Food and Agriculture Organization
of the United Nations

USER MANUAL

AGRICULTURAL STRESS INDEX SYSTEM / COUNTRY-LEVEL

MODULE II

IMPLEMENTATION OF COUNTRY-LEVEL ASIS

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IMPLEMENTATION OF COUNTRY-LEVEL ASIS

BY

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PANAMA CITY, 2023

Hernández, T. 2023 *User Manual Agricultural Stress Index System/Country-Level* – Module II: Implementation of country-level ASIS. Panama city, FAO. https://doi.org/10.4060/ca2247en

ISBN 978-92-5-137439-9

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Acknowledgements

This work is undertaken as part of the ACToday Columbia World Project, Columbia University in the City of New York. The valuable inputs of the International Research Institute for Climate and Society of the Columbia Climate School and translation by Ezequiel González Camaño are especially recognized.

Foreword

Eighty percent of the world's agriculture is rainfed, making it highly vulnerable to climate fluctuations and stresses, such as those brought about by climate variability and change. Many parts of the world, especially the poorest and most vulnerable rural communities, have experienced a significant increase in climate variability over the past decade, which has led to more frequent weather extremes such as droughts. Because millions of farmers around the world, particularly smallholder and subsistence farmers, depend upon agriculture for their livelihoods, such rainfall shortages can impede food production, access to financial and natural assets, and the ability to recover in subsequent crop seasons. This means that climate variability in agriculture not only affects the availability of the food and nutrients farmers consume, but also their income and broader resilience in the face of these changes. Variability in rainfall and temperature can also have adverse effects on livestock and the pastoralists whose livelihoods depend upon it.

Thus, all development planning and practice in the agriculture and related sectors need to take climate variability and long-term climate change into account. Climate services, such as early warning and monitoring systems for extreme events, can contribute to the alleviation of a range of climate-sensitive development challenges, including those related to agricultural production and food and nutrition security. Furthermore, their integration and reinforcement within public policies, processes, programs, and plans can strengthen disaster risk reduction and management, as well as underpin resilience and adaptation to climate variability and change.

In recognition of this, the Food and Agriculture Organization of the United Nations (FAO) monitors the evolution of drought and other meteorological phenomena, with special attention to the potential impacts on agriculture and food and nutritional security. Beyond this, the FAO also strengthens early warning and monitoring systems for drought in agriculture by supporting governments around the world to implement the Agricultural Stress Index System (ASIS). The ASIS tool provides continuous satellite monitoring data (every 10 days), which allows quick and timely decisions to be made regarding the risk of drought. Once calibrated to the conditions of each country as Country-Level ASIS, it monitors agricultural areas and pastures to detect periods of water stress in vegetation, and evaluates the severity (intensity, duration, and spatial extension) of agricultural drought during crop development. And, perhaps most critically for decision-makers, the system simulates and automates the analysis that an expert in remote sensing would undertake and simplifies the interpretation and use of the data for users who are not remote sensing experts.

This manual is part of a series of technical documents that provide the information you need to set up, customize, understand, and ultimately use Country-Level ASIS. It was developed in close collaboration with the International Research Institute for Climate and Society of the Columbia Climate School through the Adapting Agriculture to Climate Today, for Tomorrow (ACToday) Columbia World Project and the FAO office in the Islamic Republic of Iran through the Integrated Programme for Sustainable Water Resources Management in the Urmia Lake Basin project, financed by the government of Japan. We hope that this system will be very useful to increase the capacity for preparation, prevention, mitigation and contingency planning in the face of drought, and to reduce losses in agriculture and the risk of food insecurity.

Adoniram Sanches
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FAO Subregional Office for Mesoamerica
Food and Agriculture Organization of the United Nations

Fuente: "Source of Administrative boundaries: The Global Administrative Unit Layers (GAUL) dataset, implemented by FAO within the CountrySTAT and Agricultural Market Information System (AMIS) projects"

1. Introduction

The Agricultural Stress Index System (ASIS) is a tool developed globally by the Food and Agriculture Organization of the United Nations (FAO), with the support of the European Union (EU) through the Improving Global Governance for Hunger Reduction programme.

The ASIS aims to detect, with the use of satellite data, those agricultural areas with a high probability of suffering from water stress – drought. It was developed with the technical support of the Flemish Institute for Technological Research (VITO), the European Commission Joint Research Center (JRC) and the University of Twente in the Netherlands.

ASIS is a development of the office of Climate Change, Biodiversity and Environment (OCB) and the Markets and Trade Division (EST/GIEWS) of FAO.

Based on the global tool, a country-level ASIS version was developed that adds new functionalities with the ability to adapt to local conditions in a given region or country, allowing agricultural drought monitoring at regional, national or subnational scales using customized data on land cover, administrative units and crop phenology.

With the Country-level ASIS, it is possible to define the optimal settings for the country data of administrative units and land use; the period of analysis, phenology data (SOS, MOS, EOS) and other parameters for the generation of drought indicators (weight according to VHI, Kc), adjustments in the output maps, among other operations.

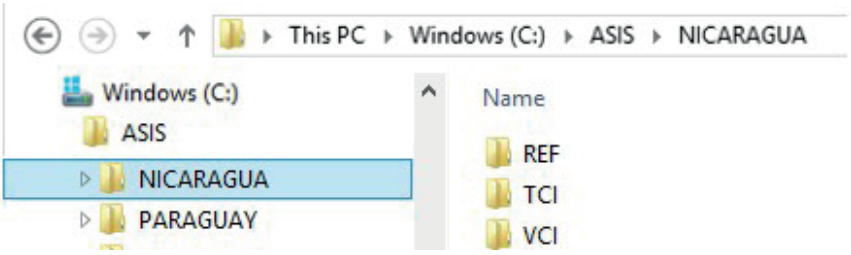
This document provides the description of the Country-level ASIS and the fundamental procedures for the different components or modules of the system.

2. Configuration of a project with the Country-level ASIS

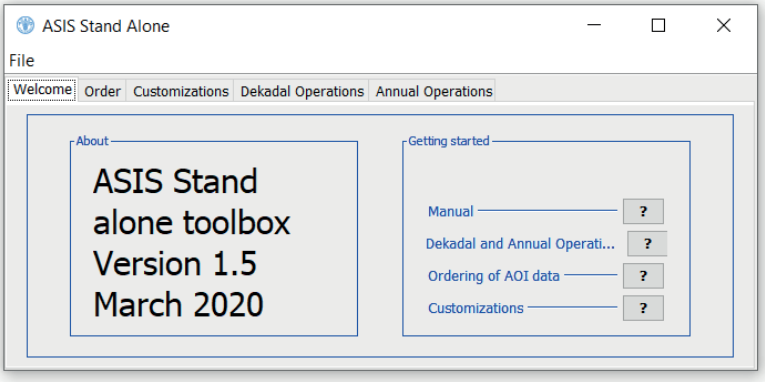
2.1. Creation of a new project

To start a new country or regional project from scratch:

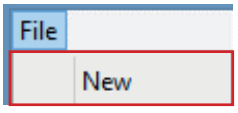
- Copy the project folder – previously obtained from a data order for ASIS – to the path defined by the user. As an example, select the project folder corresponding to NICARAGUA, located in the path C:\ASIS\NICARAGUA.
- Verify that the project folder contains the input directories REF, TCI, VCI and their respective subdirectories and files for the country or area of interest.



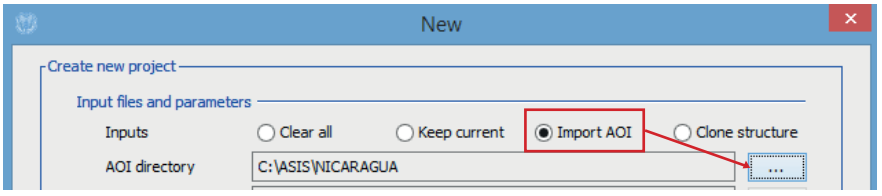
- Open the **Country-level** ASIS by double clicking on the executable file Asis.jar located in the installation directory.



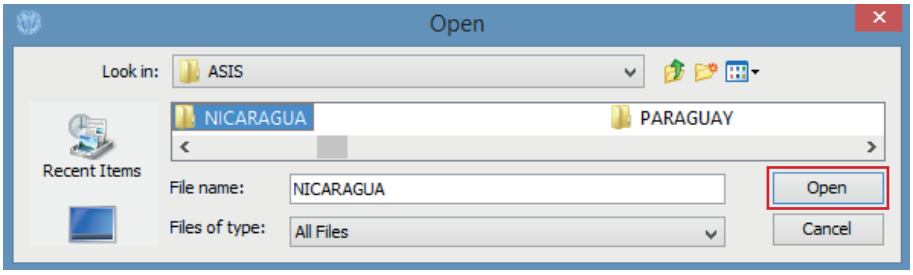
- Go to the **File** menu and select the **New** command to create a new project and/or reset the application status for a new country or area of interest.



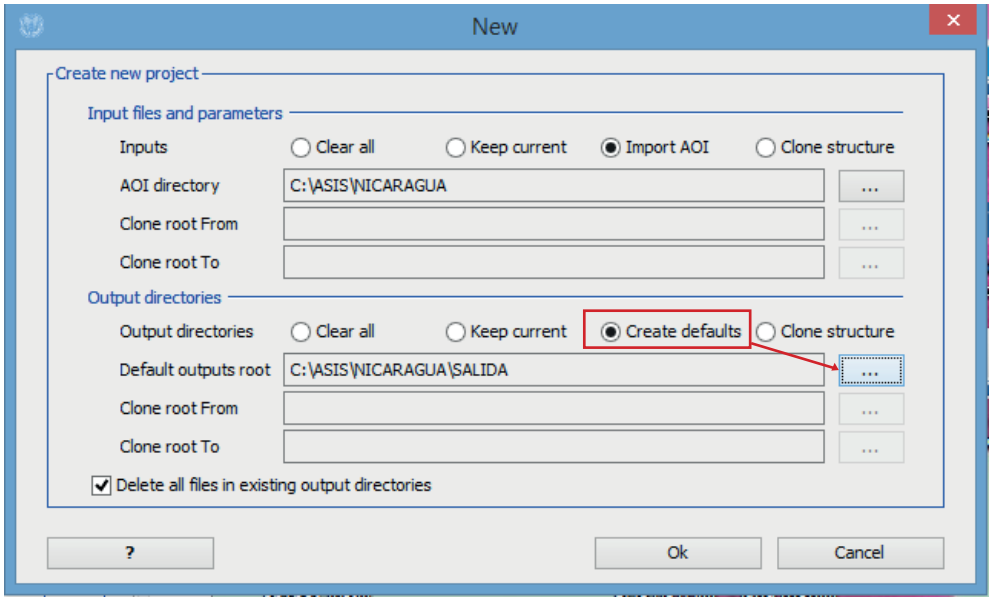
- Configure the options for the input files and parameters. Select Import AOI (Import Area of Interest), and locate the project folder by clicking on the ... button.



- In the "Open" window, select the project folder and click the Open button. In this way the directory of the area of interest – "AOI directory" – is defined. In this case, it corresponds to NICARAGUA.

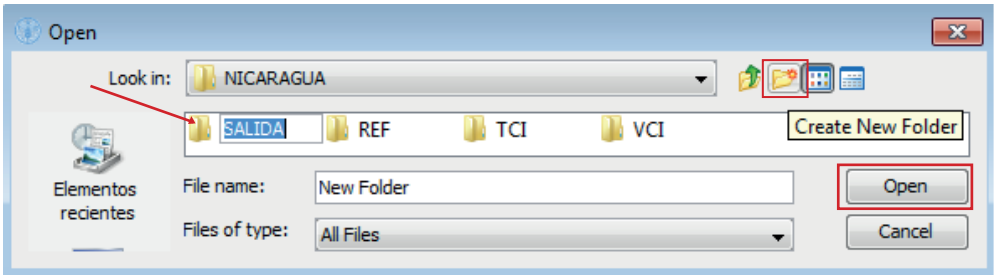


- Configure the output directories by selecting the **Create defaults** option and then defining the output directory path by clicking on the ... button.



- When creating a project from scratch, it is necessary to create a new output directory. In the "Open" window, click on the **Create New Folder** icon and name the new folder **OUTPUT.**
- Select the created folder and click the **Open** button. In this way the output root directory is defined. For the example, it was set to the path C:\ASIS\NICARAGUA\OUTPUT
- ASIS creates the various output subdirectories for the different operations according to the default directory structure, described in section 5 below.

2. Configuration of a project with the Country-level ASIS



All the options available for the **File → New** are described below. The options described previously are the most commonly used.

Description of Country-level ASIS input files and parameters

- **Clear all**: all input parameters, files, directories are defined blank, which means that the user must explicitly specify them manually.
- **Keep current:** leaves all input parameters, files, directories as currently specified.
- **Import AOI:** assumes that the user obtained a dataset or file containing all input data properly organized with the default input data structure.

Description of output directories

- **Clear all:** all output directories are set to blank, which means that the user must explicitly specify them manually.
- **Keep current:** leaves all output directories as currently specified.
- **Import AOI:** creates a default directory structure (Tables 3 and 4) on disk (if necessary) and populates the output directories according to this structure. In this case, a root directory must be specified for this structure, which is recommended to be located inside the project directory.
- The check box ☐ Delete all files in existing output directories allows you to delete files in the specified output directories to the extent that they exist. You select this option, for example, when you want to import a new AOI directory previously created, but want to clean up all existing output directories.

2.2 Layout of auxiliary data sets

General features

The main auxiliary data sets that can be customized with country data are as follows:

- **Classes IMG:** categorical raster file in IMG format with land use classification. This file can be a single file for the whole country or multiple class raster files. The Country-level ASIS allows working with more than one raster with crop distribution, one for each separate crop season. This raster contains its metadata file (*.hdr).
- **Regions IMG:** categorical raster file in IMG format of administrative units. Three levels are used: GAUL0 - country boundary, GAUL1 - region or province/department, GAUL2 - municipality/district or another unit. If custom country data is available, it is necessary to rename it to: ADM0.img, ADM1.img and ADM2.img, each with its metadata (*.hdr) to facilitate the execution of the tool.

- **SHP file (0,1,2):** vector files in shape format, corresponding to the same administrative units as the Regions IMG files (GAUL0, GAUL1, GAUL2). All files that make up this standard format must also be renamed to ADM0, ADM1 and ADM2. Three are indispensable: *.shp, *.shx and *.dbf.
- **Weights TXT:** text file in CSV or TXT format, which specifies the combination of region and class to create the Vegetation Health Index (VHI) weighted images. It can carry any name that identifies it.
- **SOS/MOS/EOS TXT:** fixed phenology text file in CSV or TXT format, specifying the start (SOS), maximum (MOS) and end (EOS) dates of the crop season by region and/or class. One TXT file per crop season is required. It can carry any name that identifies it. Example: PHE_s1.csv for season1, PHE_s2.csv for season 2.
- **Kc-Types TXT:** text file in CSV or TXT format, containing the allocation of crop coefficient (Kc) types by region and/or class. It can carry any name that identifies it.
- **Weights per type TXT:** text file in CSV or TXT format, which specifies the Kc by type for the beginning (SOS), maximum (MOS) and end (EOS) of the crop season. It can carry any name that identifies it.

Organization of auxiliary data within the Country-level ASIS project

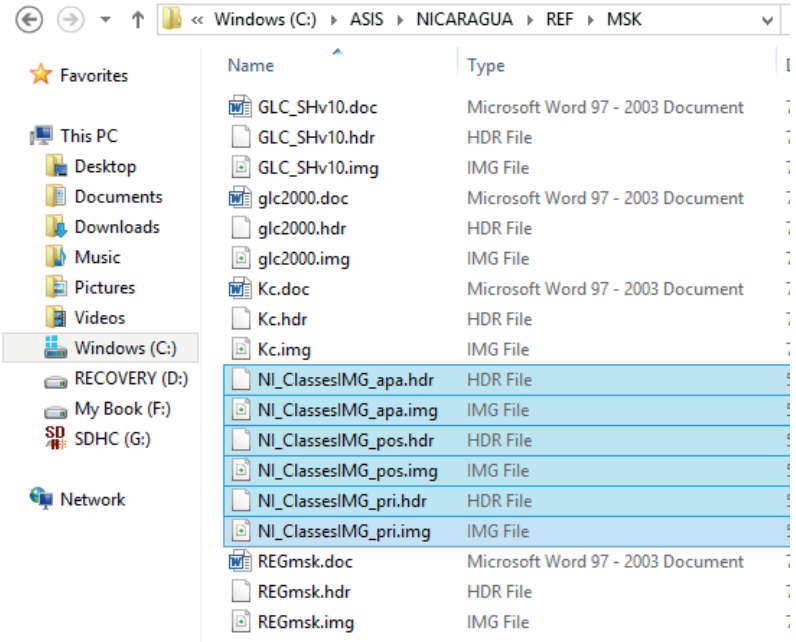
Table 2 in Section 5, "Structure and organization of the data within Country-level ASIS", describes the structure of the input data folders. Based on this structure, the auxiliary data sets for the example should be copied into the corresponding paths.

Auxiliary data set	Required path
Classes IMG	C:\ASIS\NICARAGUA\REF\MSK\
Regions IMG	C:\ASIS\NICARAGUA\REF\REG\
SHP file (0,1,2)	C:\ASIS\NICARAGUA\REF\VEC\
Weights TXT	C:\ASIS\NICARAGUA\REF\MSK\
SOS/MOS/EOS TXT	C:\ASIS\NICARAGUA\REF\PHE\
Kc-Types TXT	C:\ASIS\NICARAGUA\REF\PHE\
Weights per type TXT	C:\ASIS\NICARAGUA\REF\PHE\

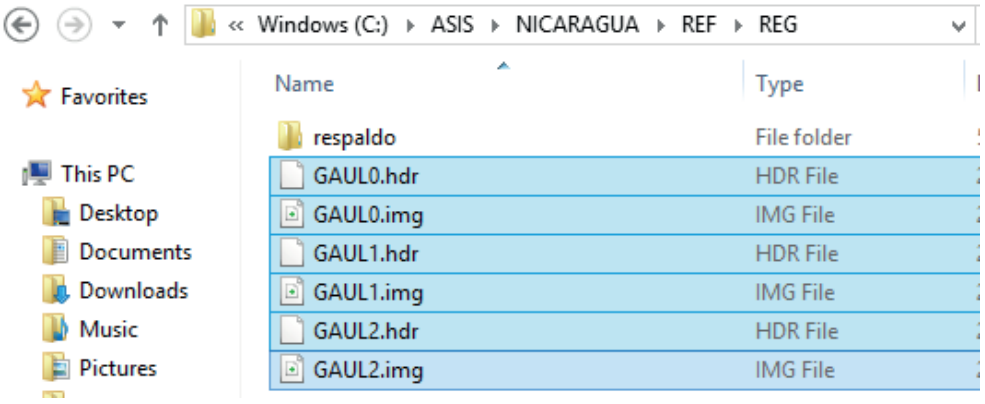
2. Configuration of a project with the Country-level ASIS

Example: Organization of auxiliary data sets for the project

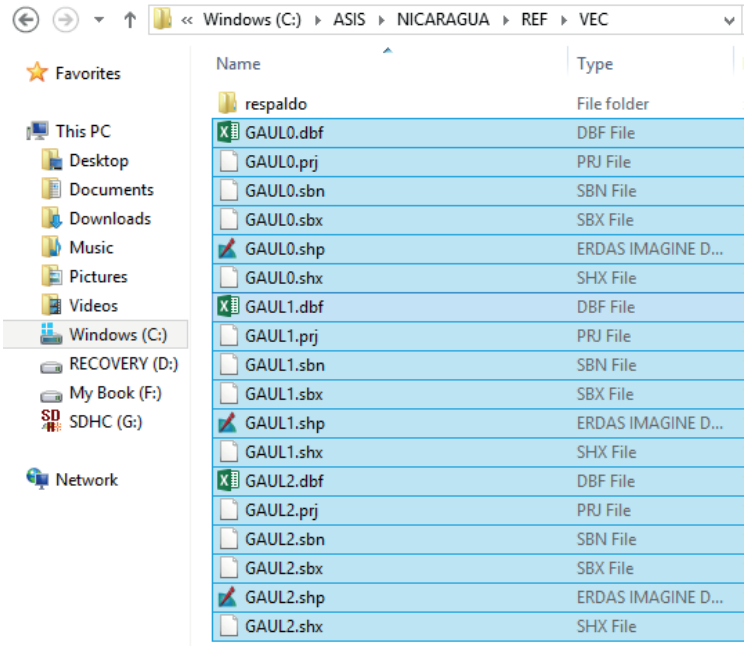
- For the Nicaragua project, there are three (3) class raster files, one per crop season. These are located in the project path C:\ASIS\NICARAGUA\REF\MSK



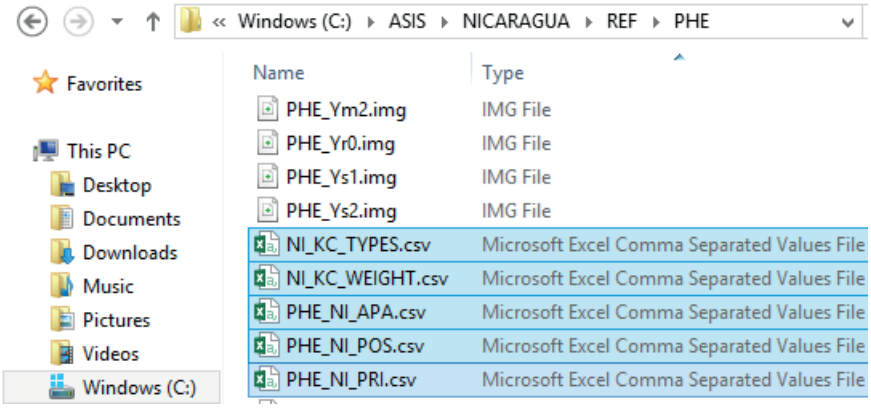
- For administrative units, it is recommended to back up the global data before replacing it with the country data. Regions IMG raster files are located in the project path: C:\ASIS\NICARAGUA\REF\REG



- Similarly, for vector data of administrative units, it is recommended to back up the global data before replacing them. Vector files are located in the project path: C:\ASIS\NICARAGUA\REF\VEC



- There is a fixed phenology table (SOS/MOS/EOS TXT) per crop season. All tables related to phenology calculations (SOS/MOS/EOS TXT, Kc-Types TXT, Weights per type TXT) are located in the project path: C:\ASIS\NICARAGUA\REF\PHE



2.3. Saving and opening a project

To save and open a country or region project:

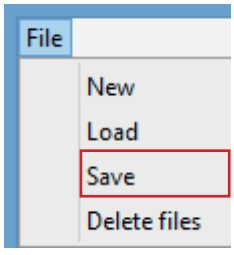
The Country-level ASIS stores on shutdown the current state and settings inside the session (Asis.asi) as well as the configuration (Asis.cfg) files, located in the installation directory.

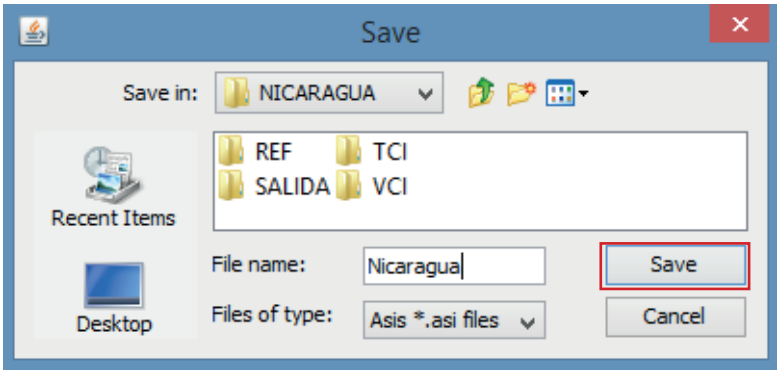
When the tool is (re)started, the session state is restored, allowing you to continue where you stopped.

It is possible to save the current session state of the tool in a file (.asi) with the settings and configurations of all panels and subpanels. Typically, these **Save/Open** functions are used when working on different projects, with different areas of interest and/or different parameter settings.

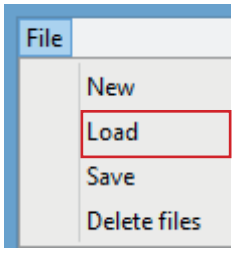
To perform the Save and Open functions:

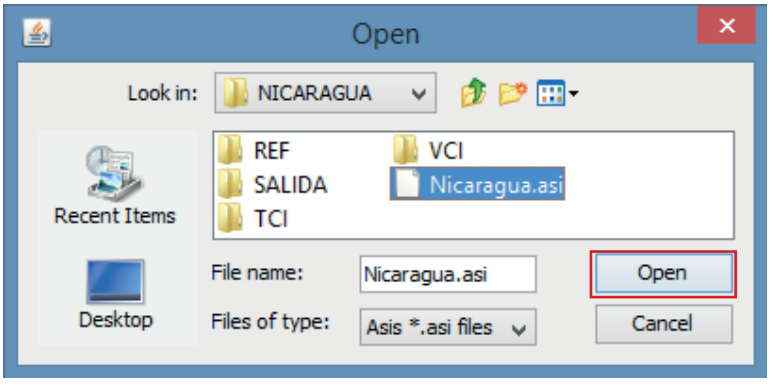
- Go to the **File** menu and select the **Save** command to save the current session.
- In the "Save" window, define the path and file name (.asi) and click the **Save** button.





Go to the **File** menu and select the **Load** command to open a project saved as an (.asi) file. This function restores the status and settings saved in that file.





2.4. Deleting files

To delete files in output directories:

The different Country-level ASIS operations generate output files (e.g. IMG/HDR, RUM, PNG, CSV) in the directories specified by the user or default directories of the tool.

Table 3 (see section 6).

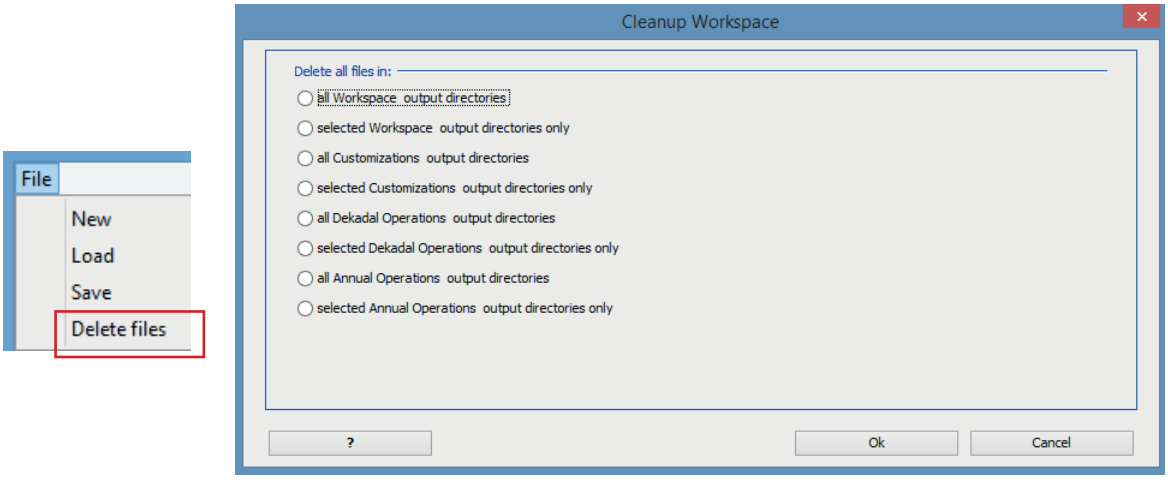
The **Delete files** function facilitates the deletion of these output files and presents a list of options for deleting the results of the various Country-level ASIS operations:

Description of disposal options

- **all Workspace output directories:** deletes all output directories. It is recommended to select this option after changing any common parameter to avoid mixing output files created under previous configurations.
- **selected Workspace output directories only:** deletes only the selected output directories.
- **all Customizations output directories:** deletes all output directories for Customizations operations.
- **selected Customizations output directories only:** deletes only the output directories selected for Customizations operations.
- **all Dekadal Operations output directories:** deletes all output directories of all Dekadal Operations.
- **selected Dekadal Operations output directories only:** deletes only the selected output directories of Dekadal Operations.
- **all Annual Operations output directories:** deletes all output directories of Annual Operations.
- **selected Annual Operations output directories only:** deletes only the selected output directories of the Annual Operations.

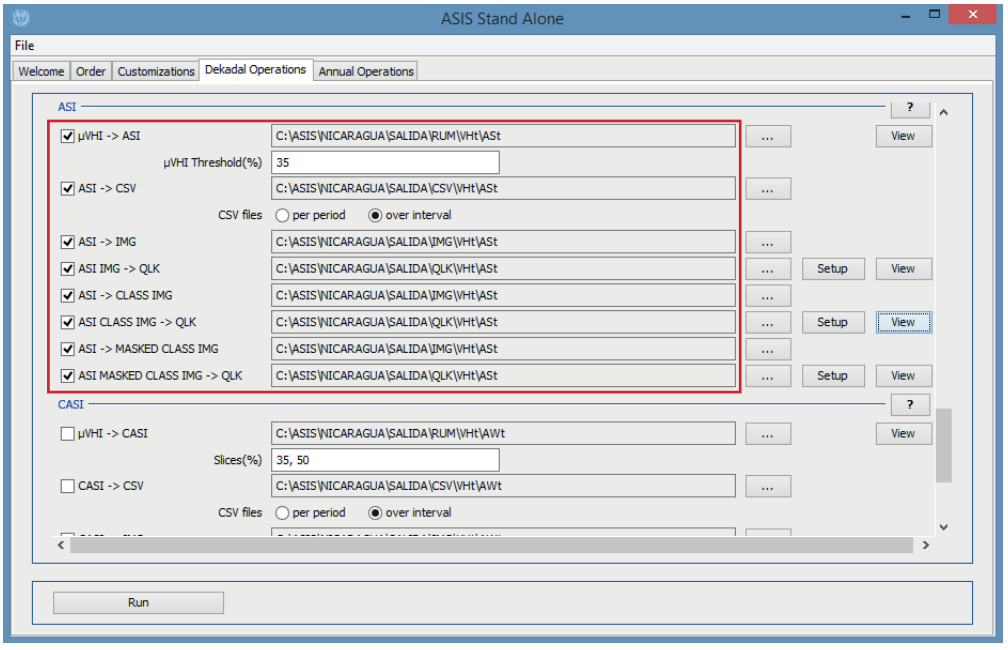
NOTE: It should be noted that for options that delete selected directories, the corresponding checkboxes in the Customizations, Dekadal Operations and/or Annual Operations panels must first be selected.

- Go to the **File** menu and select the **Delete files** command to open the "Cleanup Workspace" window.
- Select the appropriate option to delete the output directories.



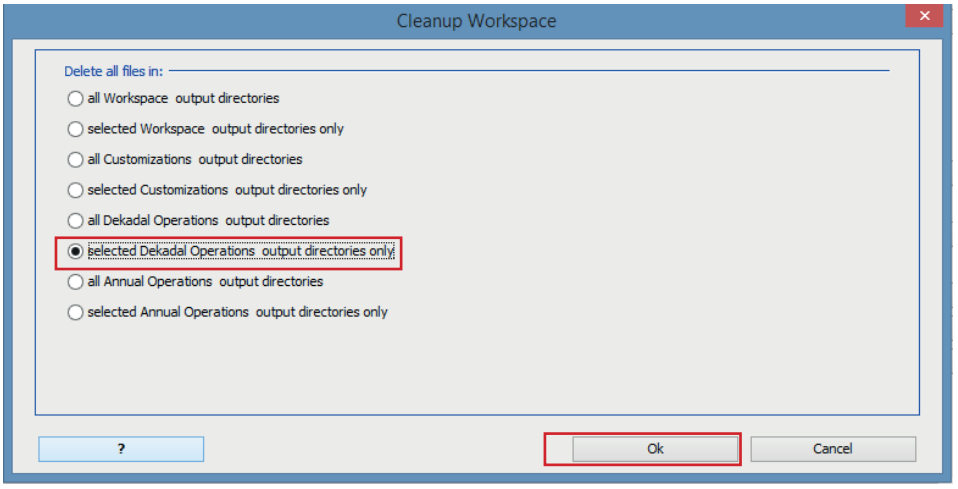
Example: Deleting files from selected output directories in dekadal operations

- In the "Dekadal Operations" panel, select the output files to be deleted by checking the corresponding checkboxes. In this example, we want to delete the output files of the entire ASI block.



WARNING: Make sure that you really want to delete these files. The tool does not provide a security warning, nor does it allow you to undo the changes.

- Go to **File → Delete files**
- In the "Cleanup Workspace" window, select the option "selected Dekadal Operations output directories only".
- Click **OK**. The deletion of the files will start immediately. You can check that they have been deleted using Windows Explorer.



3. Customizations within Country-level ASIS

Customizations panel overview

The "Customizations" panel contains the functions for creating auxiliary IMG raster files, which influence operations by dekad or year. Instead of using the default settings, the following data can be customized according to the user's needs:

- Vegetation Health Index (VHI) weighted images
- Fixed phenology images (SOS/MOS/EOS)
- Images weighted by phenology types according to crop coefficient (Kc)
- Crop season progress images

The panel is subdivided into five (5) blocks: the general block where the common input files for all operations are defined; and the four procedures previously mentioned.

Buttons on the customization operation panel	
?	The help buttons "?" are located on the right side of the title of each block. They open the corresponding section of the Country-level ASIS user manual for the selected block (in English).
...	The browse buttons "..." are used to select/modify both input directories and files as well as output files. They provide a view to the default folder defined when the project is created; however, it is allowed to modify the path of the files.
Setup	The "Setup" configuration buttons are available for QLK output files. They allow you to modify the general layout and content of the maps. Another window "QLK parameters" opens where you can define the different parameters for the QLKs as appropriate.
View	The "View" buttons appear for QLK type file folders. Clicking the button opens an "Open" window that displays all files within the output folder. When one of these files is selected and Open is clicked, the display window with a map appears.
Run	The "Run" buttons are used to execute the operations. The procedures are executed independently, so each has a separate "Run" button. When running, a task panel will appear showing the status and progress of the individual steps.

Customizations panel input and/or output file types	
IMG	Binary format raster file (*.img), used for both input and output files. This file is accompanied by its respective metadata file (*.hdr). It can be used with spatial processing software (ENVI, IDRISI, ERDAS, QGIS, ArcGIS...).
CSV (Comma separated values)	Comma-separated ASCII-TXT text file, which specifies the input data by administrative region and/or by class.
QLK (Quicklook)	Graphic file (.png format) that provides an overview of the progress of the agricultural season represented as a map. It has configurable elements: margins, map size, title, symbology and legend, notes, logos, outline of administrative regions, etc. These files weigh less than 1 MB and are convenient for use in documents, presentations, newsletters, web sites.

3.1 Customization blocks

"Customizations" Panel

"Common" block

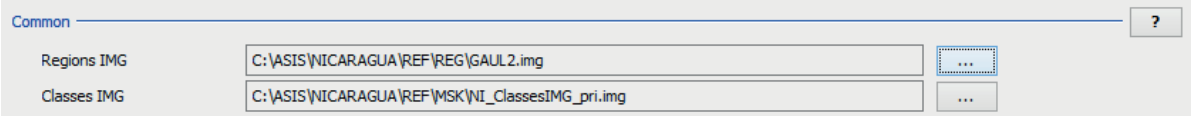
In the common block of the Customizations panel, the parameters common to all the procedures of the subsequent blocks must be specified. All of them require the input of at least one of the following two IMG rasters:

Input raster	Default path and file for the project
Region IMG	C:\ASIS\NICARAGUA\REF\REG\GAUL2.img
Classes IMG	C:\ASIS\NICARAGUA\REF\MSK\ GLC_SHv10.img

When the new project is created, both input files are routed to the default raster. If the country has its own custom raster of administrative regions and land use classes, it is recommended to place them in the default paths. For administrative unit files only, remember to assign as file names ADM0, ADM1 and ADM2 for both IMG raster and SHP vector files (see 2.2).

⚠ **WARNING:** It should be noted that when modifying these two input raster files in the Customizations panel, the changes are automatically reflected in the common blocks of the dekadal and annual operations panels. The same happens if you change these files from the other panels, those modifications are translated directly to the Customizations panel.

NOTE: When selecting a CSV file as an input file, you must choose "All Files" as the file type in the Open window in order to view it.



Regions IMG

Specifies the path and categorical raster file in IMG format of administrative regions. Each pixel carries the code of an administrative region. For example: ADM0: country, ADM1: province, ADM2: municipality.

Classes IMG

Specifies the path and categorical raster file in IMG format with the land use classification. This file must be BYTE type (0-255) with the value "0" reserved for the class "Unclassified". Each pixel must contain the code of one class following a fixed legend, for example: 1 = rice, 2 = corn, 3 = beans.

"Create/Adapt IMGs with fixed SOS/MOS/EOS" block

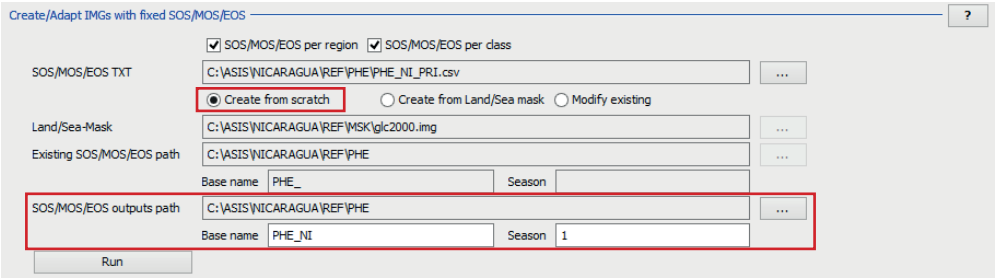
This block is used to create new fixed phenology rasters or to adapt the regional phenologies included with the Country-level ASIS. Phenology is assumed to remain fixed over the years.

There are three (3) options:

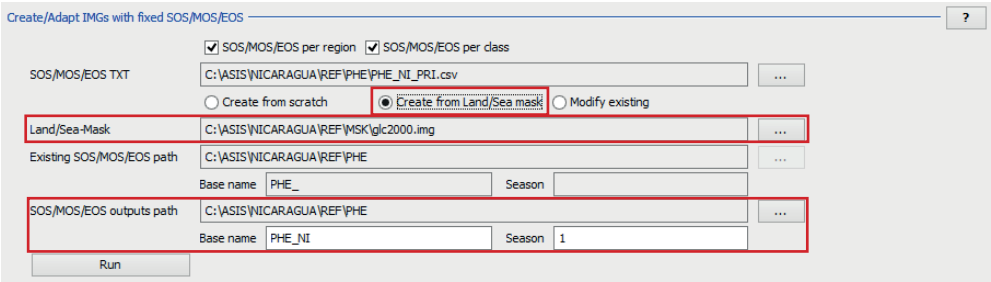
- **Create from scratch:** Create the phenology raster(s) from scratch from the phenology table(s). In case you have more than one crop season, it is important to have a phenology table for each one. The tool is run for each crop season separately, assigning a different number to each crop season, from 1 onwards.
- **Create from Land/Sea mask:** create the phenology raster(s) from a Land/Water mask raster file.
- **Modify existing:** modify the existing phenology raster included with the tool, which by default correspond to two agricultural seasons per year. It is suggested to keep a backup copy of the original files provided.

Depending on the selected option, the block controls are activated or deactivated.

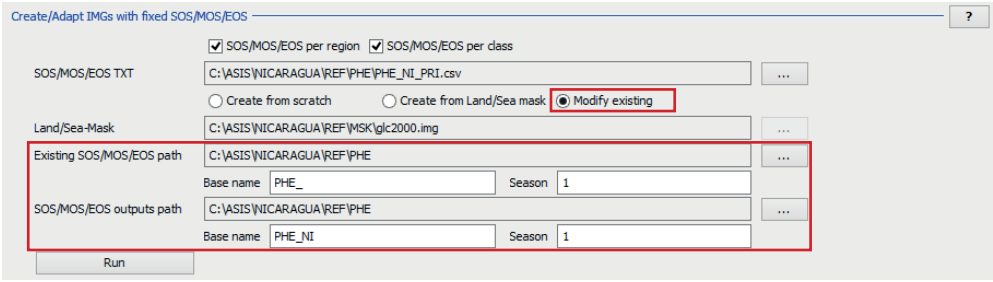
Option 1: Create from scratch



Option 2: Create from Land/Sea mask

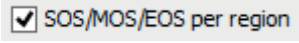


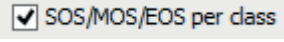
Option 3: Modify existing



SOS/MOS/EOS TXT

Specifies the fixed phenology path and file. This table contains the Region_ID and/or Class_ID, SOS, MOS and EOS columns, where dates are expressed in terms of dekad in the range [1-36]. The parameters of the TXT file define the phenology of the crop season different from that of the original images where the phenology varies per pixel.

If you have the detailed data by region, click on the checkbox 

If you have the detailed data per class, click on the checkbox 

Both boxes are checked if the table contains detailed data by both administrative unit and land use class.

Land/Sea-Mask

Specifies the path and raster file used as a mask of water bodies and land surface to generate the phenology raster(s).

It is enabled only if the second option—"Create from Land/Sea mask"–is selected.

Existing SOS/MOS/EOS path

Defines the path of existing phenology files derived from the global ASIS2. It is activated only if the third option "Modify existing" is selected.

In this case, the "Base name" of the files, which by default is PHE_, and the agricultural season number must be entered in the text box.

SOS/MOS/EOS outputs path

Defines the path of the output files for the phenology IMG raster. A "Base name" and the "Season" number, parameters used by the tool to name the output files, must be specified. If you have several crop seasons, the tool should be run for each one independently, changing the crop season number.

Three (3) IMG images of phenology are produced per crop season (SOS, MOS, EOS) with all dekads translated to a range of 3 years [1-108].

"Create Kc-types IMG for PHENOcum" block

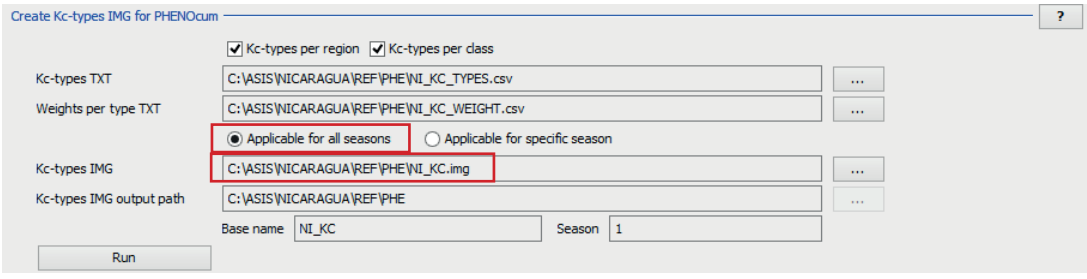
This block allows the creation of weight images or weighting by phenological types according to crop coefficient (Kc), required for the calculation of the average of the Vegetation Health Index (μVHI).

Essentially two input files are required, previously prepared according to procedures described in the country-level ASIS user manual Module I: Preparation of geographic data for Country-level ASIS.

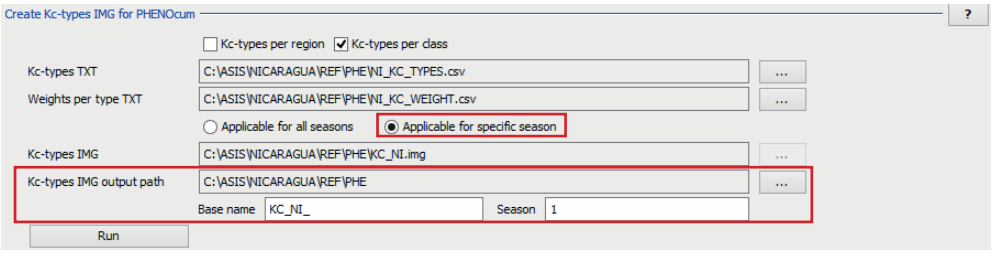
There are two (2) options:

- **Applicable for all seasons:** applicable to all crop seasons. Kc values are assigned equally across all cropping seasons using a single output IMG raster file.
- **Applicable for specific season:** applicable to a specific crop season. This option is used if you have information on different Kc coefficients per crop that vary for different crop seasons. An IMG Kc raster file is then generated for each crop season.

Option 1: Applicable for all seasons



Option 2: Applicable for specific season



Kc-Types TXT

Defines the path and text file in CSV or TXT format, containing the assignment of crop coefficient (Kc) types by region and/or class.

If you have the detailed data by region, click on the checkbox ☑ Kc-types per region

If you have the detailed data per class, click on the checkbox ☑ Kc-types per class

Both boxes are checked if the table contains detailed data by both administrative unit and land use class.

Weights per type TXT

Defines the path and text file in CSV or TXT format that specifies the Kc by type for the start (SOS), maximum (MOS) and end (EOS) of the crop season. It is related to the Kc types table (Kc-Types TXT), so the type codes must correspond in both files.

Kc-types IMG

Sets the path and name of the output IMG raster for the Kc type. This file is the single file that is generated if option 1, "Applicable for all seasons", is chosen.

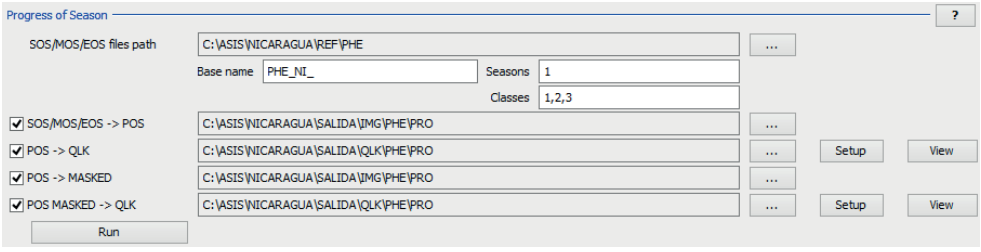
Kc-types IMG output path

Sets the path of the output IMG raster files for the Kc type by crop season. These files have the base name defined in the "Base name" text box and the crop season number in the "Season" text box.

"Progress of Season" block

The crop season progress operations allow the creation of IMG raster files and QLK images for all dekads of the year (1..36), based on the SOS and EOS raster files. The progress of the crop season evolves between 0% (not started) and 100% (finished).

These images help to interpret the indices by dekad μVHI,y,t,s, μ*VHI,y,t,s and ASIy,t,s, the results of which become relevant as soon as the season has progressed significantly.

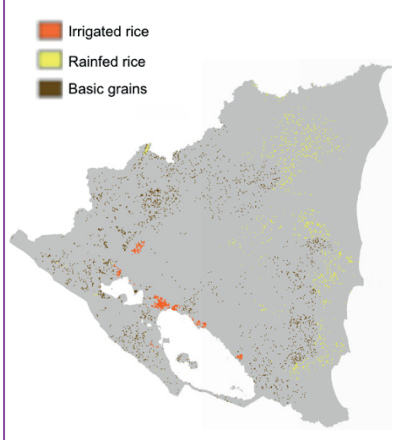


SOS/MOS/EOS → POS	
Generates the IMG raster files of the progress of the crop season – POS. The following parameters must be set: the path of the output files, the base name, the number of the crop season and the land use classes.	
Name format:	pro_mNN_dd_s1, _s2... (dd: dekad 1..36)
POS → QLK	
Generates the POS raster QLK graphic files by dekad for the entire study area and all land use classes for each cropping season.	
Name format:	pro_mNN_dd_s1, _s2... (dd: dekad 1..36)
POS → MASKED	
Produces IMG raster files of crop season progress – POS – masked by class for 36 dekads per year and crop season.	
Name format:	pro_mCM_dd_s1, _s2... (C: land use class ID)
POS MASKED → QLK	
Generate POS MASKED raster QLK graphic files by dekad for the entire study area and by land use class.	
Name format:	pro_mCM_dd_s1, _s2... (C: land use class ID)

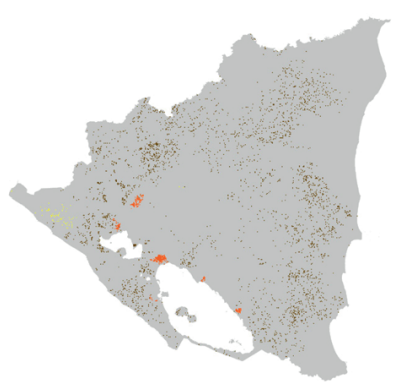
Example: Execution of phenology customizations, Kc types and progress of the crop season

In this example, the country has land use data by crop season; that is, a Classes IMG raster file with the location of the different crops throughout the national territory for each of the crop seasons.

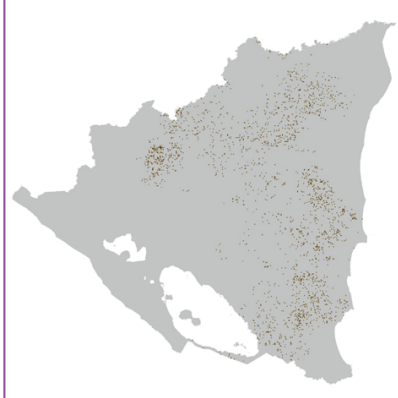
It may be the case that the same area for the first crop season has a specific crop – for example, rice – and that during the rest of the year beans are sown in that location. Country-level ASIS allows this type of analysis, as long as the operations are carried out individually for each crop season.



Agricultural season 1:
first (NI_ClassesIMG_pri.img)



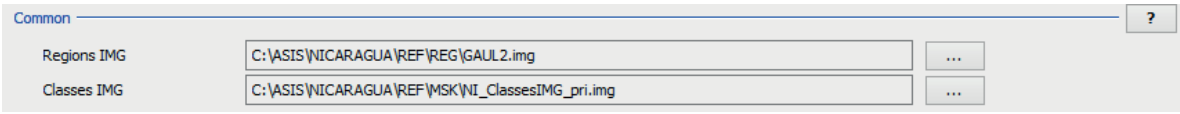
Agricultural season 2:
second (NI_ClassesIMG_pos.img)



Agricultural season 3:
third (NI_ClassesIMG_apa.img)

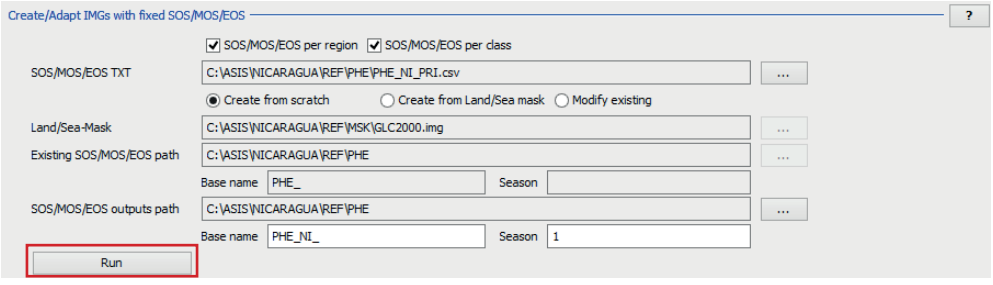
"Common" block

- Define the parameters of the common block for crop season 1: first, with administrative units at municipality level (GAUL2.img) and the corresponding class raster (NI_ClassesIMG_pri.img).

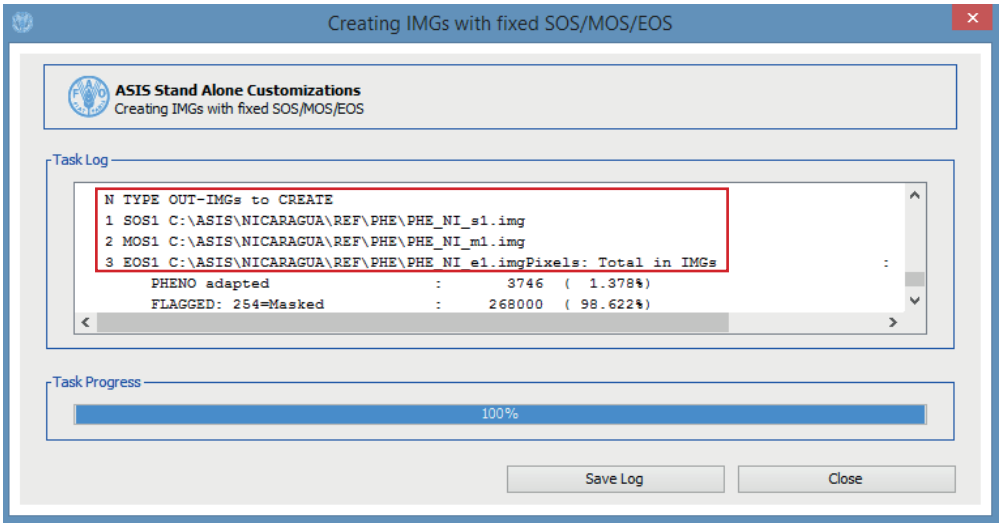


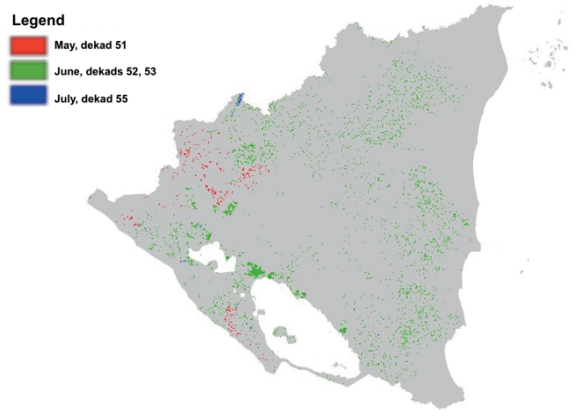
"Create/Adapt IMGs with fixed SOS/MOS/EOS" block

- Set the parameters to create a new phenology raster for crop season 1:
  - Use the phenology table **PHE_NI_PRI.csv**, which contains the data of start (SOS), maximum (MOS), and end (EOS) dates of the first crop season by municipality and by crop.
  - Select the option to create the raster from scratch.
  - Define the output directory, base name of the output files and crop season number.
- Execute the operations by clicking on the **Run** button.

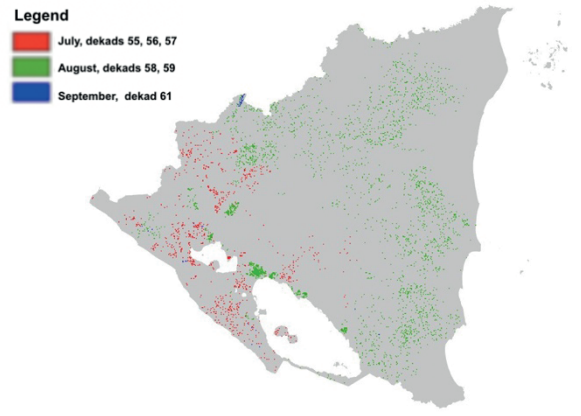


- The "Creating IMGs with fixed SOS/MOS/EOS" window shows the processing status. Once finished, verify in the task log that the three (3) phenology raster files for crop season 1 have been successfully created: PHE_NI_s1.img, PHE_NI_m1.img and PHE_NI_e1.img.





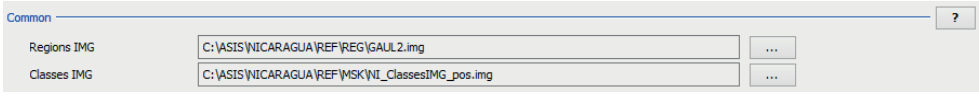
Phenology for the start of the crop season (SOS)

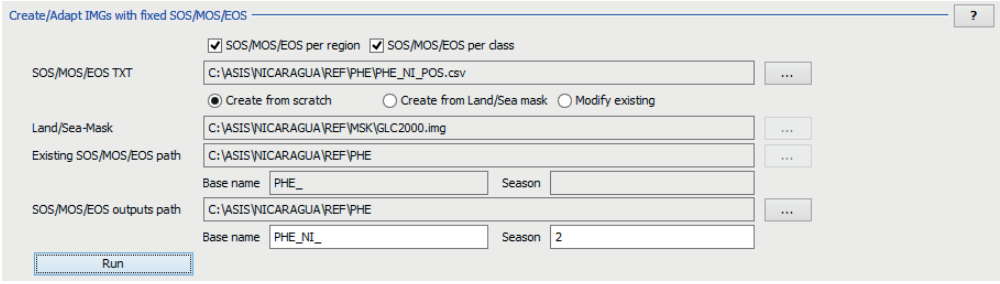


Phenology for the end of the crop season (EOS)

- To execute these processes with the other two crop seasons, repeat the same procedure, changing the following:
  - Classes IMG raster in the common block: NI_ClassesIMG_pos.img – second crop season NI_ClassesIMG_apa.img – third crop season
  - Phenology table:
    PHE_NI_POS.csv – second crop season
    PHE_NI_APA.csv – third crop season
  - Crop season number:
    2 – second crop season
    3 – third crop season

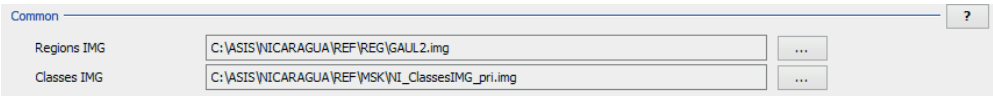
Configuration for the second crop season

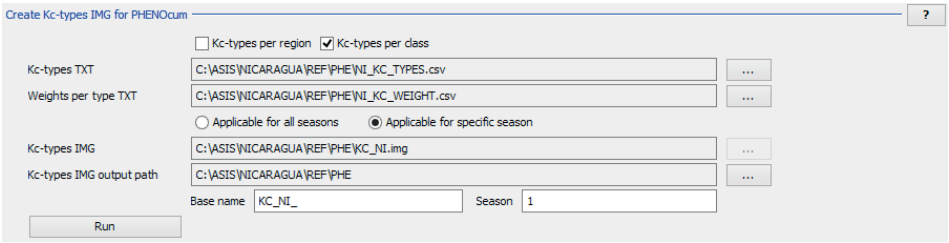





```
N TYPE OUT-IMGs to CREATE
1 SOS2 C:\ASIS\NICARAGUA\REF\PHE\PHE_NI_s2.img
2 MOS2 C:\ASIS\NICARAGUA\REF\PHE\PHE_NI_m2.img
3 EOS2 C:\ASIS\NICARAGUA\REF\PHE\PHE_NI_e2.imgPixels: Total in IMGs
```

Configuration for the third crop season






```
N TYPE OUT-IMGs to CREATE
1 SOS3 C:\ASIS\NICARAGUA\REF\PHE\PHE_NI_s3.img
2 MOS3 C:\ASIS\NICARAGUA\REF\PHE\PHE_NI_m3.img
3 EOS3 C:\ASIS\NICARAGUA\REF\PHE\PHE_NI_e3.imgPixels: Total in IMGs
```

"Create Kc-types IMG for PHENOcum" block

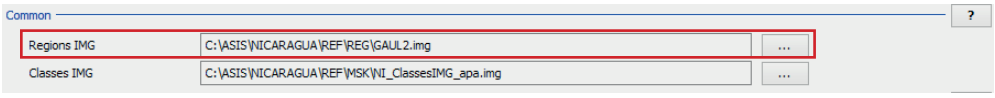
- Set the parameters to create the Kc raster of the first crop season:
  - Check that the class raster of the first crop season is selected in the common block.
  - Use the tables of crop coefficient types Kc and weights per type previously prepared: **NI_KC_TYPES.csv** and **NI_KC_WEIGHT.csv**
  - Select the "Applicable for specific season" option.
  - Specify the output file path, the base name and the crop season number.
- Execute the operations by clicking on the **Run** button.

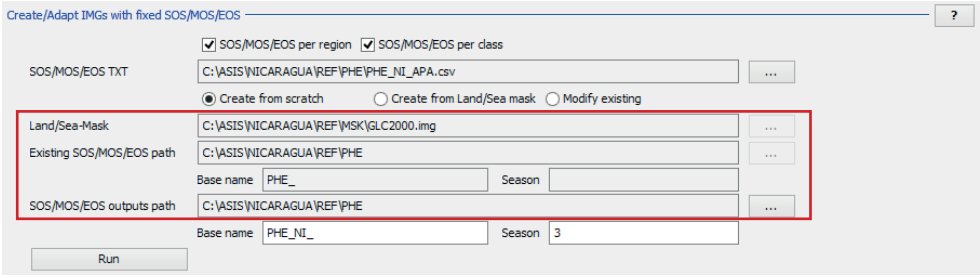
REG	K	TYPE	COMMENT
0	1	1	Irrigated rice
0	2	2	Rainfed rice
0	3	3	Basic grains

NI_KC_TYPES.csv file contents

TYPE	SOS	MOS	EOS
1	105	120	90
2	95	100	97
3	30	120	35

NI_KC_WEIGHT.csv file contents

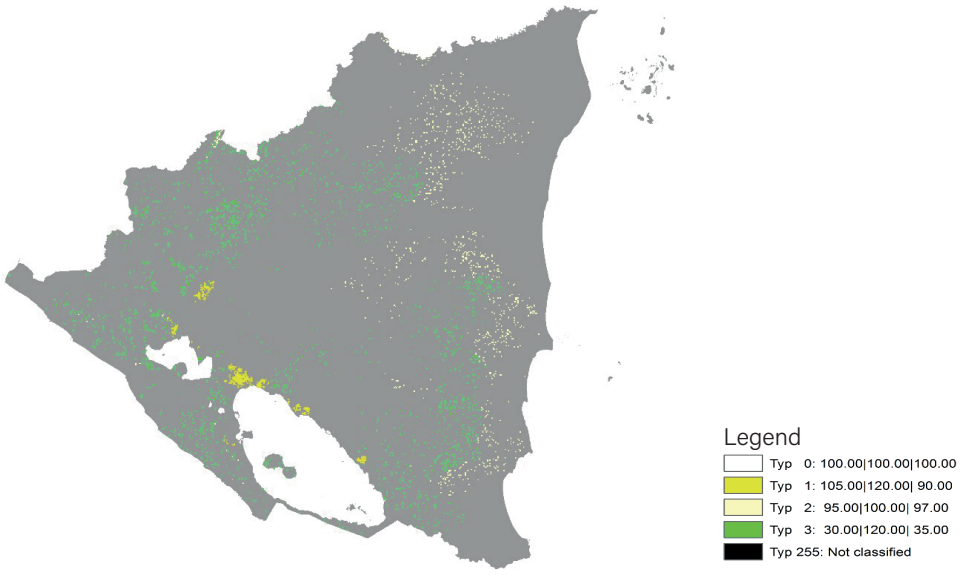




Verify in the task log that the NI_KCs1.img raster has been successfully created and view it in a GIS software.

```
   OUTPUT-IMG (BYTE-Classification)
p5.OUT-IMG with Kc-TYPES              (no ext.) =>C:\ASIS\NICARAGUA\REF\PHE\KC_NI_s1Pixels: Total in IMGs
        Normally treated        (V=0-  3)       :       3746  (  1.378%)
        Missing Region OR Class (Flagged V=255) :     268000  ( 98.622%)

<INFO    > Program in task step 1 ended with exit code(0)
<ENDED   >
```



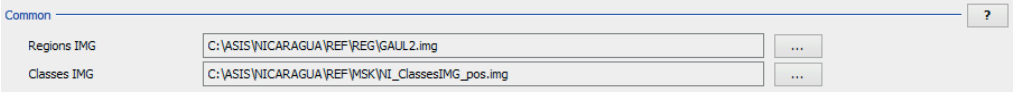
Raster Kc crop season 1: first (KC_NI_s1.img)

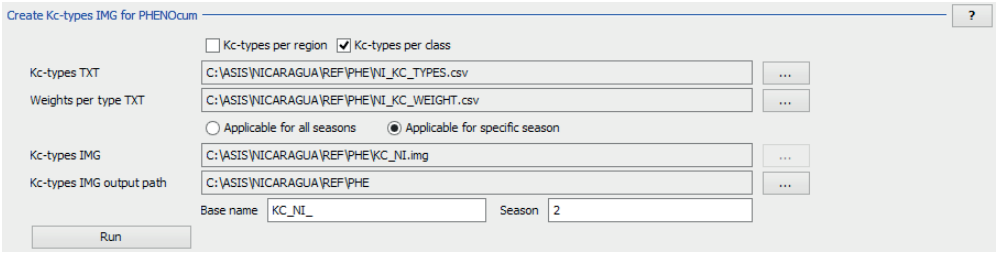
- To run the processes for the other two crop seasons, repeat the same procedure, keep the same CSVs and only change the following:
  - Classes IMG raster in the common block: NI_ClassesIMG_pos.img – second crop season NI_ClassesIMG_apa.img – third crop season
  - Crop season number:

    2 – second crop season

    3 – third crop season

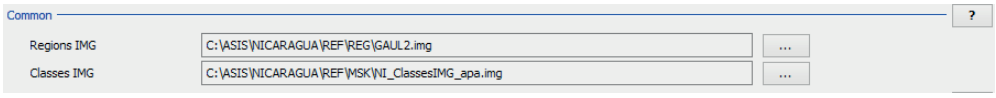
Configuration for the second crop season

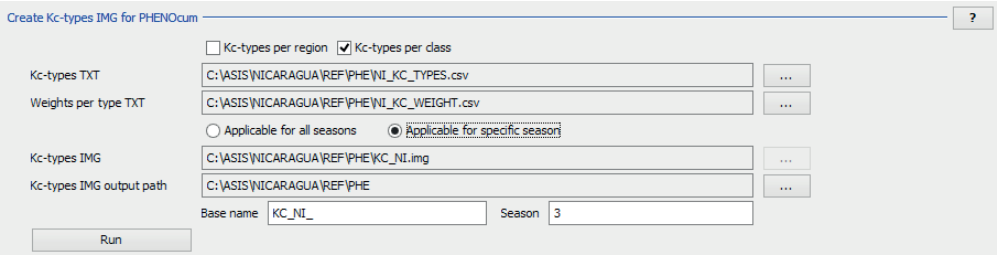




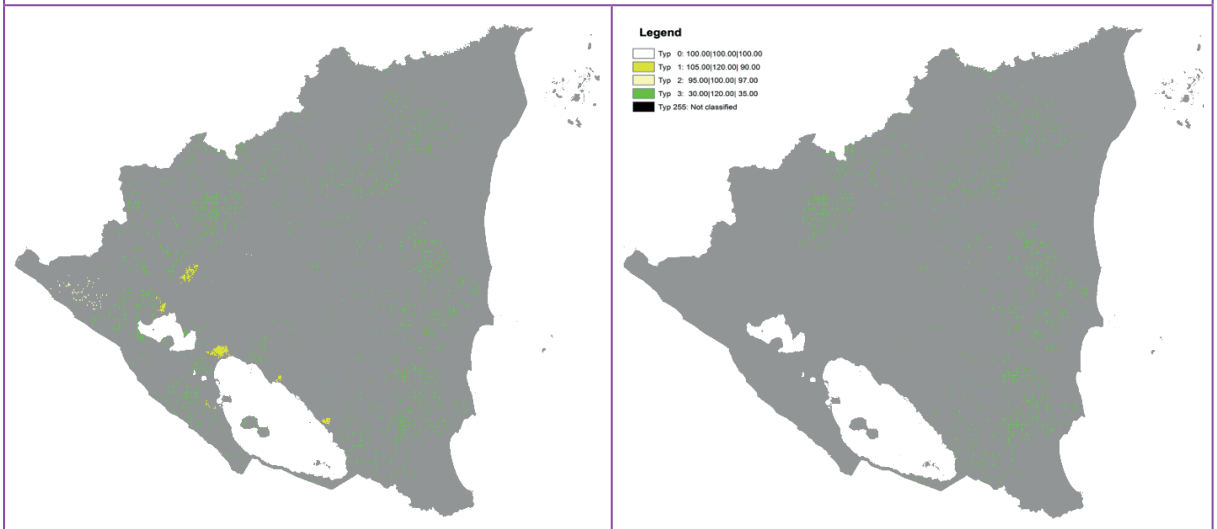

```
   OUTPUT-IMG (BYTE-Classification)
p5.OUT-IMG with Kc-TYPES                (no ext.) =>C:\ASIS\NICARAGUA\REF\PHE\KC_NI_s2Pixels: Total in IMGs
       Normally treated        (V=0-  3)        :       3567  (  1.313%)
       Missing Region OR Class (Flagged V=255) :     268179  ( 98.687%)
```

Configuration for the third crop season






```
   OUTPUT-IMG (BYTE-Classification)
p5.OUT-IMG with Kc-TYPES                (no ext.) =>C:\ASIS\NICARAGUA\REF\PHE\KC_NI_s3Pixels: Total in IMGs
       Normally treated        (V=0-  3)        :       2302  (  0.847%)
       Missing Region OR Class (Flagged V=255) :     269444  ( 99.153%)
```

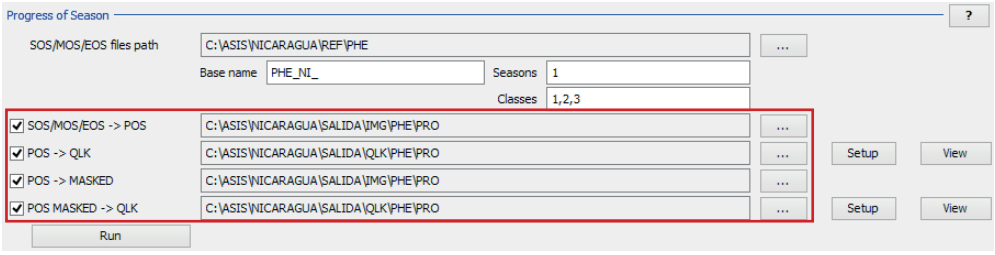


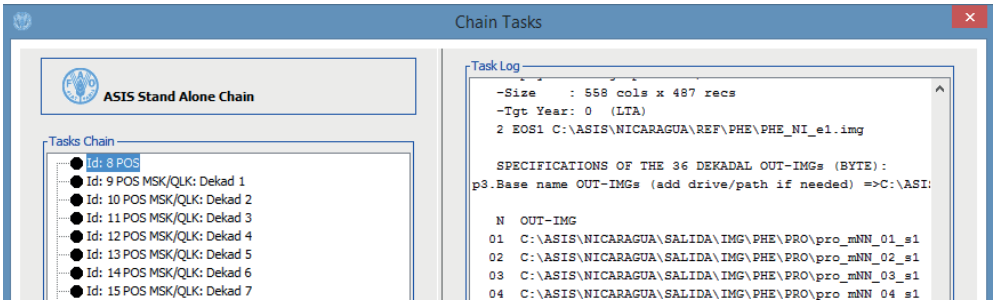
- Raster Kc crop season 2 (KC_NI_s2.img)

Raster Kc crop season 3 (KC_NI_s3.img)

“Progress of Season” block

- Set the parameters to create the progress raster of the first crop season:
  - Verify that the class raster of the first crop season is selected in the common block.
  - Set the following parameters: path of the output files, base name, crop season number and land use class codes. The path and base name should correspond to those previously set in the “Create/Adapt IMGs with fixed SOS/MOS/EOS” block so that the tool can find these input rasters.
- Activate the checkboxes for all operations. You can leave the default output folders.
- Execute the operations by clicking the Run button. The “Chain Tasks” window opens showing the progress and specifying the 36 output files.

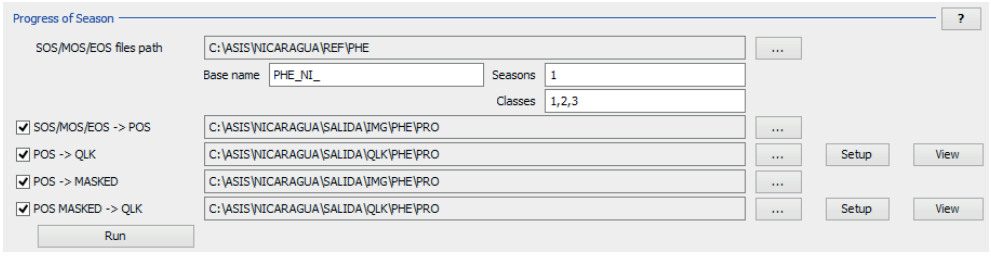


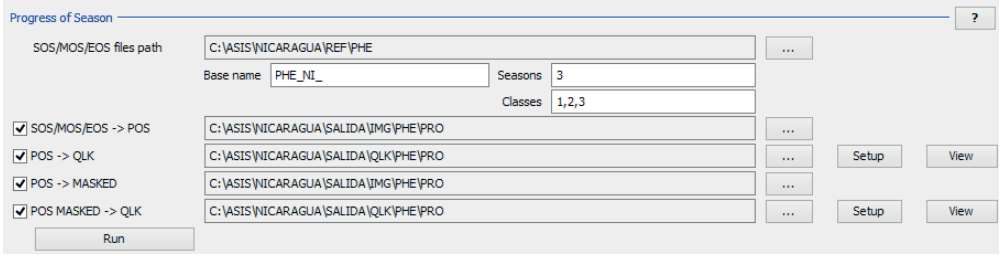


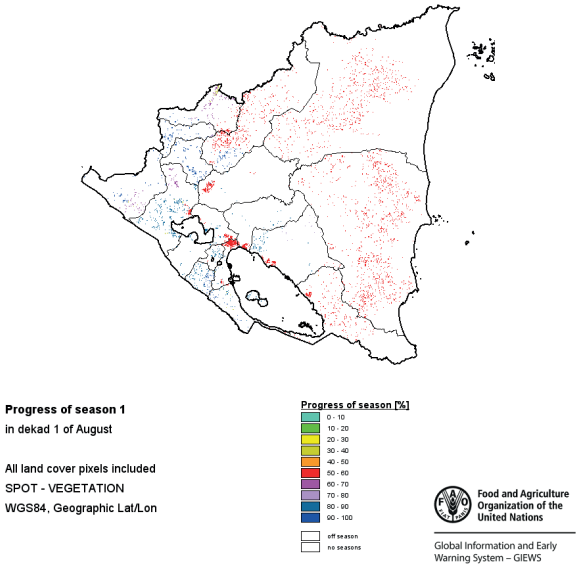
- To run the processes for the other two crop seasons, repeat the same procedure, changing:
  - Classes IMG raster in the common block: NI_ClassesIMG_pos.img – second crop season NI_ClassesIMG_apa.img – third crop season
  - Crop season number:

    2 – second crop season

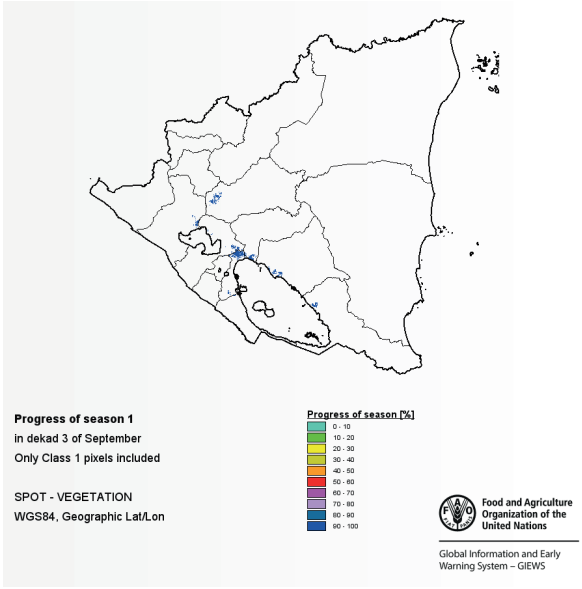
    3 – third crop season







Progress of crop season 1, dekad 1 of August for all land use classes



Progress of the crop season 1, dekad 3 of September for irrigated rice class

4. Operations by dekad and year

General aspects of operations by dekad and by year

The "Dekadal Operations" and "Annual Operations" panels contain multiple functions needed to create the different drought indices for a given time period and study area. Dekadal operations are mainly used to analyze drought behavior over time or for early warning purposes, while annual operations are used to analyze historical droughts.

The panels are subdivided into a series of blocks grouped by index – separated by blue lines – within which it is possible to activate or deactivate check boxes to indicate to the tool which operations will be executed. It should be noted that there are certain dependencies for the calculation of indices and their derivatives; that is, some indices are prerequisite for the calculation of others.

Date formats supported by the Country-level ASIS

- In a temporal sense, Country-level ASIS works mainly with data by dekad or by year. The year is subdivided into 12 months and 36 dekads; that is, each month of the year has 3 dekads. The first two dekads of the month always comprise ten days (1-10, 11-20); while the third dekad is variable and covers the remaining number of days of the month (21-30, 31 or 28/29 for February).
- The start and end dates for operations by dekad are expressed in the following **YYYYMMDD** format:
  - **YYYY**: year expressed in 4 digits. It is possible to enter the start date from 1984 onwards.
  - **MM**: month of the year expressed in 2 digits, between 01 to 12.
  - **DD**: days of the month expressed in 2 digits. The days in terms of dekads are DD=01, 11, 21; however, regardless of which DD day value is entered, the tool resets it to the beginning of the corresponding dekad. Example: If you enter 20161231 → 20161221.
- The interval or period of analysis for the annual operations must be specified in terms of years in the format **YYYY.** Example: "start=1984","end=2016".

Buttons on the operation panels by dekad and by year

?	The help buttons "?" are located on the right side of the title of each block. They open the section of the Country-level ASIS user manual for the selected block.
...	The browse buttons "..." are used to select/modify both input directories and files as well as output files. They provide a view to the default folder defined when the project is created; however, it is allowed to modify the path of the files.
Setup	The "Setup" configuration buttons are available for the QLK and CHART output files. They allow you to modify the general layout and content of the maps and charts. Another window opens where you can define the different parameters for the QLK and CHART as appropriate.
View	The "View" buttons appear for the QLK and RUM type file folders. Clicking the button opens a window that displays all files within the output folder. When you select one of the files and click open, the view window appears with a map for the QLK files or a table for the RUM files.
Run	The "Run" button is used to execute the operations. Country-level ASIS scans all blocks and generates the requested products for all dekads or years of the defined period. The tool performs the operations in the set order until the end of the list is reached. An additional window then opens, showing the progress of the tasks.

Output file types of operations by dekad and by year	
RUM (Regional Unmixed Means)	Comma-separated ASCII-TXT text file containing the numerical values of the MEAN of the input image files (IMG) by administrative region (ADM) and by land use class. It contains the 12 fields described in Table 1.
QLK (Quicklook)	Graphic file (.png format) that provides an overview of the derived index. It has configurable elements: margins, map size, title, symbology and legend, notes, logos, outline of administrative regions, others. These files weigh less than 1 MB and are useful for use in documents, presentations, newsletters, websites.
CSV (Comma separated values)	Comma-separated ASCII-TXT text file containing all the data from the RUM file, which can be easily imported into MS Excel to create custom tables and graphs.
IMG	Binary format raster file (*.img), with one of the following data types: BYTE, INTEGER, LONG or FLOAT. This file is accompanied by its respective metadata file (*.hdr). It can be used with spatial processing software (ENVI, IDRISI, ERDAS, QGIS, ArcGIS...).
CHART	Graphic file (.png format) containing the output graphic with the defined graphic elements (curve colors, background, fonts, titles, legends, X and Y axes).

Table 1. Contents of the RUM tables. Fields 1-8 are "labels" describing the input files; fields 9-12 contain the results. The mean value is stored in field 11.

No.	FIELD	CONTENTS
1	Region_ID	ID code of the "region" (administrative, ecological, or other). Specify with the "Regions IMG" raster.
2	Class_ID	ID code of the land use class. Note: A field with Class ID=0, with UMmet ID=0 and Rejection Threshold=0 is always included.
3	UMmet_ID	Case or method 0=No unmixing (simple regional averaging, without any class selection) 1=Hard classification (hard classification, categorical pixel-by-pixel) 2=Soft via AFIs with fixed, class-specific rejection thresholds Tk (soft classification via area fraction images – AFI – fixed) 3=Soft via AFIs but with "optimized "rejection thresholds "Tr,k (not applicable in ASIS, soft classification via area fraction images – AFI– but optimized)
4	Rejection threshold	Rejection threshold. If UMmet_ID=2 or 3: All pixels with area fraction fk below this threshold are discarded.
5	Sensor_ID	Sensor ID (SPOT-VGT, METOP-AVHRR, ECMWF, RFE, ...).
6	Variable_ID	Variable ID (NDVI, VHI, lluvia, ...).
7	Periodicity	Periodicity: 1=day, 10=dekad, 30=month, 360=year.
8	Date [YYYYMMDD]	Date: Initial day or day of a dekad/month/year.
9	RA1	Relative pixel area used in the calculation for a specific combination (region x class), accounting for all indicators in the corresponding input image.
10	RA2	Same as RA1, but only per pixel the area fractions fk of the class of interest (RA2 ≤ RA1).
11	Mean	Value of the mean (Regional unmixed mean) in terms of the image unit of measure (Y-units)
12	St. Deviation	Corresponds to the standard deviation.

4. Operations by dekad and year

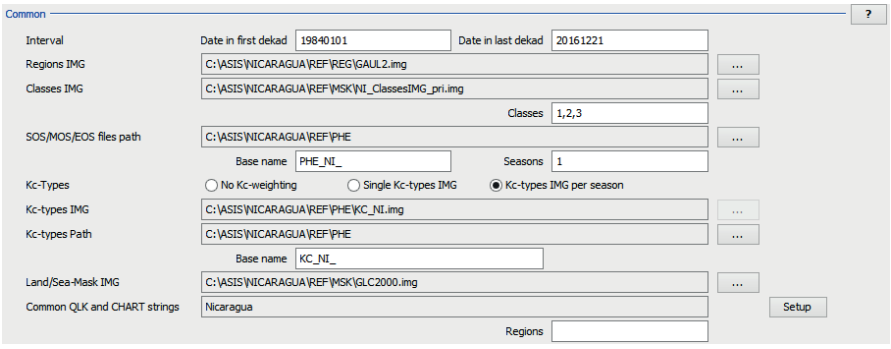
4.1. Operations by dekad

4.1.1. Common block

"Dekadal Operations" panel

Common block

At the top of the "Dekadal Operations" panel, the parameters common to multiple functions within the Country-level ASIS should be specified. These are:



Interval

Consists of the interval or time period over which the Country-level ASIS functions will be executed, determined by the date of the first and last dekad of the series under study in the format YYYYMMDD.

Regions IMG

Specifies the path and categorical raster file in IMG format of administrative regions. Each pixel carries the code of an administrative region. For example: GAUL0: country, GAUL1: province, GAUL2: municipality.

Classes IMG

Specifies the path and categorical raster file in IMG format with the land use classification. This file must be BYTE type (0-255) with the value "0" reserved for the class "Unclassified". Each pixel must contain the code of one class following a fixed legend, for example: 1 = rice, 2 = corn, 3 = beans.

Classes

List of classes code of the Classes IMG raster, separated by comma, considered for operations.

SOS/MOS/EOS files path

Defines the path of the phenology files, derived from the global ASIS2 or created by means of the Customizations functions. In "Seasons", the crop seasons (1,2,3...) are inputted.

Kc-Types/Kc-types IMG/Kc-types Path

Defines the controls on the crop coefficient Kc. If applicable, specify the path and raster files, derived from the global ASIS2 or from the Customizations functions.

Land/Sea Mask IMG

Specifies the path and raster file used as a mask for bodies of water in the QLKs.

Common QLK and CHART strings

Specifies the configurable parameters for the output graphic files: QLK maps and CHART charts. By clicking on the "Setup" button, you can configure parameters such as title, name of land use classes according to the uniquely identified code, and administrative regions.

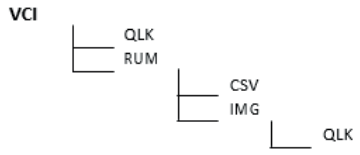
4.1.2. VCI block

VCI block

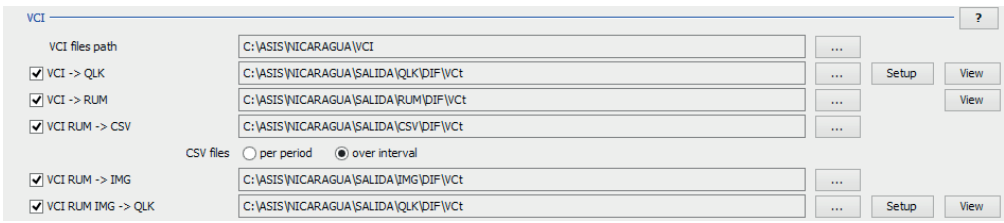
The Vegetation Condition Index (VCI) is an index used for the detection and monitoring of drought, which allows the evaluation of its duration, area covered, intensity and impacts on vegetation. The VCI is derived from the Normalized Difference Vegetation Index (NDVI), obtained from the historical series of METOP-AVHRR satellite images since 1984. The equation for the calculation is: VCI=(NDVI-NDVImin)/(NDVImax-NDVImin).

The VCI IMG raster files are an essential part of the basic inputs for the area of interest that come with Country-level ASIS. By default, the path to the input VCI raster files in the project folder is addressed.

Dependencies of VCI index and their derivates



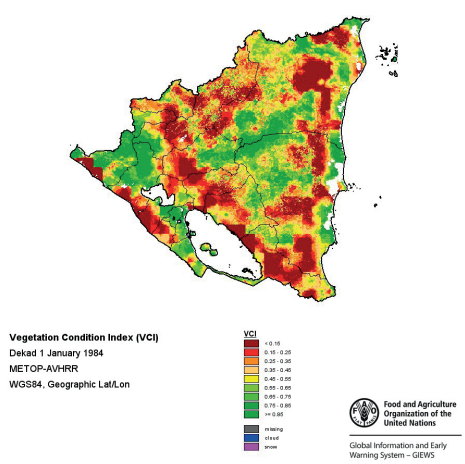
VCI block functions



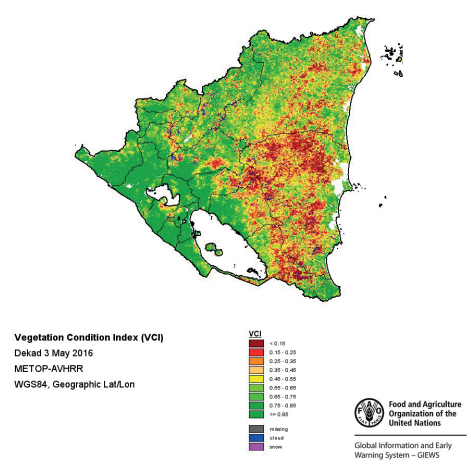
VCI → QLK

Generates QLK graphic files of the VCI index by dekad for the entire study area during the period defined in the common block.

Name format:	otYYYYMMDDc.png



a) VCI QLK for dekad 1 of January 1984



b) VCI QLK for dekad 3 of May 2016

4. Operations by dekad and year

VCI → RUM

Generates the RUM files for the VCI index. The "Mean" field contains the mean VCI values by administrative region and by land use class.

Name format:	otYYYYMMDDc.rum

ot20160521c.RUM

Region_ID	Class_ID	UMmet_ID	Threshold	Sensor_ID	Variable_ID	Periodicity	Date	RA1	RA2	Mean	StdDev
505	1	1	100	1	21	10	20160521	0	0	-99,999.999	-99,999.999
505	2	1	100	1	21	10	20160521	3.226	3.226	0.477	0.156
505	3	1	100	1	21	10	20160521	6.452	6.452	0.555	0.155
510	0	0	0	1	21	10	20160521	96.667	96.667	0.639	0.148
510	1	1	100	1	21	10	20160521	0	0	-99,999.999	-99,999.999

VCI RUM → CSV

Converts one or more RUM files to multiple or a single CSV file. There are two options:

- **Per period:** Each RUM file per dekad is translated into a separate CSV file.
- **Over interval:** All RUM files by dekad are combined into a single CSV.

Name format:	otYYYYMMDDc.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	REG	K	UMM	THR	SSR	VAR	PER	ITEM	19840101	19840111	19840121	19840201	19840211	19840221	19840301
2	REG	K	UMM	THR	SSR	VAR	PER	ITEM	1984	1984	1984	1984	1984	1984	1984
3	REG	K	UMM	THR	SSR	VAR	PER	ITEM	1	2	3	4	5	6	7
4	505	0	0	0	1	21	10	MU	0.401	0.157	0.266	0.098	0.004	0.003	0.093
5	505	0	0	0	1	21	10	SD	0.185	0.138	0.165	0.125	0.021	0.022	0.134

ot19840101_20161201c

VCI RUM → IMG

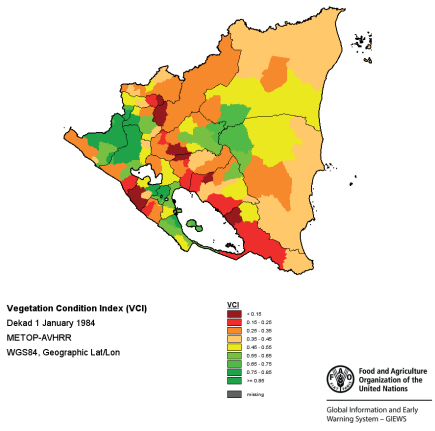
Reconverts RUM files to IMG image files with the average VCI values per region.

Name format:	otYYYYMMDDc_mNN.img

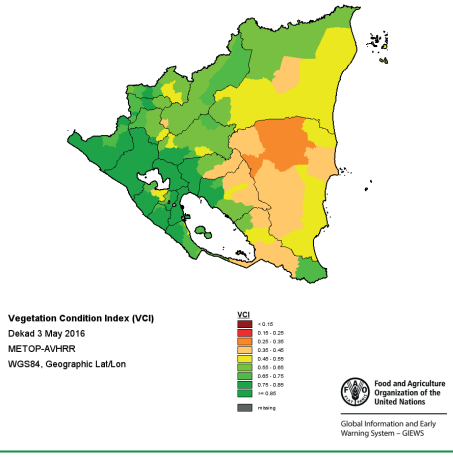
VCI RUM IMG → QLK

Generates QLK graphic files of the VCI RUM IMG raster by dekad for the entire study area during the period defined in the common block.

Name format:	otYYYYMMDDc_mNN.png



a) VCI RUM QLK for dekad 1 of January 1984



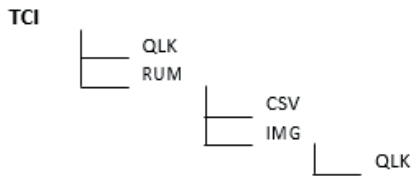
b) VCI RUM QLK for dekad 3 of May 2016

4.1.3. TCI block

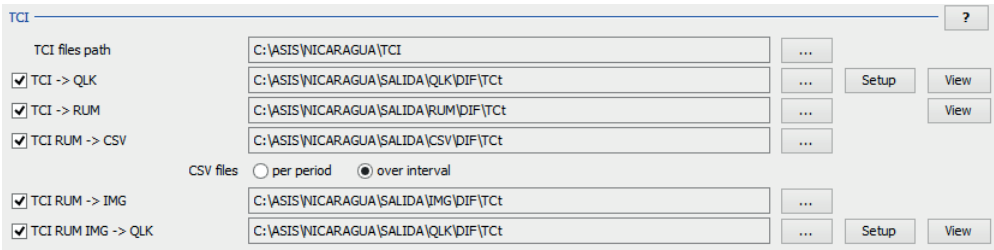
TCI block

The Temperature Condition Index (TCI) is an index derived from the estimated brightness temperature measurements of the thermal infrared band (10.3-11.3 µm) of the AVHR sensor. BT4 – Brightness Temperature band 4 – is a good indicator of the Earth's surface temperature. The mathematical formulation is: TCI1=(Tmax-T)/(Tmax-Tmin).

Dependencies of TCI index and their derivates



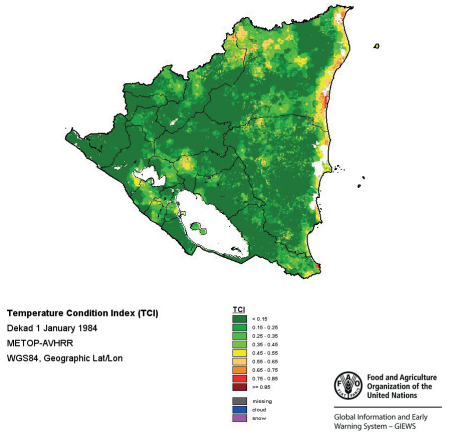
TCI block functions



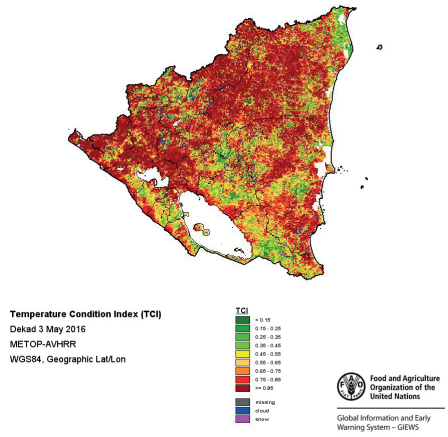
TCI → QLK

Generates QLK graphic files of the TCI index by dekad for the entire study area during the period defined in the common block.

Name format:	otYYYYMMDDe.png



a) TCI QLK for dekad 1 of January 1984



b) TCI QLK for dekad 3 of May 2016

4. Operations by dekad and year

TCI → RUM

Generates the RUM files for the TCI index. The "Mean" field contains the mean TCI values by administrative region and by land use class.

Name format:	otYYYYMMDDe.rum

ot20160521e.RUM

Region_ID	Class_ID	UMmet_ID	Threshold	Sensor_ID	Variable_ID	Periodicity	Date	RA1	RA2	Mean	StdDev
505	0	0	0	1	22	10	20160...	97.507	97.507	0.713	0.303
505	1	1	100	1	22	10	20160...	0	0	-99,999.999	-99,999.999
505	2	1	100	1	22	10	20160...	3.226	3.226	0.834	0.312
505	3	1	100	1	22	10	20160...	6.452	6.452	0.754	0.28
510	0	0	0	1	22	10	20160...	96.667	96.667	0.704	0.266

TCI RUM → CSV

Converts one or more RUM files to multiple or a single CSV file. There are two options:

- **Per period:** Each RUM file per dekad is translated into a separate CSV file.
- **Over interval:** All RUM files by dekad are combined into a single CSV.

Name format:	otYYYYMMDDe.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	REG	K	UMM	THR	SSR	VAR	PER	ITEM	19840101	19840111	19840121	19840201	19840211	19840221	19840301
2	REG	K	UMM	THR	SSR	VAR	PER	ITEM	1984	1984	1984	1984	1984	1984	1984
3	REG	K	UMM	THR	SSR	VAR	PER	ITEM	1	2	3	4	5	6	7
4	505	0	0	0	1	22	10	MU	0.197	0.089	0.054	0.006	0.001	0	0.003
5	505	0	0	0	1	22	10	SD	0.094	0.081	0.069	0.031	0.009	0.003	0.016

ot19830101_20161201e

TCI RUM → IMG

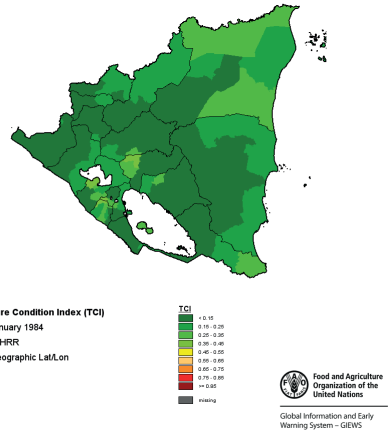
Reconverts RUM files to IMG image files with TCI mean values by region.

Name format:	otYYYYMMDDe_mNN.img

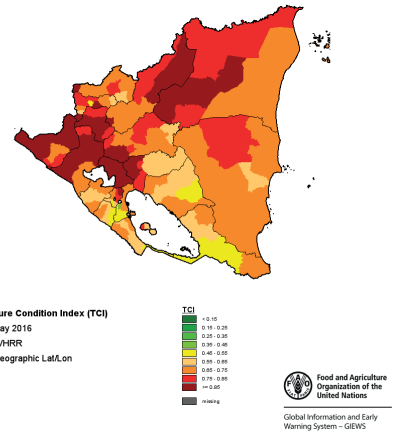
TCI RUM IMG → QLK

Generates the QLK graphic files of the TCI RUM IMG raster by dekad for the entire study area during the period defined in the common block.

Name format:	otYYYYMMDDe_mNN.png



a) TCI RUM QLK for dekad 1 of January 1984



b) TCI RUM QLK for dekad 3 of May 2016

4.1.4. VHI block

VHI block

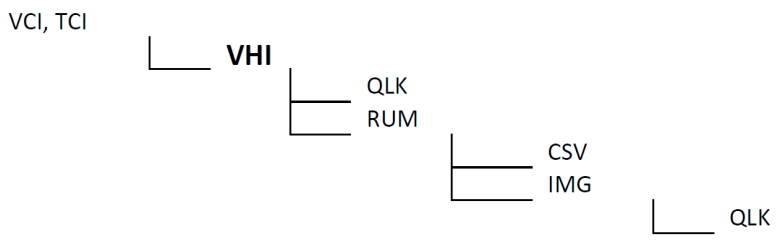
The **Vegetation Health Index** (VHI) is calculated by the weighted combination of two anomalies: The Vegetation Condition Index (VCI) and the Temperature Condition Index (TCI), both derived by terrestrial observation. The equation used is:

$$VHI = w \cdot VCI + (1-w) \cdot TCI$$

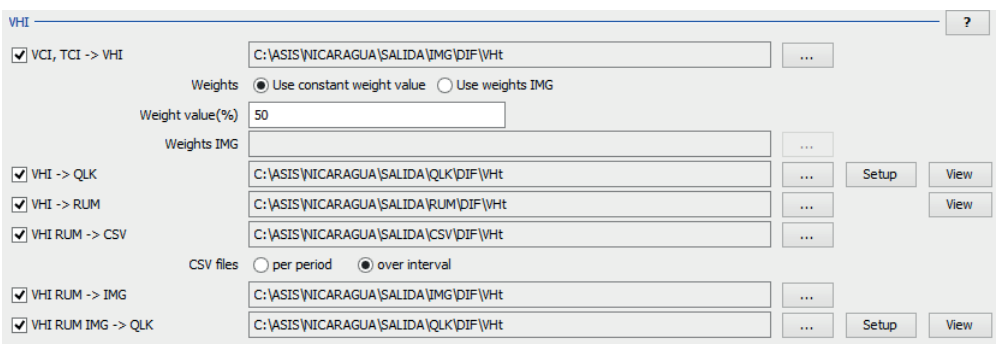
where w is the weight, the value of which is between 0.0 and 1.0.

The VHI is the most basic indicator and the main input for ASIS, and is available per pixel and per dekad. The basic idea of the indicator is as follows: the lower the observed VCI (relatively poor green vegetation) and the higher the observed TCI (relatively warm temperature), the lower the VHI. Low VHIs are indicators of drought, especially when they persist for long periods of time.

Dependencies of VHI index and their derivates



VHI block functions



VCI, TCI → VHI

Produces IMG files of the VHI index by dekad from the VCI and TCI raster, using the equation described above. The values of w can be defined:

- **Using a constant weight value (w):** By default, ASIS specifies equal weight for the VCI and TCI indices, setting a fixed value of 0.5 (or 50%). It is possible to define another value (between 1 to 100) in the "Weight value(%)" text box.
- **Using an IMG weight raster (w-IMG):** Weights can be variable by region and/or class and read from a raster "Weights IMG" file previously generated from the Customizations panel. If this option is chosen, the corresponding path and file must be defined.

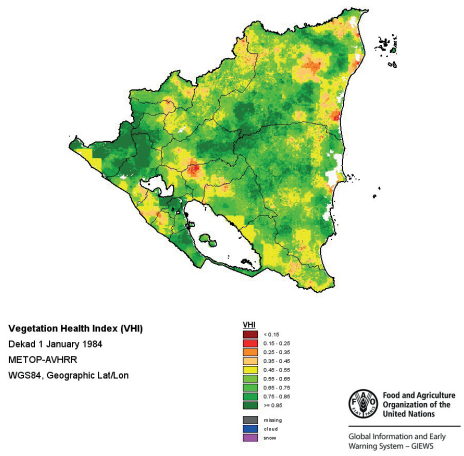
Name format:	otYYYYMMDDh.img

4. Operations by dekad and year

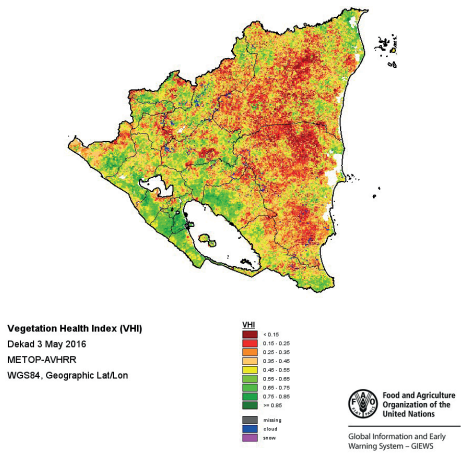
VHI → QLK

Generates QLK graphic files from the VHI raster by dekad for the entire study area during the period defined in the common block.

Name format:	otYYYYMMDDh.png



a) VHI QLK for dekad 1 of January 1984



b) VHI QLK for dekad 3 of May 2016

VHI → RUM

Generates the RUM files from the VHI index. The "Mean" field contains the mean VCI values by administrative region and by land use class.

Name format:	otYYYYMMDDh.rum

ot20160521h.RUM

Region_ID	Class_ID	UMmet_ID	Threshold	Sensor_ID	Variable_ID	Periodicity	Date	RA1	RA2	Mean	StdDev
505	0	0	0	1	41	10	20160521	97.507	97.507	0.439	0.192
505	1	1	100	1	41	10	20160521	0	0	-99,999.999	-99,999.999
505	2	1	100	1	41	10	20160521	3.226	3.226	0.323	0.123
505	3	1	100	1	41	10	20160521	6.452	6.452	0.401	0.17
510	0	0	0	1	41	10	20160521	96.667	96.667	0.468	0.15
510	1	1	100	1	41	10	20160521	0	0	-99,999.999	-99,999.999

VHI RUM → CSV

Convert one or more RUM files to multiple or a single CSV file. There are two options:

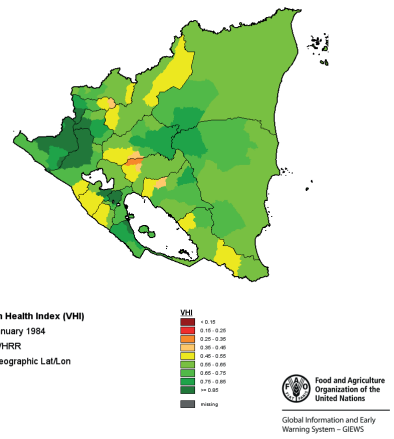
- **Per period:** Each RUM file per dekad is translated into a separate CSV file.
- **Over interval:** All RUM files by dekad are combined into a single CSV.

Name format:	otYYYYMMDDh.csv

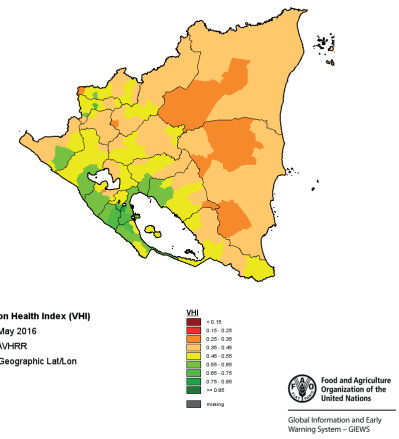
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	REG	K	UMM	THR	SSR	VAR	PER	ITEM	19840101	19840111	19840121	19840201	19840211	19840221	19840301
2	REG	K	UMM	THR	SSR	VAR	PER	ITEM	1984	1984	1984	1984	1984	1984	1984
3	REG	K	UMM	THR	SSR	VAR	PER	ITEM	1	2	3	4	5	6	7
4	505	0	0	0	1	41	10	MU	0.603	0.535	0.607	0.547	0.501	0.501	0.546
5	505	0	0	0	1	41	10	SD	0.109	0.082	0.093	0.062	0.011	0.011	0.066

ot19830101_20161201h

VHI RUM → IMG	
Reconvert RUM files to IMG image files with VHI mean values by region.	
Name format:	otYYYYMMDDh_mNN.img
VHI RUM IMG → QLK	
Generates VHI RUM IMG raster QLK graphic files by dekad for the entire study area during the period defined in the common block.	
Name format:	otYYYYMMDDh_mNN.png



a) QLK of the mean VHI by municipality for dekad 1 of January 1984



b) QLK of the mean VHI by municipality for dekad 3 of May 2016

4.1.5. VHI DEFICIT block

VHI DEFICIT block

The **"Drought Forecasting"** or DEFICIT is a qualitative indicator of productivity, useful as a complement to the Country-level ASIS drought indicators. It represents the probability that the current cropping season will be labeled as "bad" in terms of vegetation productivity. The procedure divides historical seasons into "good" and "bad" years, based on the "minimum μVHI threshold" or "% of bad years", and compares the current crop year with the historical archive. The dekadal version reflects the actual situation in the selected dekad.

The requirements for execution are:

- The SOS/MOS/EOS IMG raster for the selected crop season, defined in the common block of operations by dekad.
- The start and end dates of the study period, which establish the creation of the output files.
- Consecutive series of images per dekad of the VHI index covering at least 15 years. The date range can be specified in the VHI DEFICIT block.
- Similar to the case of the μVHI, VHI input files can be weighted or unweighted with Kc factors, defined in the common block.

4. Operations by dekad and year

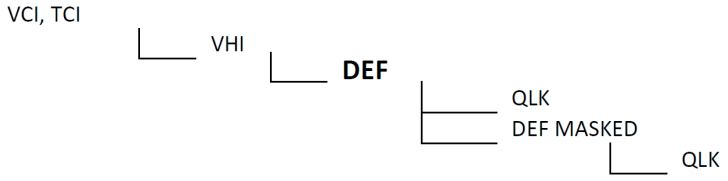
- The most cumbersome aspect is the preliminary identification of "good" and "bad" years. Pixels with μVHI values below the minimum threshold (35% by default) are labeled as "1=bad", the others as "0=good". N0 and N1 represent the number of good and bad years respectively. For this, the μVHI values between SOS and EOS are calculated and then:
  - In the standard procedure – where the minimum μVHI threshold is 0 and the percentage of bad years is 25% – the 25% worst years (with lowest μVHI) are labelled as bad, the others as good..
  - The minimum μVHI threshold can be set. In this case, N0 and N1 correspond respectively to the number of years with a μVHI above and below the threshold. In this respect, it may be the case that N0=0 (all years are bad) or N1=0 (there are only good years). Such pixels are marked as "permanent drought" or "never drought" respectively. But if it is the case that (N0>0 and N1>0), there are two other situations:
    - If the % of bad years is greater than 0 (with 25% predetermined), the standard fractionation of the % of bad years is maintained (minimum threshold of μVHI = 0).
    - If the % of bad years is equal to 0, the fractionation is adapted per pixel to N1/(N0+N1).

The following table summarizes the above:

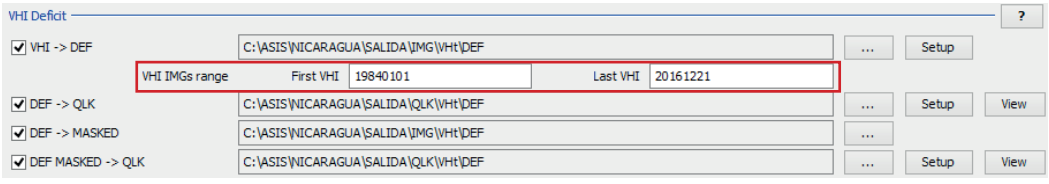
Minimum μVHI threshold	Percentage of bad years	Comments
= 0	= 0	Input error
= 0	> 0	Fixed fractionation of good/bad years
> 0		First pixels omitted N0 = 0 or N1 = 0
	> 0	For the remaining pixels, keep the fractionation fixed
	= 0	Adaptation of the pixel fractionation N1/(N0+N1)

NOTE: Processing may take several days. If there is any interruption in the process due to technical problems, you can continue where you left off.

Dependencies of DEF index and their derivates



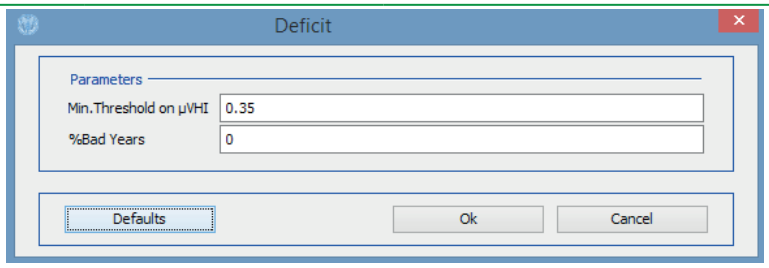
VHI DEFICIT block functions



VHI → DEF

Specifies the output path and produces the DEFICIT IMG files for the VHI date range defined in the block throughout the crop season (SOS → EOS). Parameters can be configured:

Minimum μVHI threshold: default value of 0.35 is defined for the minimum threshold of the mean VHI Percentage of bad years: percentage of years labeled as "bad".

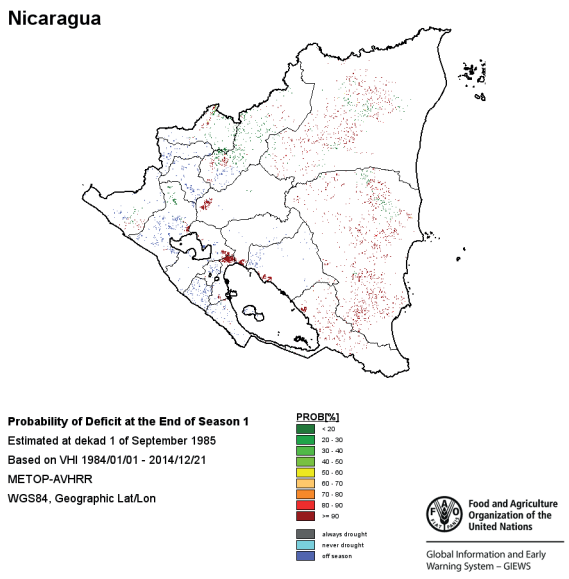


Name format:	otYYYYMMDDq_s1, _s2, ... img

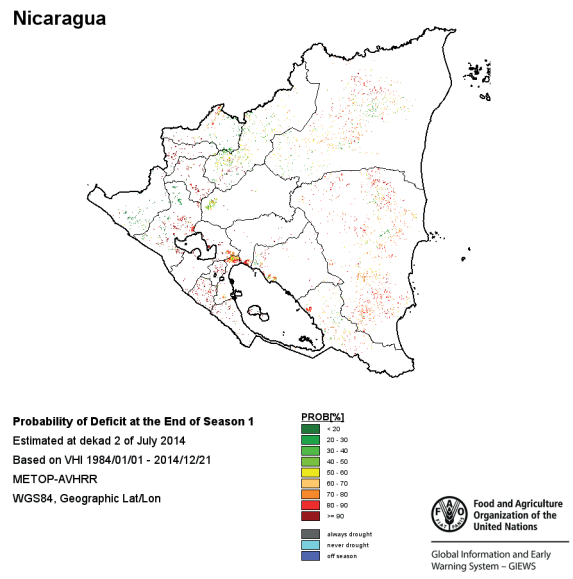
DEF → QLK

Generates QLK graphic files from the DEFICIT raster by dekad for the entire study area during a defined period.

Name format:	otYYYYMMDDq_s1, _s2, ... png



a) DEFICIT QLK for dekad 1 of September 1985 (s1: first)

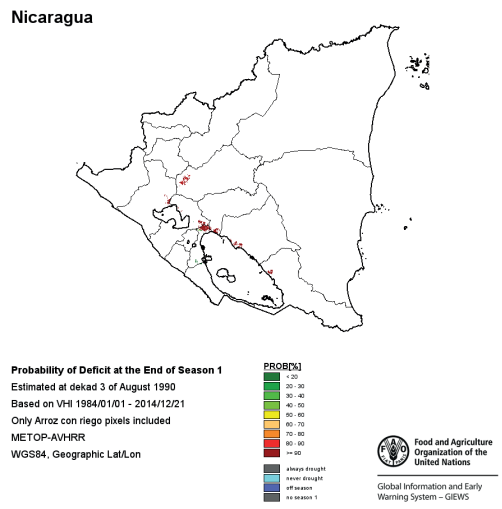


b) DEFICIT QLK for dekad 2 of July 2014 (s1: first)

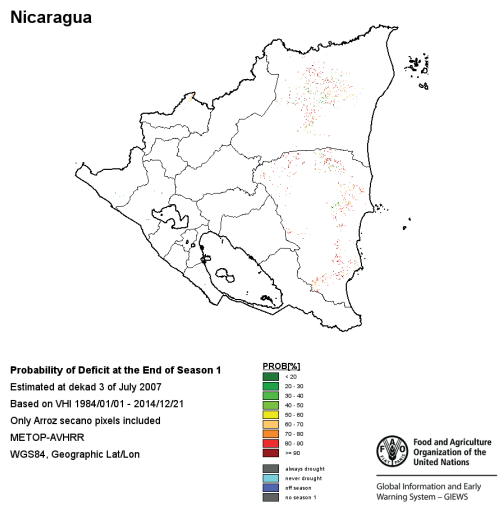
DEF → MASKED

Produces DEFICIT IMG files masked by land use class according to the classes specified in the common block parameters for each crop season.

Name format:	otYYYYMMDDq_m2M_s1, _s2, ...img otYYYYMMDDq_m3M_s1, _s2, ... img otYYYYMMDDq_m...M_s1, _s2, .. img
DEF MASKED → QLK	
Generates QLK graphic files of raster masked by DEFICIT class by dekad during a defined period.	
Name format:	otYYYYMMDDq_m2M_s1, _s2, ... png otYYYYMMDDq_m3M_s1, _s2, ... png otYYYYMMDDq_m...M_s1, _s2, .. png



c) DEFICIT QLK for dekad 3 of August 1990 (s1: first) with irrigated rice



d) DEFICIT QLK for dekad 3 of July 2007 (s1: first) with rainfed rice

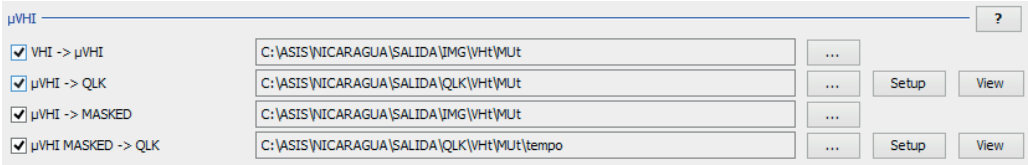
4.1.6. µVHI block

µVHI block
Mean VHI during the crop cycle (µVHI – Mean VHI) is the integrated value of the VHI index over the agricultural season from the start date to the dekad of analysis. This indicator reflects the state of the current season. The calculation is performed for each specified crop season and uses the phenology (SOS, MOS, EOS) and crop coefficient weighting (Kc) files, delimited in the common block. Pixels with µVHI = 50% are "normal", so the Country-level ASIS focuses on pixels with low µVHI, where stunting occurs; i.e. drought affectation. These µVHI raster files are needed for the calculation of the µ*VHI, ASI and CASI indices.

Dependencies of μVHI index and their derivates

VCI, TCI
└── VHI
└── **μVHI**
├── QLK
└── μVHI MASKED
└── QLK

μVHI block functions



VHI → μVHI

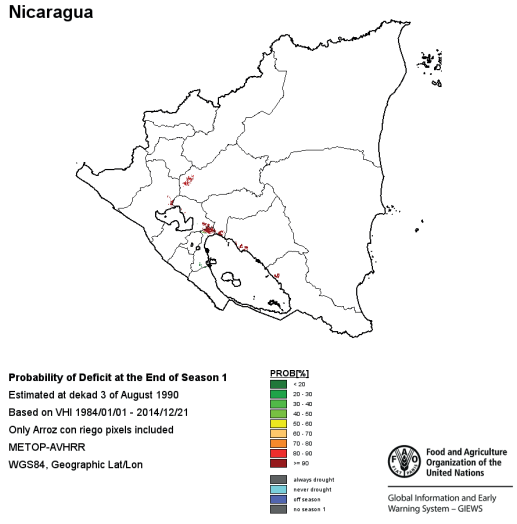
Obtains the IMG files of the μVHI, integrating the VHI values over the specified crop seasons. One IMG file per crop season is produced for each dekad (suffix s = 1/2/3…).

Name format:	otYYYYMMDDu_mNN_s1, _s2, … img

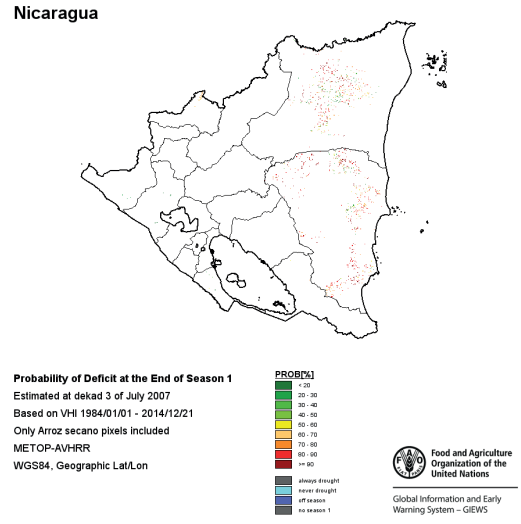
μVHI → QLK

Generates QLK graphic files from the μVHI raster by dekad for the entire study area during the period defined in the common block.

Name format:	otYYYYMMDDu_mNN_s1, _s2, … png

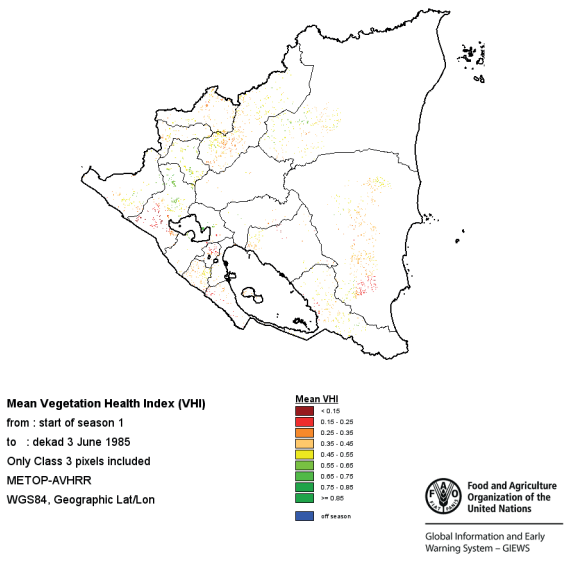


a) QLK of μVHI for dekad 3 of August 1990 (s1: first)

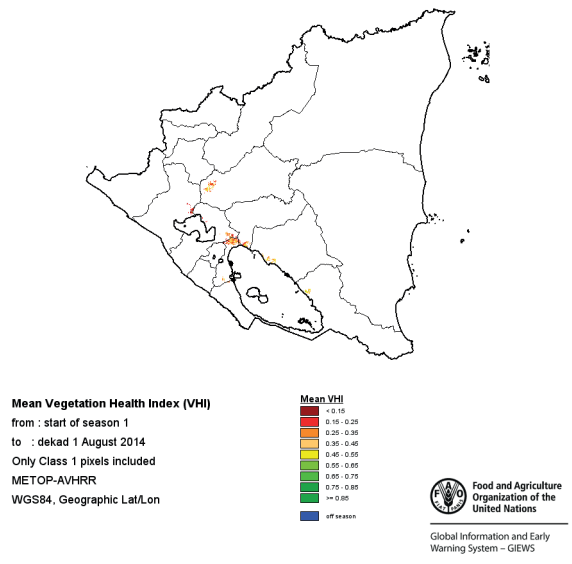


b) QLK of μVHI for dekad 3 of July 2007 (s2: second)

µVHI → MASKED	
Produces µVHI IMG files masked by land use class according to the classes specified in the common block parameters for each crop season.	
Name format:	otYYYYMMDDu_m2M_s1, _s2, ... img otYYYYMMDDu_m3M_s1, _s2, ... img otYYYYMMDDu_m...M_s1, _s2, ... img
µVHI MASKED → QLK	
Generates QLK graphic files of raster masked by µVHI index class per dekad during the period defined in the common block.	
Name format:	otYYYYMMDDu_m2M_s1, _s2, ... png otYYYYMMDDu_m3M_s1, _s2, ... png otYYYYMMDDu_m...M_s1, _s2, ... png



a) QLK of µVHI for dekad 3 of June 1985 with basic grains (s1: first).



b) QLK of µVHI for dekad 1 of August 2014 with irrigated rice (s1: first).

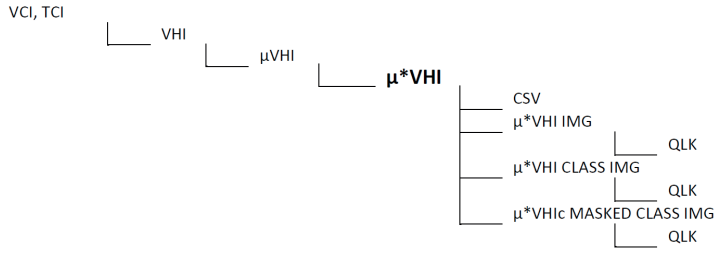
4.1.7. μ*VHI block

μ*VHI block

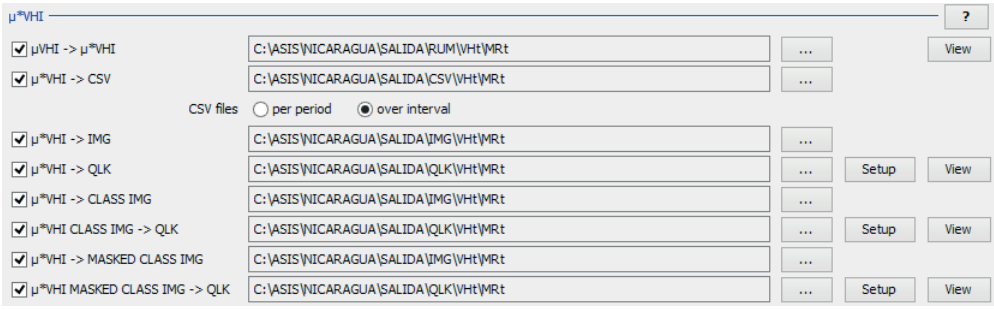
The **drought category** index or weighted mean VHI (μ*VHI – weighted mean VHI) is a regionally aggregated derivative of the mean VHI – μVHI, which indicates the intensity of drought, categorizing it into mild, moderate, severe or extreme drought.

RUM files are obtained by averaging the μVHI values by region for all land cover classes specified in the common block.

Dependencies of μ*VHI index and their derivates



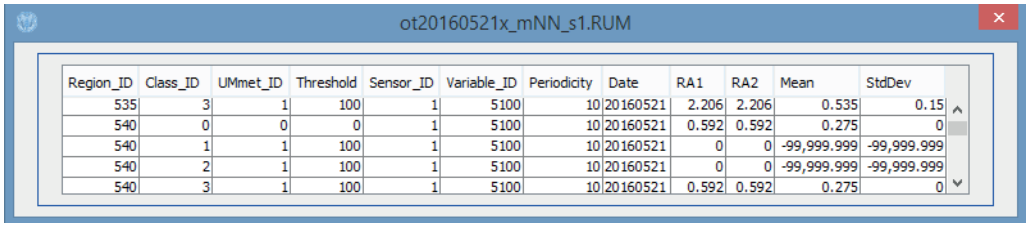
μ*VHI block functions



μVHI → μ*VHI

Generates the μ*VHI RUM files for each crop season defined in the common block.

Name format:	En la versión en español esta casilla aparece vacía



Region_ID	Class_ID	UMmet_ID	Threshold	Sensor_ID	Variable_ID	Periodicity	Date	RA1	RA2	Mean	StdDev
535	3	1	100	1	5100	10	20160521	2.206	2.206	0.535	0.15
540	0	0	0	1	5100	10	20160521	0.592	0.592	0.275	0
540	1	1	100	1	5100	10	20160521	0	0	-99,999.999	-99,999.999
540	2	1	100	1	5100	10	20160521	0	0	-99,999.999	-99,999.999
540	3	1	100	1	5100	10	20160521	0.592	0.592	0.275	0

μ*VHI → CSV

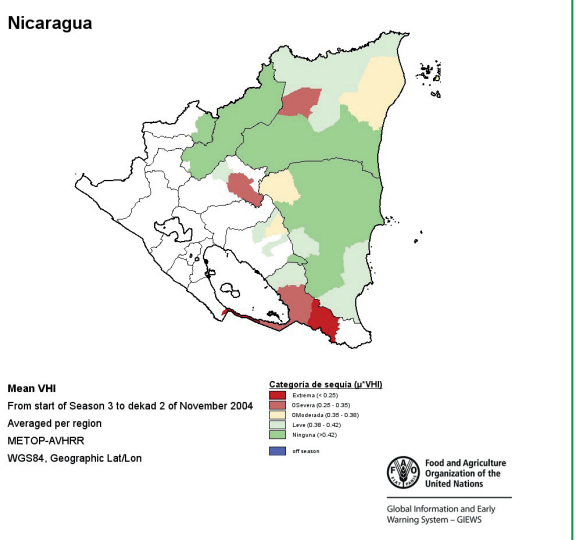
Converts one or more RUM files to multiple or a single CSV file. There are two options:

- **Per period:** Each RUM file per dekad is translated into a separate CSV file.
- **Over interval:** All RUM files by dekad are combined into a single CSV.

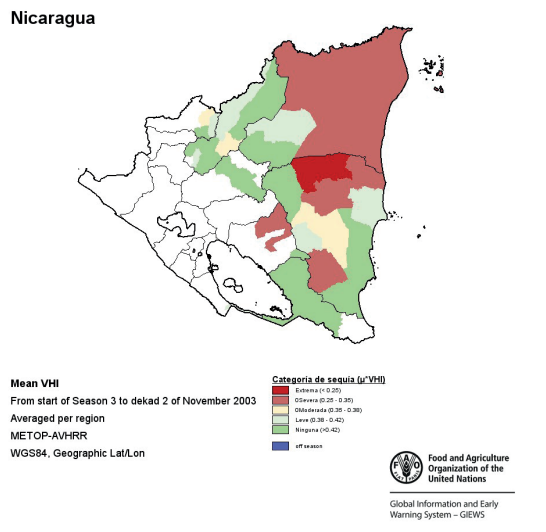
Name format:	otYYYYMMDDx_mNN_s1, _s2, ... csv

4. Operations by dekad and year

μ*VHI → IMG	
Reconverts RUM files to IMG image files with the mean μ*VHI values per region.	
Name format:	otYYYYMMDDx_mNN_s1, _s2, ... img
μ*VHI → QLK	
Generates the QLK graphic files of the μ*VHI IMG raster by dekad and crop season for the entire study area for the defined period of the common block.	
Name format:	otYYYYMMDDx_mNN_s1, _s2, ... png



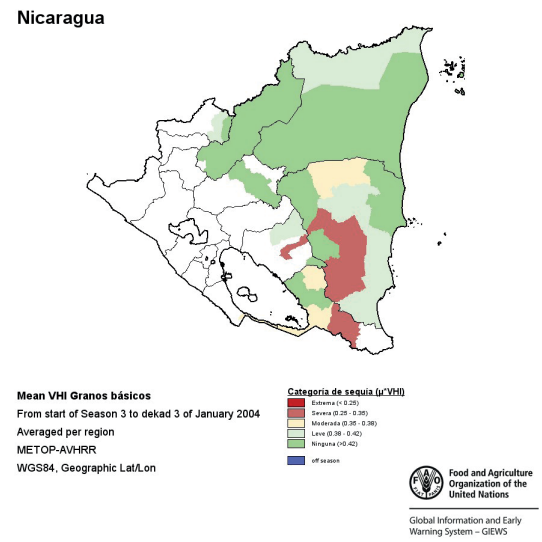
a) QLK of μ*VHI IMG for dekad 2 of November 2004 (s3: third)



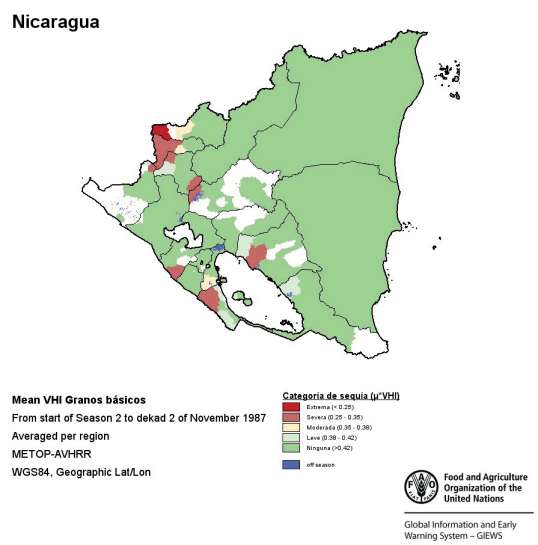
b) QLK of μ*VHI CLASS IMG for dekad 2 of November 2003 (s3: third)

μ*VHI → CLASS IMG	
Creates IMG raster files by dekad and crop season for each specific class in the common block and defined period.	
Name format:	otYYYYMMDDx_m2N_s1, _s2, ... img otYYYYMMDDx_m3N_s1, _s2, ... img otYYYYMMDDx_m...N_s1, _s2, ... img
μ*VHI CLASS IMG → QLK	
Generates QLK graphic files of the μ*VHI CLASS IMG raster by year and crop season.	
Name format:	otYYYYMMDDx_m2N_s1, _s2, ... png otYYYYMMDDx_m3N_s1, _s2, ... png otYYYYMMDDx_m...N_s1, _s2, ... png
μ*VHI → MASKED CLASS IMG	
Produces IMG raster files of masked μ*VHI by land use class according to the classes specified in the parameters of the common block for each crop season.	
Name format:	otYYYYMMDDx_m2M_s1, _s2, ... img otYYYYMMDDx_m3M_s1, _s2, ... img otYYYYMMDDx_m...M_s1, _s2, ... img

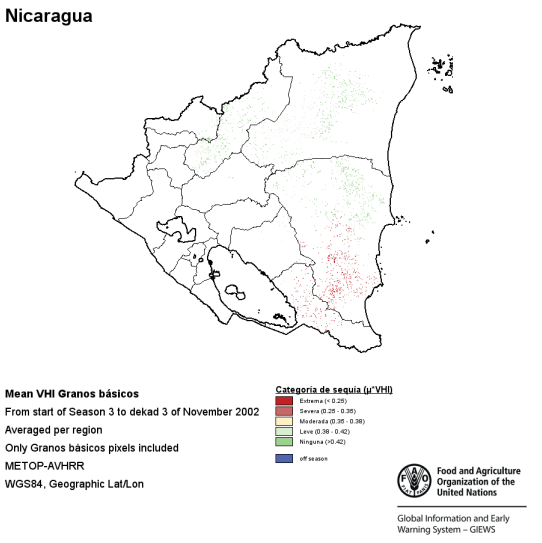
μ*VHI MASKED CLASS IMG → QLK	
Generates QLK graphic files of raster masked by index class μVHI per dekad during the period defined in the common block.	
Name format:	otYYYYMMDDx_m2M_s1, _s2, ... png otYYYYMMDDx_m3M_s1, _s2, ... png otYYYYMMDDx_m...M_s1, _s2, ... png



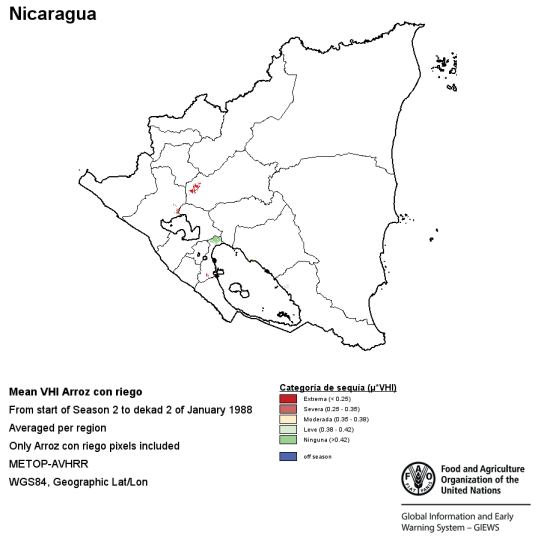
a) QLK of μ*VHI CLASS IMG for dekad 3 of January 2004 (s3: third) with basic grains



b) QLK of μ*VHI CLASS IMG for dekad 2 of November 1987 (s2: second)



a) QLK of μ*VHI MASKED CLASS IMG for dekad 3 of November 2002 (s3: third) with basic grains



b) QLK of μ*VHI MASKED CLASS IMG for dekad 2 of January 1988 (s2: second) with irrigated rice

4.1.8. ASI block

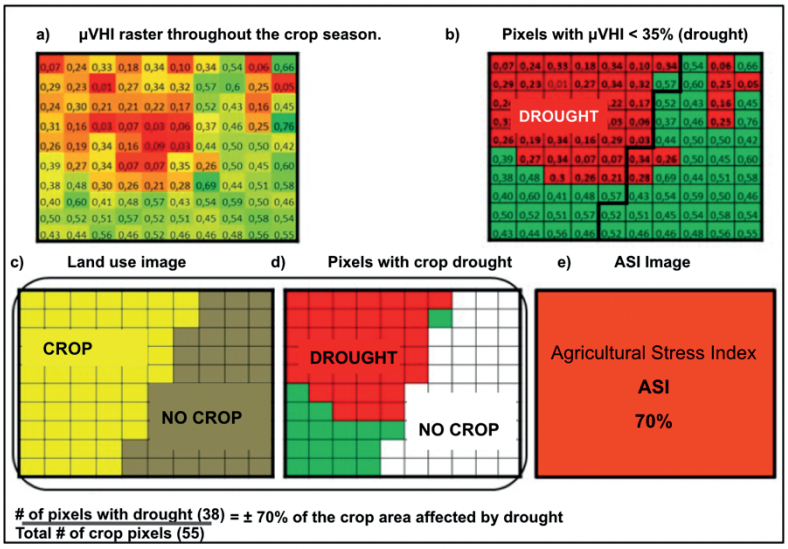
ASI block

The **Agricultural Stress Index** (ASI) is an indicator that shows anomalies in vegetation growth and potential droughts in crop areas during a given crop season. It represents the percentage of pixels of a specific crop type or land use within each administrative region that is affected by drought over the course of the crop season. Pixels with µVHI values below the 35% threshold are identified as drought.

When more than 50% of the cultivated area is suffering from drought, we can assume that we are facing an extreme drought event with serious impacts on food security.

The following figure illustrates the ASI calculation using a fictitious example of a 10 x 10 pixel region. Starting from the µVHI raster (a), which contains for the whole region the mean VHI values throughout the crop season during the study period, a spatial integration is performed considering only the cultivated area (c). ASI is the percentage of the cropped area within the region with µVHI values less than 0.35. All pixels in the administrative region acquire the value of ASI (e).

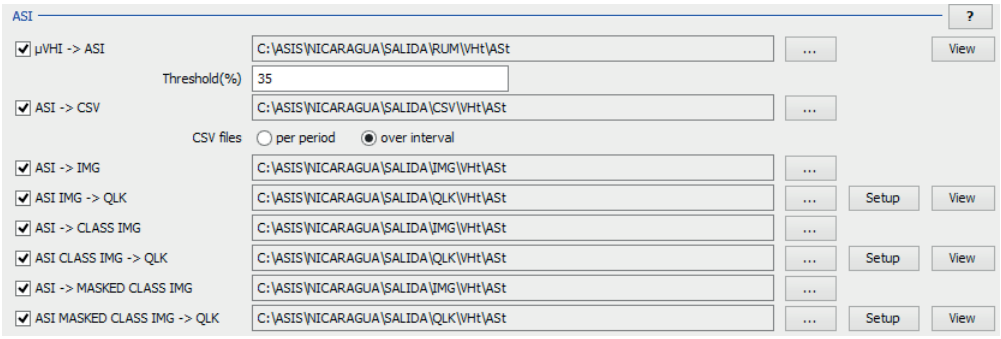
The final evaluation results in an extreme drought event (ASI > 50%) for that region.



Dependencies of ASI index and their derivates

- VCI, TCI
  - VHI
    - µVHI
      - **ASI**
        - CSV
        - ASI IMG
          - QLK
        - ASI CLASS IMG
          - QLK
        - ASI MASKED CLASS IMG
          - QLK

ASI block functions



µVHI → ASI

Generates the RUM files for ASI, which contain the frequencies by region for all land use classes specified in the common block.

Name format:	otYYYYMMDDa_mNN_s1, _s2, ... rum

ASI → CSV

Converts one or more RUM files to multiple or a single CSV file. There are two options:

- **Per period:** Each RUM file per dekad is translated into a separate CSV file.
- **Over interval:** All RUM files by dekad are combined into a single CSV.

Name format:	otYYYYMMDDa_mNN_s1, _s2, ... csv

ASI → IMG

Reconverts RUM files to IMG image files with ASI values for all classes per region.

Name format:	otYYYYMMDDa_mNN_s1, _s2, ... img

ASI IMG → QLK

Generates QLK graphic files of ASI IMG raster by dekad for all classes together and by crop season during the period defined in the common block.

Name format:	otYYYYMMDDa_mNN_s1, _s2, ... png

ASI → CLASS IMG

Creates the IMG raster files with the values of the RUM files for each class, but without masking them.

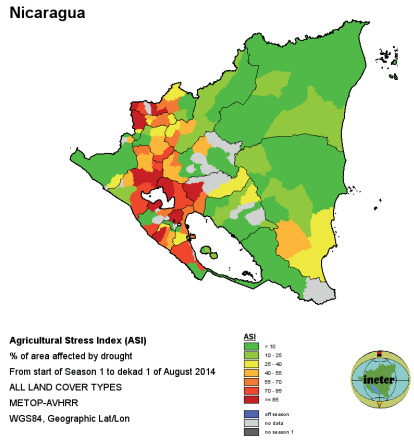
Name format:	otYYYYMMDDa_m2N_s1, _s2, ... img otYYYYMMDDa_m3N_s1, _s2, ... img otYYYYMMDDa_m...N_s1, _s2,... img

ASI CLASS IMG → QLK

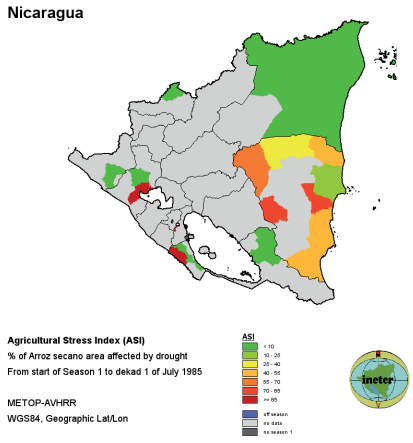
Generates QLK graphic files of the ASI CLASS IMG raster by dekad for each class separately and by crop season during the period defined in the common block.

Name format:	otYYYYMMDDa_m2N_s1, _s2, ... png otYYYYMMDDa_m3N_s1, _s2, ... png otYYYYMMDDa_m...N_s1, _s2,... png

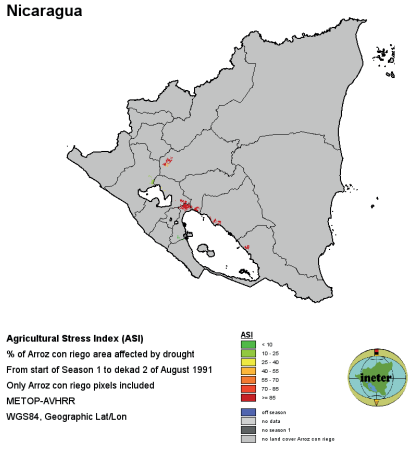
ASI → MASKED CLASS IMG	
Creates the IMG image files with the values of the RUM files for each masked class. Uses the Classes IMG raster for masking. Pixels that do not belong to the specified class are omitted.	
Name format:	otYYYYMMDDa_m2N_s1, _s2, ... png otYYYYMMDDa_m3N_s1, _s2, ... png otYYYYMMDDa_m...N_s1, _s2,... png
ASI MASKED CLASS IMG → QLK	
Generates QLK graphic files of the ASI MASKED CLASS IMG raster by dekad for each masked class and by crop season during the period defined in the common block.	
Name format:	otYYYYMMDDa_m2M_s1, _s2, ... png otYYYYMMDDa_m3M_s1, _s2, ... png otYYYYMMDDa_m...M_s1, _s2,... png



a) ASI IMG QLK for dekad 1 of August 2014 (s1: first)



b) ASI IMG QLK for dekad 1 of July 1985 (s1: first) for rainfed rice



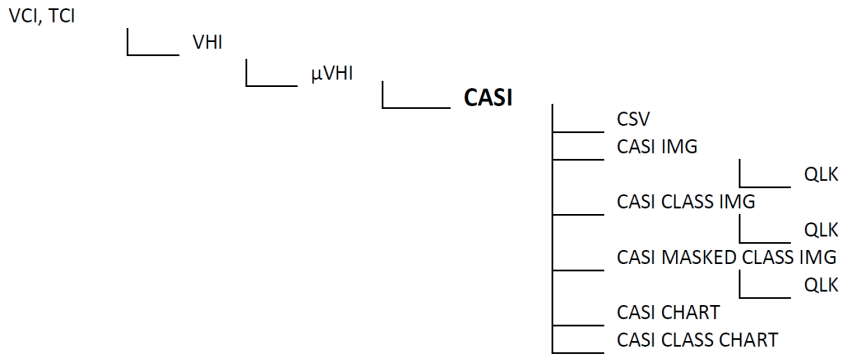
c) ASI MASKED CLASS IMG QLK for dekad 2 of August 1991 (s1: first) for irrigated rice

4.1.9. CASI block

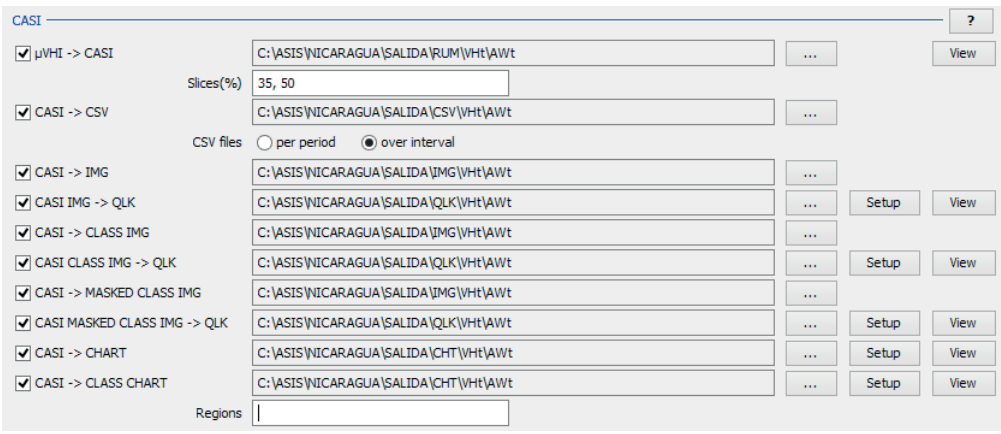
CASI block

The Categorical ASI (CASI) indicator represents the percentage of pixels (land-use specific) within each administrative region belonging to a specific user-defined drought category. It considers different µVHI categories with user-specified thresholds instead of the binary classification with µVHI≤35% or µVHI> 35% of the ASI index.

Dependencies of CASI index and their derivates



CASI block functions



µVHI → CASI

Generates the RUM files for CASI, which contain the percentage of pixels per region with µVHI values between the defined intervals (categories) for all land use classes specified in the common block.

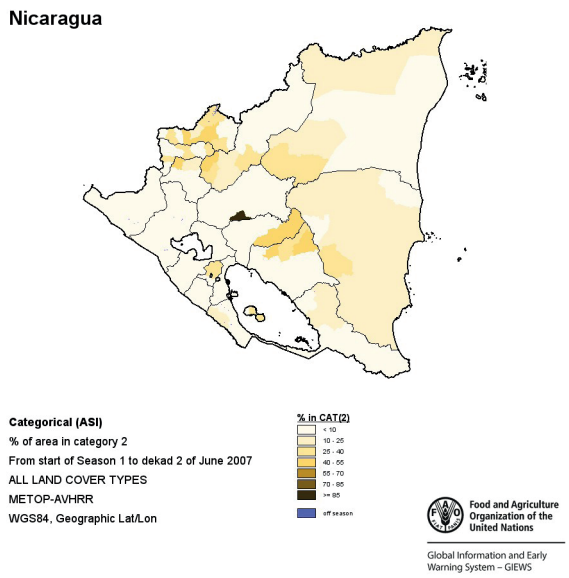
Name format:	otYYYYMMDDw_mNN_s1, _s2, … rum

CASI → IMG

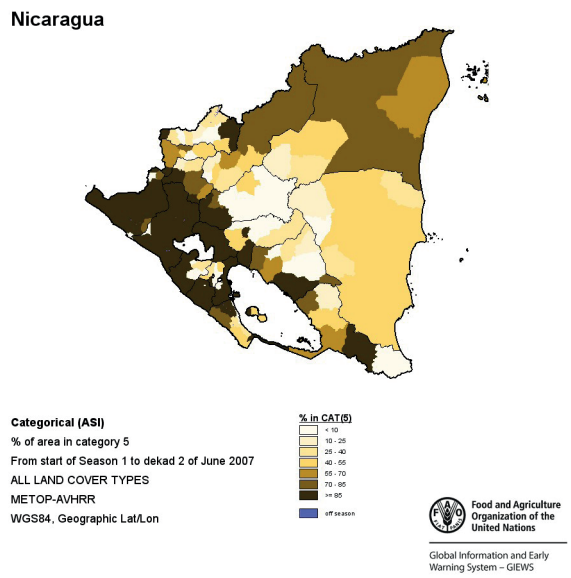
Creates IMG raster files from RUM files by category for all land uses.

Name format:	otYYYYMMDDw_c1_mNN_s1, _s2, … img otYYYYMMDDw_c2_mNN_s1, _s2, … img otYYYYMMDDw_c.._mNN_s1, _s2, … img

CASI IMG → QLK	
Generates QLK graphic files of CASI IMG rasters by dekad for all classes together and by crop season for the period defined in the common block.	
Name format:	otYYYYMMDDw_c1_mNN_s1, _s2, ... png otYYYYMMDDw_c2_mNN_s1, _s2, ... png otYYYYMMDDw_c.._mNN_s1, _s2, ... png



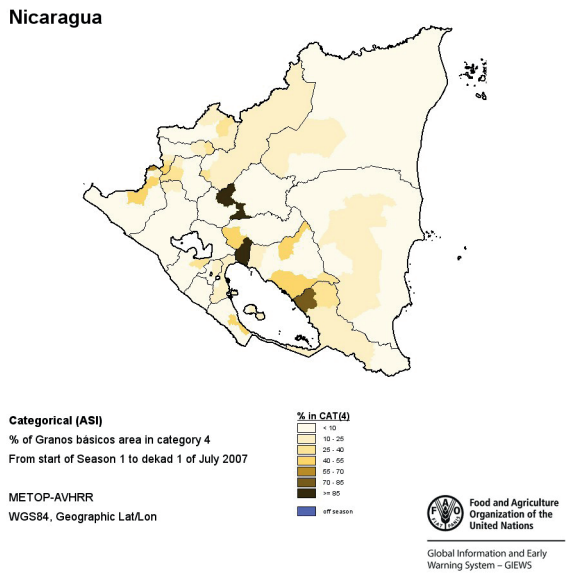
a) CASI IMG QLK for dekad 2 of June 2007 (s1: first) Category 2 CASI



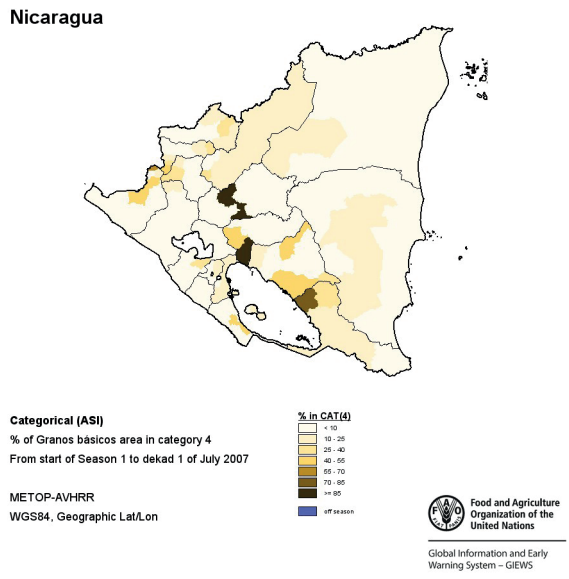
b) CASI IMG QLK for dekad 2 of June 2007 (s1: first) Category 5 CASI

CASI → CLASS IMG	
Creates the IMG raster files from the RUM files by category for each land use class specified in the common parameters.	
Name format:	otYYYYMMDDw_c1_m2N_s1, _s2, ... img otYYYYMMDDw_c2_m2N_s1, _s2, ... img otYYYYMMDDw_c.._m2N_s1, _s2, ... img otYYYYMMDDw_c1_m3N_s1, _s2, ... img ...

CASI CLASS IMG → QLK	
Generates QLK graphic files of the CASI CLASS IMG raster by dekad for each land use class and by crop season during the period defined in the common block.	
Name format:	otYYYYMMDDw_c1_m2N_s1, _s2, ... png otYYYYMMDDw_c2_m2N_s1, _s2, ... png otYYYYMMDDw_c.._m2N_s1, _s2, ... png otYYYYMMDDw_c1_m3N_s1, _s2, ... png ...



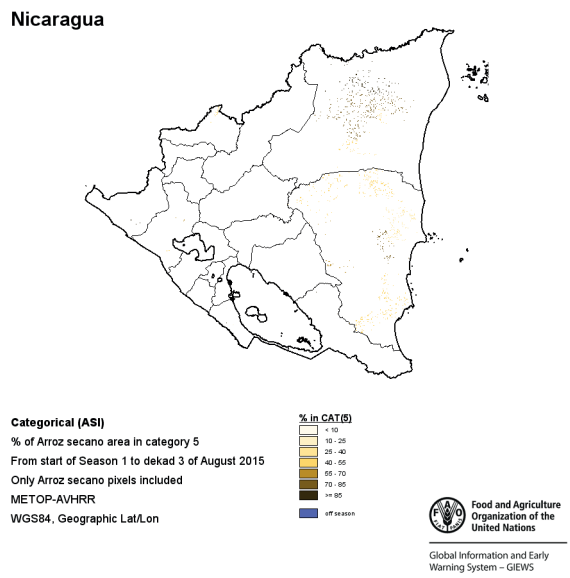
a) CASI CLASS IMG QLK for dekad 1 of July 2007 (s1: first) CASI Category 4



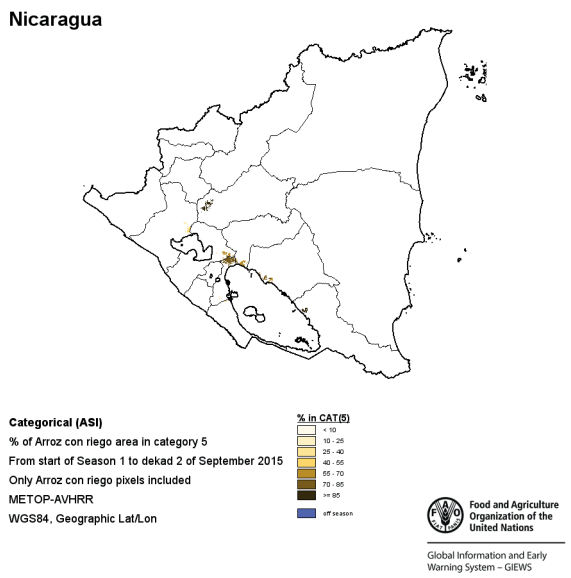
b) CASI CLASS IMG QLK for dekad 2 of July 2007 (s1: first) Category 5 CASI for rainfed rice

CASI → MASKED CLASS IMG	
Creates IMG raster files from the RUM files by category for each masked land use class specified in the common parameters.	
Name format:	otYYYYMMDDw_c1_m2M_s1, _s2, ... img otYYYYMMDDw_c2_m2M_s1, _s2, ... img otYYYYMMDDw_c.._m2M_s1, _s2, ... img otYYYYMMDDw_c1_m3M_s1, _s2, ... img ...
CASI MASKED CLASS IMG → QLK	
Generates QLK graphic files of the CASI MASKED CLASS IMG raster by dekad for each masked land use class and by crop season during the period defined in the common block.	
Name format:	otYYYYMMDDw_c1_m2M_s1, _s2, ... png otYYYYMMDDw_c2_m2M_s1, _s2, ... png otYYYYMMDDw_c.._m2M_s1, _s2, ... png otYYYYMMDDw_c1_m3M_s1, _s2, ... png ...
CASI → CHART	
Generates bar charts of the specified administrative regions for all land uses with the distribution of CASI categories.	

Name format:	otYYYYMMDDw_mN_rR_s1, _s2, ... png otYYYYMMDDw_mN_rR_s1, _s2, ... png ... (R: Region ID)
CASI → CLASS CHART	
Generates bar charts of the specified administrative regions by land use class with the distribution of CASI categories.	
Name format:	otYYYYMMDDw_m2_r1_s1, _s2, ... png otYYYYMMDDw_m2_r2_s1, _s2, ... png ...



a) CASI MASKED CLASS IMG QLK for dekad 3 of August 2015 (s1: first) Category 5 CASI for rainfed rice

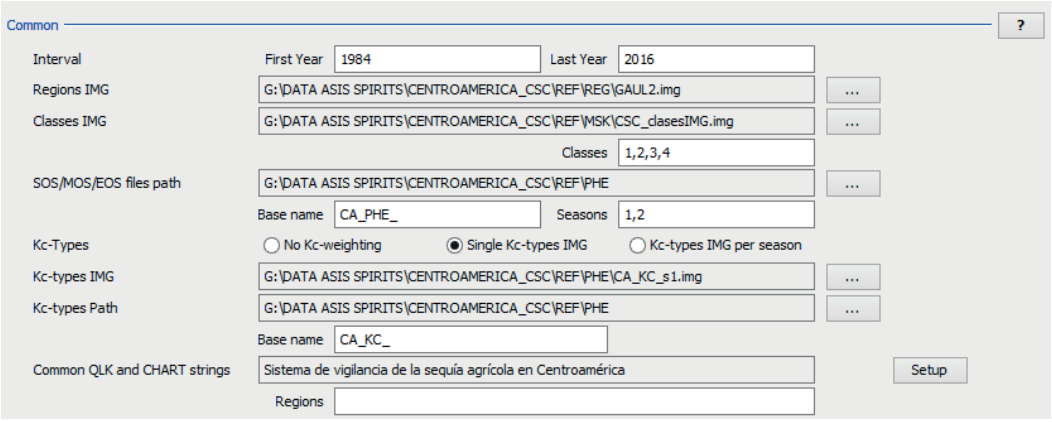


b) CASI MASKED CLASS IMG QLK for dekad 2 of September 2015 (s1: first) Category 5 CASI for irrigated rice

4.2. Annual operations

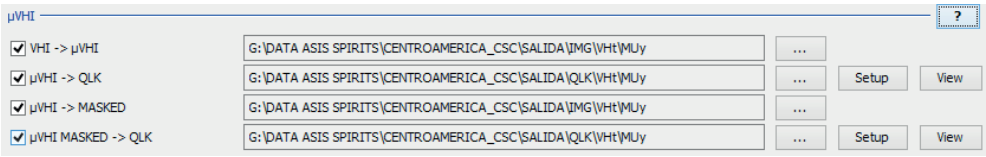
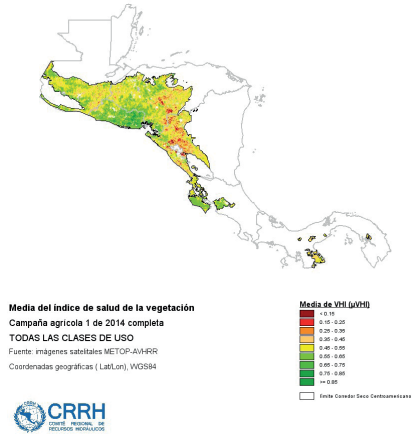
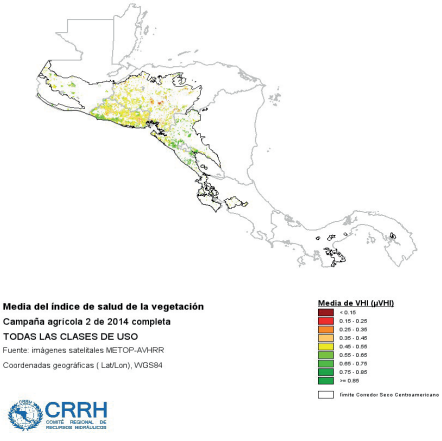
4.2.1. Common block

"Annual Operations" Panel
Common block
At the top of the Annual Operations panel, you must specify the parameters common to multiple functions within Country-level ASIS. These are:

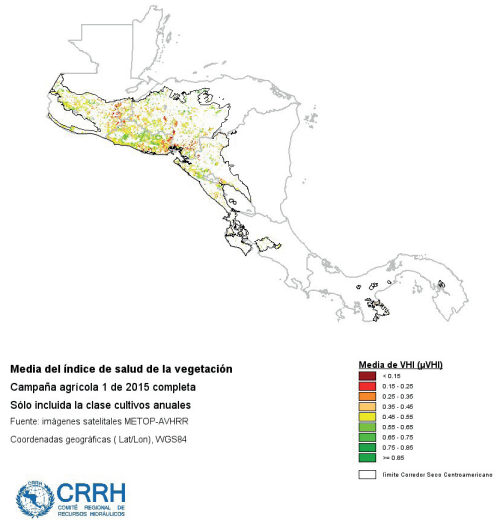


Interval
Consists of the interval or period of time over which the Country-level ASIS functions will be executed, determined by the date of the first and last year of the series under study in the format YYYY.
Regions IMG
Specifies the path and categorical raster file in IMG format of administrative regions. Each pixel carries the code of an administrative region. For example: GAUL0: country, GAUL1: province, GAUL2: municipality.
Classes IMG
Specifies the route and categorical raster file in IMG format with the land use classification. This file must be BYTE type (0-255) with the value "0" reserved for the class "Unclassified". Each pixel must contain the code of a class following a fixed legend, for example: 1 = rice, 2 = corn, 3 = beans.
Classes
List of Classes IMG raster classes codes, separated by comma, considered for operations.
SOS/MOS/EOS files path
Defines the path of the phenology files, derived from the global ASIS2 or created by means of the Customizations functions. In "Seasons", the crop seasons (1,2,3...) are placed.
Kc-Types/Kc-types IMG/Kc-types Path
Defines the controls on the crop coefficient Kc. If applicable, specify the path and raster files, derived from the global ASIS2 or from the Customizations functions.
Common QLK and CHART strings
Specifies the configurable parameters for the output graphic files: QLK maps and CHART charts. By clicking on the "Setup" button, you can configure parameters such as title, name of land use classes according to the uniquely identified code, and administrative regions.

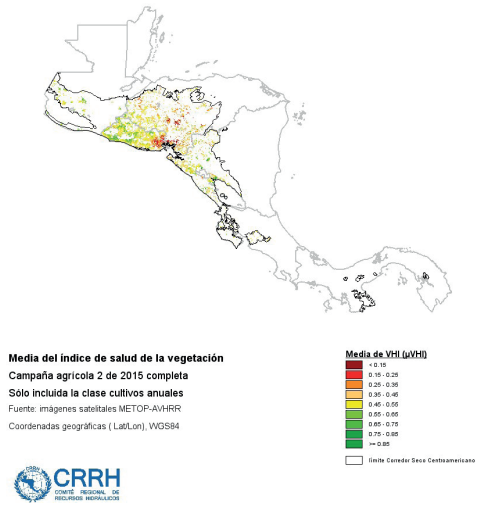
4.2.2. µVHI block

µVHI block
The mean VHI (µVHI – Mean VHI) is the integrated value of the VHI index over the agricultural season, which for the annual version reflects the final state of the selected year. In order to run the annual operations, it is necessary to have previously calculated the operations per dekad of the VHI index for all the dekads of the selected year. The calculation uses the raster of phenology and crop coefficient specified in the common parameters.
Dependencies of µVHI index and their derivates
VCI, TCI └── VHI └── **µVHI** ├── QLK └── µVHI MASKED └── QLK
µVHI block functions

VHI → µVHI
Obtains the IMG files of the µVHI, integrating the VHI values over the specified crop seasons. One IMG file is produced per crop season for each year (suffix s = 1/2/3...).
Name format: oyYYYYu_mNN_s1, _s2, ...img
µVHI → QLK
Generates QLK graphic files from the µVHI raster by year for the entire study area during the period defined in the common block.
Name format: oyYYYYu_mNN_s1, _s2, ... png
	
c) QLK of µVHI for the year 2014 (s1: first)	d) QLK of µVHI for the year 2014 (s2: second)

µVHI → MASKED	
Produces µVHI IMG files masked by land use class according to the classes specified in the common block parameters for each crop season.	
Name format:	oyYYYYu_m2M_s1, _s2, ... img oyYYYYu_m3M_s1, _s2, ... img oyYYYYu_m...M_s1, _s2, ... img
µVHI MASKED → QLK	
Generates QLK graphic files of raster masked by µVHI index class per dekad during the period defined in the common block.	
Name format:	oyYYYYu_m2M_s1, _s2, ... png otYYYYu_m3M_s1, _s2, ... png otYYYYu_m...M_s1, _s2, ... png



c) QLK of µVHI for 2015 for annual crops (s1: first)



d) QLK of µVHI for 2015 for annual crops (s2: second)

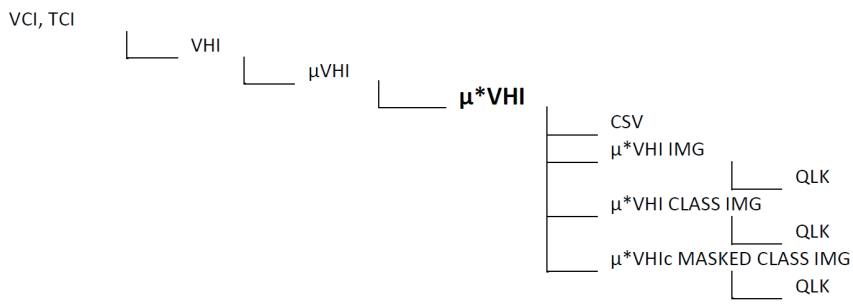
4.2.3. µ*VHI block

µ*VHI block

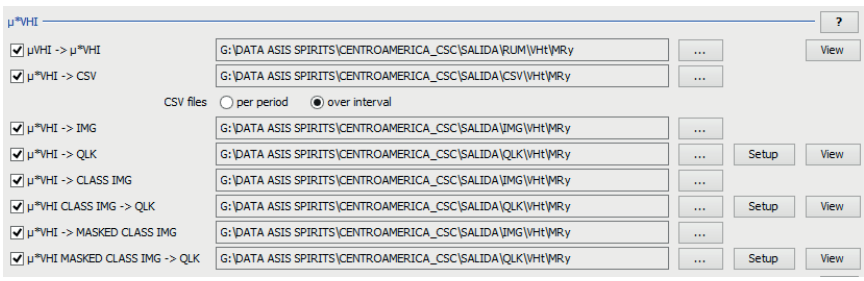
The **drought category index** or weighted mean VHI (µ*VHI – weighted mean VHI) is a regionally aggregated derivative of the mean VHI – µVHI, which indicates the intensity of drought, categorizing it into mild, moderate, severe or extreme drought.

In the annual version, the final state of the selected year is reflected.

Dependencies of µ*VHI index and their derivates



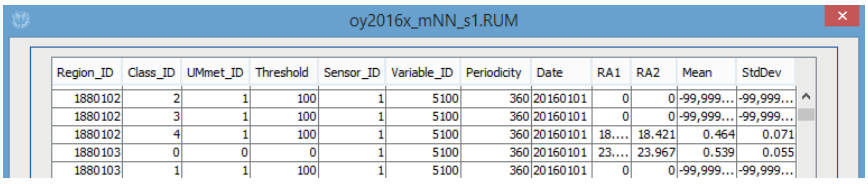
µ*VHI block functions



µVHI → µ*VHI

Generates the µ*VHI RUM files for each crop season defined in the common block.

Name format:	otYYYYx_mNN_s1, _s2, ... rum



Region_ID	Class_ID	UMmet_ID	Threshold	Sensor_ID	Variable_ID	Periodicity	Date	RA1	RA2	Mean	StdDev
1880102	2	1	100	1	5100	360	20160101	0	0	-99,999...	-99,999...
1880102	3	1	100	1	5100	360	20160101	0	0	-99,999...	-99,999...
1880102	4	1	100	1	5100	360	20160101	18....	18.421	0.464	0.071
1880103	0	0	0	1	5100	360	20160101	23....	23.967	0.539	0.055
1880103	1	1	100	1	5100	360	20160101	0	0	-99,999...	-99,999...

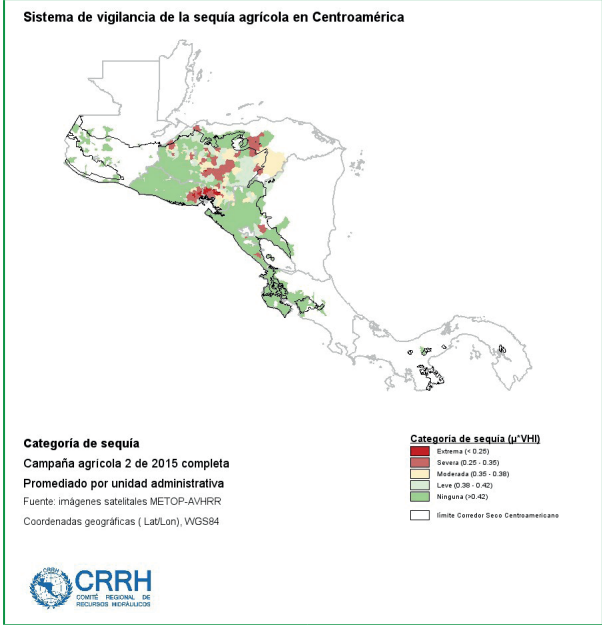
µ*VHI → CSV

Converts one or more RUM files to multiple or a single CSV file. There are two options:

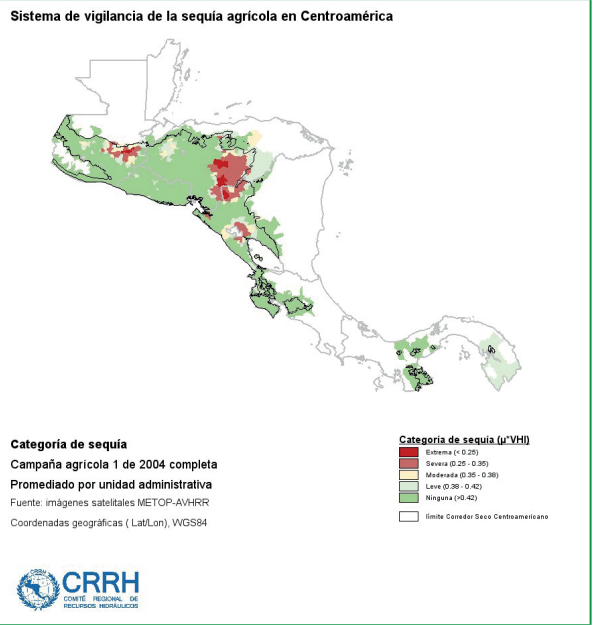
- **Per period:** Each RUM file per year is translated into a separate CSV file.
- **Over interval:** All RUM files by year are combined into a single CSV.

Name format:	otYYYYx_mNN_s1, _s2, ... csv

μ*VHI → IMG	
Reconverts RUM files to IMG image files with the mean μ*VHI values per region.	
Name format:	otYYYYx_mNN_s1, _s2, ... img
μ*VHI → QLK	
Generates the QLK graphic files of the μ*VHI IMG raster by year and crop season for the entire study area during the period defined in the common block.	
Name format:	otYYYYx_mNN_s1, _s2, ... png

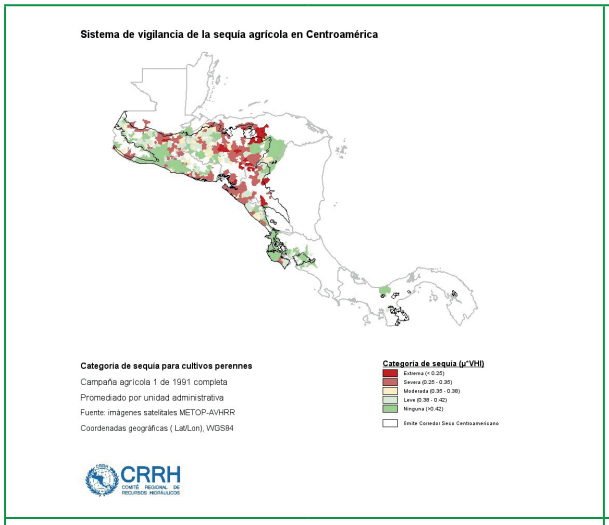


a) QLK of μ*VHI IMG for the year 2004 (first)

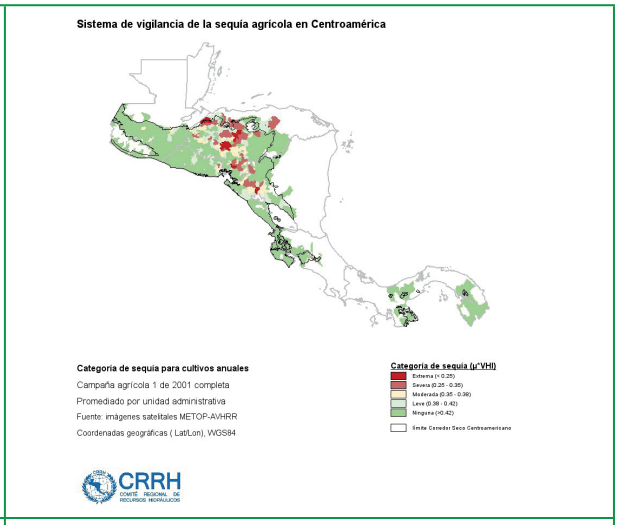


b) QLK of μ*VHI CLASS IMG for the year 2015 (second)

μ*VHI → CLASS IMG	
Creates IMG raster files by year and crop season for each class specified and period defined in the common block.	
Name format:	otYYYYx_m2N_s1, _s2, ... img otYYYYx_m3N_s1, _s2, ... img otYYYYx_m...N_s1, _s2, ... img
μ*VHI CLASS IMG → QLK	
Generates QLK graphic files of the μ*VHI CLASS IMG raster by year and crop season.	
Name format:	otYYYYx_m2N_s1, _s2, ... png otYYYYx_m3N_s1, _s2, ... png otYYYYx_m...N_s1, _s2, ... png



a) QLK of perennial crops for the year 1991



b) QLK of annual crops for the year 2001

µ*VHI → MASKED CLASS IMG

Produces IMG raster files of masked µ*VHI by land use class according to the classes specified in the parameters of the common block for each crop season.

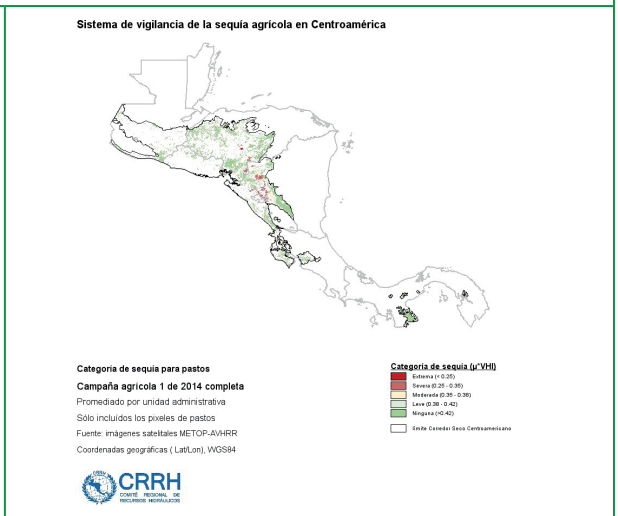
Name format:	otYYYYx_m2M_s1, _s2, ... img otYYYYx_m3M_s1, _s2, ... img otYYYYx_m...M_s1, _s2, ... img

µ*VHI MASKED CLASS IMG → QLK

Generates QLK graphic files of masked rasters by index class µVHI per year during the period defined in the common block.

Name format:	otYYYYx_m2M_s1, _s2, ... png otYYYYx_m3M_s1, _s2, ... png otYYYYx_m...M_s1, _s2, ... png

c) QLK of perennial crops for the year 1991



d) QLK of pasture for the year 2014

4.2.4. ASI block

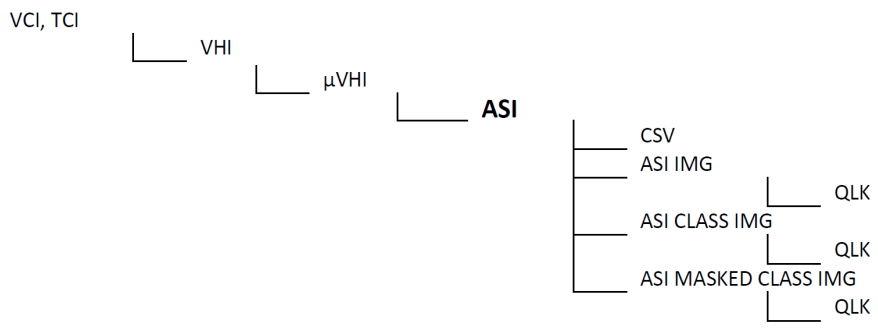
ASI block

The **Agricultural Stress Index (ASI)** represents the percentage of pixels of a specific crop type or land use within each administrative region that is affected by drought throughout the crop season. Pixels with µVHI values below the 35% threshold are identified as drought.

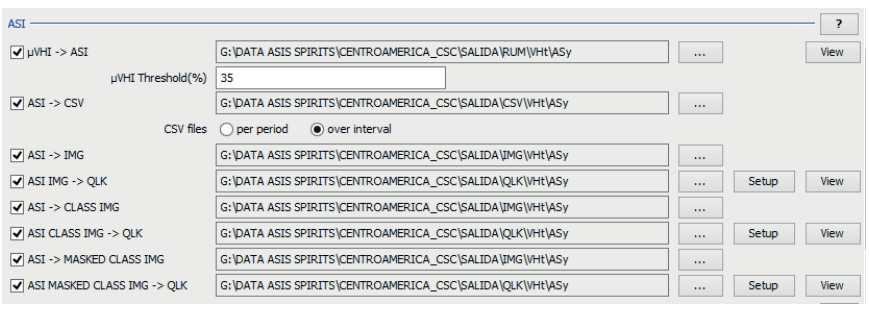
In annual operations, the ASI index shows the final status of the selected year and crop seasons. It is recommended to perform the annual calculations at different administrative levels in order to obtain general statistics of the drought situation also by province and/or country.

The ASI calculation for a given year can only be performed if the complete data for the following year are available; for example, to calculate the year 2017, the data for the entire year 2018, from January to December, are required.

Dependencies of ASI index and their derivates



ASI block functions



µVHI → ASI

Generates the RUM files for ASI, which contain the frequencies by region for all land use classes specified in the common block.

Name format:	otYYYYa_mNN_s1, _s2, ... rum

ASI → CSV

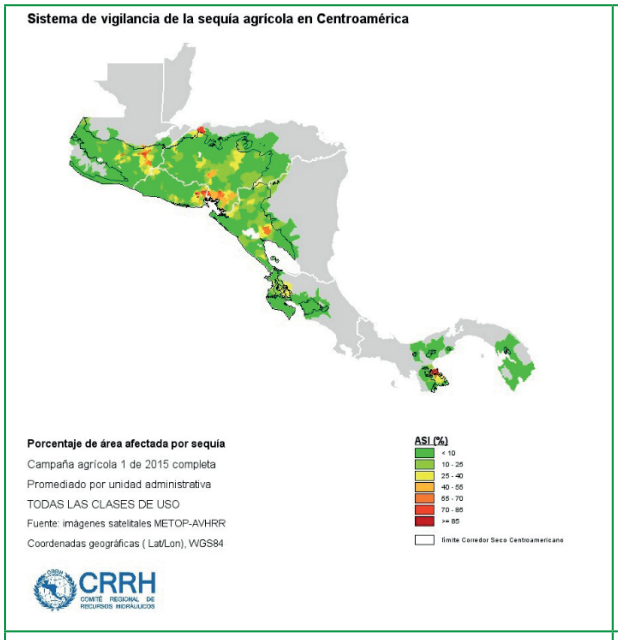
Converts one or more RUM files to multiple or a single CSV file. There are two options:

- **Per period:** Each RUM file per dekad is translated into a separate CSV file.
- **Over interval:** All RUM files by dekad are combined into a single CSV.

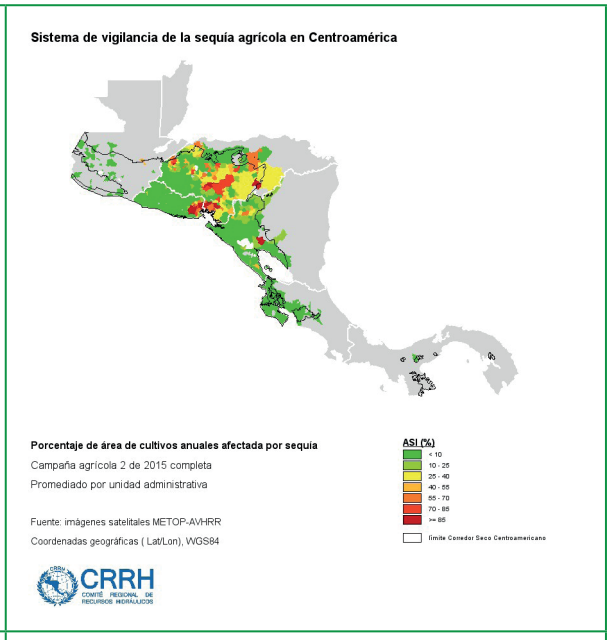
Name format:	otYYYYa_mNN_s1, _s2, ... csv

4. Operations by dekad and year

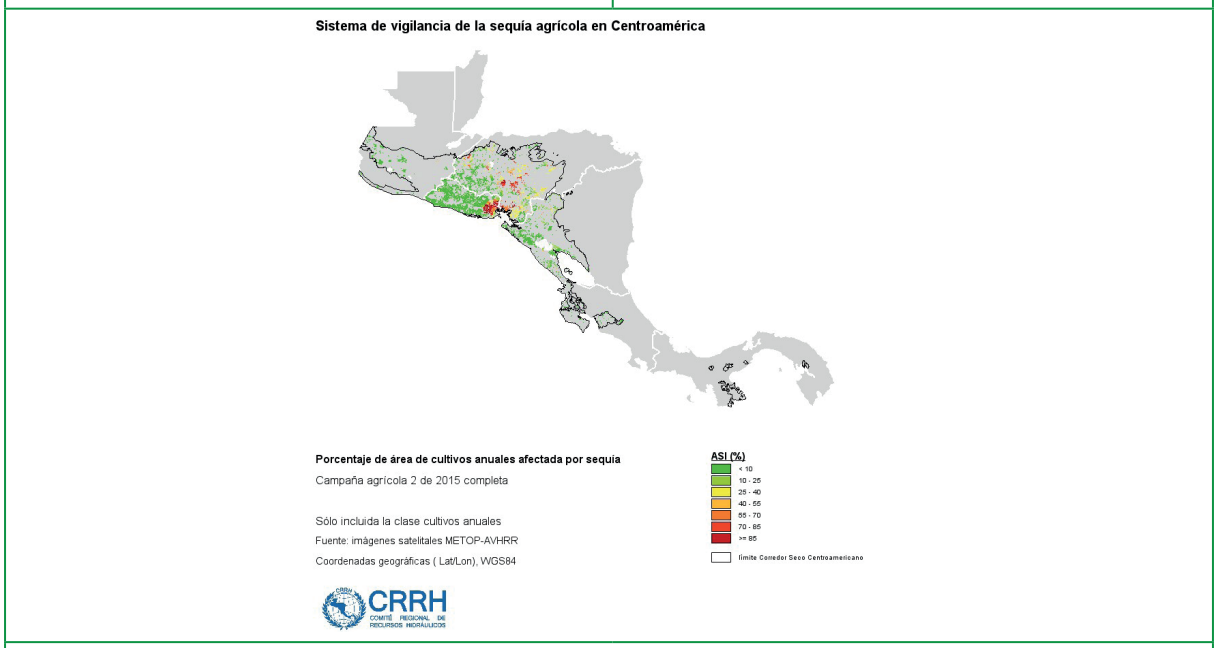
ASI → IMG	
Reconverts RUM files to IMG image files with ASI values for all classes per region.	
Name format:	otYYYYa_mNN_s1, _s2, ... img
ASI IMG → QLK	
Generates QLK graphic files of ASI IMG raster by dekad for all classes together and by crop season during the period defined in the common block.	
Name format:	otYYYYa_mNN_s1, _s2, ... png
ASI → CLASS IMG	
Creates the IMG raster files with the values of the RUM files for each class, but without masking them.	
Name format:	otYYYYMMDDa_m2N_s1, _s2, ... img otYYYYMMDDa_m3N_s1, _s2, ... img otYYYYMMDDa_m...N_s1, _s2,... img
ASI CLASS IMG → QLK	
Generates QLK graphic files of the ASI CLASS IMG raster by year for each class separately and by crop season during the period defined in the common block.	
Name format:	otYYYYMMDDa_m2N_s1, _s2, ... png otYYYYMMDDa_m3N_s1, _s2, ... png otYYYYMMDDa_m...N_s1, _s2,... png
ASI → MASKED CLASS IMG	
Create IMG image files with the values of the RUM files for each masked class. Use the Classes IMG raster for masking. Pixels that do not belong to the specified class are omitted.	
Name format:	otYYYYMMDDa_m2M_s1, _s2, ... img otYYYYMMDDa_m3M_s1, _s2, ... img otYYYYMMDDa_m...M_s1, _s2,... img
ASI MASKED CLASS IMG → QLK	
Generates QLK graphic files of the ASI MASKED CLASS IMG raster by year for each masked class and by crop season during the period defined in the common block.	
Name format:	otYYYYMMDDa_m2M_s1, _s2, ... png otYYYYMMDDa_m3M_s1, _s2, ... png otYYYYMMDDa_m...M_s1, _s2,... png



a) ASI IMG QLK for the year 2015 (s1: first)



b) ASI CLASS IMG QLK for the year 2015 (s2: second) for annual crops



c) ASI MASKED CLASS IMG QLK for the year 2015 (s2: second) for annual crops

4.2.5. PE block

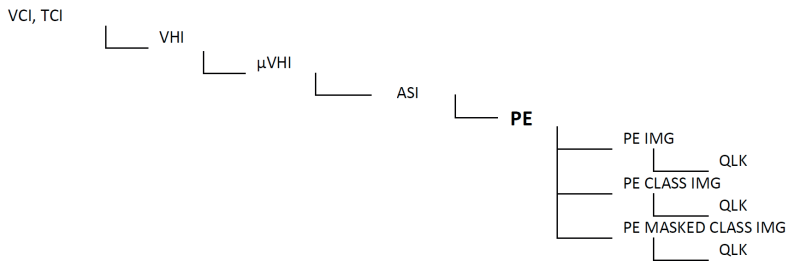
PE block

Historical **Drought Probability** (PE) indicates the historical frequency of drought throughout all years of the time series defined in the common block.

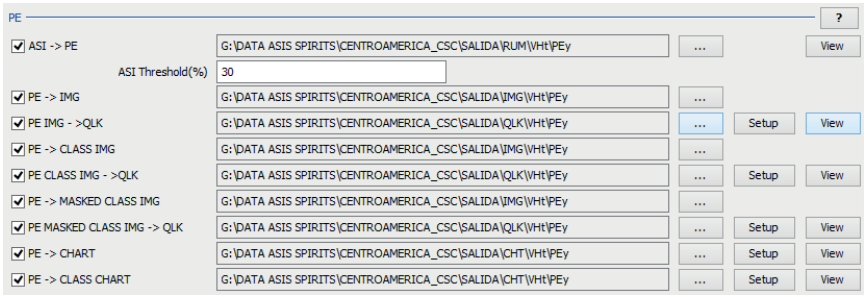
PE RUM files are obtained by calculating the percentage of years exceeding a specific ASI threshold (e.g. ASI > 30%) by administrative region. The resulting file contains these percentages by region for all land uses and by land use class specified in the common parameters for the fixed set of thresholds Te 0,10,20, ... 90, plus the threshold explicitly specified by the user in the PE block.

PE operations are only available for annual operations and their calculation can only be performed for a range of years.

Dependencies of PE index and their derivates



PE block functions



ASI → PE

Generates the RUM files for PE, which contain the percentage of years exceeding the specified ASI threshold by administrative region for all land use classes in the common block.

Name format:	pyYYYY_YYYYa_mNN_s1, _s2... rum

PE → IMG

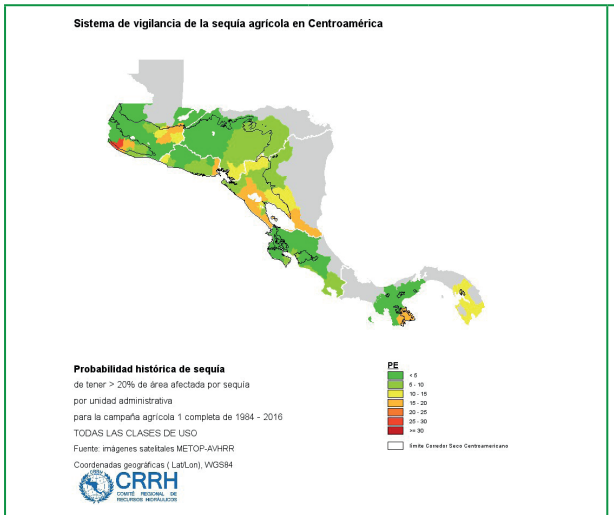
Creates IMG raster files from the RUM files for all land uses. You must define the ASI threshold in the ASI Threshold (%) text box.

Name format:	pyYYYY_YYYYa_tT_mNN_s1, _s2... img (T: ASI threshold 0..99)

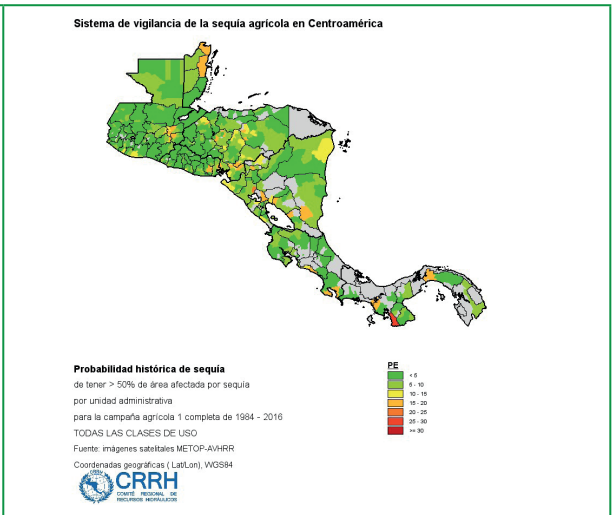
PE IMG → QLK

Generates QLK graphic files from PE IMG raster for all classes together and per crop season during the period defined in the common block.

Name format:	pyYYYY_YYYYa_tT_mNN_s1, _s2... png

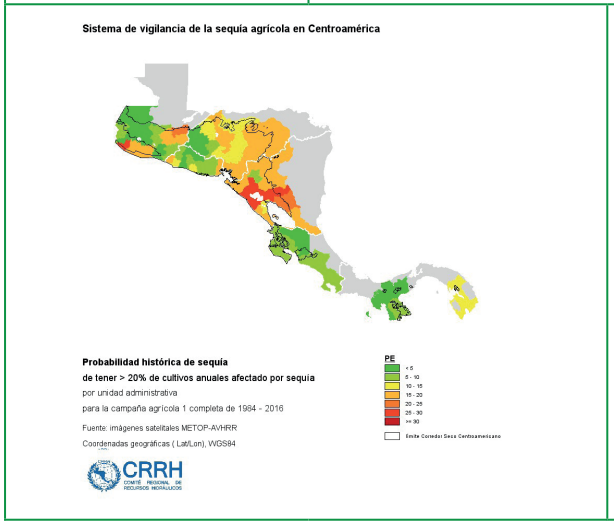


a) PE IMG QLK for the period 1984-2016, crop year 1 (s1: first), ASI threshold > 20%, province level

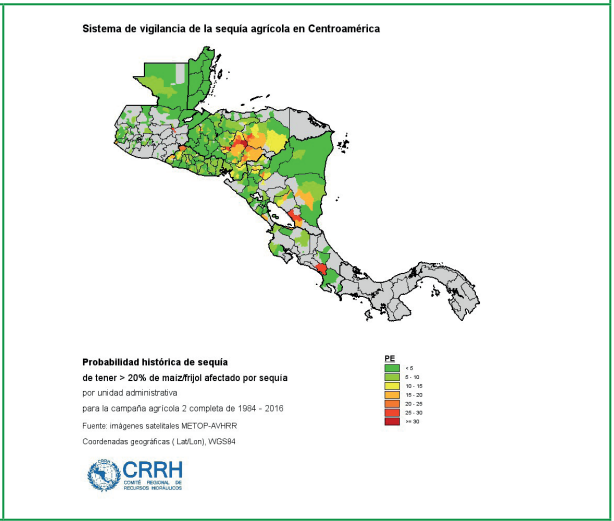


b) PE IMG QLK for the period 1984-2016, crop year 1 (s1: first), ASI threshold > 50%, municipality level

PE → CLASS IMG	
Creates the IMG raster files from the RUM files by category for each land use class specified in the common parameters.	
Name format:	pyYYYY_YYYYa_tT_mCN_s1, _s2... img (C: Class ID)...
PE CLASS IMG → QLK	
Generates QLK graphic files of the PE CLASS IMG raster for each land use class and per crop season during the period defined in the common block.	
Name format:	pyYYYY_YYYYa_tT_mCN_s1, _s2... png (C: Class ID)...



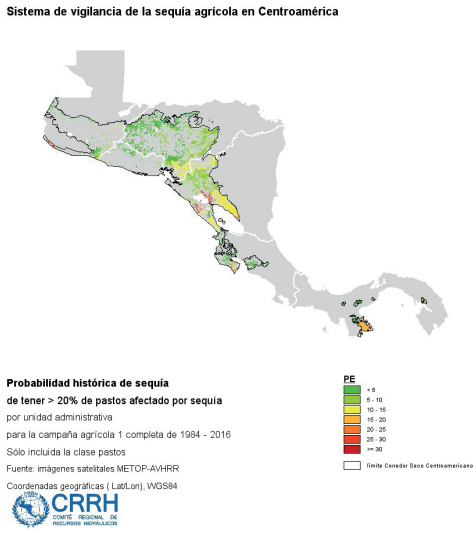
a) PE CLASS IMG QLK for the period 1984-2016, crop season 1 (s1: first), annual crops class, ASI threshold > 20%, province level



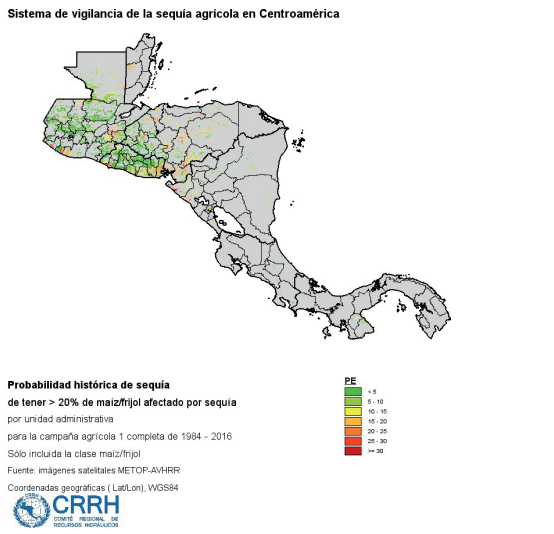
b) PE CLASS IMG QLK for the period 1984-2016, crop season 1 (s1: first), corn/bean class, ASI threshold > 20%, municipality level

4. Operations by dekad and year

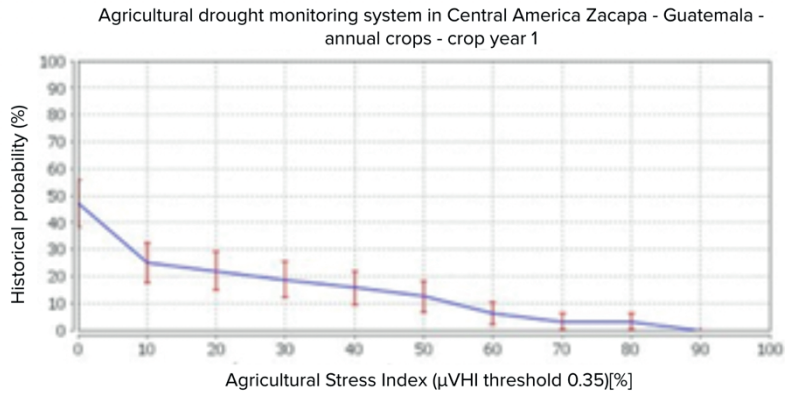
PE → MASKED CLASS IMG	
Creates IMG raster files from the RUM files by category for each masked land use class specified in the common parameters.	
Name format:	pyYYYY_YYYYa_tT_mCM_s1, _s2... img (C: Class ID)...
PE MASKED CLASS IMG → QLK	
Generates QLK graphic files of the PE MASKED CLASS IMG raster for each masked land use class and per crop season during the period defined in the common block.	
Name format:	pyYYYY_YYYYa_tT_mCM_s1, _s2... (C: Class ID)...
PE → CHART	
Generates graphs of specified administrative regions for all land uses using the historical probability of drought.	
Name format:	pyYYYY_YYYYa_mNM_rR_s1, _s2... (R: Region ID)
PE → CLASS CHART	
Generates graphs of specified administrative regions by land use class using historical probability of drought.	
Name format:	pyYYYY_YYYYa_mCM_rR _s1, _s2... (C: Class ID , R: Region ID)...



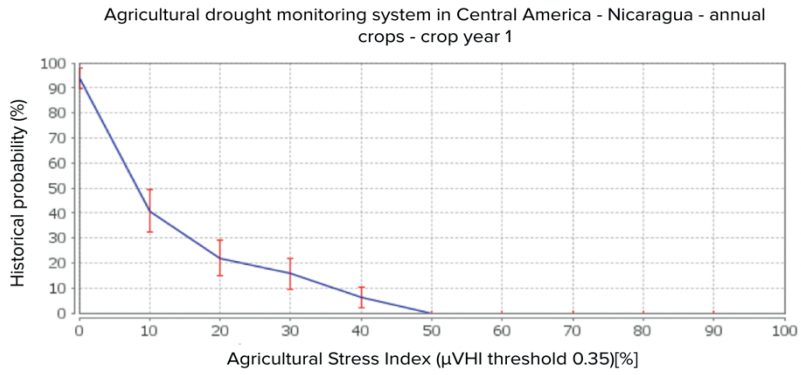
e) PE MASK CLASS IMG QLK for the period 1984-2016, crop season 1 (s1: first), pasture class, ASI threshold > 20%, province level



d) PE MASK CLASS IMG QLK for the period 1984-2016, crop season 1 (s1: first), corn/bean class, ASI threshold > 20%, municipality level



e) CLASS CHART for the period 1984-2016, crop season 1 (s1: first), annual crops class, province level

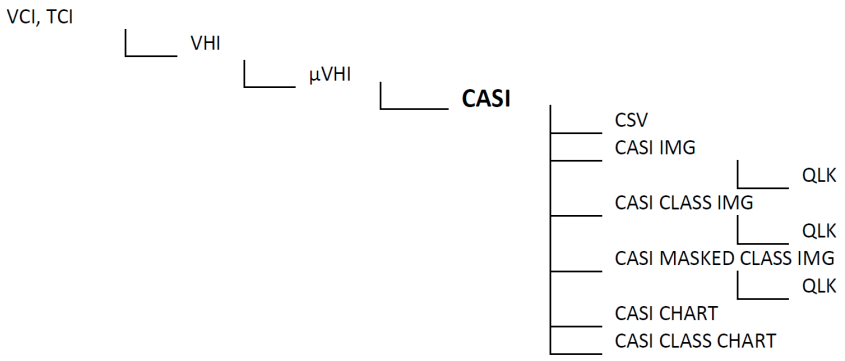


f) CLASS CHART for the period 1984-2016, crop season 1 (s1: first), annual crops class, country level

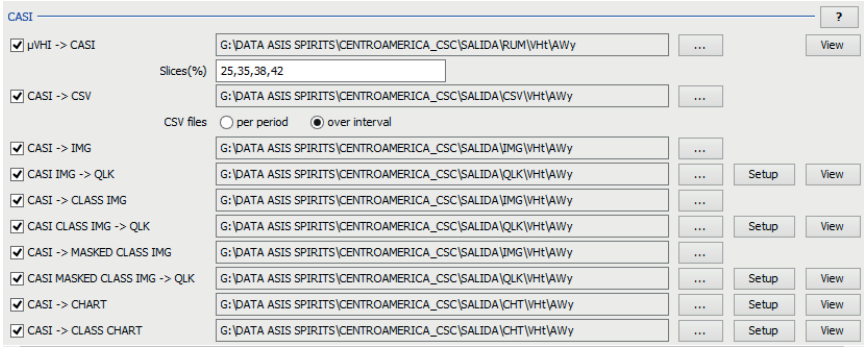
4.2.6. CASI block

CASI block
The **Categorical ASI (CASI)** indicator represents the percentage of pixels (land-use specific) within each administrative region belonging to a specific user-defined drought category. It considers different µVHI categories with user-specified thresholds instead of the binary classification with µVHI≤35% or µVHI> 35% of the ASI index. For the annual version, the indicator reflects the final status for the selected year.

Dependencies of CASI index and their derivates



CASI block functions



µVHI → CASI

Generates the RUM files for CASI, which contain the percentage of pixels per region with µVHI values between the defined intervals (categories) for all land use classes specified in the common block.

Name format:	otYYYYw_mNN_s1, _s2, ... rum

CASI → IMG

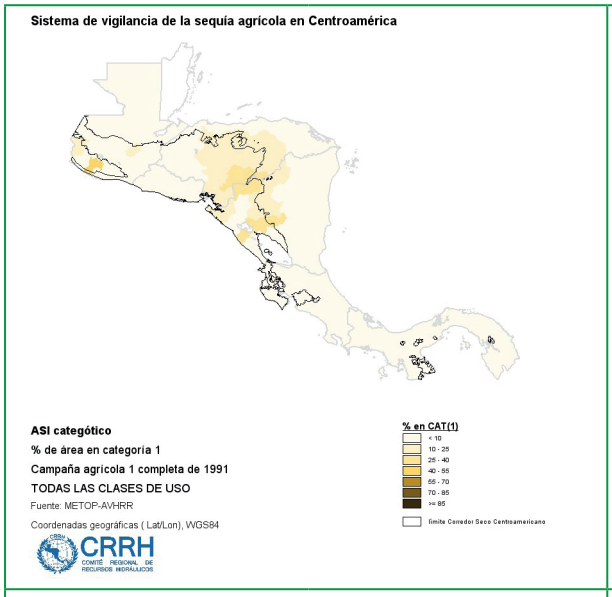
Creates IMG raster files from RUM files by category for all land uses.

Name format:	otYYYYw_c1_mNN_s1, _s2, ... img otYYYYw_c2_mNN_s1, _s2, ... img otYYYYw_c..._mNN_s1, _s2, ... img

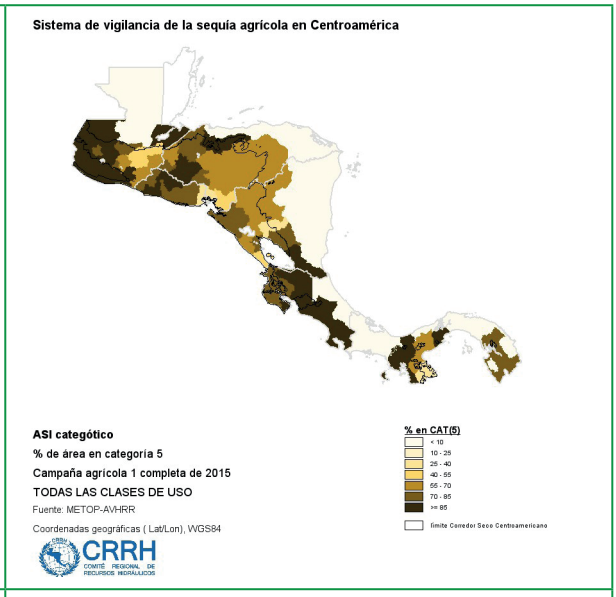
CASI IMG → QLK

Generates QLK graphic files of CASI IMG rasters per year for all classes together and per crop season for the period defined in the common block.

Name format:	otYYYYw_c1_mNN_s1, _s2, ... png otYYYYw_c2_mNN_s1, _s2, ... png otYYYYw_c..._mNN_s1, _s2, ... png

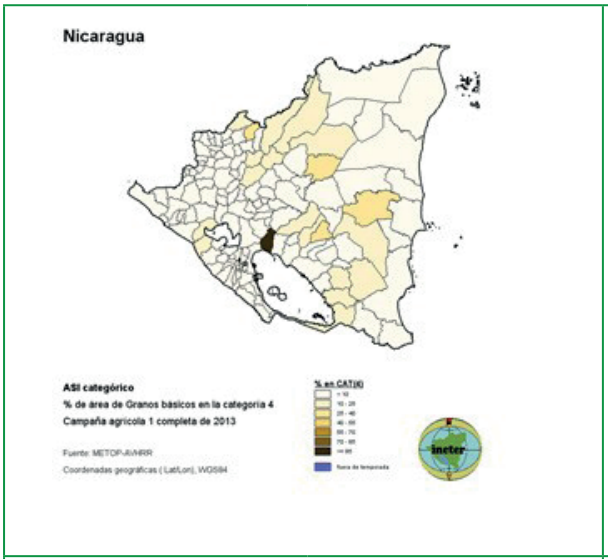
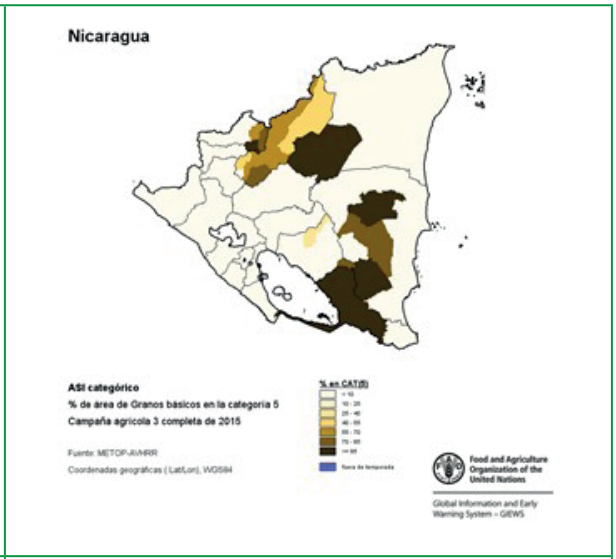


c) CASI IMG QLK for the year 1991 (s1: first) Category 1 CASI by province



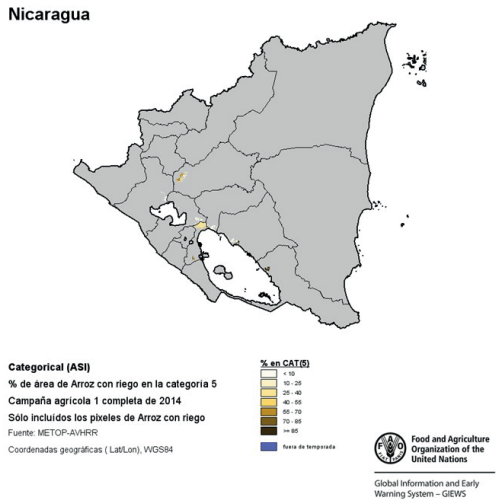
d) CASI IMG QLK for the year 2015 (s1: first) Category 5 CASI by province

CASI → CLASS IMG	
Creates the IMG raster files from the RUM files by category for each land use class specified under the common parameters.	
Name format:	otYYYYw_c1_m2N_s1, _s2, ... img otYYYYw_c2_m2N_s1, _s2, ... img otYYYYw_c.._m2N_s1, _s2, ... img otYYYYw_c1_m3N_s1, _s2, ... img ...
CASI CLASS IMG → QLK	
Generates QLK graphic files of the CASI CLASS IMG raster by year for each land use class and by crop season for the period defined in the common block.	
Name format:	otYYYYw_c1_m2N_s1, _s2, ... png otYYYYw_c2_m2N_s1, _s2, ... png otYYYYw_c.._m2N_s1, _s2, ... png otYYYYw_c1_m3N_s1, _s2, ... png ...

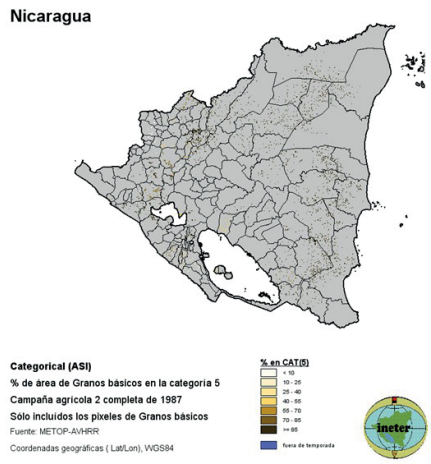
	
e) CASI CLASS IMG QLK for the year 2013 (s1: first) CASI Category 4 for basic grains	f) CASI CLASS IMG QLK for the year 2015 (s3: third) CASI Category 5 for basic grains

CASI → MASKED CLASS IMG	
Creates IMG raster files from the RUM files by category for each masked land use class specified in the common parameters.	
Name format:	otYYYYw_c1_m2M_s1, _s2, ... img otYYYYw_c2_m2M_s1, _s2, ... img otYYYYw_c..._m2M_s1, _s2, ... img otYYYYw_c1_m3M_s1, _s2, ... img ...
CASI MASKED CLASS IMG → QLK	
Generates QLK graphic files of the CASI MASKED CLASS IMG raster by year for each masked land use class and by crop season for the period defined in the common block.	
Name format:	otYYYYw_c1_m2M_s1, _s2, ... png otYYYYw_c2_m2M_s1, _s2, ... png otYYYYw_c..._m2M_s1, _s2, ... png otYYYYw_c1_m3M_s1, _s2, ... png ...
CASI → CHART	
Generates bar charts of the specified administrative regions for all land uses with the distribution of CASI categories.	
Name format:	otYYYYw_mN_rR_s1, _s2, ... png otYYYYw_mN_rR_s1, _s2, ... png (R: Region ID)

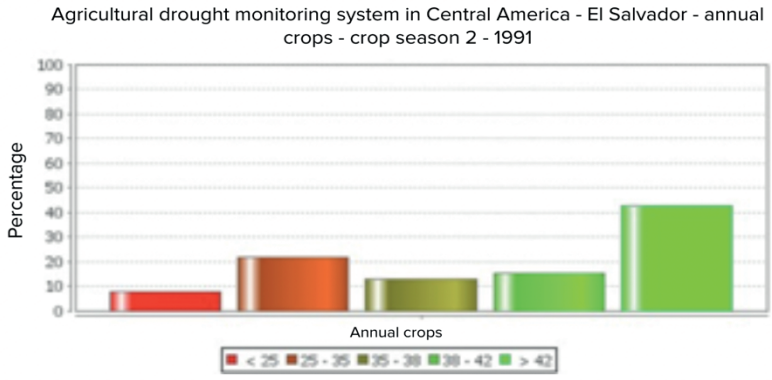
CASI → CLASS CHART	
Generates bar charts of the specified administrative regions by land use class with the distribution of CASI categories.	
Name format:	otYYYYw_m2_r1_s1, _s2, ... png otYYYYw_m2_r2_s1, _s2, ... png



g) CASI MASKED CLASS IMG QLK for the year 2014 (s1: first) Category 5 CASI for irrigated rice



h) CASI MASKED CLASS IMG QLK for the year 1987 (s2: second) Category 5 CASI for basic grains



i) CASI CLASS CHART for the year 1991, crop season 2, annual crops class, country level (El Salvador)

4.3. Configuration of common operation parameters by dekad and year

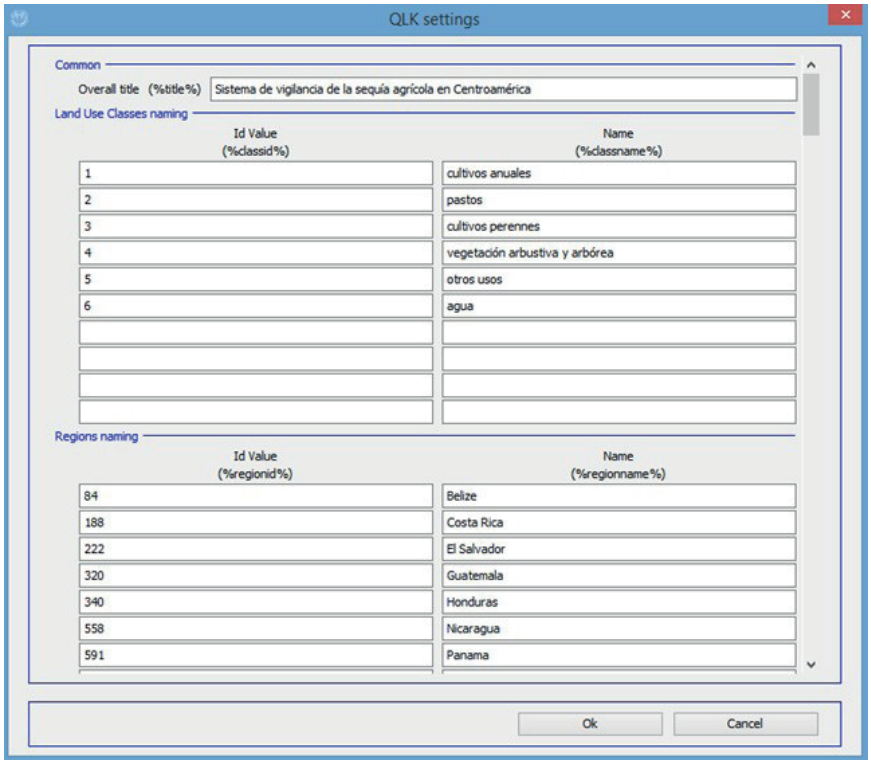
4.3.1. Parameters used for maps and graphics

PARAMETERS	DESCRIPTION
34%	Date: YYYYMMDD, example: 20150101
35%	Date: year (date), example: 2015
36%	Date: month 1.. 12
37%	Date: month Jan, Feb, ... Dec
38%	Date: month Jan, Feb, ... Dec
39%	Date: day within month 1..31
40%	Date: day within year 1..365
41%	Date: dekad within month 1..3
42%	Date: dekad within year 1..36
%TITLE%	Constant specifying the title in QLK map and CHART charts
%SEASON%	Number of the crop season 1, 2, ...
%CLASSID%	Land cover class ID
%CLASSNAME%	Constant specifying the class name in QLK maps and CHART graphics
%CATEGORY%	(CASI) category 1, 2,...
%MVHITHRPR%	Threshold value of μVHI in percent (ASI operations)
%MVHITHRFR%	Threshold value of μVHI as a fraction (ASI operations)
%ASITHRPR%	ASI threshold value in percent (PE operations)
%ASITHRFR%	ASI threshold value as a fraction (PE operations)
%FIRSTYEAR%	First year (annual operations only)
%LASTYEAR%	Last year (annual operations only)

4.3.2. QLK map texts and charts

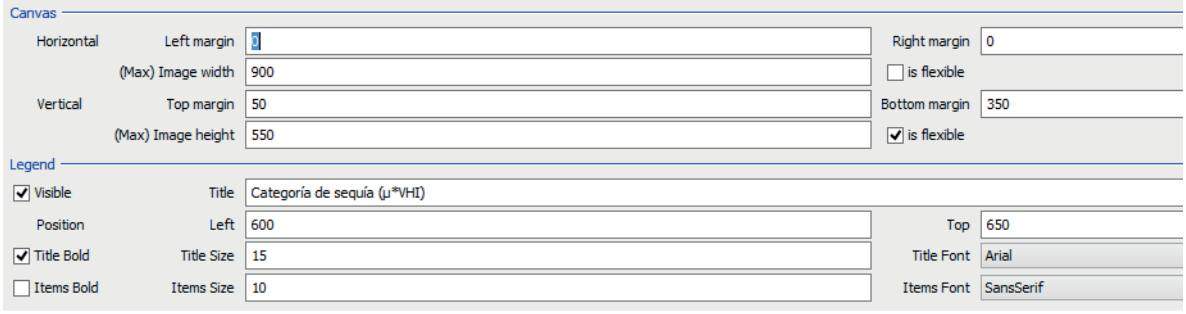
In the Common Block of both operation panels (by dekad and year), it is possible to configure the common parameters for the texts used in the QLK maps and CHART charts. By clicking the Setup button, the QLK settings dialog box is displayed, where you can define a title, up to 10 land cover classes, and 200 administrative units by means of the text boxes.

Example. Definition of the title (variable %title%) of QLK maps and graphics, name of land use classes (variable %classname%) and administrative units (%regionname%).



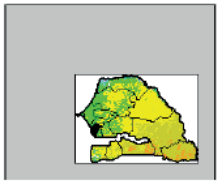
4.3.3. QLK maps

For QLK map generation operations, additional parameters can be configured through the Setup dialog box to define the location and content of elements in QLK maps: title of indices, legend and other texts.



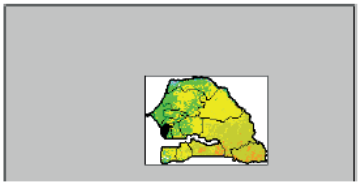
The top, left, bottom and right margins will always be constant, while the width or height of the image can be selected to be flexible. Depending on the aspect ratio of the actual IMG, either landscape or portrait orientation will be selected, whichever fits best.

vertical scaling



Left 80
Width 300 Flexible
Right 20
Tot: 240 (shrunken)

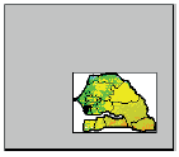
Top 80
Height 100
Bot 20
Tot: 200



Left 80
Width 300 Fixed
Right 20
Tot 400

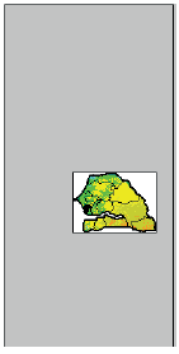
Top 80
Height 100
Bot 20
Tot: 200

horizontal scaling



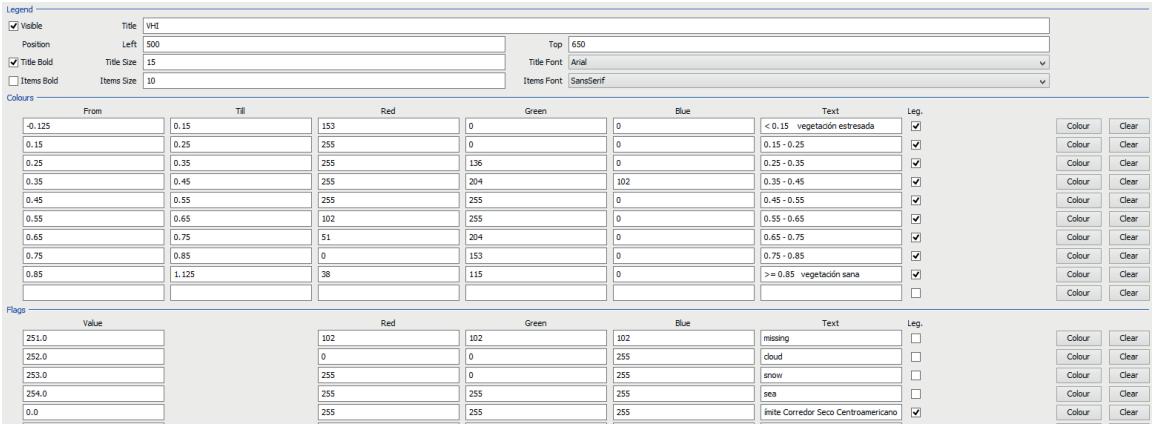
Left 80
Width 100
Right 20
Tot 200

Top 80
Height 300 Flexible
Bot 20
Tot: 171 (shrunken)



Left 80
Width 100
Right 20
Tot 200

Top 80
Height 300 Fixed
Bot 20
Tot: 400



Legend

☑ Visible	Title	VHI	
Position	Left	500	Top 650
☑ Title Bold	Title Size	15	Title Font Arial
☐ Items Bold	Items Size	10	Items Font SansSerif

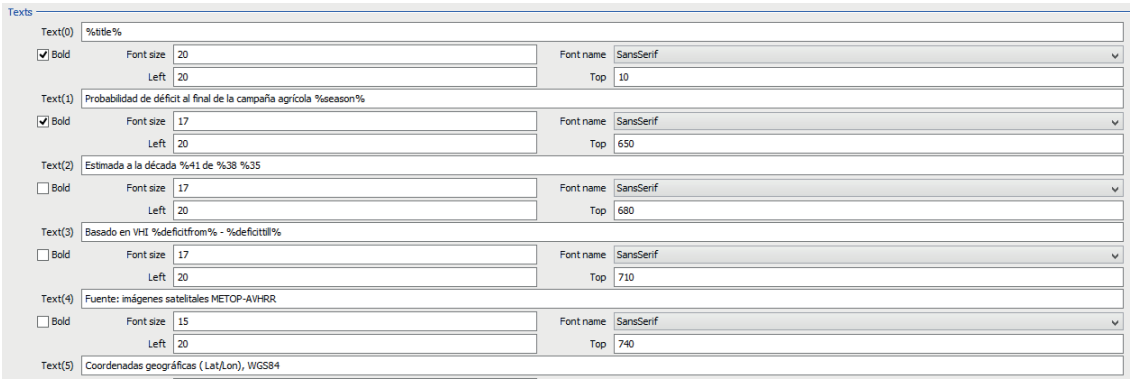
Colours

From	Till	Red	Green	Blue	Text	Leg.		
-0.125	0.15	153	0	0	< 0.15 vegetación estresada	☑	Colour	Clear
0.15	0.25	255	0	0	0.15 - 0.25	☑	Colour	Clear
0.25	0.35	255	136	0	0.25 - 0.35	☑	Colour	Clear
0.35	0.45	255	204	102	0.35 - 0.45	☑	Colour	Clear
0.45	0.55	255	255	0	0.45 - 0.55	☑	Colour	Clear
0.55	0.65	102	255	0	0.55 - 0.65	☑	Colour	Clear
0.65	0.75	51	204	0	0.65 - 0.75	☑	Colour	Clear
0.75	0.85	0	153	0	0.75 - 0.85	☑	Colour	Clear
0.85	1.125	38	115	0	>= 0.85 vegetación sana	☑	Colour	Clear
						☐	Colour	Clear

Flags

Value	Red	Green	Blue	Text	Leg.		
251.0	102	102	102	missing	☐	Colour	Clear
252.0	0	0	255	cloud	☐	Colour	Clear
253.0	255	0	255	snow	☐	Colour	Clear
254.0	255	255	255	sea	☐	Colour	Clear
0.0	255	255	255	límite Corredor Seco Centroamericano	☑	Colour	Clear

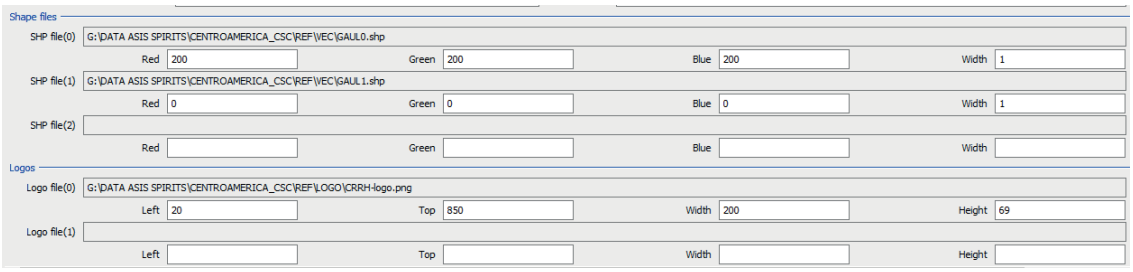
QLK Parameters – Legend parameters and color palette on maps (RGB)



Texts

Text(0)	%title%			
☑ Bold	Font size	20	Font name	SansSerif
	Left	20	Top	10
Text(1)	Probabilidad de déficit al final de la campaña agrícola %season%			
☑ Bold	Font size	17	Font name	SansSerif
	Left	20	Top	650
Text(2)	Estimada a la década %41 de %38 %35			
☐ Bold	Font size	17	Font name	SansSerif
	Left	20	Top	680
Text(3)	Basado en VHI %deficitfrom% - %deficittill%			
☐ Bold	Font size	17	Font name	SansSerif
	Left	20	Top	710
Text(4)	Fuente: imágenes satelitales METOP-AVHRR			
☐ Bold	Font size	15	Font name	SansSerif
	Left	20	Top	740
Text(5)	Coordenadas geográficas (Lat/Lon), WGS84			

QLK Parameters – Texts



Shape files

SHP file(0)	G:\DATA ASIS SPIRITS\CENTROAMERICA_CSC\REF\VEC\GAUL0.shp						
	Red	200	Green	200	Blue	200	Width 1
SHP file(1)	G:\DATA ASIS SPIRITS\CENTROAMERICA_CSC\REF\VEC\GAUL1.shp						
	Red	0	Green	0	Blue	0	Width 1
SHP file(2)							
	Red		Green		Blue		Width

Logos

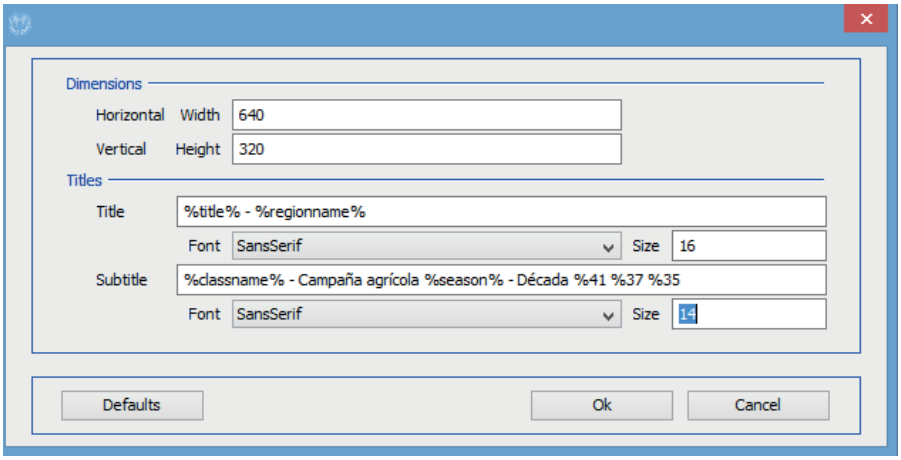
Logo file(0)	G:\DATA ASIS SPIRITS\CENTROAMERICA_CSC\REF\LOGO\CRRH-logo.png						
	Left	20	Top	850	Width	200	Height 69
Logo file(1)							
	Left		Top		Width		Height

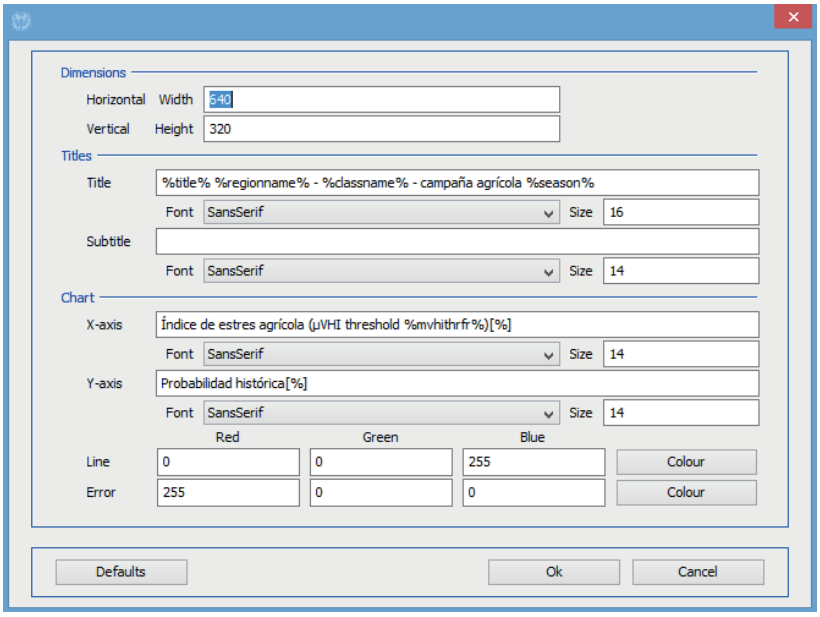
QLK Parameters – Shapefiles and Logos

4.3.4. Graphics

The CASI and PE block operations include the generation of CHART plots. The parameters of these output plots can be configured using the Setup panel, which is accessed by clicking on the Setup button of each CHART operation.

Configurable parameters include chart size, text size, titles and subtitles, X and Y axis names, among others.





PE/CASI chart parameters. The same parameters as the QLK texts can be used.

5. Structure and organization of data in Country-level ASIS

The Country-level ASIS has a Windows-based graphical user interface, and manages a defined structure of data, organized in different levels of file directories to facilitate analysis and processing.

- The first level of directories – DIR1 – corresponds to the project directory, determined for the area of interest. It is suggested that this folder be named after the country or region.
- The second level of directories – DIR2 – contains the folders with the basic inputs needed to run the Country-level ASIS and the results folder. These directories are mainly:
  - VCI: folder containing the historical series of Vegetation Condition Index (VCI) images since 1984 for the area of interest, derived from METOP-AVHRR images.
  - TCI: folder containing the historical series of Temperature Condition Index (TCI) images since 1984 for the area of interest, derived from METOP-AVHRR images.
  - REF: reference folder, which stores several subfolders with previously prepared country data, such as FAO GAUL (Global Administrative Unit Layers) layers, country administrative regions, land use and phenology mainly.
  - OUTPUT: the path where the Country-level ASIS output data and products are stored can be configured by the user. It is recommended to define this folder with the name OUTPUT in the second level of directories at the time. It automatically generates a number of subfolders with their respective default names.
- The third level of directories contains the folders and contents detailed in the following table.

Table 2. Folder structure and file names for Country-level ASIS input data.

DIR1	DIR2	DIR3	FILES	CONTENT DESCRIPTION
Project Route	VCI		otYYDDc.img/hdr	Vegetation Condition Index-VCI (NDVI-based anomaly from METOP-AVHRR). YY=year expressed in two digits [84=1984/17=2017] DD=day within month [01-31]
	TCI		otYYDDt.img/hdr	Temperature Condition Index - TCI (temperature-based anomaly METOP-AVHRR). YY=year expressed in two digits [84=1984/17=2017] DD=day within month [01-31]
	REF	PHE	PHE_s1 y PHE_s2.img/hdr PHE_ m1 y PHE_m2.img/hdr PHE_e1 y PHE_e2.img/hdr	Phenology metrics based on NDVI index, derived from SPOT- VEGETATION long-term statistics (s=start, m=maximum, e=end of crop season) for the first and second crop seasons.
		PHEv2	PHE_s1 and _s2.img/hdr PHE_ m1 and _m2.img/hdr PHE_e1 and _e2.img/hdr	Alternative calculations for the parameters of the SPOT-VEGETATION files. In this variant, the agricultural campaigns tend to be longer.
		REG	GAUL0.img/hdr GAUL1.img/hdr GAUL2.img/hdr	Raster layers of administrative regions for the three levels (0: country, 1: subnational, 2: provinces). These default raster layers contain the codes derived from the 2014 FAO GAUL maps.

DIR1	DIR2	DIR3	FILES	CONTENT DESCRIPTION
Project Route	REF	VEC	GAUL0.shp/dbf/shx GAUL1.shp/dbf/shx GAUL2.shp/dbf/shx	Vector layers of administrative regions of the three levels (0: country, 1: subnational, 2: provinces). By default, Country-level ASIS uses FAO GAUL maps.
		LOGO	LOGO.png	FAO logo by default. Can be customized with an institutional logo.
		MSK	GLC_SHv10.img/hdr	Excerpt from the global land cover map (GLC-SHARE).
			MSK_CROPS_01.img/hdr MSK_CROPS_10.img/hdr MSK_CROPS_25.img/hdr	Binary land cover maps, which include all pixels of the GLC-SHARE map that have a fraction of crop lands within a 1km pixel respectively more than 1%, 10% and 25%. The 1% variant will show a large distribution of crops, while the 25% variant is more limited.
			MSK_GRASSLAND_01.img/hdr MSK_CGRASSLAND_10.img/hdr MSK_GRASSLAND_25.img/hdr	Similar to the above, but for pastures.
			glc2000.img/hdr	

Table 3. Structure of Country-level ASIS output directories (Customizations)

DIR2	DIR3	DIR4	DIR5	FILE NAME	EXT	OPERATION
REF	PHE			[Base name]s1, s2... [Base name]m1, m2... [Base name]e1, e2...	*.img,*.hdr	SOS/MOS/EOS IMG
				[Base name]s1, s2...	*.img,*.hdr	KC IMG
OUTPUT	IMG	PHE	PRO	pro_mNN_dd_s1, _s2... (dd: dekad 1..36)	*.img,*.hdr	SOS/MOS/EOS → POS
				pro_mCM_dd_s1, _s2... (C: land use class ID)	*.img,*.hdr	POS → MASKED
	QLK	PHE	PRO	pro_mNN_dd_s1, _s2... (dd: dekad 1..36)	*.png	POS → QLK
				pro_mCM_dd_s1, _s2... (C: land use class ID)	*.png	POS MASKED → QLK

Table 4. Structure of outbound directories of Country-level ASIS operations by dekad

DIR2	DIR3	DIR4	DIR5	FILE NAME FORMAT	EXTENSION	OPERATION
OUTPUT	CHT	VHt	AWt	otYYYYMMDDw_mN_rR_s1, _s2, ... otYYYYMMDDw_mN_rR_s1, _s2, ... (R: Region ID)	*.png	CASI → CHART
				otYYYYMMDDw_m2_r1_s1, _s2, ... otYYYYMMDDw_m2_r2_s1, _s2, ...	*.png	CASI → CLASS CHART
	CSV	DIF	TCt	otYYYYMMDDe	*.csv	TCI RUM → CSV
			VCt	otYYYYMMDDc	*.csv	VCI RUM → CSV
			VHt	otYYYYMMDDh	*.csv	VHI RUM → CSV
		VHt	ASt	otYYYYMMDDa_mNN_s1, _s2, ...	*.csv	ASI → CSV
			AWt	otYYYYMMDDw_mNN_s1, _s2, ...	*.csv	CASI → CSV
			MRt	otYYYYMMDDx_mNN_s1, _s2, ...	*.csv	μ*VHI → CSV
	IMG	DIF	TCt	otYYYYMMDDe_mNN	*.img, *.hdr	TCI RUM → IMG
			VCt	otYYYYMMDDc_mNN	*.img, *.hdr	VCI RUM → IMG
		VHt		otYYYYMMDDh	*.img, *.hdr	VCI, TCI → VHI
				otYYYYMMDDh_mNN	*.img, *.hdr	VHI RUM → IMG
		VHt	ASt	otYYYYMMDDa_mNN_s1, _s2, ...	*.img, *.hdr	ASI → IMG
				otYYYYMMDDa_m2N_s1, _s2, ... otYYYYMMDDa_m3N_s1, _s2, ... otYYYYMMDDa_m...N_s1, _s2,...	*.img, *.hdr	ASI → CLASS IMG
				otYYYYMMDDa_m2M_s1, _s2, ... otYYYYMMDDa_m3M_s1, _s2, ... otYYYYMMDDa_m...M_s1, _s2,...	*.img, *.hdr	ASI → MASKED CLASS IMG
			AWt	otYYYYMMDDw_c1_mNN_s1, _s2, ... otYYYYMMDDw_c2_mNN_s1, _s2, ... otYYYYMMDDw_c.._mNN_s1, _s2, ...	*.img, *.hdr	CASI → IMG
				otYYYYMMDDw_c1_m2N_s1, _s2, ... otYYYYMMDDw_c2_m2N_s1, _s2, ... otYYYYMMDDw_c.._m2N_s1, _s2, ... otYYYYMMDDw_c1_m3N_s1, _s2, ...	*.img, *.hdr	CASI → CLASS IMG
				otYYYYMMDDw_c1_m2M_s1, _s2, ... otYYYYMMDDw_c2_m2M_s1, _s2, ... otYYYYMMDDw_c.._m2M_s1, _s2, ... otYYYYMMDDw_c1_m3M_s1, _s2, ...	*.img, *.hdr	CASI → MASKED CLASS IMG
			DEF	otYYYYMMDDq_s1, _s2, ...	*.img, *.hdr	VHI → DEF
				otYYYYMMDDq_m2M_s1, _s2, ... otYYYYMMDDq_m3M_s1, _s2, ... otYYYYMMDDq_m...M_s1, _s2, ..	*.img, *.hdr	DEF → MASKED

DIR2	DIR3	DIR4	DIR5	FILE NAME FORMAT	EXTENSION	OPERATION
OUTPUT	IMG	VHt	MRt	otYYYYMMDDx_mNN_s1, _s2, ...	*.img, *.hdr	μ*VHI → IMG
				otYYYYMMDDx_m2N_s1, _s2, ... otYYYYMMDDx_m3N_s1, _s2, ... otYYYYMMDDx_m...N_s1, _s2,...	*.img, *.hdr	μ*VHI → CLASS IMG
				otYYYYMMDDx_m2M_s1, _s2, ... otYYYYMMDDx_m3M_s1, _s2, ... otYYYYMMDDx_m...M_s1, _s2,...	*.img, *.hdr	μ*VHI → MASKED CLASS IMG
			MUt	otYYYYMMDDu_mNN_s1, _s2, ...	*.img, *.hdr	VHI → μVHI
				otYYYYMMDDu_m2M_s1, _s2, ... otYYYYMMDDu_m3M_s1, _s2, ... otYYYYMMDDu_m...M_s1, _s2, ..	*.img, *.hdr	μVHI → MASKED
	QLK	DIF	TCt	otYYYYMMDDe	*.png	TCI → QLK
				otYYYYMMDDe_mNN	*.png	TCI RUM IMG → QLK
			VCt	otYYYYMMDDc	*.png	VCI → QLK
				otYYYYMMDDc_mNN	*.png	VCI RUM IMG → QLK
			VHt	otYYYYMMDDh	*.png	VHI → QLK
				otYYYYMMDDh_mNN	*.png	VHI RUM IMG → QLK
		VHt	ASt	otYYYYMMDDa_mNN_s1, _s2, ...	*.png	ASI IMG → QLK
				otYYYYMMDDa_m2N_s1, _s2, ... otYYYYMMDDa_m3N_s1, _s2, ... otYYYYMMDDa_m...N_s1, _s2,...	*.png	ASI CLASS IMG → QLK
				otYYYYMMDDa_m2M_s1, _s2, ... otYYYYMMDDa_m3M_s1, _s2, ... otYYYYMMDDa_m...M_s1, _s2,...	*.png	ASI MASKED CLASS IMG → QLK
			AWt	otYYYYMMDDw_c1_mNN_s1, _s2, ... otYYYYMMDDw_c2_mNN_s1, _s2, ... otYYYYMMDDw_c..._mNN_s1, _s2, ...	*.png	CASI IMG → QLK
				otYYYYMMDDw_c1_m2N_s1, _s2, ... otYYYYMMDDw_c2_m2N_s1, _s2, ... otYYYYMMDDw_c..._m2N_s1, _s2, ... otYYYYMMDDw_c1_m3N_s1, _s2, ...	*.png	CASI CLASS IMG → QLK
				otYYYYMMDDw_c1_m2M_s1, _s2, ... otYYYYMMDDw_c2_m2M_s1, _s2, ... otYYYYMMDDw_c..._m2M_s1, _s2, ... otYYYYMMDDw_c1_m3M_s1, _s2, ...	*.png	CASI MASKED CLASS IMG → QLK
			DEF	otYYYYMMDDq_s1, _s2, ...	*.png	DEF → QLK
				otYYYYMMDDq_m2M_s1, _s2, ... otYYYYMMDDq_m3M_s1, _s2, ... otYYYYMMDDq_m...M_s1, _s2, ..	*.png	DEF MASKED → QLK

DIR2	DIR3	DIR4	DIR5	FILE NAME FORMAT	EXTENSION	OPERATION
OUTPUT	QLK	VHt	MRt	otYYYYMMDDx_mNN_s1, _s2, ...	*.png	μ*VHI → QLK
				otYYYYMMDDx_m2N_s1, _s2, ... otYYYYMMDDx_m3N_s1, _s2, ... otYYYYMMDDx_m...N_s1, _s2,...	*.png	μ*VHI CLASS IMG → QLK
				otYYYYMMDDx_m2M_s1, _s2, ... otYYYYMMDDx_m3M_s1, _s2, ... otYYYYMMDDx_m...M_s1, _s2,...	*.png	μ*VHI MASKED CLASS IMG → QLK
			MUt	otYYYYMMDDu_mNN_s1, _s2, ...	*.png	μVHI → QLK
				otYYYYMMDDu_m2M_s1, _s2, ... otYYYYMMDDu_m3M_s1, _s2, ... otYYYYMMDDu_m...M_s1, _s2, ..	*.png	μVHI MASKED → QLK
	RUM	DIF	TCt	otYYYYMMDDe	*.rum	TCI → RUM
			VCt	otYYYYMMDDc	*.rum	VCI → RUM
			VHt	otYYYYMMDDh	*.rum	VHI → RUM
		VHt	ASt	otYYYYMMDDa_mNN_s1, _s2, ...	*.rum	μVHI → ASI
			AWt	otYYYYMMDDw_mNN_s1, _s2, ...	*.rum	μVHI → CASI
			MRt	otYYYYMMDDx_mNN_s1, _s2, ...	*.rum	μVHI → μ*VHI

Table 5. Structure of Country-level ASIS annual operations output directories

DIR2	DIR3	DIR4	DIR5	FILE NAME FORMAT	EXTENSION	OPERATION
OUTPUT	CHT	VHt	AWy	oyYYYYw_mN_rR_s1, _s2, ... oyYYYYw_mN_rR_s1, _s2, ...	*.png	CASI → CHART
				oyYYYYw_m2_rR_s1, _s2, ... oyYYYYw_m2_rR_s1, _s2, ...	*.png	CASI → CLASS CHART
			PEy	pyYYYY_YYYYa_mNM_rR_s1, _s2... (R: Region ID)	*.png	PE → CHART
				pyYYYY_YYYYa_mCM_rR _s1, _s2...	*.png	PE → CLASS CHART
	CSV	VHt	ASy	oyYYYYa_mNN_s1, _s2, ...	*.csv	ASI → CSV
			AWy	oyYYYYw_mNN_s1, _s2, ...	*.csv	CASI → CSV
			MRy	oyYYYYx_mNN_s1, _s2, ...	*.csv	μ*VHI → CSV
	IMG	VHt	ASy	oyYYYYa_mNN_s1, _s2, ...	*.img, *.hdr	ASI → IMG
				oyYYYYa_m2N_s1, _s2, ... oyYYYYa_m3N_s1, _s2, ... oyYYYYa_m...N_s1, _s2,...	*.img, *.hdr	ASI → CLASS IMG
				oyYYYYa_m2M_s1, _s2, ... oyYYYYa_m3M_s1, _s2, ... oyYYYYa_m...M_s1, _s2,...	*.img, *.hdr	ASI → MASKED CLASS IMG

DIR2	DIR3	DIR4	DIR5	FILE NAME FORMAT	EXTENSION	OPERATION
OUTPUT	IMG	VHt	AWy	oyYYYYw_c1_mNN_s1,_s2... oyYYYYw_c2_mNN_s1,_s2... oyYYYYw_c..._mNN_s1,_s2...	*.img, *.hdr	CASI → IMG
				oyYYYYa_c1_m2N_s1, _s2, ... oyYYYYa_c2_m2N_s1, _s2, ... oyYYYYa_c..._m2N_s1, _s2, ... oyYYYYa_c1_m3N_s1, _s2, ...	*.img, *.hdr	CASI → CLASS IMG
				oyYYYYa_c1_m2M_s1, _s2, .. oyYYYYa_c2_m2M_s1, _s2, .. oyYYYYa_c..._m2M_s1, _s2, .. oyYYYYa_c1_m3M_s1, _s2, ...	*.img, *.hdr	CASI → MASKED CLASS IMG
			MRy	oyYYYYx_mNN_s1, _s2, ...	*.img, *.hdr	μ*VHI → IMG
				otYYYYMMDDx_m2N_s1, _s2, ... otYYYYMMDDx_m3N_s1, _s2, ... otYYYYMMDDx_m...N_s1, _s2,...	*.img, *.hdr	μ*VHI → CLASS IMG
			MUy	oyYYYYu_mNN_s1, _s2, ...	*.img, *.hdr	VHI → μVHI
				oyYYYYu_m2M_s1, _s2, ... oyYYYYu_m3M_s1, _s2, ... oyYYYYu_m...M_s1, _s2,...	*.img, *.hdr	μVHI → MASKED
	IMG	VHt	PEy	pyYYYY_YYYYa_tT_mNN_s1, _s2... (T: ASI threshold 0..99)	*.img, *.hdr	PE → IMG
				pyYYYY_YYYYa_tT_mCN_s1, _s2... (C: land use class ID)	*.img, *.hdr	PE → CLASS IMG
				pyYYYY_YYYYa_tT_mCM_s1, _s2...	*.img, *.hdr	PE → MASKED CLASS IMG
	QLK	VHt	ASy	oyYYYYa_mNN_s1, _s2, ...	*.png	ASI IMG → QLK
				oyYYYYa_m2N_s1, _s2, ... oyYYYYa_m3N_s1, _s2, ... oyYYYYa_m...N_s1, _s2,...	*.png	ASI CLASS IMG → QLK
				oyYYYYa_m2M_s1, _s2, ... oyYYYYa_m3M_s1, _s2, ... oyYYYYa_m...M_s1, _s2,...	*.png	ASI MASKED CLASS IMG → QLK
			AWy	oyYYYYw_c1_mNN_s1,_s2... oyYYYYw_c2_mNN_s1,_s2... oyYYYYw_c..._mNN_s1,_s2...	*.png	CASI IMG → QLK
				oyYYYYa_c1_m2N_s1, _s2, ... oyYYYYa_c2_m2N_s1, _s2, ... oyYYYYa_c..._m2N_s1, _s2, ... oyYYYYa_c1_m3N_s1, _s2, ...	*.png	CASI CLASS IMG → QLK
				oyYYYYa_c1_m2M_s1, _s2, .. oyYYYYa_c2_m2M_s1, _s2, .. oyYYYYa_c..._m2M_s1, _s2, .. oyYYYYa_c1_m3M_s1, _s2, ...	*.png	CASI MASKED CLASS IMG → QLK

DIR2	DIR3	DIR4	DIR5	FILE NAME FORMAT	EXTENSION	OPERATION
OUTPUT	QLK	VHt	MRy	oyYYYYx_mNN_s1, _s2, ...	*.png	μ*VHI → IMG
				oyYYYYx_m2N_s1, _s2, ... oyYYYYx_m3N_s1, _s2, ... oyYYYYx_m...N_s1, _s2,...	*.png	μ*VHI CLASS IMG → QLK
			MUy	oyYYYYu_mNN_s1, _s2, ...	*.png	μVHI → QLK
				oyYYYYu_m2M_s1, _s2, ... oyYYYYu_m3M_s1, _s2, ... oyYYYYu_m...M_s1, _s2,...	*.png	μVHI MASKED → QLK
			PEy	pyYYYY_YYYYa_tT_mNN_s1, _s2...	*.png	PE IMG → QLK
				pyYYYY_YYYYa_tT_mCN_s1, _s2...	*.png	PE CLASS IMG → QLK
				pyYYYY_YYYYa_tT_mCM_s1, _s2...	*.png	PE MASKED CLASS IMG → QLK
	RUM	VHt	ASy	oyYYYYa_mNN_s1, _s2, ...	*.rum	μVHI → ASI
			AWy	oyYYYYw_mNN_s1, _s2, ...	*.rum	μVHI → CASI
			MRy	oyYYYYx_mNN_s1, _s2, ...	*.rum	μVHI → μ*VHI
			PEy	pyYYYY_YYYYa_mNN_s1, _s2...	*.rum	ASI → PEI

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ISBN 978-92-5-137439-9

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CA2247EN/1/05.23