Practical exercises Lesson 5: Import of Fire products disseminated through the DevCoCast and AIDA initiatives, MPEF and MODIS Fire data, examples using Lowveld FDI, McArthur FDI and the MPEF (MSG based), MODIS derived fire products, the TAMSAT 10 day rainfall product and CBERS merged product and external Web Mapping Services

Within the EUMETCast data stream, various near real time fire products produced, can now be received, also products that are created from the African continent. An important initiative is the DevCoCast project. Check further details on DevCoCast using the link: Handout_DevCoCast_Africa.pdf or http://www.devcocast.eu

1. Import and processing of the Lowveld and McArthur Forest Fire Danger Indices.
Before starting to import the various DevCoCast and other relevant products from South Africa that are available in the GEONETCast data stream you need to check the settings of the directories that contain the raw data. From the "*Geonetcast*" and "*Toolbox*" main menu select the option "*Configuration*" and "*Folder*" and select "*Modis Fire Product*", "*TAMSAT*", "*DevCoCast Africa*", "*MPEF*". Browse to the appropriate data input and output locations and for this exercise the data and products are stored in the directory "*E:\GNC_data\...........*", where "*E:*" is the designated DVD drive location, see also figure 1. Here as output location "*d:\GNC_out*" is used. Press "*Save*" to store the settings. Then press "*Close*".

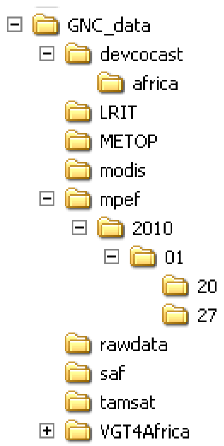


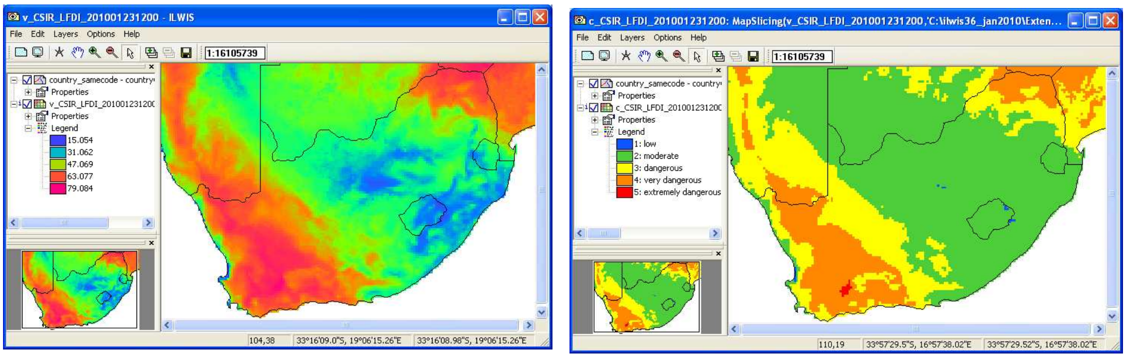
Figure 1: Data source folders

Lowveld Fire Danger Index (LFDI). From the "*Geonetcast*" and "*Toolbox*" main menu select the "*DevCoCast-AIDA*", "*Africa*" and "*CSIR*" sub menu items. Select the "*Lowveld Forest Fire Danger Index*" to import the LFDI product. Note the "*Date*" format; specify an appropriate time stamp, here "*201001231200*" is used. As there is one product a day the convention of the time stamp (for hhmm) is '1200'. Press "*Import*" to execute the import.

Two maps are created as a result of the import of the Lowveld Fire Danger Index, a map with the prefix "v_" showing the original fire danger values and a map having a prefix "c_", showing the associated danger classification. Display both maps, for the "*v_CSIR_LFDI_date*" a "*pseudo*" "Representation" can be used, for the "*c_CSIR_LFDI_date*" the default "Representation" should be used. Add also the country boundaries (no info and boundaries only). Browse with the left mouse button pressed over the active map window to inspect the values / fire danger class assignment. Your import results should resemble those of figure 2.

The current fire danger rating model used in parts of South Africa is an adaptation of a Fire Hazard Index developed by Michael Laing in Zimbabwe in 1968. The basic model uses the same inputs as the McArthur models, which are scaled to produce a simple model that can calculate numbers easily without the need of any complex calculations. It is often referred to as the Lowveld Fire Danger System (LFDI) since this is where it has been most widely used.

Figure 2: LFDI, fire danger values (left) and associated fire danger classification (right)



Mc**Arthur Forest Fire Danger Index (FFDI).** The McArthur Forest Fire Danger Index (FFDI) was developed in the 1960s by CSIRO scientist A.G. McArthur to measure the degree of danger of fire in Australian forests. The index combines a record of dryness, based on rainfall and evaporation, with daily meteorological variables for wind speed, temperature and humidity.

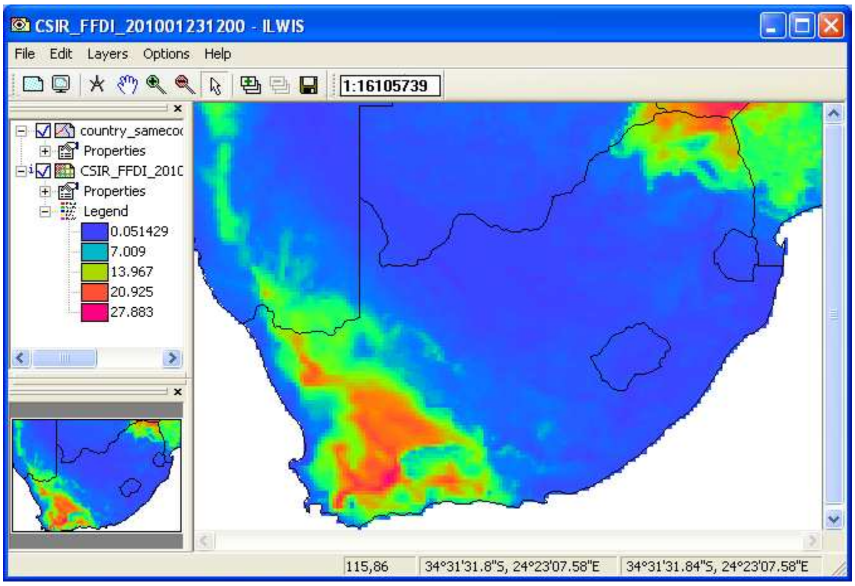
The index has a scale from 0 to 100. A fire danger rating between 12 and 25 on the index is considered a "high" degree of danger, while a day having a danger rating of over 50 is considered an "Extreme" fire danger day. McArthur used the conditions of the Black Friday fires of 1939 as his example of a 100 rating (source: Wikipedia).

From the "*Geonetcast" and "Toolbox*" main menu select the "*DevCoCast-AIDA*", "*Africa*" and "*CSIR*" sub menu items. Select the "*McArthur Forest Fire Danger Index*" to import the FFDI product. Note the "*Date*" format; specify an appropriate time stamp, here "201001231200" is used. Press "*Import*" to execute the import.

To display the imported map "*CSIR_FFDI_date*" a "*pseudo*" "Representation" can be used. Add also the country boundaries (no info and boundaries only). Browse with the left mouse button pressed over the active map window to inspect the values, your import results should resemble those of figure 3.

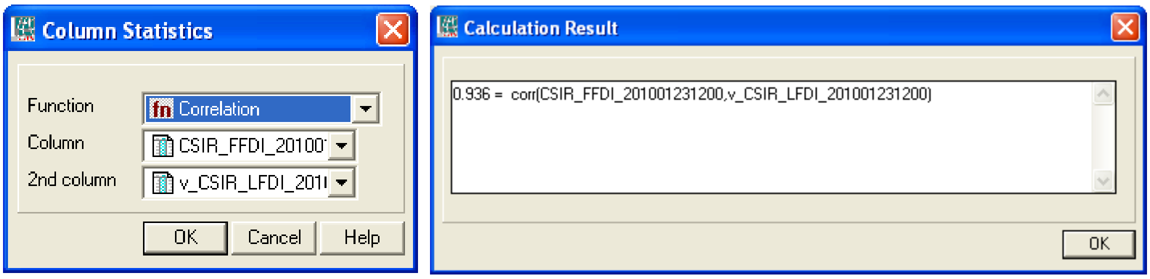
When comparing the two forest fire value maps you note a similar pattern, but the index values are different. To check the similarity between the two maps, both can be crossed and from the cross table the correlation between both maps can be determined.

Figure 3: McArthur Forest Fire Danger Index (FFDI)



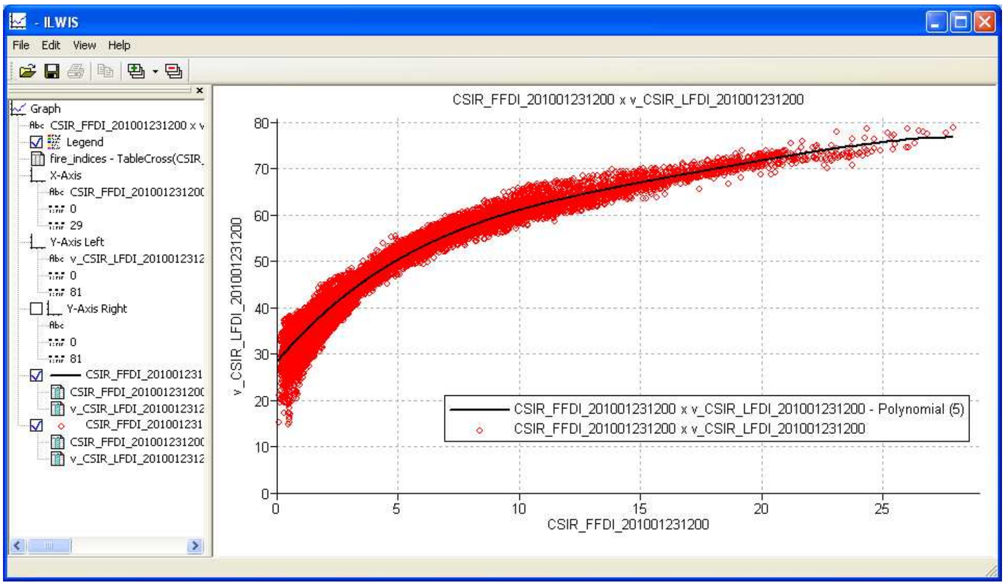
To do so open from the main ILWIS menu "*Operations*", subsequently "*Raster Operations*" and "*Cross*". Specify as first map "*the imported FFDI map*" and as second map the "*imported v_LFDI value map*". Specify as output cross table: "*fire_compare*", all other options can be left as default, like "*Ignore Undefined*" and don't "*Create an Output Map*". Execute the map crossing by pressing "*Show*". After the crossing is completed the cross table will appear on your screen. Now select from the Table menu, the option "*Column*" and from the drop down menu "*Statistics*", as statistical function select "*Correlation*" and specify the appropriate columns that have to be used to calculate the correlation (the LFDI and FFDI) and press "*OK*". See also figure 4. It can be noted that both maps show a high degree of similarity.

Figure 4: Selection of statistical function "correlation" applied to LFDI and FFDI



From the main table menu select the "*Graph*" option . From the "*Create Graph*" window, select the "*FFDI map*" for the "*X*" and the "*LFDI*" for the "*Y*" axis and press "*OK*". Now from the new "Graphics" window menu, select "*Edit*", "*Add Graph*" and "*Least Square Fit*". Note that the column assignment for the X and Y axis should be identical to those specified in the graph, select as "*Function*" "*Polynomial*" and use as "*Number of Terms*" "*5*" and press "*OK*". Your results should resemble those of figure 5.

Figure 5: FFDI versus LFDI scatter plot and polynomial function



2. Importing the MPEF FIRE product

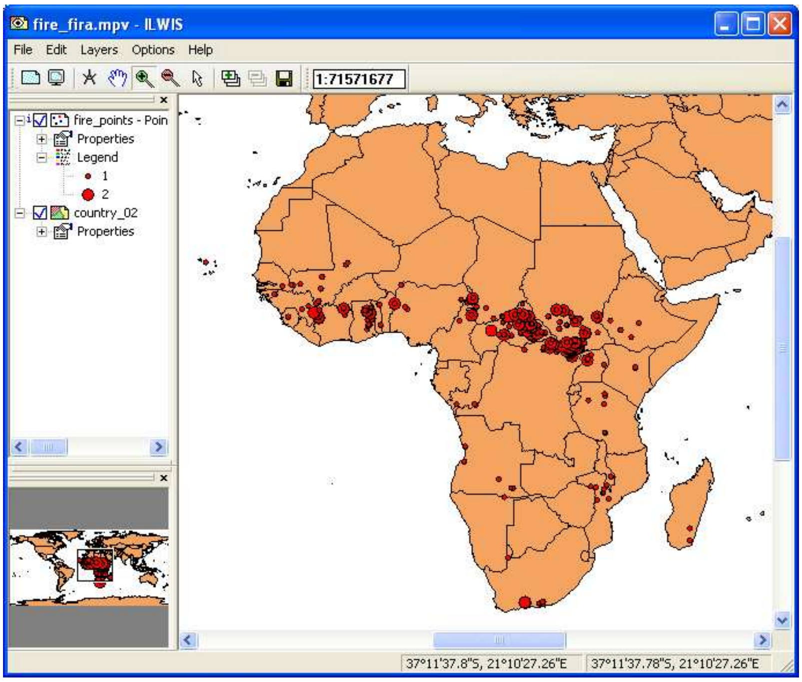
The MSG satellite thermal signature is used to extract hotspots. The product, called the FIRE product, is produced at the same temporal frequency as MSG. In the "*Geonetcast*" and "*Toolbox*" main menu, it is located under "*MPEF*" and subsequently "*MPEF FIRA*". The "A" refers to "ascii" as during the import routine an ascii table is imported and visualized.

Check the input and output directories from the FIRA import menu (note that this directory might be date specific, see also figure 1) and specify an appropriate date stamp (e.g. "*201001201200*"). Make sure that the input and output directories are correctly specified. Press "*Import"* to execute the import.

In case you encounter an error message during import (like can't find table), close ILWIS and open ILWIS again. ILWIS keeps track of the directory that was used during the last session. If you have moved to a new directory during the present session this import routine might still point to the previous working directory. Once closing and opening ILWIS from you present working directory is solving this problem. ILWIS should now start with the catalogue content of your present working directory.

Refresh the ILWIS catalogue (select from the main ILWIS menu "Window" and "Refresh") and open the map view  "fire_fira". Also open the newly created table, called: fire. The last column in this table is used to classify the fires: 1 = Possible and 2 = Probable fire. Your import results should resemble those of figure 6.

Figure 6: Imported MPEF fire product shown as a map view



3. Import of the CSIR MODIS-AFIS fire product over Southern Africa
MODIS Terra and Aqua data that are received in South Africa are used to extract the thermal anomalies. The data is subsequently disseminated via GEONETCast. The MODIS active fire products form part of the Advanced Fire Information System (AFIS) that provides fire relation information to people in Southern Africa. The CSIR (South Africa) produce MODIS active fire products from two MODIS direct readout receiving stations located in Pretoria and Hartbeeshoek. The MODIS active fire products consist of the following parameters: Latitude, Longitude, Brightness temperature, Fire Radiative Power, Scan, Date, Time, Satellite and Confidence (source: Geonetcast Product Navigator).

From the "*Geonetcast*" and "*Toolbox*" main menu select the "*DevCoCast-AIDA*", "*Africa*" and "*CSIR*" sub menu items. Select the "*AIDA MODIS-AFIS Fire product-Aqua*" to import the MODIS-Aqua active fire product. Note the "*Date*" format; specify an appropriate date stamp, here "*20100291059*" is used. Note the format: yyyyjjjhhmm, which stand for year(yyyy), julian day(jjj), hour(hh) and minute (mm). Press "*Import*" to execute the import.

In case you encounter an error message during import (like can't find table), close ILWIS and open ILWIS again. ILWIS keeps track of the directory that was used during the last session. If you have moved to a new directory during the present session this import routine might still point to the previous working directory. Once closing and opening ILWIS from you present working directory is solving this problem. ILWIS should now start with the catalogue content of your present working directory.

From the "*Geonetcast"* and *"Toolbox*" main menu select the "*DevCoCast-AIDA*", "*Africa*" and "*CSIR*" sub menu items. Select the "*AIDA MODIS-AFIS Fire product-Terra*" to import the MODIS-Terra active fire product. Note the "*Date*" format; specify an appropriate date stamp, here "*20100330748*" is used. Note the format: yyyyjjjhhmm, which stand for year(yyyy), julian day(jjj), hour(hh) and minute (mm). Press "*Import*" to execute the import.

Display the vector file country_02 (located in your working directory), no info and boundaries off, use a red colour for the boundaries. From the active map display window, select "*Layers*", "*Add Layer*" and now select the newly created point map (modisa_fire* and modist_fire*, *=yyyyjjjhhmm) and press "*OK*" to show it.

3. Import of the MODIS Aqua and Terra Fire Product (import multiple MODIS Fire product over a region, both Terra and Aqua from NOAA).

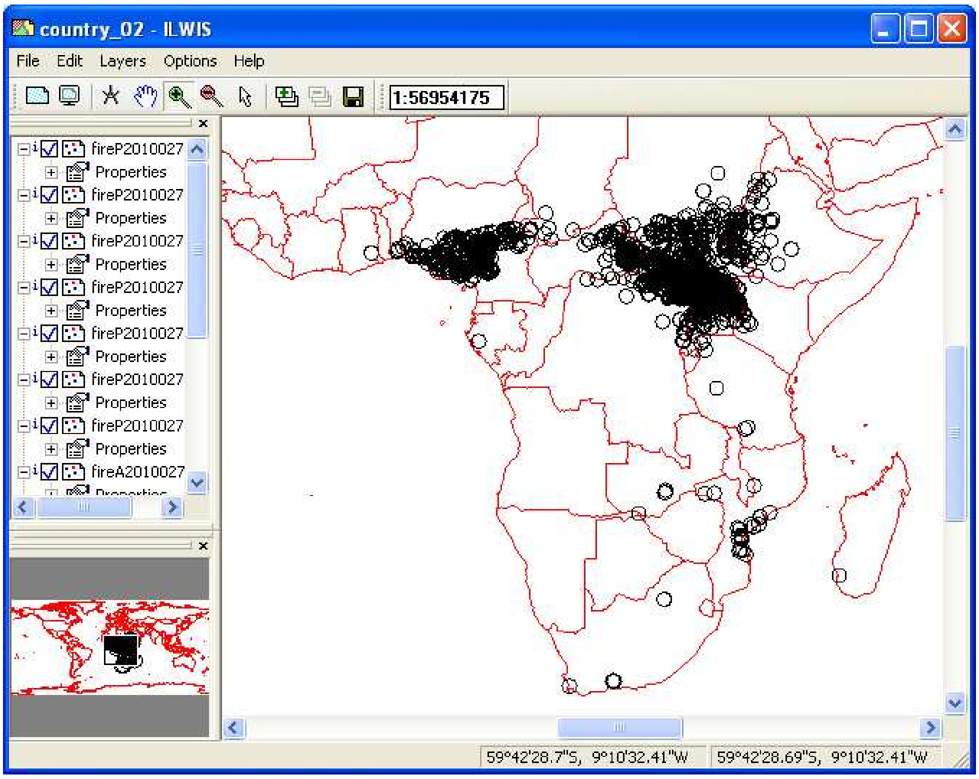
This is the most basic fire product in which active fires and other thermal anomalies, such as volcanoes, are identified. The Level 2 product is defined in the MODIS orbit geometry covering an area of approximately 2340 by 2030 km in the across- and along-track directions, respectively. It is used to generate all of the higher-level fire products, and contains the following components: An active fire mask that flags fires and other relevant pixels (e.g. cloud); - a pixel-level quality assurance (QA) image that includes 19 bits of QA information about each pixel; - a fire-pixel table which provides 19 separate pieces of radiometric and internal-algorithm information about each fire pixel detected within a granule; - extensive mandatory and product-specific metadata; - a grid-related data layer to simplify production of the Climate Modeling Grid (CMG) fire product. Product-specific metadata within the Level 2 fire product includes the number of cloud, water, non-fire, fire, unknown, and other pixels occurring within a granule to simplify identification of granules containing fire activity (source: Geonetcast Product Navigator).

Keep in mind that the Modis Terra is passing over the equator during the morning and evening, the Aqua is having an afternoon and night time overpass (local time). As this MODIS fire Product is a global product 2 * 270 files are generated which need to be processed on a daily basis to cover the whole globe. Here we only want to select a certain area and therefore only those MODIS Terra and Aqua products that are passing over our area of interest have been selected for a certain Julian day.

In the "*Geonetcast*" and "*Toolbox*" main menu select the option "*MODIS Aqua and Terra Fire Product*" and "*MODIS Aggregated Fire Product per Day*". Having all relevant files covering southern Africa in your sub directory (see figure 1, the sub directory "*Modis*"), you can start the import of the multiple MODIS fire files. Specify the appropriate year (2010) and Julian day number (027) and press "*Import*". The import will start and processes all files, for those that contain fires, the vector files will be retrieved and transformed into a point file with associated table. Wait until the import has finished and update the Catalogue of you working directory.

After the import has been completed open the vector file "*Country_02*", no info and boundaries only, use a red colour for the boundaries. Now with the left mouse button select the first imported fire point maps (fireA* and fireP*, *=yyyyjjj_hhmm) and drag it to the active map display window, press "OK" to accept the default display options. Repeat the procedure for all other point maps in the catalogue. Zoom to the southern African continent to see the spatial distribution of the fires. Also open one of the associated tables belonging to a point map and check the content. Your results should resemble those as of figure 7.

Figure 7: MODIS fire point maps over southern Africa, of 2010, julian day 027



4. TAMSAT 10 day rainfall product over Africa

Rainfall Estimate for Africa. Ten-daily (dekadal) 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 are currently disseminated via GEONETCast. In order to import this data from the "*Geonetcast*" and "*Toolbox*" main menu select the option "*TAMSAT Rainfall Product*" and "*TAMSAT 10 day rainfall product for Africa*"

Import the 3 dekadal rainfall maps available of the month of April 2010, for dk1 up to dk3. Note the format that is required for the Date stamp (yyyy_m-dk1, which in your case can be entered as 2010_4-dk1).

After import the import is completed open the file " rfe2010_4dk1, use as "*Representation*" "*rfe*". Add the vector file "*Country_02*", no info and boundaries only, use a black colour for the boundaries.

Conduct the import of the other 2 dekades of April 2010 ("*2010_4-dk2*" and "*2010_4-dk3*") and optionally calculate the total monthly precipitation by adding the three decadal maps to obtain the total monthly precipitation (in mm!). Display this map using as "*Representation*" "*pseudo*". Browse with the left mouse button pressed over the map and not the values.

5. Colour Composite CCD-HRC - CBERS - Africa

A new DevCoCast product, these level-2 colour composites are created by a fusion process that combines the high-resolution CCD Camera's colour bands and the High Resolution Camera's (HRC) panchromatic band. The composite scene (sector) images will have approximately the boundaries of the HRC imagery (27km swath), 10 meter average resolution and are radiometrically and geometrically corrected. They are broadcasted as 3-band GeoTiff images, with a frequency of 1 scene per day over some regions (about 27x27 km) of Africa.

From the "*Geonetcast*" and "*Toolbox*" main menu select the "*DevCoCast-AIDA*", "*Africa*" and "*INPE*" sub menu items, activate the "*CBERS resolution merge product for Africa*". Note the input date string convention. This is a complicated string as also satellite row and column are included in the file name. Check using Window explorer the CBERS files that are available on your data disk.

Here use is made of the relevant string section: "*20080812_091_D_104_1*". Enter this string in the "*Date*" field and execute the import. Double click on the map list icon "*INPE_CBERS_2B_CHC_AF_**" (*=string used for import) and display the image as a colour composite (band 1 in red, band 2 in green and band 3 in blue). Note that the coordinates have a UTM projection and the pixel size is 10 meters.

6. External Web Mapping Services

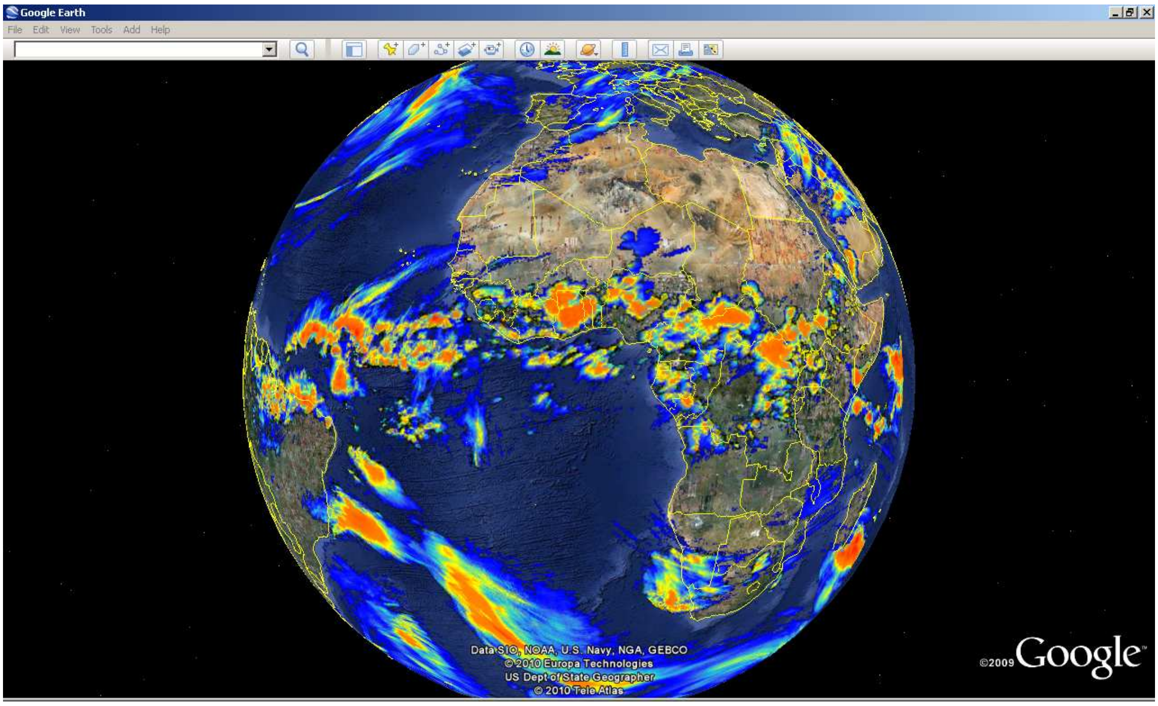
Within the toolbox you also have the possibility to use to external links, providing you with already processed data, which was delivered by GEONETCast.

From the "*Geonetcast*" and "*Toolbox*" main menu select the "*Web Mapping Services*", "*MPE to Google*" and "*Aggregated 24 hour MPE to Google Earth*" sub menu. In this case only the "*Date*" field and the "*Output Directory*" need to be specified. Enter a suitable date, e.g. "*20100501*" to extract the 24 hr aggregated Multi Sensor Precipitation Estimate from the ITC-FTP site and press "*Import*". Note that in order to produce this map, 96 events over a 24 hour period have been processed, and you extract the sum of these 15 minutes events. The unit is in mm / 24 hrs, from 00:00 to 23:45 UTC for a given day. During UTC noon the precipitation map of the previous day is available from this FTP site.

This application expects that you have Google Earth installed locally and have access to the internet!

Run the application and see the 24 hr aggregated precipitation of a selected day. Your results should resemble those of figure 8.

Figure 8: 24 hr aggregated MPE downloaded from the ITC-FTP site, displayed on Google Earth for 01 May 2010



More Web Mapping Services are currently under development, like the "Fire Service for Africa"