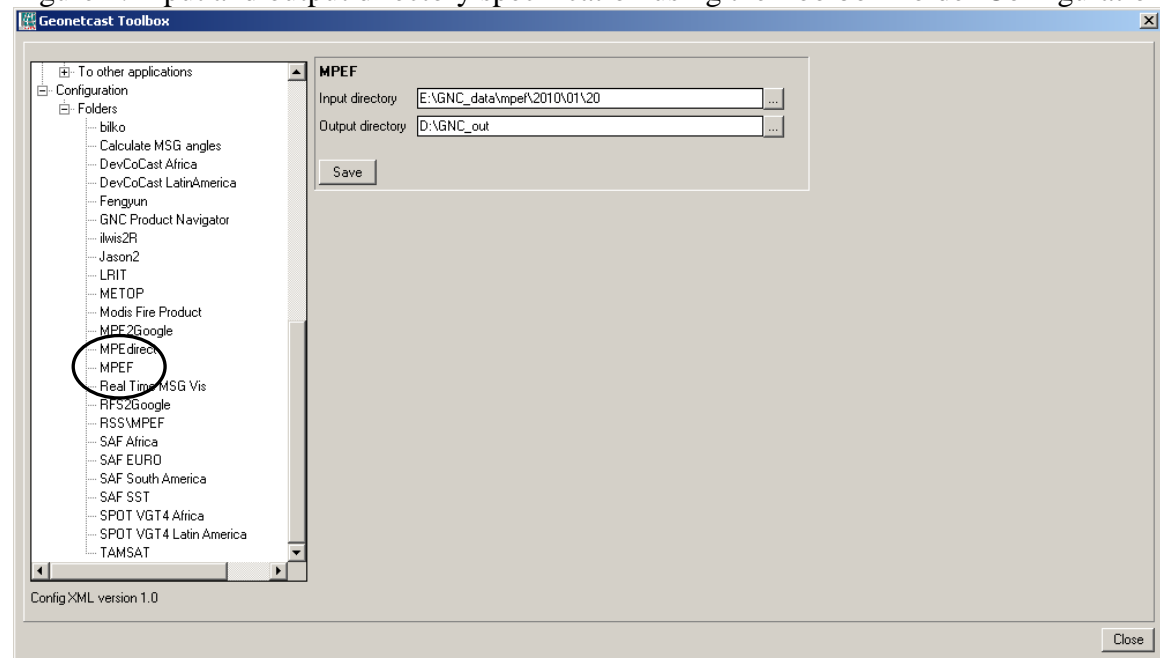


## Practical exercises Lesson 3: Import products generated by the Meteorological Product Extraction Facility and Satellite Application Facility.

### Import and processing of MPEF data

Before starting to import the various other data types 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 “*MPEF*”. Browse to the appropriate data input and output locations and in the case of MPEF note that the data is stored in a year-month-day specific directory (here “*E:\GNC\_data\mpef\2010\01\20*”, where “*E:\*” is the designated DVD drive location). Here as output location “*d:\GNC\_out*” is used. Press “*Save*” to store the settings. See also the figure below. Then press “*Close*”.

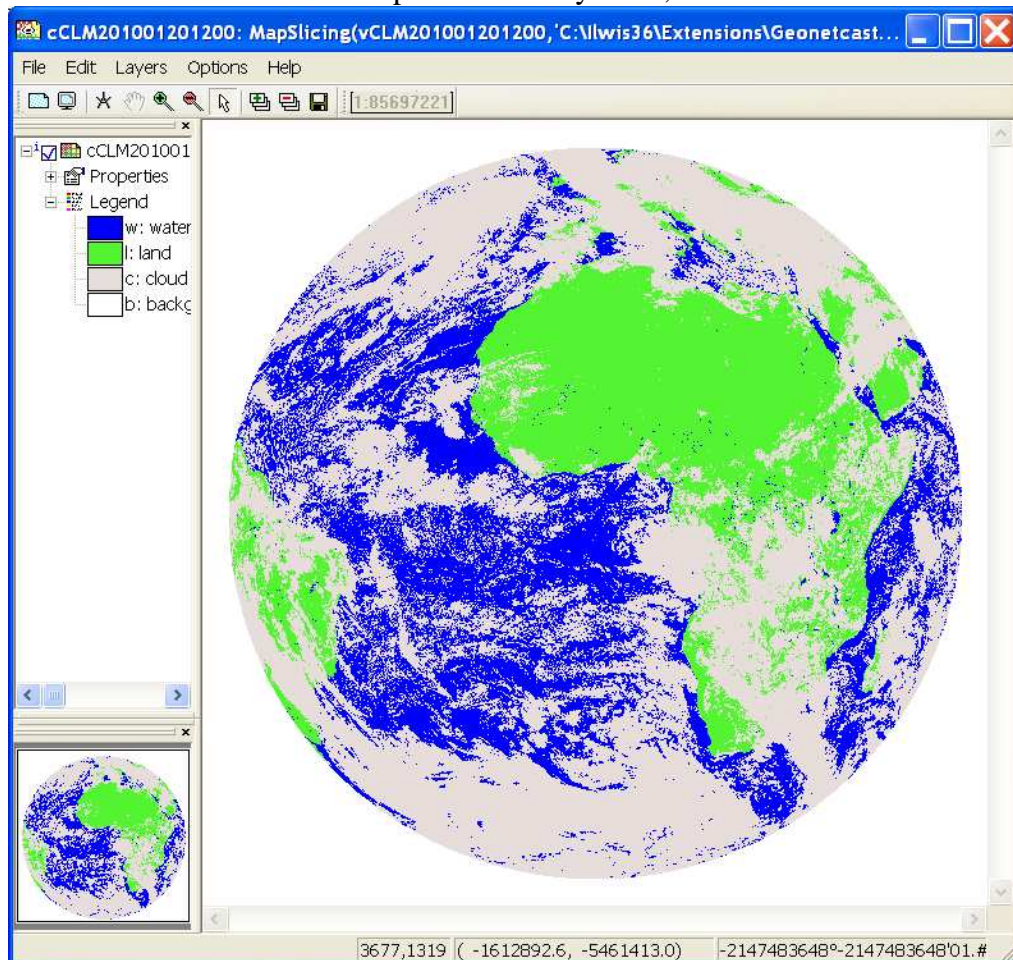
Figure 1: Input and output directory specification using the Toolbox Folder Configuration



From the “*Geonetcast*” and “*Toolbox*” main menu select “*Meteorological Product Extraction Facility (MPEF)*” and “*MPEF CLM*” to import the Cloud Mask (CLM). Select for the “*Date*” the identical time as used when importing the MSG images, in this case 201001201200. Specify this time stamp according to the format required in the “*Date*” field (“*yyyymmddhhmm*” is in this case “*201001201200*”). Press “*Import*” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “*Window*” and “*Refresh F5*”) and note that two new files have been created: *vCLM\** and *cCLM\** (\*=*yyyymmddhhmm*), a value (*vCLM\**) and a classified cloud mask map (*cCLM\**) respectively. Open both maps and check their values or class names. A cloud mask class map is also given in figure 2.

Figure 2: Classified cloud mask map of 20 January 2010, 12:00 UTC



Close all active layers before you continue.

The Multi-Sensor Precipitation Estimate (MPE) product consists of the near-real-time rain rates in mm/hr for each Meteosat image in original pixel resolution. The algorithm is based on the combination of polar orbiter microwave measurements and thermal images recorded by the Meteosat IR-108 channel by a so-called blending technique. The MPE is most suitable for convective precipitation.

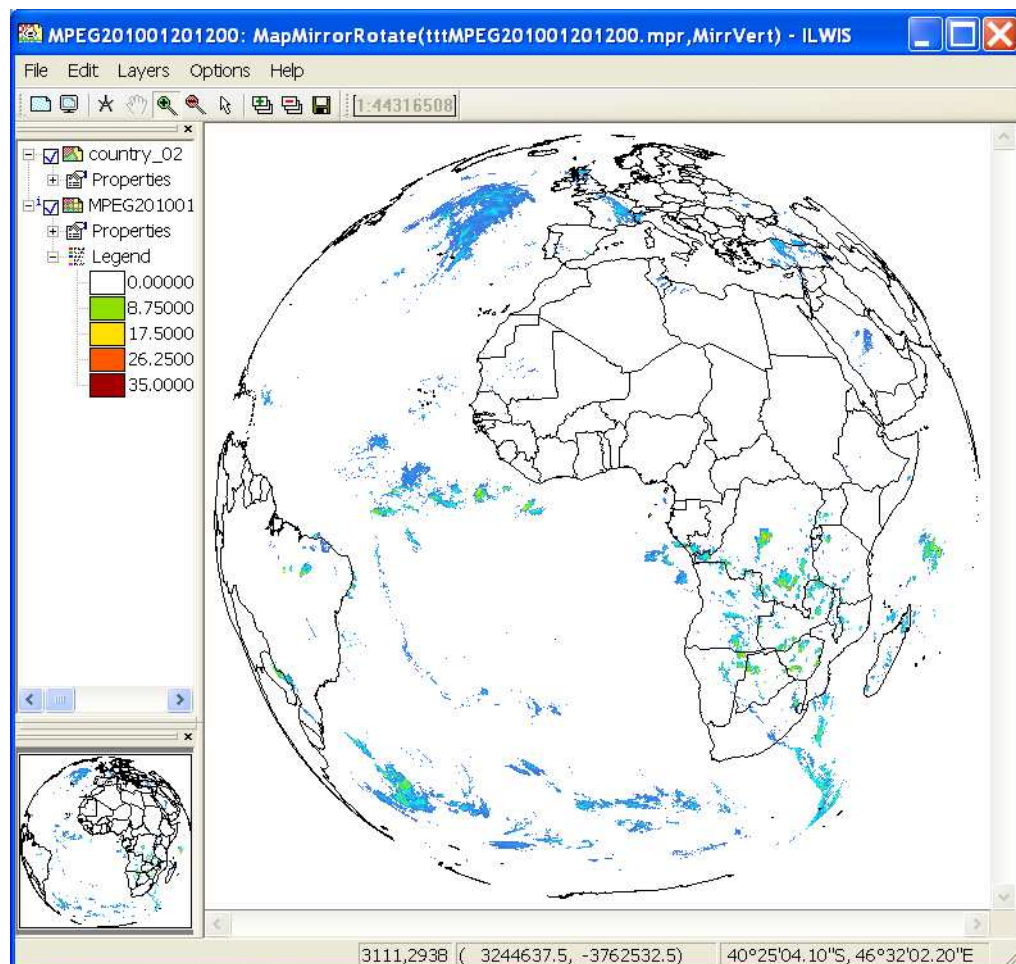
Applications and Users of the MPE product: Operational weather forecasting in areas with poor or no radar coverage (source: [http://www.eumetsat.int/Home/Main/Access\\_to\\_Data/%20Meteosat\\_Meteorological\\_Products/Product\\_List/index.htm?l=en](http://www.eumetsat.int/Home/Main/Access_to_Data/%20Meteosat_Meteorological_Products/Product_List/index.htm?l=en)).

From the “*Geonetcast*” and “*Toolbox*” main menu select “*Meteorological Product Extraction Facility (MPEF)*” and “*MPEF MPEG*” to import the Multi-sensor Precipitation Estimate (MPE) product. Select for the “*Date*” the identical time as used when importing the Cloud Mask: “201001201200”. Specify this time stamp according to the format required in the “*Date*” field. Also note if the input directory (note that this can

be date specific!) and output directory are correctly defined. Press “*Import*” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “*Window*” and “*Refresh F5*”) and note the file that has been created: MPEG\* (\*=yyyymmddhhmm). Display this map, using as “*Representation*” “*mpe\_single*”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note that these are in mm/hr. The results obtained should resemble those of figure 3.

Figure 3: Multi Sensor Precipitation Estimate of 20 January 2010, 12:00 UTC



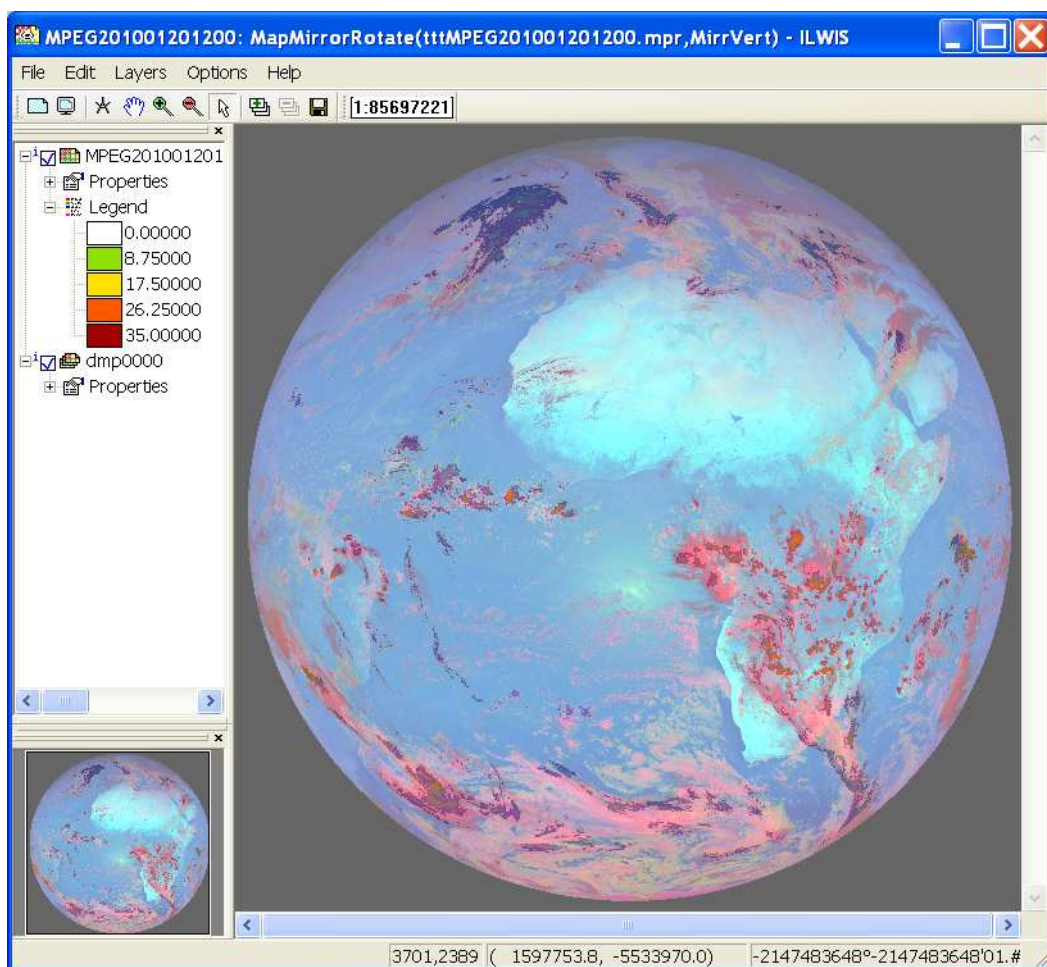
Display also the map that you calculated before (in lesson 2) showing the potential rainfall areas, called “*pot\_rain*” and the cloud mask created before. What can you observe when comparing the maps?

Activate the Map Window showing the MPE map. From the Map Window Menu select “*Add Layer*” and select the daytime microphysical colour scheme composite map list imported in lesson 2 (“*dmp0000*”). Add this layer to the map as a “*ColorComposite*”.



Display band 1 (VIS006) as Red, band 2 (IR\_039) as Green and Band 3 (IR\_108) as Blue, use the default stretch options. Move the map layer down in the legend (drag and drop it below the MPEG layer as in the left hand legend window of figure 4). Double click on the MPEG layer, as “*Display Options*” activate now the option “*Transparent*”, select a transparency of 60 % and press OK. The results should look like in Figure 4 (note that the transparency does not always work, depending on your graphic board). Move the mouse cursor over the screen while keeping the left mouse button pressed. Note the rainfall and the cloud colours.

Figure 4: MPE over a daytime microphysical colour scheme composite



Before you continue, modify the input data folder of MPEF as you will be working on data from 27 January 2010. From the “*Geonetcast*” and “*Toolbox*” main menu select the option “*Configuration*” and “*Folder*” and select “*MPEF*” (see also figure 1). Browse to the appropriate data input and output locations and in the case of MPEF note that the data is stored in a year-month-day specific directory (here “*E:\GNC\_data\mpef\2010\01\27*”, where “*E:\*” is the designated DVD drive location). Press “*Save*” to store the new settings. Press “*Close*”.

From the “*Geonetcast*” and “*Toolbox*” main-menu select “*Meteorological Product Extraction Facility (MPEF)*” and “*MPEF MPEG*” to import the Multi-sensor Precipitation Estimate (MPE) product. Select for the “*Date*” the appropriate time stamp, here use is made of the data for 27 January 2010 and as time step 1200 UTC is entered. Specify the time stamp according to the format required in the “*Date*” field. Also note if the input directory (this can be date specific!) and output directory is correctly defined. Press “*Import*” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “*Window*” and “*Refresh F5*”) and note the file that has been created: MPEG\* (\*=yyyymmddhhmm). Display this map, using as “*Representation*” “*mpe\_single*”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note that these are in mm/hr. Your results should resemble those of figure 5A (left), close the map when finished.

Note that for 27 January 2010 more MPEF products are available, you can check the MPEF directory. If time allows you can import a number of these products. In order to import them, select the appropriate time stamp according to the format required in the “*Date*” field (e.g. for AMV: “201001271145”, for CLAI: “201001271145”, for CTH: “201001271145”).

### **Import and processing of the LSA SAF data**

The original LSA SAF products are provided for Africa in two windows, one covering Northern Africa, one for Southern Africa. During the import routines provided below an output map is created for the whole continent and this results in a slightly longer time needed to complete the full import cycle to create a single map covering the whole African continent. Before you start the import, select from the “*Geonetcast*” and “*Toolbox*” main menu the option “*Configuration*” and “*Folder*” and select “*SAF*” (see also figure 1). Browse to the appropriate data input (here “*E:\GNC\_data\saf*“, where “*E:\*” is the designated DVD drive location) and output locations (here “*d:\GNC\_out*”). Press “*Save*” to store the settings, and “*Close*”.

**Surface Albedo (Albedo).** Land surface albedo is a key variable for characterising the energy balance in the coupled soil-vegetation-atmosphere system. The albedo quantifies the part of the energy that is absorbed and transformed into heat and latent fluxes. Owing to strong feedback effects the knowledge of albedo is important for determining weather conditions at the atmospheric boundary layer. Climate sensitivity studies with Global Circulation Models have confirmed the unsteady nature of the energy balance with respect to small changes in surface albedo. Other domains of applications are in hydro-meteorology, agro-meteorology and environment-related studies (source: <http://landsaf.meteo.pt/>).

From the “*Geonetcast*” and “*Toolbox*” main menu select “*Satellite Application Facility (SAF)*”, “*Africa*” and “*Albedo*” to import the Surface Albedo product. Select for the “*Date*” the appropriate time stamp, here use is made of the data for 27 January 2010 and

as time step “0000” is entered as the product is generated once a day. Specify the time stamp according to the format required in the “Date” field (e.g. “201001270000”). Press “Import” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “Window” and “Refresh F5”) and note the file that has been created: Albedo\_Africa\* (\*=yyyymmddhhmm). Display this map, using as “Representation” “pseudo”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note that these are in percentage. Your results should resemble those of figure 5A (right), close the map when finished.

**Land Surface Temperature (LST).** Land Surface Temperature (LST) is the radiative skin temperature over land. LST plays an important role in the physics of land surface as it is involved in the processes of energy and water exchange with the atmosphere. LST is useful for the scientific community, namely for those dealing with meteorological and climate models. Accurate values of LST are also of special interest in a wide range of areas related to land surface processes, including meteorology, hydrology, agrometeorology, climatology and environmental studies (source: <http://landsaf.meteo.pt/>).

From the “Geonetcast” and “Toolbox” main menu select “Satellite Application Facility (SAF)”, “Africa” and “LST” to import the Land Surface Temperature product. Select for the “Date” the appropriate time stamp, here use is made of the data for 27 January 2010 and as time step “1200” UTC is entered. Specify the time stamp according to the format required in the “Date” field (e.g. “201001271200”). Also note if the input directory and output directory is correctly defined. Press “Import” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “Window” and “Refresh F5”) and note the file that has been created: LST\_Africa\* (\*=yyyymmddhhmm). Display this map, using as “Representation” “pseudo”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note that the temperature is in Celsius. Your results should resemble those of figure 5B (left), close the map when finished.

**Evapotranspiration (ET).** Evapotranspiration (ET) accounts for the flux of water evaporated at the Earth-atmosphere interface (from soil, water bodies and interception) and transpired by vegetation through stomata in its leaves as a consequence of photosynthetic processes. ET is an important component of the water cycle and it is associated with the latent heat flux (LE), a key link between the energy and water cycles. In other words, LE represents the energy needed for the ET process. Evaluating energy fluxes at the Earth surface is of great importance in many disciplines like weather forecasting, global climate monitoring, water management, agriculture and ecology. This product currently is in a pre-operational status (source: <http://landsaf.meteo.pt/>).



From the “Geonetcast” and “Toolbox” main menu select “Satellite Application Facility (SAF)”, “Africa” and “ET” to import the Evapotranspiration product. Select for the “Date” the appropriate time stamp, here use is made of the data for 27 January 2010 and as time step “1200” UTC is entered. Specify the time stamp according to the format required in the “Date” field (e.g. “201001271200”). Press “Import” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “Window” and “Refresh F5”) and note the file that has been created: ET\_Africa\* (\*=yyyymmddhhmm). Display this map, using as “Representation” “pseudo”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note that the ET is in mm/hr. Your results should resemble those of figure 5B (right), close the map when finished.

Figure 5A: Imported products from MPEF and LSA SAF: MPE (left) and Albedo (right)

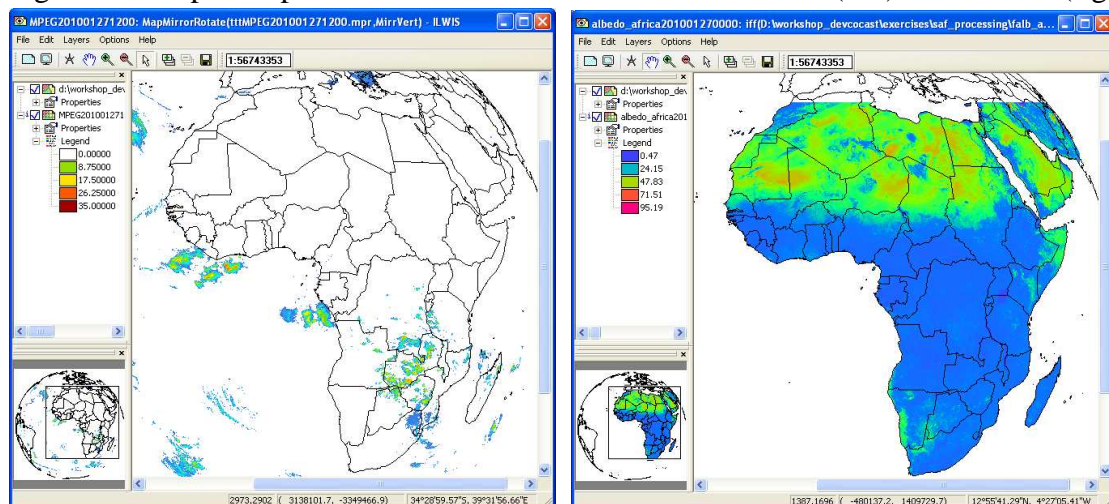
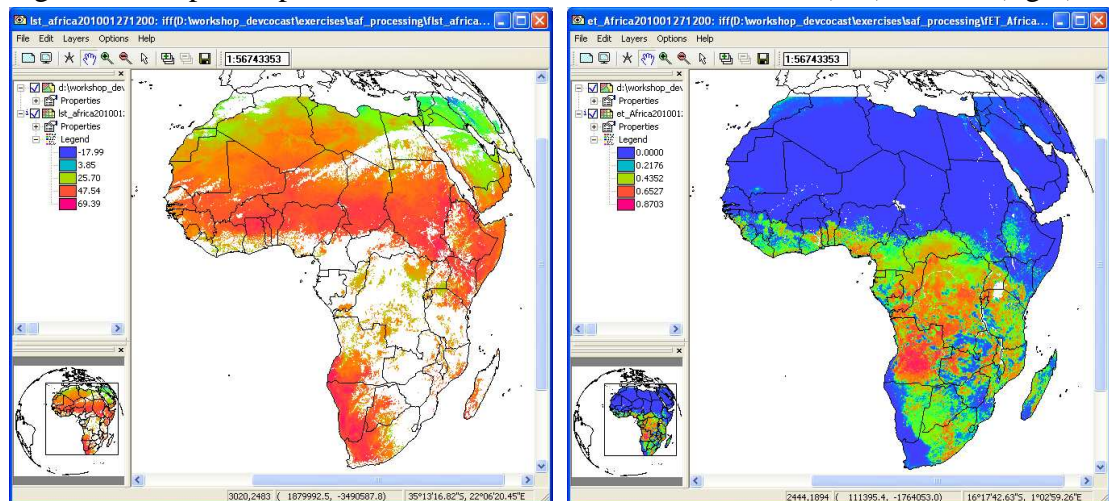


Figure 5B: Imported products from MPEF and LSA SAF: LST (left) and ET (right)



You will now continue to import a number of Vegetation Parameters that are generated once a day by the LSA SAF, using the data collected by the SEVIRI instrument onboard of MSG.

**Fraction of Vegetation Cover (FVC).** The FVC product is currently generated daily at the full spatial resolution of the MSG/SEVIRI instrument, and will be later provided on a 10-days and monthly basis. The product is based on the three short-wave channels (VIS 0.6 $\mu$ m, NIR 0.8 $\mu$ m, SWIR 1.6 $\mu$ m) using as input the  $k_0$  parameter of a parametric BRDF (Bi-directional Reflectance Distribution Function) model (Roujean et al. 1992). The  $k_0$  parameter (normalized reflectance) provides cloud-free observations over the SEVIRI disk based on an iterative scheme with a characteristic time scale of five days. The FVC product is expressed in the range from 0 % to 100 %. It is corrected from uncertainty derived of the view/sun angles and also the anisotropy effects of surface's reflectance in the SEVIRI image. The FVC product includes routine quality check and error estimates. The product will be validated in order to define the product uncertainties over a range of global conditions studies (source: <http://landsaf.meteo.pt/>).

From the “*Geonetcast*” and “*Toolbox*” main menu select “*Satellite Application Facility (SAF)*”, “*Africa*” and “*FVC*” to import the Fraction of Vegetation Cover product. Select for the “*Date*” the appropriate time stamp, here use is made of the data for 11 May 2010 and as time step “0000” UTC is entered as the product is generated once a day. Specify the time stamp according to the format required in the “*Date*” field (e.g. “201005110000”). Press “*Import*” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “*Window*” and “*Refresh F5*”) and note the file that has been created: FVC\_Africa\* (\*=yyyymmddhhmm). Display this map, using as “*Representation*” “*fvc*”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note that these are in percentage (0 to 1 represents 0 to 100 percent). Your results should resemble those of figure 6A, close the map when finished.

**Leaf Area Index (LAI).** Leaf Area Index (LAI) is a dimensionless variable [ $m^2/m^2$ ], which defines an important structural property of a plant canopy. LAI is defined as one half the total leaf area per unit ground area (Chen and Black, 1992). It provides complementary information to the FVC, accounting for the surface of leaves contained in a vertical column normalized by its cross-sectional area. It defines thus the area of green vegetation that interacts with solar radiation determining the remote sensing signal, and represents the size of the interface between the vegetation canopy and the atmosphere for energy and mass exchanges. LAI is thus a necessary input for Numerical Weather Prediction (NWP), regional and global climate modelling, weather forecasting and global change monitoring. Besides, the LAI is relevant for Land Biosphere Applications such as agriculture and forestry, environmental management and land use, hydrology, natural hazards monitoring and management, vegetation-soil dynamics monitoring and drought conditions studies (source: <http://landsaf.meteo.pt/>).



From the “*Geonetcast*” and “*Toolbox*” main menu select “*Satellite Application Facility (SAF)*”, “*Africa*” and “*LAI*” to import the Leaf Area Index product. Select for the “*Date*” the appropriate time stamp, here use is made of the data for 11 May 2010 and as time step “0000” UTC is entered, as the product is generated once a day. Specify the time stamp according to the format required in the “*Date*” field (e.g. “201005110000”). Press “*Import*” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “*Window*” and “*Refresh F5*”) and note the file that has been created: LAI\_Africa\* (\*=yyyymmddhhmm). Display this map, using as “*Representation*” “*lai\_saf*”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note these are m<sup>2</sup>/m<sup>2</sup>. Your results should resemble those of figure 6B, close the map when finished.

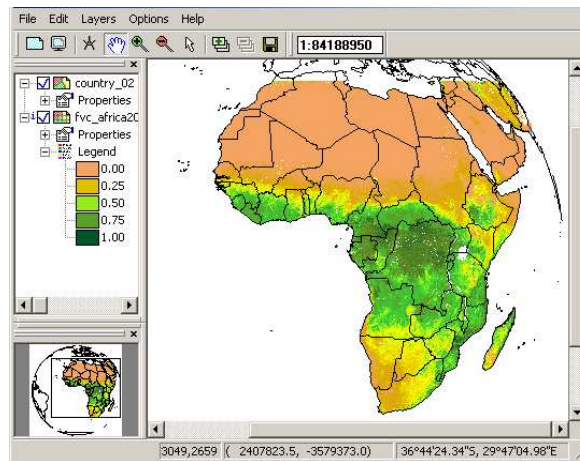
**Fraction of Absorbed Photosynthetically Active Radiation (FAPAR).** Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) defines the fraction of PAR (400-700 nm) absorbed by the green parts of the canopy, and thus expresses the canopy’s energy absorption capacity. FAPAR depends both on canopy structure, leaf and soil optical properties and irradiance conditions. FAPAR has been recognized as one of the fundamental terrestrial state variables in the context of the global change sciences (Steering Committee for GCOS, 2003; Gobron et al., 2006). It is a key variable in models assessing vegetation primary productivity and, more generally, in carbon cycle models implementing up-to-date land surfaces process schemes. Besides, FAPAR it is an indicator of the health of vegetation. FAPAR is generally well correlated with the LAI, the more for healthy fully developed vegetation canopies studies (source: <http://landsaf.meteo.pt/>).

From the “*Geonetcast*” and “*Toolbox*” main menu select “*Satellite Application Facility (SAF)*”, “*Africa*” and “*FAPAR*” to import the Fraction of Absorbed Photosynthetically Active Radiation product. Select for the “*Date*” the appropriate time stamp, here use is made of the data for 11 May 2010 and as time step “0000” UTC is entered, as the product is generated once a day. Specify the time stamp according to the format required in the “*Date*” field (e.g. “201000110000”). Press “*Import*” to start the import. Note that during import a command window is activated, have also a look at what is displayed in this window.

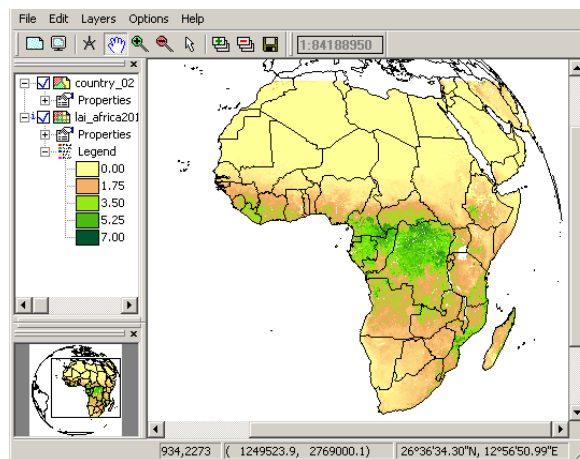
After completion of the import, update the ILWIS catalogue (from the main ILWIS menu, select “*Window*” and “*Refresh F5*”) and note the file that has been created: FAPAR\_Africa\* (\*=yyyymmddhhmm). Display this map, using as “*Representation*” “*fapar*”, also add the country boundaries (no info, boundaries only using a black colour). Check the values obtained, note that the FAPAR unit is in percentage, 0 to 1, 1=100 percent. Your results should resemble those of figure 6C, close the map when finished.

Figure 6: LSA SAF vegetation products FVC, LAI and FAPAR

A: Fraction of Vegetation Cover



B: Leaf Area Index



C: Fraction of Absorbed Photosynthetically Active Radiation

