GEONETCast Toolbox Factsheet XML version 1.2

1. Introduction

The GEONETCast-Toolbox provides an open and flexible integrated solution to manage the EUMETCast-GEONETCast data stream, import of the various image types and data products and bring them together in a common GIS and RS environment for further processing. This approach is further elaborated upon in figure 1.

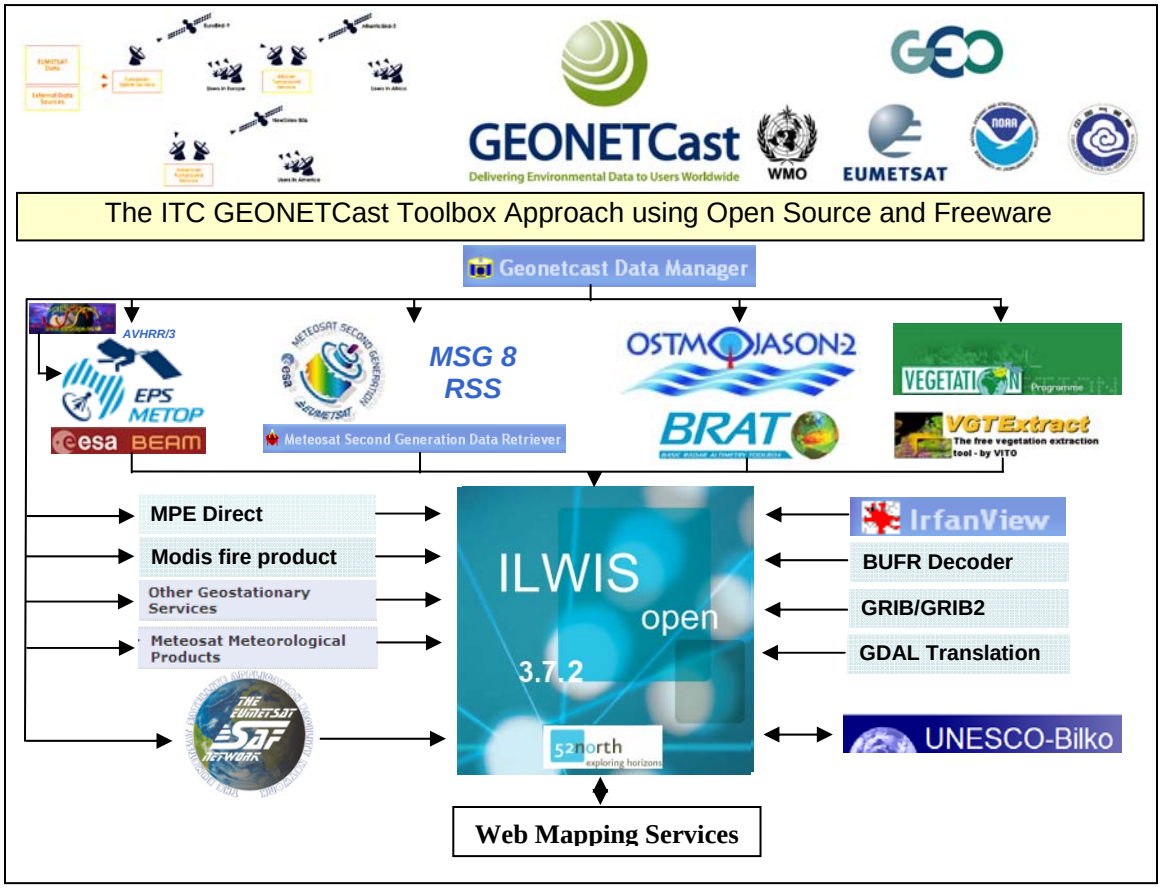

Figure 1: Overall concept of the GEONETCast-Toolbox

The data disseminated by EUMETCast-GEONETCast is consisting of various formats. Over time a number of utilities have been developed at ITC to be able to import these data types. Also other existing freeware utilities have been used and integrated in the toolbox, such as BUFR and GRIB (2) decoders. Also use can be made of other available software routines, such as BEAM, BRAT and VGT-Extract for pre-processing. In that case import routines are available to seamless transfer the data into an ILWIS data format.

Last but not least attention was given to use data that is made available through the World Wide Web. A number of routines are available to incorporate relevant environmental and forecasting information in this manner, extending the functionality beyond the

EUMETCast-GEONETCast direct reception. To be able to use these services an internet connectivity is required.

2 The GEONETCast-Toolbox functionality (XML Version 1.2)

Below a short description with instructions to import the data / run a utility is provided of the main menu items that are available in the GEONETCast-Toolbox, XML version 1.2. The sequence followed is identical to the menu structure as given in figure 2.

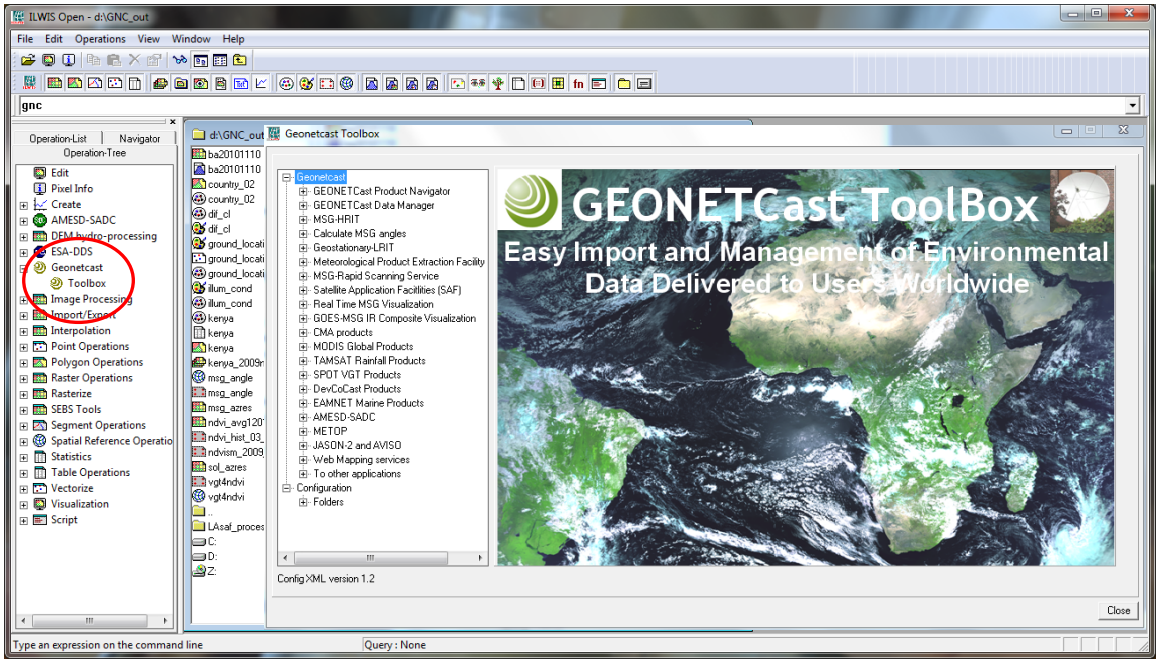

Figure 2: GEONETCast toolbox menu

2.1 GEONETCast Product Navigator

The Product Navigator is developed and maintained by EUMETSAT showing the details of the GEONETCast data stream. All kind of selection criteria can be applied to find the data that might be of interest to the various users. This is a good starting point to discover the data that is currently globally disseminated.

2.2 GEONETCast Data Manager

This utility allows the system administrator to transfer the newly incoming data on the ground receiving station to a central archive based on all kind of rules and decisions. This utility generates a menu based on an ascii text file. This file can be modified and adapted using a text editor if new data has arrived or if the organization wants to maintain only a certain portion of the full data stream.

2.3 MSG-HRIT, MSG Data Retriever

This utility can be used to import the recordings from the SEVIRI instrument onboard METEOSAT 8, the so called Rapid Scanning Service, and METOSAT 9, covering the whole footprint. Allows easy selection of time series, radiometric conversions and geometric transformations. Works also from command line, see also figure 3.

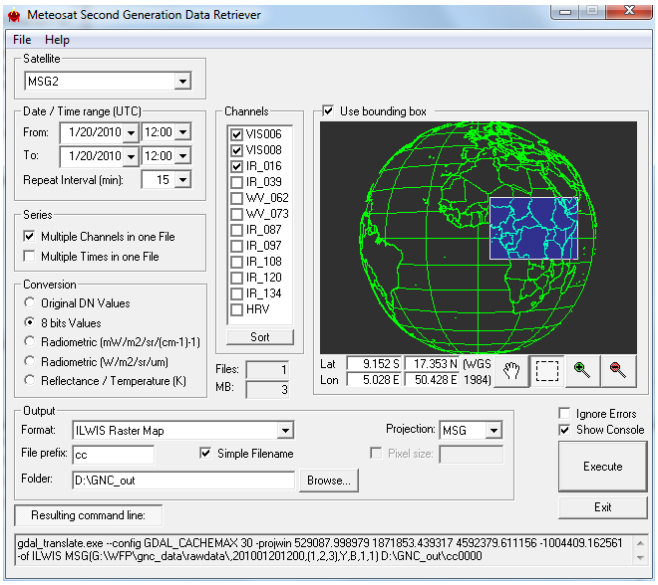

Figure 3: The MSG Data Retriever

2.4 Calculate MSG angles

For many applications corrections to the pixels have to be applied based on satellite or sun azimuth and zenith angles. A Java applet has been created which allows computation of MSG satellite and sun azimuth and zenith angles based on date and time. This routine is called by an ILWIS script that allows the user to calculate the solar and MSG satellite solar / zenith angles for a certain time for the MSG field of view using a simple user interface.

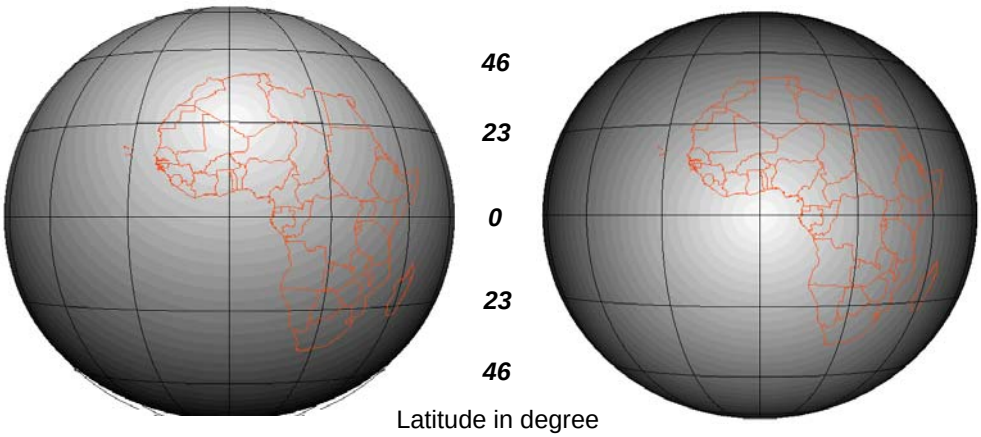

Figure 4: Example of Sun (for 21 June 2006, 12.00 UTC) and MSG satellite zenith angles (for 0°N latitude and 0°E longitude, left and right hand picture respectively)

2.5 Geostationary-LRIT

Under this menu a number of utilities are present that allow for the import of the other geostationary satellite data that is broadcasted. Using the Low Rate Image Transmission the full temporal resolution is not available. Currently the following geostationary satellite import routines are supported: Fengyun-2E, the high resolution sensor and the multi spectral low resolution sensor, GOES East and GOES West, METEOSAT 7 and 9

as well as MTSAT2. The data is imported as byte images, except GOES East and West, which are transformed to albedo (for the visible channel) and temperature in Kelvin, for the thermal channels.

As last option under this heading the so called “TIR Composite” is available. The 10.8 micron band of GOES West, GOES East, MSG, METEOSAT7 and MTSAT2 is imported, resampled and glued to create a global thermal composite. The time stamp required here should adhere to: yearmonthdayhour, as the common temporal resolution of the LRIT geostationary data is 1 hour. An example is given in figure 5.

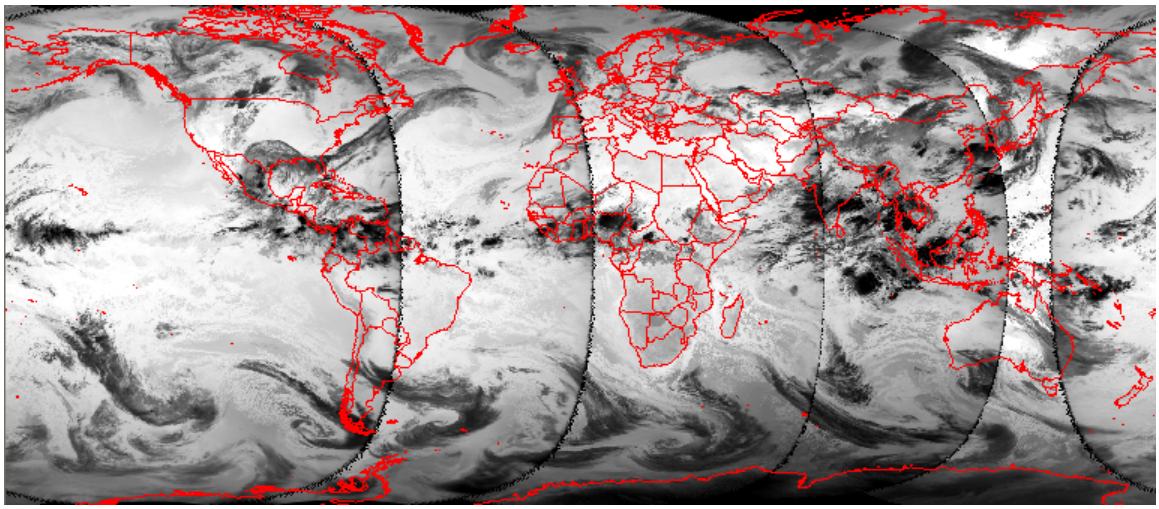

Figure 5: Example of a global thermal composite

2.6 Meteorological Product Extraction Facility (MPEF)

The MPEF is a part of the MSG Ground Segment; its primary function is the generation of Meteorological Products from the Level 1.5 SEVIRI image data supplied by the Image Processing Facility (IMPF). The products are then quality controlled and encoded prior to being passed to the Data Acquisition and Dissemination Facility (DADF) for delivery to users.

2.7 MSG-Rapid Scanning Service (RSS)

Under this heading a number of routines are available to import the various products that are generated by the MPEF-RSS at EUMETSAT. These products are generated using METEOSAT 8 which currently operates the Rapid Scanning Service (RSS), scanning 1/3 of the northern portion of the MSG field of view, with an increased temporal resolution.

2.8 Satellite Application Facilities (SAF)

Satellite Application Facilities (SAFs) are specialised development and processing centres within the EUMETSAT Applications Ground Segment. Utilising specialised expertise in Member States, they complement the production of standard meteorological products derived from satellite data at EUMETSATs Central Facilities.

The routines available here are grouped per geographic region (Africa, Europe and Latin America) and are produced by the Satellite Application Facility (SAF) on Land Surface

Analysis (LSA). There is also a routine that allows the import of a combined GOES-MSG sea surface temperature product which is produced by the SAF on Ocean and Sea Ice.

3.2.9 Real Time MSG Visualization

Utilities are developed to automatically import a natural colour transformed image of the visible and near infrared bands of the SEVIRI instrument. Once a region is selected and the appropriate input and output directories are specified, the utility automatically starts at a given system clock time, scheduled in such a way to ensure that the last recorded images have arrived at the ground reception station. The task is automatically repeated every 15 minutes, in sync with the temporal resolution of MSG.

3.2.10 GOES-MSG TIR Composite Visualization

This visualization option shows an animated sequence of TIR composites of the last 5 hours of GOES and MSG. The utility starts a Windows Scheduled Task event is automatically repeated every 15 minutes. An example of a certain time stamp is given in figure 6.

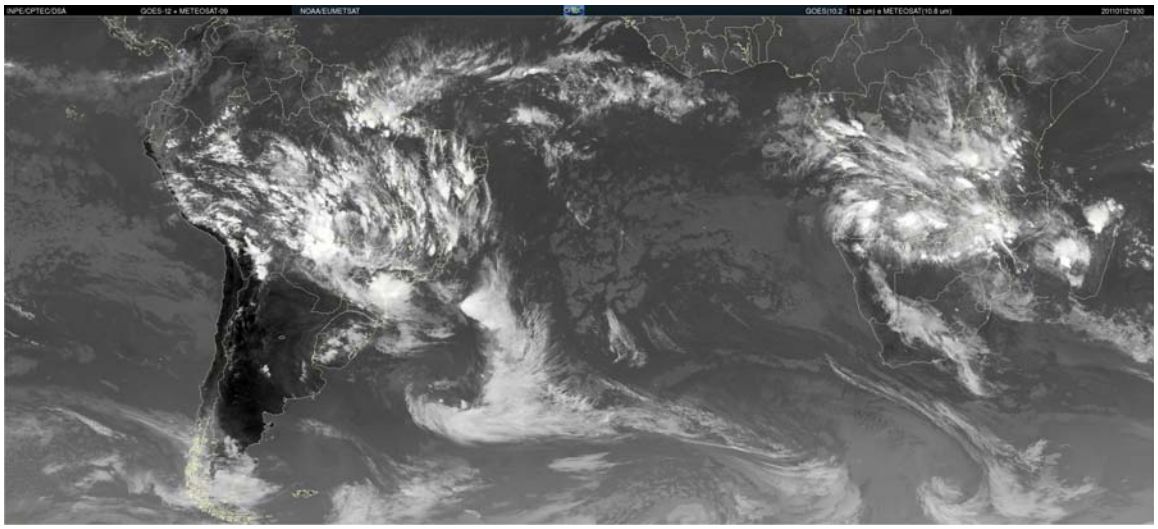

Figure 6: GOES-12 and MSG-9 Composite of 2011-01-12 at 1930 UTC

2.11 CMA products

Under this heading a number of routines are available to import the various products that are generated by the Chinese Meteorological Agency (CMA). These products are generated using the FengYun series of satellites by CMA. The products use different geographical extent. For some of the products the radiometric calibration coefficients should still be implemented. In these cases the data is transformed into a byte format.

2.12 MODIS Global Products

Global Fire Product from MODIS - Aqua / Terra. This is the most basic fire product in which active fires and other thermal anomalies, such as volcanoes, are identified. The product is covering an area of approximately 2340 by 2030 km in the across- and along-track directions, respectively. Another MODIS global product is the Chlorophyll Alpha

product; mapped at a spatial resolution of 4 km. and can be used to describe the physiological state of the phytoplankton, help to determine the cause of phytoplankton bloom collapses and help to make more robust estimates of primary productivity on a global scale.

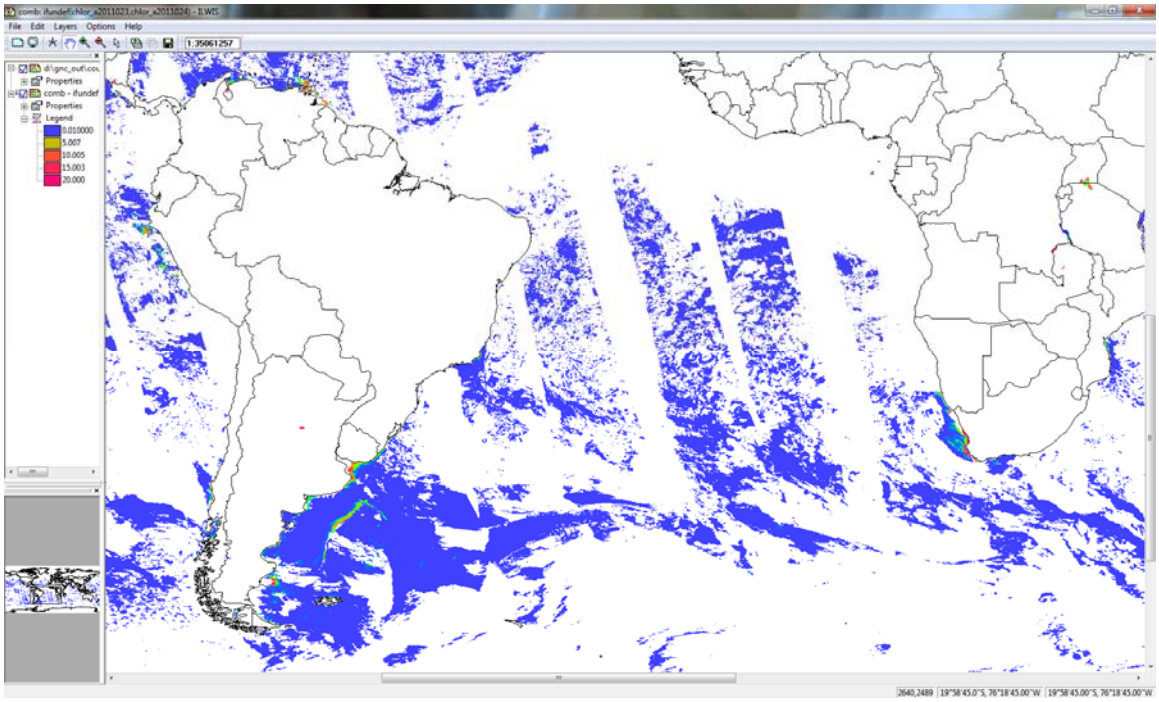

Figure 7: Chlorophyll Alpha from MODIS, combination of Julian day 023 and 024 -2010

3.2.13 TAMSAT Rainfall Products

Within the GEONETCast data stream also non-meteorological organizations contribute. An example is the rainfall product for Africa, produced by the TAMSAT group from the University of Reading, UK, which are producing ten-daily (decadal) and monthly rainfall estimates and anomalies derived from Meteosat Thermal Infra-Red (TIR) channels based on the recognition of storm clouds and calibration against ground-based rain gauge data. Using this set of import routines the 10 day accumulated RFE rainfall product can be imported as well as a monthly accumulated rainfall product. Furthermore a decadal anomaly and monthly anomaly rainfall product can be imported.

2.14 SPOT VGT Products

Based on recordings of the Vegetation Instrument onboard SPOT, three monthly 10 day synthesis products are produced and disseminated of Africa and Latin America. Various SPOT VGT Africa product import routines are available within the GEONETCast-Toolbox, including the recently produced burned area product. Also NDVI, NDWI and DMP products for the Latin American window which have recently become available, can be imported in a similar manner.

2.15 DevCoCast Products

Many Developing Countries face serious environmental risks and need adequate Earth Observation (EO) data and derived environmental information for their sustainable

development. The GEONETCast for and by Developing Countries (DevCoCast) project involves Developing Countries more closely in the GEONETCast initiative. This project is funded under EU FP7.

Through this project various partners collaborate and the products produced for Africa (both land and ocean products) and Latin America are disseminated by EUMETCast – GEONETCast to the global user community. For each geographical region the various types of data can be accessed through sub-menu items which have been named after the organization producing the products, currently for Africa: CSIR (fire products), INPE (CBERS merged colour composite) and PML (Ocean products) are sending operational products. For Latin America INPE (rainfall, fire, fortracc, NDVI, CBERS merged product, etc), INTA (absolute and anomaly NDVI, Evapotranspiration and fire risk maps) and PML (Ocean products) are the main product providers. In the near future more products are to be expected.

2.16 EAMNET Marine Products

Within the European African Marine Network various marine products derived from MODIS (Chlorophyll-A, Kd-490, Normalized Fluorescence Line Height and Sea Surface Temperature) and MERIS (Algal 1 and Algal-2, Total Suspended and Yellow Substances) are produced and disseminated using GEONETCast. Temporal resolution is one day; spatial resolution is 36 seconds (1111.95 metres using a Sphere radius of 6371007.180 metres). UCT is providing the data for various regions in Africa: Angola, Ivory Coast, Guinea, Mauritania, Mozambique Channel, Namibia, Nigeria, Senegal, Somalia (north and south), Southern Africa (eastern, southern and western part) and Tanzania.

2.17 AMESD-SADC

A set of import routines is added to import the products that are (going to be) disseminated through GEONETCast produced by AMESD-SADC, related to agriculture, drought, fire and weather forecasting. Not all import routines are operational at this moment. Products have decadal temporal resolution; the region covered is from 35 degree south to 6 degree north latitude and from 11 to 41 degree east longitude.

For development of the routines use is made of sample data in a format that will be disseminated by GEONETCast in the near future. Currently import routines have been checked for the following items:

- Agriculture**:** Agricultural products from Remote Sensing (Current rainfall estimates map, Rainfall estimates compared with average (%), Cum rainfall map, Cum rainfall map compared with average, NDVI compared with average (difference), NDVI compared with average (%), WRSI, SMI, Cum DMP, Cum DMP compared with average);
- Drought: Vegetation performance maps (VCI, SDVI, PASG);
- CSIR Fire and SAWS Seasonal Forecast: All product import routines have been checked with sample data provided by CSIR and SAWS.

A sample product, the Water Requirement Satisfaction Index, is provided in figure 8.

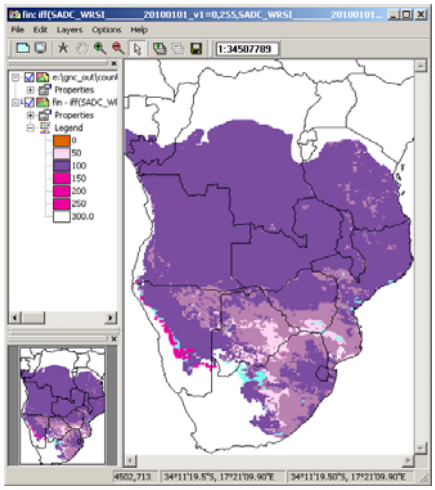

Figure 8: Water Requirement Satisfaction Index of 20100101

2.18 METOP

The METOP instrument is carrying various sensors. The products derived from the ASCAT instrument, the surface soil moisture and the ocean vector winds, are disseminated both via Ku and C band reception. For these two data types, with 12.5 km resolution, import routines are available. An import routine has also been made to use the data from the AVHRR/3 instrument on METOP. In this case VISAT-BEAM is used as pre-processor. The input file expected should be of a "GeoTif" format.

2.19 JASON-2 and AVISO

An import routine has also been made to use the data from the JASON-2 altimeter. In this case BRAT is used as pre-processor. Also the ocean observation products from AVISO (licensed service, for further information see: http://www.aviso.oceanobs.com) like the Geophysical Data Records, coastal and hydrological products such as (corrected) Sea Surface Heights and Mean Sea Level, can be imported using the same pre-processing routines. The input file expected should be of a "NetCDF" format and the resolution (from 1/3 to 1/9 of a degree) should be specified as well upon import.

2.20 Web Mapping Services

Various types of relevant data are available on the World Wide Web. A number of routines have been developed to extend the toolbox beyond the direct EUMETCast – GEONETCast data processing capability. To use these services the system should have internet access. Utilities available are:

- **Last 24 hr MPE from EUMETSAT Website:** This utility automatically extracts to a specific output directory the Multi Sensor Precipitation Estimates (MPE) produced by EUMETSAT, made available on their 24 hour rolling archive. The user can select the MPE from METEOSAT-7 and MSG;
- **Fire Service for Africa:** This web mapping service is developed by the Institute for Geo Information (IfGI), University of Muenster, Germany and is currently under further development. Newly arriving active fire products from MODIS

(Maryland - USA) are added to a list of fires and are visualized on a world map which can be seen using Google Chrome or FireFox as web browsers;

- **MPE and RFS to Google:** These two services make use of the 15 minutes precipitation products, the MPE derived from MSG and the RFS derived from GOES. At ITC these 15 minutes products are aggregated to obtain the 24 hr precipitation (from 00:00 to 23:45 UTC). These files are compressed and subsequently transferred to a FTP site (ftp://ftp.itc.nl/pub/mpe/). After specifying an output directory the application can be started, the accumulated 24 hr precipitation map is downloaded, decompressed and transformed into a PNG format (with a transparent layer for the areas that have not received precipitation). A "KML" file is created and executed which invokes Google Earth to start and display the results. These applications assume that Google Earth is locally available;
- **Surface Pressure Forecast over Europe:** This application automatically downloads the surface pressure forecast over Europe prepared by the UK Met-Office. New forecasts become available at 07:30 UTC. Forecasts are downloaded and visualized using IrfanView as an animation with maps showing the surface pressure from T+0 to T+84;
- **Current position of the African ITF:** This application automatically downloads the latest image showing the current position of the Inter Tropical Convergence Zone (ITCZ), also called the Inter Tropical Front, produced by NOAA, available from: http://www.cpc.noaa.gov/products/fews/ITCZ;
- **Integrated Surface Data (ISD):** Here utilities are available to incorporate the archive maintained and updated by the NCDC, providing a global surface summary of daily products on various climatological parameters, such as temperature, rainfall, dew point, surface pressure, etc. A map can be visualized showing the locations and the station numbers of the climatological stations and another routine allows extraction and import of station data for a certain year. The resulting table provides the parameters also in SI units;
- **NOAA Weather Charts:** The NWS Gateway provides access to the latest version of the weather facsimile chart they operationally distribute. The charts are not altered or enhanced and are in the original black-and-white form used by NWS offices, available from: ftp://tgftp.nws.noaa.gov/fax/. The utilities provided download and animate the NOAA weather charts for the Northern Hemisphere, Europe and Africa, Africa and Asia and Latin America and Africa, showing the forecast up to 36 hours;

2.21 To other applications

For the user to be capable of using other applications, in turn using ILWIS and the GEONETCast Toolbox as pre-processor, export routines have been created:

- **Export to BILKO:** BILKO is used as a training package for the marine community. Here utilities are available to export the data to BILKO, for a single layer as a Tif, for multiple layered data a HDF4 output file is created;
- **Export to R:** R is a freeware statistical package developed by the Foundation for Statistical Computation which can be applied e.g. for further time series analysis, a capability which is much more advanced than what is currently available under

ILWIS. The data is exported to a *.Rda format. Figure 9 shows a sample script that has been used to import in R a digital elevation model and the corresponding visualization in R.

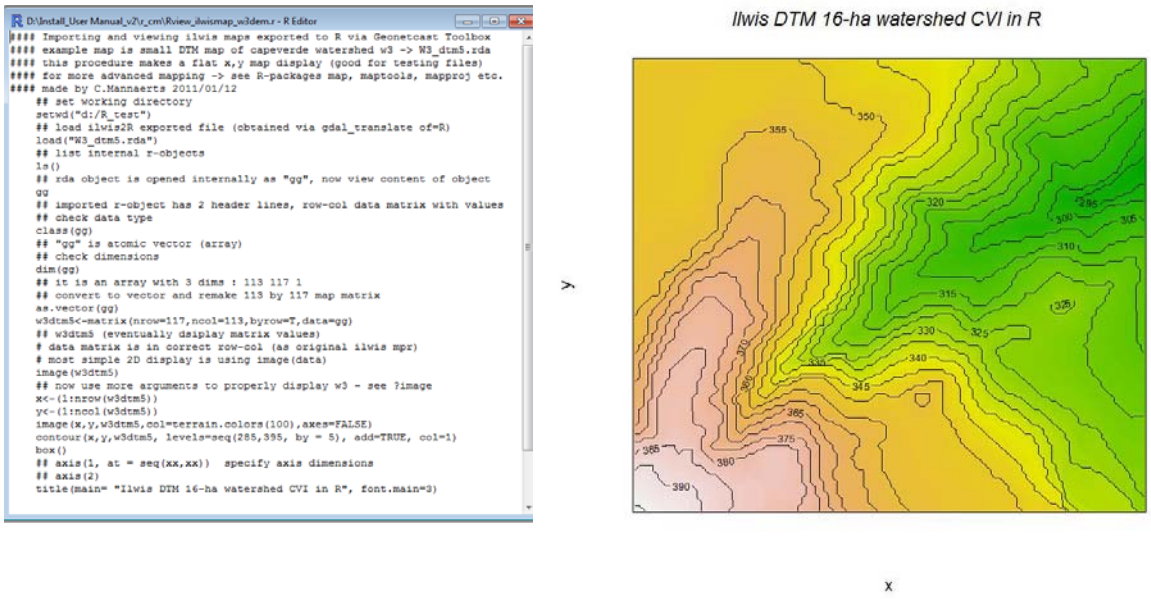

Figure 3.13: Import script and visualization of a Digital Terrain Model in R

2.22 Configuration and folder settings

For you to conveniently work with the GEONETCast toolbox the data sources (on your local area network) and the local system output (working) directories need to be defined. In general the input and output folders are set over here and are subsequently used in the various import routines to pre-set the input and output folders over there. This prevents the need to specify the folder specifications time and again!