

FACULTY OF GEO-INFORMATION SCIENCE
AND EARTH OBSERVATION

ITC

ESA DDS TOOLBOX

**INSTALLATION, CONFIGURATION AND
USER GUIDE OF THE ESA-DDS
TOOLBOX PLUG-IN FOR ILWIS 3.7**

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Preface

Over the recent years many developments have taken place to provide the global user community with large amounts of environmental data, provided free of charge and delivered through satellite based communication systems. In order for the user community to handle and process the data the “DDS-Toolbox” has been developed.

The DDS-Toolbox allows the user to import the data types disseminated via the European Space Agency “Data Dissemination System” into the freeware and open source RS-GIS ILWIS package and its existing processing capability can be used for further analysis.

This document is providing a description where to download all the freeware utilities, how to install and configure them. The Toolbox developed is an open utility, it can be easily modified and tuned to the user needs and furthermore it can be expanded to cope with the increasing data stream without the need for programming skills.

The utilities provided are extensively tested using various operating systems, such as Windows Vista, XP (various service packages) and Windows-7 and have found to be performing in a stable manner. The toolbox currently does not work under LINUX. In case unexpected behaviour or bugs are observed, additions to the functionality are required or if you have developed new utilities that you want to share, please contact: maathuis@itc.nl.

This document is not describing how to setup a low cost ground reception station. Additional documentation in this respect can be found at: <http://www.itc.nl/Pub/WRS/WRS-GEONETCast> or at: <http://52North.org>, under the “Earth Observation” Community page. Here new additions and modifications will be posted and you can register to a mailing list as well, to keep you updated on ongoing developments.

August 2010

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List of acronyms and abbreviations

52North	52°North Initiative for Geospatial Open Source Software
AATSR	Advanced Along Track Scanning Radiometer
ASAR	Advanced Synthetic Aperture Radar
AVHRR	Advanced Very High Resolution Radiometer
BEAM	Basic ERS and Envisat AATSR and MERIS Toolbox
DDS	Data Dissemination System
DMP	Dry Matter Productivity
DN	Digital Number
DVB	Digital Video Broadcast
ENVISAT	Environmental Satellite
ESA	European Space Agency
EUMETCast	A satellite based data dissemination of various (mainly satellite based) data covering Europe and Africa
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
FVC-FCOVER	Fraction of Vegetation Cover
GDAL	Geospatial Data Abstraction Library
GEO	Group on Earth Observation
GEONETCast	A global network of satellite based data dissemination systems
GEOSS	Global Earth Observation System of Systems
GMFS	Global Monitoring for Food Security
GNC	Geonetcast
GUI	Graphical User Interface
ILWIS	Integrated Land and Water Information System
ITC	Faculty of Geo-Information Science and Earth Observation
IR	Infra Red
LAI	Leaf Area Index
MERIS	Medium Resolution Imaging Spectrometer
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
NIR	Near Infra Red
PHENOKS	Phenology Key Stages
RGB	Red – Green – Blue colour assignment
SPOT	Système Probatoire d’Observation de la Terre ou Satellite Pour l’Observation de la Terre
SWB	Small Water Bodies
SWIR	Short Wave Infra Red
TIR	Thermal Infra Red
VGT-extract	Software tool developed by VITO to import products derived from the Vegetation instrument
VGT instrument	Vegetation instrument onboard of SPOT
VIS	Visible
VITO	Flemish Institute for Scientific Research

VPI	Vegetation Production Indicator
UTC	Universal Time Coordinated
XML	Extensible Markup Language

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1 General installation and configuration instructions

1.1 Introduction.

Follow the instructions provided below to install ILWIS37, the DDS-Toolbox and a number of other free software utilities, in order to work with the data provided using the European Space Agency Data Dissemination System. Read the instructions carefully and proceed with the installation of the various utilities. In case you want to use the DDS-Toolbox, be aware that at this moment it is *not* running under LINUX-Ubuntu. Furthermore this DDS-Toolbox version is not downwards compatible; you need to use at least ILWIS3.7.

1.1.1 Download ILWIS

<http://52north.org/>

From this location select the navigation tab: “Downloads” and select “<http://52North.org/download/ILWIS>”. Select the latest (multiple file) ILWIS37 version and download the ZIP file(s), save the file(s) in a temporary directory on your hard disk. Unzip the file and run the ILWIS setup. When you intend to use the DDS-Toolbox *do not install ILWIS37 under the default installation directory “c:\program files”* as this might cause problems with respect to administration rights (especially under Windows 7) when creating temporary files and because the toolbox is utilizing DOS batch routines, which can be affected by the space in the directory file name “program files”. Select as your installation “*drive:directory*” a location where you have the proper administrative rights (e.g. “D:\ilwis37”). In the “ilwis37” directory a shortcut to the ILWIS.exe can be created, you can copy this shortcut to your desktop.

Please take into consideration straight from the start the following golden rules when using ILWIS:

- *Don't use spaces in file names, instead use underscores;*
- *Do not use numbers as file names;*
- *Do not work in multiple output directories;*
- *Start ILWIS, navigate to your working directory and close ILWIS. Open ILWIS again to ensure that your current working directory is also the actual ILWIS working directory.*

1.1.2 Download the DDS-Toolbox

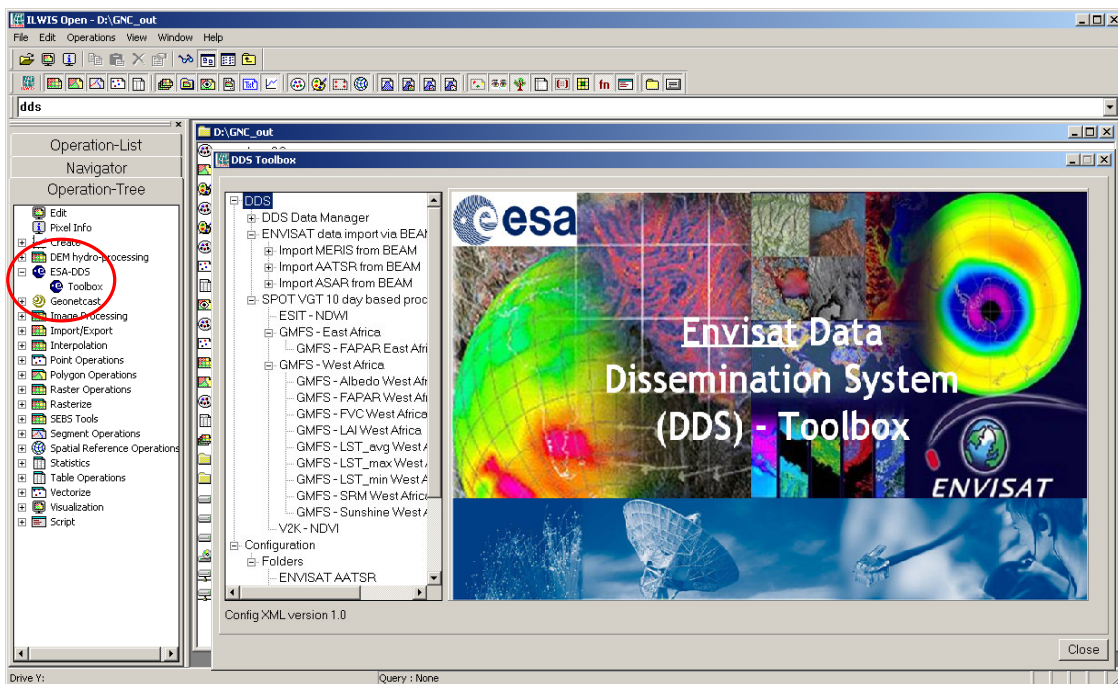
<http://52north.org/>

Select from the 52north.org website the navigation tab: “Earth Observation”. Download the file: “DDS-Toolbox.zip” available over there and store it in a temporary directory. After download is completed, copy this ZIP file in the ILWIS sub-directory “\Extensions”. *There is no need to unzip the file! ILWIS automatically detects the ZIP file in this directory then unzips the file and installs the plug-in when a new instance of ILWIS is started. Afterwards the ZIP file is deleted in this sub-directory!*

Start ILWIS and in the Operation-Tree of ILWIS the “ESA-DDS” tab will appear (see also figure 1.1). Double click the “ESA-DDS” tab and the subsequent “Toolbox” tab and various (sub) menus are now at your disposal. These options can be used to import several image and data sources that are disseminated via the ESA Data Dissemination System, a system that uses digital video broadcast (DVB) to deliver images recorded by instruments onboard of ENVISAT and various other environmental datasets, like those from GMFS. A total of 15 image and products disseminated over Africa turn around service is currently supported. As the dissemination system is constantly developing, keep checking the ITC website (<http://www.itc.nl/Pub/WRS/WRS-GEONETCast>) or the “Earth Observation” community webpage at <http://52north.org>, for new (toolbox) developments. Modifications and added functionality for the DDS-Toolbox are made available here on an ad hoc basis, so check if you are working with the latest version.

For the main “DDS-Toolbox” menu see figure 1.1. Also note the “GEONETCast” menu item under the Operation Tree. This is another “plug-in” developed to import the satellite images and additional products for e.g. Africa that are disseminated via the “GEONETCast” Data Delivery System. Also this plug-in is available via the “Earth Observation” community link provided above.

Figure 1.1: The DDS-toolbox main and sub menu structure under ILWIS37.



Close ILWIS as you might need to install additional utilities. Check if you have already installed the Java runtime environment. If this is not the case, use the link provided in chapter 1.1.3 and follow the additional installation instructions.

1.1.3 Download Java Runtime Environment

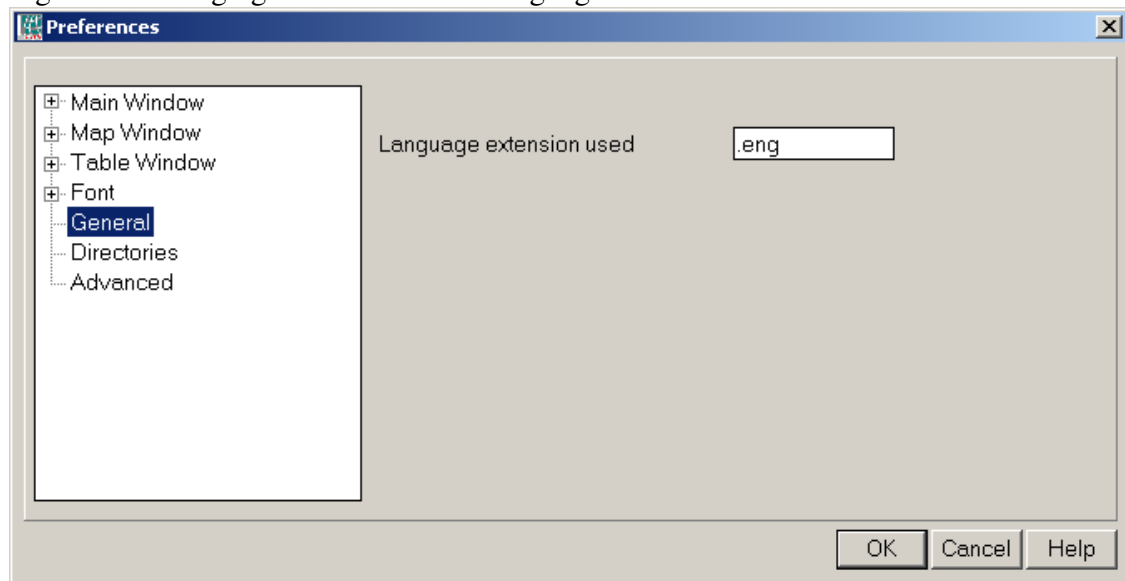
<http://www.java.com/en/download/index.jsp>

Some DDS toolbox applications make use of JAVA, like the Data Manager. If the system does not have the JAVA Runtime Environment installed already, move to the website indicated above, select the “Free Java Download” button and install it. Accept the License Agreement to start and complete the installation (using default settings).

1.1.4 Changing the ILWIS language settings, from English to French

The ILWIS 3.7.1 version supports currently next to English also French. It is envisaged to include also Spanish and Portuguese languages in the near future. To switch languages start ILWIS. Subsequently from the main ILWIS menu, select the option “File” and “Preferences”. Under “Font”, “General”, the language of the ILWIS menu can be defined. By default the English language is defined, using as Language extension “.eng” (for English). This can be changed to “.fr” (for French), to show the menu of ILWIS in French. See also figure 1.2. After this modification press “OK”, close ILWIS and start ILWIS again. The menu will be shown in the language specified.

Figure 1.2 Changing the ILWIS menu language



1.1.7 Concluding remarks

With ILWIS, the DDS toolbox plug-in and the other necessary utility-software installed you still need to continue with the DDS-Toolbox configuration settings which are further described in the next chapter (1.2).

Note that also use is made of other freeware utilities for pre processing of the ENVISAT (MERIS, AATSR and ASAR) data. For this purpose VISAT-BEAM is used. Links to these resources are provided in Appendix 1. Also install the VISAT BEAM software according to the description provided.

1.2 Configuration of the data stream using the DDS Data Manager

1.2.1 Introduction.

Once having installed and configured a local DDS ground receiving station the satellite and environmental data that is (re-) broadcasted via communication satellites can be received and stored on a storage device (server). As the data is received during the night / early morning time – 7 days a week basis, the “DDS Data Manager”, a data management system, has been developed that can be easily configured using a simple ascii text file. How to prepare or modify this ascii configuration file and to run the Data Manager is described below. This section is of special relevance to the system administrator that is operating the ground receiving station. On the 52north.org website (the navigation tab: “Earth Observation”) also a recent ascii “DDS Data Manager” configuration file is available, so new users don’t need to start from scratch constructing the ascii file. Within the DDS-toolbox an ascii configuration file is also available.

1.2.2 General design considerations for development of the DDS Data Manager

The DDS Data Manager is a software application for Windows / Linux written in Java that - in short – examines computer files, and transfers them to a proper location, based on filename-patterns. It was developed at ITC (<http://www.itc.nl>).

The primary purpose for developing this application is to organize the large amount of data files received on a DDS receiving station (a computer with a Digital Video Broadcast (DVB) card connected to a satellite dish). The data that is received on the receiving station must be transferred to computer storage that is independent of the receiving station's disk storage before users can access it. Users are not allowed to work directly with the data on the receiving station, because it should perform its primary task undisturbed, which is to be available all the time for storing the files captured by the (DVB) card.

Main objectives of the DDS Data Manager application:

- To organize all files in the "incoming" folder of the DDS receiving station, according to “rules” defined by the local system administrator.
- To detect and log "missing files". The application can be fed with knowledge about the files that are expected from a certain category. The "missing files" log is very helpful when users need to check data consistency prior to time-series analysis.
- Be extremely reliable to work continuously, 24 hours per day, 7 days per week, preferably unattended for several months, because if the application stops working unexpectedly (and nobody is available to solve the problem), after a couple of days, the files accumulated in the "incoming" folder on the receiving station could reach the maximum available disk capacity.
- Cause as little as possible disturbance to the receiving station (lightweight activity), or otherwise the station will be too busy and occasionally miss the reception of files (fail to store some of the files captured by the DVB card).

- It must be easy to restore the configuration of the DDS Data Manager after a software or hardware crash or a power failure, even by non-experts, as the local system administrator may not be available at all times.
- The DDS Data Manager must be able to process a large number of files in a single folder at one time. Therefore it must be able to handle all files that have been accumulated in the "incoming" folder in case the application has not worked for a couple of days.
- The type of files that the DDS Data Manager can process must not be fixed to a specific type (e.g. satellite images). Therefore the application will only depend on the fact that files have specific filename-patterns. With this, the process of detecting a file's category can be kept lightweight, as the file does not need to be opened.
- The “rules” with which files are organized are kept simple in the initial implementation (transfer files to a new location, delete after a certain time period, delete immediately or keep forever, ignore specific files, etc.), which is sufficient for the primary objective of the application. However, it is not difficult to extend their capability if such demand exists.
- The system administrator must be able to easily adapt the configuration file, so that new data that is broadcasted can be easily handled, as the DDS system is further developing and it is expected that in the future more data will be broadcasted.
- The system manager should be able to fine-tune the storage of the data that is received to be tailored for a specific organization. Given the data load it is impossible to store all of the data. Each organization will have its own specific data storage requirements!

The DDS Data Manager can run without problems on the receiving station, but can also run on another computer, as long as all necessary folders can be accessed through the network connection. *Note that the (sub-) directories assigned to store the various data files can be created (manually) prior to starting the Data Manager or can be automatically generated.*

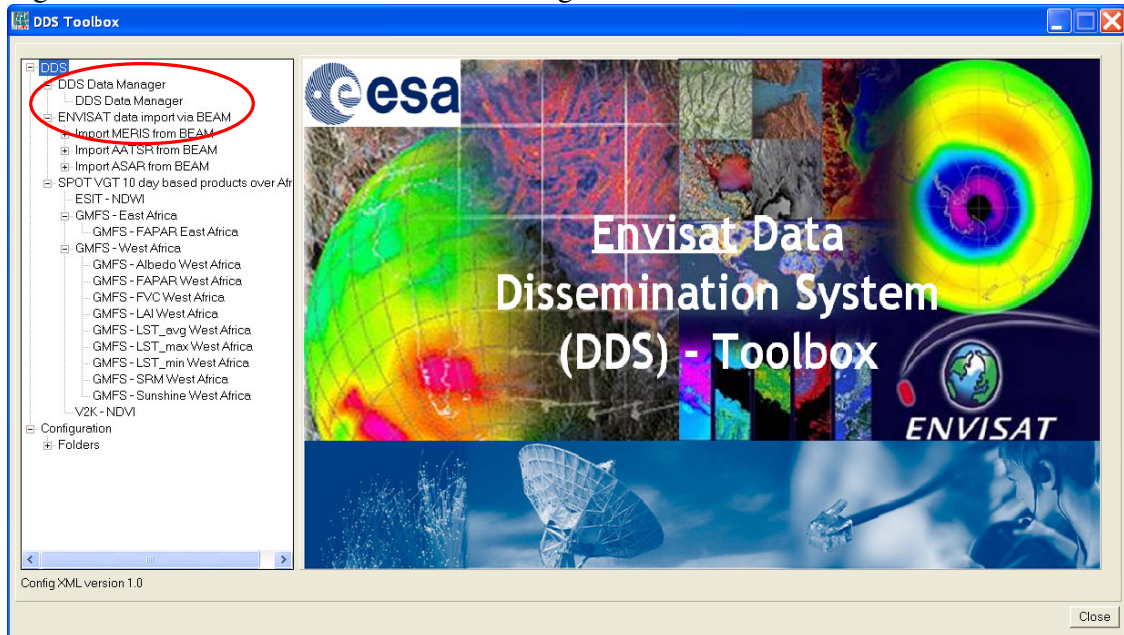
1.2.3 The DDS Data Manager - “Rules”

The local DDS system administrator creates the file-processing rules. This is initially done by editing a text-file (the configuration file that is used by the DDS Data Manager). At a later stage, the rules are fine-tuned in the user-interface of the DDS Data Manager. This was done to keep the user-interface simple and understandable. For example, file patterns or expected frequency of a category of files must be changed in the configuration file, using a text-editor. However, the destination location or the duration of storage of a category of files is changed in the user-interface, because it is considered a "last-minute" change: the administrator may frequently change his mind about this. The user-interface of the DDS Data Manager adapts itself to the rules that are defined. Rules are organized in “groups” and “items”. Each group becomes a tab, and each item becomes a box within a tab.

1.2.4 Configuring the DDS Data Manager

Open ILWIS and from the Operation-Tree select the “ESA-DDS” and the “Toolbox” tab. Subsequently select the option “DDS Data Manager” (see also the figure 1.3 below) and start the “Data Manager” by pressing the “Start Data Manager” button.

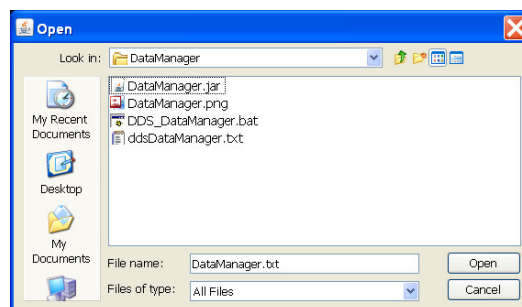
Figure 1.3: Location of the DDS Data Manager in the Toolbox menu.



Note that this utility only needs to be configured by the system manager-administrator to ensure that the data which is required by the organization – institute is properly stored and can be accessed by the other users within the organization – institute. There is no need to start the application as an instance of the DDS Data Manager might already be running by the system administrator.

Once the DDS Data Manager is activated an input configuration file needs to be specified as indicated in figure 1.4. A sample configuration file that is used at ITC for the C-Band DDS broadcasting is provided. Note that this configuration file does not incorporate all the services that are broadcasted via Ku-Band (for Europe). Select the file “ddsDataManager.txt” and a menu will appear on the screen. A menu sample is shown in figure 1.5.

Figure 1.4: Selection of the input configuration file

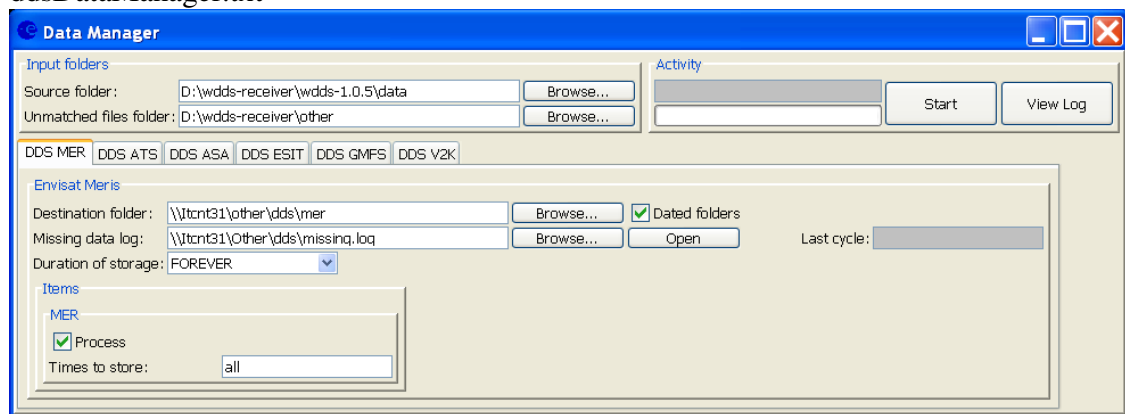


The menu that subsequently appears is based upon the settings that are provided in the “ddsDataManager.txt” file. Examine the various tabs (“groups”) and look at the “items” within each of these groups (once more: don’t start the application!).

The User Interface allows the system administrator to define the “Source folder”, the directory where the newly incoming data arrive on the ground receiving station, the “Destination folder” is used to store the newly arrived data on the archiving system. A location for the “Missing Data log” can be specified if for each “Item” the number if “Times per day” is specified (see also figure 1.6). Also “Duration of storage” can be interactively defined and how the data is stored, e.g. by a date formatted folder structure, activating the “Dated folders” option.

This configuration file can also be opened using a text editor and can be modified according to the specific need of the user. The Data Manager can be closed by clicking the closing button in the top-right corner.

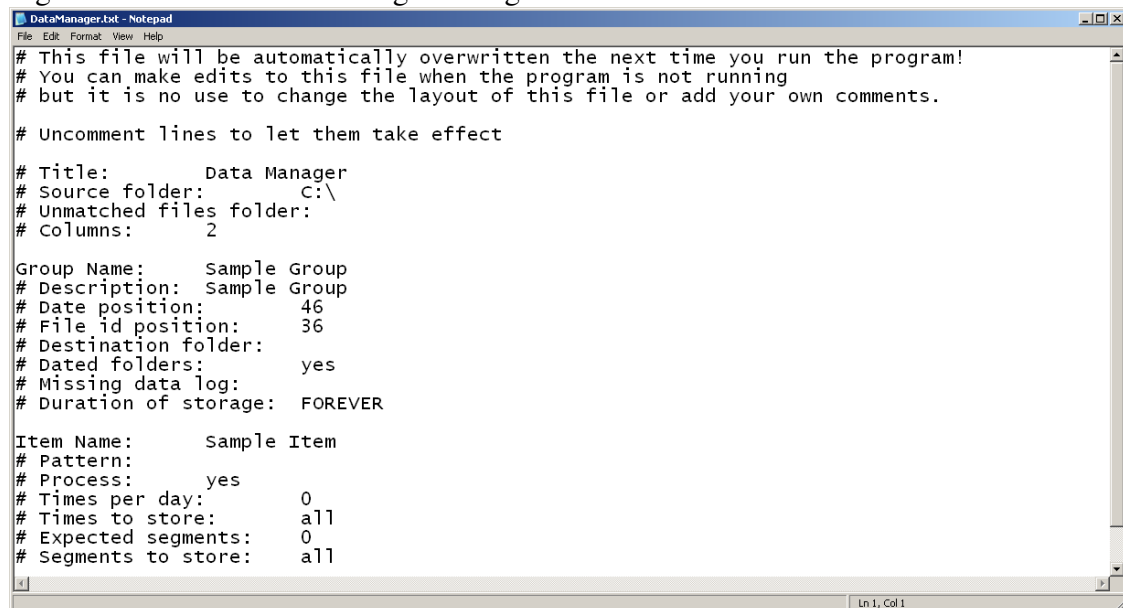
Figure 1.5: The DDS Data Manager, showing the menu as defined by the text file ddsDataManager.txt



Use the Windows Explorer, move to the ILWIS directory and move to the following sub-directory: \Extensions\DDS-Toolbox\DataManager.

Select the file “DataManager.txt”, double click the file to open it using Notepad. This file is the default file that can be used to build your own data storage configuration file (see also figure 1.6).

Figure 1.6: Default Data Manager configuration file



```
# This file will be automatically overwritten the next time you run the program!
# You can make edits to this file when the program is not running
# but it is no use to change the layout of this file or add your own comments.

# Uncomment lines to let them take effect

# Title:          Data Manager
# Source folder:  C:\
# Unmatched files folder:
# Columns:        2

Group Name:       Sample Group
# Description:    Sample Group
# Date position:  46
# File id position: 36
# Destination folder:
# Dated folders:  yes
# Missing data log:
# Duration of storage:  FOREVER

Item Name:        Sample Item
# Pattern:
# Process:         yes
# Times per day:   0
# Times to store: all
# Expected segments: 0
# Segments to store: all
```

As indicated in the application description before (chapter 1.2.3 DDS Data Manager - “Rules”) you are able by adapting the “Group Name” and “Item Name” to modify the menu that will subsequently be generated when starting the application using the modified configuration file, which should be saved using a different name (else it will be overwritten when a new instance of the Data Manager is started using the default “DataManager.txt” file). To ensure that the changes are implemented when a new event of the Data Manager is started the lines should be uncommented to let them take effect.

The DDS Data Manager can also be used as a stand alone. All required files are situated in the ILWIS sub-directory \Extensions\DDS-Toolbox\DataManager. This directory can be copied to the appropriate system with JAVA installed and the “DataManager.jar” can be directly started from there as well.

Having the capability to easily adapt the menu and therefore also the storage of the incoming data stream any new modifications resulting from adaptations of the DDS system can be easily incorporated without the need to wait for software updates. This is important as the system will further develop and broadcast more satellite and environmental data. Using simple copy and paste options the text file can be configured according to the need of the user, the system manager-administrator does not need to have any programming experience to do these types of manipulations.

Note that any data which is not assigned by the rules specified is stored in the Directory assigned under the “Unmatched File Folder”. If this Directory is regularly checked the new data that has arrived can be easily captured in a set of new “rules” and stored if required relevant or deleted.

Carefully check the content of the text file “ddsDataManager.txt” using Notepad to see how at ITC the full range of data broadcasted via DDS is configured / handled and which

data is stored (for various durations). Check also the various “Group and Item names”, “Pattern” and “Source and Destination folder” and that is used.

Note that new DDS users can use this configuration file to get them going and adapt it to their local circumstances (using copy, paste and delete!). On the <http://52north.org> website (navigation tab: “Earth Observation”) also a recent ascii “DDS Data Manager” configuration file is available, which can be downloaded and used.

1.2.5 Making the DDS data available within the organisation

The data that is received via DDS is commonly stored on a file server that can be accessed by all users within the organization according to the Data Manager settings described above. When using the “ddDataManager.txt” configuration file, the data is stored under the sub directory OTHER\DDS. Some relevant sub-directories in this folder are:

- MER: the ENVISAT-MERIS orbits recorded over Africa, note a date formatted folder structure
- ATS: the ENVISAT-AATSR orbits recorded over Africa, note a date formatted folder structure
- ASA: the ENVISAT ASAR orbits recorded over Africa, note a date formatted folder structure
- ESIT: the SPOT Vegetation NDWI for Africa, decadal product
- GMFS: the Global Monitoring for Food Security data disseminated, covering East and West Africa, decadal product
- V2K: the SPOT Vegetation NDVI for Africa, decadal product

To get easy access to the data, as it is stored on a “distant” file server, it is convenient to map the sub directory “DDS” as a Network Drive using the Windows Explorer Tools option.

Open Windows Explorer, from the Menu, select Tools and Map Network Drive. Specify a Drive letter, select the shared network folder from Windows and browse to the target folder. If you have configured your system using the “ddsDataManager.txt” file, specify a network mapping for the folder “DDS” (e.g. as drive Z:\).

These settings will vary for different locations. You have to consult the system manager to get the details of how the data is stored in the archive. Note that there are differences with respect to the type of data disseminated by Ku and C-Band DDS service (over Europe and Africa respectively) and a certain organization might not store all the data that are disseminated.

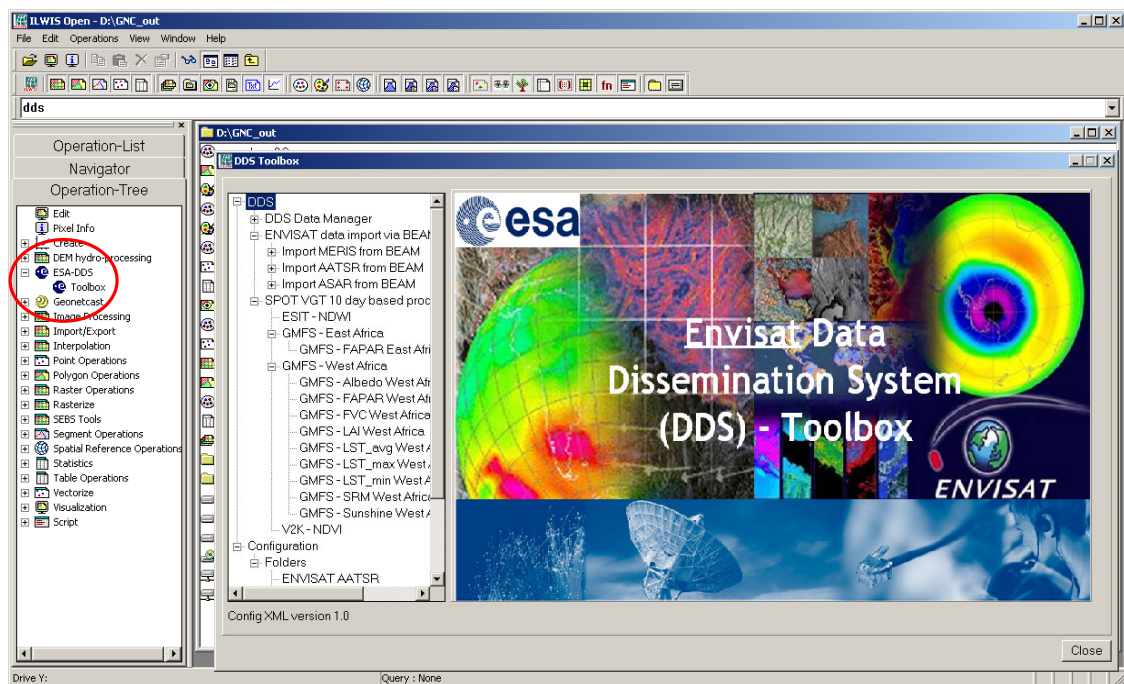
2. Overview of the DDS Toolbox Architecture

2.1 Introduction

The DDS toolbox is developed as a plug-in under ILWIS 3.7. The general installation instructions are described before. Note that this Toolbox version is not ILWIS downward compatible; in such a case download the ILWIS 3.7 version from <http://52north.org>.

The main objective of the Toolbox is to allow the user, who operates a DDS ground receiving station to easily manage the incoming data stream and to import the data into a common freeware GIS-RS environment for further analysis, in this case using the functionality of ILWIS version 3.7 or higher. This toolbox version allows import of various data sources through a Graphical User Interface (GUI). Here the toolbox architecture is described into more detail. Once the toolbox is installed and ILWIS is newly started the “ESA-DDS” toolbox should appear as a menu item under the ILWIS Operation Tree (see figure 2.1).

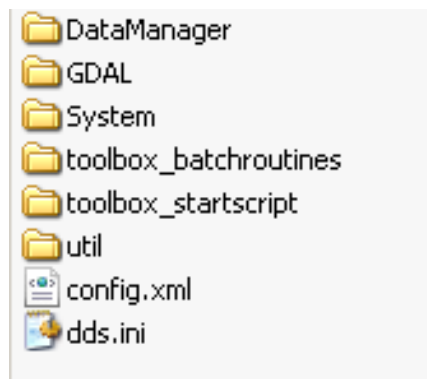
Figure 2.1: The DDS toolbox plug-in Graphical User Interface



2.2 Structure of the DDS toolbox

To operate the DDS-toolbox, the file “DDS-toolbox.zip” is copied under the ILWIS sub-directory \Extensions. Once a new event of ILWIS37 is started this ZIP file is extracted and the content is stored in the sub-directory \DDS-toolbox within the same \Extensions sub-directory. Within the DDS-toolbox sub-directory a number of other sub-directories appear (see figure 2.2).

Figure 2.2: Toolbox sub-directory structure



The folder *\DataManager* contains the “DDS Data Manager”, a utility that allows automated archiving of the newly incoming data. This application requires the Java Runtime Environment. It is advised to run this utility as a stand alone application if operated on a ground receiving station as it should be operated continuous. This utility is described in chapter 1.2.

The folder *\GDAL* (Geospatial Data Abstraction Library) contains a translator library for raster geospatial data formats that is released under an X/MIT style Open Source license by the Open Source Geospatial Foundation (<http://www.gdal.org>).

The folder *\System* is storing the ILWIS service objects. Service objects are used by data objects; they contain accessories required by data objects besides the data itself. Upon installation of the toolbox, these objects are copied to the main ILWIS directory *\System*.

The folder *\Toolbox_batchroutines* provides the batch files that are used to execute most of the actual operations. These files can be opened and modified using a text editor. Currently 15 routines are available for accessing the various images and data products in the DDS data stream. Further information is provided in chapter 2.6.

The folder *\Toolbox_startscript* is containing various sub-directories containing ILWIS scripts. Upon selection of an import routine, from the DDS toolbox User Interface a script is called and this script subsequently calls a batch file which executes the operation. The scripts can also be opened and modified using ILWIS. Further information is provided in chapter 2.5.

In the *\Util* folder ILWIS service objects are stored, like lookup tables, georeferences, domains, etc. Furthermore a number of executables are stored here that are used by various toolbox batch routines

The file “*config.xml*” contains the DDS-toolbox GUI menu structure. This file can be edited using a text editor. In case the user wants to add new routines, this XML file can

be adapted and modified. The resulting menu will be adapted accordingly when a new instance of the Toolbox is started. This allows users that do not have programming experiences to adapt the toolbox to their own preferences. A more detailed description is provided below in chapter 2.3.

The file “*dds.ini*” contains the settings of the input and output directories for each “folderid” that is defined in the “*config.xml*”. This file is storing the settings as defined from the Toolbox menu: Configuration and Folders. Further information on the input and output folder settings is provided in chapter 2.4.

2.3 Structure of the Config.xml

One of the main criteria during the development of this utility was to make the toolbox as open as possible, allowing persons with no programming background to make modifications in case new sensor data - products become available as the DDS data stream will further evolve-change. As indicated before, all scripts and batch routines used can be adapted by the user. Next to this, the user can also modify the menu of the Toolbox GUI. The file that generates the user interface, “config.xml”, can be opened using a text editor.

The structure of the file is kept as simple as possible. The “Level” is defining the main (Level1) and sub menu structure (Level2 – Level”N”). For the “Level value=” a menu name can be defined. Within a certain level a “Product value=” can be specified, which will generate the name of the respective (sub) menu.

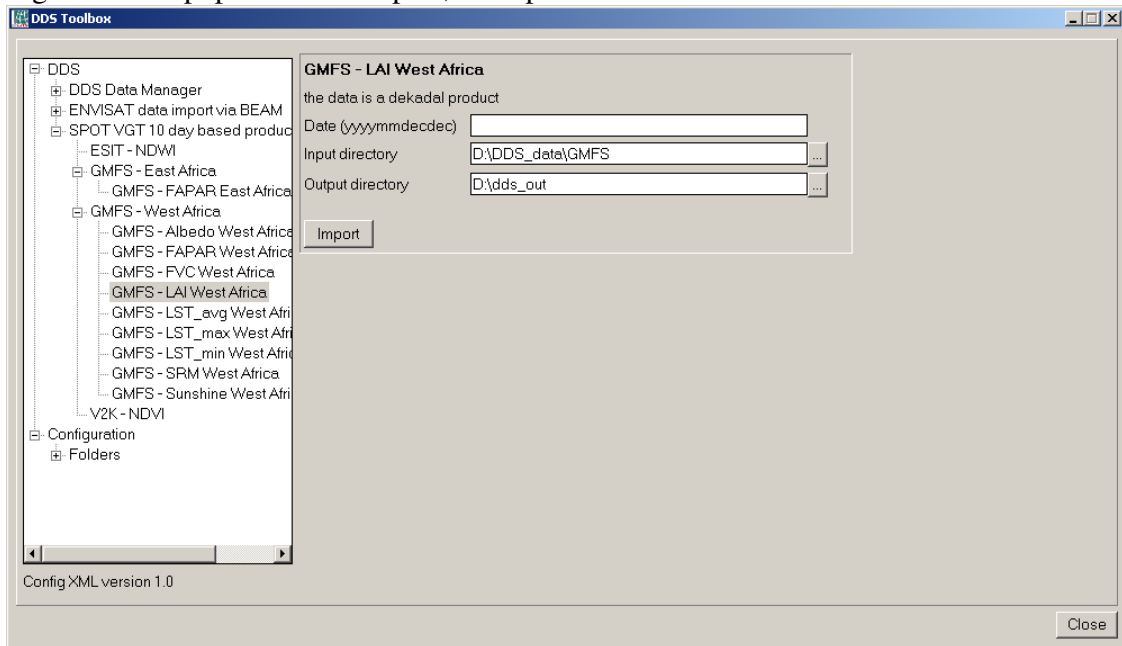
The string starting with “Product value=” contains mostly a number of other items, like “script”, “format”, “type”, “folderid” and “comment”.

- *Script*. The item script defines the sub-directory where the respective ILWIS script is located and the name of the script that should be executed;
- *Format*. The text string that can be entered here will appear in the popup window when importing a certain image or product. It is used to ensure that e.g. the appropriate “time stamp” is entered on the user interface (see the “Date” on figure 2.3). For the various images and products these can have a different formats, in the example of figure 2.3 the “Date” stamp expected should have the format “yyyymmdecdec” (y=year, m=month, dec=dekade);
- *Type*. This is the only part of the toolbox that does not allow user modification without programming experiences. Various forms, that generate the pop-up windows are available within the toolbox and are called by their specific names given. These forms generate the appearance of the popup windows when importing a specific product. The popup menu that is given in figure 2.3 is generated from a “type” called: “dec”;
- *Folderid*. This item generates a folder item in the “dds.ini” file. From the main Toolbox menu, Configuration and Folders option, this Folder item is now available and can now be further specified by defining the appropriate input and output directories. As example a “folderid” of “ENVISAT MERIS” is given. When opening the “dds.ini” file, using a text editor, an item [ENVISAT MERIS] is added and the input and output folders can now be specified here as well by providing the relevant directory names, like:

```
InputFolder=D:\DDS_exercisedata\MER
OutputFolder=D:\DDS_out
```

- *Comment*. Additional information (one line of text) can be provided in the popup menu to notify the user on any specific information that might be relevant. In figure 2.3 a comment string is added indicating the temporal resolution of the GMFS-LAI West Africa product.

Figure 2.3: Popup menu for import, example GMFS-LAI West Africa



Other syntax used in the config.xml is:

<	Start of a new line
/>	End of a line
<Level...	Start of a new level
</Level"n">	End of level "n"

Note that all the text should be entered between quotation marks "".

The first few lines of the config.xml are:

```

1:    <DDS>
2:        <Version id="1.0"/>
3:        <Path value="Extensions\DDS-Toolbox" inifile="dds.ini" />

```

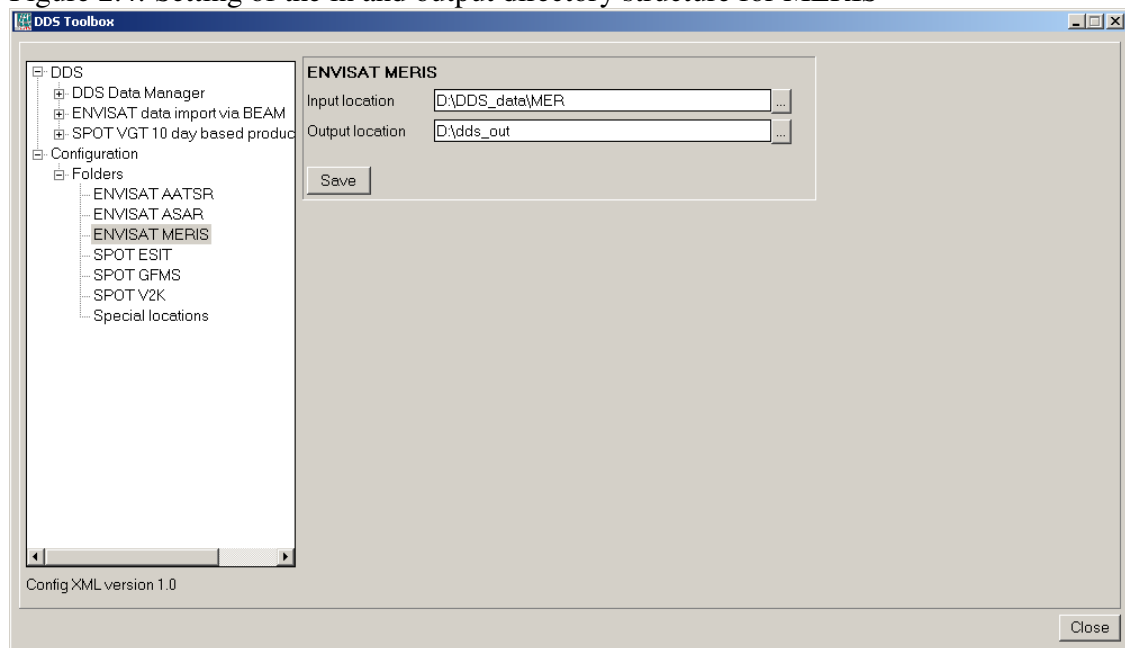
Line 1 provides the link to the plug-in and the menu name, note that this is also the last line of the XML. Note that also a plug-in for GEONETCast is developed. Line 2 provides the opportunity to indicate a version number, useful if modifications are done to the original XML. The version number is also shown in the main DDS toolbox menu, in the lower left hand corner. Line 3 refers the "dds.ini" file, which provides the links to the input and output directories.

After changes are made to the config.xml the file should be saved and a new instance of the toolbox should be started, showing the adaptations. Before modifying the file first make a backup!

2.4 General DDS Toolbox Configuration - Folder settings

For you to conveniently work with the DDS toolbox the data sources (on your local area network) and the local system output (working) directories need to be defined. From the main DDS Toolbox menu, select “Configuration” and the sub-menu “Folders”. In figure 2.4 below the in- and output directory for the MERIS data is used as example. Note that use can be made of a “Network Mapping” as described in chapter 1.2.5. Note that some input folders can be date formatted according to the specifications of the local system administrator. These directories are having a year, month and day structure.

Figure 2.4: Setting of the in and output directory structure for MERIS



Configure the input directory “Folders” according to the settings given by the local system configuration. It might not be necessary to specify all folders as some of the data services are not stored by the local ground reception infrastructure. There is a “Special locations” folder to select the location and programme-executable. This utility is not used currently within this plug-in.

2.5 Structure of the ILWIS DDS toolbox scripts

Most of the ILWIS scripts, situated within the SPOTVEGETATION sub-directory in the directory `\Toolbox_startscripts`, contain a single line which is identical. Below an example is given of a normalized difference vegetation index (VGT4_NDVIimport) import routine:

```
!%7\Extensions\DDS-Toolbox\toolbox_batchroutines\VGT4_ndviimport.bat %1 %2  
%3 %4 %5 %6 %7 %8
```

The command line starts with: ! This syntax (!) instructs ILWIS to start an external application. The application that should be started is situated in “`%7\Extensions\DDS-Toolbox\toolbox_batchroutines\`” and called “`VGT4_ndviimport.bat`”. This is a DOS batch routine which should be executed. The parameters required to execute the batch routine are given as `%1` to `%8`:

<code>%1</code>	Longfilename	remark: the time stamp entered for the specific product
<code>%2</code>	InputDrive	remark: input data drive, can also be a network mapping
<code>%3</code>	InputDir	remark: input data directory
<code>%4</code>	OutputDrive	remark: output data drive
<code>%5</code>	OutputDir	remark: output data directory
<code>%6</code>	gdalDir	remark: location of GDAL directory within toolbox
<code>%7</code>	IlwDir	remark: location of the ILWIS directory
<code>%8</code>	UtilDir	remark: location of the Util directory within toolbox

A number of these parameters are generated by the user interface such as `gdalDir`, `IlwDir` and `UtilDir` as these are fixed locations within the toolbox. Other parameters require user interaction, such as `longfilename`, `InputDrive`, `InputDir`, `OutputDrive`, `OutputDir`, as these change based on the user preferences. These parameters can be interactively provided in the popup menu when importing an image or product, see e.g. figure 2.3 above and the Date field provides the “Longfilename”, input and output directory for the “InputDrive”, “InputDir”, “OutputDrive” and “OutputDir” respectively.

When pressing the “Import” button of the popup menu (see again figure 2.3) a command line is generated which is executed. Using the script example above of importing a normalized difference vegetation index map, the following command line is generated and executed:

```
!C:\ilwis371\Extensions\DDS-Toolbox\toolbox_batchroutines\VGT4_ndviimport.bat  
20100401 D: DDS_data\V2K D: dds_out C:\ilwis371\Extensions\ DDS-  
Toolbox\GDAL\bin C:\ilwis371 C:\ilwis371\Extensions\DDS-Toolbox\util
```

The parameters are now defined as follows:

<code>%1</code>	Longfilename	20100401
<code>%2</code>	InputDrive	D:
<code>%3</code>	InputDir	DDS_data\V2K
<code>%4</code>	OutputDrive	D:

%5	OutputDir	dds_out
%6	gdalDir	C:\ilwis371\Extensions\ DDS-Toolbox\GDAL\bin
%7	IlwDir	C:\ilwis37
%8	UtilDir	C:\ilwis371\Extensions\DDS-Toolbox\util

Now with all parameters set the batch file “VGT4_ndviimport.bat”, situated in the ILWIS sub-directory \Extensions\DDS-Toolbox\toolbox_batchroutines\ can be executed. Starting the command with the !, ILWIS knows it has to execute an external command, given the fact that the extension is “.bat”, Windows knows it has to execute this file using the Batch command line processor.

2.6 Structure of the ILWIS GEONETCast-toolbox batch routines

As is the case with the ILWIS scripts, also most of the batch files follow a similar structure. As an example the VGT4_ndvi import routine is given below. The first 3 lines (see line numbers) are giving some remarks. Line 1 is giving the “ECHO” command, which allows, or turns off, the display of messages in the command line window. The comments given in line 2 and 3 are displayed on the command line screen. From line 4 to line 12 in the batch file, the parameters are passed, originating from the ILWIS script, to the batch file using the “SET” command. This command displays, sets, or removes Windows Environment Variables. Once these parameters are known the actual import routine can start. Special attention should be given to lines 4 and 5. The time stamp is defined as longfilename1 and is set in line 4. In line 5 this time stamp is used, starting from position 0, for 8 characters. In this case if a time stamp is used, like 20100401 (as yyyyymmdekkadekkade), the whole time stamp will be set as “shortfilename1”, as this has a length of 8 characters. This allows flexibility in selections of portions of strings, but does not have any influence for this specific import routine, here longfilename and shortfilename1 are the same.

Lines 13 to 15 ensure that the application moves to the appropriate output directory. Once in the output directory, line 16 copies the requested input data, using the appropriate time stamp, note %shortfilename1% and the file is renamed to “temp.zip” in line 17.

Lines 18 and 19 extract from the zipped HDF file the layers NDV.tif and SM.tif and the original file and extracted layers are renamed in lines 20 to 22 to obtain for the extracted files (NDV and SM) a shorter filename and these two files are imported into ILWIS format in lines 23 and 24, using GDAL.

Once the file is in ILWIS format, ILWIS is executed from the command prompt in lines 25 to 28 (ilwis.exe -C) and a number of map calculations are performed, e.g. in line 25 the calibration coefficients are applied and in line 26 the file is georeferenced for the NDVI layer. In line 27 the Status map is transformed into a byte map and line 28 appends the georeference for this file as well.

Lines 29 – 33 are deleting the files that have become obsolete.

Start of batch file listing: VGT4_ndviimport.bat

```
1: @echo off
2: echo output NDVI map is a value map, value ranges from 0 to 1
3: echo output Status map is a byte map, value ranges from 0 to 255

4: set longfilename=%1
5: set shortfilename1=%longfilename:~0,8%
6: set InputDrive=%2
7: set InputDir=%3
8: set OutputDrive=%4
9: set OutputDir=%5
10: set gdalDir=%6
11: set IlwDir=%7
12: set UtilDir=%8

13: cd\
14: %OutputDrive%
15: cd %OutputDir%

16: copy %inputDrive%\%InputDir%\V2KRNS10__%shortfilename1%_NDVI__Africa.zip
17: ren V2KRNS10__%shortfilename1%_NDVI__Africa.zip temp.zip
18: %UtilDir%\7z e temp.zip 0001/0001_NDV.tif
19: %UtilDir%\7z e temp.zip 0001/0001_SM.tif

20: ren temp.zip V2KRNS10__%shortfilename1%_NDVI__Africa.zip
21: ren 0001_NDV.tif ndvi%shortfilename1%.tif
22: ren 0001_SM.tif ndvi%shortfilename1%SM.tif

23: "%GdalDir%\gdal_translate.exe" -of ilwis "ndvi%shortfilename1%.tif" tndvi%shortfilename1%
24: "%GdalDir%\gdal_translate.exe" -of ilwis "ndvi%shortfilename1%SM.tif" tndvi%shortfilename1%_SM

25: "%IlwDir%\ilwis.exe" -C %OutputDrive%\%OutputDir%\ndvi%shortfilename1%.mpr
    {dom=value;vr=0.000:1.000:0.001}:(=%OutputDrive%\%OutputDir%\tndvi%shortfilename1%*0.004-0.1);

26: "%IlwDir%\ilwis.exe" -C setgrf %OutputDrive%\%OutputDir%\ndvi%shortfilename1%.mpr %UtilDir%\vgt4ndvi;

27: "%IlwDir%\ilwis.exe" -C %OutputDrive%\%OutputDir%\ndvi%shortfilename1%_SM.mpr
    {dom=image;vr=1:1:255}:(=%OutputDrive%\%OutputDir%\tndvi%shortfilename1%_SM);

28: "%IlwDir%\ilwis.exe" -C setgrf %OutputDrive%\%OutputDir%\ndvi%shortfilename1%_SM.mpr
    %UtilDir%\vgt4ndvi;

29: del "ndvi%shortfilename1%*.mp*"
30: del "ndvi%shortfilename1%*.csy"
31: del "ndvi%shortfilename1%*.grf"
32: del *.tif
33: del *.xml
```

End of Batch file listing.

Although the content of the batch files can vary significantly, the sequence of activities is mostly the same:

- Some remarks are given at the start of the batch file
- Setting of the environment variables, passing over the parameters from the ILWIS scripts

- Copy the original data to a local disk
- Import of the data into ILWIS format
- Execute various ILWIS routines from the command prompt
- Delete obsolete files

2.7 Changes and modifications

As the DDS data stream is changing-evolving the user has the capability to easily modify or create new import routines and subsequently change the graphical user interface. For all these actions no programming experiences are required. New lines can be added in the “config.xml” file, and using the option “folderid” a new entry is created in the “dds.ini” file. When opening a new instance of the DDS toolbox GUI, these changes are incorporated and using the option “Configuration” and “Folders” the appropriate input and output directories can be specified. A new script can be made, which in turn is executing a new batch file, to be created by the user. There are a number of existing batch files and portions of these files can be used as example how to create new ones.

It is advised to keep track of the changes using the XML version number. This version number can be modified in the “config.xml” file as well.

2.8 Advanced use

If certain operations have to be repeated on a continuous basis, e.g. import of a certain data type, e.g. for which basically only the time stamp has to be modified, it is advised to copy the command line string that is generated through the graphical user interface, available from the command line, in the main menu of ILWIS, to the WINDOWS command line processor (CMD.exe). Delete the “!” from the start of the string and execute the expression. Within the string the date stamp can be easily modified.

Also from the main menu of ILWIS, the command line history can be checked. Select the appropriate string generated through the graphical user interface, modify the time stamp and execute the expression again.

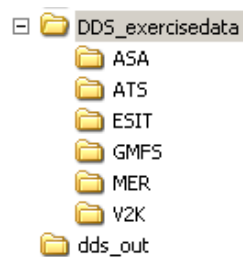
2.9 Concluding remark

With all the configuration settings provided you are now ready to utilize the DDS Toolbox and explore the data that is delivered via DVB broadcast. Note that services available in Europe (like the MERIS Full Resolution) are NOT available via the African turn around services.

3. Using the data delivered through DDS, some exercises using the DDS-Toolbox

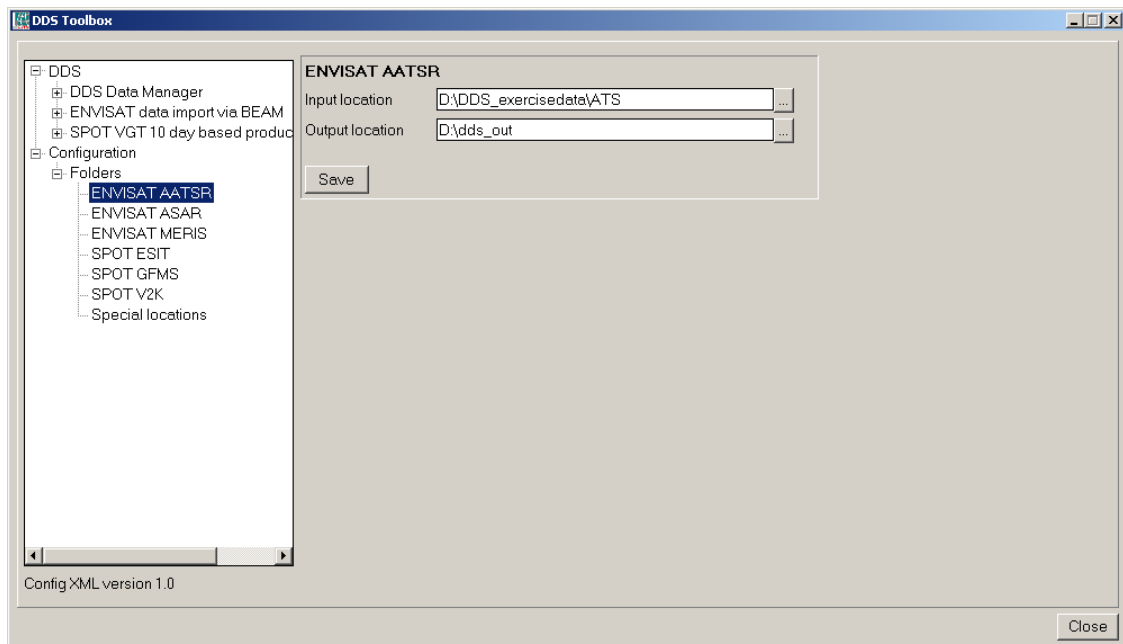
On the “DDS_exercisedata” directory on DVD or from the web (browse to “Earth Observation” community at <http://52north.org>) sample data is provided that can be used for the exercises (nearly 2 GB of data!). Check if you have sufficient disk space and copy the data to your local hard disk; preferably use the same directory structure, see also figure 3.1). Also create a new directory; called “*dds_out*”, this will be your working directory. In this case as hard disk drive “D:\” is used. Further information on the content of the folders is given in chapter 1.2.5. Note that the files in the sub-directories ASA, ATS and MER are zipped!

Figure 3.1: Data directory structure used for the exercises



Open ILWIS, from the left hand menu, select the option “*Navigator*” and browse to your working directory d:\dds_out. From the left hand menu, select “*Operation-Tree*” and open the “*ESA-DDS*” and “*Toolbox*” sub menu items. Now select from the toolbox menu the option “*Configuration*” and “*Folders*”. Specify the appropriate locations of the input and output folders and “*Save*” them, see also figure 3.2.

Figure 3.2: Specification of input and output folder locations



3.1 Incorporating the data recorded by ENVISAT

3.1.1 Using BEAM as pre-processor

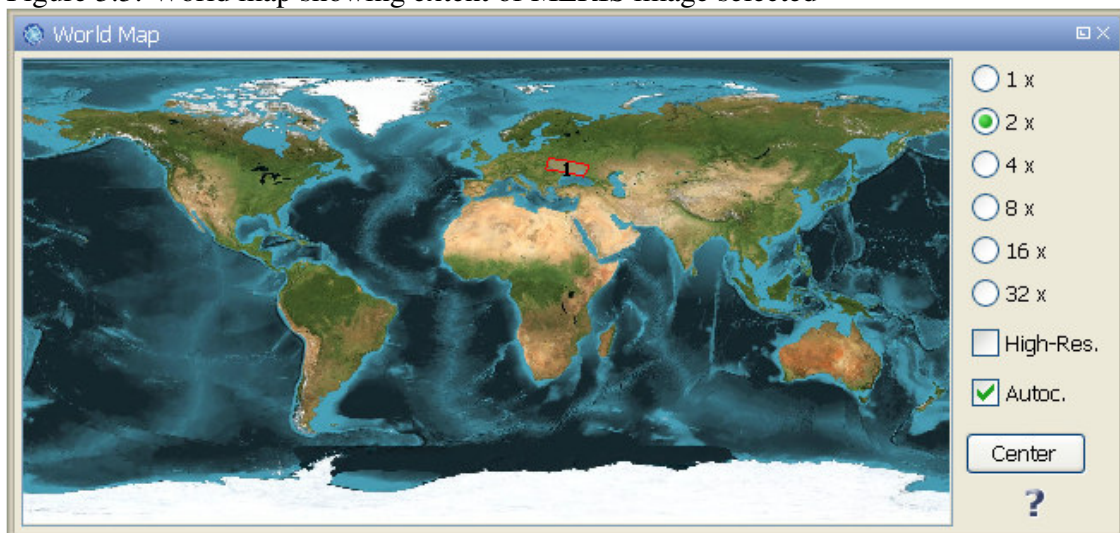
Download and install VISAT-BEAM according to the installation instructions provided. In appendix 1 the link to the software is provided.

After installation is completed, open VISAT-BEAM, select from the main menu the option “File”, “Open”, navigate to the sub-directory \MER and select the file:

MER_FRS_1PNPDK20100807_083305_000000732091_00465_44106_3277.N1.gz

Press “Open”. This is a MERIS Full Resolution Geolocated and Calibrated TOA Radiance image. The file name now appears in the product view. To get an idea of the area recorded by this image select from the main menu “View”, “Tool Windows” and “World Map”. The field of view of the specific recording is indicated over a world map. See also figure 3.3 below.

Figure 3.3: World map showing extent of MERIS image selected



After having seen the area covered by the selected image you can close the world map and you can display the image. Right click with the mouse over the filename in the Product View and from the context sensitive menu select the option: “Open RGB Image View”. From the “VISAT – Select RGB-Image Channels”, select from the drop down list under “Profile”: MERIS L1b – 13,5,1 and press “OK”. Once the image is displayed, you can zoom in and out using the navigator available at the top left portion of the image display window. Note the various layers of the image in the product view.

Once more click on the file name of the imported image in the Product View, when selected it will appear blue. Now select from the main menu the option: “Tools”, “Map Projection”. Change the “Name” to an appropriate name, e.g. Meris_geographic and under “Projection” select Geographic Lat/Lon. The other settings can be used as default, press OK. In the Product View window a new item is now added (e.g. called

Meris_geographic). Right click with the mouse over the filename in the Product View and from the context sensitive menu select the option: “*Open RGB Image View*”. From the “*VISAT – Select RGB-Image Channels*”, select from the drop down list under “*Profile*”: MERIS L1b – 13,5,1 and press “*OK*”. In a new display the resampled image will be shown, you can zoom in and out using the navigator available at the top left portion of the image display window.

Once more click on the file name of the projected image (Meris_geographic) in the Product View, when selected it will appear blue. Now select from the main menu the option “*File*” and “*Export*”, “*Export GeoTIFF Product*”. Select an appropriate output directory, in this case “*d:\dds_out*” and press “*Export Product*”. This will take some time as all bands are exported. Note from the Products View the various bands that are available (radiance 1 to 15, 11flags, detector index, latitude, longitude, etc). Note the band numbers of the radiances as you will use these later in ILWIS. Upon completion of the export, select “*File*” and “*Close all*”, there is no need to save the data.

The use of VISAT BEAM for the ASAR and AATSR is identical. As example here use is made of ASAR. Select from the main menu the option “*File*”, “*Open*” and navigate to the sub-directory \ASA. Select the file:

ASA_GM1_1CNPDE20100807_211205_000012082091_00472_44113_2811.N1

Press “*Open*”, this is an ASAR Global Monitoring Mode Image, consisting of two layers, the Amplitude and Intensity respectively. Right click, using the mouse, on the Amplitude band in the Product View and from the pop-up menu, select the option “*Open Image View*”, the Amplitude image is displayed. Repeat this for the intensity image as well. To get an idea of the area recorded by this image select from the main menu “*View*”, “*Tool Windows*” and “*World Map*”. The field of view of the specific recording is indicated over a world map. Close the world map.

Once more click on the Amplitude band of the imported image in the Product View, when selected it will appear blue. Now select from the main menu the option: “*Tools*”, “*Map Projection*”. Change the “*Name*” to an appropriate name, e.g. ASARampli_geographic and under “*Projection*” select Geographic Lat/Lon. The other settings can be used as default, press OK. In the Product View window a new item is now added (e.g. called ASARampli_geographic). Double click it to see the content and subsequently right click, using the mouse, on the Amplitude band in the Product View and from the pop-up menu, select the option “*Open Image View*”. In a new display the resampled image will be shown, you can zoom in and out using the navigator available at the top left portion of the image display window.

Once more click on the file name of the projected image (ASARampli_geographic) in the Product View, when selected it will appear blue. Now select from the main menu the option “*File*” and “*Export*”, “*Export GeoTIFF Product*”. Select an appropriate output directory, in this case “*d:\dds_out*” and press “*Export Product*”. This will take some time as all bands are exported. Note from the Products View the various bands that are

available (Amplitude, intensity, latitude, longitude, etc). Note the band number of the Amplitude as you will use these later in ILWIS. Upon completion of the export, select “File” and “Close all”, there is no need to save the data.

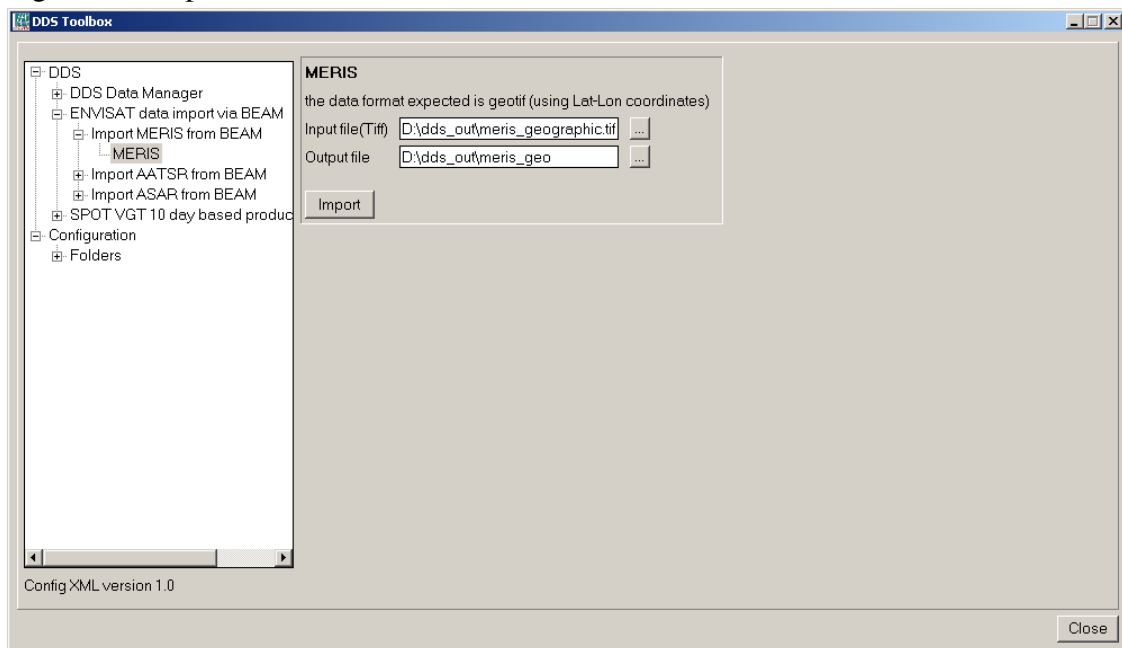
You can also close VISAT-BEAM when the export is completed.

3.1.2 Import of MERIS in the DDS toolbox

Open ILWIS. Note the working directory! This should be “dds_out”. If this is not the case, from the left hand menu, select the option “Navigator” and browse to your working directory d:\dds_out. Close ILWIS and open ILWIS again, it should now open in the directory “dds_out”.

From the left hand menu, select “Operation-Tree” and open the “ESA-DDS” and “Toolbox” sub menu items. Now select from the toolbox menu the option “Import MERIS from BEAM” and “MERIS”. Use the browse button to select the file from the input directory, in this case “Meris_geographic” and select the browse button to define the appropriate output directory and file name, e.g. “d:\dds_out\meris_geo” and press “Import” to conduct the import (see also figure 3.4).

Figure 3.4: Import window for the MERIS data





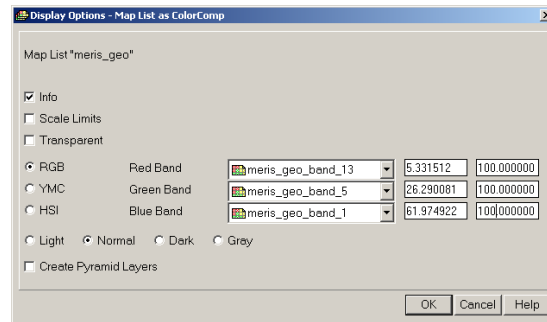
Upon completion of the import, select from the ILWIS main menu, the option “Window” and from the drop down menu “Refresh F5”. To display the image double click the maplist icon  “meris_geo” and in the Map List “meris_geo” menu select the “Open as ColorComposite” option . Display the bands according to the assignment in the figure 3.5 below, the upper stretch limit can be changed to a value of 100 for each of the bands. Note that the map list is containing 32 layers.

Figure 3.5: Band assignment for visualization.




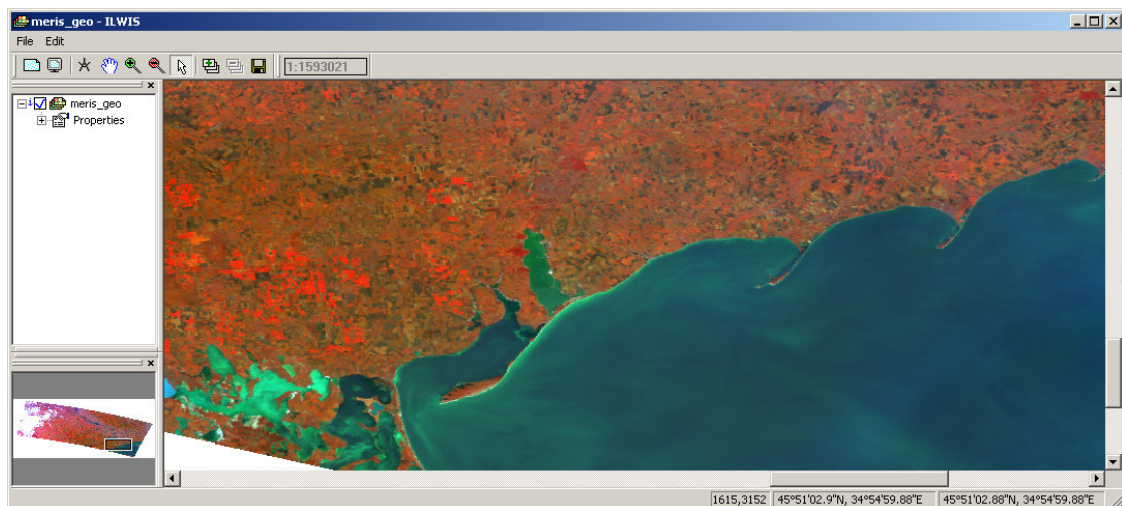
Activate the  “Normal” option from the active map display window. When you move the mouse cursor over the image and simultaneously press the left mouse button you can also see the values (note the units). From the active map window, select “Options”, “No Zoom”. Your results should resemble those of figure 3.6.

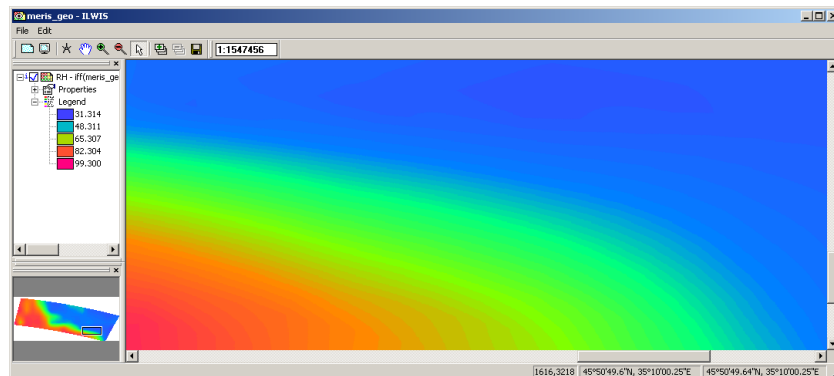
Figure 3.6: Colour composite a MERIS Full Resolution image, bands 13, 5, 1 in RGB



The last layer in the map list is the relative humidity. In the Map List “meris_geo” menu select the image “meris_geo_band_32”. Double click the layer, in the “Display Options-Raster Map” window, select as representation “Pseudo”, as upper stretch limit specify the value of 100 (relative humidity of 100 %) and press OK to show the image. Move the mouse cursor over the image and simultaneously press the left mouse button to see the values (note the unit).

From the active map window, select “Options”, “No Zoom”. Your results should resemble those of figure 3.7. When finished close all active ILWIS map and map list layers.

Figure 3.7: The relative humidity geophysical product



3.1.3 Import of ASAR in the DDS Toolbox

From the left hand menu, select “*Operation-Tree*” and open the “*ESA-DDS*” and “*Toolbox*” sub menu items. Now select from the toolbox menu the option “*Import ASAR from BEAM*” and “*ASAR*”. Use the browse button to select the file from the input directory, in this case “*ASARampli_geographic*” and select the browse button to define the appropriate output directory and file name, e.g. “*d:\dds_out\asar_geo*” and press “*Import*” to conduct the import.


Upon completion of the import, select from the ILWIS main menu, the option “*Window*” and from the drop down menu “*Refresh F5*”. To display the image double click the maplist icon  “*asar_geo*” and in the Map List “*asar_geo*” menu select the image “*asar_geo_band_1*”. Double click the layer, in the “*Display Options-Raster Map*” window, select as representation “*Gray*”, as upper stretch limit specify the value of 7500 and press “*OK*” to show the image. Move the mouse cursor over the image and simultaneously press the left mouse button to see the values (note the unit). From the active map window, select “*Options*”, “*No Zoom*”. Your results should resemble those of figure 3.8. When finished close all active ILWIS map and map list layers.

Figure 3.8: ASAR Amplitude image



3.2 The SPOT Vegetation NDVI and NDWI

Open ILWIS and select from the “*Operation-Tree*” and the “*ESA-DDS*” and “*Toolbox*” sub menu items. Now select the option “*Configuration*” and “*Folders*”. Check the input and output folders specified for the “*SPOT ESIT*” and “*SPOT V2K*”. These need to be specified to import the NDWI and NDVI respectively. As output directory “*d:\dds_out*” is assumed.

3.2.1 Import of the NDVI and NDWI

Consult the “*Vegetation for Africa User Manual*” and read the NDWI and S10-NDVI product description (pp 97- 114). The document can be downloaded from:
http://www.vgt4africa.org/PublicDocuments/VGT4AFRICA_user_manual.pdf.

From the DDS-toolbox menu, select the options “*SPOT VGT 10 day based products over Africa*”, “*ESIT-NDWI*” and specify as “*Date*” stamp: *20100401*. Note that this is a decadal product, decade number 01 consists of the first 10 days of the month, decade number 11, is the period from day 11 to day 20 and decade number 21 refers to the remainder of the month.

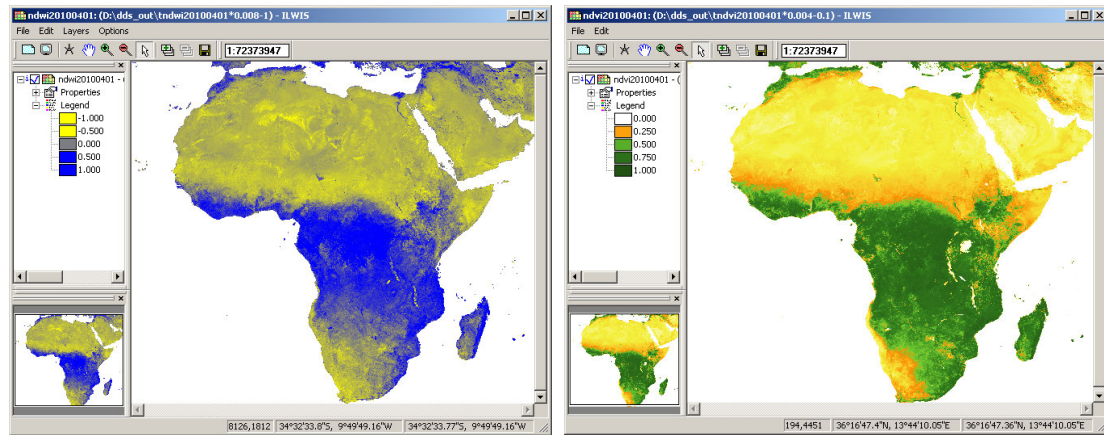
Upon completion of the import, select from the ILWIS main menu, the option “*Window*” and from the drop down menu “*Refresh F5*”. To display the image double click the new map created called: “*ndwi20100401*”. As Representation select “*ndwi*” and press “*OK*” to show the map. Move the mouse cursor over the image and simultaneously press the left mouse button to see the values (note the unit). From the active map window, select “*Options*”, “*No Zoom*”. Your result should resemble the left hand map as of figure 3.9.

From the DDS-toolbox menu, select the options “*SPOT VGT 10 day based products over Africa*”, “*V2K-NDVI*” and specify as “*Date*” stamp: *20100401*. Note that this is a decadal product, decade number 01 consists of the first 10 days of the month, decade number 11, is the period from day 11 to day 20 and decade number 21 refers to the remainder of the month.

Upon completion of the import, select from the ILWIS main menu, the option “*Window*” and from the drop down menu “*Refresh F5*”. To display the image double click the new map created called: “*ndvi20100401*”. As Representation select “*ndvi*” and press “*OK*” to show the map. Move the mouse cursor over the image and simultaneously press the left mouse button to see the values (note the unit). From the active map window, select “*Options*”, “*No Zoom*”. Your result should resemble the right hand map as of figure 3.9.

Note that next to the import of the NDVI also the Status map has been imported.

Figure 3.9: SPOT Vegetation NDWI (left) and DNVI (right) map of the 1st decade of April 2010



3.2.2 VGT Africa NDVI correction using Status Map

Some of the VGT4Africa products come with a status map which can be used to filter the values on their quality. To display the NDVI Status Map, double click the map “ndvi20100401_SM” use a “Pseudo” Representation and press OK to show the map. Check the values of this map and note that a byte range is used. The status map needs to be interpreted on a bitwise basis. The status map flag filter matrix for the NDVI product is shown in figure 3.10.

Figure 3.10: The NDVI Status Map flag filter matrix

Bit Sequence	Meaning
X X X X X X (0) (0)	Clear (cloud-free) pixel
X X X X X X 0 1	Shadow detected
X X X X X X 1 0	Shadow/cloud detection is uncertain
X X X X X X 1 1	Cloud detected
X X X X X 0 X X	No ice/snow
X X X X X 1 X X	Ice/snow detected
X X X X 0 X X X	Sea/water pixel
X X X (1) X X X	Land pixel
X X X 0 X X X X	Bad radiometric quality of SWIR band (interpolated value)
X X X 1 X X X X	Good radiometric quality of SWIR band
X X 0 X X X X X	Bad radiometric quality of NIR band (interpolated value)
X X (1) X X X X X	Good radiometric quality of NIR band
X 0 X X X X X X	Bad radiometric quality of red band (interpolated value)
(1) X X X X X X	Good radiometric quality of red band
0 X X X X X X X	Bad radiometric quality of blue band (interpolated value)
1 X X X X X X X	Good radiometric quality of blue band

The bit position of the Status Map (in byte format) generated needs to be interpreted from right to left (under Bit Sequence):

7	6	5	4	3	2	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

The red circles in figure 3.10 define the criteria that can be used to select only the good NDVI quality pixels for further analysis:

Clear (cloud-free) pixel	bit sequence position 0 (2^0)	flag = 0
Clear (cloud-free) pixel	bit sequence position 1 (2^1)	flag = 0
Land pixel:	bit sequence position 3 (2^3)	flag = 1
Good radiometric quality of NIR band:	bit sequence position 5 (2^5)	flag = 1
Good radiometric quality of red band:	bit sequence position 6 (2^6)	flag = 1

To address this, the following bit pattern sequence applies: X 1 1 X 1 X 0 0, at the 0th, 1st, 3rd, 5th and 6th position in the bit sequence (from right to left!). Note that the “X” position is not indicating a relevant flag in the case of the NDVI product.

To test if the bits at these positions are according to the selection criteria the DIV and MOD operators in ILWIS can be used:

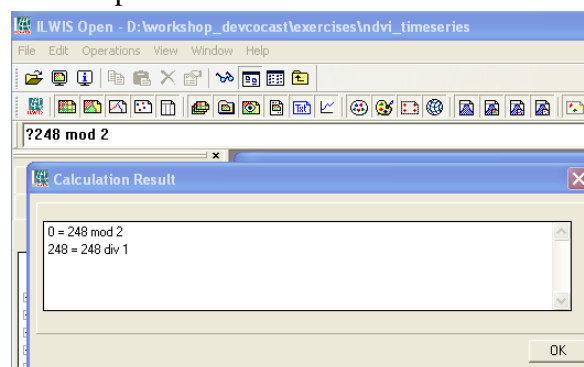
DIV: The integer division operator divides two integers and returns the integer quotient, i.e. $a \text{ DIV } b$. ($248 \text{ DIV } 8 = 31$, $246 \text{ DIV } 8 = 30$)

MOD: The modulus operator returns the remainder of a divided by b , i.e. $a \text{ MOD } b$. ($10 \text{ MOD } 3 = 1$, $11 \text{ MOD } 5 = 1$)

Assuming we have an output Status Map pixel value of 248. To test whether for this pixel the flag value at the first bit position (0th position) is 0, the pixel value is divided by the corresponding power of 2, in this case 1, as 1 is being the result of 2^0 . Type the following command on the ILWIS command line in the main ILWIS menu (see also figure 3.11):

?248 DIV 1, press enter and you will see as output value 248

Figure 3.11: DIV and MOD operators from the ILWIS command line



Now the MOD operator is used to check if there is any remainder if divided by 2 (as a bit can only consist of a 0 or a 1):

?248 MOD 2

A value of 0 is returned as there is no remainder if divided by 2. Note that with the “?” prior to the expression the ILWIS command line can be used as a pocket calculator

To test whether for this pixel value the second position is 0, the pixel value is divided by the corresponding power of 2, in this case 2, as 2 is being the result of 2^1 :

?248 DIV 2 = 124
?124 MOD 2 = 0

To test whether for this pixel value the fourth position is 1, the pixel value is divided by the corresponding power of 2, in this case 8, as 8 is being the result of 2^3 :

?248 DIV 8 = 31
?31 MOD 2 = 1 (as the remainder of the division by 2 is 1)

To check this for the 5th ($2^5 = 32$) and 6th ($2^6 = 64$) position the procedure is identical:

?248 DIV 32 = 7 ?7 MOD 2 = 1
?248 DIV 64 = 3 ?3 MOD 2 = 1

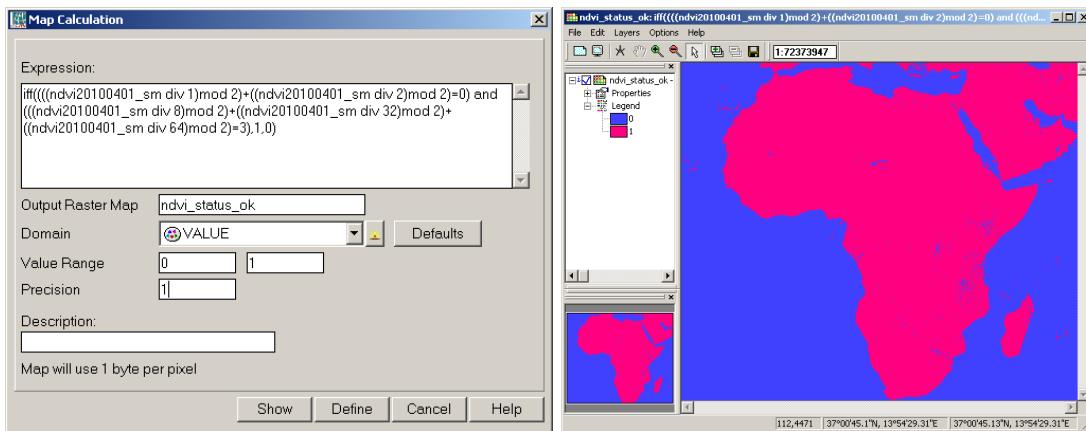
In the example of a pixel value in the status map of 248, for the 0th, 1st, 3rd, 5th and 6th position are 0, 0, 1, 1 and 1 respectively. They are meeting the above indicated selection criteria. Check it yourself using as Status Map flag value: 232 and think of the “?” in front of the expression if the ILWIS command line calculator option is used.

A sample ILWIS “*map calculation*” statement to extract the 5 selection criteria from the bit sequence positions is:

```
outmap:=iff((((ndvi_sm div 1)mod 2)+((ndvi_sm div 2)mod 2)=0) and (((ndvi_sm div 8)mod 2)+((ndvi_sm div 32)mod 2)+((ndvi_sm div 64)mod 2)=3),1,0)
```

Note that: “*outmap*” = the output map and “*ndvi_sm*” = the status map that belongs to the NDVI map. To use this expression open from the main ILWIS menu the “*Operations*” item and select from the drop down menu “*Raster Operations*” menu and subsequently “*Map Calculation*”. Enter the appropriate expression; here “*ndvi20100401_sm*” is used as status map. The other settings are specified in figure 3.12 as well as the output map generated, using “*Pseudo*” Representation for visualization of the map.

Figure 3.12: Map Calculation expression to extract the relevant NDVI flags (left) and resulting output map (right)



The output map has two values, 0: “not meeting the selection criteria”, and 1: “meets all criteria”. This map can now be used to retain only those values in the NDVI map that meet the selection criteria.

In order to derive the NDVI map for only those areas that have passes the quality assessment, open from the main ILWIS menu the “*Operations*” item and select from the drop down menu “*Raster Operations*” menu and subsequently “*Map Calculation*”. Enter the appropriate expression:

$$\text{iff}(\text{ndvi_status_ok}=1, \text{ndvi20100401}, ?)$$

Specify as output map: “*ndvi20100401_cor*”, “*domain*”: “*Value*” and “*Range*” from 0 to 1, “*precision*”: 0.001

Display the resulting corrected NDVI map as well as the status map using the appropriate Representations. Note that in the expression a “?” is used, this results in “*not_a_value*” or undefined areas for those pixels that do not meet the status criteria (which have been assigned 0 in the status map). If you compare your results with the status map you will see that the blue coloured pixels over land are now undefined (check the map value and you will see a “?” returned for these areas), for those pixels that have been assigned 1 in the status map the NDVI value is assigned.

Also the NDWI has a status map. Currently only for the NDVI product the status map is extracted. The procedure how this is done can be seen from the batch file that is used for the import of the VGT4Africa NDVI product. The batch file listing is discussed in chapter 2.6. If a few lines are added to the batch file used to import the NDWI product also this status map can be extracted. Note that the flags are different for this product as the NIR and the SWIR bands are used to generate this product, see also page 111 in the VGT4Africa user manual.

3.3 Import data from GMFS

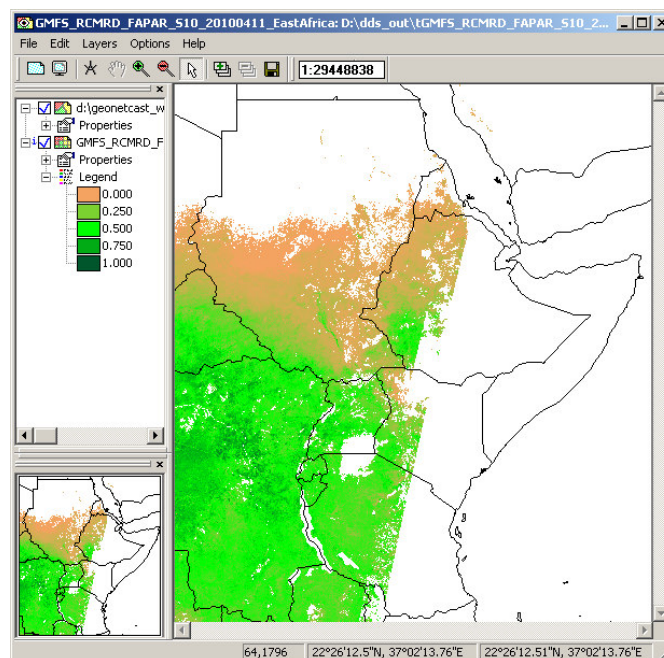
Open ILWIS and select from the “*Operation-Tree*” and the “*ESA-DDS*” and “*Toolbox*” sub menu items. Now select the option “*Configuration*” and “*Folders*”. Check the input and output folders specified for the “*SPOT GMFS*”. This directory needs to be specified to import the GMFS products. As output directory “*d:\dds_out*” is assumed.

3.3.1 GMFS, Eastern Africa

From the DDS-toolbox menu, select the options “*SPOT VGT 10 day based products over Africa*”, “*GMFS-East Africa*” and “*GFMS – FAPAR East Africa*”. Specify as “*Date*” stamp: *20100411*. Note that this is a decadal product, decade number 01 consists of the first 10 days of the month, decade number 11, is the period from day 11 to day 20 and decade number 21 refers to the remainder of the month.

Upon completion of the import, select from the ILWIS main menu, the option “*Window*” and from the drop down menu “*Refresh F5*”. To display the image double click the new map created called: “*GFMS_RCMRD_FAPAR_S10_20100411_EastAfrica*”. As Representation select “*fapar*” and press “*OK*” to show the map. Move the mouse cursor over the image and simultaneously press the left mouse button to see the values (note the unit). From the active map window, select “*Options*”, “*No Zoom*”. Your result should resemble figure 3.13.

Figure 3.13: GMFS-FAPAR East Africa



3.3.2. GMFS Western Africa

From the DDS-toolbox menu, select the options “SPOT VGT 10 day based products over Africa”, “GMFS-West Africa”. Here are a number of import routines to import products like land surface temperature (minimum, maximum and average), leaf area index, albedo, sunshine hours, etc. Select the option “*GMFS Albedo West Africa*”. Specify as “Date” stamp: 20100401. Note that this is a decadal product, decade number 01 consists of the first 10 days of the month, decade number 11, is the period from day 11 to day 20 and decade number 21 refers to the remainder of the month.

Upon completion of the import, select from the ILWIS main menu, the option “Window” and from the drop down menu “Refresh F5”. To display the image double click the new map created called: “*GMFS_CRA_ALBEDO_S10_20100401_WestAfrica*”. As Representation select “Pseudo” and press “OK” to show the map. Move the mouse cursor over the image and simultaneously press the left mouse button to see the values (note the unit). From the active map window, select “Options”, “No Zoom”. Your result should resemble figure 3.14.

Import in a similar manner also some of the other products, e.g. the FVC and the LAI, using the same “Date” stamp for import and as Representation for display purposes the “fvc” and “lai” respectively. Your result should resemble those given in figures 3.15 and 3.16. For the other products, consult the data input sub-directory and use the appropriate “Date” stamps.

Figure 3.14: GMFS Albedo West Africa

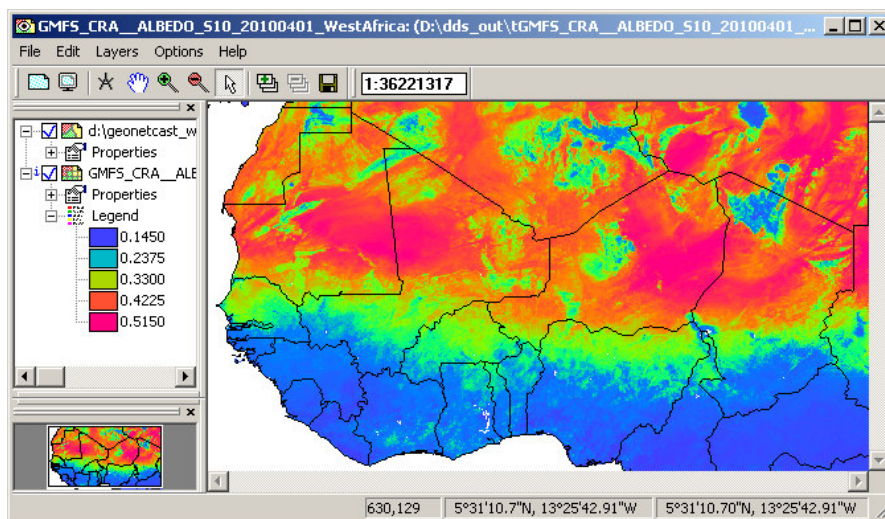


Figure 3.15: GMFS Leaf Area Index West Africa

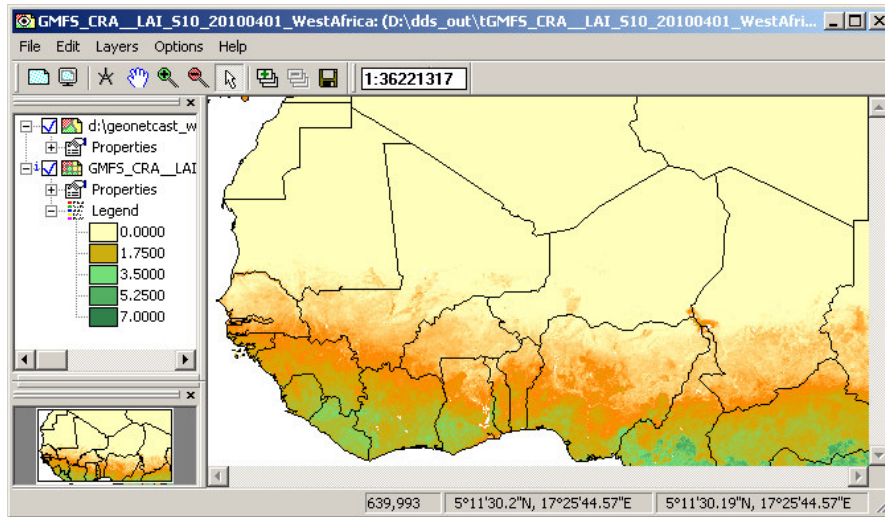
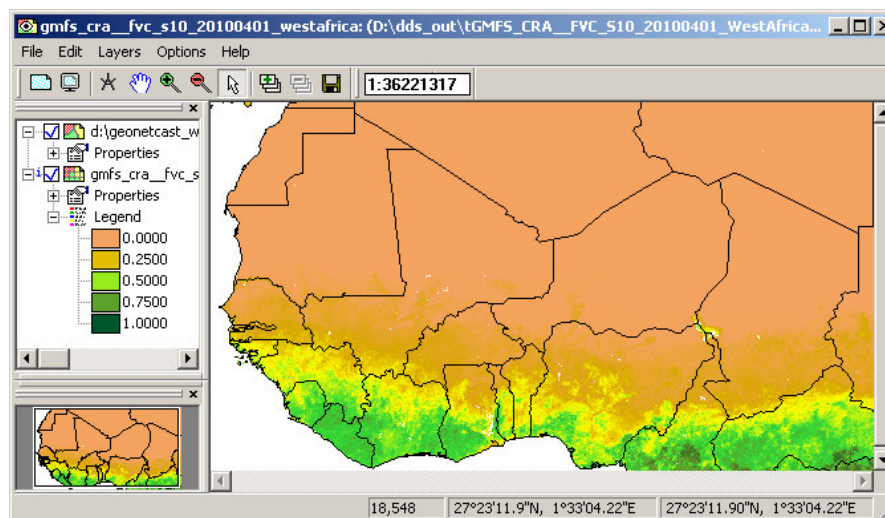


Figure 3.16: GMFS Fraction of Vegetation Cover West Africa



Appendix 1: Other freeware utilities that can be used in conjunction with ILWIS3.7

For Jason-2 Data:

Basic Radar Altimetry Toolbox is available at:

http://www.altimetry.info/html/data/toolbox_en.html or
http://earth.esa.int/brat/html/data/toolbox_en.html

For SPOT-Vegetation data:

New version of the VGTEExtract software. This new version is 1.2, build/release 2. With additional output format: ILWIS (.mpr)

Windows, with JAVA integrated:

http://www.vgt4africa.org/VGTEExtract/Windows/VM/setupVGTEExtract_VM.exe

Windows version, without JAVA (JAVA should already be installed)

http://www.vgt4africa.org/VGTEExtract/Windows/NoVM/setupVGTEExtract_NoVM.exe

Linux, without JAVA

http://www.vgt4africa.org/VGTEExtract/Linux/NoVM/setupVGTEExtract_NoVM.bin

Linux, with JAVA

http://www.vgt4africa.org/VGTEExtract/Linux/VM/setupVGTEExtract_VM.bin

For METOP-AVHRR/3 Data:

VISAT-BEAM, with the Metop-AVHRR/3 import plug-in (version 1.3):

Home page BEAM:

<http://www.brockmann-consult.de/beam/>

Downloads of BEAM:

<http://www.brockmann-consult.de/beam/downloads.html>

Download of METOP AVHRR Level-1b Product Reader

<http://www.brockmann-consult.de/beam-wiki/display/BEAM/Plug-ins>

For Satellite Position Prediction software:

SATSCAPE is a satellite tracking program for Windows

<http://www.satscape.co.uk/main/modx/>

David Taylor: WXTRACK

<http://www.satsignal.eu/software/wxtrack.htm#DownloadWXtrack>

For more Marine Applications and Processing:

BILKO, supported by UNESCO, BILKO is available from homepage:

<http://www.noc.soton.ac.uk/bilko/>