THE LAND COVER COMPONENT OF THE ESA CLIMATE CHANGE INITIATIVE

CURRENT ACHIEVEMENTS: A CONSISTENT GLOBAL LAND COVER TIME SERIES AT 300 USED BY CLIMATE MODELING GROUPS


(1) UCLouvain-Geomatics, Belgium; (2) JRC, Italy; (3) Brockmann Consult GmbH, Germany; (4) University of Pavia, Italy; (5) Max Plank Institute for Meteorology, Germany; (6) MET Office, United Kingdom; (7) LSCE, France; (8) University of Jena, Germany; (9) GAMMA Remote Sensing, Switzerland; (10) ESA, Italy; (11) LIST, Lux.
Land cover consistency over time: the priority for climate modelling

(Bontemps S. et al., BGS 2012)
Annual EO time series: transition zone prone to LC unconsistency

Nbr of occurrence of the same LC class from annual land cover maps

Stable versus less stable region for land cover mapping

⇒ 3 strategies to address this major issue:
- to revisit land cover to include seasonal components
- to rely on full archive of EO rather than single/best year
- to design the appropriate workflows and algorithms

(Bontemps S. et al., BGS 2012)
Revisited land cover concept: land cover + land surface seasonality

Land cover can not be the (observed) physical and biological cover on the terrestrial surface (LCCS 2005; GTOS ECV 2009) … and remains stable and consistent over time (as requested by climate modelers)

=> Mapping land cover and land surface seasonality

Climatology of 3 variables over 12 y.

Defourny et al., 2013
Surface reflectance production with improved QC and cloud screening

- 4 sets of full EO archive to process:
  - Envisat MERIS Full Resolution (nearly global every 3-9 days 300-m reflectance in 15 bands (blue to NIR), 2003-2012)
  - Envisat MERIS Reduced Resolution (global every 3 days 1.2 km reflectance in 15 bands (blue to NIR), 2003-2012)
  - SPOT Vegetation 1 & 2 (global daily 1-km surface reflectance in 4 bands (blue to SWIR), 1998-2012)
  - Envisat SAR WS & GM from 2005 to 2011

=> 3rd global full archive reprocessing of MERIS (160 TB) + VGT 10TB
Full MERIS archive processed in surface reflectance (2003-2012)
300 m global land/water mask as shared CCI dataset

6 years of ENVISAT SAR data on G-POD + consolidation with
⇒ 1st release in Dec. 2014 as output of phase 1
⇒ 2nd release in Sept. 2015 at 150 m resolution

Santoro et al., RS 2014
1st release of all CCI LC products in 2014
2nd release of the CCI LC maps in Sept 15
2000, 2005 and 2010 CCI Land cover products
Great consistency between the land surface seasonality variables

7-day resolution for ‘climatological’ data set (computed from 12 years of data)
CCI LC maps viewer on-line with 3 consistent land surface season.

Usertool for climate modellers to convert in Plant Functional Types

Poulter et al., 2011, 2015

Tree broadleaf evergreen at 9,8 km for 2003-2007
Downloads over time

- Land Cover Map 2008-2012 epoch
- Land Cover Map 2003-2007 epoch
- Land Cover Map 1998-2002 epoch
- User tool
- Water Bodies
- Land Surface Seasonality, vegetation greenness
- Land Surface Seasonality, snow occurrence
- Land Surface Seasonality, burned areas occurrence
**Downloads by product**

<table>
<thead>
<tr>
<th>Product</th>
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<tbody>
<tr>
<td>Land Cover Map 2008-2012 epoch</td>
<td>1236 downloads, 2,584.95 GB</td>
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<tr>
<td>Land Cover Map 2003-2007 epoch</td>
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**2307 maps (4126 GB)**

**315 tools**

**362 LSS (3095 GB)**

*MERIS Surface reflectance time series*
IP localization
Major CCI LC Validation effort by experts using specific interface

1. Layer box
2. Zooms
3. Tools (navigation, NDVI, select object, paint class)
4. Legend
5. Comment
Completion of the multi-epoch CCI LC Validation database

=> 2591 interpreted points for each epoch (2000/2005/2010) by 19 experts

(expert confidence: 64% certain, 30% reasonable, 6% doubtful)
3 climate models experiment: on LC and PFT table on albedo and LST

CCI - Default

Change in albedo

- JULES
- JSBACH
- ORCHIDEE

Change in land surface temperature

- JULES
- JSBACH
- ORCHIDEE
On-going experiment using uncertainty:
LC and PFT conversion uncertainty impacts on model input and output

4 different perturbations of PFT fractions generated using 2 levels:
- Land cover uncertainty with alternative classes selected only when
  (i) biomass is minimised, (ii) biomass is maximised
- Cross walking table uncertainty with fractions adjusted to
  (i) minimise biomass, (ii) maximise biomass
1st Results – impact related to uncertainty from LC or/and PFT table according to regions

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<tr>
<th>PFT</th>
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<th>Reference</th>
<th>MAX biomass</th>
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Scenario
7 different instruments plus Sentinel-1 and 2

AVHRR archives – 1km HRPT - 1992-1998

PROBA-V – 300 m & 100 m 2014 -2015

Sentinel-3 OLCI –SLSTR SYN product – 300 m
On-going annual 1-km change detection using a 13-y SPOT-VEGETATION + PROBA-V

Majority and specific decision rules (pixel based)

16 annual global land cover products
Detection of annual change:
Drying up of Toshka lakes (Egypt)
Starting Sentinel 1 & 2 data use as input for high resolution output

- On-going round robin to exploit Sentinel-1 time series for urban
- Sentinel-2 processing test over large scale

## Table

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Sentinel-2 time series (Africa)
Sentinel-1 time series (Boreal zone) + RR on urban mapping
Last but not least achievement: a very collaborative team with 3 climate groups closely interacting among them and with the EO groups.

Thank you for your attention.