

First POSTEL products: POLDER “Land surfaces” biophysical parameters

Introduction

The POSTEL “Continental surfaces” thematic unit prefigures the setting-up of a European Service Centre devoted to bio-geophysical parameters (CSP). The goal is to provide varied users with satellite products that meet their specific needs. With this aim, POSTEL has achieved thematic and computing skills: this double competence allows both to develop operational jobstrings from algorithms specified by Expertise Centres, and to validate scientifically the products thus generated.

Within POSTEL, MEDIAS-France takes charge of the “Land Surfaces” jobstring of the POLDER project which reproduces the biophysical properties of continental ecosystems from surface bi-directional reflectances. The data processing architecture of this jobstring was first reorganised to meet industrial quality criteria, then the whole system was made operational before being delivered to the POLDER Production Centre of the CNES. Today, the activity consists in maintaining a computer and algorithmic follow-up, and in assessing the quality of biophysical parameters before distributing them to users. Such actions are performed in co-operation with scientific laboratories (LSCE, LOA) and companies (NOVELTIS) partners of the project that develop its algorithms. Lastly, MEDIAS-France acts as an interface with the users and meet their specific demands.

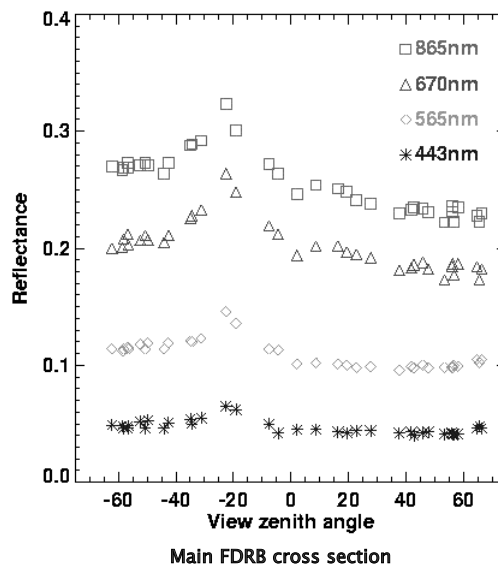
Validated available products

The “Land surfaces” biophysical parameters derived from POLDER-1 data are the first components of the catalogue of POSTEL products. They include directional albedos, NDVI (Normalised Difference Vegetation Index), LAI (Leaf Area Index), FVC (Fraction of Vegetation Cover), FAPAR (Fraction of Absorbed Photosynthetically Active Radiation), with a 6-km/10-day spatio-temporal resolution. The Bi-directional Reflectance Distribution Function (BRDF) is another product specific to

POLDER which is now available. You will find them on-line at the POSTEL site:

<http://medias.obsmp.fr/postel/Projets/POLDER/produits/>

Such products meet the needs of specific users. For instance, the BRDF database concerns those involved in measurement physics (e.g. the CSIRO and the University of Boston), that develop more and more effective radiative transfer models. Albedos, LAI, FVC and FAPAR are essential to model water, energy and carbon exchanges at the ground-vegetation-atmosphere interface. They are aimed at scientists and at institutes developing operational methods in hydrology, meteorology, climatology, carbon cycle, land use changes, food security and agricultural production.



BRDF database

The BRDF describes how the surface reflects the sun radiation according to the directions of light and observation. The main BRDF features are a peak of reflectance for back-scattering when the solar and viewing angles coincide, and a minimum reflectance for forward-scattering. 22594 BRDFs collected by POLDER-1 from November 1996 to June 1997 have been gathered. They pro-

vide exclusive information on the anisotropy of the main continental biomes and their natural variability. They are consequently an exceptional product for many environmental studies, and a remarkable tool to test the performances of radiative transfer models.

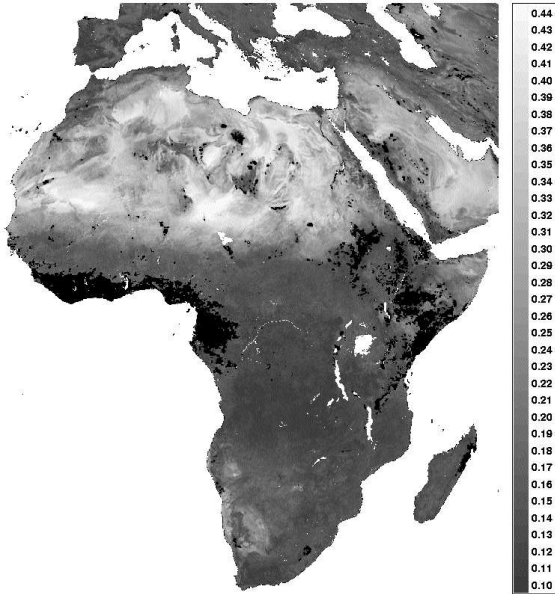
Directional albedos and NDVI

Directional albedos show the reflective power of the surface integrated on the set of zenithal and azimuthal viewing directions. They are derived from the inversion of a BRDF linear semi-empirical model on the spectral bi-directional reflectances measured during the 30 days of synthesis period. The short-wave directional albedo represents the wide band (250nm, 2500nm). It is computed by a linear combination of spectral directional albedos at 443nm, 670nm, 765nm and 865nm. The NDVI derived from the spectral directional albedos at 670nm and 865nm is thus corrected from angular effects. Its temporal evolution is then linked only to changes in the state of surface.

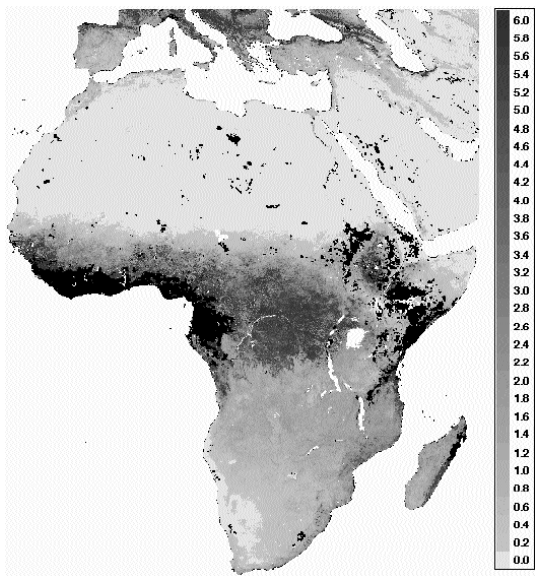
LAI, FVC and FAPAR

The LAI represents the quantity of leaves that intercept the sun radiation while the FVC quantifies the share of surface covered with vegetation. These parameters derive from the inversion of a model of radiative transfer by neural network. The daily FAPAR is assessed by a linear relation with a vegetation index computed in the optimum angular configuration to minimise ground contribution.

Albedos, NDVI, LAI and FAPAR evidence the different continental biomes, their area, their transitions and their spatial heterogeneity. The temporal evolution of parameters at a 10-day resolution shows the natural seasonal variations, the consequences of extreme climatic events and the man-induced damage suffered by ecosystems.



Albedo short wave directional from POLDER data, June 1997



LAI from POLDER data, June 1997

Validation plan

These products are validated, first of all to assess their accuracy for their users, and then to obtain a feedback in order to improve computing algorithms. The validation plan includes 4 stages. During the first phase, the reality of biophysical parameters is assessed by analysing their spatial variability at the continental scale and their temporal evolution over a yearly cycle. The second stage consists in comparing the new products with those of previous versions - if any - in order to estimate the impact of the improved algorithms. During the

following third phase, the new products are inter-compared with equivalent concomitant products derived from other sensors (VEGETATION, AVHRR, MERIS, MODIS), with similar or different methods. Fourth and last stage, the satellite-derived biophysical parameters are compared with in-situ measurements. Some of them are collected during international or regional campaigns, that are available in the literature or in various databases. Others are spatialised reference data. Currently, they only concern LAI maps drawn up within the scope of the VALERI project (VALidation of Land European Remote sensing Instrument) that are established from ground measurements and high-resolution satellite images. The documents that present validation results are associated with the products and are made available to users.

Tools and services

POSTEL also aims at providing tools that make the use of its products easier. Developments are performed in co-operation with Expertise Centres and have to meet the requirements expressed by users. A practical application of this concept is for instance the availability on the POSTEL Web site of a tool designed to display the BRDFs developed by the LSCE. This tool allows to invert models and to compare results with measurements.

In the same perspective, the CNRM and MEDIAS-France are partners in the development of a tool designed to handle EUMETSAT SAF-Land products, and more widely, POSTEL products. After canvassing users' opinion, the resulting top-priority concerns the change of projection and the file format. The re-sampling of grids to be able to modify spatial resolution and the extraction of areas of interest for regional studies are also functions largely requested.

Assistance to users is materialised in concrete terms by the implementation of

specific actions, such as the extraction of BRDFs in selected sites to be used as references in studies on radiative transfer. Also to help users, biophysical parameters (change of projection and of spatial resolution, extraction of areas) have been formatted to meet the specifications of the AMMASAT satellite database managed by the LMD and the IPSL within the framework of the AMMA international project (Multi-disciplinary Analysis of the African Monsoon).

Outlook

In Spring 2004, the catalogue of POSTEL products will expand with the first surface parameters generated within the scope of the CYCLOPES project, co-financed by the 5th RDFP, the Terre et Espace network, the CNES and the Midi-Pyrenees Region. Albedos, LAI, FVC and FAPAR will be estimated through algorithms common to all sensors (AVHRR, VEGETATION, POLDER, MERIS, MSG). These algorithms are precursors of innovative methods that will be developed in order to merge data of various origins and of different instrument characteristics. When the project terminates at the end of 2005, the aim is to generate global maps of multi-sensor biophysical parameters with a spatio-temporal continuity guaranteed over the period 1997-2003.

Lastly, at the beginning of 2005, other parameters (surface temperature and humidity, incident radiative flux, burnt areas, rainfall etc...) will be produced by the GEOLAND consortium, backed by the 6th RDFP within the framework of the GMES activities of the European Community. When such elements are added to its catalogue of products, the POSTEL thematic unit will become a European Service Centre for bio-geophysical parameters. ♦

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