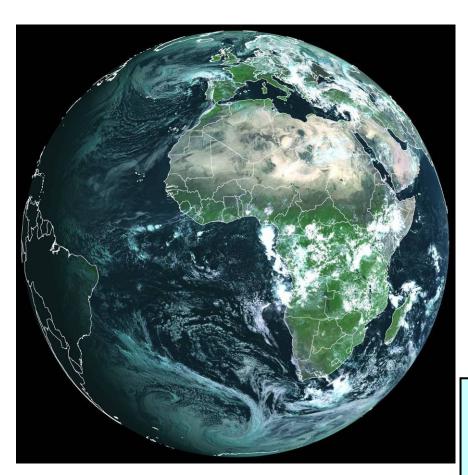
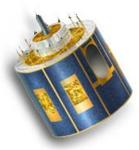
GEONETCast overview and the ITC GEONETCast toolbox approach





Ben Maathuis
&
Chris Mannaerts
Department of Water
Resources
ITC-Enschede
The Netherlands



1st Meteosat-8 image received at CGIS-NUR, using local EUMETCast reception facility, 04-04-2006, 09:15 UTC, bands VIS006, VIS008 and IR_016, transformed into a pseudo natural colour appearance



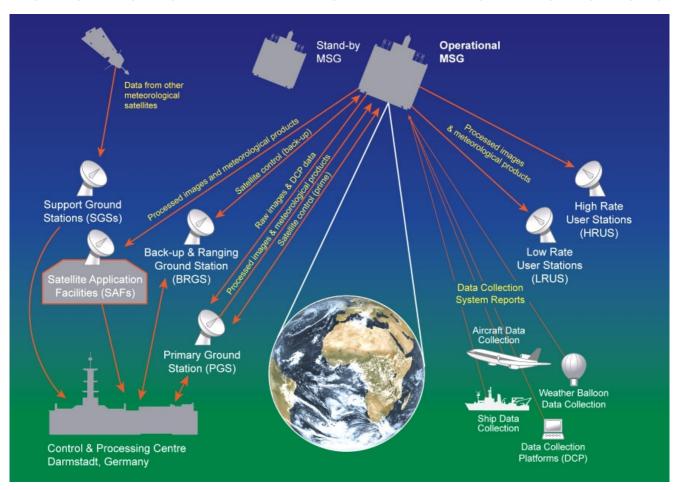
Overview of presentation

- What is GEONETCast;
- Toolbox developed;
- Examples of current toolbox capability:
 - HRIT and LRIT processing;
 - Other GEONETCast products (MPEF & SAF);
 - Direct MPE extraction from EUMETSAT;
 - Future toolbox development;
- Concluding remarks.



GEONETCast: Near real-time satellite reception

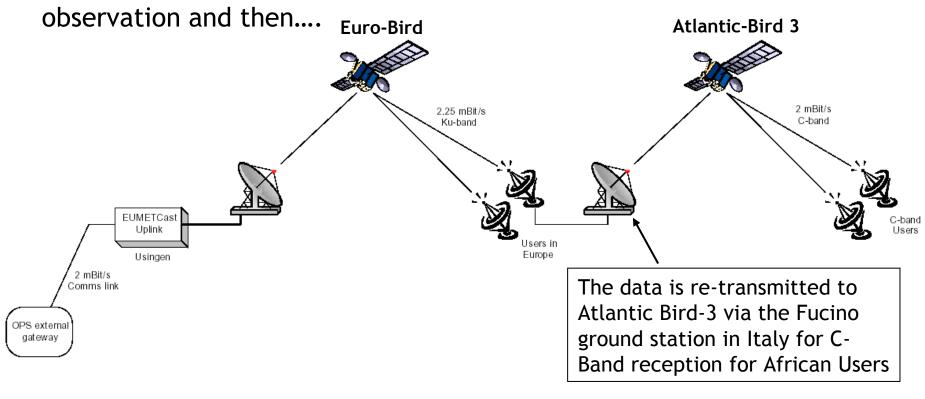
COMMUNICATION SATELLITE BASED DATA DISTRIBUTION SYSTEM





Near real-time satellite reception-MSG

After central ground processing at EUMETSAT, images in full resolution are transmitted in HRIT mode, within five minutes of



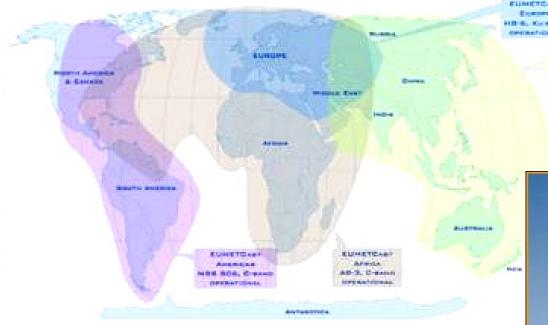


Before the signal is received at the CGIS-NUR system it has traveled: from MSG -> Darmstadt -> Usingen -> Eurobird-6 -> Fucino -> Atlantic Bird-3 -> Local Station (approximate distance is 5 * 36.000 km!!)

GEONETCast coverage

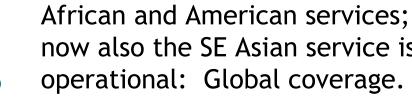


Global coverage



Operational are the European,

Franchise Cont.



now also the SE Asian service is operational: Global coverage.



Why Geonetcast at ITC



- Near Real Time processing capability;
- Trans boundary (global) information;
- Long EO missions (next generation satellites is already planned);
- Development of algorithms currently under way (e.g. MPEF / SAF);
- Requires a high degree of (semi) automated processing.

Some current GEONETCast data - products



- Current data-products disseminated:
 - Meteosat-7, MSG-8 (at 9.5 East) rapid scanning Europe window (15N-70N, 5 minutes), MSG-9 (at 0, 15 minutes) and messages
 - GOES East, GOES West, MTSAT-1R, Fenyung-2C and messages
 - Meteorological Products (e.g. CLM, CLAI, GII/RII, MPE, etc)
 - Satellite Application Facilities products (e.g. AL, LST, SST, FVC, etc)
 - Jason 2
 - Products from external sources (e.g. VGT4Africa and Servir Central America)
 - METOP, 11 instruments (currently only on Ku service)
 - NOAA, e.g: AVHRR (GAC), ATOVS, MHS, GOME, AMSU-A and HIRS
 - MODIS fire product
 - RANET (Radio + Internet Technology for Communication of Hydro-Meteorological and Climate Information for Rural Development)
 - Training and "disaster warning" channel

• Future:

 more Space - Air and Ground based observations (e.g. CBERS for Africa, rain radars western Africa) and products produced by organizations in developing countries (e.g. DevCoCast-initiative / AIDA).

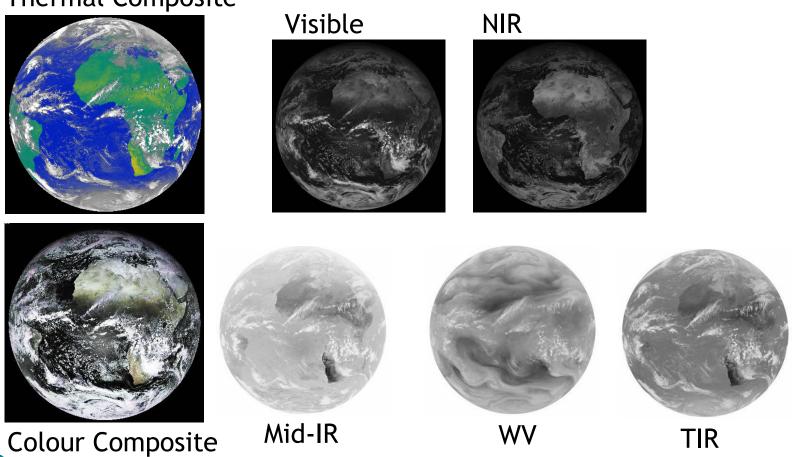


Backbone: Meteosat LRIT and HRIT



Meteosat 9 (at 0 degree) LRIT, 2008-01-10, 12:15 UTC

Thermal Composite

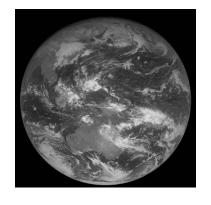


Foreign satellites (1)



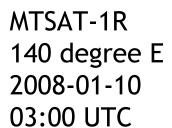
MTSat-1R and Met-7

VIS WV

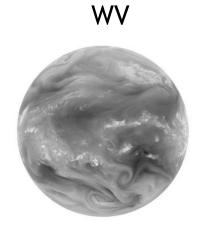












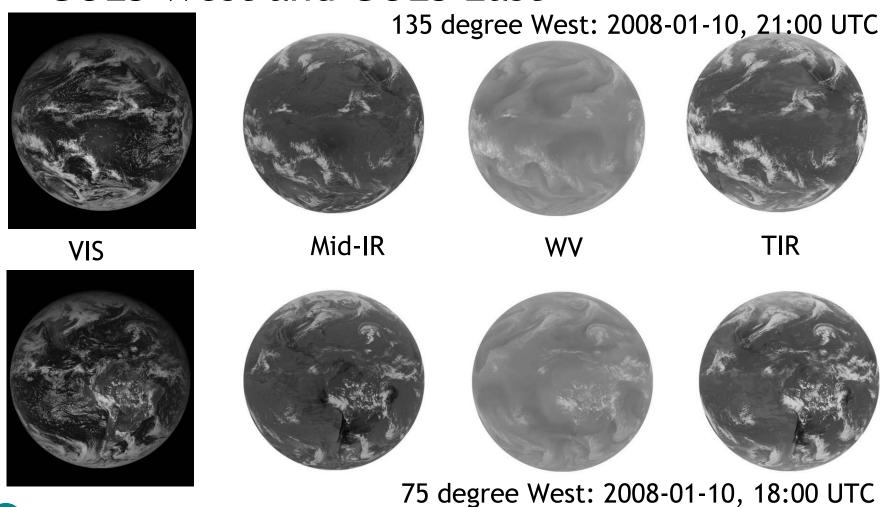


Meteosat-7 57 degree E 2008-01-10 06:00 UTC



Foreign satellites (2)

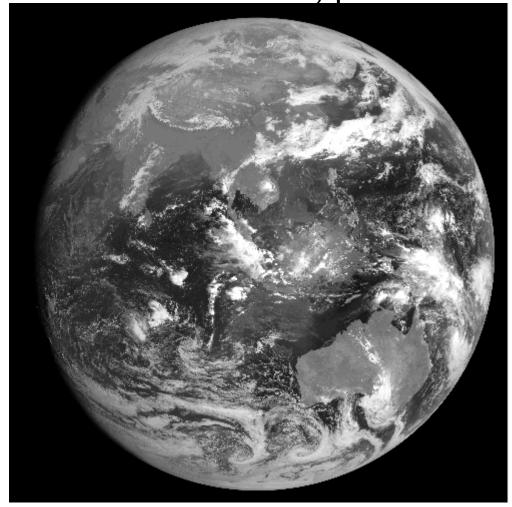
GOES West and GOES East





Foreign satellites (3)

• FENYUNG-2C High, 104.30 degree.minutes East, resolution of 1.25 km, panchromatic channel.



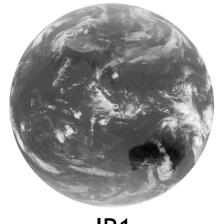


Foreign satellites (4)

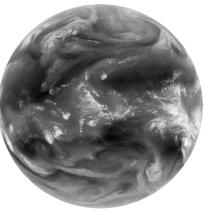
 FENYUNG-2C Low, 104.30 degree.minutes East, resolution of 5 km



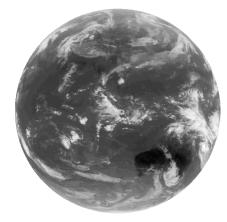




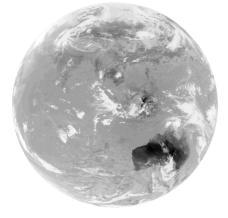
IR1



IR3



IR2



IR4



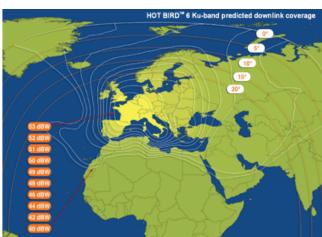
2009-03-24, 03:00 UTC

MSG data reception through Hotbird 6

- KNMI license (free for Science Education)
- Eurobird 6 Ku band
- 88 cm satellite dish (TV)
- Most GEONETCast services received











MSG data reception through Atlantic Bird



GEONETCast African Service received in Africa



Atlantic Bird 3 C-band dBW footprint



Satellite Dish installed at CGIS-NUR

Satellite Dish installed at RCMRD



System Hardware setup at CGIS-NUR, Rwanda

Station system setup

CPU: 3.2 GHZ Pentium 4 (both receiving and

processing stations)

RAM: 1 GByte

Harddisk: 75 GB internal disk

PCI bus: 5 Volt, compatible with the DVB PCI

card (in receiving station)

Operating System: Microsoft Windows XP SP2

External disks: LaCie Big Disk Extreme Terra Byte

high speed USB-2.0 disks

EUMETCast Tellicast Multicast Distribution System Client software & eToken USB-key License



(2) CGIS-NUR MSG ground station



METEOSAT-8 (MSG) at CGIS-NUR

Direct ground reception and processing facility

(3) MSG processing and calibration system

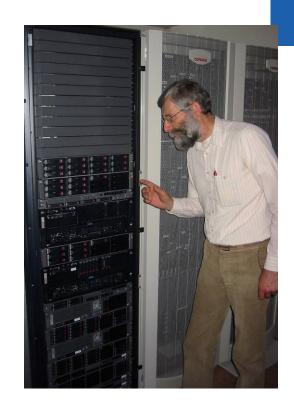




On-line storage for time series development @ ITC

- SEVIRI level 1.5 "raw" data, 12 channels;
- High Rate Information Transmission (HRIT);
- Full 3 year MSG HRIT archive which can be accessed on-line, using 13 TB archiving facility.
- Other data / products received, only stored for limited time;
- Wavelet compressed data;
- Currently stored 10 GB per day;





GEONETCast Toolbox developed

To work with the data processing tools are required!!!

- GEONETCast toolbox developed under ILWIS 3.6 Open at ITC, incorporating other (free) software routines:
 - GEONETCast File Manager

☐ Geonetcast Toolbox
 ☐ DevCoCast Products
 ☐ Land Products

Geostationary

MSG HRIT

LRIT Fenyung

LRIT GOES EAST

RIT GOES WEST

☐ LRIT MSG
☐ LRIT MTSAT-1R
☐ LRIT TIR Composite

MET7-based
MSG-based

MPEF CLM
MPEF CTH
MPEF FIRA
MPEF GII
MPEF MPEG

□ Polar Orbitting

SAF Albedo

☐ SPOT Vegetation
☐ SPOT Vegetation DMP
☐ SPOT Vegetation NDVI

☐ MSG Satellite and Solar Zenith / Azimuth Angles
☐ Satellite Angles
☐

Polar Orbitting METOP AVHRR/3
Polar Orbitting NOAA AVHRR/3 GAC

■ Real Time MSG Visualization and Animation

The SAF SST MSG-GOES Combined

SPOT Vegetation NDWI
SPOT Vegetation PHENOKS

 ☐ SPOT Vegetation PHENOMAX
 ☐ SPOT Vegetation SWB
 ☐ SPOT Vegetation VPI
 ☐ Toolbox Settings and Export

☐ MPEF AMV

☐ MPEF CLAI

☐ Ocean Products☐ ☐ Geonetcast Data Manager

m Geonetcast Data Manager

- Images: HRIT, LRIT and RSS import routines
- Products: MPEF, SAF, VGT and Modis-fire import routines
- Real time visualization of MSG HRIT data
- Other in-house developed software routines, Java applets,
 Batch files and Scripts to calculate satellite and solar angles
- Use of other freeware tools: BUFR, GRIB(2), FWtools and Irfanview.

GEONETCast toolbox plug-in - ILWIS 3.6 OPEN



Free download at 52N.org



Release in April/May 2009

Some exiting I360 Key-features:

- Integrated raster and vector design
- Import and export of widely used data formats
- On-screen and tablet digitizing
- Comprehensive set of image processing tools
- Orthophoto, image geo referencing, transformation and mosaicing
- Advanced modeling and spatial data analysis
- 3D visualization with interactive editing for optimal view findings
- Rich projection and coordinate system library
- Geo-statistical analyses, with Kriging for improved interpolation
- Production and visualization of stereo image pairs
- Spatial Multiple Criteria Evaluation



GEONETCast File Manager - user defined menu



Geonetcast Date	a Manager									
Input folders					Activity				1	
iource folder:	\\Pc\Received			Browse				Start		
Inmatched files folder	: \\pc\Other			Browse				Start		
MTSAT-1R LRIT	GOES-11 LRIT	GOES-12 LRIT	METOP NOAA		MPEF_PRO	MPEF-Data	SAF_EURO/A	SAF_SA	Messages	To be delete
MSG HRIT	MSG HRIT RSS	MSG LRIT RS	S SERVIR	FENGYUN	MSG LRIT	JASON	MODIS	EARS U	INKNOWN	MET-7 LRIT
Meteosat Second Ge	eneration (Meteosat 8	/9 at 0 degree East)							
Destination folder:	\\pc\Rawdata			Browse		ders	Current cycle:			
Missing data log:	\\pc\Other\missing\missing-hrit.log			Browse Open			Current cycle:			
Duration of storage:	FOREVER	~					L			
Items										
PRO			(EPI				HRV			
✓ Process			✓ Process				✓ Process			
Times to store:	all		Times to sto	7.0	l		Times to store:		all	
,					<u> </u>		Segments to store	n:	all	
VIS006			VIS008			1	IR016			
✓ Process			✓ Process				✓ Process			
Times to store:	all Times t		Times to sto	imes to store: all		Times to store: all				
Segments to store	e: all		Segments to	store: a	l		Segments to store	:	all	
IR039			WV062				WV073			
✓ Process			✓ Process				✓ Process			
Times to store:	all		Times to sto	re: a	I		Times to store:	T.	all	
Segments to store	e: all		Segments to	Segments to store: all				Segments to store: all		
IR087			IR097				IR108			
✓ Process			✓ Process				✓ Process			
Times to store:	all		Times to sto	re: a	I		Times to store:	[all	
Segments to store	e: all		Segments to	store: a	Ĭ,		Segments to store	:: [all	
IR120			IR134							
✓ Process			✓ Process							
Times to store:	all		Times to sto	ire: a	ı					
Segments to store	e: all		Segments to	store: a	I					

- Can be created by user based on simple ascii configuration file which can accommodate the whole GEONETCast data stream
- Duration of storage, times and segments to store can be defined per sensor, data product to enable users to store only the information they want



GEONETCast Data Manager - configuration file

- A simple ascii text editor builds the menu;
- Ground station manager can easily adapt the config file to incorporate new products in the data stream as the systems quickly evolves.

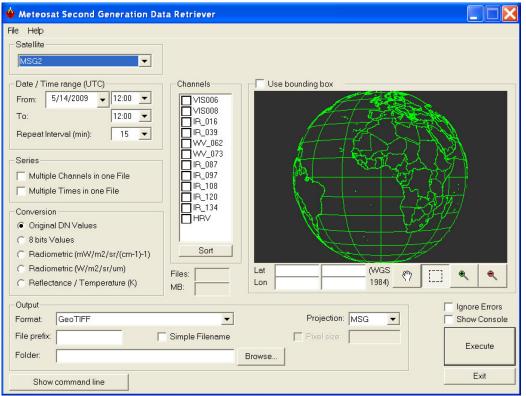
GeonetcastDataManager-ITC. txt - Notepad										
File Edit Format View Help										
# This file will be automatically overwritten the next time you run the program! # You can make edits to this file when the program is not running # but it is no use to change the layout of this file or add your own comments.										
# Uncomment lines to let them take effect										
Source folder: \\Pc2133-24004\Received Unmatched files folder: \\Itcnt31\Other Columns: 3										
Group Name: MSG HRIT Description: Meteosat Second Generation (Meteosat 8/9 at 0 degree East) # Date position: 46 # File id position: 36 Destination folder: \\Itcnt31\Rawdata # Dated folders: yes # Dated folders: \\Itcnt31\Other\missing\missing-hrit.log # Duration of storage: FOREVER										
Item Name: PRO Pattern: H-000-MSG2MSG2PRO # Process: yes Times per day: 96 # Times to store: all Expected segments: 1 # Segments to store: all										
Item Name: EPI Pattern: H-000-MSG2MSG2EPI # Process: yes Times per day: 96 # Times to store: all Expected segments: 1 # Segments to store: all										
Item Name: HRV Pattern: H-000-MSG2MSG2HRV # Process: yes Times per day: 96 # Times to store: all Expected segments: 24 # Segments to store: all										
>										





MSG HRIT data import

The MSG Data Retriever: MSG HRIT Data retrieval
 & pre-processing system for MSG-8 RSS / 9



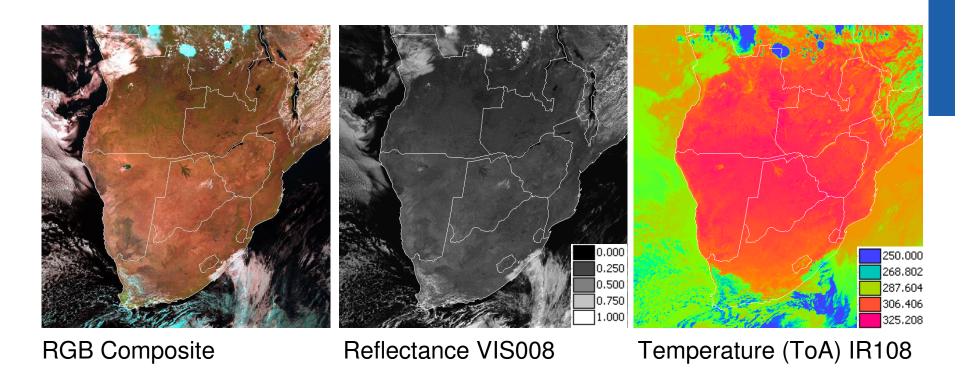
Some Key-features:

- Based on open source GDAL drivers;
- Fully controlled geometry & radiometry, conversions to diff. data formats: DN, radiances, reflectance, temperature;
- Diff. user defined output formats and resolutions (interpolation);
- Easy date/time range selection and series construction.



MSG HRIT data import

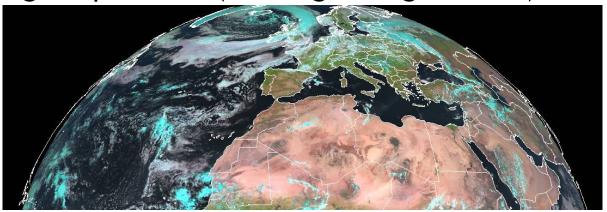
The MSG Data Retriever: MSG HRIT Data retrieval
 & pre-processing system for MSG-8 / 9 / RSS





Extension of import routines also for RSS

 The new Rapid Scan Service (RSS) from Meteosat-8 started on 13 May 2008 from a position at 9.5°E. The RSS delivers MSG image data every 5 minutes as well as a selection of meteorological products (starting in August 2008).



RSS 5 minute scan of reduced area (1/3 rd of full disk)

Product	Format	Frequency
Atmospheric Motion Vectors (AMV) (Channels 2 (VIS 0.8) and 9 (IR 10.8)	BUFR	Every 20 minutes
Clear Sky Radiances (CSR)	BUFR	Every 15 minutes
Multi-sensor Precipitation Estimate (MPE)	GRIB	Every 5 minutes
Active Fire Monitoring (FIRG)	GRIB	Every 5 minutes
Active Fire Monitoring (FIRA)	ASCII	Every 5 minutes
Global Instability Index (GII) (Segment size = 3x3 pixels)	BUFR	Every 5 minutes

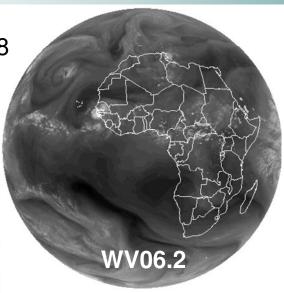


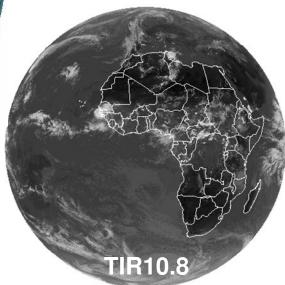


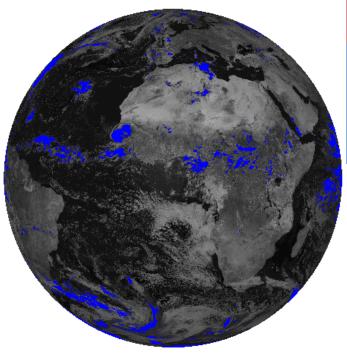
MSG HRIT Data in I-36 O: "map list" calculator

Natural looking color composite VIS006, VIS008 and IR_016 for cloud visualization







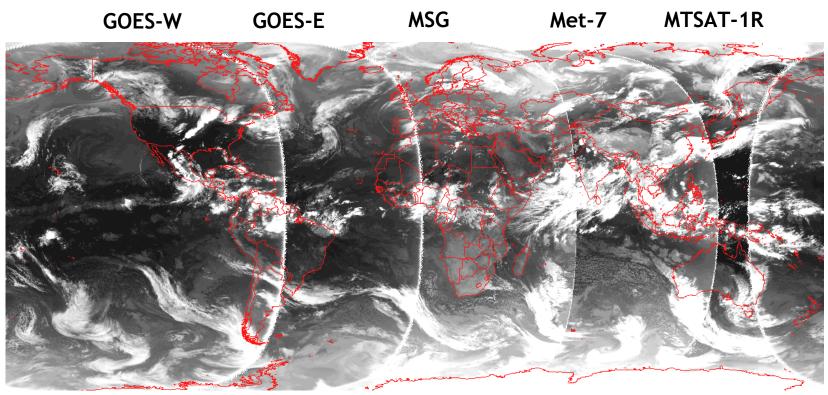


Small brightness temperature differences (<11K) between WV06.2 and TIR10.8 as an indicator for precipitating clouds



LRIT MSG-Met7 and foreign satellites

 Import routines are developed for the LRIT data as well as a routine to construct global composites of the TIR bands of several geostationary satellites.

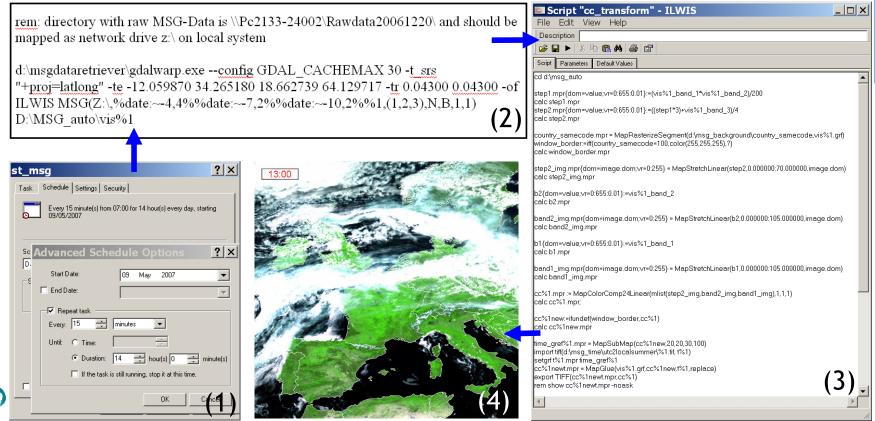




Capabilities of the system: visualization



- Near-real time visualization:(1) using Windows Scheduler (2) batch routines to extract new data - (3) Ilwis scripts for processing and (4) IrfanView for image display
- Virtually any application can be built depending on the User needs

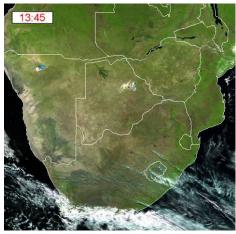


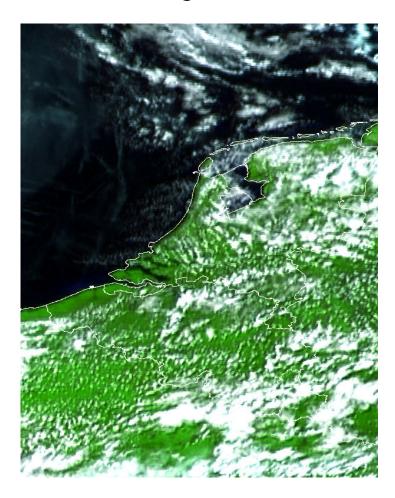


Standard visualization windows

- Sample windows over Europe, North and South Africa, South America
- User defined window over the Netherlands showing fused MSG HRV and VISO06, VISO08 and IR_016 colour transformed image











GEONETCast data stream



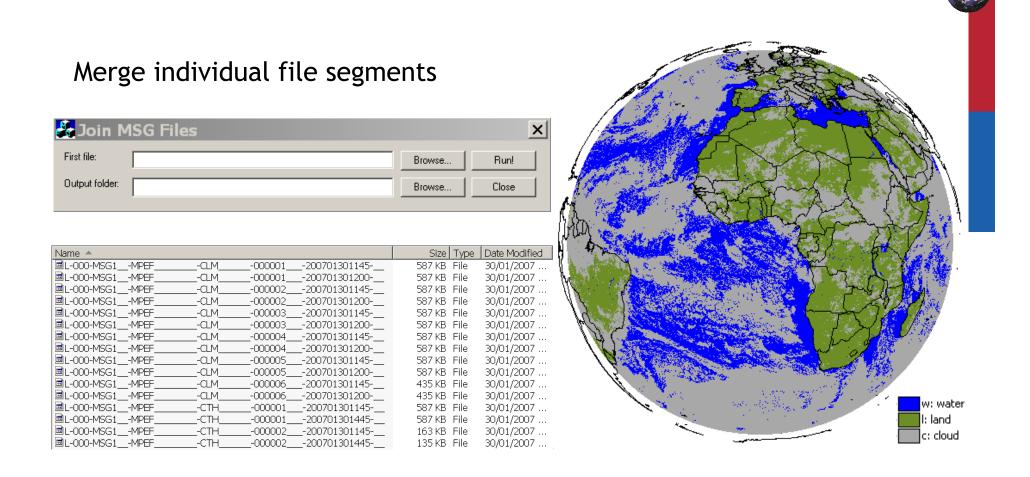
MPEF products and other information

Products	Sat.	Product Times	Format	Dissemination	
		Dissemination Frequency (min) ⁴	Timeliness (min)		
Atmospheric Motion Vectors (AMV)	8	60	15	BUFR	EUMETCast
Climate Data Set (CDS)	8	15	15	BUFR	EUMETCast
Cloud Mask (CLM)	8	15	15	GRIB2	EUMETCast
Cloud Analysis (CLA)	8	180	15	BUFR	EUMETCast
Cloud Image (CLAI)	8	180	15	GRIB2	EUMETCast
Clear Sky Reflectance Map (CRM)	8	once Wed./Sun.	n/a	GRIB2	EUMETCast
Cloud Top Height (CTH)	8	180	15	GRIB2	EUMETCast
Clear-Sky Radiances (CSR)	8	60	15	BUFR	EUMETCast
Global Instability Index (GII)	8	15	15	BUFR	EUMETCast
High resolution Precipitation Index (HPI)	8	once/day	n/a	-	EUMETCast
Total Ozone (TOZ)	8	60	15	BUFR	EUMETCast
Tropospheric Humidity (TH)	8	60	15	BUFR	EUMETCast



→ GRIB/GRIB2 and BUFR decoders are implemented

Grib decoder for GEONETCast CLM





IMPORT GRIB: Gdal_translate.exe -of ILWIS GRIB_in output

GRIB decoding and multi temporal processing

- Batch processing for time series data;
 - Import of GEONETCast segments
 - File name modification
 - Reclassification in ILWIS and export to Tiff



```
File Edit Format View Help

for %%j in (*0001*) do joinmsg %%j out
cd out
for %%j in (*.grib) do gdal_translate.exe -of ILWIS %%j %%j_ILWIS

for %%j in (*.mpr) do runclm1 %%j

cd ..
```

```
File Edit Format View Help

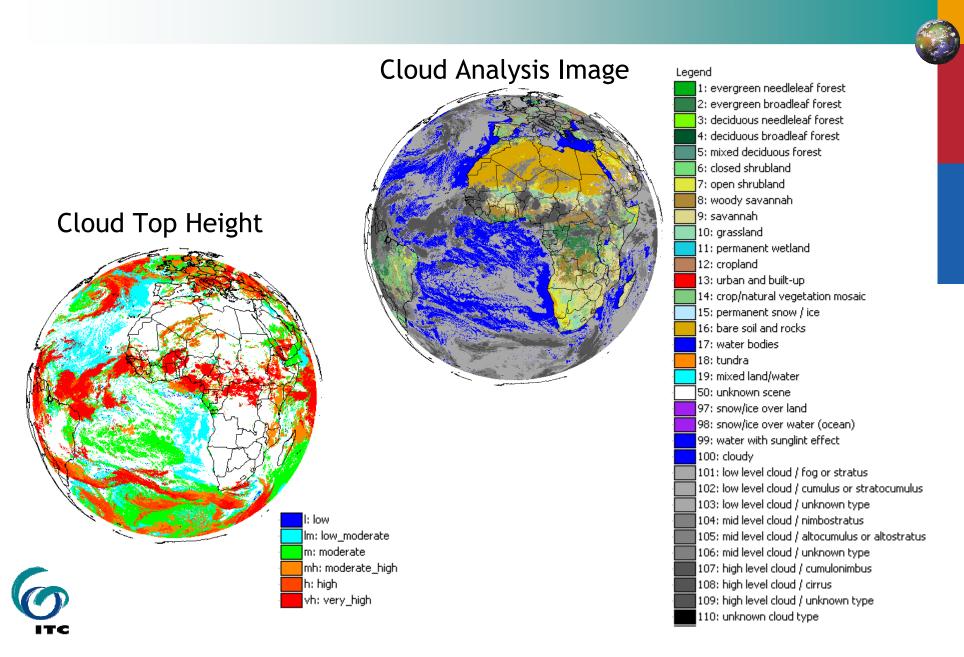
set longfilename=%1
set shortfilename1=%longfilename:~0,61%
set shortfilename2=%longfilename:~26,32%
set shortfilename3=%shortfilename2:~0,3%%shortfilename2:~20,12%
ILWISComClient.exe '%shortfilename3%'.mpr{dom=clm.dom}:=MapSlicing('%shortfilename1%'.mpr,clm.dom)
ilwiscomclient.exe export tiff ('%shortfilename3%'.mpr, %shortfilename3%')

del/q *.grib
```

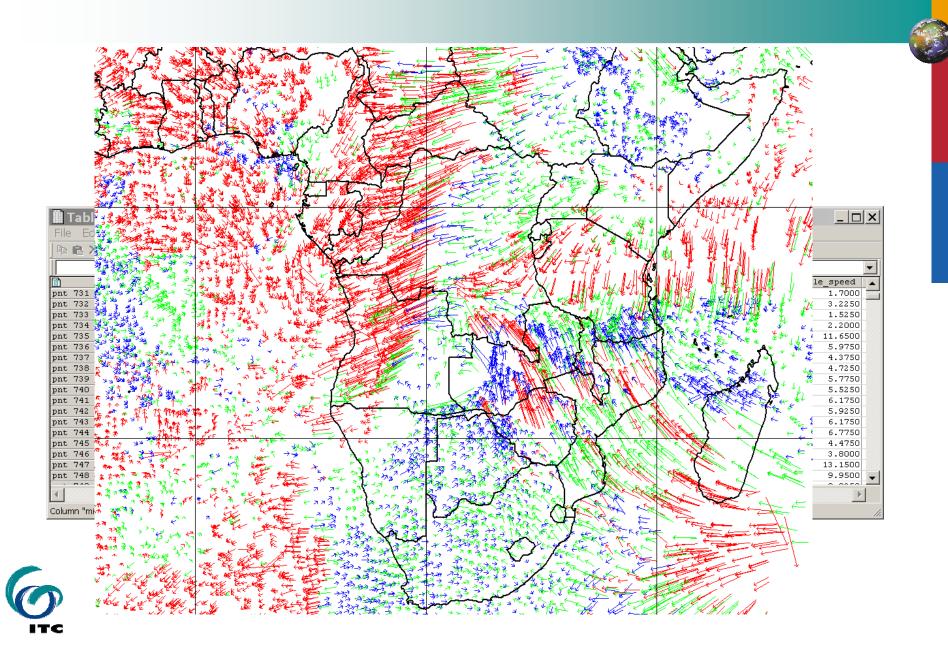




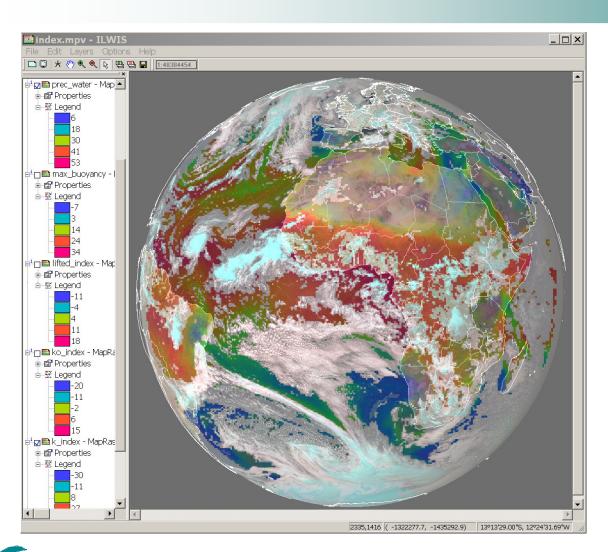
Grib decoder for GEONETCast CTH, CLAI



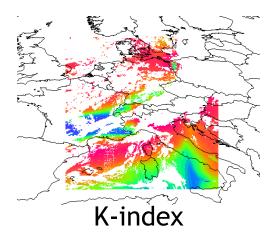
Bufr decoder for GEONETCast AMV

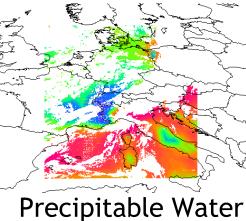


Bufr decoder for GEONETCast GII/RII



RII - Regional -Central Europe, resolution 2 km



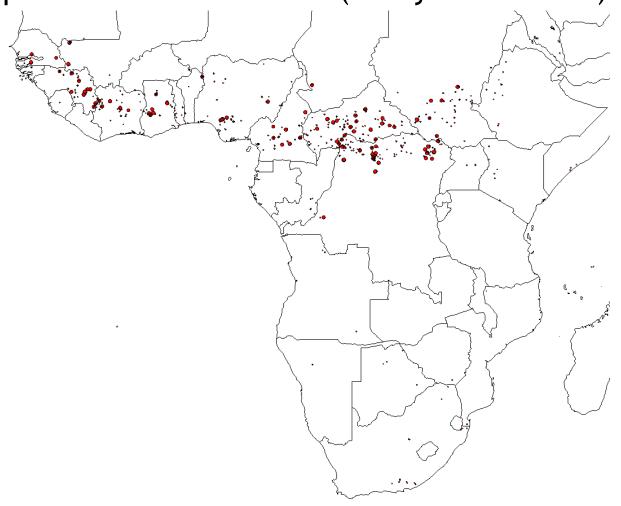




GII- whole FOV, resolution 30 km

Other GEONETCast products: Fire product (ascii)

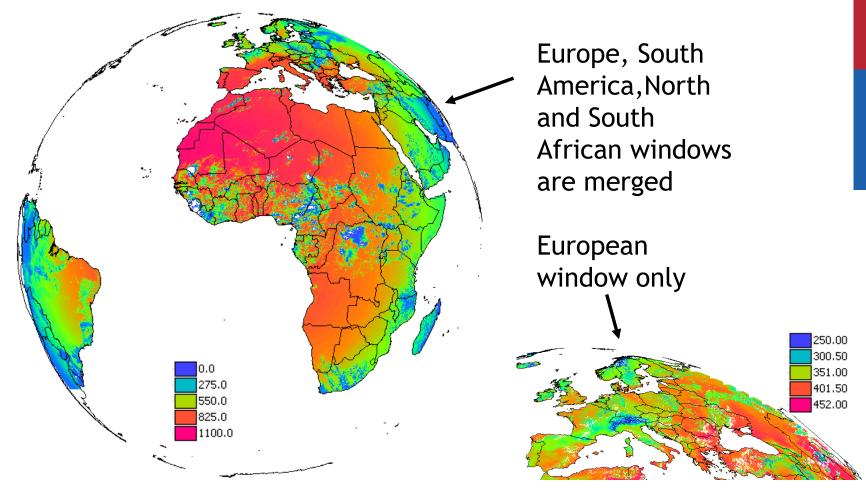
 Direct import of ascii table (FIR-A) indicating possible and probable fire locations (every 15 minutes)





SAF products: import of DSSF/DSLF (HDF5) for Surface Radiation Budget

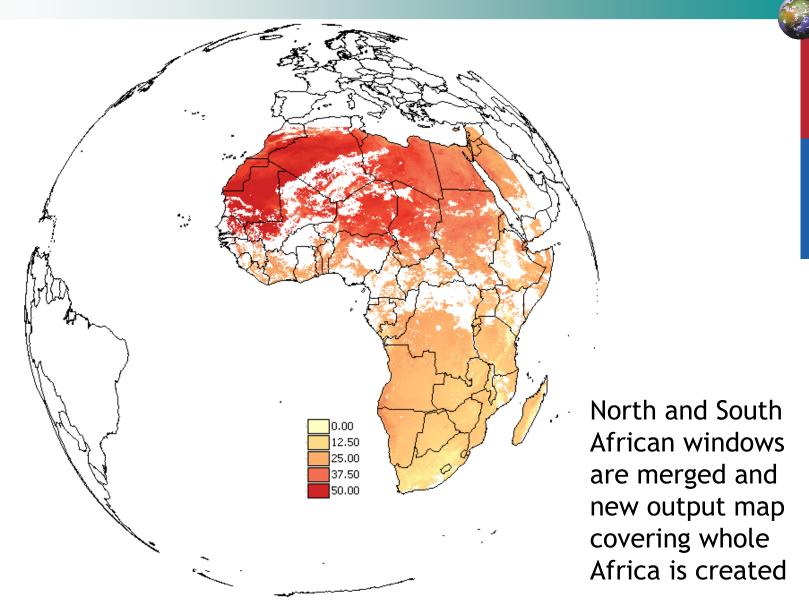
Down-welling Surface Short-wave Radiation Flux (W/m2)





Down-welling Surface Long-wave Radiation Flux (W/m2)

SAF products: import of LST-Africa (HDF5) for Surface Radiation Budget

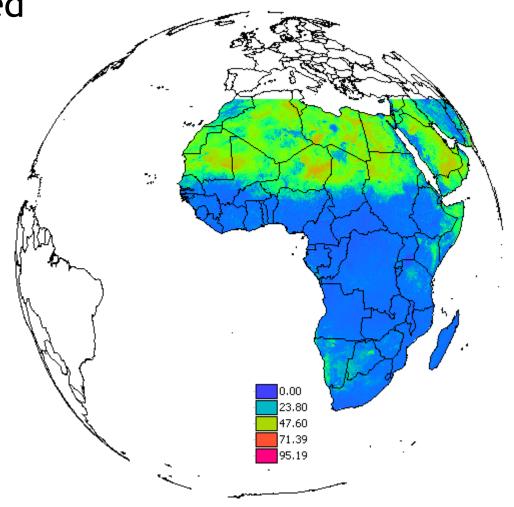




SAF products: import of Albedo (HDF5) for Surface Radiation Budget

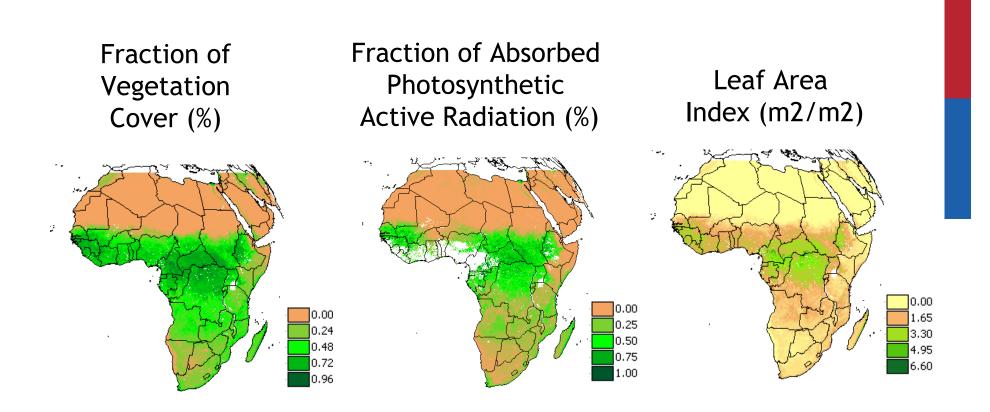
Albedo, North and South African window are

merged





SAF products: import of fAPAR, FVC and LAI - Africa (HDF5) / Biogeophysical areas Parameters

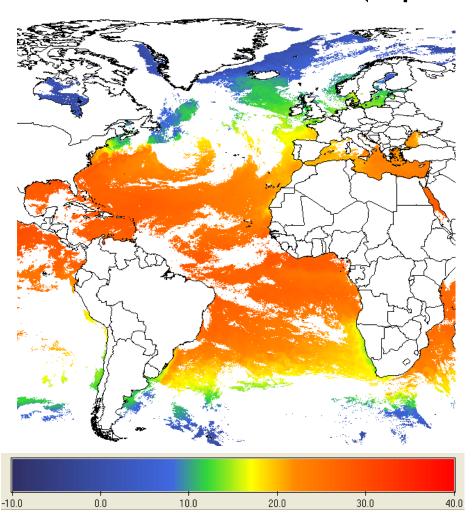


Product available once a day



SAF products: import of OSI-SST (Grib)

SST combined GOES and MSG (2 products/day)

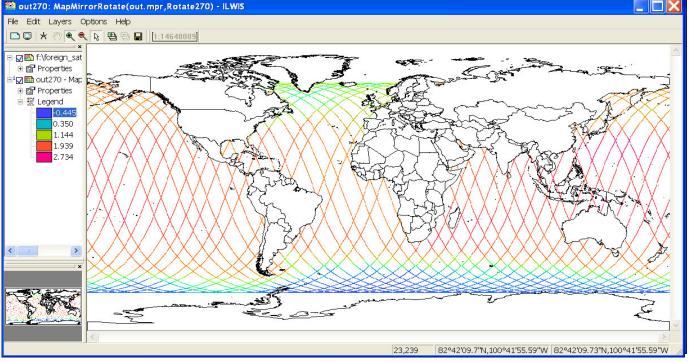


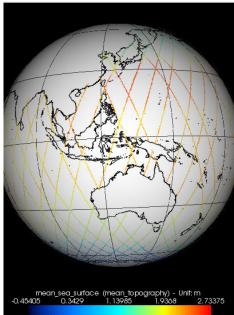


Jason 2, Altimetry: SSH and SLA

Altitude = 1336 km, non sun synchronous orbit, inclined 66 degrees, 10 day repeat cycle. Jason-2 near real time altimetry products are disseminated by EUMETSAT and NOAA within 3 hours from acquisition, using GEONETCast.





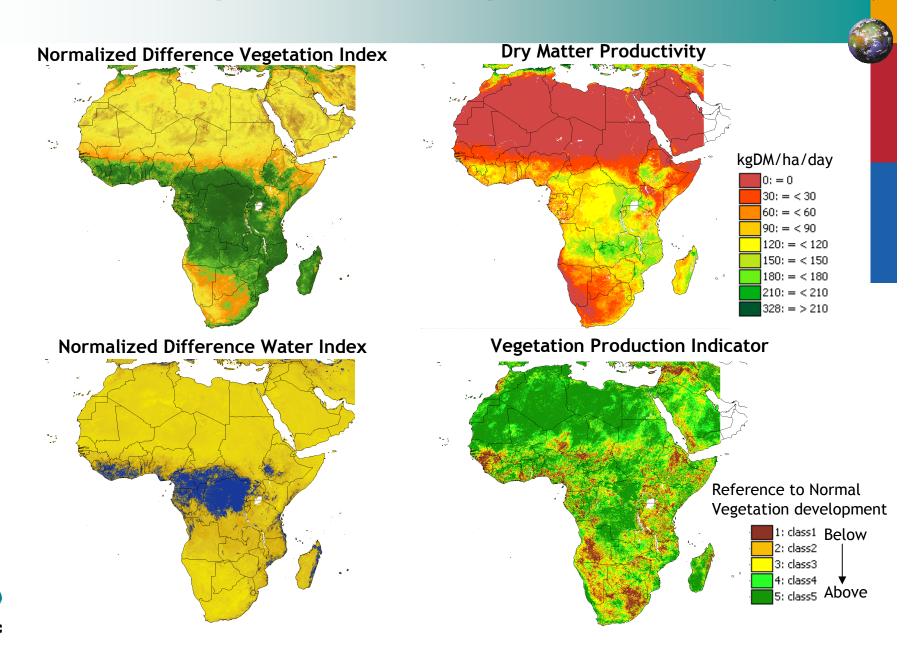






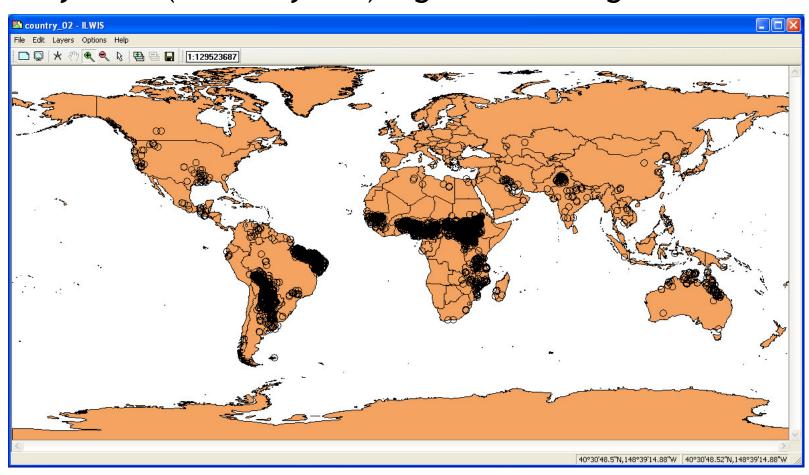
Using BRAT as preprocessor

Other satellite products: example VGT-10 day (HDF4)



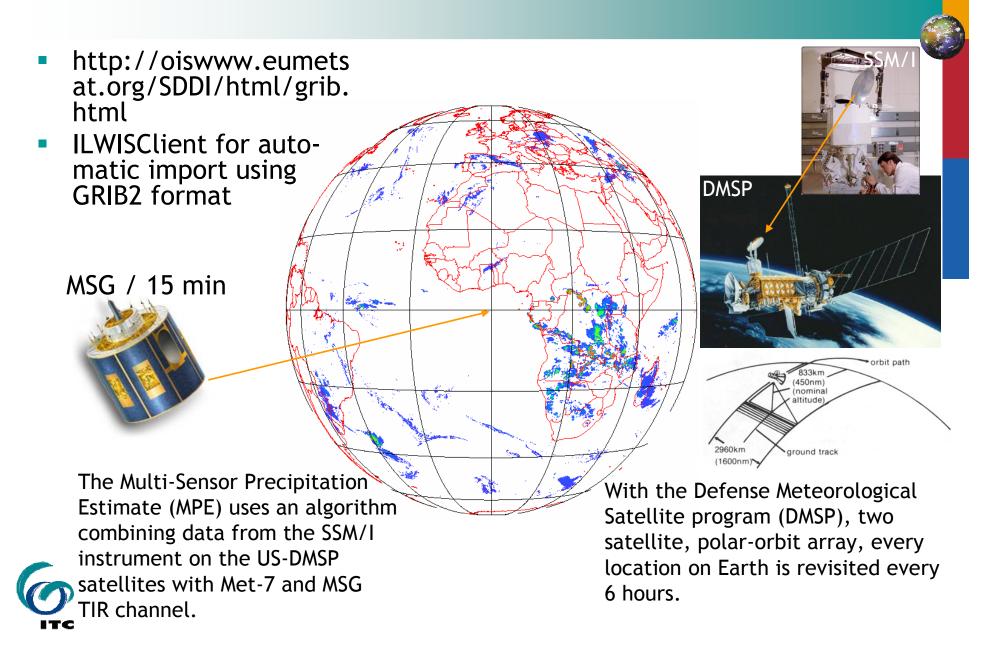
Other satellite products: Modis Fire product

 Direct import of Modis Fire Product, aggregated on daily basis (2008-day 326) / global coverage





Import from Eumetsat Archive MPE



Auto-Import from WWW @ Eumetsat: MPE time series

- Batch processing for time series data rainfall;
 - Copy GRIB files from Eumetsat
 - File name modification and import of data
 - Reclassification in ILWIS and aggregation



```
runmpe.bat - Notepad

File Edit Format View Help

Cd\
g:
cd mpe_time
for %%j in (*.grb) do wgrib2.exe -ieee %%j_GRIB %%j
for %%j in (*.grb_grib) do runmpe1 %%j
```

```
File Edit Format View Help

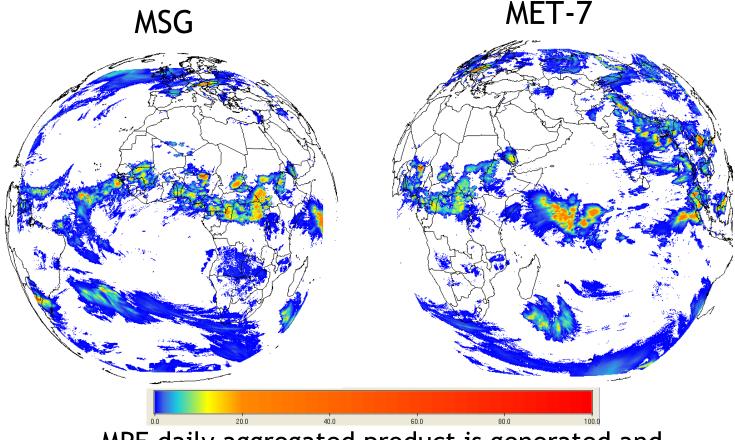
set longfilename=%1
set shortfilename2=%longfilename:~0,32%
set shortfilename2=%longfilename:~0,17%

ILWISComclient.exe '%shortfilename2%'.mpr:=map('%
shortfilename1%',genras,Convert,3712,0,Real,4,SwapBytes)
ilwiscomclient.exe %shortfilename2%_1.mpr{dom=value;vr=0:100:0.00001}:=%shortfilename2%*1000*4
ilwiscomclient.exe %shortfilename2%_2.mpr{dom=value;vr=0:100:0.00001}:=MapMirrorRotate(%
shortfilename2%_1,Mirrvert)
ilwiscomclient.exe setgrf '%shortfilename2%_2'.mpr mpe_georef.grf
```



Auto-Import from WWW @ Eumetsat: MPE time series

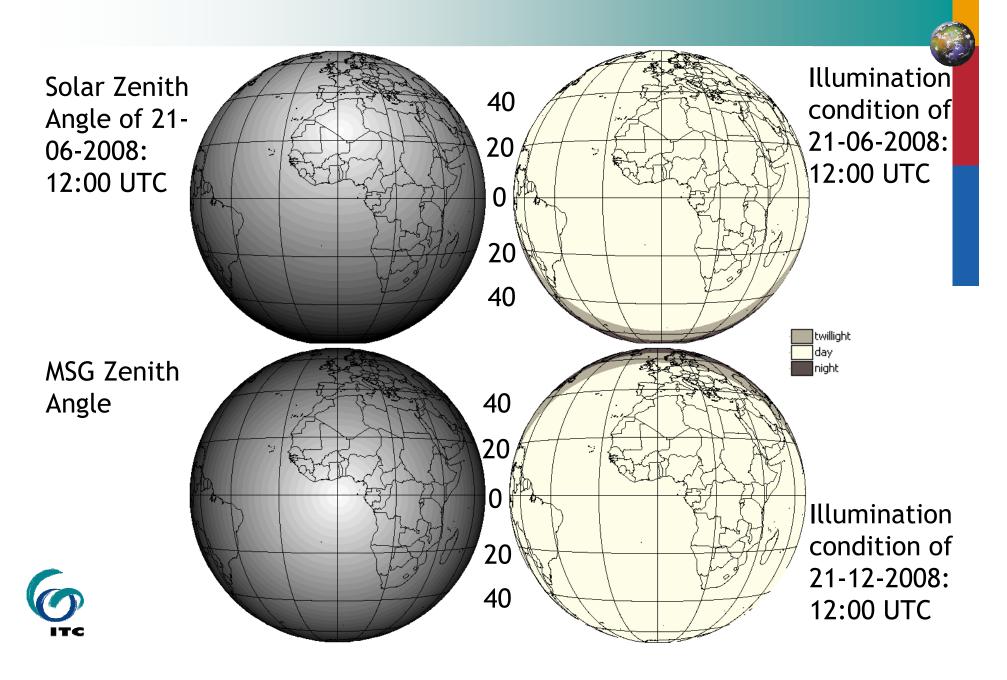
 24 hr aggregated precipitation automatically calculated using the MPE-Direct function





MPE daily aggregated product is generated and an archive is under construction at ITC

MSG satellite and solar azimuth / zenith angles



MetOp-AVHRR/3 Reader and import routines for other sensors

- Example Metop AVHRR/3, 3 minutes scan 200708300935-200708300958
- Not active on the C-Band service yet!!!



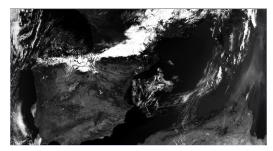


25 minutes - going south, start time 09:43 UTC 2007-08-30, 8 of 9 segments, 2048*1020

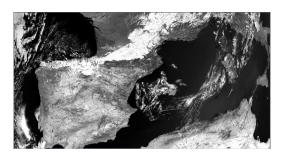
MetOp-AVHRR/3 Reader



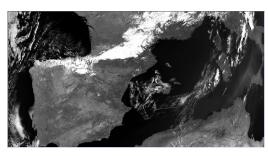
Bands of AVHRR/3 (day) 2007-08-30 / 09:55-09:58



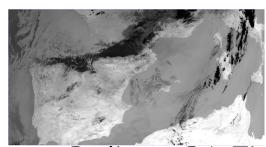
Radiance B1, Vis



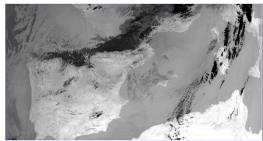
Radiance B2, Nir



Radiance B3A (Nir, day-time)



Radiance B4, Tir

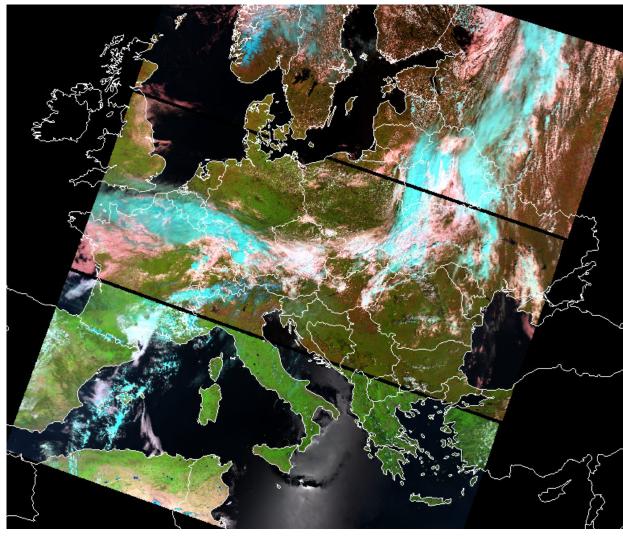


Radiance B5, Tir



Using BEAM plugin MetOp-AVHRR/3 Reader



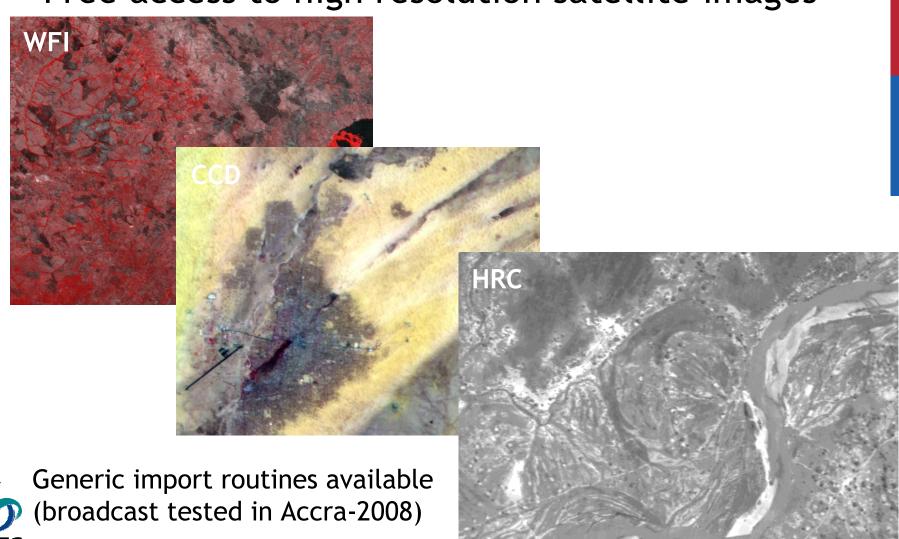




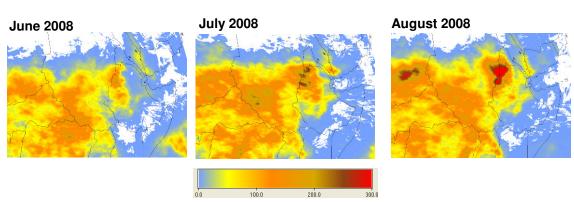
VISAT EPS level 1B, each frame is 3 minutes recording, morning overpass 20095012

Future developments: CBERS for Africa

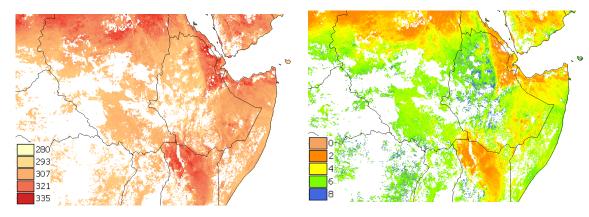
Free access to high resolution satellite images



Future developments: Satellite derived rainfall & ETa



MSG-based Multisensor Precipitation Estimate 15 minutes Product; aggregated on monthly basis (96*nday_month) in mm. for June, July and August 2008, Eastern Africa. Automatically processed.





From Land Surface Temperature (LST) to daily Evaporation (ETa), application of DATTUTDUT-model using as input 10.00, 12.00 and 14.00 UTC LST (in Kelvin), Sum ETa in mm/day. White areas are cloud covered. Date:16 Sept 2008.

Conclusions

- Low cost processing system is good alternative for "non-meteorological" user community, e.g. academic institutions, environmental research institutes and (national) water authorities for multitude of (environmental) applications;
- Main bottleneck (import of data in GIS) nearly solved (METOP) and other GEONETCast products, e.g. from Vegetation Instrument, can be imported and processed;
- Including CBERS, Geoneticast prodives near real-time data that covers spatial resolutions from 5 km down to 2.5 metres;
- By utilizing the toolbox relevant products can be processed for (near real time) environmental assessment by national (and international) organizations for better policy making;

Conclusions



- The toolbox is flexible and can be adapted to suit the user needs;
- Will be released as plug-in under ILWIS 3.6 Open, for further analysis the generic ILWIS RS and GIS routines can be applied;
- ILWIS.exe can be used to develop automated processing routines, works from the command prompt;
- ILWIS has over the years been used by a large EO and GIS community e.g. in Africa;
- ILWIS 3.6 Open is capable of incorporating external web services and this information can be integrated with the processing results from GEONETCast extracted information.