

MONITORING BIODIVERSITY FROM SPACE: THE ESA DIVERSITY PROJECT

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Definition of appropriate benchmarks and indicators as well as the development of monitoring systems are indispensable to assess the progress made to achieve the 2010 Biodiversity Target adopted by the United Nations Convention on Biological Diversity (CBD) in 2002. On the last Conference of the Parties (COP8) the current indicator framework of the CBD has been established listing a provisional list of biodiversity indicators (Decision VIII/15). Earth Observation (EO) from space is considered to make a major contribution to the development and monitoring of these indicators.

The monitoring by EO of several different CBD indicators mainly in the region of Central America was addressed by a group of NGOs, UNESCO, the CBD secretary supported by the European Space Agency (ESA) and a team of European institutions.

The DIVERSITY project, funded by ESA through its Data User Element (DUE) program, demonstrates the contribution of EO to monitor the trends and status of different marine and terrestrial ecosystems relevant to biodiversity. DIVERSITY thus aims at studying, defining, and assessing geo-information services based on EO technology for supporting the user community involved in the implementation of the CBD.

The project is carried out in collaboration with the CBD Secretariat and UNESCO representing the international community. It mainly address the information needs of the CCAD (as an intergovernmental organization) and MarViva (an NGO working in the field of environmental management and conservation). During the project, a number of information services were developed, implemented, validated and demonstrated through the service cases described below:

Global EO-derived biodiversity indicators to support the CBD 2010 Biodiversity Target

According to the CBD, 47% of the land surface of the Earth constitutes drylands. Home to a richness of biological diversity, they are also central to the livelihoods of almost 2 billion people. Dryland ecosystems receive very erratic rainfall, and as a result are very fragile. Biodiversity in these ecosystems is under threat from a variety of human activities. The transformation of habitats for human use, mostly agricultural as well as increases in overexploitation, including overgrazing, has led to the degradation of up to 20 % of dryland ecosystems – with stark results: desertification and drought, the endangerment of many species and strong economic losses.

As a result, the objective of this service is to support the CBD with an up-to-date map on the extent of drylands (dry and sub-humid lands) at global level and their changes. The product will be a status map of worldwide drylands as well as a trend of their changes over the past 13 years (1993 to 2005).

Coral Reef Mapping

Coral reefs are one of the most biodiverse ecosystems on the Earth. In the same time coral reef ecosystems are very sensitive to natural, anthropogenic and climatic pressures. In fact coral reef bleaching is considered as an climate change indicator as corals are sensitive to sea temperature rise. Thus there is a need for regional to global monitoring of the status of coral reef systems, in particular coral bleaching. Satellite EO data can improve significantly the effectiveness of coral monitoring due to the remoteness of coral reefs and

transient nature of bleaching events. The coral reef mapping component of DIVERSITY provides regional habitat level maps of coral reef areas in the Mesoamerican area based on MERIS SPOT data for hotspot sites... Region-wide maps are produced for 2007 and early 2005, prior to a significant coral bleaching event in the Caribbean which occurred due to elevated surface temperatures in the second half of 2005. Additionally an ocean water quality and algae bloom monitoring service is implemented based on satellite EO data to be integrated with other information for studies of the Mesoamerican Coral Reef in the Caribbean Sea. The service includes information about chlorophyll-a, sediments, dissolved organic compounds (DOC), turbidity, sea surface temperature (SST), and surface current expressions.

Integrity of Ecosystems: Forests and Mangroves

The seven Mesoamerican nations occupy a mere 0.51% of the planet's surface, but around 9% of the world's biological richness is concentrated in this region. For the 1980s, it was estimated that the region was losing 2.1% of its forests annually, one of the highest deforestation rates in the world. Accounting for this fact, Mesoamerican countries agreed on the foundation of the "Mesoamerican Biological Corridor" (MBC) to increase the sustainable development within the region. As a solid basis for planning, developing and surveying the MBC and the progress of its implementation, an adequate information base is necessary.

Within the DIVERSITY project regional land cover maps are produced for the years 2000 and 2007 covering the complete MBC based on MERIS data. Based on these maps the status and change in forest fragmentation is derived, which represents an important biodiversity indicator for ecosystem integrity.

A similar study has been performed on the change on status of mangroves based on Synthetic Aperture Radar (SAR) data from the ERS sensors for two different areas in Mesoamerica. Mangrove forests are an integral part of the coastal environment but they are put at increasing risk through the consequent growth of intensively operated shrimp farms as well as by water pollution.

Trends in distribution of species: Wildlife migration

Understanding how marine animals use the oceanic environment and its constraints is crucial for the development of sound management strategies for marine ecosystems that are threatened by climate change and direct anthropogenic pressure. This could not be achieved without the detailed observation of free-ranging organisms, which is now possible through the electronic tagging of individuals supported by satellite EO data. Tracks of marine animals in the wild are of prime interest not only to identify habitats and high-risk areas, but also to gain detailed information about the behaviour of these animals. Using satellite EO data jointly with hammerhead shark tracking data allowed studying how the shark movements, and in particular the timing and route of its migrations), are linked to ocean conditions.

The wildlife migration service developed in DIVERSITY relies on near-real-time satellite-derived maps of oceanographic conditions (sea surface temperature, water quality, surface current) in the Tropical East Pacific Corridor (TEPC) area. The different EO products are derived using results from the current ESA's Medspiration and GlobColour projects. The relations between the observed animal movements and EO data of oceanic conditions are analyzed to find the oceanic parameters that trigger, constrain or facilitate the sharks' migrations.