



## **‘San Marco’ Italian Space Centre in Malindi (Kenya) and its Contribution to Sustainable Development for Africa**

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## Premise 1/2

- Various studies associate unsustainable development with **environmental degradation** resulting from deforestation, soil erosion and loss of biodiversity.
- On the other hand, findings of several studies identify the **lack of access to safe water supply** as one of the most imperative causes of food insecurity.
- Today there is little controversy regarding the contribution of science and technology to the solution of these problems.
- However, are **space science and technology** able to play a relevant role in ensuring food security and sustainable development?
- We have the challenge to give an answer to this question and the Italian Space Agency is aware of this responsibility.
- After some necessary introduction, the following presentation tries to expose our programs regarding just these two critical goals:  
**Environmental degradation and Access to safe water.**

## Premise 2/2

**Italy and Kenya have been co-operating since 1964 in the San Marco Project, with the development of a Space Centre in Malindi (Kenya), called “Broglia Space Centre” (BSC).**

- ❖ During the last months, ASI has been revising and improving the Remote Sensing activities carried out at the BSC.
- ❖ This with the intent and aspiration to develop more and more BSC into a Remote Sensing Space Centre serving the Region.

A description of ongoing and planned activities follows

## Background (1/4)

- ❖ The facility was established in 1964, managed by the University of Rome “La Sapienza” until 2004. Since then, the management has been transferred to the Italian Space Agency – ASI.
- ❖ In 1995 an agreement between Italy and Kenya has renewed the bilateral cooperation concerning the Satellite Tracking and Launching Station at the BSC in Malindi.
- ❖ Activities at BSC during the past 40 years span from rocket launches to satellite Telemetry, Tracking and Command support and Remote Sensing image acquisition. A Remote Sensing Centre (RSC) is active at BSC to acquire, pre-process, archive and distribute EO satellite data.

## Background (2/4)

The BSC is located at 3° South and 40° East, by the sea near Malindi, in Kenya



An ideal location to launch and support equatorial satellites

## Background (3/4)

The San Marco Base is composed by two parts:



**Sea Segment**



**Land Segment**



## Background (4/4)

The Sea Segment is dedicated to orbital and suborbital launches for scientific payloads and satellites from the off-shore platforms

Number of launches performed: 27 (9 satellites): 100% success

- LV: Scout; Nike; SuperARCAS; ASTROBeed
- First launch: March 1964 - Nike Apache
- Last launch: March 1988 – SCOUT SV 206 – San Marco D/L

The Land Segment supports launches and the other BSC activities.

On a 35.000 sq m area are located:

- 3 Ground Stations for Satellite Data Acquisition
- **Remote Sensing Centre**
- **Meeting and Training Centre**
- Logistic Facilities

## Remote Sensing facilities and activities (1/5)

RS activities started in 1997 with the acquisition of ERS-1 SAR.

The area covered by the acquisition circle has a radius of about 2,000 Km for a typical EO satellite altitude.

This allows the acquisition of satellite images covering all the East and Central African countries including the islands in the Western Indian Ocean region (WIO).



Images regularly acquired at BSC include MODIS/Terra, MODIS/Aqua, SAR/Ers-2, AVHRR/NOAA and SeaWiFS/SeaStar

## Remote Sensing facilities and activities (2/5)



The Remote Sensing Centre at the BSC acquires EO satellite images both in L-band and in X-band. An average of 12 to 15 images per day are acquired from different sensors, processed and archived. The 6.2 m antenna in X-band is used to acquire MODIS/Terra and MODIS/Aqua

## Remote Sensing facilities and activities (3/5)



The L-band system hosted at BSC Remote Sensing Centre, used to acquire NOAA/AVHRR and SeaStar/SeaWiFS

## Remote Sensing facilities and activities (4/5)

**All data present at the RSC, including satellite imagery, is available for free to the Kenyan research community and other governmental agencies.**

Satellite data very valuable to ocean applications is available at the BSC and used by the Kenya Marine and Fisheries Research Institute (KMFRI)

Data from the BSC has also been used by other researchers in assessing desertification hot spots in the Northern frontier districts in Kenya, or in studying and tackling the Lake Victoria water hyacinth issue.

**Interested researchers from institutions in the region may access this data through partnership with the local research communities, or seek authorization from the Kenya Government**

## Remote Sensing facilities and activities (5/5)



Activities at the Geophysical Station started in 1999 with a regular balloon atmospheric sounding.

**Balloons, filled with helium, are released in the atmosphere measuring the ozone content, pressure, temperature and humidity during their ascent that usually reaches around 35 Km.**

**Data acquired locally are compared with those obtained at Kenya Meteorological Department station in Nairobi.**

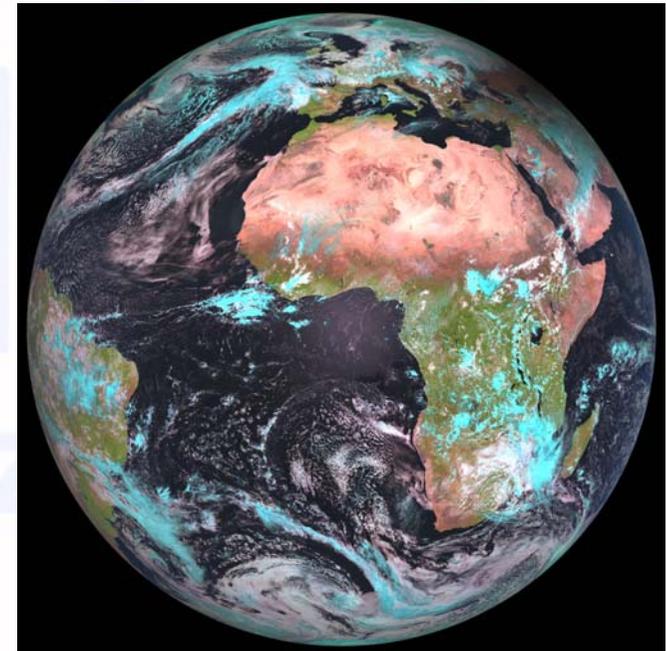
**BSC is part of the international project SHADOZ (Southern Hemisphere Additional Ozonesondes) that gathers ozone atmospheric data from a network of facilities distributed all around the world**

## Sustainable development: Remote Sensing applications (1/4)

### Against the **environmental degradation**: 2 applications

**1.** The Hot-Spot Detection System (HSDS) based on Meteo Sat second generation (MSG) images, devoted to the **early detection of wild fires** in the region.

The operational activation of this service for the Central and East Africa region is foreseen at the mid year 2007.



An example of an RGB composite image obtained with channels 3,2,1 of MSG/SEVIRI.

## Sustainable development: Remote Sensing applications (2/4)

2. Another RS application against **environmental degradation** regards the **detection of oil spill**.

Based on ERS2/SAR images, the system is already operational at the ASI Matera Centre for the Mediterranean Sea and will be soon transferred to BSC.

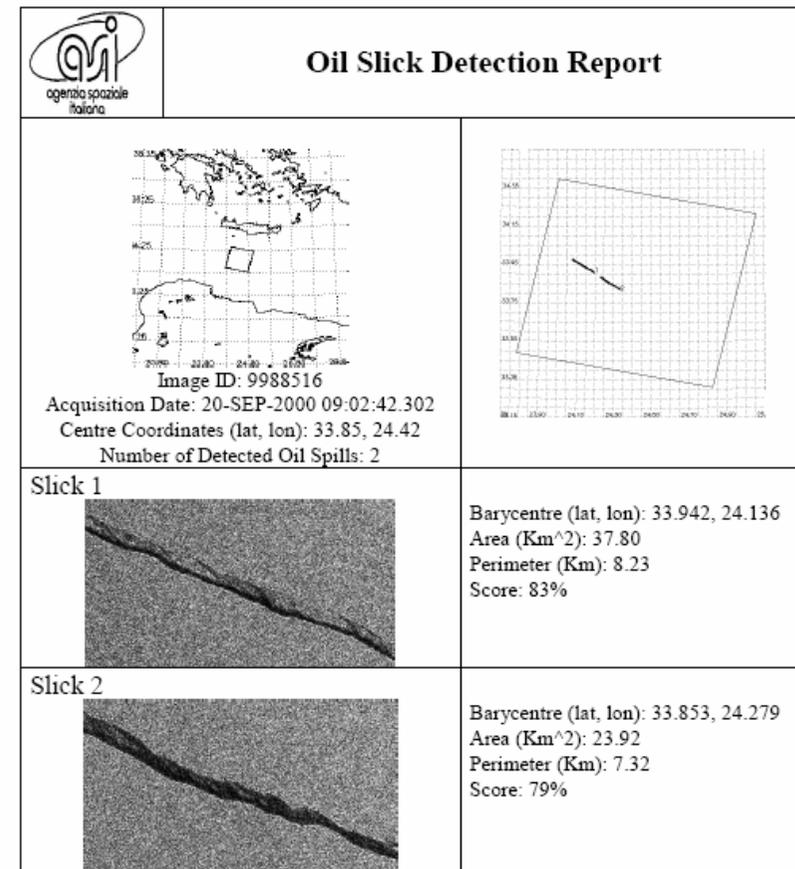


Fig. 1 Geographical localisation of a detected oil spill and related information.

## Sustainable development: Remote Sensing applications (3/4)

### **Future activity:** Land management

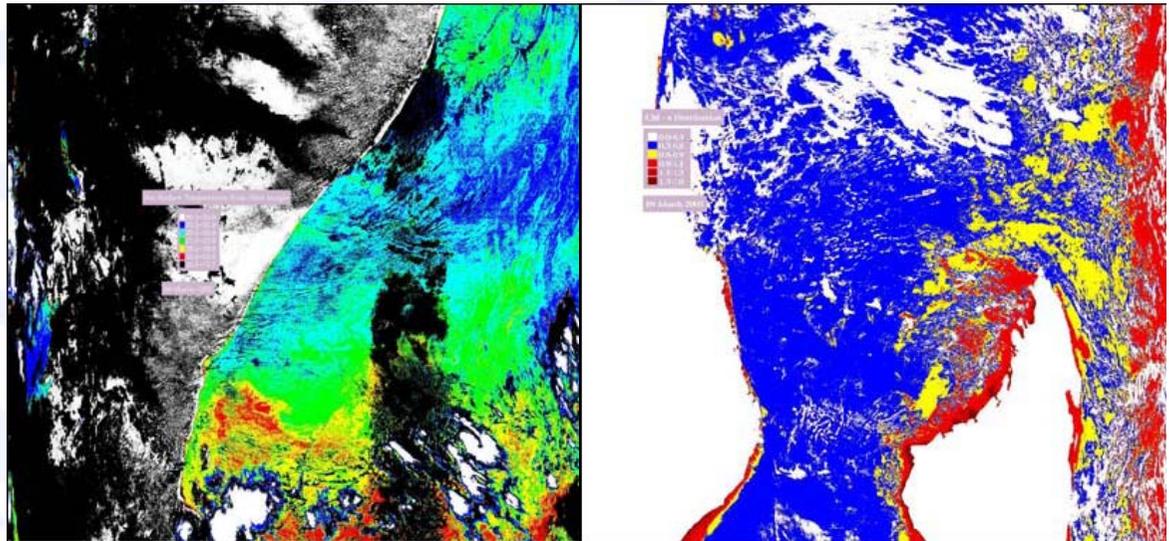
Low resolution satellite data, e.g. SEVIRI, MODIS, AVHRR, will be useful to make recommendations for appropriate and effective interventions for sustainable land management in the region (e.g. vegetation coverage).

## Sustainable development: Remote Sensing applications (4/4)

### 1. Sustainable fishing activity

Monitoring of sea colour and surface temperature change using a combination of AVHRR and SeaWiFS images is suitable to make an assessment of biomass (phytoplankton) and temperature gradients. This combination in fact is favourable for Tuna and tuna-like fish gathering.

### In favour of food security: 2 initiatives



This work has been carried out, in the recent past, in cooperation with KMFRI and will be further developed so to implement a regular service to the local community for a sustainable fishing activity.

## Sustainable development: Technology Transfer

### 2. Access to safe water supply

- A very promising activity regards an assessment study of a radar sounder, named **SORATTE (SOunding Radar AeroTrasportato TERrestre)**
- It will be based and make use of the experience gained in the development of the MARSIS (ESA - Mars Express) and SHARAD (NASA – Mars Reconnaissance Orbiter) sensors for the discovery of underground water on Mars.
- SORATTE will be devoted to the detection of underground water in arid and semi-arid regions of Africa.
- It will fly over the arid area on board a simple aeroplane.
- The research will also study the geological and socio-economic sustainability of the project.

### Future Activity: Crop forecasting

Low resolution satellite images and other ancillary data (precipitation and temperature data, climatic map, land use map, etc.), will be used to set up a system devoted to crop forecasting in East Africa region.

## Sustainable development: Training on RS applications 1/2

Several courses have so far been organized at the BSC by the University of Roma “La Sapienza” with participants drawn from the local universities, research institutions and Kenya government departments.



Italian Universities are also involved to guarantee adequate training and study cycles, so that students from the region have a platform and environment to develop their theses, post graduate studies and access to advanced technology and knowledge.

## Sustainable development: Training on RS applications 2/2

### Capacity-building and technology transfer

- 29 Kenyan students have completed educational programs (5 Ph.D. and 1 engineering degree at the University of Rome, 23 technologists trained at the BSC)
- 11 Kenyan students will be coming to Italian Universities in the next future.
- BSC is open to share its expertise and experience to support courses organized, by
  - the European Commission Joint Research Centre
  - the European Space Agency

### As Regional Centre for Space-based information for Disaster Management, ASI plans to develop:

- implementation of expertise in use of space technology in disaster management
- access to space-based information relevant to disaster management

## Cooperation and Partners

Various local and regional institutions have shown interest in cooperating with the BSC satellite receiving station to utilize and add value to the data available.

Currently, negotiations are going on with the following institutions:

### Kenyan

- Department of Resource Survey and Remote Sensing (DRSRS)
- Department of Meteorology at the School of Physical Sciences, University of Nairobi
- Kenya Marine and Fisheries Research Institute (KMFRI)
- Kenya Meteorological Department (KMD)

### Regional and international

- IGAD Climate Prediction and Applications Centre (ICPAC)
- Intergovernmental Oceanographic Commission (IOC/UNESCO)
- Regional Centre for Mapping of Resources for Development (RCMRD)

## Conclusions

### Space technology for sustainable development is a challenge that ASI accepts

- The BSC offers a unique opportunity to acquire satellite imagery for the Central and East Africa region.
- The presence of the remote sensing facility at BSC and the various space related activities enhance the opportunities for real-time data availability for various applications against environmental degradation and in favour of food security.
- The necessary capacity building training can be provided by the involvement of the Italian Universities.
- The study regarding a radar sounder devoted to the detection of underground water in arid and semi-arid regions of Africa is very promising.
  - **We would be pleased to cooperate with any African country had interest in these projects**

Thank you for your kind attention

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