Tutorial 3bis: A quick look at Satellite and in-situ datasets for Water & Food Security monitoring

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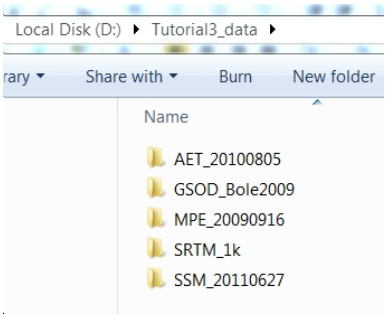
Objectives

In this third tutorial, a quick overview of the use of some major hydrological satellite data (rainfall, evapotranspiration, soil moisture) data for use in drought analysis is demonstrated. The following satellite data are exposed, retrievable from the GEONETCast data stream:

- MSGMPE near real time satellite rainfall (instantaneous 15-minute and daily sum)
- AET (LSA SAF DMET (daily sum) actual evapotranspiration)
- SSM index (METOPa ASCAT surface soil moisture index)

The sample data are contained in your ***Tutorial3_data*** sub-directory (on your laptop).



Rainfall assessment

Rainfall is forms probably one of the most important inputs in the whole process of drought analysis and early warning for food security. Several datasets from different sources are available today and can be used or merged using Ilwis.

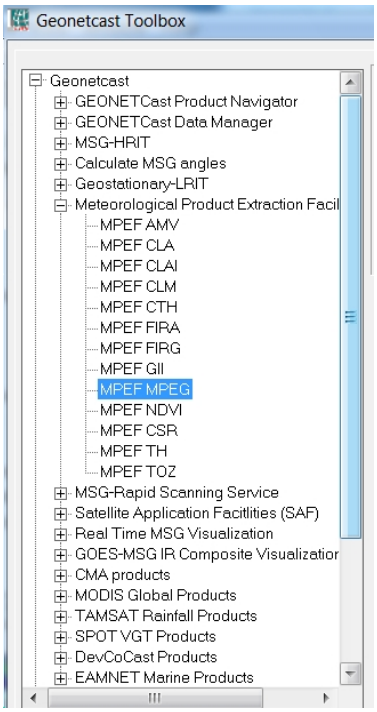
As a rule, a single data source is usually always prone to a certain uncertainty, and cross validation of several input data (e.g. satellite derived) and/or ground-based may be the best approach for un-biased evaluation and assessment of rainfall. This can be done using Ilwis (see also GEONETCast Application Manual – Devcocast project use cases).

The GEONETCast offers direct real time rainfall satellite observations for Africa at 3-km resolution and 15-minute interval, i.e. MSGMPE. Also other rainfall data like TAMSAT decadal rainfall is now

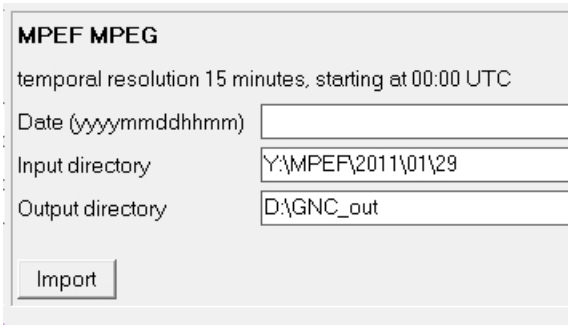
transmitted via Eumetcast. Other internet available products can also be imported in Ilwis using Toolbox web-based routines e.g. RFE2, CMORPH, TRMM, etc.

Case 1: MSG-MPE 15' estimate

If you are linked to the GEONECast LAN server, import one time interval (15') and analyze. Proceed as follows. Open the Toolbox and go to the MPEF Meteosat Product Extraction Facility (data):



- select an appropriate date/time (available on server)
- Verify your input and output directory



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- (Ps. Your local input directory is NOT necessarily the same as above)
- View the image and give a color representation "Precipitation"
- Pls. stretch the data range for better view colour resolution
- Optional: Create a map window for Ethiopia

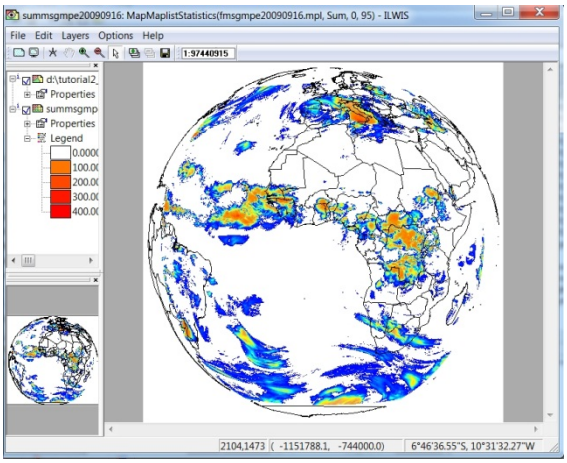
If you have no access to the GEONETCast server, use the sample files provided during the workshop and go immediately to Case 2.

Case 2: MSG-MPE daily

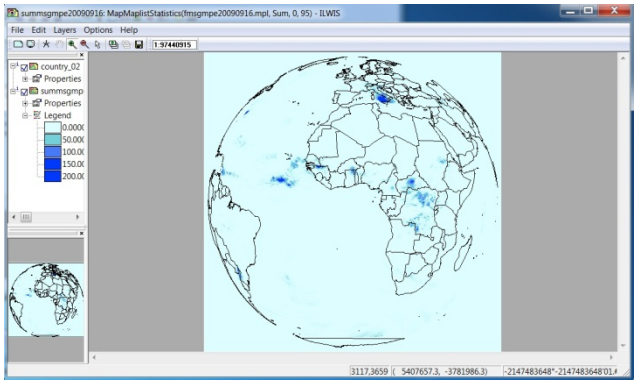
As an example a Meteosat MSGMPE daily rainfall sum estimate will be used and average rainfall per woreda will be generated (see also tutorial 2).

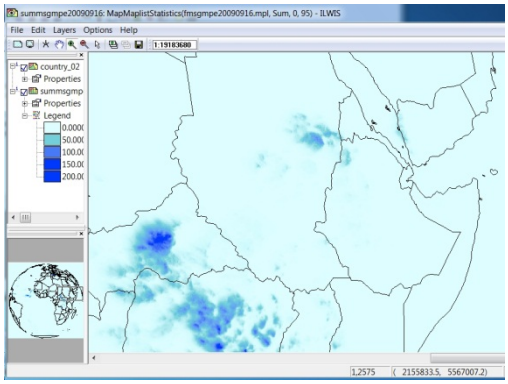
First have a look at a daily sum satellite rainfall estimate (EUMETSAT MSGMPE) from 2009-09-16, full Africa-Europe MSG disk view and a zoom-in window on Eastern Africa; right):

Go to the MPE_20090916 sub-directory, browse your directory and open the image file: ***summsgmpe20090916.mpr.*** Pls. use MPE_SUM as Color Representation:



When using the standard rainfall colour look-up -> Precipitation1 as representation, you better change the data range colour stretch for a better view. E.g. see below using Precipitation1 representation and stretching [0-150] instead the original 0-264.





We will resample this image to the LEAP window georeference (and pixel size). A window will be extracted (see below). Pls. go to the ILWIS > Operations > Spatial Reference Operations > Resample

Analyse rainfall intensity (derive pixel-based information for some locations -> as a time series plot using maplist statistics.

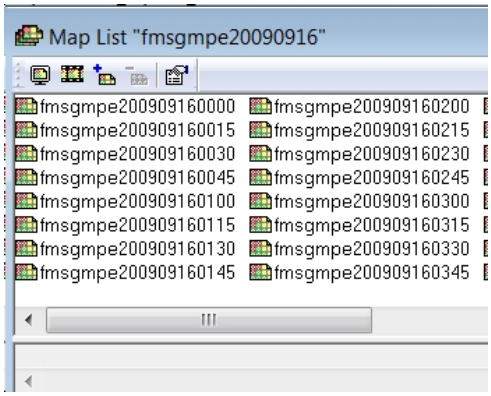
Small assignment: Make and use a Script to resample the full MSG disk rainfall sum map to Ethiopia window view (see Tutorial2_data). Use a script (see Tutorial2) to extract administrative zone or woreda average daily precipitation and export to Excel.

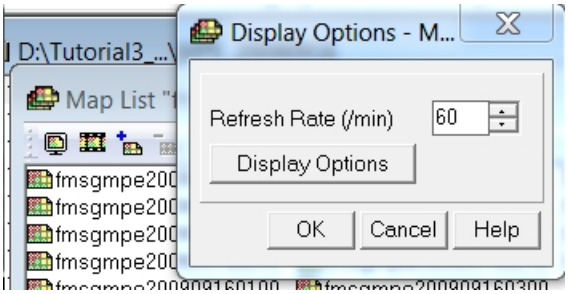
Looking and displaying a time series in Ilwis.

You can also import one day of MSGMPE data or 96 images (0000-2345 in 15'), using the already prepared full 24-hour MPE Ilwis map dataset. [*See workshop for data set*].

- Unzip the MSGMPE20090916.zip file to your working directory. Pls. Watch your laptop or PC drive space!!: 4.9 GB required. This takes a while (1-5 minutes to unzip).
- You find 96 images (15' rainrates of the full MSG dish) from 2009-09-16 0000 to 2345
- Create a Maplist from the File Menu > Create > Maplist
- Copy all 96 files to this list and give the maplist a new name : msgmpe20090916
- Open the maplist and use the Open as Slide Show icon option to view the image series.

Use MPE_sum as color representation and overlay with worldcountries boundaries. You can zoom-in to an Ethiopian window.

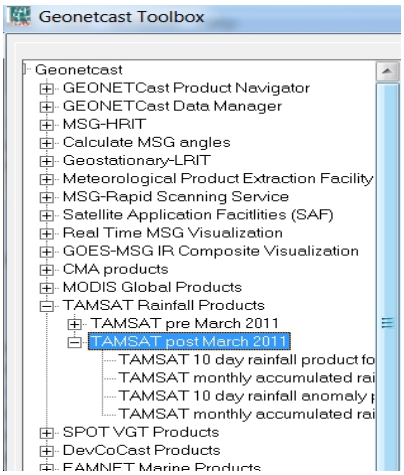




The maplist can be used to create a daily rainfall total (sum) using the maplist statistics (sum), using right-hand click on the maplist. Ps. You already have this summsgmpe20090916 map.

Case 3: TAMSAT decadal and rainfall anomaly

GEONETCast also offers the TAMSAT rainfall estimates for Africa, which are a decadal or monthly products from UK (University of Reading).



- From the Toolbox Menu, retrieval is as follows, if you have access to the GEONETCast LAN server
- Note that the decade date/time stamp specification should read e.g.: yearmmdec or 2011061 (2011-June-1st decad)
- After successful import a filename rfe2011061.mpr will appear in your working (output) directory

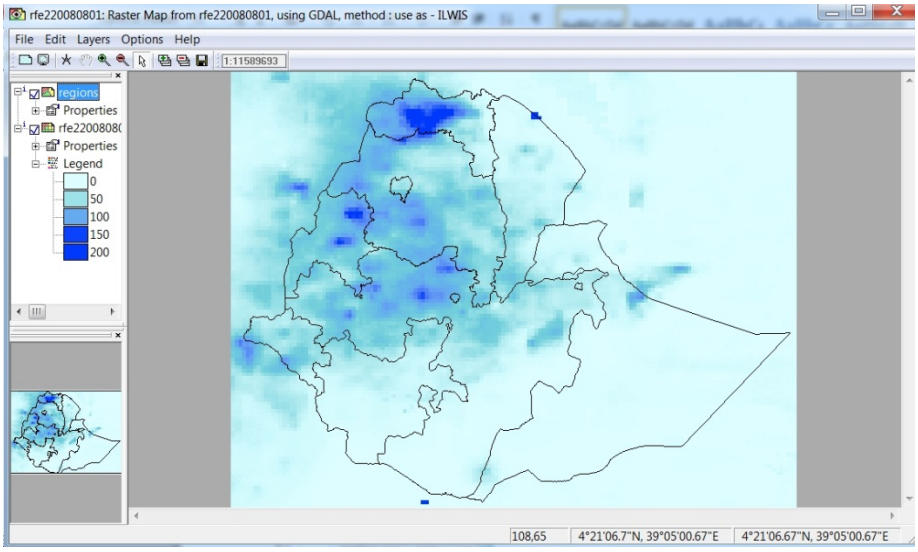
- Otherwise, use the dataset provided in the workshop.

Case 4: Import RFE2 (from LEAP or web)

A rapid method for LEAP users is to use LEAP rainfall image data (e.g. RFE2) in Ilwis. For that, open an RFE2 dataset in the LEAP viewer, and export the decadal rainfall map to GIS.

An ArcInfo binary raster map will be generated, which can then be imported directly in Ilwis using the File > Import > GDAL > Raster > ArcInfo binary grid > select file name.

The Ilwis files will have the same georeference (map window and pixel size) as the LEAP output i.e. 0.1 degrees. Pls. use an appropriate color representation (or make one of choice). See example below.



ET (evapotranspiration)

Computation of ET using Ilwis Open

ET0 or reference or potential evapotranspiration is commonly computed from standard weather station observation data, produced by National Meteorological Services and/or other organizations. It refers to the climatic demand at a time of interest on a certain location.

AET or actual evapotranspiration refers to a surface cover (e.g. a crop) and is critically dependent, besides the vegetation, also on soil and atmospheric water availability. It is commonly computed using a soil - vegetation water balance evaluation, balancing incoming rainfall vs. losses from ET processes and other hydrological sub-processes e.g. surface runoff, soil water percolation or lateral drainage or inflows.

ET0 using Ilwis Open

Two methods to produce gridded values (maps) of ET0 values are available in Ilwis.

Option 1: Interpolation of station point ET0 data

This option can be used if you have computed ET0 (e.g. Penman Monteith) values of your stations. It merely involves a station table (with coordinates) with a value list linked to the stations. We refer to paragraph (working with station data), earlier in this text. Pls. note that the choice of the spatial interpolator may have critical influence on your final results.

Option 2: Gridded ET0 computation in Ilwis

Ilwis Open contains build-in calculation routines to evaluate the ETo standard Penman-Monteith reference evapotranspiration from basic meteorological station observations for a region of interest (i.e. a map window of choice). The Ilwis ET0 calculator requires interpolated gridded fields or maps of the weather parameters, which can be made by point interpolation of e.g. NMA station data (see also above).

Other sources for gridded fields of weather variables are GLDAS, GRADS,… and in-situ data (see in-situ).

AET estimation using Ilwis

Ilwis also contains the module SEBS, which permits full evaluation of actual ET, based on the surface energy balance system approach or SEBS (ref). Evaluation requires full SEBS execution, which is an advanced procedure and is also quite data intensive. It also makes use of several satellite datasets and ground meteorological data, and we refer to a specialized course for this.

Satellite-based AET from GEONETCast

The EUMETSAT Satellite Application Facility of land surface processes (LandSAF) produces 30'-minute and daily ETa estimates, derived from Meteosat MSG satellite observations and other information. A

SVAT model or Soil vegetation atmosphere transfer modeling scheme is used to derive the ET. Scientific details (e.g. the ATBD) can be found on the LandSAF website http://landsaf.meteo.pt and Info sub-directory of the sample dataset.

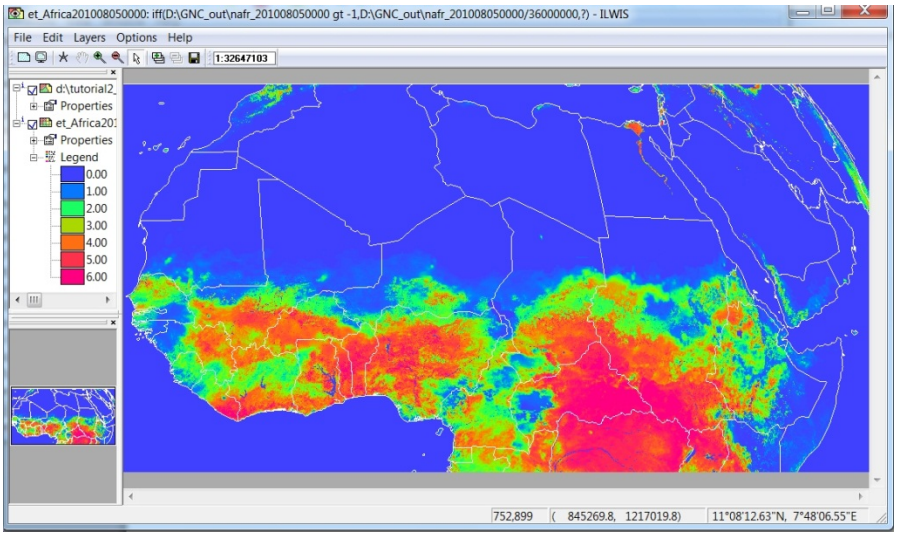
The products can be readily downloaded with the GEONETCast Toolbox and inserted in evaluations, after preliminary check of fitness of course.

In the Toolbox Menu > Satellite Application Facilities (SAF) > Africa > ET

Processing will take approx. 1' as two NAfr and SAfr subimages are processed to one full 1km Africa ET estimate. So, pls. be patient. See exercise page 117-121 on diurnal processing.

If you are not linked to the LAN network and your in-house GEONETCast Data archive, proceed as follows:

Pls. open the Daily AET dataset (LSA SAF filename: ET20100805.mpr) of North Africa and make a zoom or a view of Ethiopia or East Africa. Evaluate the values and comment. Use e.g. a Pseudo (or Temperature) representation as shown below.



Assignment: create (clip) an Ethiopia country window (adapt an existing Ilwis Script for the purpose).

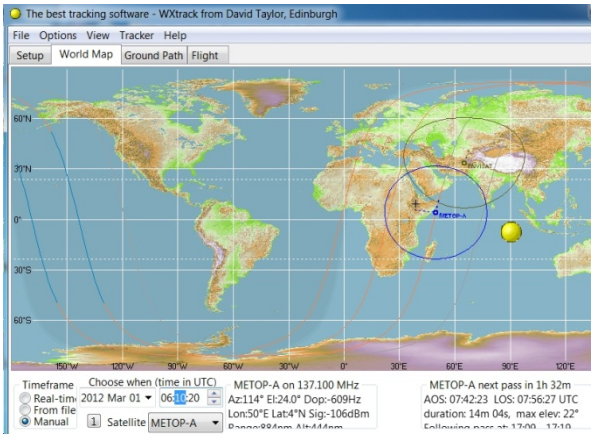
Surface soil moisture index

The GEONETCast data streams contain besides MSG and other geostationary satellite data, also polar orbiter datasets, like those e.g. from METOP (meteorological polar orbiting platform with ground segment at EUMETSAT).

The ASCAT sensor on-board METOP or the advanced scatterometer radar is very sensible to surface soil moisture variations and used therefore for soil moisture retrieval by satellites. The dataset is produced by a consortium led by the TUW (Wien), and we advise strongly to read the basic information, and scientific documentation on the reliabilities, uncertainties and uses of the data. It is basically an anomaly index, monitoring soil moisture deviations from certain indicator values. They also represent typical surface conditions, and do not always indicate soil profile storage of moisture. The ASCAT-SSM data set, can be retrieved from the GEONETCast data stream and directly imported using the Toolbox.

GEONETCast > METOP > ASCAT Surface Soil Moisture 12.5 km

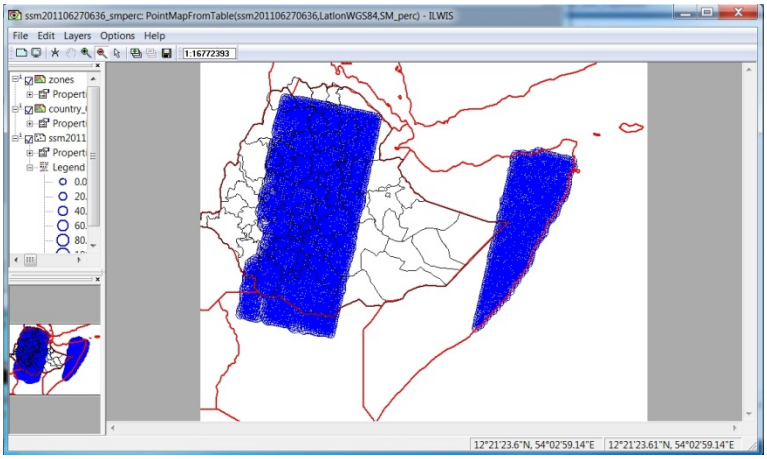
Ps. selection of the exact overpass time (also time indicator in the filename), is crucial for importing the good Ethiopia coverage of the data. You best can use a satellite tracking program (e.g. wxtrack or similar) to do so, and find the exact Metop overpass times over Ethiopia (+- 1 to 2 per day; one descending, one in ascending mode). The coverage will be partial, so approx. 50% of the territory will be scanned during one pass. The other parts need to be merged from another overpass (near in time).



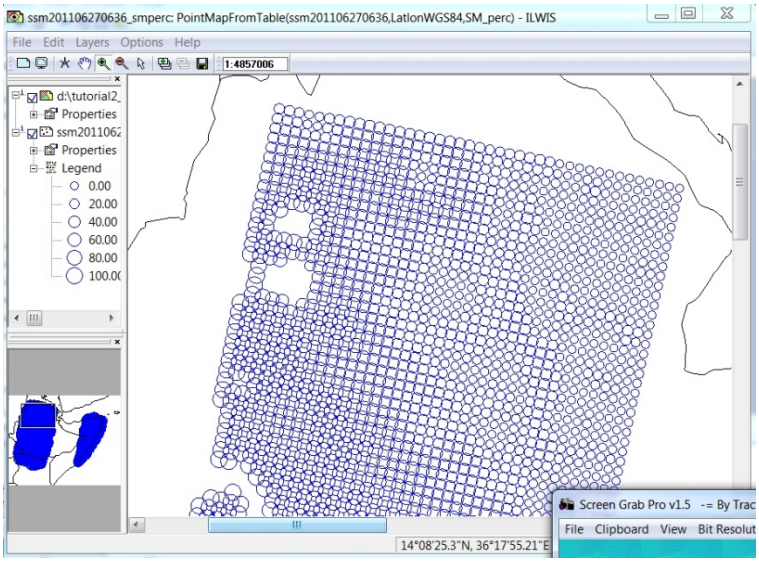
The example below shows the import of a dataset, display and interpretation of point data, and subsequent interpolation to create a surface soil moisture map surface for a region of interest.

Go to the Tutorial3_data directory and to the AET20100805 sub-directory.

Open the Point mapfile ***SSM20110627_smperc*** ssm201106270636_smperc and also change the symbol color to blue. (Open Symbol icon and change the color). Also overlay the map with the workdcountries segment file.



Now zoom-in to the ASCAT scanning area (blue area). What do you see? Pls. browse the map qith the cursor (after you de-activated the worldcountries MapInfo). Otherwise, you will read the worldcountries polygon info (number).



These point maps can further be processed (e.g. interpolated) to a continuous surface, as shown below for the Southeast Ethiopia area.