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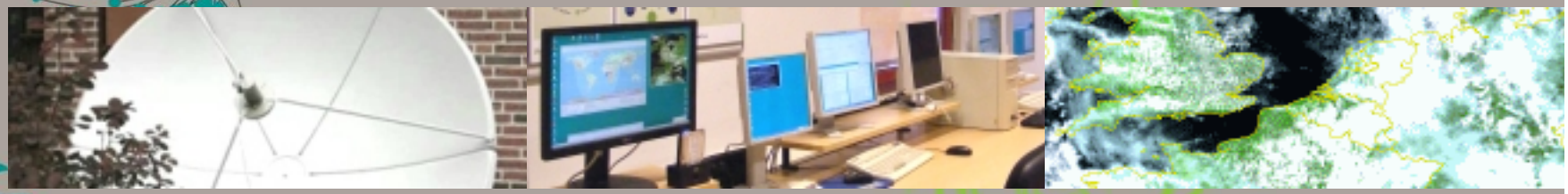
ITC GEONETCast Toolbox for Satellite Applications Development in GEO EU projects & Beyond

Chris Mannaerts & Ben Maathuis

Presentation at GEO EU Projects Workshop
April, 15-16 2013, @UAB, Barcelona, Spain



ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Overview

- ITC-UT & GEONETCast
- ILWIS Open & GEONETCast Toolbox approach
- Some Application Use Cases across the globe
  - DEVCoCast experience
  - AMESD-SADC GEONETCast Services
  - GEONETCast 4 EW & Food Security – Ethiopia (WFP)
  - AGRICAB project synergies
  - GNC in SE ASIA, Latin America & other regions
- Tools for the meteorological, weather and climate community
- User resources, network, future actions

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ITC

Faculty of Geo-Information Science and Earth Observation

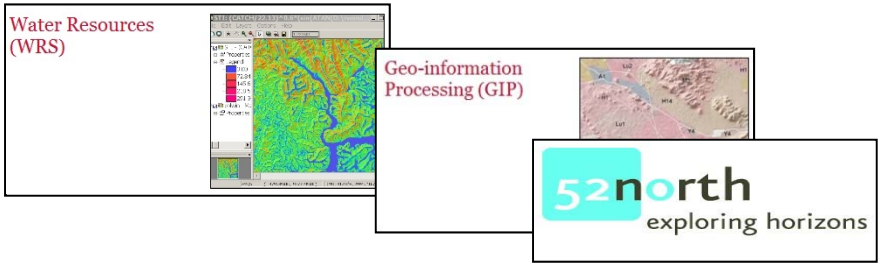
Study Research Services Alumni Library Organisation

EO Mission: Developing and transferring know-how in societal relevant satellite applications using geo-informatics & space science and technologies
Int'l staff: approx. 100 scientists & 120 support staff (>50 nationalities)
Alumni network: >21,000 graduates worldwide (1950-onwards)
Average # in-house students (MSc, PhD): 250, 100 with >80 nationalities (on average)
Location: Enschede (NL) with partners in Europe, Africa, Latin America, Middle-east, Asia
Annual budget range: (2008-2012) approx. 30-35.10^6 EUR p.a. (70/30)
See www.itc.nl

GEOSS RESEARCH & CAPACITY DEVELOPMENT @ITC

USING GEONETCAST & OPEN SOURCE TECHNOLOGY

- ***Goals and objectives***
- Increase EO data use and application through education and research processes
- Enhance collaboration on EO data use, among int'l academia and centers in Africa, Europe, America's, Asia and also with operational users and agencies
- Research & design user-driven applications using open source technologies
- ***Work concept***:
  - Facilitate fast access to earth observation, weather, climate and other *in-situ* data: ***solution -> GEONETCast + Toolbox***
  - Easy access to learning materials -> *open access ware*
  - Joint research, training & science support
  - Knowledge communication to citizens and general public



ITC reception control

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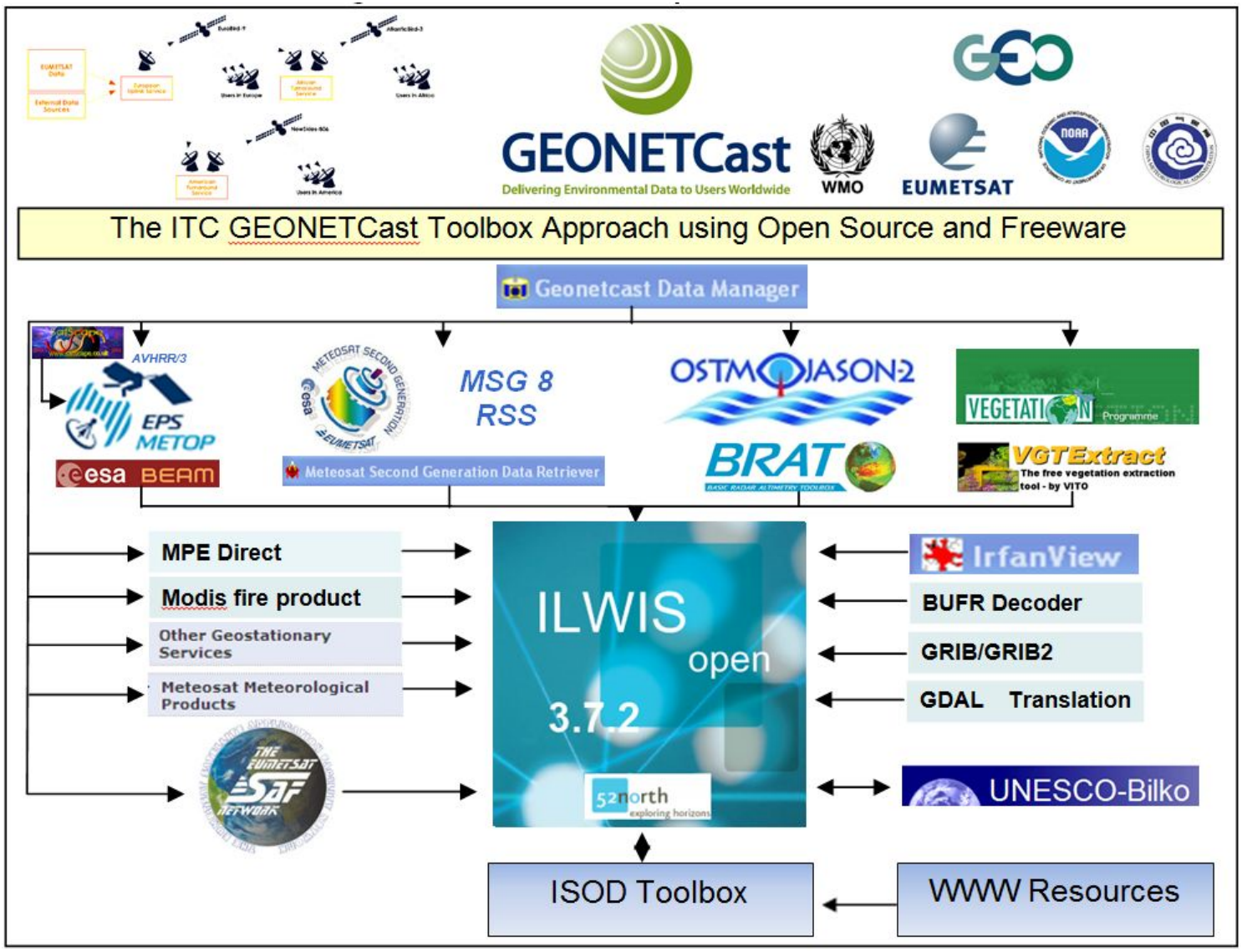
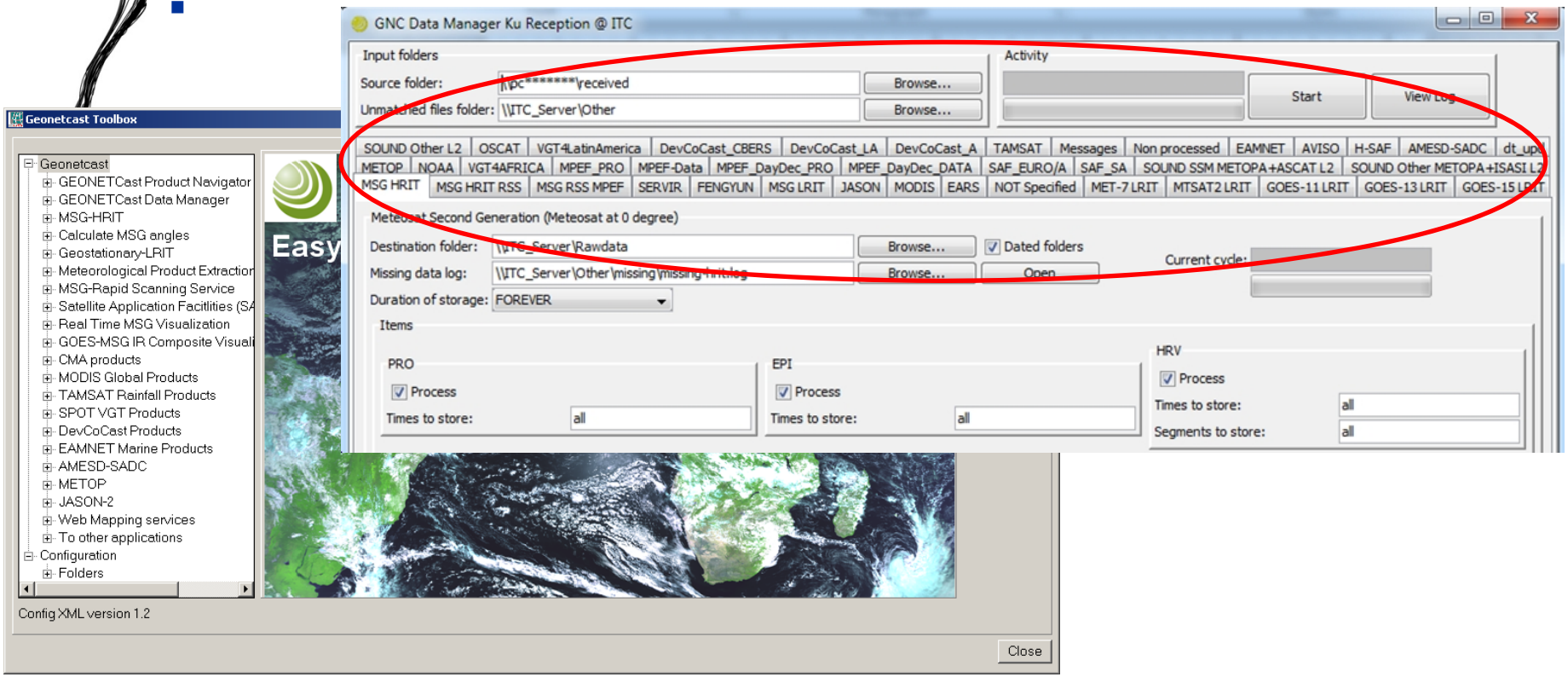
ITC GEONETCAST TOOLBOX APPROACH



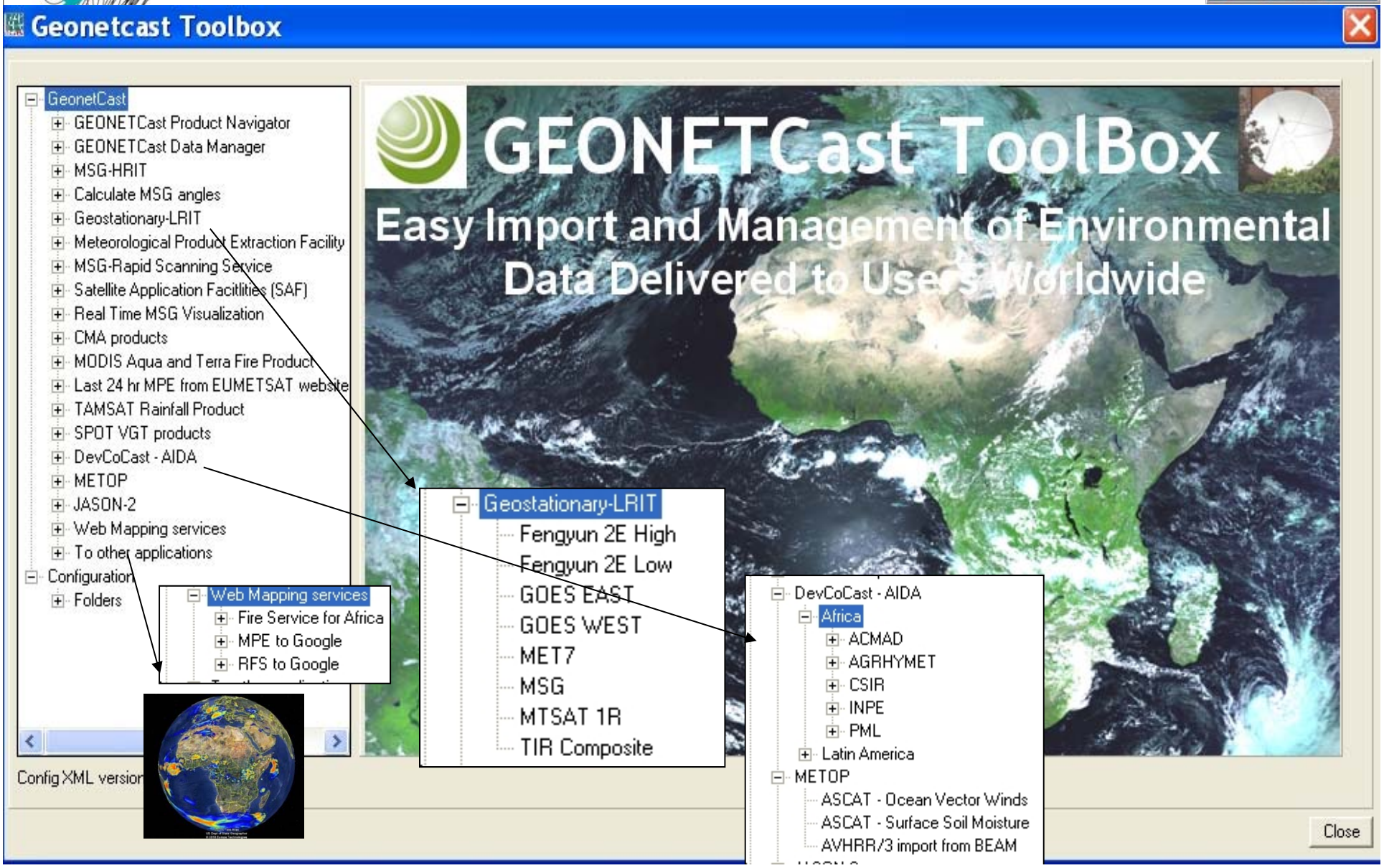
ILWIS GEONETCAST TOOLBOX OPEN SOURCE CONCEPT

See www.52north.org or www.itc.nl

- Plug-in in Ilwis Open
- GEONETCast incoming data stream manager
- Menu based on XML configuration file, according to preferences of user
- New functionality can be added without need for programming
-

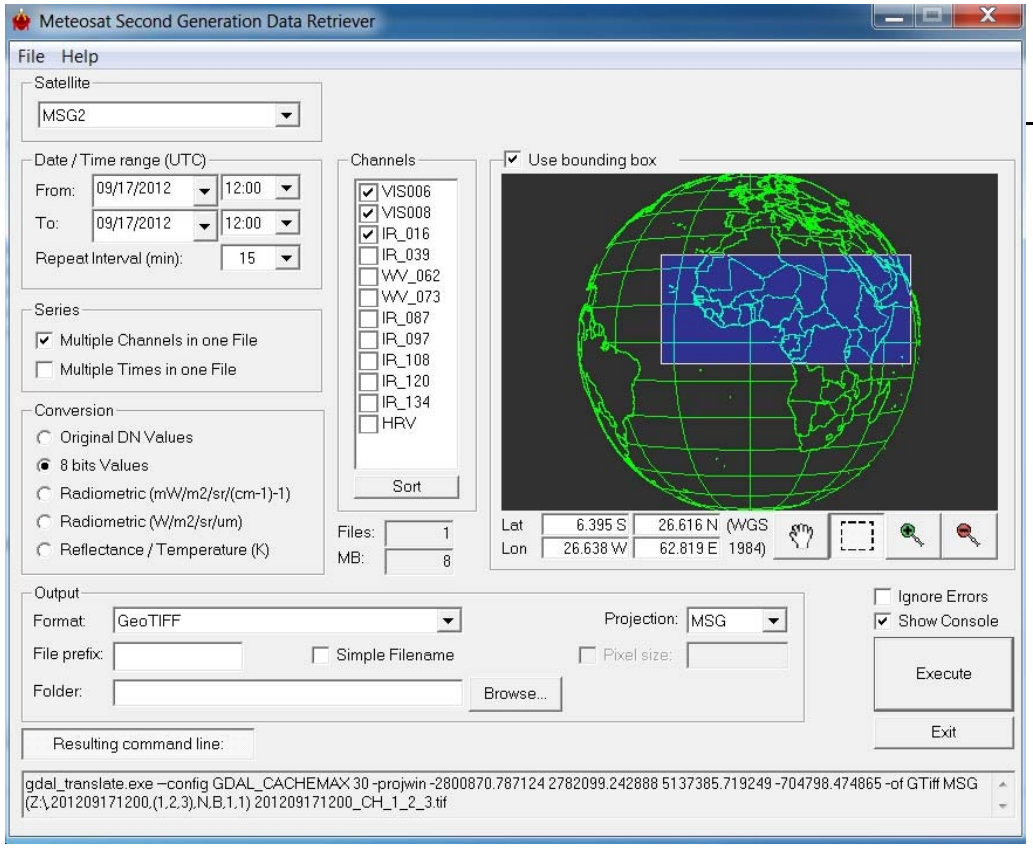


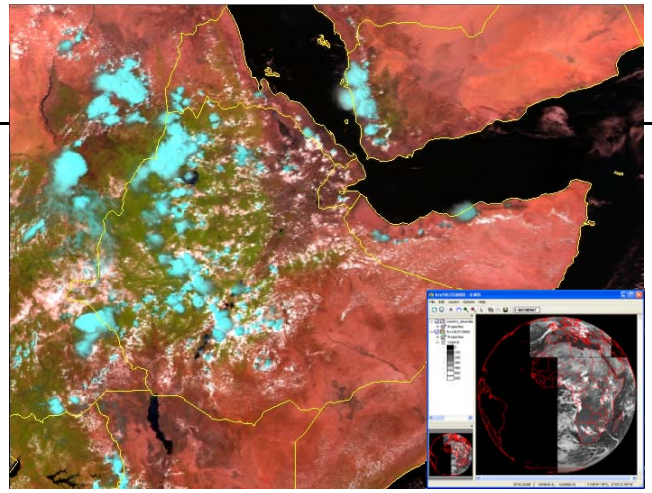
ILWIS Open GEONETCast ToolBox v.3.72

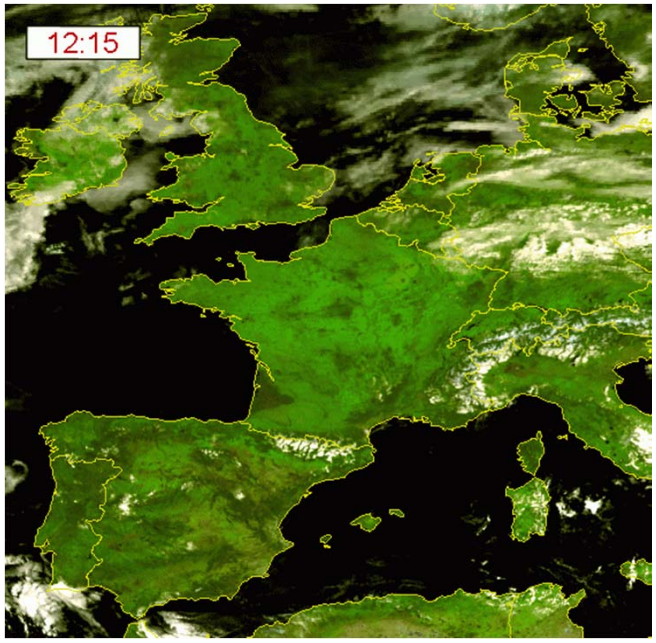


Toolbox Example routine: MSG HRIT Data Retriever

.







- Rapid SEVIRI channel import, user-defined windowing
- Optional resampling, (re)projection to MSG, Lat-Lon, UTM
- Extraction of time series or channel composites in one file,
- Various output formats: byte, radiances, reflectance, BT,..
- Open code access (GDAL), choice output formats

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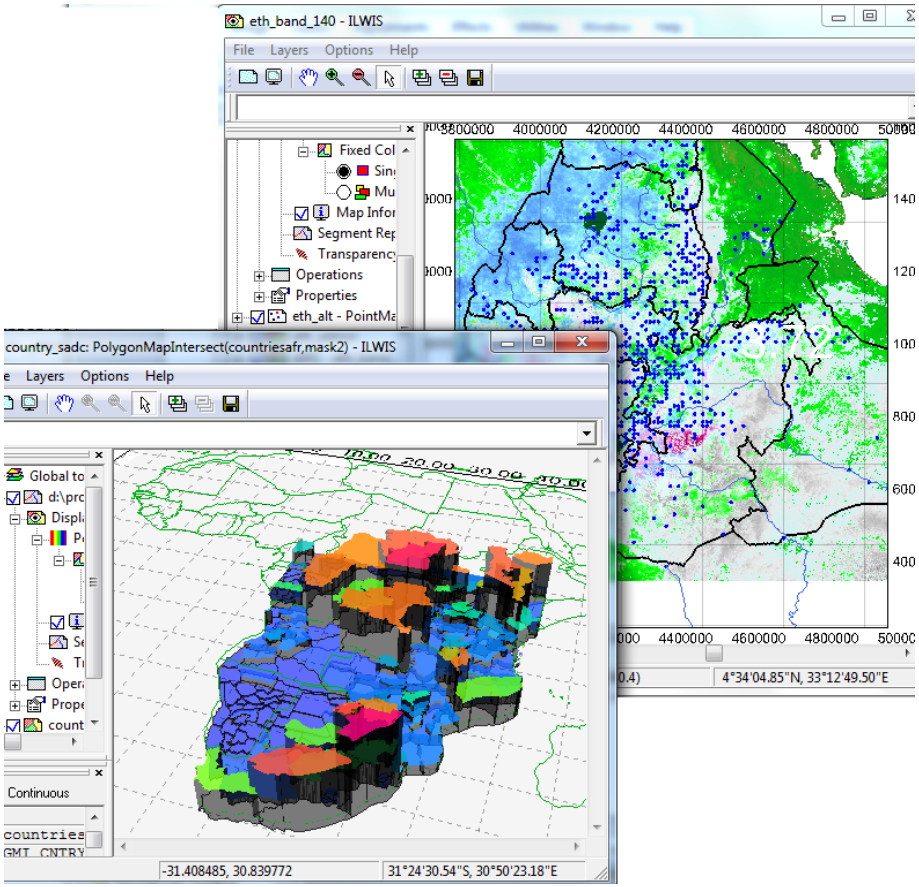
ILWIS OPEN

MODULAR PC-BASED REMOTE SENSING & GIS PACKAGE



Key features:

- integrated raster and vector design
- import - export of widely used geospatial data formats
- on-screen digitizing
- comprehensive image processing tools
- orthophoto, image georeferencing, transformation and mosaicking
- advanced modeling and spatial data analysis
- 3D visualization & animation (optional 3D)
- auto resampling of different spatial geometries
- rich projection and coordinate system library
- geo-statistical analyses & interpolators
- Spatial Multiple Criteria Evaluation
- Web Mapping & Processing Services
- Hydrological digital terrain modeling
- Surface Energy Balances (SEBS) functionality
- Application Plug-in architecture (Toolboxes)

Compact main package: 20 Mb only!

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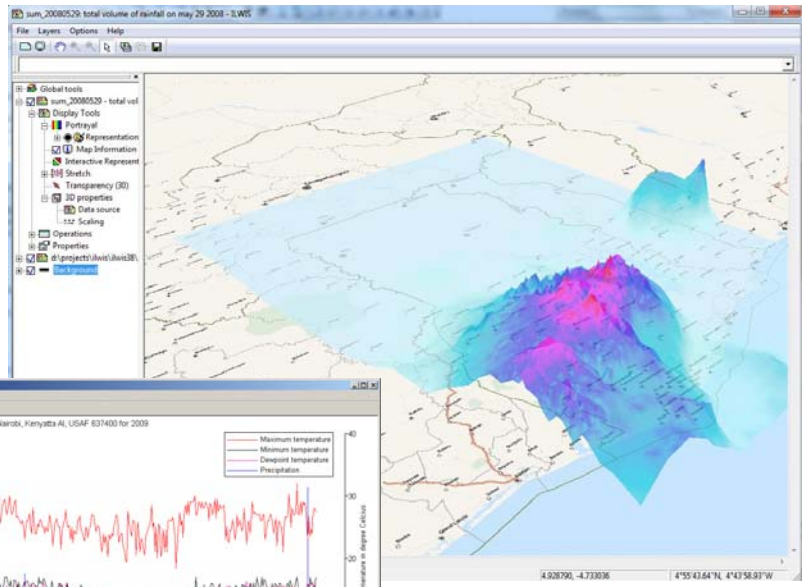
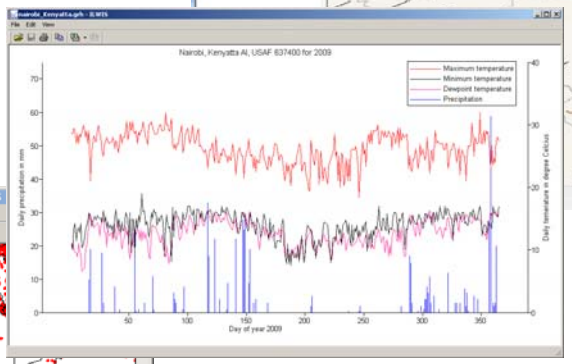
ILWIS OPEN v.3.8.3: NEW VISUALIZATION USING OPEN-GL

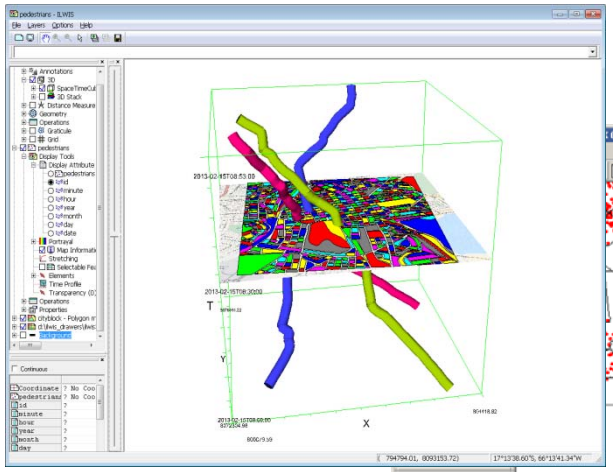
APPLICATIONS FOR SATELLITE & IN-SITU DATA 4 SOCIETAL BENEFIT AREAS

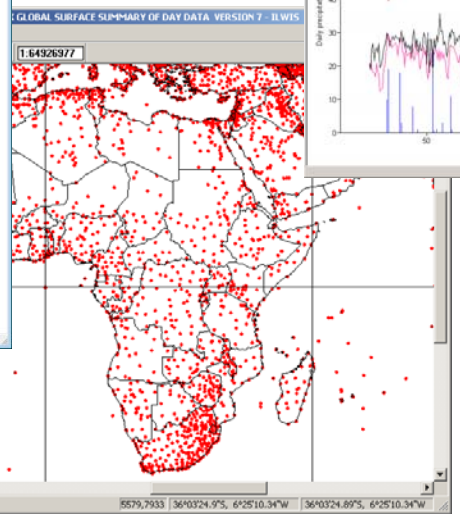
- Dynamic data views (incl.3D)
- Vector and raster
- Point data (station obs.)
- Tables & graphs
- Space – time cubes
- All RS-GIS functions available

for GEONETCast Toolbox users









Some examples:

- MSGMPE rainfall over Ghana, W- Africa
- GSOD stations
- GSOD Nairobi Jomo Kenyatta Airport data of 2010: Temp, Prec
- Space-time cube

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ITC GEONETCAST TOOLBOX SATELLITE APPLICATIONS DEVELOPMENTS IN AFRICA

BRIEF HISTORY

- From the first low cost station setup by ITC in 2006 (@ NUR, Butare, Rwanda) to a fast growing network of academic & operational users today

Also through major EU project thrusts:

- EU FP7 DEVCOCAST (Africa & Latin America): a success story 2007-2011
- EU EDF AMESD - SADC component
- EU FP7 EO2Heaven (Europe; Africa)

Recent initiatives (>2011-today...)

- UN WFP Ethiopia: early warning food security
- EU FP7 AGRICAB (PanAfrica)

Many other user initiatives (universities, orgs)

- RSA: UWC & UCT, Cape town
- Zimbabwe UZ, Botswana UB, BCA
- Kenya: RCMRD, KWS, CETRAD,...
- Ethiopia: AAU, Bahir Dar Univ, Mekelle Univ., DRMFSS, NMA, WFP,...
- Tunisia (IRA), Uganda, Zimbabwe, Benin,...
- A growing list and network

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GEONETCast
Delivering Environmental Data to Users Worldwide

AGRICAB
Africa Platform for knowledge sharing on Earth Observation, Forest and Agriculture

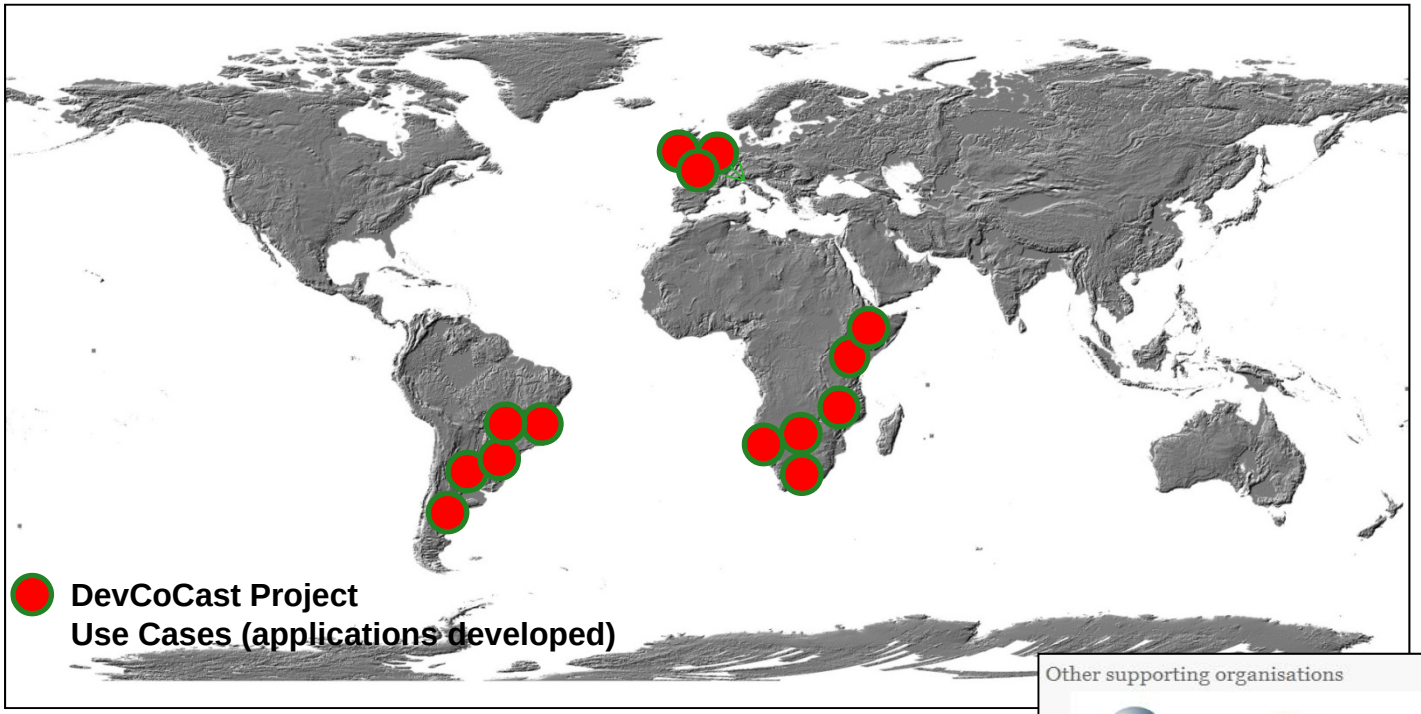
Other supporting organisations

EUMETSAT GEONETCast GEO SEVENTH FRAMEWORK PROGRAMME

Large Project consortium led by vito

ITC Capacity Building

- First large project using GEONETCast and ITC GEONETCast Toolbox Concept
- GNC station setups and data hubs for third party data streams
- Applications were successfully developed by Users in Africa & Latin America
- Accessible in open source also as training use cases on www.itc.nl/



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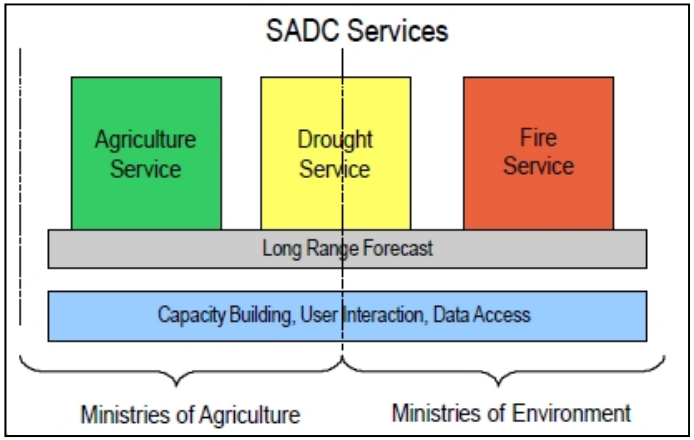
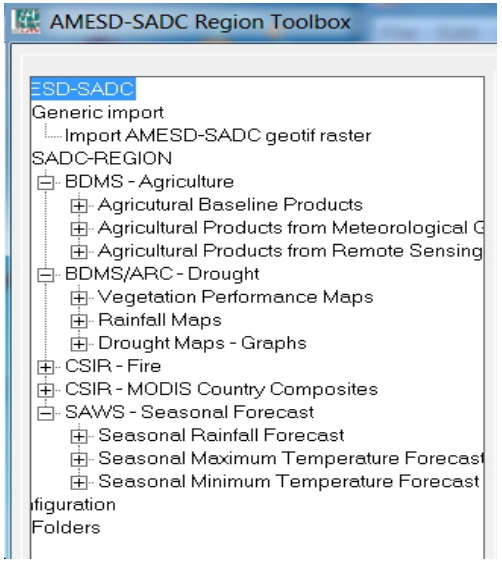
Other supporting organisations

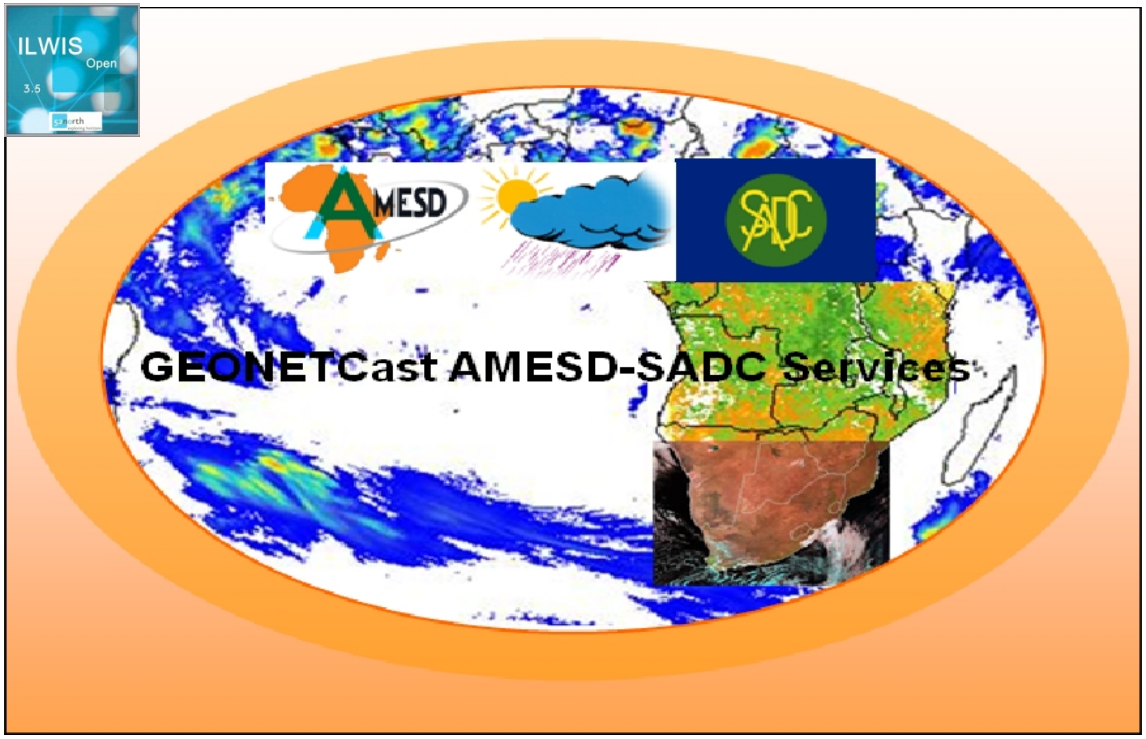
EUMETSAT GEONETCast GEO SEVENTH FRAMEWORK PROGRAMME

African Monitoring of the Environment for Sustainable Development (AMESD)



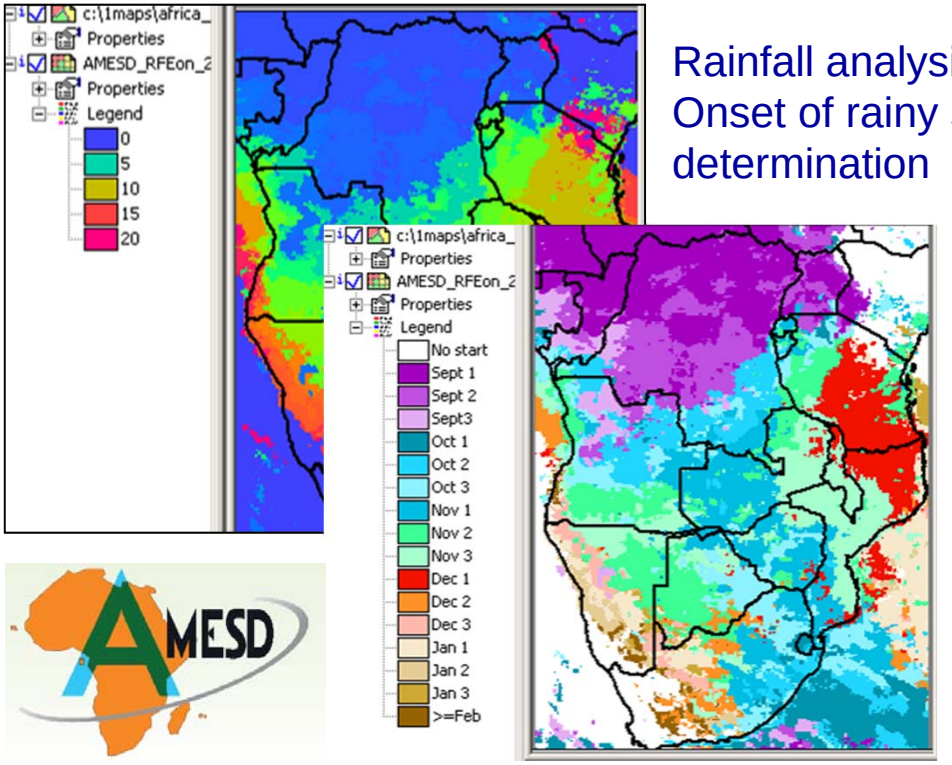
- Dedicated GEONETCast Toolbox for SADC Earth Observation Services in ILWIS Open
- Developed by SADC project & education partners: BDMS, CSIR, ARC, UZ, UB, BCA, ITC
- Data products disseminated via EUMETCast





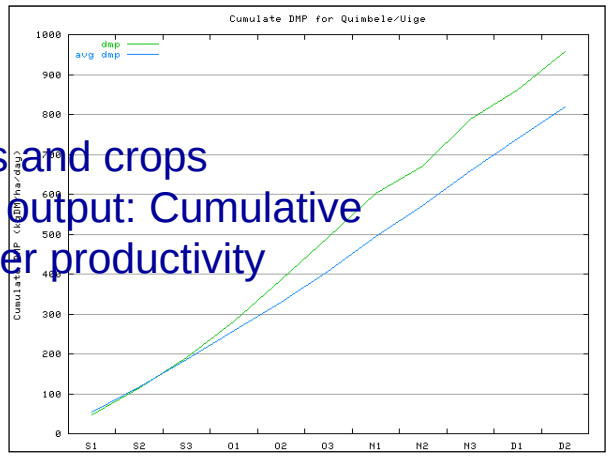
AMESD-SADC GNC TOOLBOX: SNAPSHOTS

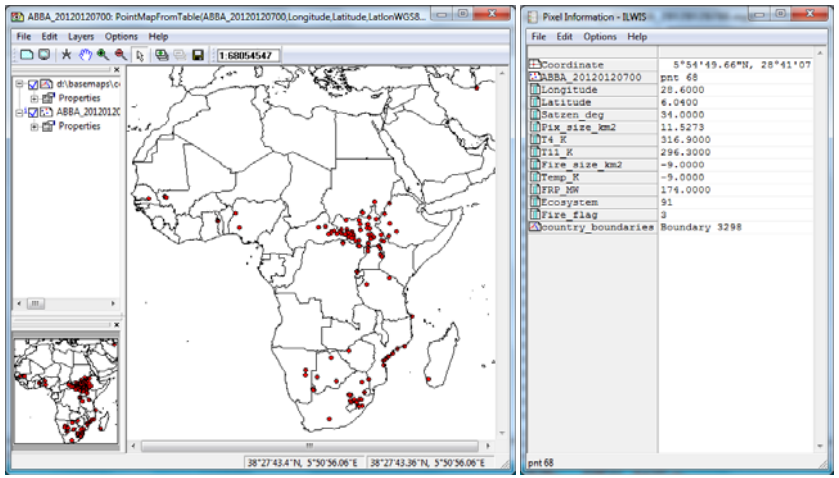
AN ILWIS OPEN V.3.72 PLUG-IN



Rainfall analysis and Onset of rainy season determination

Biomass and crops Graphic output: Cumulative dry matter productivity





ABBA-MSG fire incidence

Training opportunities (end 2012) using Distance Education by our SADC partners UZ, UB & BCA using the ITC digital BB environment

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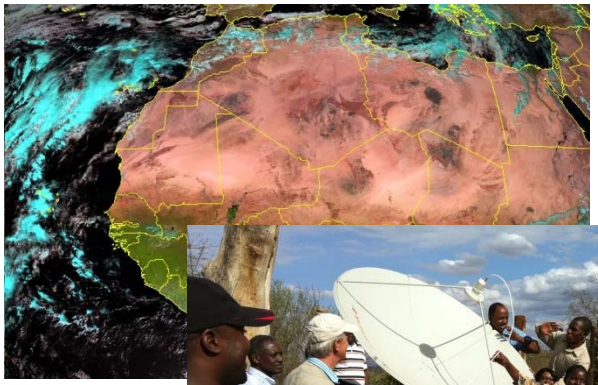
ITC GEONETCAST TOOLBOX IN THE EU FP7 AGRICAB PROJECT

REGIONAL AFRICA TRAININGS: NAIROBI & OUAGADOUGOU 2012 WORKSHOPS

- Training workshops incl. on-location station setup and near real time data use
- Pic 1: Ouaga antenna and laptop receiving system & portable 2GB data disk

-> smallest and cheapest mini-configuration of an operational GEONETCast data reception, image analysis & application development system

- Pic 2: System setup demo in Tsavo National Park, Kenya



AGRICAB
Africa Platform for knowledge sharing on Earth Observation, Forest and Agriculture

GEONETCAST SERVICES FOR FOOD SECURITY EARLY WARNING - ETHIOPIA

- ITC cooperation with Government of Ethiopia and WFP: Early Warning for Food Security to support their Livelihood Early Assessment & Protection program
- Use of GEONETCast satellite and *in-situ* data reception and analysis systems and GNC Toolbox open source software technologies
- Focus: capacity development (training) & research
- Partners:

GEONETCast
Delivering Environmental Data to Users Worldwide

MOArD/DRMFSS Disaster Risk Management Food Security Sector Agency

NMA | National Meteorological Agency
Federal Democratic Republic of ETHIOPIA

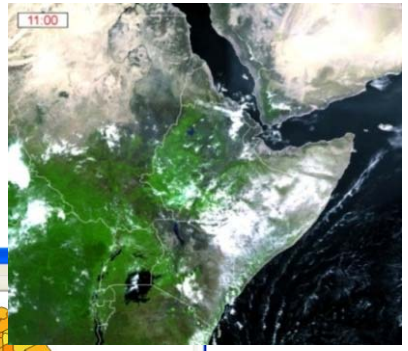
WFP
wfp.org

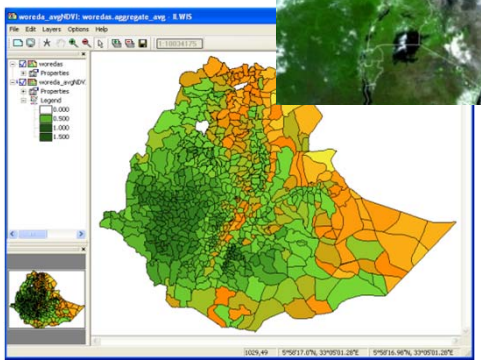
UN World Food Program
Country Office Ethiopia

ITC

Department of Water Resources

Faculty of Geo-Information Science and Earth Observation



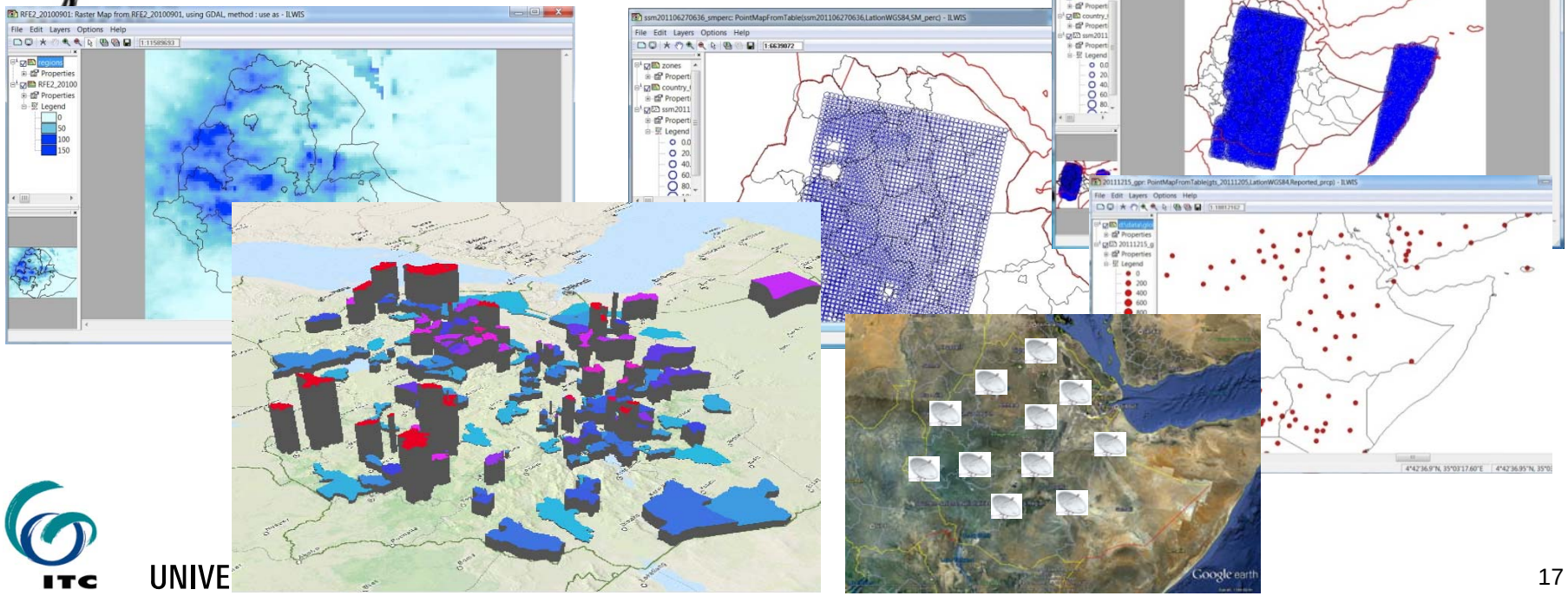


World Food Programme of the United Nations
The World Bank
The Federal Government of Ethiopia
The Livelihoods Integration Unit (LIU) supported by USAID

SOME WFS-ETHIOPIA PROJECT OUTPUTS : GEONETCAST & *IN-SITU* DATA FOR FOOD SECURITY EARLY WARNING

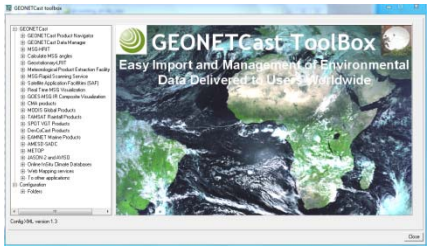
GEONETCAST4WFS PROJECT OUTPUTS (ITC-DRMFSS-NMA-WFP)

- Satellite rainfall MSGMPE, TAMSAT,
- Surface soil moisture indices e.g. Metop/ASCAT
- actual evapotranspiration estimates (LSA-SAF AET) & in-situ NMA
- vegetation indices (e.g. NDVI SPOTVGT, MSG, FVC, fAPAR,
- To compute crop water requirement & crop yield reduction (YR)
- affected population # early warning at district level scale



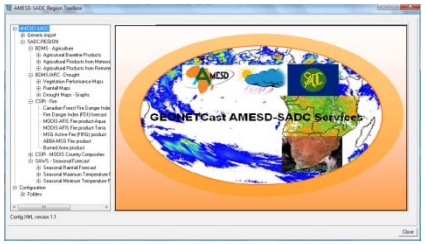
DEVELOP YOUR OWN EARTH OBSERVATORY APPLICATION

DESIGN YOUR OWN DEDICATED GEONETCAST TOOLBOX

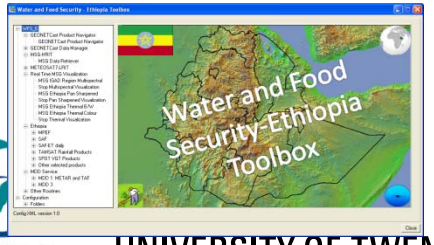


Standard GEONETCast Toolbox v.1.3 -> generic & global application
Import of Geostationary Constellation: MSG-1,2, MET-7, GOES-E/W, FY-2D/E, MTSAT
Import of Polar Orbiting satellites: EPS/METOP-a, NOAA -series, JASON-2,..
EUMETSAT MPEF and Satellite Application Facilities (SAF) data e.g. LSA-SAF
3th party Data: NOAA, CMA , INPE-CPTEC, MODIS products, SPOT Vegetation, DevCoCast
Real time MSG visualization. calculation of solar and MSG zenith and azimuth angles,…

In-situ & Online Data Toolbox v.1.0 -> generic & global data
Direct import of data from *internet* online archives related to *in-situ* climatological observations, gauge and satellite derived rainfall estimates, weather forecasts, normalized difference vegetation indices and elevation information. Examples: GSOD, GLDAS, ERA-I, GPR, CMORPH, FEWSNET,..

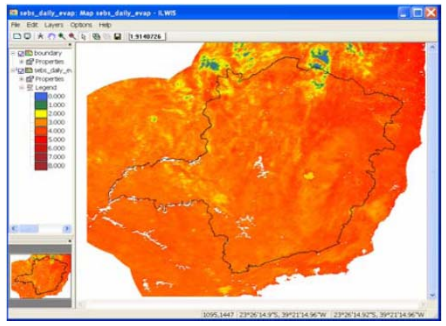


AMESD SADC project Toolbox -> regional Southern African countries
Import and pre-processing of all products disseminated by the AMESD-SADC program related to agriculture, drought, fire and long range forecasting.
Developed together with AMESD-SADC Regional Implementation Centre, Botswana Department of Meteorological Services (BDMS).



Early Warning for Water & Food Security -> project Toolbox for country
Import and processing of data from GEONETCast for water and food security monitoring in Ethiopia, like MPEF, SAF, VGT, TAMSAT and fire products, real time visualization, surface soil moisture and WMO GTS MDD service. Developed together with National Meteorological Agency, Ministry of Agriculture and UN-WFP Ethiopia.

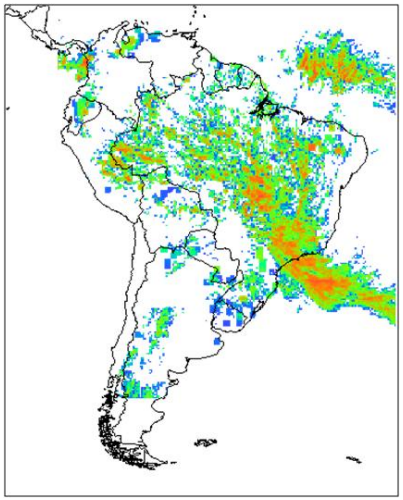
ITC GEONETCAST TOOLBOX USE AND DEVELOPMENT IN LATIN AMERICA



- Several users in Brazil, Argentina, Bolivia, Colombia and regional partners (ps. Ilwis is quite known in LAm)
- Using synergies in open source RS/GIS software development for GEO with e.g. INPE (TerraLib), LAPIS, see also current EU FP7 AgriCAB project
- A number of successful applications from the DEVCOCAST project, available (in En or Sp, Pt) at

  http://www.itc.nl/Pub/WRS/WRS-GEONETCast
  DevCoCast Application Manual

- New (PhD) research cooperations on-going e.g. in Amazon basin (Hydropower reservoirs), Minas Gerais (sugar cane monitoring), etc.



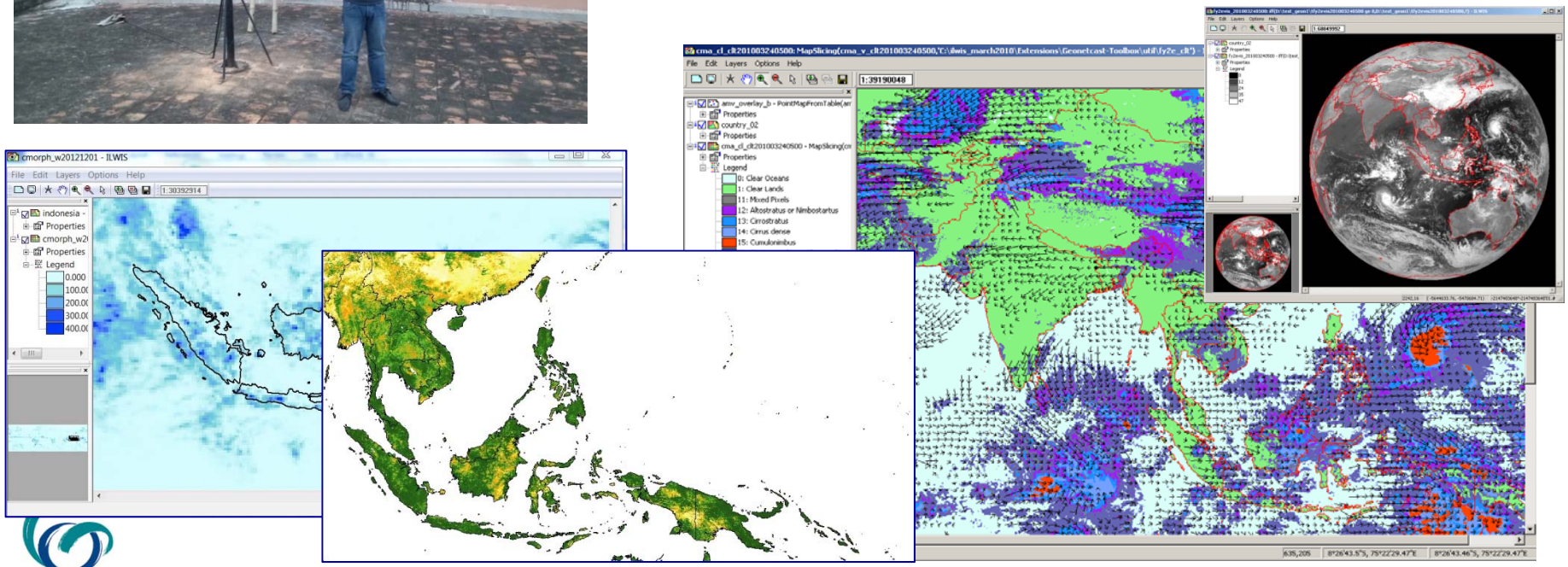
Other supporting organisations

EUMETSAT GEONETCast GEO SEVENTH FRAMEWORK PROGRAMME

ITC GEONETCAST TOOLBOX USE IN SE ASIA

USE OF GEOSS CONSTELLATION FROM EUMETCAST AND/OR CMACAST

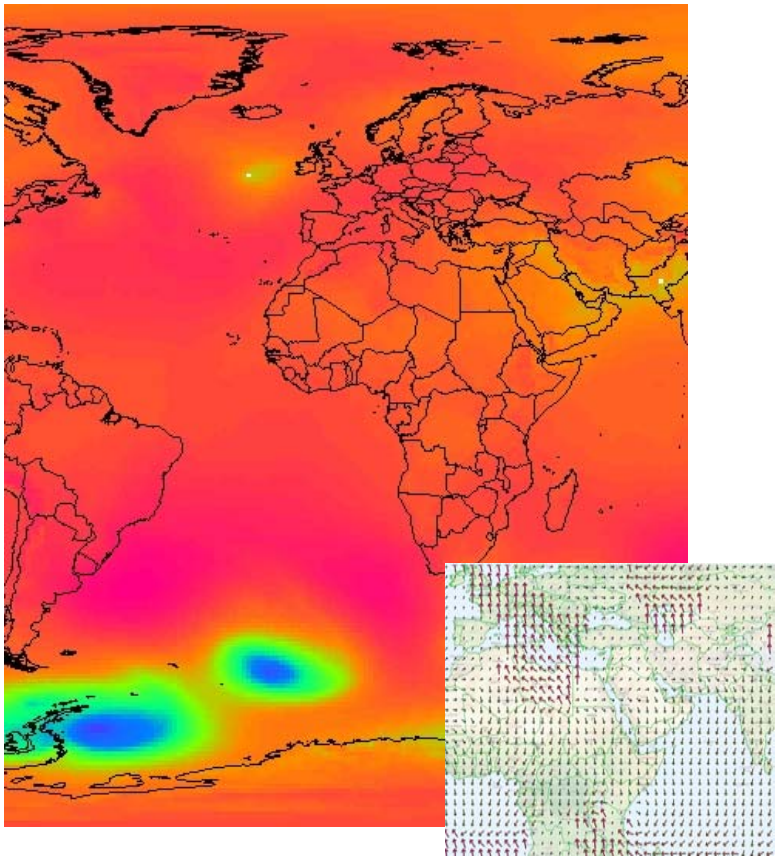
Global data access incl. Asian geostationary satellites:
FY-2D, FY-2E, MTSAT2, polar orbiters EPS-METOP, NOAA,...
- Bandung Water Resources workshop, RI 2010
- Hanoi WRS University System setup, VNM 2012
- ITC (Enschede) training course for BMKG
Indonesian Meteorological Agency, Jan-Feb 2013



NEW DEVELOPMENTS: METEOROLOGICAL SERVICE, WEATHER AND CLIMATE TOOLS

DEDICATED TOOLS FOR WMO GTS USERS

Example: MDD3 MSL H98 import

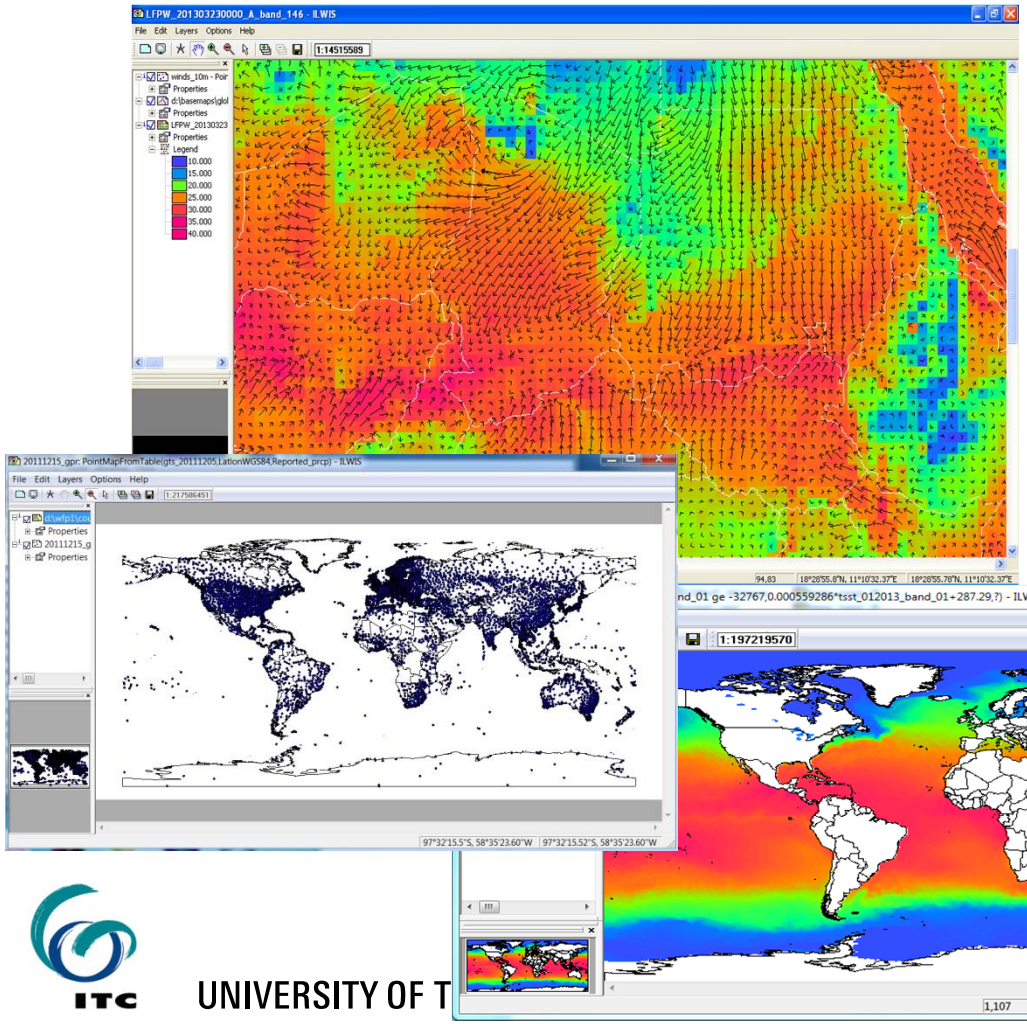


- Dedicated Toolbox for NMHS - agencies
- Full meteorological satellite data stream and products access:
  - MSG-2, METEOSAT-7, MET-8,9,10
  - Foreign satellites: GOES, MTSAT, FY-2D/E
  - EPS: Metop-A/B, JASON-2,…
  - MPEF and SAF data and products
  - Third party GNC data SPOT-VGT, CPTEC/INPE,…
- GTS – MDD text message and data visualization
  - SYNOPS, METAR, TAF…
  - Imports of MDD1, MDD3,…
- 3D (4D) visualizations (early 2013 with ILWIS 3.8.3)

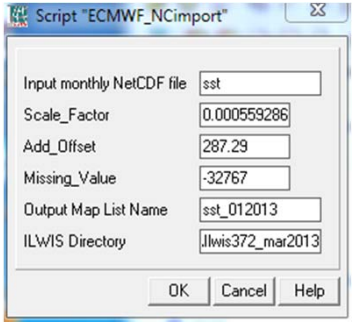
** Prototype under testing in WFS-Ethiopia Project*

METEOROLOGICAL SERVICES, WEATHER AND CLIMATE COMMUNITY TOOLS

GLOBAL WEATHER PREDICTION MODEL AND CLIMATE DATA



- Direct imports of GTS MDD, Weather prediction model forecasts e.g. *Arpege* model forecast (France)
- Global weather data (real time)
- Climate data sets (long term) such as ECMWF ERA-Interim, NOAA GLDAS imports
- Direct reads of BUFR, GRIB and netCDF formats using open ILWIS script language

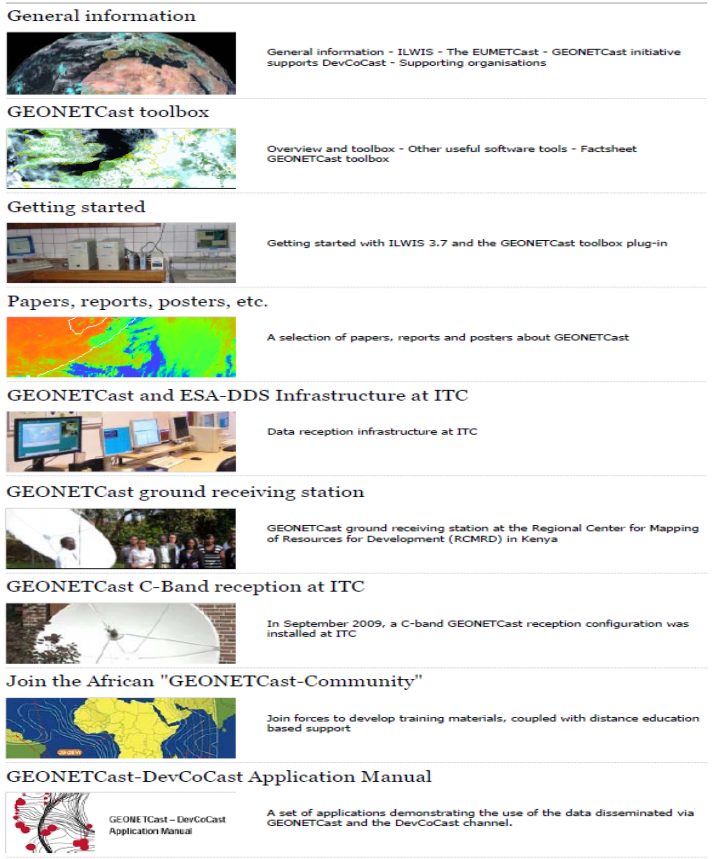


OPEN ACCESS USER RESOURCES for Capacity Development and Research @

- **Software portal**: @ 52NORTH (OS consortium partner)
  - Software to handle and process the EUMETCast and GEONETCast data received is freely available through the ***Earth Observation*** **Community** @ (**http://52north.org**).
- **Capacity development portal**: @ ITC
  - Further information, hands on exercises, sample data

  http://www.itc.nl/Pub/WRS/WRS-GEONETCast)
- Registered components of **GEO**

  -> GEOSS Common Infrastructure



SUMMARY & ROAD AHEAD

- Fast access to satellite and *in-situ* data via the EUMETCast - GEONETCast system, combined with Open Source technologies and scientific cooperation, foster uptake of GEOSS concepts and design of satellite applications by users in Europe, Africa, the Americas and Asia.
- Strong interest and commitment from academia and universities and others institutions with climate a/o natural resources monitoring mission.
- Increasing interest by national operational authorities e.g. National Met Services, government agencies, NGO's (see project case of Ethiopia).
- Growing user network and new applications are invented by the community
- Cont'd use in current and upcoming EU FP7 (& other) projects, development of user toolboxes for more GEOSS SBA's.

UNIVERSITY OF TWENTE.

Thank you and for further information, contact us @ www.itc.nl or Utwente

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