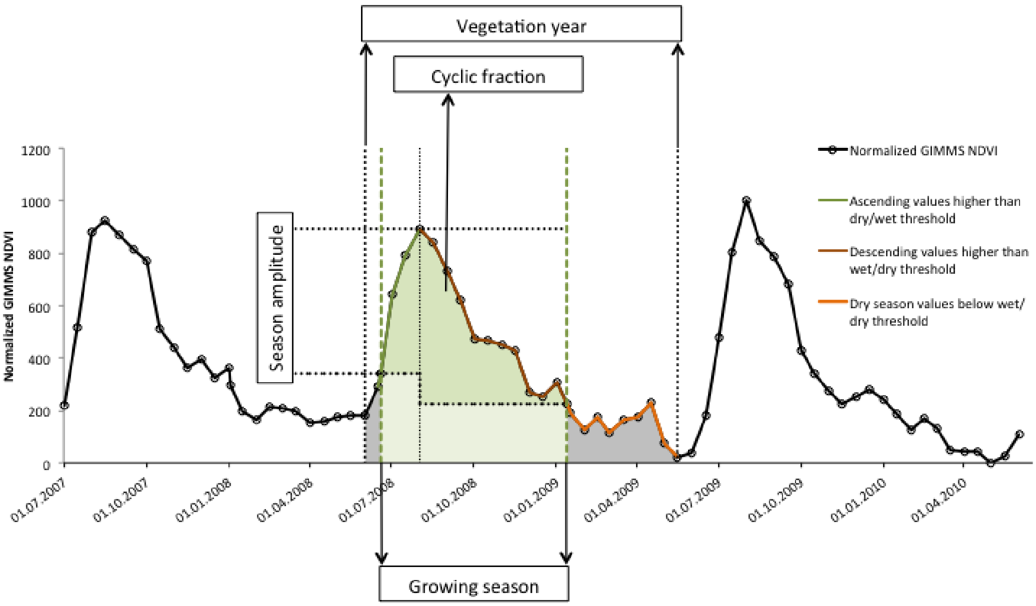


Figure 6: Scheme of the extracted phenological descriptors and periods . Note: the actual NPP proxies are derived based on MERIS fAPAR

For the above described phenological periods, the MERIS fAPAR values have been temporally integrated to either sum or average values, or in case of the season amplitude (figure 4), the difference between the fAPAR at the start of the growing season and the peak fAPAR is taken. The results are called "***NPP proxies***", and constitute yearly (one value per vegetation year) values. The indicator maps presented in this preliminary version of the booklet are based on the following NPP proxies:

- ***Average vegetation year fAPAR:*** Mean value of all fAPAR values within one full vegetation cycle, constituting a proxy for the annual NPP.

- ***Cyclic fraction fAPAR:*** The cyclic fraction of the vegetation comprises summed fAPAR values of the green peak(s) during a vegetation year, subtracting the non-cyclic base levels. The cyclic fraction fAPAR can be interpreted as the amount of NPP that is directly related to the annual cycle of the climatic vegetation growth factors, especially rainfall.

- ***Average dry season fAPAR:*** For the dry season the low fAPAR values after the green peak are taken, defined by a 10% amplitude threshold. The dry season greenness values reflect the portion of plants that remain green after senescence of the annual vegetation or grow new green leaves during the dry period. High dry season levels indicate the presence of shrubs, bushes and trees.

From Proxies to Indicators

By analyzing the annual NPP proxies and rainfall through time, a set of indicators for vegetation/ecosystem condition and change is derived. The indicators shown so far can be divided into status and trend type. Given the MERIS data period from June 2002 to March 2012 and the globally varying vegetation cycles, NPP proxy and Rain Use Efficiency indicators for a total of eight vegetation years could be extracted, starting in 2003/(2002) and ending in 2011/(2012).

Hence, the status and trend indicators cover worldwide eight vegetation years. Status indicators for this period include 8-year averages and the coefficients of variation. In addition, the 8-year period was subdivided into two epochs covering four vegetation years each. The corresponding epochal status maps and epochal difference maps are not shown in this booklet.

For the trend indicators, absolute and relative trends are shown. They were derived with the non parametric Theil Sen trend slope estimator (Theil 1950, Sen 1968) and limited with the Mann Kendall significance test (Kendall 1962) to trends with a probability greater than 0.95.

All indicator maps show distinct ranges of the original continuous values, using the same class intervals and colour scheme worldwide.

Maps of Indicators

The following section contains maps for the entire test site and surrounding regions for each indicator product. The first two maps of each item depict status and variability maps while the third and fourth map show absolute and relative trends maps, respectively. An exception is the rainfall maps, where instead of the relative trend the difference between the two epochs (2002 – 2006 and 2007 – 2011, respectively) is shown. The maps are described with short product specifications.

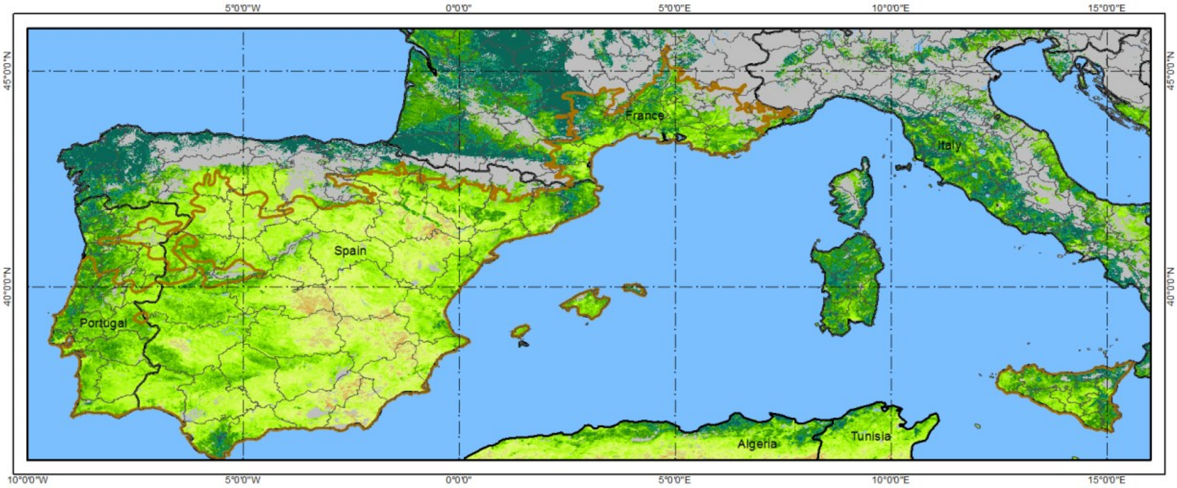
They can be downloaded from:

Domain: ftp.brockmann-consult.de

Username: diversity-pub

Password: dl&iw-usr

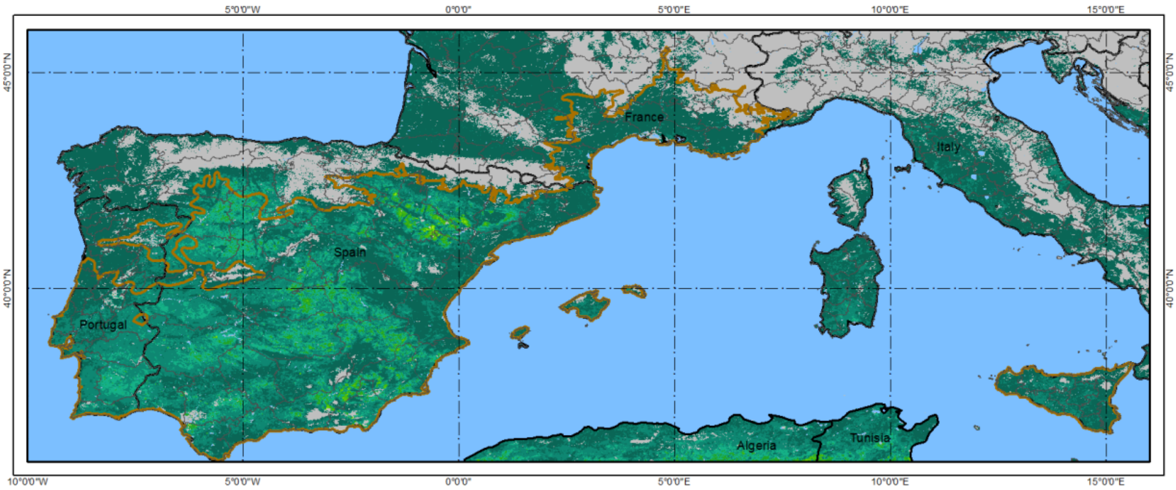
Average Vegetation Year Greenness

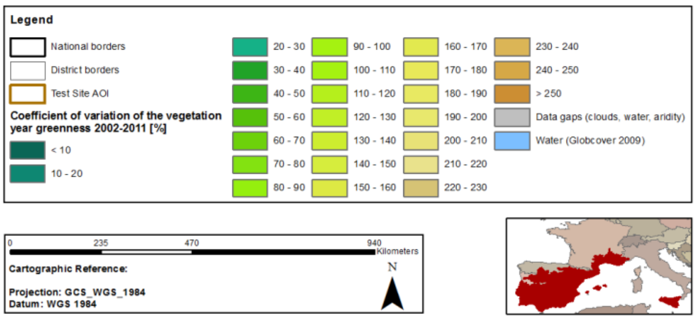


Description:

Status of ENVISAT MERIS fAPAR average vegetation year greenness, calculated as mean value for the period 2002-2011 in test site southern Europe. One vegetation year comprises one full phenological cycle of the vegetation.

Vegetation Year Variability

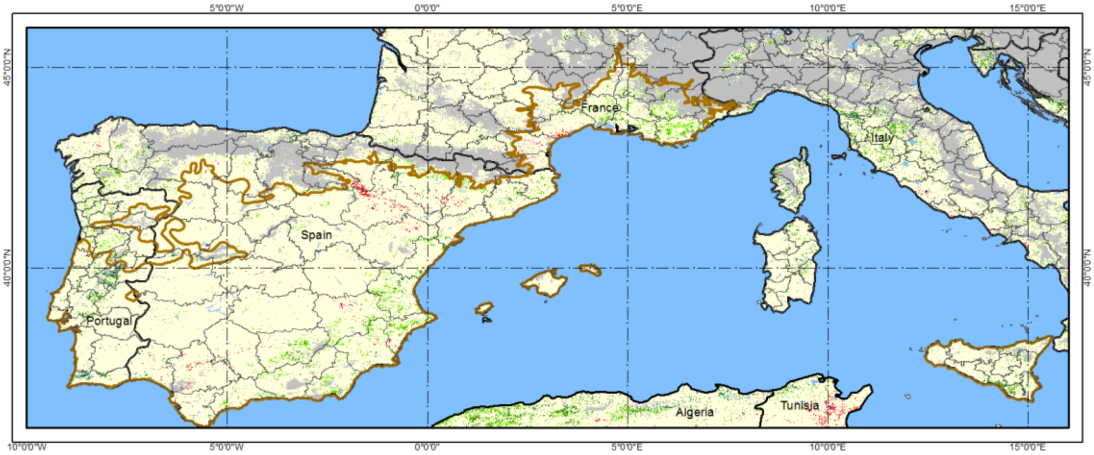




Description:

Variability of ENVISAT MERIS fAPAR vegetation year greenness expressed by the coefficient of variation for the period 2002-2011 in test site southern Europe. One vegetation year comprises one full phenologic cycle of the vegetation.

Vegetation Year Greenness Trend (abs.)

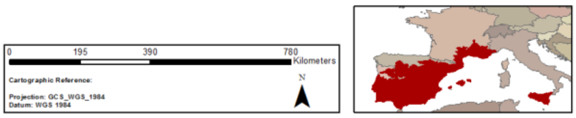


Legend

National borders
District borders
Test Site AOI

Absolute trend slopes of vegetation year average greenness 2002 – 2011

yearly decrease > 15
yearly decrease 12 - 15
yearly decrease 9 - 12
yearly decrease 6 - 9
yearly decrease 3 - 6
yearly decrease 1 - 3
yearly increase 1 - 3
yearly increase 3 - 6
yearly increase 6 - 9
yearly increase 9 - 12
yearly increase 12 - 15
yearly increase > 15
Insignificant or trend < 1
Data gaps (clouds, water, aridity)
Water (Globcover 2009)



Description:

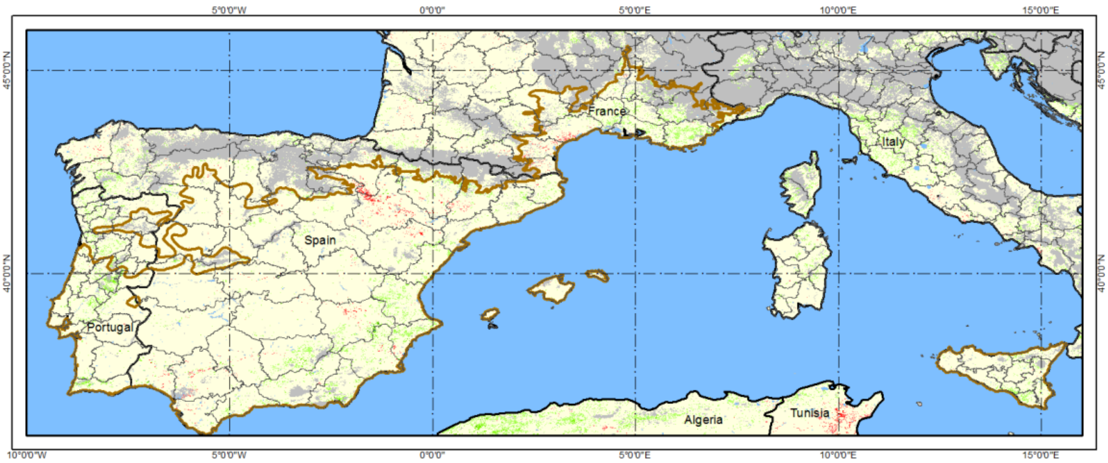
Slopes of absolute trends of ENVISAT MERIS fAPAR vegetation year averages in test site southern Europe throughout the period 2002-2011. One vegetation year comprises one full phenological cycle of the vegetation and hence constitutes a proxy for the overall annual NPP. The vegetation year is defined to start at the onset of vegetation greening following first rainfalls and last until the end of the dry season. The actual start of each vegetation year is individually determined for each year.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Trend values indicate average change per year. Original fAPAR values reach from 0 to 1 and have been stretched from 0 to 1000.

Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out.

Vegetation Year Greenness Trend (rel.)

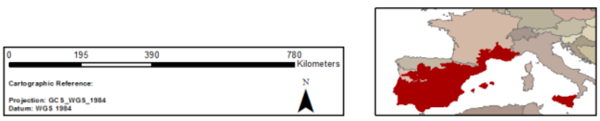


Legend

National borders
District borders
Test Site AOI

Relative trend of vegetation year average greenness 2002 – 2011

yearly decrease > 15%
yearly decrease 10 - 15 %
yearly decrease 5 - 10 %
yearly decrease < 5 %
yearly increase < 10 %
yearly increase 10 - 20 %
yearly increase 20 - 30 %
yearly increase 30 - 40 %
yearly increase 40 - 50 %
yearly increase 50 - 60 %
yearly increase 60 - 80 %
yearly increase > 80 %
Insignificant or abs. trend < 0.5
Data gaps (clouds, water, aridity)
Water (Globcover 2009)



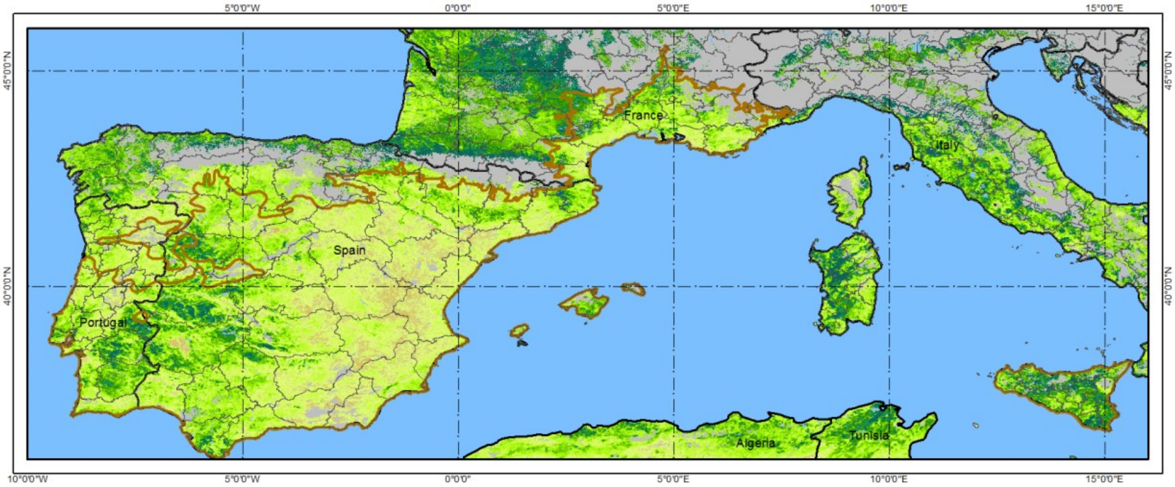
Description:

Relative yearly changes of ENVISAT MERIS fAPAR vegetation year averages in test site southern Europe throughout the period 2002-2011. One vegetation year comprises one full phenological cycle of the vegetation and hence constitutes a proxy for the overall annual NPP. The vegetation year is defined to start at the onset of vegetation greening following first rainfalls and last until the end of the dry season. The actual start of each vegetation year is individually determined for each year.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

Cyclic Vegetation Greenness



Legend

- National borders
- District borders
- Test Site AOI

Status of cyclic vegetation greenness 2002-2011

< 175; 175 - 350; 350 - 525; 525 - 700; 700 - 875; 875 - 1050; 1050 - 1225; 1225 - 1400; 1400 - 1575; 1575 - 1750; 1750 - 1925; 1925 - 2100; 2100 - 2275; 2275 - 2450; 2450 - 2625; 2625 - 2800; 2800 - 2975; 2975 - 3150; 3150 - 3325; 3325 - 3500; 3500 - 3675; 3675 - 3850; 3850 - 4025; 4025 - 4200; 4200 - 4375; > 4375; Data gaps (clouds, water, aridity); Water (Globcover 2009)

0 235 470 940 Kilometers

N

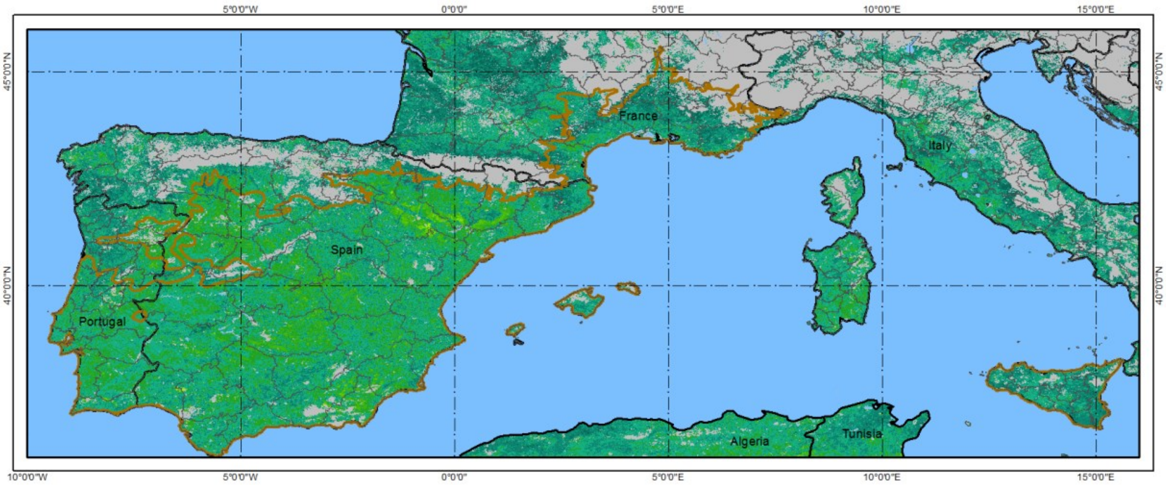
Cartographic Reference:

Projection: GCS_WGS_1984
Datum: WGS 1984

Description:

Status of ENVISAT MERIS fAPAR cyclic vegetation greenness calculated as mean value for the period 2002-2011 in test site southern Europe. The cyclic fraction of the vegetation comprises summed fAPAR values of the green peak(s) during a vegetation year, subtracting the non-cyclic base levels.

Cyclic Vegetation Variability



Legend

- National borders
- District borders
- Test Site AOI

Coefficient of variation of the cyclic vegetation greenness 2002-2011 [%]

< 10; 10 - 20; 20 - 30; 30 - 40; 40 - 50; 50 - 60; 60 - 70; 70 - 80; 80 - 90; 90 - 100; 100 - 110; 110 - 120; 120 - 130; 130 - 140; 140 - 150; 150 - 160; 160 - 170; 170 - 180; 180 - 190; 190 - 200; 200 - 210; 210 - 220; 220 - 230; 230 - 240; 240 - 250; > 250; Data gaps (clouds, water, aridity); Water (Globcover 2009)

0 235 470 940 Kilometers

N

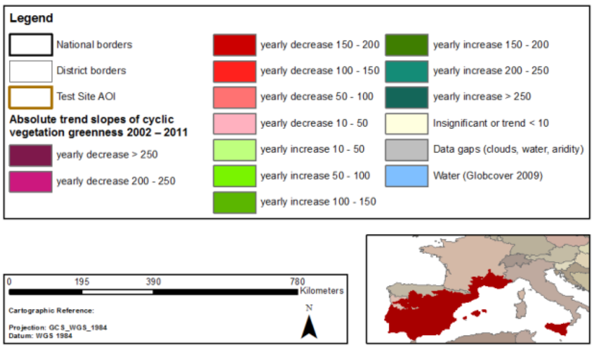
Cartographic Reference:

Projection: GCS_WGS_1984
Datum: WGS 1984

Description:

Variability of ENVISAT MERIS fAPAR cyclic vegetation greenness expressed by the coefficient of variation for the period 2002-2011 in test site southern Europe. The cyclic fraction of the vegetation comprises summed fAPAR values of the green peak(s) during a vegetation year, subtracting the non-cyclic base levels.

Cyclic Vegetation Greenness Trend (abs.)



Description:

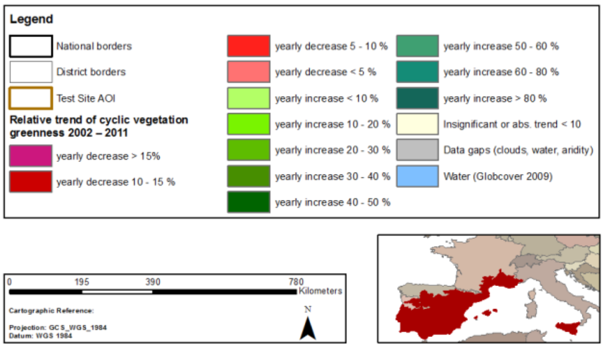
Slopes of absolute trends of ENVISAT MERIS fAPAR "cyclic fraction" values in test site southern Europe throughout the period 2002-2011. The cyclic fraction of the vegetation comprises summed fAPAR values of the green peak(s) during a vegetation year, subtracting the non-cyclic base levels. The cyclic fraction fAPAR can be interpreted as the amount of NPP being directly related to the annual cycle of the climatic vegetation growth factors, especially rainfall.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Trend values indicate average change per year. Original fAPAR values reach from 0 to 1 and have been stretched from 0 to 1000.

Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

Cyclic Vegetation Greenness Trend (rel.)



Description:

Relative yearly changes of ENVISAT MERIS fAPAR "cyclic fraction" values in test site southern Europe throughout the period 2002-2011. The cyclic fraction of the vegetation comprises summed fAPAR values of the green peak(s) during a vegetation year, subtracting the non-cyclic base levels. The cyclic fraction fAPAR can be interpreted as the amount of NPP being directly related to the annual cycle of the climatic vegetation growth factors, especially rainfall.
Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

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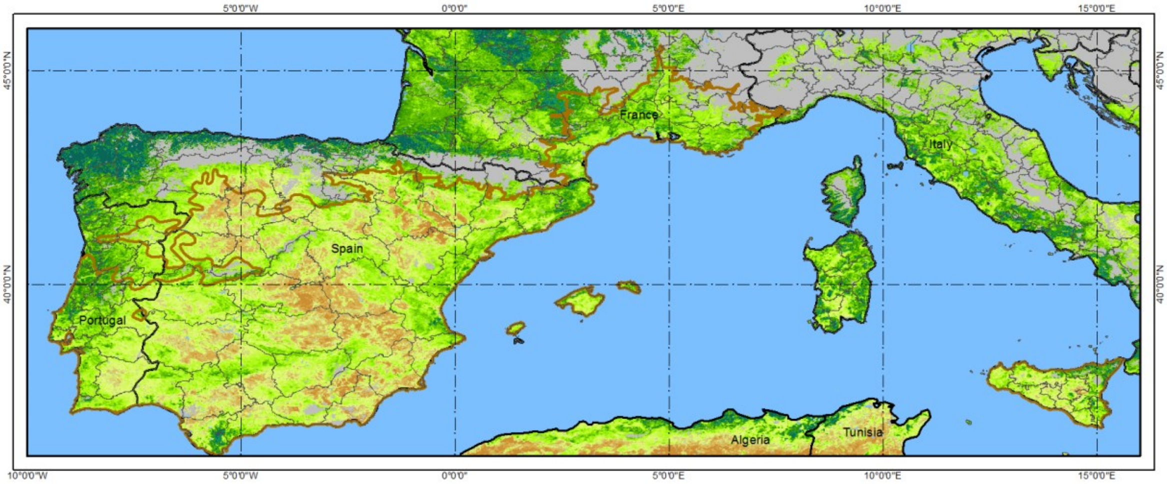
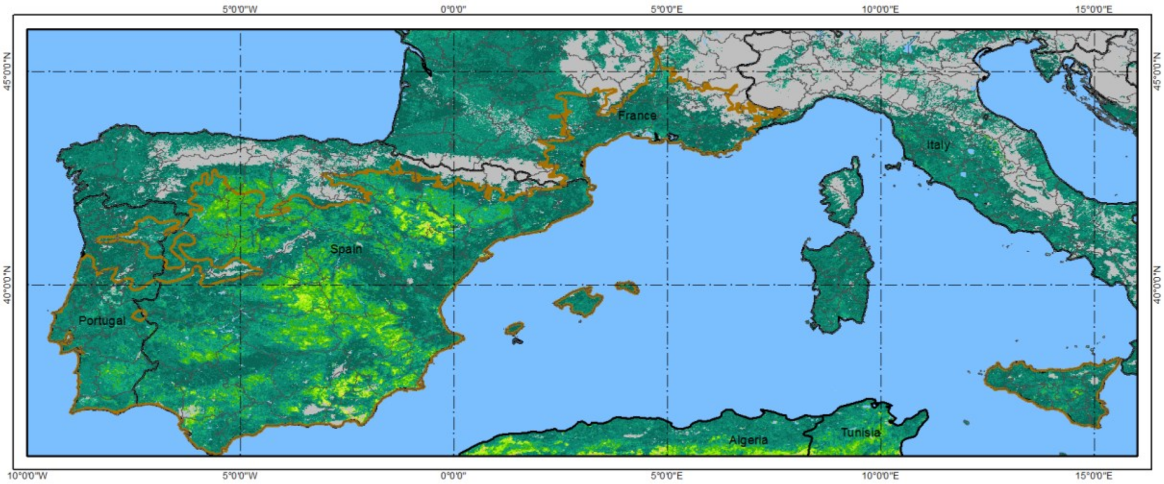
Dry Season Greenness

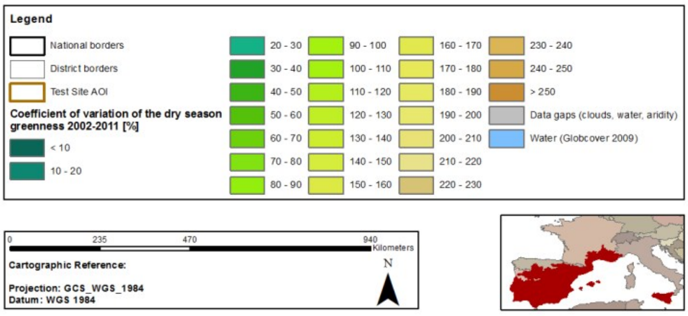


Description:

Status of ENVISAT MERIS fAPAR dry season greenness calculated as mean value for the period 2002-2011 in test site southern Europe. The dry season greenness values reflect the portion of plants that remain green after senescence of the annual vegetation or grow new green leaves during the dry period.

Dry Season Variability





Description:

Variability of ENVISAT MERIS fAPAR dry season greenness expressed by the coefficient of variation for the period 2002-2011 in test site southern Europe. The dry season greenness values reflect the portion of plants that remain green after senescence of the annual vegetation or grow new green leaves during the dry period.

Dry Season Greenness Trend (abs.)

Legend

- National borders
- District borders
- Test Site AOI

Absolute trend slopes of dry season greenness 2002 – 2011

- yearly decrease > 10
- yearly decrease 8 - 10
- yearly decrease 6 - 8
- yearly decrease 4 - 6
- yearly decrease 2 - 4
- yearly decrease 1 - 2
- yearly increase 1 - 2
- yearly increase 2 - 4
- yearly increase 4 - 6
- yearly increase 6 - 8
- yearly increase 8 - 10
- yearly increase > 10
- Insignificant or trend < 1
- Data gaps (clouds, water, aridity)
- Water (Globcover 2009)

0 195 390 780 Kilometers

Cartographic Reference:
Projection: GCS_WGS_1984
Datum: WGS 1984

N

Description:

Slopes of absolute trends of ENVISAT MERIS fAPAR dry season averages in test site southern Europe throughout the period 2002-2011. For the dry season the low fAPAR values after the green peak are taken, defined by a 10% amplitude threshold. The dry season greenness values reflect the portion of plants that remain green after senescence of the annual vegetation or grow new green leaves during the dry period.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Trend values indicate average change per year. Original fAPAR values reach from 0 to 1 and have been stretched from 0 to 1000.

Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

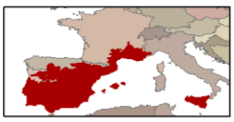
Dry Season Greenness Trend (rel.)

Legend

- National borders
- District borders
- Test Site AOI

Relative trend of dry season greenness 2002 – 2011

- yearly decrease > 15%
- yearly decrease 10 - 15 %
- yearly decrease 5 - 10 %
- yearly decrease < 5 %
- yearly increase < 10 %
- yearly increase 10 - 20 %
- yearly increase 20 - 30 %
- yearly increase 30 - 40 %
- yearly increase 40 - 50 %
- yearly increase 50 - 60 %
- yearly increase 60 - 80 %
- yearly increase > 80 %
- Insignificant or abs. trend < 0.5
- Data gaps (clouds, water, aridity)
- Water (Globcover 2009)



0 195 390 780 Kilometers

Cartographic Reference:
Projection: GCS_WGS_1984
Datum: WGS 1984

N

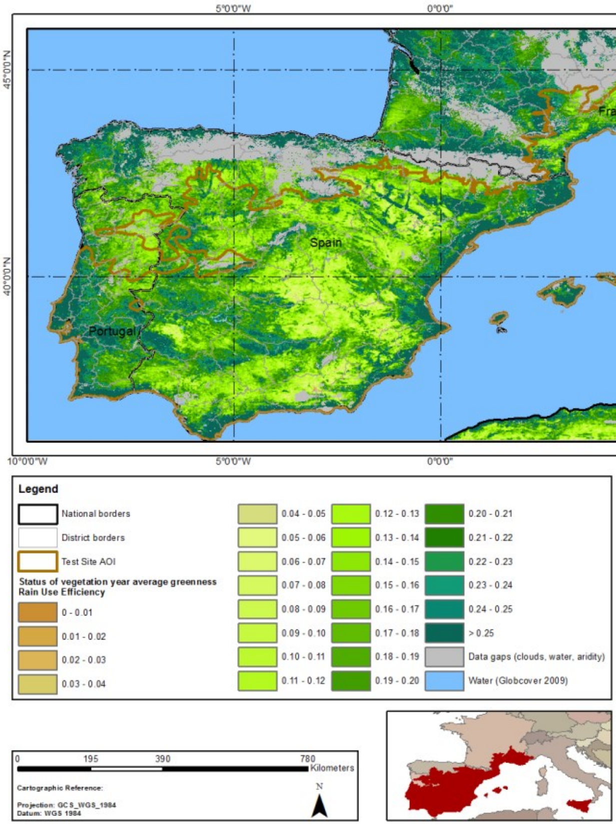
Description:

Relative yearly changes of ENVISAT MERIS fAPAR dry season averages in test site southern Europe throughout the period 2002-2011. For the dry season the low fAPAR values after the green peak are taken, defined by a 10% amplitude threshold. The dry season greenness values reflect the the portion of plants that remain green after senescence of the annual vegetation or grow new green leaves during the dry period.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

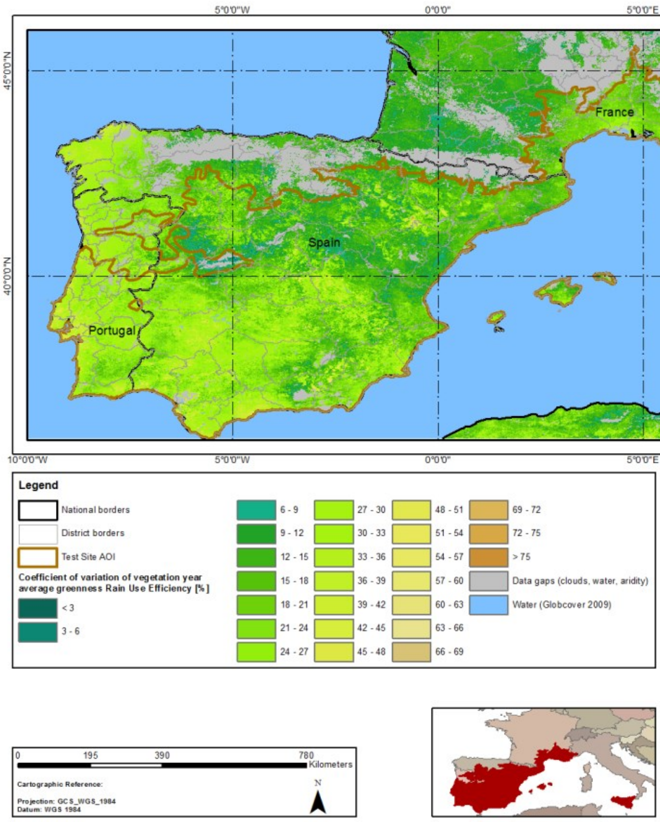
Average Vegetation Year Rain Use Efficiency Status



Description

Status of ENVISAT MERIS fAPAR vegetation year average greenness Rain Use Efficiency calculated as mean value for the period 2002-2011 in test site southern Europe. Vegetation year average greenness RUE calculation is based on ENVISAT MERIS fAPAR values (averaged over one vegetation year) divided by rainfall data (TRMM 3b42 precipitation). TRMM 3b42 precipitation estimates are bilinearly resampled to technically match the MERIS fAPAR spatial resolution, knowing that their actual spatial resolution of 0.25° does not (!) match the fAPAR data.

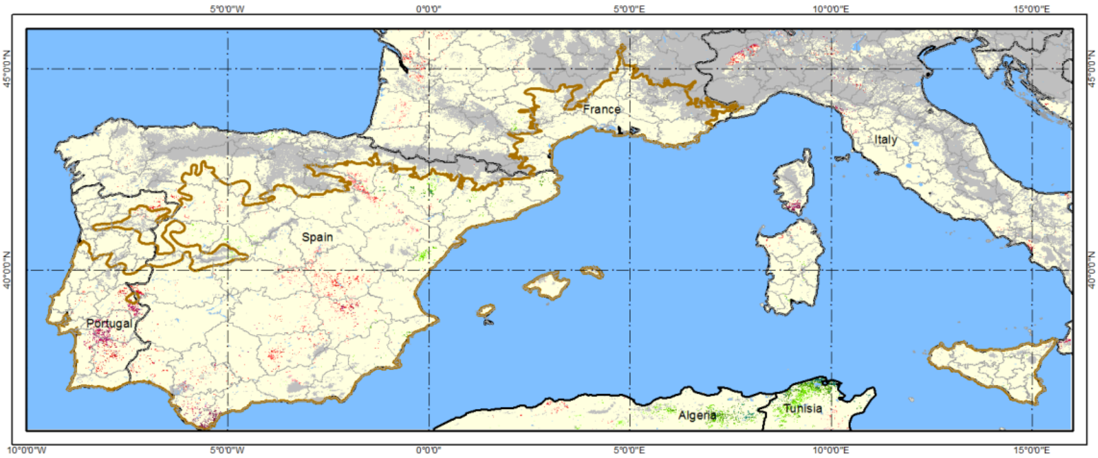
Vegetation Year Rain Use Efficiency Variability



Description

Variability of vegetation year average greenness Rain Use Efficiency expressed by the coefficient of variation for the period 2002-2011 in test site southern Europe.

Vegetation Year Rain Use Efficiency Trend (abs.)



Legend

- National borders
- District borders
- Test Site AOI

Absolute trend slopes of vegetation year average greenness Rain Use Efficiency 2002 –2011

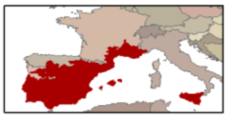
- yearly decrease > 0.05
- yearly decrease 0.04 - 0.05
- yearly decrease 0.03 - 0.04
- yearly decrease 0.02 - 0.03
- yearly decrease 0.01 - 0.02
- yearly decrease 0.001 - 0.01
- yearly increase 0.001 - 0.01
- yearly increase 0.01 - 0.02
- yearly increase 0.02 - 0.03
- yearly increase 0.03 - 0.04
- yearly increase 0.04 - 0.05
- yearly increase > 0.05
- Insignificant or trend < 0.001
- Data gaps (clouds, water, aridity)
- Water (Globcover 2009)

0 195 390 780 Kilometers

Cartographic Reference:

Projection: GCS_WGS_1984
Datum: WGS 1984

N



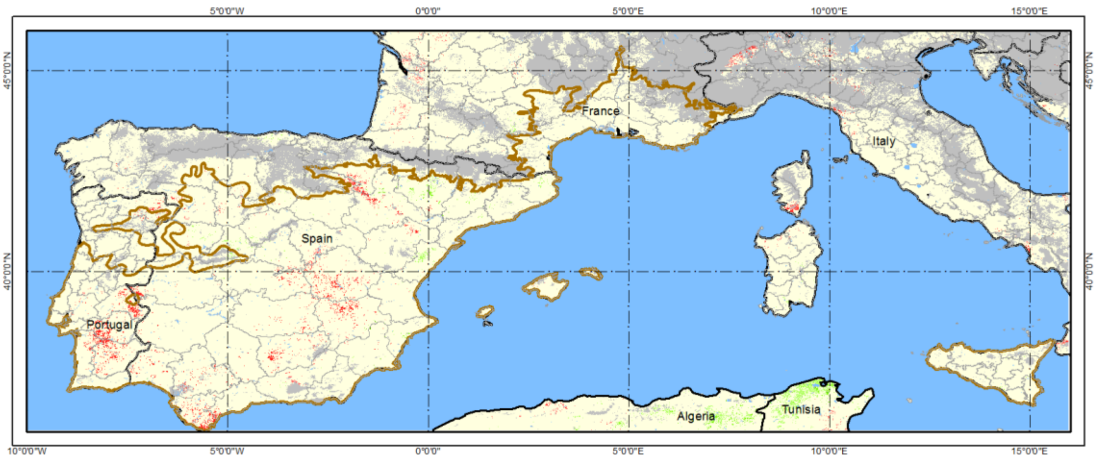
Description:

Slopes of absolute trends of vegetation year average greenness Rain Use Efficiency – RUE in test site southern Europe throughout the period 2002-2011. Vegetation year average greenness RUE calculation is based on ENVISAT MERIS fAPAR values (averaged over one vegetation year) divided by rainfall data (TRMM 3b42 precipitation). TRMM 3b42 precipitation estimates are bilinearly resampled to technically match the MERIS fAPAR spatial resolution, knowing that their actual spatial resolution of 0.25° does not (!) match the fAPAR data.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Trend values indicate average change per year. Original fAPAR values reach from 0 to 1 and have been stretched from 0 to 1000.Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

Vegetation Year Rain Use Efficiency Trend (rel.)



Legend

- National borders
- District borders
- Test Site AOI

Relative trend of vegetation year average greenness Rain Use Efficiency 2002 –2011

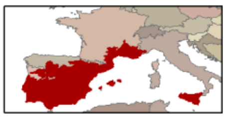
- yearly deacrease > 15%
- yearly deacrease 10 - 15%
- yearly deacrease 5 - 10%
- yearly increase < 5%
- yearly increase < 10 %
- yearly increase 10 - 20%
- yearly increase 20 - 30%
- yearly increase 30 - 40%
- yearly increase 40 - 50%
- yearly increase 50 - 60 %
- yearly increase 60 - 80%
- yearly increase > 80 %
- Insignificant or abs. trend < 0.05
- Data gaps (clouds, water, aridity)
- Water (Globcover 2009)

0 195 390 780 Kilometers

Cartographic Reference:

Projection: GCS_WGS_1984
Datum: WGS 1984

N



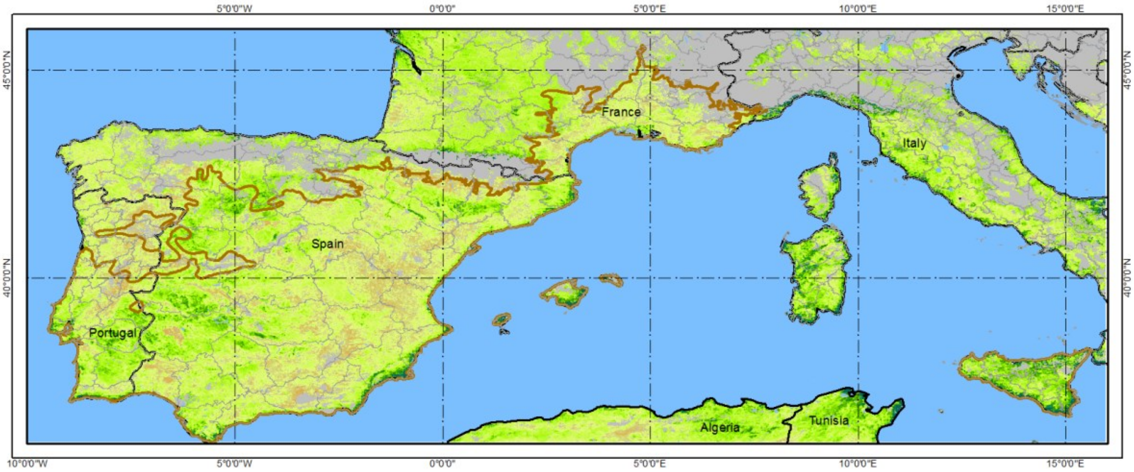
Description:

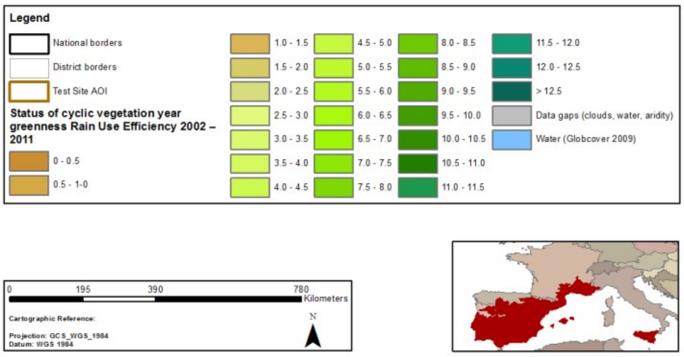
Relative yearly changes of vegetation year average greenness Rain Use Efficiency – RUE in test site southern Europe throughout the period 2002-2011. Vegetation year average greenness RUE calculation is based on ENVISAT MERIS fAPAR values (averaged over one vegetation year) divided by rainfall data (TRMM 3b42 precipitation). TRMM 3b42 precipitation estimates are bilinearly resampled to technically match the MERIS fAPAR spatial resolution, knowing that their actual spatial resolution of 0.25° does not (!) match the fAPAR data.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Trend values indicate average change per year. Original fAPAR values reach from 0 to 1 and have been stretched from 0 to 1000.Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

Cyclic Vegetation Rain Use Efficiency Status

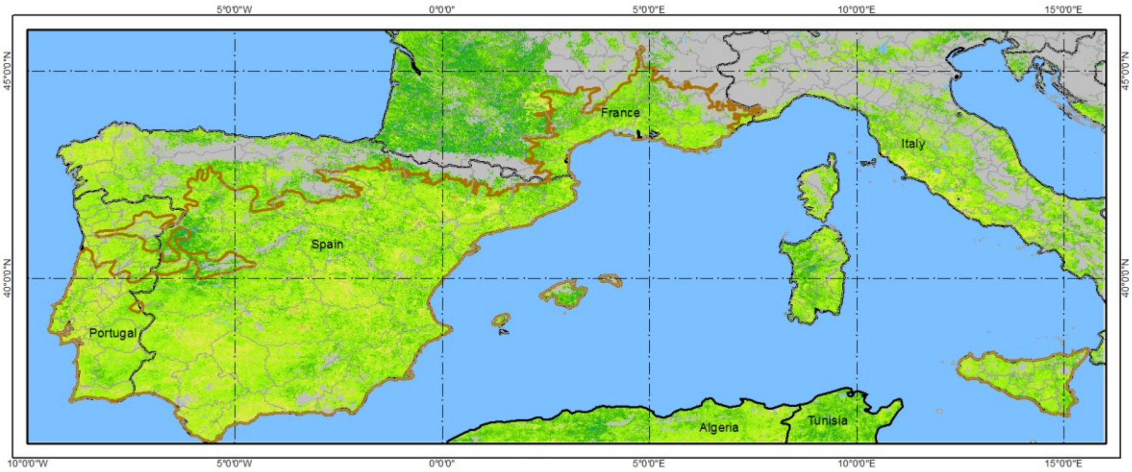


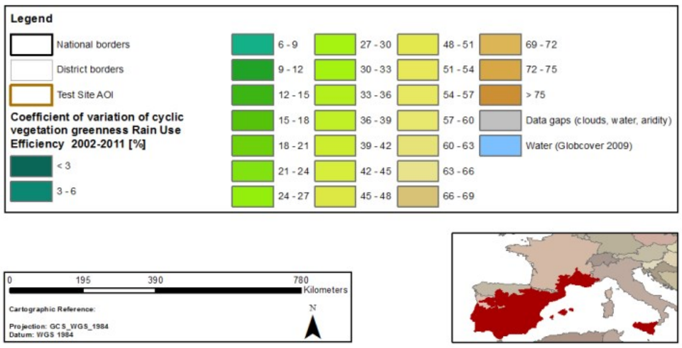


Description:

Status of ENVISAT MERIS fAPAR cyclic vegetation greenness Rain Use Efficiency calculated as mean value for the period 2002-2011 in test site southern Europe. Cyclic vegetation greenness RUE calculation is based on ENVISAT MERIS fAPAR values (averaged over one vegetation year) divided by rainfall data (TRMM 3b42 precipitation). TRMM 3b42 precipitation estimates are bilinearly resampled to technically match the MERIS fAPAR spatial resolution, knowing that their actual spatial resolution of 0.25° does not (!) match the fAPAR data.

Cyclic Vegetation Rain Use Efficiency Variability

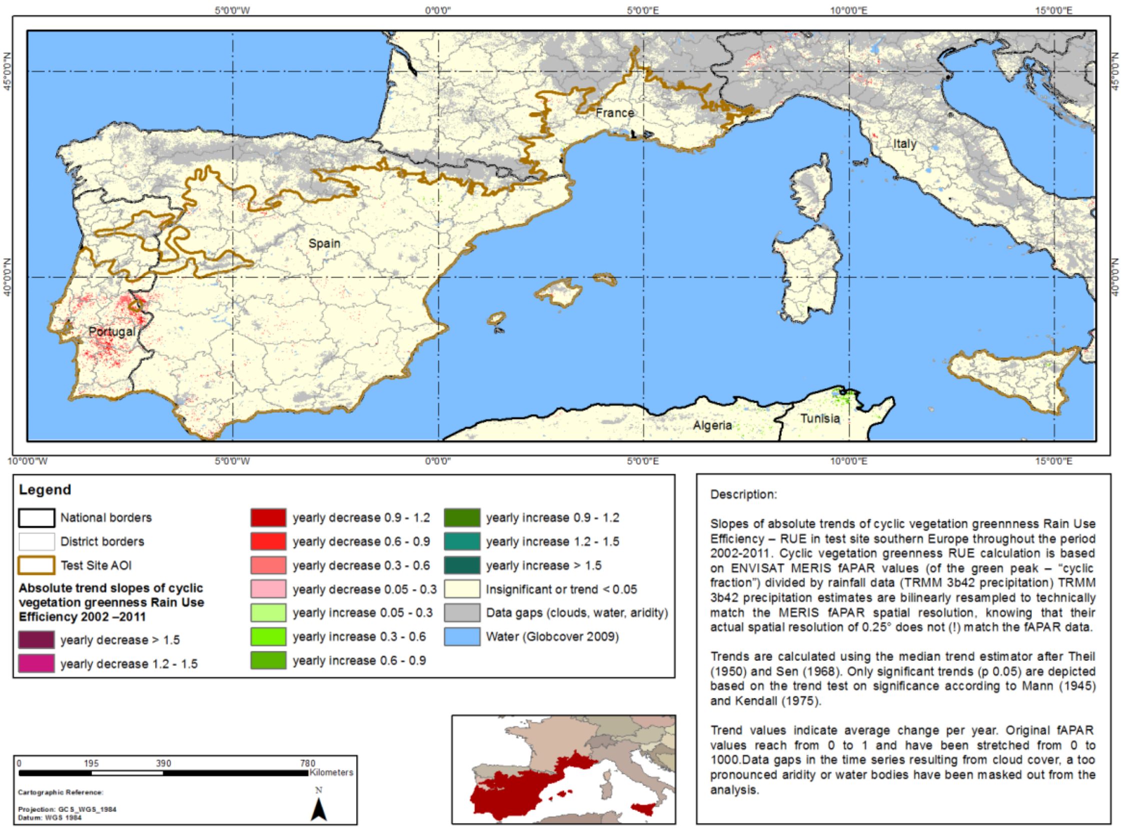




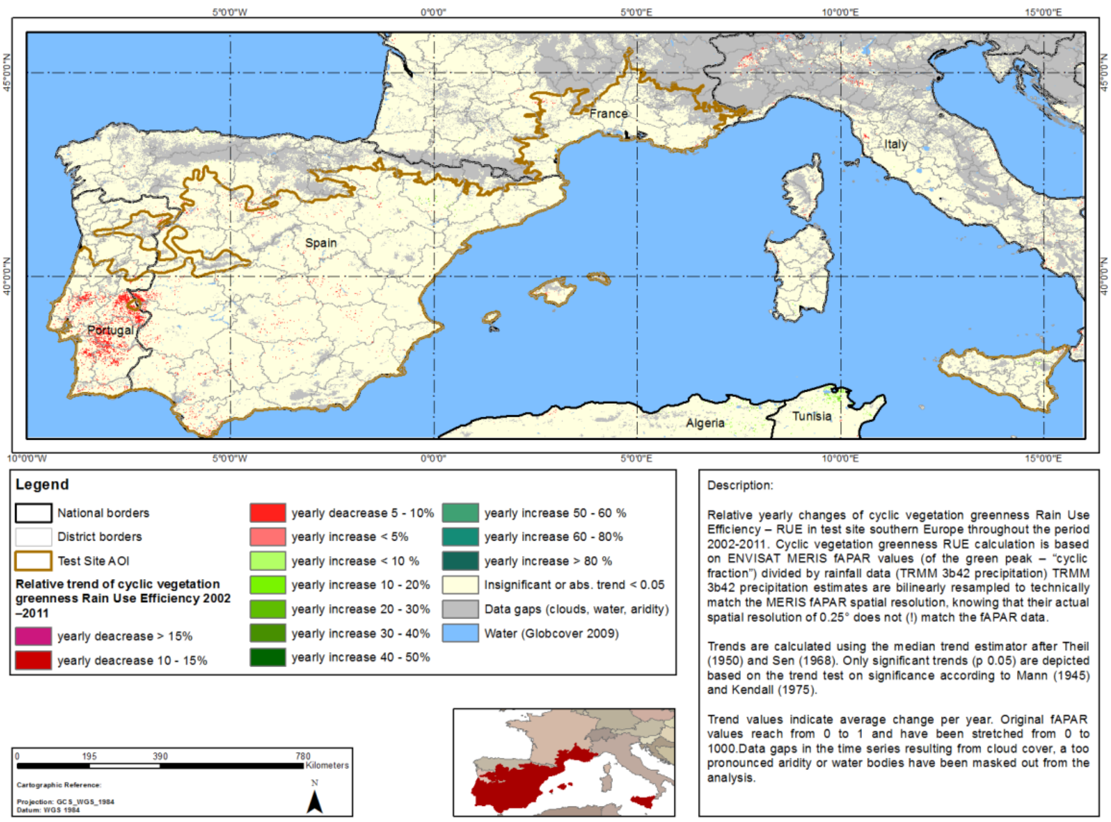
Description:

Variability of cyclic vegetation greenness Rain Use Efficiency expressed by the coefficient of variation for the period 2002-2011 in test site southern Europe.

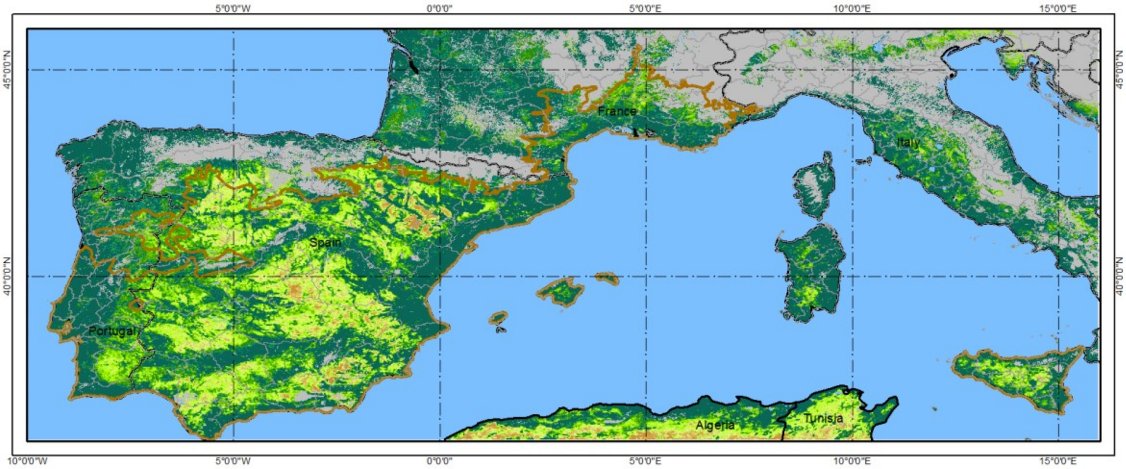
Cyclic Vegetation Rain Use Efficiency Trend (abs.)



Cyclic Vegetation Rain Use Efficiency Trend (rel.)



Dry Season Rain Use Efficiency Status



Legend

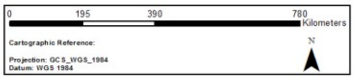
- National borders
- District borders
- Test Site AOI

Status of dry season greenness Rain Use Efficiency 2002-2011

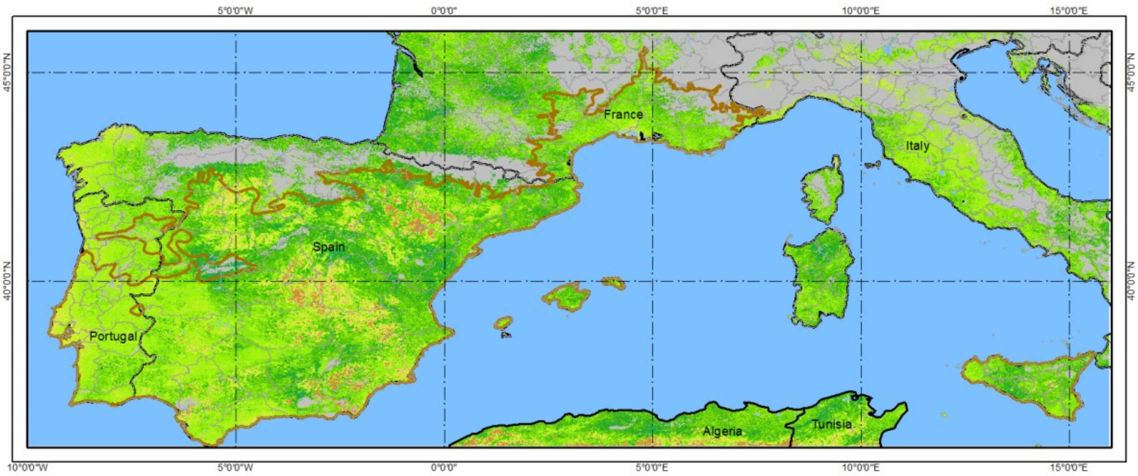
0 - 0.01; 0.01 - 0.02; 0.02 - 0.03; 0.03 - 0.04; 0.04 - 0.05; 0.05 - 0.06; 0.06 - 0.07; 0.07 - 0.08; 0.08 - 0.09; 0.09 - 0.10; 0.10 - 0.11; 0.11 - 0.12; 0.12 - 0.13; 0.13 - 0.14; 0.14 - 0.15; 0.15 - 0.16; 0.16 - 0.17; 0.17 - 0.18; 0.18 - 0.19; 0.19 - 0.20; 0.20 - 0.21; 0.21 - 0.22; 0.22 - 0.23; 0.23 - 0.24; 0.24 - 0.25; > 0.25; Data gaps (clouds, water, aridity); Water (Globcover 2009)

Description:

Status of ENVISAT MERIS dry season greenness Rain Use Efficiency calculated as mean value for the period 2002-2011 in test site southern Europe. Dry season vegetation greenness RUE calculation is based on ENVISAT MERIS fAPAR values (averaged over the dry season after the green peak) divided by rainfall data (TRMM 3b42 precipitation). TRMM 3b42 precipitation estimates are bilinearly resampled to technically match the MERIS fAPAR spatial resolution, knowing that their actual spatial resolution of 0.25° does not (!) match the fAPAR data.



Dry Season Rain Use Efficiency Variability



Legend

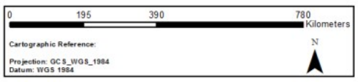
- National borders
- District borders
- Test Site AOI

Coefficient of variation of dry season greenness Rain Use Efficiency 2002-2011 [%]

< 3; 3 - 6; 6 - 9; 9 - 12; 12 - 15; 15 - 18; 18 - 21; 21 - 24; 24 - 27; 27 - 30; 30 - 33; 33 - 36; 36 - 39; 39 - 42; 42 - 45; 45 - 48; 48 - 51; 51 - 54; 54 - 57; 57 - 60; 60 - 63; 63 - 66; 66 - 69; 69 - 72; 72 - 75; > 75; Data gaps (clouds, water, aridity); Water (Globcover 2009)

Description:

Variability of dry season greenness Rain Use Efficiency expressed by the coefficient of variation for the period 2002-2011 in test site southern Europe.



Dry Season Rain Use Efficiency Trend (abs.)

Legend

- National borders
- District borders
- Test Site AOI

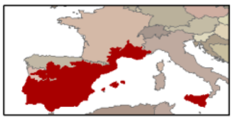
Absolute trend slopes of dry season greenness Rain Use Efficiency 2002 –2011

- yearly decrease > 0.025
- yearly decrease 0.02 - 0.025
- yearly decrease 0.015 - 0.02
- yearly decrease 0.01 - 0.015
- yearly decrease 0.005 - 0.01
- yearly decrease 0.001 - 0.005
- yearly increase 0.001 - 0.005
- yearly increase 0.005 - 0.01
- yearly increase 0.01 - 0.015
- yearly increase 0.015 - 0.02
- yearly increase 0.02 - 0.025
- yearly increase > 0.025
- Insignificant or trend < 0.001
- Data gaps (clouds, water, aridity)
- Water (Globcover 2009)

0 195 390 780 Kilometers

Cartographic Reference:
Projection: GCS_WGS_1984
Datum: WGS 1984

N



Description:

Slopes of absolute trends of dry season greenness Rain Use Efficiency – RUE in test site southern Europe throughout the period 2002-2011. Dry season greenness RUE calculation is based on ENVISAT MERIS fAPAR values (averaged over the dry season after the green peak) divided by rainfall data (TRMM 3b42 precipitation). TRMM 3b42 precipitation estimates are bilinearly resampled to technically match the MERIS fAPAR spatial resolution, knowing that their actual spatial resolution of 0.25° does not (!) match the fAPAR data.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Trend values indicate average change per year. Original fAPAR values reach from 0 to 1 and have been stretched from 0 to 1000.Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

Dry Season Rain Use Efficiency Trend (rel.)

Legend

- National borders
- District borders
- Test Site AOI

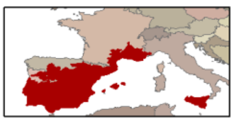
Relative trend of dry season greenness Rain Use Efficiency 2002 –2011

- yearly deacrease > 15%
- yearly deacrease 10 - 15%
- yearly deacrease 5 - 10%
- yearly increase < 5%
- yearly increase < 10 %
- yearly increase 10 - 20%
- yearly increase 20 - 30%
- yearly increase 30 - 40%
- yearly increase 40 - 50%
- yearly increase 50 - 60 %
- yearly increase 60 - 80%
- yearly increase > 80 %
- Insignificant or abs. trend < 0.05
- Data gaps (clouds, water, aridity)
- Water (Globcover 2009)

0 195 390 780 Kilometers

Cartographic Reference:
Projection: GCS_WGS_1984
Datum: WGS 1984

N



Description:

Relative yearly dry season vegetation greenness Rain Use Efficiency – RUE in test site southern Europe throughout the period 2002-2011. Dry season vegetation greenness RUE calculation is based on ENVISAT MERIS fAPAR values (averaged over the dry season after the green peak) divided by rainfall data (TRMM 3b42 precipitation). TRMM 3b42 precipitation estimates are bilinearly resampled to technically match the MERIS fAPAR spatial resolution, knowing that their actual spatial resolution of 0.25° does not (!) match the fAPAR data.

Trends are calculated using the median trend estimator after Theil (1950) and Sen (1968). Only significant trends (p 0.05) are depicted based on the trend test on significance according to Mann (1945) and Kendall (1975).

Trend values indicate average change per year. Original fAPAR values reach from 0 to 1 and have been stretched from 0 to 1000.Data gaps in the time series resulting from cloud cover, a too pronounced aridity or water bodies have been masked out from the analysis.

Vegetation Year Precipitation Status

Legend

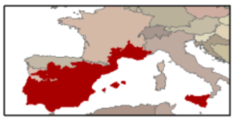
- National borders
- District borders
- Test Site AOI

Status of vegetation year precipitation 2002-2011

- < 40
- 40 - 80
- 80 - 120
- 120 - 160
- 160 - 200
- 200 - 240
- 240 - 280
- 280 - 320
- 320 - 260
- 360 - 400
- 400 - 440
- 440 - 480
- 480 - 520
- 520 - 560
- 560 - 600
- 600 - 640
- 640 - 680
- 680 - 720
- 720 - 760
- 760 - 800
- 800 - 840
- 840 - 880
- 880 - 920
- 920 - 960
- 960 - 1000
- > 1000
- Data gaps/no rainfall
- Water (Globcover 2009)

0 195 390 780 Kilometers

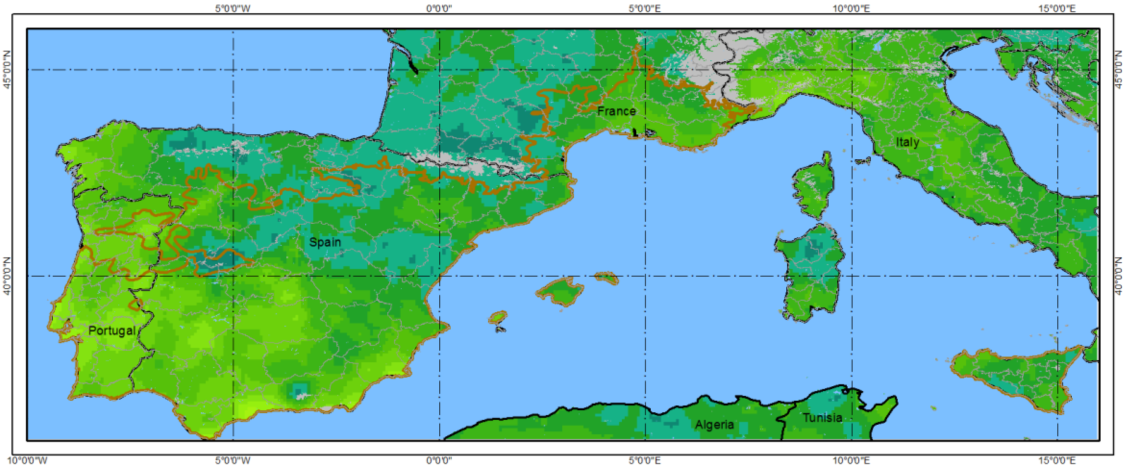
Cartographic Reference:
Projection: GCS_WGS_1984
Datum: WGS 1984



Description:

Status of TRMM 3b42 precipitation estimates summed over vegetation years calculated as mean value for the period 2002-2011. Yearly aggregation periods are derived from the corresponding vegetation year with a temporal backward shift of two months. Thus, each precipitation vegetation year starts and ends two months earlier than the corresponding vegetation year.

Vegetation Year Precipitation Variability



Legend

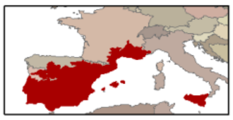
- National borders
- District borders
- Test Site AOI

Coefficient of variation of vegetation year precipitation 2002-2011 [%]

- > 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- 90 - 95
- 95 - 100
- 100 - 105
- 105 - 110
- 110 - 115
- 115 - 120
- 120 - 125
- > 125
- Data gaps/no rainfall
- Water (Globcover 2009)

0 195 390 780 Kilometers

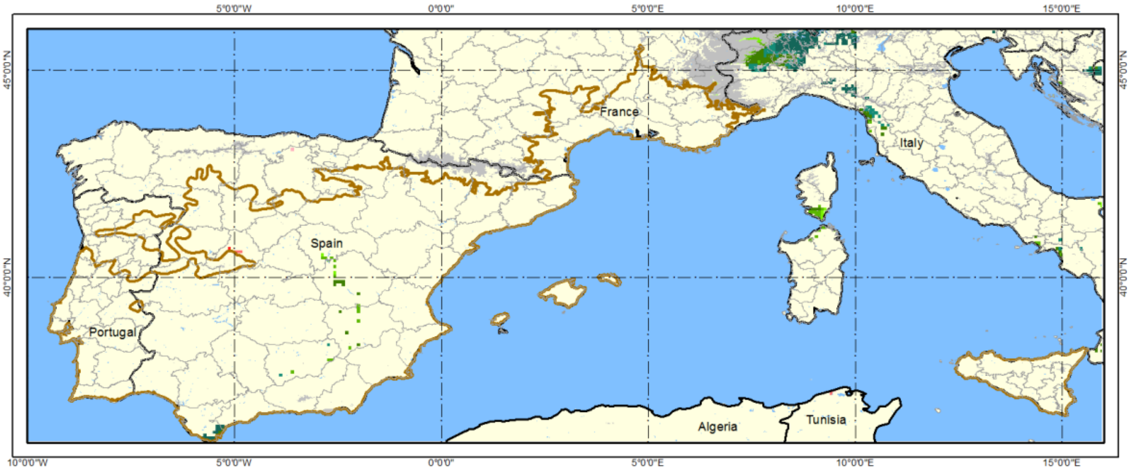
Cartographic Reference:
Projection: GCS_WGS_1984
Datum: WGS 1984



Description:

Variability of TRMM 3b42 precipitation estimates summed over vegetation years expressed by the coefficient of variation for the period 2002-2011. Yearly aggregation periods are derived from the corresponding vegetation year with a temporal backward shift of two months. Thus, each precipitation vegetation year starts and ends two months earlier than the corresponding vegetation year.

Vegetation Year Precipitation Trend (abs.)



Legend

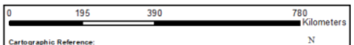
- National borders
- District borders
- Test Site AOI

Absolute trend slopes of vegetation year precipitation 2002-2011

- yearly decrease > 15
- yearly decrease 12 - 15
- yearly decrease 9 - 12
- yearly decrease 6 - 9
- yearly decrease 3 - 6
- yearly decrease 0.5 - 3
- yearly increase 0.5 - 3
- yearly increase 3 - 6
- yearly increase 6 - 9
- yearly increase 9 - 12
- yearly increase 12 - 15
- yearly increase > 15
- Insignificant or no trend
- Data gaps (clouds, water, aridity)
- Water (Globcover 2009)

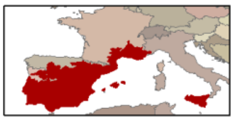
Description:

Slopes of absolute trends of TRMM 3b42 precipitation estimates summed over vegetation years in test site southern Europe throughout the period 2002-2011. Yearly aggregation periods are derived from the corresponding vegetation year with a subsequent temporal backward shift of two months. Thus, each precipitation vegetation year starts and ends two months earlier than the corresponding vegetation year.

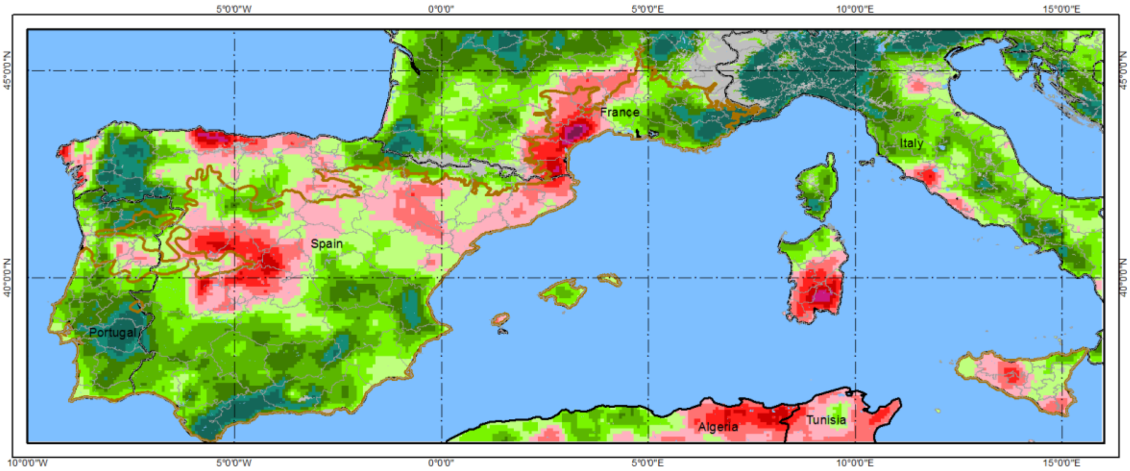


Cartographic Reference:

Projection: GCS_WGS_1984
Datum: WGS 1984



Vegetation Year Precipitation Change



Legend

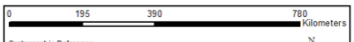
- National borders
- District borders
- Test Site AOI

Change in vegetation year precipitation between the epochs 2002-2006 and 2007-2011

- decrease > 200
- decrease 160 - 200
- decrease 120 - 160
- decease 80 - 120
- decrease 40 - 80
- decrease 0 - 40
- increase 0 - 40
- increase 40 - 80
- increase 80 - 120
- increase 120 - 160
- increase 160 - 200
- increase > 200
- Data gaps/no rainfall
- Water (Globcover 2009)

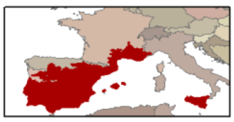
Description:

Change in TRMM 3b42 precipitation estimates summed over vegetation years between the two epochs 2002-2006 and 2007-2011 in test site southern Europe. The calculation of per-epoch precipitation is based on epoch median values. Yearly aggregation periods are derived from the corresponding vegetation year with a temporal backward shift of two months. Thus, each precipitation year starts and ends two months earlier than the corresponding vegetation year.



Cartographic Reference:

Projection: GCS_WGS_1984
Datum: WGS 1984



Generic Interpretation of the Maps with regard to Degradation and Potential Loss of Biodiversity

The maps that are so far shown in the booklet include phenologically differentiated NPP proxy (Net Primary Production) and RUE (Rain Use Efficiency) status and trend maps, as well as rainfall status, trend – and change maps.

Overall the status maps describe the amount and variability (coefficient of variation) of greenness (NPP proxy) in the differentiated phenological seasons, as well greenness in relation to the amount of rainfall (RUE).

While vegetation productivity obvious follows the rainfall gradients at the large scale (not considering temperature and radiation differences), the smaller scale differentiations exhibit the presence of further influences on vegetation growth at more local scales. These local and regional factors are especially land use, soil properties and topography and include also the protection status of areas. For instance many linear features with (mostly) higher NPP proxy and RUE values than their surroundings can be related to river valleys (often with only seasonal or ephemeral surface water).

Consequently, the spatial distribution of RUE varies not only with rainfall, but depends on the constellation of all these factors at various scales. Hence RUE status (average condition) values, even if stratified according to aridity, cannot directly be interpreted in terms of existing soil degradation or exposure to degradation or richness/poverty of biodiversity without knowledge about growth factors other than rainfall, and about bio-geographical properties.

Biomes with rich floristic biodiversity can be expected to exhibit higher NPP response to rainfall throughout the year as diverse plant communities may be characterised by a high phenological variability with optimised water exploitation. However, it is not known whether, where and to which degree this theory translates into measurable spatial differences of RUE. Here an assessment of the results by local experts and the usage of reference maps and information will help interpret the results. An example with an extended area of extraordinary high average RUE conditions is the Succulent Karoo biome in South Africa ("*The Succulent Karoo is notable for the world's richest flora of succulent plants, and harbours about one-third of the world's approximately 10,000 succulent species*" http://en.wikipedia.org/wiki/Succulent_Karoo).

The differentiation of the NPP and RUE indicators into phenological periods helps diagnose the seasonal behaviour of the vegetation and thus provides clues about the presence and dominance of evergreen perennial vegetation versus annual vegetation (e.g. annual grasses, crops). Accordingly, changes and trends of the phenological vegetation behaviour can be used as indicators for developments such as land use change and land cover change. For instance the worldwide observed phenomenon of bush encroachment (woody encroachment, woody thickening) in drylands (Ratajczak et al. 2011) will lead to a shift of vegetation phenology, where especially an increase of dry season greenness, possibly, but not necessarily combined with a decrease of the cyclic greenness can be expected.

Bush encroachment in drylands is often perceived as negative development, where the bushes lead to range land degradation by reducing grass cover and impeding the access of cattle to the remaining grass. Also impoverishment of biodiversity was frequently found as an effect of bush encroachment (Ratajczak et al. 2011). The greening trends especially in the dry season are indeed a widespread phenomenon in the derived NPP proxy maps (p. 16), possibly pointing to continued bush encroachment or enhanced growth and greening of existing bushes, partly related to rainfall increases. Dry season greening may also be caused by the plantation of (especially evergreen) woody plants and forests. In case of greening trends related to commercial forest plantations, the trends can also be interpreted as a biodiversity loss.

The “classical” degradation measure is exhibited by decreasing RUE trends, i.e. the decrease of NPP proxies in relation to rainfall, theoretically indicating the decreasing ability of the vegetation to exploit available water. In the test sites so far studied, RUE decreases are rarely observed for the cyclic vegetation of the growing season (p. 20). This means, the cyclic vegetation response to rainfall is not widespread diminished and degradation of soils leading to reduced usability of rainfall for vegetation growth seems to be hardly found in the test sites so far. Where it is found it seems to co-occur with regional rainfall increases, and may be interpreted as lacking ability of the vegetation to respond to apparently improved hydrologic growing conditions. Extended areas in South and East Portugal are an example for wide spread RUE decreases of the cyclic vegetation related to rainfall increase (p. 24) without cyclic vegetation decrease (p. 14). However, increased rainfall quantities may also come with higher rainfall intensities and may have also negative effects (increased runoff, more erosive power), and can be assumed to be not generally positively correlated with vegetation productivity.

RUE decreases are more frequently found when looking at the vegetation of the entire vegetation year (p. 18), and are also often related to rainfall increases, and not to greenness decreases. RUE decreases are not only indicating potential degradation developments (progressing degradation triggered e.g. by land over-utilisation), but may be as well related to land cover/use changes, such as the conversion of rangeland into cropland, deforestation (less important in dry lands), etc. Especially processes such as urbanisation or mining will lead to extreme NPP proxy and RUE decreases. Decreases of only the dry season RUE (p. 22) may in particular be related to conversion of rangeland into rainfed cropland, assuming a lower primary productivity of the cropland during the dry season. Also the clearing of shrubs, bushland and savannah vegetation may lead especially to dry season RUE decreases.

To summarize the observable NPP proxy and RUE trends cannot be directly interpreted as degradation or biomass losses, or, in case of positive trends, as land improvements. There are always multiple possible underlying causes and developments, hence in situ knowledge and information is indispensable for the interpretation of these developments, as well as for the average conditions expressed in the status maps. Especially the frequently found greening trends in the dry season, at first glance positive trends, may even be primarily related to adverse processes such as bush encroachment. However, caution is also necessary in this respect, as likewise range land improvement and tree planting activities may lead to diverse positive trends.

Finally it must me stated that the observation period is rather short, with several consequences for this study. The variability of rainfalls and subsequently vegetation greenness from year to year is so significant in drylands that it certainly hides trends, which in such a short period may be rare and not very pronounced. Trends must pass a high statistical significance threshold to be recognised as significant trends. There may be more relevant changes going on than the trend maps with only the highly significant trends can show, especially as many change events cannot be expected to exhibit gradual indicator developments. Also the rainfall trend maps (p. 24) show hardly any significant trends, while the rainfall change map between the two epochs shows large positive and negative change regions with partly big epochal rainfall differences.

On the other hand, the epochal change maps (differences between the means or median values of epochs, part of the overall products) are strongly influenced by variability and do certainly not only reflect “true” changes in the sense of concrete changes (e.g. land use change) or persisting developments (trends). Therefore these maps (that - except for rainfall - are not shown in the booklet) must be used with care.

Outlook

The phenologically differentiated analysis of NPP proxies and RUE so far performed will allow for a combination of the single results into integrated second order products. Their intention is to provide more evaluative assessments of the possible recent developments than the individual indicators. For instance, the occurrence of dry season greening in the absence of positive cyclic vegetation trends or in combination with negative cyclic vegetation trends may be derived as a an indicator for bush encroachment, either in the past and/or ongoing, where theoretically also the trend of the ratio of dry season to vegetation year greenness may support the diagnosis of increases of woody vegetation at the expense of grasses. The generation and/or interpretation of second order products may also be supported by means of land cover data.

Further on, CCI soil moisture (http://www.esa-soilmoisture-cci.org/) data, where available without greater data gaps, will be used as an additional and alternative measure for available water, and "Soil Moisture Use Efficiency" (SMUE) products analogue to RUE products will be derived thereof. Theoretically, soil moisture is the better suited water parameter for this purpose, as it almost directly constitutes the available water for plants, whereas rainfall only partly penetrates into the soil. The comparison of the SMUE with the RUE products will be of high interest.

Selected second order indicators will be added to these booklets, while the first order indicator maps may be reduced to keep the booklets focused on the most significant results. The results will be interpreted in terms of so-called "Biodiversity Stories", which will verbally highlight the most prominent and significant developments found in the data.

Description of Biodiversity of Test Site 10 Southern Europe

The study area considered here covers the north-western part of the Mediterranean basin, and includes the Iberian Peninsula (except for the more Atlantic influenced northwest), the Balearic Islands, southern France and the island of Sicily. The area encompasses many types of ecoregions (WWF 2013b,c,d,e,f), but overall it is characterized by either oak tree, coniferous and deciduous forest where water availability is relatively higher, or sclerophyllus shrublands in dryer regions (Derneği 2010). Altogether the area is subjected to the typical Mediterranean type climate, with cool and wet winters followed by hot and dry summers (Blondel et al. 2010). Annual average temperatures may vary between 8-19^{o}C, and annual precipitation from 300-900 mm (WWF 2013b,c,d,e,f), although the Mediterranean basin is known for holding very distinct local microclimates, and the climatic conditions can be very unpredictable within one year and/or during successive years (Blondel et al. 2010). During autumn/winter it is quite common for torrential rainfalls to occur that can lead to violent floods, while in the summer the availability of surface water is very low and severe droughts can last for up to two months (Blondel et al. 2010).

The topography of the region certainly contributes for the climatic variability. The region contains sand dunes, cliffs and salt lagoon systems along the coastal strip, wide plains and plateaus, deep river valleys and extensive mountain chains, not to mention the many island systems (Blondel et al. 2010;WWF 2013b,c,d,e,f). In terms of the geological background, the region is predominantly composed of Mesozoic and Quaternary sedimentary rock with some extents such as the central plateau between Portugal and Spain (the Iberian massif) and areas in the Balearic Islands constituted by older crystalline rock (WWF 2013b,c,e,f). Also important to mention is the active Etna Volcano in Sicily, and consequently the volcanic rock that characterizes that area (WWF 2013d). The Mediterranean basin has a complex geological history, and the region has gone through many great scale tectonic and orogenic events, one of the most recent being the Messinian Salinity Crisis around 5.5 million years ago (Govers 2009; Blondel et al. 2010).

With such a complex geographic setting, the Mediterranean basin harbours an astonishing biodiversity. It was one of the first regions to be recognized into the 25 Global Biodiversity Hotspots (Myers et al. 2000), of which it is the third richest in terms of plant diversity (Mittermeier et al. 2004). The north-western Mediterranean vegetation is composed of a mix of evergreen, deciduous and conifer tree species, like wild olive (*Olea europaea*), oak trees (*Quercus* spp.) and pine trees (*Pinus* spp.) (WWF 2013c). Shrublands, or “maquis”, include species such as *Myrtus communis*, *Juniperus phoenicea* and *Chamaerops humilis*, while in river beds we can found *Tamarix* spp., *Fraxinus angustifolia*, *Salix* spp., among many others (WWF 2013c,f). The region includes many centres of plant diversity and endemism rates go from 10 to over 20 %. The Balearic Islands host 180 endemic plant species (out of 1450), while Sicily is home for 310 endemics (out of 2700 species) (WWF 2013d, f).

Faunal richness is also high in north-western Mediterranean. While mammals and birds are mostly of Eurasian and African origin, the amphibian, reptile and freshwater fish fauna present considerable rates of endemism (Derneği 2010; Cox et al. 2006). Rivers in the region harbour unique fish species like *Aphanius iberus*, *Anaecypris hispanica* and *Barbus microcephalus* (WWF 2013b,c). In terms of amphibians, we have the examples of the Mediterranean tree frog (*Hyla meridionalis*), the Western spadefoot toad (*Pelobates cultripes*) and the Iberian ribbed newt (*Pleurodeles waltl*) (Gasc et al. 1997; Cox et al. 2006), and for reptiles we have examples such as of the Iberian worm lizard (*Blanus cinereus* - only member of the amphisbaenians found in Europe), the Mediterranean turtle (*Mauremys leprosa*), many species of lizards (*Iberolacerta* spp., *Podarcis* spp., *Psammodromus* spp.) and of snakes/vipers (*Natrix* spp., *Vipera* spp.), among many other examples of herpetofauna (Gasc et al. 1997; Cox et al. 2006). The region is also home for emblematic endemic species of mammals such as the Iberian lynx (*Lynx pardinus*) and the rare Sicilian shrew (*Crocidura sicula*), as well as important populations of otter (*Lutra lutra*) and European polecat (*Mustela putorius*) (WWF 2013b,c,d,f). Finally, bird diversity is also tremendous, and the region constitutes an important wintering and nesting ground for countless species. Important populations of endangered raptor species can be found in the area, like the black vulture (*Aegypius monachus*), griffon vulture (*Gyps fulvus*) and imperial eagle (*Aquila heliacal*) (WWF 2013c,f). Another endangered species present in the region is the great bustard (*Otis tarda*) (WWF 2013b). Some delta areas can harbour up to 30,000 pairs of water birds that include many ducks (*Anas* spp.), gulls (*Larus* spp.), terns (*Sterna* sp.) and countless other species (WWF 2013c). The region even holds the only European populations of flamingos (*Phoenicopterus ruber*) (WWF 2013c,e).

The Mediterranean basin is one of the richest regions in terms of biodiversity, but also one of the most threatened. For several millennia, the region has sustained some of the greatest civilization in History (Derneği 2010). So the landscape has been severely modified and nowadays very little pristine habitat spots still exist (Blondel et al. 2010; Derneği 2010). Then again, this has given time for the fauna and flora of the region to adapt to the new altered environmental settings, and some species are now dependent on the coexistence with humans, mainly in agricultural systems (Cox et al. 2006; Blondel et al. 2010). The greatest threat to biodiversity has been, without a doubt, the continuous destruction, fragmentation and modification of habitat, whether it is for agricultural use, urban or industrial development. For example, the intensification of agricultural practices has been responsible for the loss of wetlands that are essential for the survival of amphibian species (Ferreira & Beja in press). The entire Mediterranean basin is home for more than 400 million people, and future predictions show an additional increase. Furthermore, the Mediterranean countries are international tourism destinations, receiving around 200 million people per year, mainly along the coast line (Cox et al. 2006; Cuttelod et al. 2008). So establishing conservation efforts is always an arduous endeavour due to the variety of conflicts it can generate (Derneği 2010). Another major issue is water availability. The combination of dry summers, unsustainable farming practices and construction of river dams, result in dried up river beds that affect freshwater habitat species, and desertification, degradation and erosion of the land (60% of Portugal for example faces a moderate risk of desertification) (Cox et al. 2006; Cuttelold et al. 2008). All of the above pressures will become even more problematic as a result of global climate change, and forest fires and severe droughts will increase in frequency and severity (Cuttelold et al. 2008).

The Mediterranean basin is considered as one of the Global Biodiversity Hotspots (CI 2013b), and fortunately in the last decades, efforts made by various institutions, from the European Union to more local forms of government, not to mention NGOs, have been responsible for the emergence of numerous conservation sites that include the Natura 2000 sites, national and regional wildlife parks and reserves (Cuttelold et al. 2008). A good example is the Doñana National Park in Spain, which holds the remaining wild population of the Iberian lynx. Additionally the test site holds one AZE site (AZE 2013) and many Ramsar sites (Ramsar 2013) and IBAs (BirdLife International 2013). Conservation sites alone do not ensure the protection of biodiversity, but together with species specific actions, continuous research and monitoring, as well as better education and communication with the general public, many species have been saved from extinction (Cuttelold et al. 2008).

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User Questionnaire

You can find an on-line version of this questionnaire here:

http://www.diversity2.info/testsites/ppd/uq/

1. How do you judge the overall relevance and quality of the presented products?

2. Please comment shortly on the presentation of the methods and results

3. What further products (level one) would be interesting to you to have?

4. Do you have any suggestions concerning possible "second level" products, which are supposed to show the results in a more abstract and/or synthesised way?