GLOBCOVER 2009

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ABSTRACT

GlobCover 2009 has been processed from MERIS Full Resolution data collected from 1 January 2009 to 31 December 2009. The data set coverage is discussed. The GlobCover processing facts are highlighted. The validation and quality assessment of the final products (Land Cover following LCCS from FAO) and composites is also discussed. An independent quality check will be performed by JRC, while a systematic validation is organized by the Université Catholique de Louvain using an international team of 16 land cover experts.

1. INTRODUCTION: WHY STILL GLOBCOVER?

GlobCover v2.2 was a major success for ESA and its partners [1]. The initiative was launched in the framework of the Data User Element (DUE) and concluded in October 2008 with the creation of the sharpest so far (300 m.) global land cover map, having an LCCS-compatible legend with 22 informational classes (see [2]). The user community of GlobCover counts 4800 registered users coming from a large variety of disciplines, which proves the need and interest for global land cover products.

In parallel, it has been released that regular update of land cover information is of major importance, towards a better understanding of the ongoing processes which affect land cover/use dynamics [3]. Under this perception, in the framework of GlobCover ESA highlighted the need to built and demonstrate the use of systems which are able to process large amount of data and produce global informational maps without any major human intervention. This will enable future plug-and-get chains and facilitate routine production of maps. As a result, the continuation of GlobCover to produce an update of the global land cover map for 2009 has been decided.

Based on the experience gained during GlobCover v2.2, as well as the infrastructure which has been built, ESA runs internally GlobCover 2009 in partnership with JRC and Université Catholique de Louvain (UCL). Below we present the new initiative.

2. MERIS INPUT DATA ACQUISITION

The main data source of the GlobCover 2009 project are MERIS 300 m. Full Resolution Full Swath (FRS) products. The acquisitions cover a period from 1st January 2009 to 31st December 2009. MERIS FRS are not acquired systematically, therefore ESA had to make effort to cover the land mass with sufficient acquisitions, particularly in areas outside the ARTEMIS mask (e.g. East part of South America, Central America, Korean Peninsula, Patagonia). Fig. 1 provides a global overview of the acquisitions and the resulted valid cloud-free observations. Our calculations indicate that 99% of the land (excluding Antarctica) is covered by at least one MERIS FRS image.

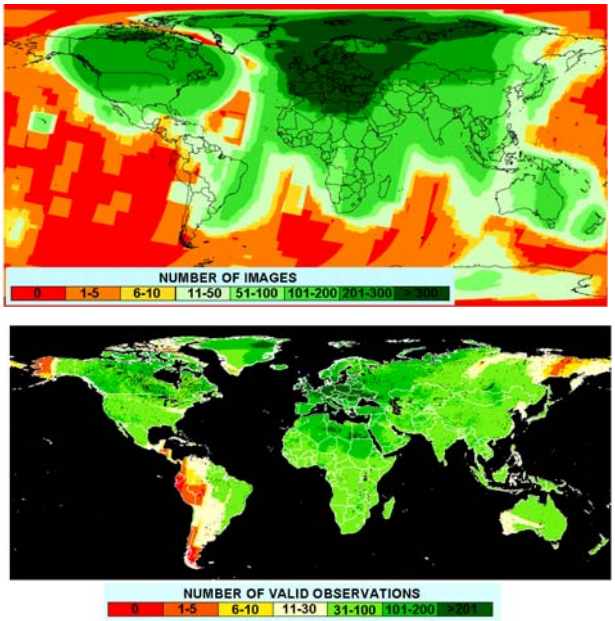

Figure 1. Up: MERIS FRS acquisition density for 2009. Down: Number of valid observations.

3. THE GLOBCOVER SYSTEM

The GlobCover system consists of three components [3]: i) the GlobCover software, ii) the execution environment and iii) the hardware. The system ingested approximately 20 TBs of zipped MERIS FRS data acquired during 2009.

3.1. Software

The GlobCover software includes two basic processing sub-systems: i) the so-called 'pre-processing' module and, ii) the classification module. The first one implements a pre-processing chain which imports MERIS FRS Level 1B data and extracts Level 3 Mosaics, which are then feed the classification process. The pre-processing chain starts with the AMORGOS tool, which geometrically corrects the images. It has been already shown from previous investigations of [4] that AMORGOS achieves very satisfying results with relative and absolute geo-location RMSE far below the requirement of 150 m. (i.e. ~50 m. relative and ~80 m. absolute RMSE).
The following processing step implements a chain of corrections to diminish the influence of the atmosphere and calculate Surface Directional Reflectance (SDR). The correction algorithms include: cloud and snow pixels screening and flagging, gaseous absorption correction, Rayleigh scattering, aerosol correction (based on MERIS RR LARS for 2009), smile correction. Finally, the directional reflectance products are projected in Plate-Carrée and subset into 5^{o}x5^{o} tiles according to the GlobCover schema (see [5]). In order to minimise the bi-directional reflectance effects we use a simple composition averaging (BRDF correction). Moreover, seasonal mosaics are created by averaging the reflectance during particular periods, which have been tuned in order to assist in the classification.
The classification subsystem runs independently for 22 equal-reasoning areas, which have been created taking into account bio-climatic criteria, in order to increase the spectral differentiation among classes. In the beginning an unsupervised ISODATA algorithm is used to classify spectrally the images, while after phenological parameters per pixel are extracted. The subsequent clustering algorithm groups classes with similar characteristics creating spectro-temporal classes. Then the product is being labelled by using a reference dataset (GlobCover v2.2 will be used to label the new product) and finally, the result has to be checked and post-processing (e.g. re-labelling) might be applied whenever needed.

3.2. Execution Environment

The GlobCover system has a modular design, which enables clear separation between the subsystems and their components. A standardised interface is used to link and execute individual modules.
A database-backed catalogue handles data provision to the pre-processing and classification subsystems and deals with the storage and retrieval of input, output and auxiliary data. The database acts as a central communication component, facilitating independent verification tasks, as well as integration testing.
The system handles routines that have been written in multiple programming languages and allows also integration of external programs, like AMORGOS, BEAM modules or ENVI routines [6].

3.3. Hardware

The hardware components of the previous GlobCover project have been received in ESRIN and whenever needed were updated with new parts. The storage capacity is 54 Tb, with 52 CPUs (at 2.3 GHz). A schematic representation of the GlobCover system is given in Fig. 2.

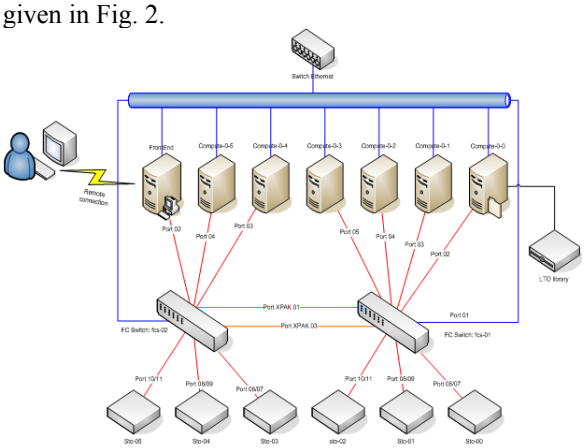

Figure 2. Schematic representation of the GlobCover system installed in ESRIN.

4. CURRENT STATE

In the 24th of June 2010, the processing of the MERIS FRS L1B input data has finished and two bi-products have been produced: i) an Annual GlobCover 2009 Composite, and ii) six Bi-monthly Composites. Our initial assessment showed that the results are of good quality when the valid observations are sufficient. The composition process has created some artefacts in some areas, where the observations are less than ~30. The products will be freely available to the users with a simple registration, through the Ionia GlobCover portal (see http://www.esa.int/due/ionia/globcover). Through Ionia users will have access to the GlobCover 2009 composites, cropped in 5^{o}x5^{o} tiles and projected in Plate-Carrée. The tiles are released in Hierarchical Data Format-EOS 2 (HDF). An example of the Annual composite mosaic is given in Fig. 3.

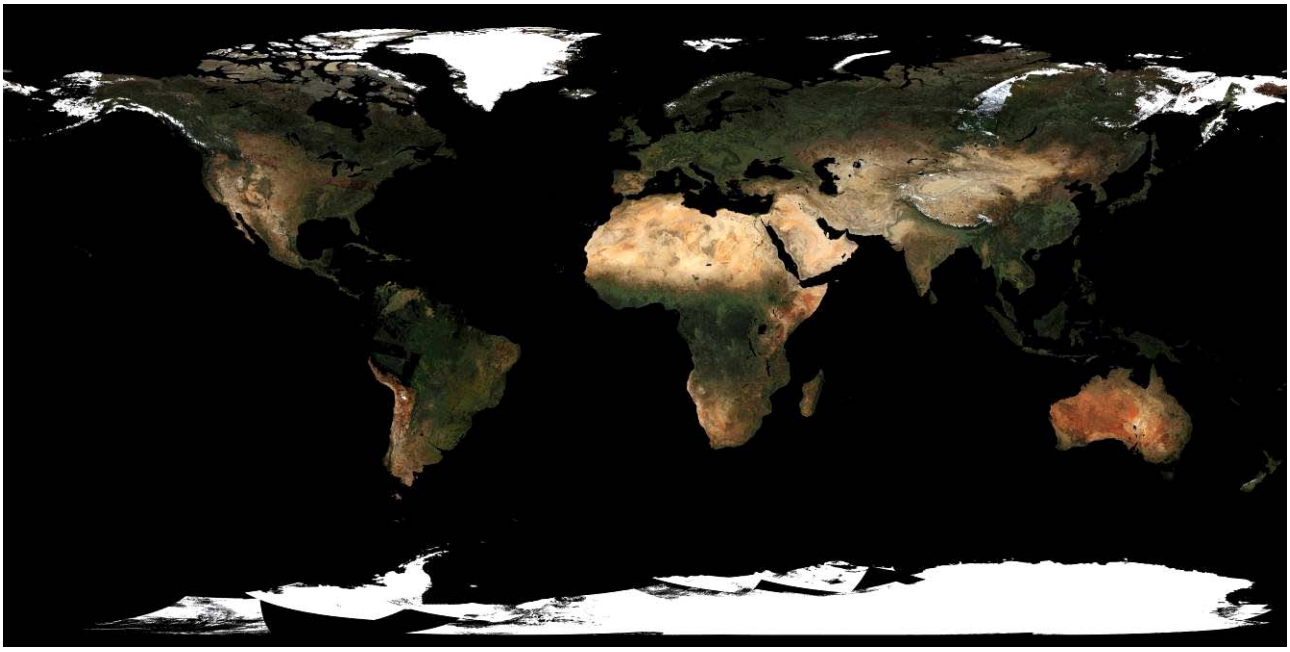

Figure 3. Annual GlobCover 2009 mosaic (MERIS FR 300m).

Currently ESA 's effo rt is c oncentrated on th e production o f the GlobCover 2009 Global L and Cover Map. Un iversité Catholique de Louv ain (UCL) will take o ver t he validation o f t he product. A we b-based validation t ool has bee n crea ted by UC L, t o assi st i n the process and a gl obal network of land cover experts will support the validation exercise as well [5].

5. CONCLUSION

The importance o f GlobCover 2009 initiative relies o n the fact that it will de monstrate the capacity to frequently up date t he gl obal l and co ver map. With GlobCover 200 9 ESA will prov ide not on ly th e m ost detailed global land cover map so far, but also the most recent and updated [7]. Atte ntion will be given on the integrity of the v alidation exercise, which i s m anaged by an experienced team of UCL. Future news regarding the in itiative an d t he fi nal pro duct will b e announced on Ionia Se rver, w hich i s t he m ain di stribution point and through the next GlobCover Newsletter.

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