

## The POSTEL Land Surface Thematic Center

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*ABSTRACT- POSTEL is a thematic centre associating R&D and services aiming at the description of the soil and vegetation from Earth Observation satellite data, at regional and global scales. It provides free of charge biogeophysical vegetation, radiation and water variables to the international science community through its Web site at <http://postel.mediasfrance.org>.*

### 1 INTRODUCTION

The aim of the POSTEL thematic centre is to federate scientific expertise and to pool the means to be implemented in order to produce validated maps of surface variables derived from Earth Observation satellite data. Within POSTEL, the main concern is the development and adaptation of scientific results for the purpose of creating operational services of data provision for the users. The thematic centre intends to become an element of the future services of the GMES (Global Monitoring for the Environment and Security) European programme to be implemented in 2008 and beyond.

The role of POSTEL is to transform the images acquired by remote sensing earth observation satellites in spatially distributed indicators describing land surface soil and vegetation properties. These indicators, called "biogeophysical variables", describe for example the vegetal cover fraction, burnt areas, the soil moisture content, the albedo, and the surface temperature.

These biogeophysical variables are useful to the development of knowledge in the field of meteorological and environmental sciences, to

understand the climatic machinery, ecophysiological processes, and surface hydrology.

They are also useful as input to environmental services that use these data, at the same time as other data types (in-situ, agrometeorological models, etc) to produce environment monitoring indicators (water quality, drought or famine risks, desertification, deforestation/reforestation, etc).

The consortium that is in charge of developing POSTEL at the French scale currently includes CNES, Météo-France, CNRS/INSU, IRD and INRA. As it is expected to quickly gain a European standing, other institutions are liable to join it.

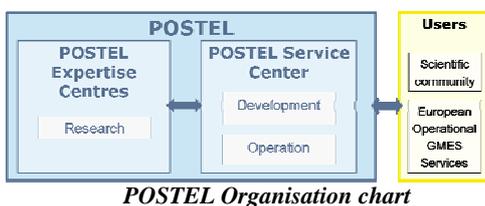
### 2 STRUCTURE

The thematic centre revolves around two types of bodies:

- ✓ A Service Centre. Its mission consists in supplying a set of technical assistance and mutual services allowing the users' community to make the most of the data and products derived from space missions related to the "Land surface" theme.
- ✓ Scientific Expertise Centres. Expertise Centres are laboratories or research

organisations that contribute to defining space missions and to designing and validating derived products. Such Expertise Centres manage all the scientific activities related to the thematic centre.

The user community benefiting from the Service Centre products and services is the international science community as well as the emerging GMES European environmental services.



**POSTEL Organisation chart**

The Service Centre fulfils two functions:

- ✓ a developing function, i.e. setting up scientific processing chains and software for the analysis of satellite data, in accordance with the specifications defined and validated by the relevant scientific Expertise Centres;
- ✓ an operating function, i.e. generating, archiving and circulating products derived from space missions.

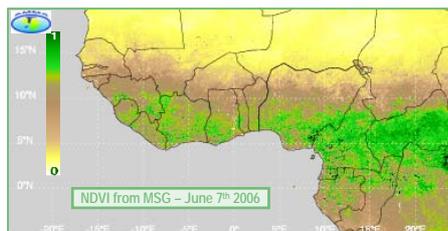
At the beginning of 2002, the MEDIAS-France Public Interest Group was commissioned to design and implement a prototype of Service Centre and its interfaces upstream and downstream. At the time of writing (September 2006), the Service Centre is now fully operational.

The bodies acknowledged as Expertise Centres are laboratories or public organisations that are engaged in the development of products delivered by the Service Centre. They supply algorithm specifications and/or data allowing to validate the products, within the scope of a number of projects outlined in Section 5.

At the time of writing, the Expertise Centres are :

- ✓ the MATIS team of CNRM / Météo-France Toulouse
- ✓ the CSE team of INRA Avignon
- ✓ the SI / MO team of CNES Toulouse
- ✓ the Venüs team of CESBIO (Toulouse)
- ✓ the Remote Sensing team of LSCE / CEA (Paris)
- ✓ the GOHS du LEGOS (Toulouse).

Other Expertise Centres will be able to join POSTEL according to future opportunities of development.

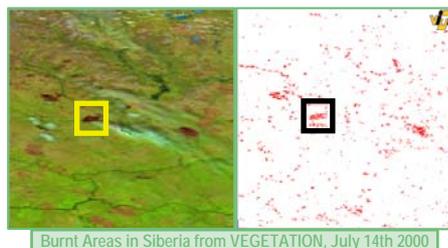


### 3 PROGRAMME OF ACTIVITIES

The activities that belong to the scope of POSTEL include:

- ✓ defining, designing and setting up a Service Centre and its interfaces upstream and downstream;
- ✓ taking part in national and European projects that are as many stages in the creation of the operational GMES operational services;
- ✓ supplying users with products through these different projects.

A 8-person team made up of 3 scientists and 5 computer scientists is currently working within the MEDIAS-France Public Interest Group in order to perform these various activities.



As already mentioned, POSTEL products are bio-physical products derived from observing satellites. Such products characterize continental surfaces: leaf area index, fraction of vegetation, albedo, land cover, downward radiative flux, surface moisture and temperature, burnt areas, etc.

The scales under consideration are regional to global scales, with time scales as long as possible.

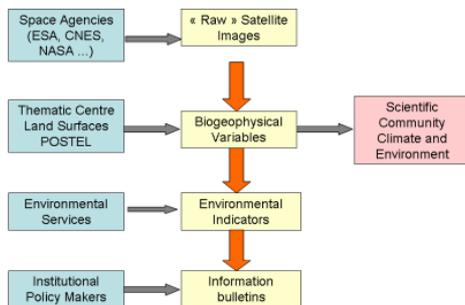
Within this scope, priority is given to the use of low to medium spatial resolution satellites (typically from 100 to 1000 metres). However, extending this to finer scales (10 m) is a conceivable development.

Products will be more and more derived from multi-sensor data according to the scientific and technological progress in this field.



#### 4 VALUE CHAIN

The information chain designed from space agencies to end-users is shown in the following figure. The input received by the Service Centre consists of level-1 data (geo-coded radiance) from space agencies (ESA, CNES, EUMETSAT, NASA ...). The Service Centre develops typically level-3 products aimed at operational services downstream (carbon & climate, food security, land cover change) and at the scientific community. The end-users (decision-making, application of European policies, assessment of international conventions) are downstream from these operational services.



#### *Situation of POSTEL in relation to Space Agencies, Operational Services and End-Users*

The volume of data is strongly reduced from top to bottom, i.e. from space agencies (Tbytes) to end-users (Kbytes), while highly increasing the value added.

The setting-up of a structural link between space agencies and end-users allows to introduce a mechanism of feedback and formalisation of users' needs. This will result eventually in the implementation of operational observing satellite series, therefore ensuring time continuity.

#### 5 PROJECTS

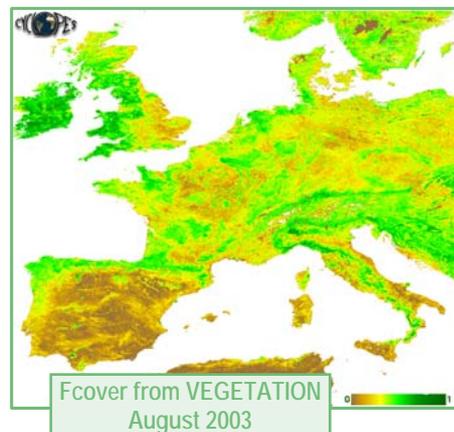
The projects in which POSTEL has been committed so far belong to three categories; they are accordingly briefly described hereunder.

##### 5.1 R&D projects

##### *CYCLOPES*

CYCLOPES (Carbon cYcle and Change in Land Observational Products from an Ensemble of Satellites) is a project led by INRA Avignon (France), which is co-funded by the Directorate-General for Research of the European Commission (within the 5<sup>th</sup> Framework Programme), the Terre & Espace network, the Midi-Pyrenees Region and the French Space Agency (CNES).

The aim of CYCLOPES is to develop and validate biophysical products (albedo, Leaf Area Index (LAI), fraction of absorbed PAR (fAPAR), vegetation cover (fCover)) derived from wide-swath sensors (AVHRR, VEGETATION, POLDER, MERIS). The algorithms used merge the available simultaneous observations; they are designed to supply continuous long-term series.



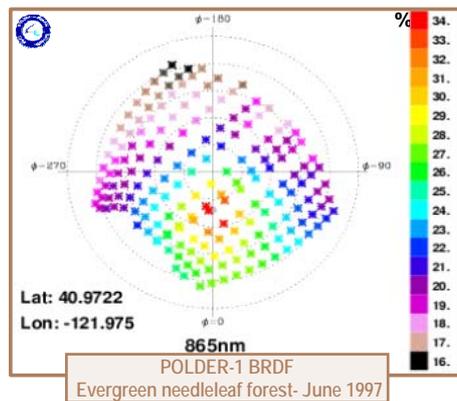
CYCLOPES products are the global fields of these variables and their associated uncertainties over the period 1997-2003, with a 1-8 km and 10-day spatio-temporal resolution. The use of these products is demonstrated within the framework of applications related to climate change.

The products available so far are LAI, fCover and fAPAR global maps derived from VEGETATION at 1 km resolution every 10 days for the period 1998 – 2003.

## AMMA

The AMMA (African Monsoon Multi-disciplinary Analyses) integrated project lies within the scope of the EU 6<sup>th</sup> Framework Programme. Its consortium gathers a number of European and African institutes and organisations.

Its purpose is to describe surface evolution over the last 50 years while distinguishing between anthropogenic and climatic forcing, and to study the possible impact of this evolution on monsoon. It will especially improve knowledge on the West African Monsoon and its variability from daily to inter-annual timescales.



POSTEL serves as a gateway to the AMMA project and its AMMASAT component, regarding low-resolution continental surface products at the West African and whole African scales, over the period 2004-2007 and beyond. Its products, that are derived from those produced operationally at the Institute of Meteorology of Portugal in the EUMETSAT/SAF program, are intended to hydrologists, ecology experts, and atmosphere scientists.

## VALERI

The VALERI (VALidation of Land European Remote sensing Instrument) project is lead by INRA Avignon and funded by the French Space Agency (CNES); it involves various universities and research institutes worldwide (Bolivia, Finland, France, Mexico, Spain, etc...).

The objectives of the project are to assess the absolute accuracy of biophysical products (LAI, fAPAR, fCover) acquired from wide-swath sensors (e.g. AVHRR, POLDER, VEGETATION, MODIS) using a range of possible algorithms, and to inter-compare the products derived from different sensors

and algorithms. Validation is performed *in-situ* through a network of sites distributed over the Earth surface.

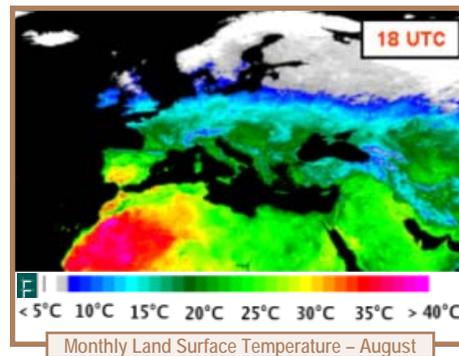
By combining algorithms, data concurrently collected from various sensors, and ground-level measurements, VALERI allows to obtain enhanced biophysical products (LAI, fCover) with improved performances and reliability.

## 5.2 GMES pre-operational projects

### Geoland

The Geoland project, launched within the scope of the 6<sup>th</sup> Framework Programme, is the backbone of GMES-related operational services. Its Biogeophysical Parameter Core Service component produces LAI, vegetation cover, water bodies, fAPAR, albedo, incoming radiance, land surface temperature and moisture, burnt areas, rainfall. Various optical and micro-wave sensors are used to that effect: VEGETATION, MERIS, METEOSAT, POLDER, AVHRR, ATSR, ERS/Scatt and AMSR.

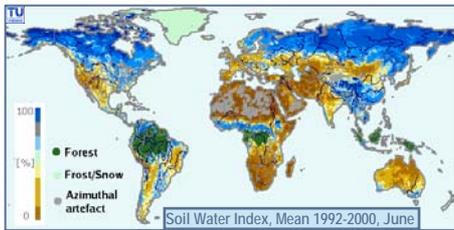
It has the goal to prove the pre-operational capacities of a future GMES service, in which VITO, IM (Portugal) and POSTEL should among others play a prominent role.



The users of the Biogeophysical Parameter Core Service are downstream services producing spatially distributed indicators of natural carbon fluxes, crop monitoring and food security, and land cover and forest global change. The latter aim at supporting the European policies and international conventions that require a continental to global scale environmental monitoring.

### VG4AFRICA

This project of the EU 6<sup>th</sup> Framework Programme is exclusively focused on Africa.



It is intended to distribute in near real time data derived from the VEGETATION instrument onboard SPOT satellites. This is to be implemented through the PUMA network of meteorological stations that are being built up all over this continent. Satellite-broadcasting will use EUMETCast, the EUMETSAT telecommunication system.

Standard data as well as high-level products related to environmental monitoring are being currently produced and timely delivered to end users in Africa.

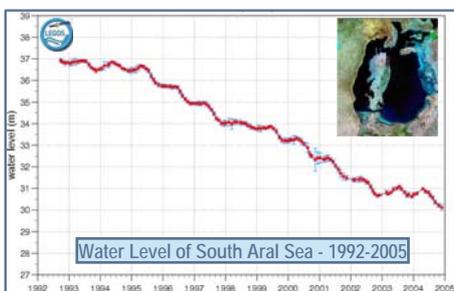
#### Globcover

The Globcover initiative falls within the scope of ESA Data User Element, i.e. the set of programmes for the development of Earth Observation applications led by the European Agency. Globcover is conducted by an international network of partners, including among others JRC, FAO, UNEP, IGBP, and GOCF-GOLD.

The aim of this project is to produce a global land-cover map by 2005, using as a main source fine resolution (300 m) data from the MERIS sensor onboard the ENVISAT satellite.

This new map will update and complement other existing global products of the same purpose, in particular thanks to its finer resolution (300 m versus 1 km).

#### 5.3 Spatial projects



#### POLDER

POLDER (POLarisation and Directionality of the Earth Reflectances) instruments are wide-swath visible

& near-infrared radiometers developed by the French Space Agency (CNES). These instruments were operated on the ADEOS-1 Japanese platform from November 1996 to June 1997, and on ADEOS-2 from April 2003 to October 2003. A third instrument is now flying on board the PARASOL micro-satellite.

The level-3 "Land Surface" processing chain reproduces the characteristics of continental surfaces based on data proceeding from POLDER sensors. The algorithm employed uses the Bi-directional Reflectance Distribution Function measured by POLDER to generate biophysical products such as albedo, LAI, and vegetation cover.



MERIS Surface Reflectance - May 2005  
300m resolution -- Valencia area

#### Venµs

VENµS (Vegetation and Environment monitoring on a New Micro-Satellite) is the first cooperation between Israel and France for the Earth observation using a superspectral sensor, dedicated to vegetation monitoring. The satellite will be operational in 2009.

VENµS scientific objective is the provision of data for scientific studies dealing with the monitoring, analysis, and modeling of land surface functioning under the influences of environmental factors as well as human activities. To fulfil this objective, VENµS will acquire every two days high resolution and superspectral images of predefined sites of interest all around the world.

POSTEL will implement the level-2 and level-3 algorithms designed by CESBIO in an operational environment and will assure the product distribution to users.

## 6. PRODUCTS

POSTEL provides spatialized biogeophysical variables produced in the framework of the various projects outlined in the previous Section in three areas :

- ✓ Continental vegetation and soil: Leaf Area Index, Fraction of vegetation cover, Fraction of radiation absorbed for photosynthesis, Land cover, Vegetation Index, Burnt Areas, Surface Reflectance
- ✓ Radiation cycle : Albedo, Bidirectional Reflectance Distribution Function, Downwelling Short-wave and Long-wave radiation fluxes, Land Surface Temperature.
- ✓ Water cycle: Precipitation, Soil Moisture, Evapotranspiration, Water Bodies, Water Level

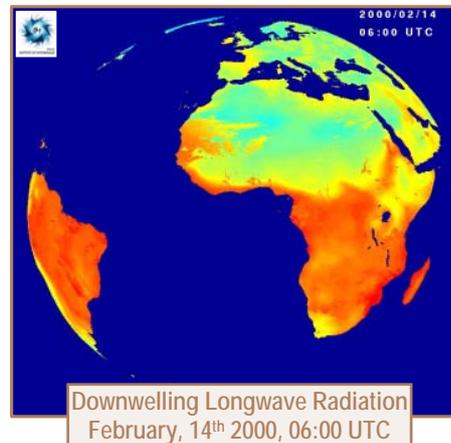
The general product catalog is shown in the Table below. All products are available free of charge for non-commercial users through the POSTEL Web site, at <http://postel.mediasfrance.org>. The detailed product catalog as well as additional information on algorithms, formats and other relevant information can also be found on this Web site.

## 7. CONCLUSION

The scope of POSTEL is bound to evolve quite appreciably in the years to come, before the

operational implementation of services within the GMES framework after 2008.

A strong point of POSTEL is the close link existing between research and services through the association between its Expertise and Service Centres. In this sense, the POSTEL venture sets aside and complements the existing Science Application Facilities of EUMETSAT through, however, a different institutional basis and a somewhat different scope, more oriented towards environmental applications than meteorological and climate applications.



Product	Parameter	Space Coverage	Time Coverage	Space Resolution	Time Resolution	Sensor
Vegetation	LAI	Continent to Global	1998 - present	1 km to 25 km	1 day to 1 month	AVHRR POLDER MSG/SEVIRI VEGETATION
	Fcover					
	FAPAR					
	NDVI					
	Burnt Area					
Surface Reflectance	Global	2005	300 m		MERIS	
Land Cover						
Radiation	BRDF	Continent To Global	1998 - 2005	1 km to 50 km	½ hour to 10 days	POLDER METEOSAT VEGETATION
	Surface Albedo					
	Downwelling Shortwave radiation					
	Downwelling Longwave Radiation					
Land Surface Temperature						
Water	Precipitation	Continent To Global	1992 - 2005	1 km to 1°	1 day to 10 days	AMSR Altimeter ERS/Scatt METEOSAT VEGETATION
	Soil Moisture					
	Evapotranspiration					
	Water Bodies					
	Water Level					

*POSTEL Product Catalog*