

Meeting Report

Report on the COSPAR-SANSA Capacity Building Workshop on Land Surface Characterization, Cape Town, South Africa, October 10-21, 2011

by Michel M. Verstraete (EC JRC and CSIR), Bob Scholes (CSIR) and Pierre-Philippe Mathieu (ESA ESRIN)

Over the last few decades, Earth Observation (EO) satellites have been monitoring our climate and environment, thereby enlarging our view on our home planet and revolutionizing our vision on how it operates as a complex, interconnected system. The emergence of consistent, global and long-term (decadal) satellite data records offers researchers considerable insight into the mechanisms that control the climate and its fluctuations, the processes that result in environmental degradations, the causes and consequences of natural hazards, and in general the global 'footprint' of human activities. Nowadays, EO data sets from a variety of missions are also routinely used to support decision-making and better management of our limited natural resources.

However, taking full advantage of these data, whether to advance our scientific understanding or to promote specific applications, remains a challenge. This is particularly true in developing and emerging countries where access to data sets and processing tools, awareness of existing EO capabilities and knowledge on how to turn data into useful information remain limited.

To address this challenge, COSPAR initiated a capacity building programme in 2001. It is conceived as a series of workshops to foster the use of EO data and space science technologies in these countries, specifically to help scientists building lasting bridges with research laboratories around the world. The aim of these workshops is to transfer know-how and expertise as appropriate, to foster contacts and collaborations between colleagues, as well as to facilitate access to state of the art data sets and products.

These workshops typically cover both the theoretical background (through a series of lectures) and practical applications (e.g., through computing, laboratory or field studies) to acquire hands-on experience with actual observations and their proper interpretation. Since 2001 a wide range of workshops have been successfully held in different scientific areas (e.g., X-ray, Gamma-ray and Space Optical and UV Astronomy, Magnetospheric Physics, Space Oceanography, Space Hydrology and Planetary Science) in a number developing countries (e.g., Brazil, India, China, South Africa, Morocco, Romania, Uruguay, Egypt and Malaysia). Initially, it was anticipated that about one such workshop would be organized per year, but the number has more than doubled recently, due to an increasing demand for the transfer of know-how and expertise through dedicated training, in order to build up human capital resources globally.

Such a capacity building workshop was recently organized by the South African National Space Agency (SANSA) and financially supported by COSPAR and SANSA, in Cape Town, South Africa, from October 10 to 21, 2011; see

<http://www.sansa.org.za/sansa--cospar-partnership-for-skillsdevelopment.aspx>.

This event aimed at providing young African scientists already active in remote sensing with an introduction to current, state-of-the art techniques and their applications to characterize land surfaces. The workshop took place on the premises of the Cape Peninsula University of Technology (CPUT) (Figure 1). The US National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL), the European Space Agency (ESA-ESRIN) and the European Commission's Joint Research Centre (JRC) contributed significantly to the workshop by supporting the participation of key international lecturers.

Carlos Gabriel (ESA and COSPAR) and Sandile Malinga (CEO of SANSA) officially opened the event. Michel M. Verstraete (JRC and CSIR) and Bob Scholes (CSIR) led the organization and implementation of the workshop, with the secretarial support of Asanda Ntswana (SANSA) and Tshepiso Sehloho (CSIR). Lecturers included a wide range of international and South African experts, including Michel Verstraete and Bernard Pinty (EC JRC), Linda Hunt (NASA Langley), Olivier Arino and Chris Stewart (ESA ESRIN), Jimmy Adegoke, Bob Scholes and Sally Archibald (CSIR), Wim Hugo (SAEON), Konrad Wessels (Meraka Institute), Wolfgang Luck (U. of Stellenbosch), and Robert Van Zyl (CPUT). Some 22 participants from 11 African countries (Botswana, Egypt, Kenya, Mozambique, Namibia, Nigeria, Rwanda, Senegal, South Africa, Uganda and Zimbabwe), as well as the USA, were selected (out of a list of over 50 applicants) on the basis of their existing competences, the intrinsic value of their research project, as well as their ability to understand course material in English, all the while maintaining a broad diversity of nationalities (Figure 2). At various times during the workshop additional, South African-based researchers attended particular lectures on an *ad hoc* basis.

This 2-week workshop provided a unique opportunity to cover both basic materials (introductions to remote sensing, etc.) as well as more advanced topics (e.g., inversion procedures). Presentations included descriptions of both American sensors (e.g., the Multiangle Imaging SpectroRadiometer (MISR) from NASA's Jet Propulsion Laboratory (JPL): see <http://www-misr.jpl.nasa.gov/>) and European instruments (such as the Medium Resolution Imaging Spectrometer, MERIS, and the Advanced Along-Track Scanning Radiometer (AATSR) on the ESA ENVISAT platform: see <https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/envisat>). Formal lectures were complemented by tutorials and practical sessions when participants got a chance to explore actual remote sensing data sets and exploit tools and techniques developed earlier.

The workshop also included a field trip, on Saturday October 15, 2011, to the Houwteq facility, soon to be incorporated into SANSA. This large industrial site is used to test components, sensors and entire satellites under space-like conditions of heat, vacuum and temperature, as well as the resistance of these items to launch

vibrations. During the afternoon, the participants had a chance to observe Fynbos vegetation in the surrounding area and to discuss the problem of acquiring field data with hand-held instruments.

This capacity building workshop provided the occasion to unveil plans to exploit data generated by MISR at the native spatial resolution of that sensor (275 m). The MISR-HR package, developed and implemented by Michel Verstraete and Linda Hunt with the support of JRC, CSIR and JPL colleagues, takes advantage of state of the art algorithms to describe the anisotropy of land surfaces (using the RPV model) and to characterize the biogeophysical properties of the vegetation and soil (using the JRC-TIP). It has been installed at SANSA and will allow the exploitation of an archive of 12+ years of already accumulated data. In fact, SANSA already acquired a large database of MISR data for the eastern half of the African Continent in 2010 (see <http://www.jpl.nasa.gov/news/news.cfm?release=2010-325>). Plans are under way to transfer the data for the western half of the continent and to initiate the reprocessing in 2012. Products include a quantitative characterization of the anisotropy of the surface, as well as statistical distributions of the Leaf Area Index (LAI), the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), ecosystem and ground albedo, leaf optical properties, etc., in terms of mean (expected) values and associated standard deviations, together with optimal estimates of all radiation fluxes (reflection, transmission and absorption) in the plant canopy and the underlying background. A number of lectures and hands-on laboratories were also dedicated to the forthcoming Sentinel programme of ESA. More information on these missions can be found on <http://www.esa.int/export/esaEO/>.

In preparation for this workshop, Linda Hunt had processed a series of 30 MISR blocks, distributed across the entire African continent (Figure 3), each covering an area on the ground of about 380 km (East-West) by 141 km (North-South). Though the input data and output products for these blocks were too large (about 3 TB) for distribution to all participants, they did have access to those files during the workshop and could use dedicated software to generate maps and extract time series for select places.

Each workshop participant received

- a 500 GB hard disk (gift of ESA) pre-loaded with MERIS, AATSR and ASAR data for Africa
- a 4 GB USB key (gift of SANSA) suitable to download the various presentations made during the workshop

In addition, each participant was invited to work on a project of direct interest and to use the techniques and the remote sensing data made available during the workshop, under the leadership of the lecturers, and to present their projects at the end of the workshop.

In summary, this capacity building workshop provided a unique opportunity for the participants to learn about state of the art remote sensing techniques and to have access to the data and products from current instruments. The learning atmosphere was excellent and the participants commended the benefits of participating in a highly interactive, multi-cultural and inter-disciplinary workshop. They also repeatedly expressed their great appreciation to SANSa and COSPAR, as well as the coordinators and lecturers, for organizing and running this event.

Figure legends:

- 1 The CPUT computer lab where the COSPAR-SANSa workshop took place.
- 2 Group picture of the participants and some of the lecturers on the CPUT campus.
- 3 Google map showing the location of 30 MISR-HR blocks that had been processed in advance of the workshop.