MULTI-SENSOR IMAGE ANALYSIS OF AFRICAN LAND AND WATER SURFACES USING THE BEAM TOOLBOX

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1. INTRODUCTION

The BEAM project was started by ESA in 2002 with the aim to support users of Envisat MERIS and AATSR data with a set of dedicated software tools, free of charge, user friendly and easy to use. The tools comprise the desktop imaging application VISAT, a set of data processors and a rich and powerful application programming interface (API) [1]. BEAM has a modular, plug-in based architecture and its API allows developing extensions for a number of possible extension points. Thanks to its open API, BEAM is no longer restricted to Envisat data but currently supports a wide range of file formats used in optical remote sensing. This paper describes the application of BEAM for the analysis of African land and water surfaces, using image data from various optical sensors.

2. THE BEAM TOOLBOX

2.1. Supported sensors and data formats

Instrument	Platform	Format
MERIS	Envisat	Envisat N1
MERIS Binned Level-3	Envisat	netCDF
AATSR	Envisat	Envisat N1
ASAR	Envisat	Envisat N1
ATSR	ERS	ERS
ATSR	ERS	Envisat N1
SAR	ERS	Envisat N1
Chris	Proba	HDF4
AVNIR-2	ALOS	CEOS
PRISM	ALOS	CEOS
MODIS land and atmosphere	Aqua, Terra	HDF
MODIS, SeaWiFS, OCTS, CZCS	various	NASA Ocean Biology Group (HDF)
AVHRR/3	NOAA-KLM	NOAA METOP
TM Thematic Mapper	Landsat 5	Fast Format
GETASSE DEM	N/A	

Generic readers are available for NetCDF and GeoTIFF.

2.2. VISAT

VISAT is an interactive image visualization and analysis tool. As a general concept, VISAT is always applying the calibration information that is available in the data products and the user works in geophysical units rather than digital numbers. The visualization functions allow fast and easy display of single bands, RGBs, comparison of images (linking) etc. A band arithmetic function provides powerful means to apply mathematical operations to one or more bands. Statistical analysis can be applied to either the full image of regions of interest. Pins, transects and other tools are available to further inspect images, spectral reflectances/radiances can be displayed in a comfortable way.

2.3. Scientific Processors

Scientific processors are tools that take one or more products as input and generate a new output product by applying a specific algorithm. BEAM includes several processors, all of them important for the analysis of land and water surfaces. Amongst others, this includes atmospheric correction over coastal and inland waters, retrieval of water constituents, cloud detection, atmospheric correction over land and retrieval of land bio-physical parameters. The processors can be run interactively or in batch-mode.

The BEAM application programming interface allows users to implement their own scientific processors, to modify existing processors, and even extend the VISAT image analysis tool.

2.4. Availability and future plans

BEAM and demon data are available free of charge under the GNU Public License from the ESA Website (envisat.esa.int/resources/softwaretools/). CD ROM Versions are produced for special occasions, such as ENVISAT Conferences. ESA considers BEAM as a long term activity; an evolutionary maintenance contract is in place to keep the tool up to date, and to extend its capabilities according to user needs.

3. APPLICATION TO AFRICAN IMAGE DATA

3.1. Coastal Waters

The coastline of Africa extends over 30,500 km; the coastal waters include the temperate Mediterranean Sea, tropical waters as well as the northern part of the Antarctic circumpolar current. Famous are the upwelling areas of the North Equatorial current off Mauretania, and of the Benguela current at the coast of Namibia. BEAM includes two scientific processors to perform an atmospheric correction and retrieve inherent optical properties and water constituents in coastal waters [2]. We will briefly introduce and demonstrate these processors.

3.2. Lakes

The Great Lakes of Africa are a series of lakes in and around the geographic Great Rift Valley formed by the action of the tectonic East African Rift. They include Lake Victoria, the second largest fresh water lake in the world in terms of surface area, and Lake Tanganyika, the world's second largest in volume as well as the second deepest. BEAM includes two processors for atmospheric correction and retrieval of water constituents of inland waters, for eutrophic and for highly absorbing waters. We will demonstrate the application of the eutrophic lakes processor to Lake Victoria, including the comparison with in-situ measurements.

3.3. Land Classification

Even though this session is dedicated to waters, we will briefly demonstrate classification techniques, available in VISAT, to various land cover types in Africa, using MERIS, Chris Proba and ALOS AVNIR data.

4. REFERENCES

[1] Fomferra, N., Regner P., Brockmann, C.: New BEAM Developments. MERIS-AATSR Workshop, ESRIN, Frascati Italy. European Space Agency, Proceedings. September 2008

[2] Kratzer, S., Brockmann, C. and Moore, G.: Using MERIS full resolution data to monitor coastal waters– a case study from Himmerfjärden, a fjord-like bay in the northwestern Baltic Sea. Remote Sensing Environment 112(5): 198-199. 2008.