ECV T10

FRACTION OF ABSORBED PHOTOSYNTHETICALLY ACTIVE RADIATION (FAPAR)

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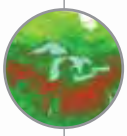


MONITORING BENEFIT

The systematic observation of the fraction of Absorbed Photosynthetically Active Radiation (FAPAR) is suitable to reliably monitor the seasonal cycle and inter-annual variability of vegetation activity related to photosynthesis of terrestrial surfaces. This ECV plays a critical role over a range of temporal and spatial resolutions, notably in the energy balance of ecosystems and in the estimation of the carbon balance.

DEFINITION

FAPAR is defined as the fraction of photosynthetically active radiation (PAR) absorbed by a vegetation canopy. PAR is the solar radiation reaching the canopy in the 0.4–0.7 µm wavelength region.

Ground-based estimates of FAPAR require the simultaneous measurement of PAR above and below the canopy, and FAPAR assessments are retrieved from space remote sensing platforms using physically-based inverse methods. Most of these derived products represent only the fraction absorbed by the green part of the leaf canopy.

ACTUAL STATUS OF OBSERVATION

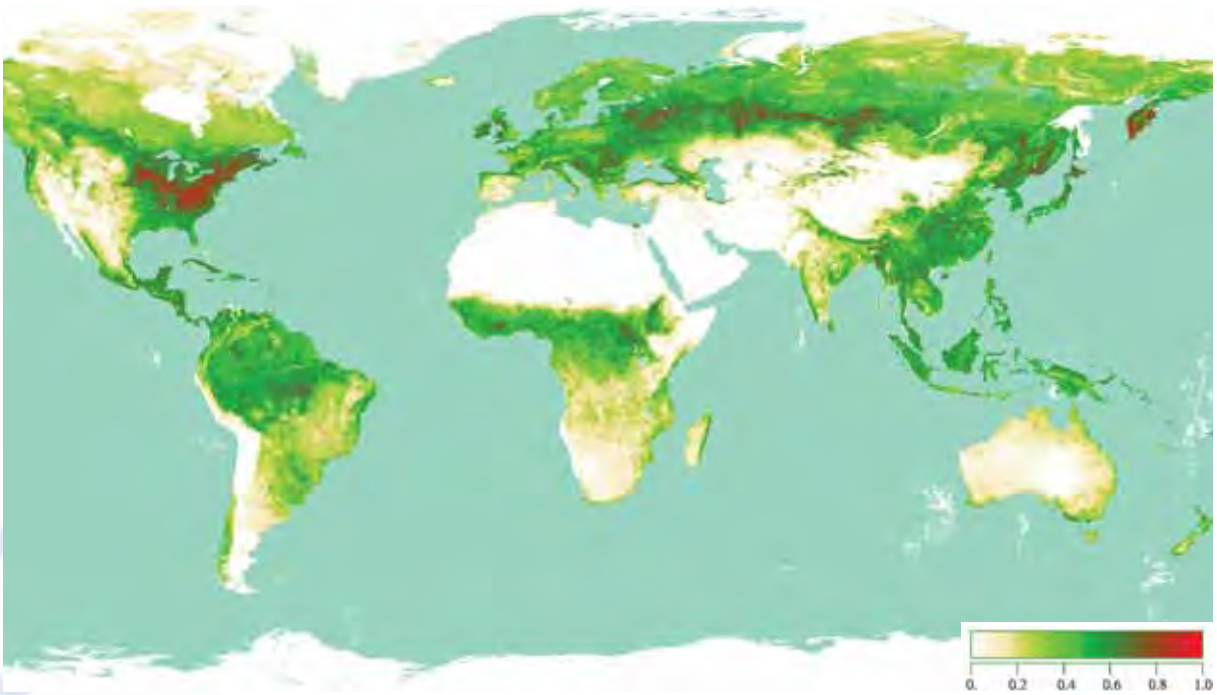
Space agencies and other institutional providers currently generate and deliver to the scientific community various FAPAR products at different temporal (from daily to monthly), and spatial resolutions over the globe. More than ten years of space-derived FAPAR data are now available from different institutions.

At ecological research sites (e.g. FLUXNET, LTER) PAR is monitored as part of the standard protocol, but few sites generate reliable measurements of green FAPAR that can be meaningfully used for validation of the satellite products. Community efforts are underway to document the accuracies of available space-derived datasets while ground-based networks, coordinated by CEOS-WGCV, will perform measurements relevant for validation exercises.

The scientific developments mainly focus on the improvement of the reliability and accuracy of these products in view of their ingestion by data assimilation systems to better understand climate changes issues. This leads, for example, to a major effort for assessing the consistency of various radiant energy fluxes between current observations and models.

Hainich forest (CarboEurope-IP site). (*Source*: Werner Kutsch)

Climate-oriented applications require global scale FAPAR time series, which can only be achieved through the use of multiple sensors



Global FAPAR from MERIS in July 2006 (*Source*: Processed by ESRIN G-POD with JRC software)

CURRENT OPERATIONAL REMOTELY SENSED FAPAR PRODUCTS

Medium-resolution satellite observations are currently being utilized from a number of instruments (e.g. MODIS, MISR, SeaWiFS and MERIS) to provide regional and global operational FAPAR products at a variety of spatial and temporal resolutions.

REQUIRED FUTURE ACTIVITIES

Long time series of accurate FAPAR products derived from space are essential for climate change studies. This requires first the development of state of the art retrieval algorithms for the reprocessing of past archive data, going back to AVHRR.

The availability of future sensors' data is also essential to ensure the continuity of systematic global scale observations. Designs of advanced sensors and updated retrieval procedures are also foreseen to better characterize and reduce the actual uncertainties as are required for the implementation of new land surfaces data assimilation systems.

Networks of ground-based measurements for the routine acquisition of relevant observations, in particular over sub-sampled geographical regions should be promoted. These networks must ensure that observations are taken in a standardized manner that allows comparison between sites. Other issues in regards to these *in situ* measurement sites is their spatial coverage, as well as benchmarking of the measurement protocols.

FUNDS

The total expense for acquisition, processing and storage of both data and geophysical products at medium resolution amounts to about €300 000 per year. The reprocessing of archives can be estimated at €10 000 per year per sensor. Cost for ground-based measurements, including analysis of data to up-scale *in situ* estimates, depends on the site infrastructure already installed and the financial support already being received. When new advanced algorithms have to be developed, substantial research costs may be required.

RELATED LINKS:

MERIS data products: http://envisat.esa.int/level3/meris | **FAPAR activities of JRC:** http://fapar.jrc.ec.europa.eu
Land Processes DAAC: http://edcdaac.usgs.gov/dataproducts.asp | **Atmospheric Science Data Center:** http://eosweb.larc.nasa.gov