→ CLIMATE CHANGE INITIATIVE

Land Cover CCI Newsletter

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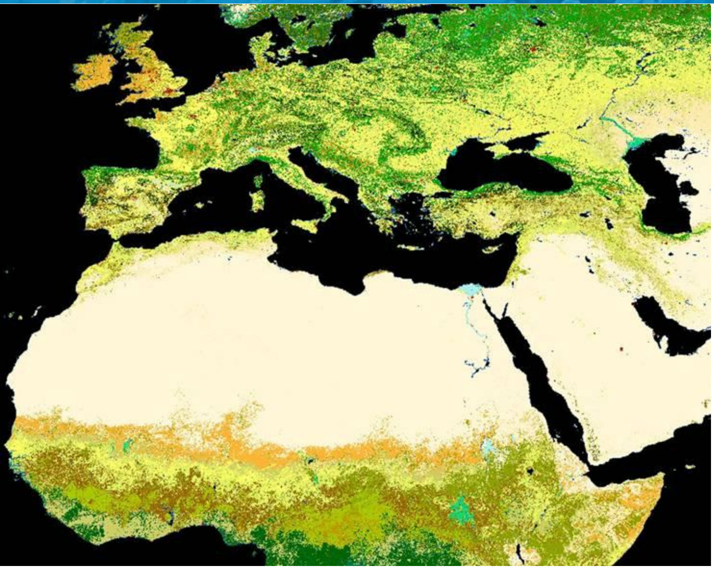


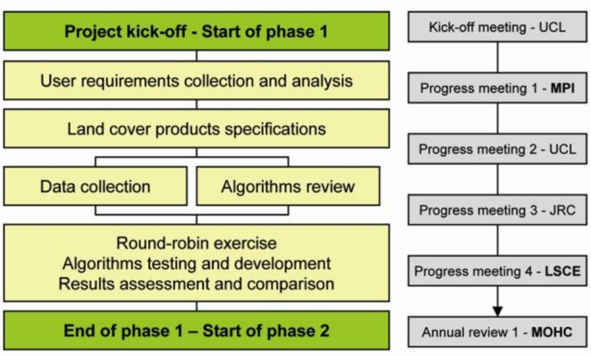
GlobCover 2009 - © ESA 2010, Université catholique de Louvain

In this issue:

Main achievements of phase 1 and expectations for phase 2

The CCI Land Cover project is now in Phase 2. During the first year, a very detailed user requirement analysis was conducted and served as input to define the technical specifications of the final products. The project has then started the next important steps, which were the data collection and the algorithms development, assessment and inter-comparison through a round-robin exercise. Six meetings were organized, during which the CCI consortium visited the premises of each climate modeler's partner.

The User Requirements Assessment was very much appreciated. Different climate modelling groups were targeted through specific web surveys about varying aspects of land cover products and their use. The global land cover community was also involved thanks to a survey dedicated to the GlobCover users' group. It resulted in 8 main findings that were already presented in the previous newsletter and that are detained in several documents *. It also defined the quantitative requirements of the products. They are presented in the first figure next page.



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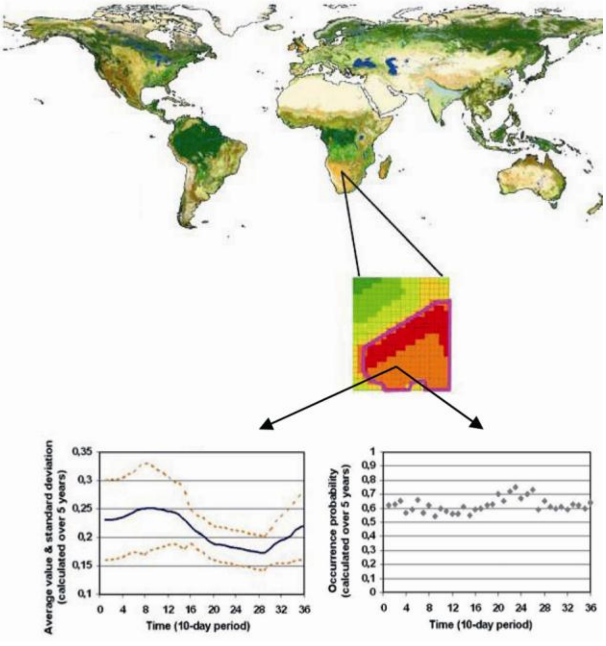
	Threshold requirement	Target requirement
	Coverage and sampling	
Geographic Coverage	*Global*	*Global with regional and local specific products*
Temporal sampling	*Best / stable map and regular updates*	*Monthly data on vegetation dynamics and change*
Temporal extent	*1-2 years, most recent*	*1990 (or earlier)-present*
	Resolution	
Horizontal Resolution	*1000 m*	*30 m*
Vertical Resolution	-	-
	Error / Uncertainty	
Precision	*Thematic land cover detail sufficient to meet current modeling user needs*	*Thematic land cover detail sufficient to meet future model needs*
Accuracy	*Higher accuracy than existing datasets*	*Errors of 5-10% either per class or as overall accuracy*
Stability	*Higher stability than existing datasets*	*Errors of 5-10% either per class or as overall accuracy*
Error Characteristics	*Independent one-time accuracy assessment*	*Operational and independent multi-date validation*

The resulting set of requirements served as input to define the land cover products specification. The land cover concept was revisited by proposing to generate maps depicting both the stable and dynamic components of the land cover.

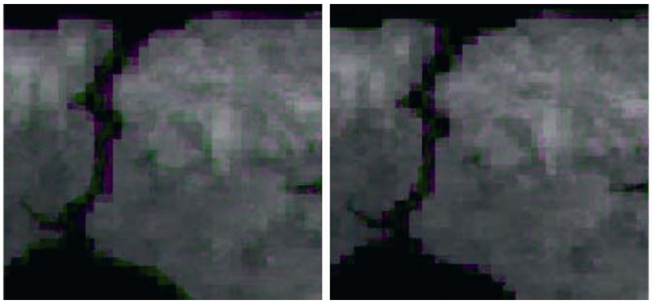
On these grounds, pre-processing and classification algorithms were reviewed, developed and tested through the round-robin exercise.



With regard to the pre-processing, a specific achievement for the documentation of geolocation accuracy has been made related to MERIS FSG and RR. The observed internal image distortion of RR has been investigated. Based on this fact the solution to update AMORGOS (developed by ACRI-ST) has been proposed. With AMORGOS, a tool has been made available by ESA which improves MERIS FSG geolocation better than 70 RMS. The new AMORGOS 4.0 provides an excellent relative geolocation accuracy of RRG with FSG and resolves the internal image distortions of RR products.

The figure shows the comparison of the geolocation accuracy for MERIS FSG and MERIS RR as well as MERIS FSG and MERIS RRG. The difference between the shapes of structures, such as the coastline, can be seen in an RGB colour composite by overlaying the two different products. For both figures the FSG band 13 has been loaded into the red and blue channels of the RGB, and RR band 13 (left figure) or RRG band 13 (right figure) into the green channel.

As a result, a grey colored pixel indicates that RR/RRG and FSG have the same radiometry, which happens if the images match perfectly but also in heterogeneous terrain. More important, green or pink color indicates that the RR/RRG pixel differs from the FSG pixel.



When looking at the coastline in the left figure a RR shift is clearly visible. The order of magnitude of this shift is about 1RR pixel, i.e. about 4 FSG. After applying AMORGOS 4.0 the excellent relative geolocation accuracy of RRG and FSG is observed.

At the end of phase 1, most algorithms have been selected and a full scale processing chain is almost ready.

The project is now on phase 2. The need to process very large volumes of data in a short timeframe to deliver on time the product to the climate groups will certainly be a big challenge. The users' requirement to have consistent land cover products over different epochs will also ask for specific methodological effort. Iterative loops between producers' and users' partners will be needed to ensure useful products and fine-tune the processing chains. To this end, the project plans to release **a first global land cover product** for the 2010 epoch to the modellers for **June 2012**, along with a preliminary validation report.

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Global water bodies product based on the entire archive of Envisat ASAR images

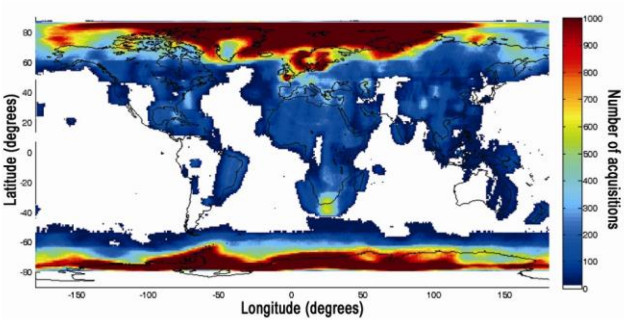
Optical medium resolution imagery always faced the detection problem of water bodies, wetlands and urban areas. All these classes play a major role in structuring the landscape and the ecosystem functioning but are often poorly mapped at global scale. The potential of SAR data to provide substantial information on such classes has therefore been carefully investigated, using ESA Envisat ASAR Wide Swath Mode (WSM) images.

From the first months of the project, Gamma RS was involved to demonstrate the capability of multi-temporal SAR backscatter measurements to detect water bodies and develop a detection algorithm to be applied at global scale.

The temporally variable nature of the SAR backscatter of water surfaces has been exploited to derive two metrics, the temporal standard deviation of the backscatter and the minimum multi-temporal backscatter, which have unique features over water surfaces.

With a simple thresholding algorithm, water bodies and land could be discriminated with accuracy over 90% for six study regions. The analysis also indicated that the spatial resolution of the data most suitable for the delineation of the water bodies is 150 m. The figure shows an example of SAR-based water body map for Northern Sweden (right in the figure) and water/non-water mask from the CORINE land cover map (left in the figure). The classification accuracy is 96.2%.

Based on the satisfactory results and the significant improvement over existing algorithms (GlobCover, Geoland II), it has been decided by the CCI-LC consortium to support the development of a global SAR-based product of water body detection and to integrate it into the land cover product.



Density of ASAR WSM acquisition since mission start (courtesy of Salvatore Pinto, ESA G-POD team)

All Envisat ASAR WSM images available are currently processed on ESA's G-POD platform. Gap fillers with ASAR Global Monitoring Mode (GMM) over areas of sparse WSM coverage are processed at GammaRS. Such multi-year datasets are then used to obtain the multi-temporal SAR metrics and classified with the detection algorithm presented above.

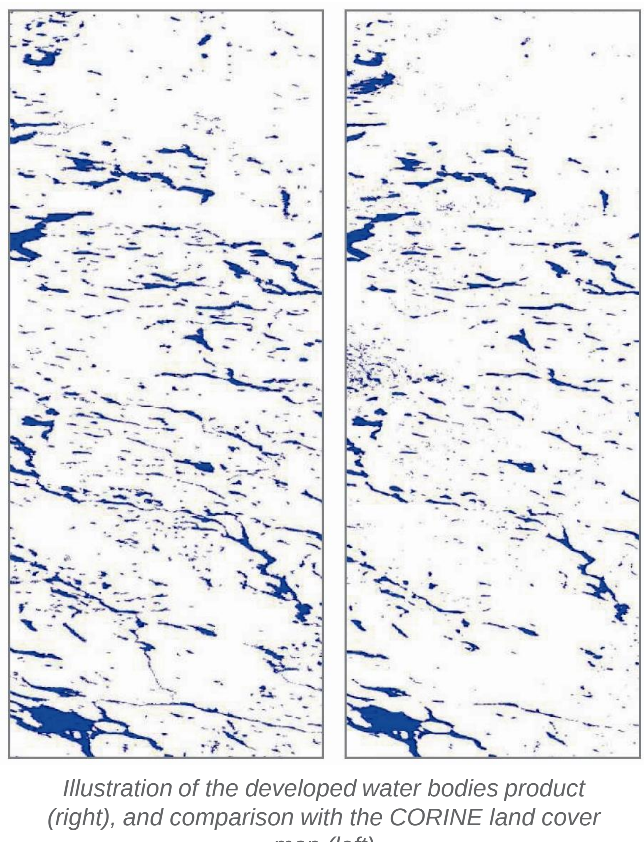


Illustration of the developed water bodies product (right), and comparison with the CORINE land cover map (left)

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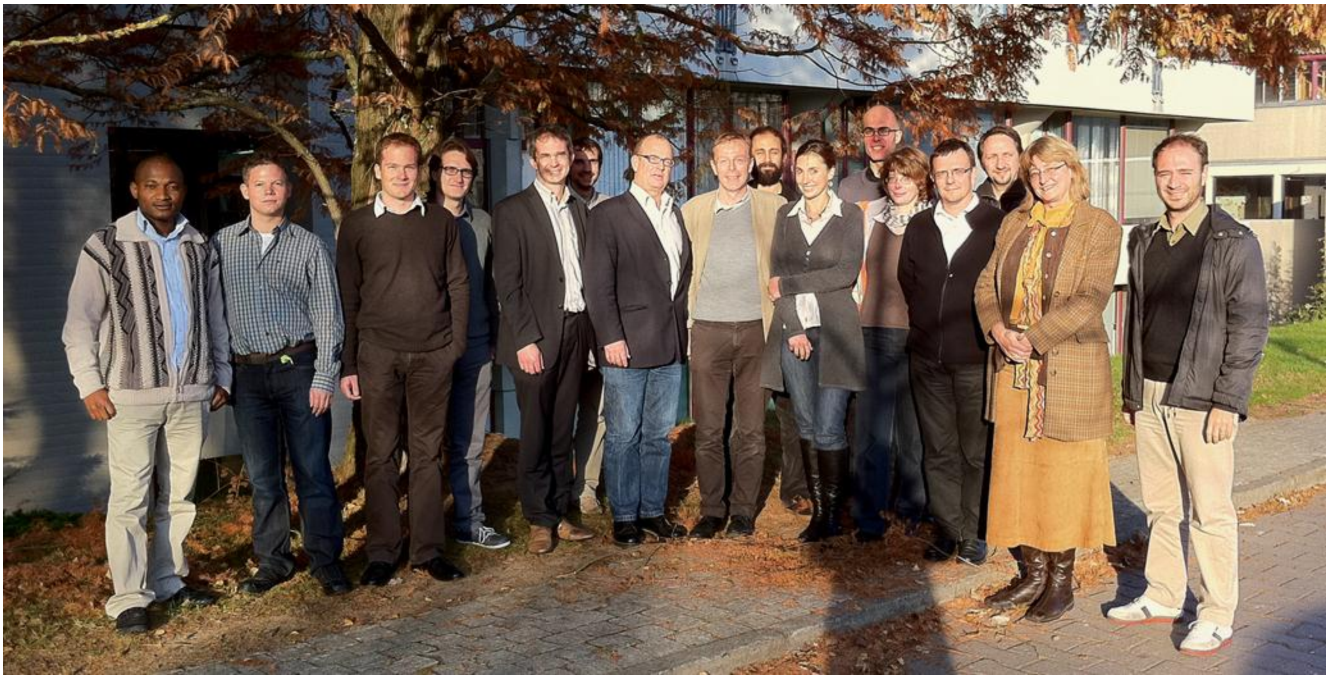
CCI Land Cover round-robin closure on October, 30 2011

Round-Robin is an activity present in all projects of the Climate Change Initiative. It amounts to an international community engagement, which aims at ensuring using in the project the "best" algorithm(s) or combination of algorithms. It is an open activity in which external research groups are invited to develop and propose their own methodologies. Results and algorithms are then compared.

The Round-Robin was launched on 1st April 2011

On the **pre-processing** side, it focused on five steps: (i) pixel identification, (ii) aerosol retrieval, (iii) atmospheric corrections, (iv) BRDF correction and (v) compositing algorithm. On the **classification** side, the activity has tested (i) a global and generic classification method and (ii) class-specific algorithms for urban areas and for water bodies based on optical and SAR data. Some of these steps were only tested internally, by the consortium. For other ones, external participants were engaged.

On the 9th November 2011, a meeting was held at the premises of Université catholique de Louvain (Belgium) to present other round-robin results. Among them, a consortium made of University of Jena (Germany) and University of Pavia (Italy) research groups demonstrated the usefulness of SAR dataset for urban detection. Their results still need a consolidated validation, which might allow their algorithms to be taken on board on the CCI-LC project. A second group led by Wageningen University presented results addressing the issue of remote sensing signals temporal stability.



Round-robin participants to the 9th November meeting, with the CCI Land Cover consortium

From left to right: Sebastine Ugbaje, Wiecher Olthof, Loïc Dutrieux , Paul Kotzerke, Dimitri Lederer, Julien Radoux, Olivier Arino, Pierre Defourny, Manos Kalomenopoulos, Sophie Bontemps, Jan Verbesselt, Grit Kirches, Carsten Brockmann, Martin Herold, Chris Schmullius, Vasileios Kalogirou – Absent on the picture: Paolo Gamba, Martin Boettcher