Land Cover CCI

Current status and achievments

UCL Université catholique de Louvain – UCL-Geomatics, Belgium
Brockmann Consult
Wageningen University
GAMMA REMOTE SENSING
Friedrich-Schiller-Universität Jena seit 1558
JRC European Commission
Max-Planck-Institut für Meteorologie
Met Office

Project highlights

- **Delivery of the first prototype of the CCI LC map in August 2012**
- **Intensive production period** (preprocessing, classification and compilation)

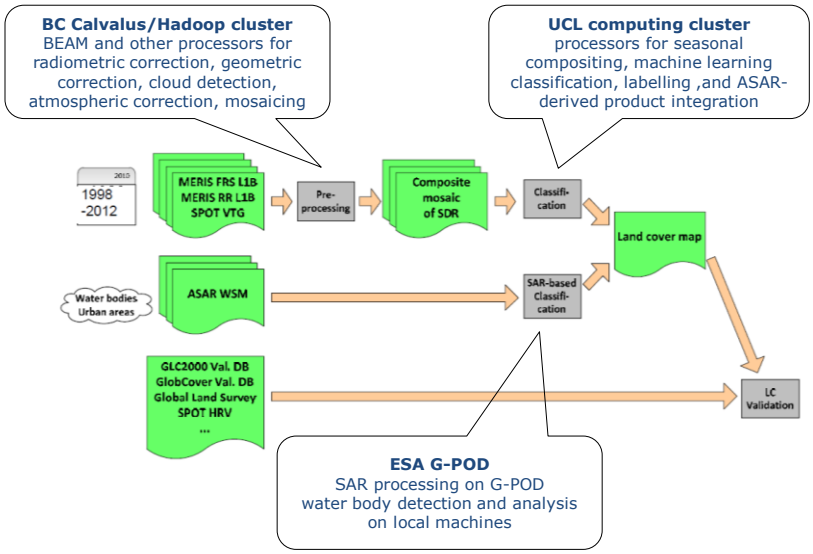
=> Delivery of the CRDP 1.0 (except the LC_CCI Water condition)

- ✓ **7-d Surface reflectance for the whole MERIS FR and RR archive**
- ✓ **Land cover states for 3 epochs**
- ✓ **Land cover conditions for Snow, Burnt Areas, Greeness (NDVI)**
- ✓ **Permanent Water bodies map**
- ✓ **Aggregation tool** (to convert LC map to gridded PFT)

- **GOFC-GOLD symposium – April 2013 in Wageningen**
  - Presentation of the project and its products
  - Announcement of the validation process and call for experts

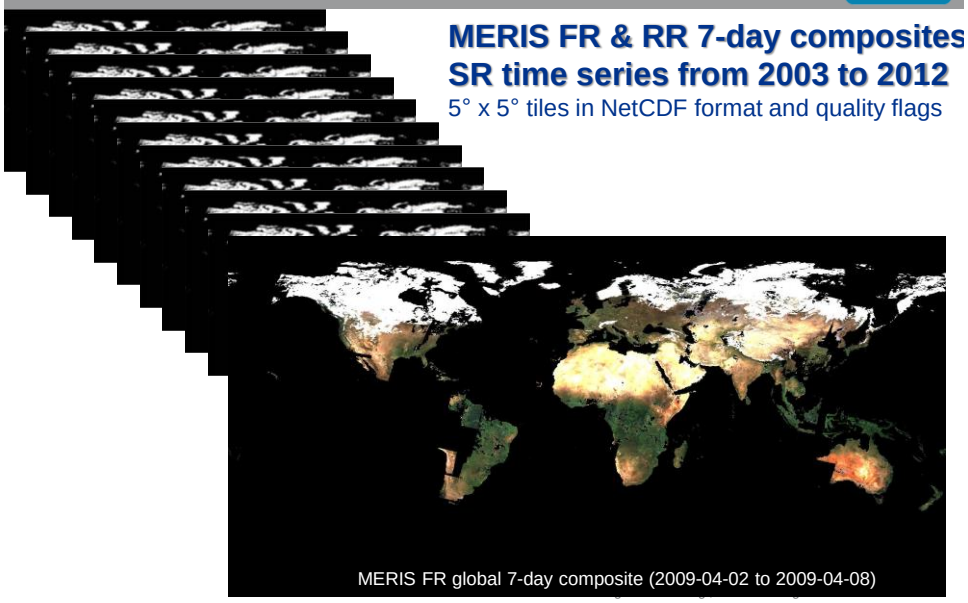
esa

Diagram of the prototype system



esa

Delivery of CRDP (1/5) : 7-d MERIS surface reflectance



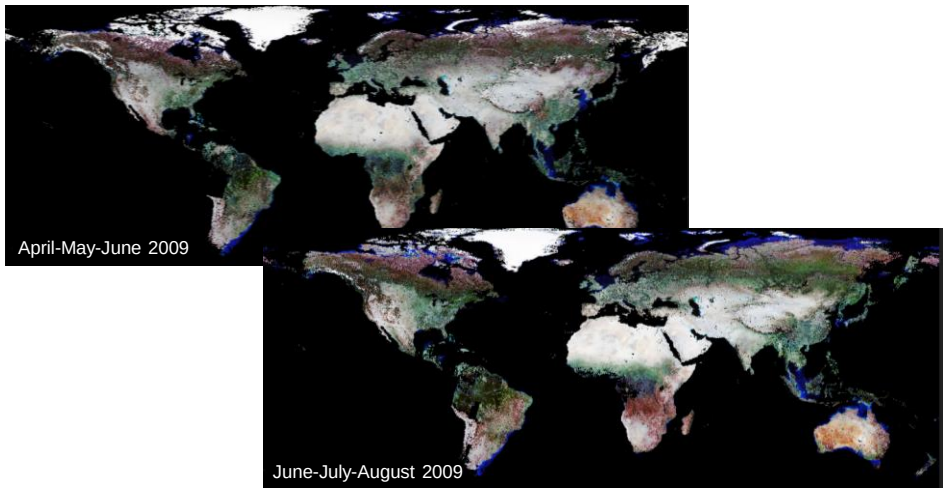
MERIS FR & RR 7-day composites SR time series from 2003 to 2012

5° x 5° tiles in NetCDF format and quality flags

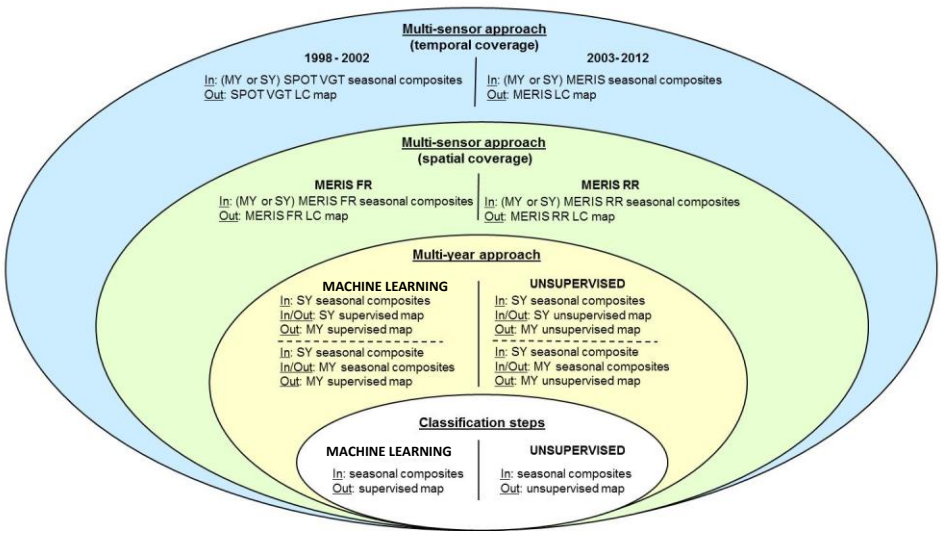
MERIS FR global 7-day composite (2009-04-02 to 2009-04-08)

Classification input : seasonal and multi-year composites

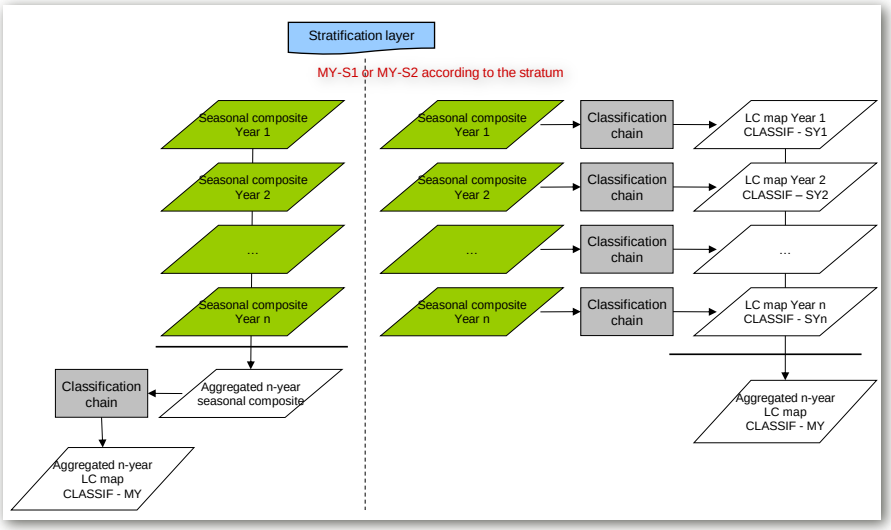
Generation of seasonal composites, i.e. composites characterized by longer compositing periods defined on a per-stratum basis



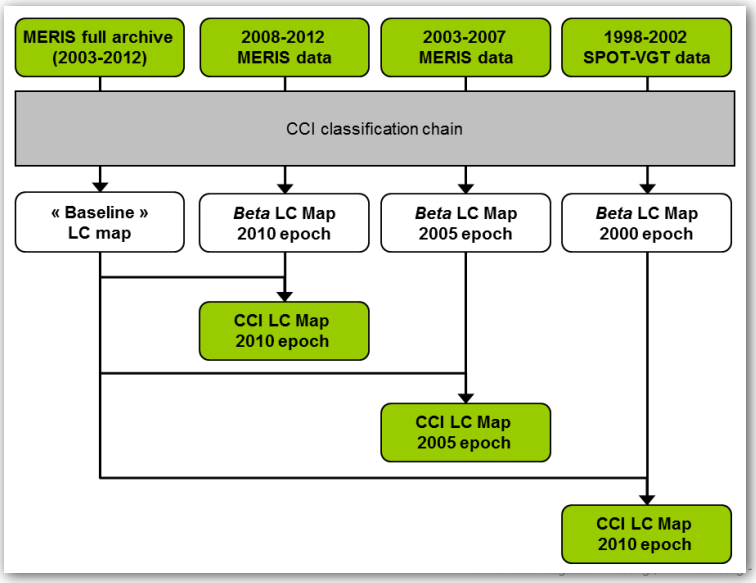
Overall classification strategy



Multi-year approach (1/2)

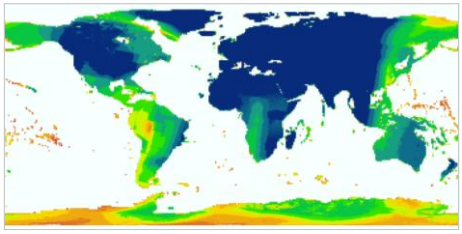


Multi-year approach (2/2)

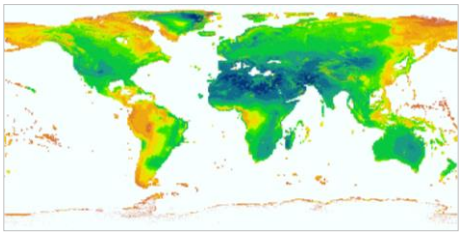


Multi-sensor approach

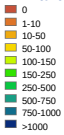
- **MERIS RR used to complement the « baseline » MERIS FR LC map**



MERIS FR acquisitions (2003-2012)

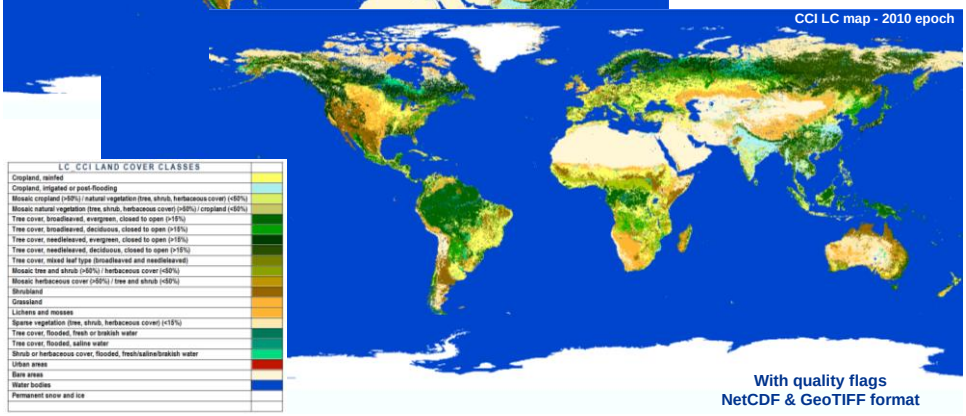


MERIS FR valid observations (2003-2012)



- **SPOT-VGT used to derive the 2000 epoch LC map (at 300m spatial resolution inherited from the « baseline » LC map)**

Delivery of CRDP (2/5)



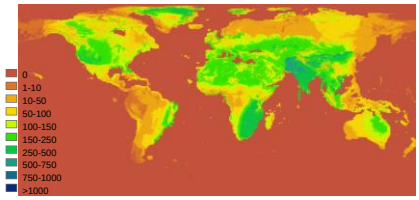
3 land cover state products for the 2000, 2005 and 2010 epochs

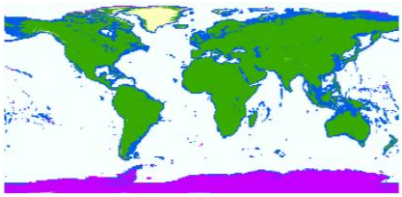
With quality flags
NetCDF & GeoTIFF format

LC state products : quality flags

#1 – Pixel processed or not

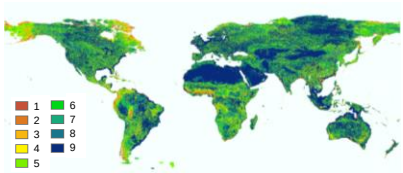
#3 – Valid observations





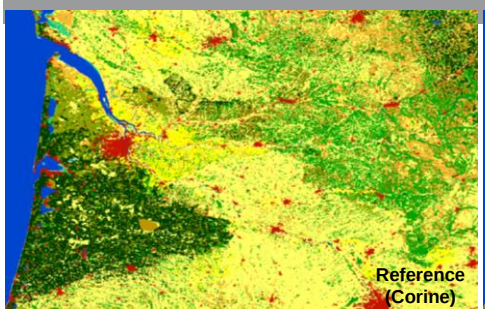
#2 – Pixel status (from pre-processing)

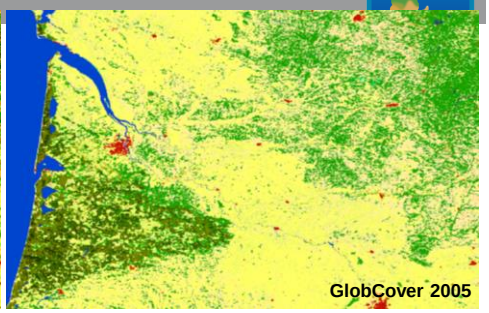
Land
Water
Snow
Cloud
Invalid

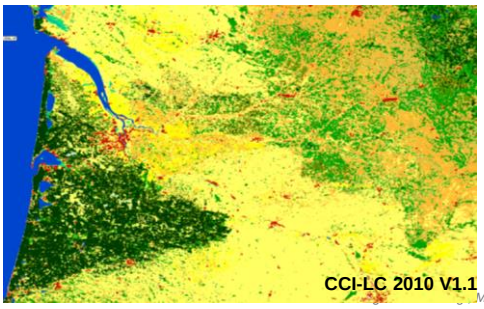


#4 – Confidence level

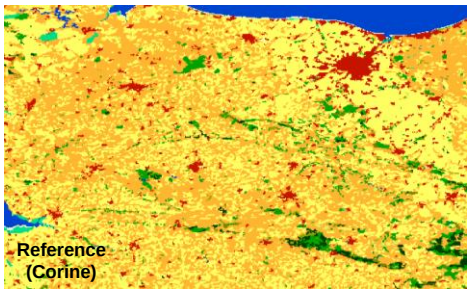
2010 Epoch – France (1)

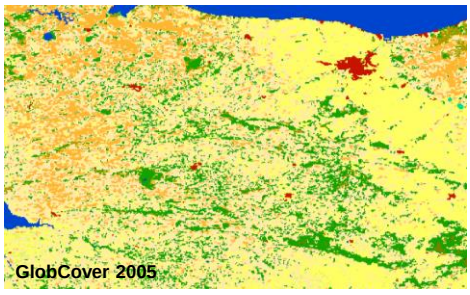


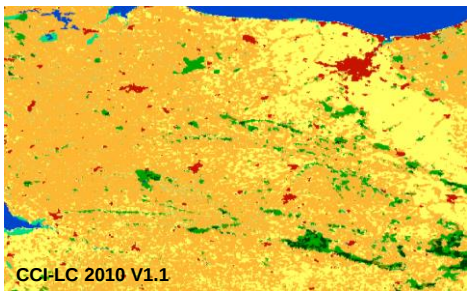




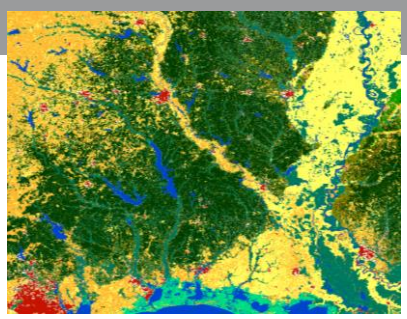
2010 Epoch – France (2)



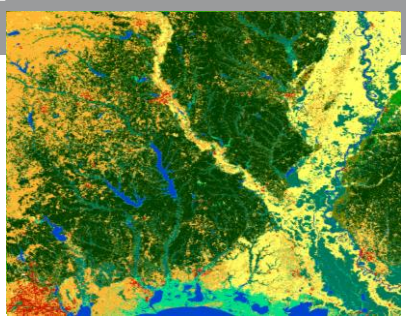




2010 Epoch – US

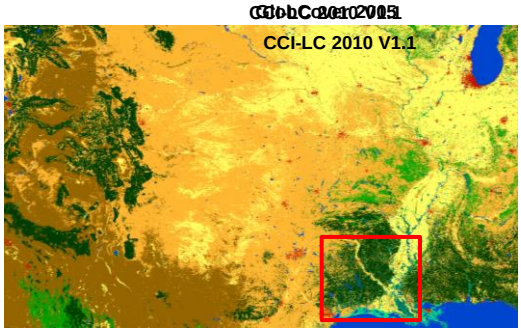


Reference
(NLCD)

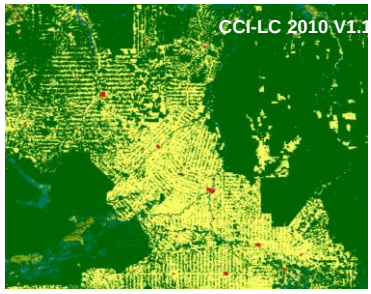


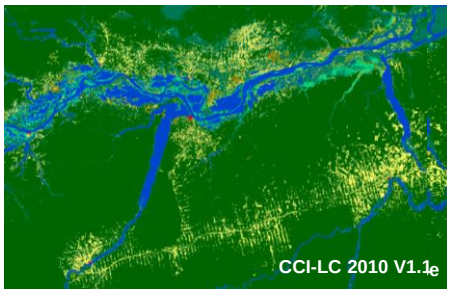
GlobCover 2005

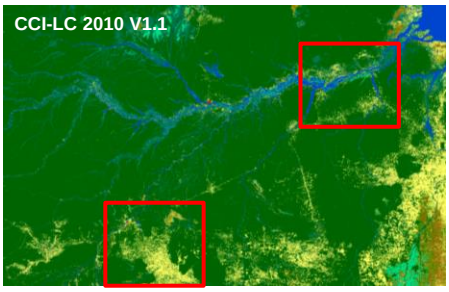
Both in Europe and US, 10 years of MERIS data allows capturing many landscape features w.r.t. high spatial resolution reference data



2010 Epoch – Amazon

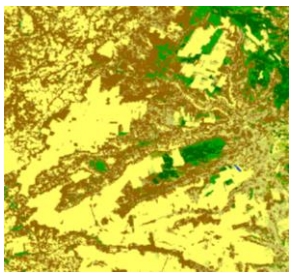




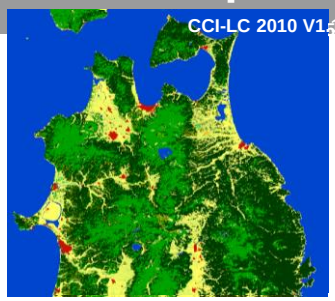


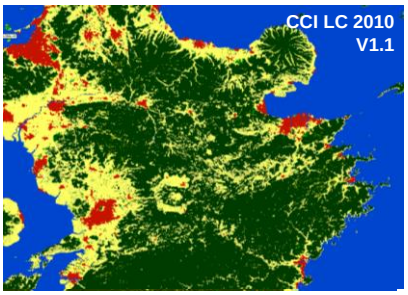
Improved detection of:
- **wetlands due to an improved supervised approach**
- **deforestation due to the multi-year appraoch**

2010 Epoch – Deforestation



2010 Epoch – Japan

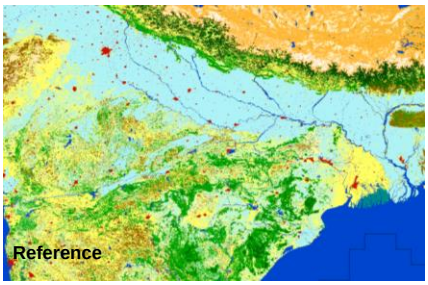


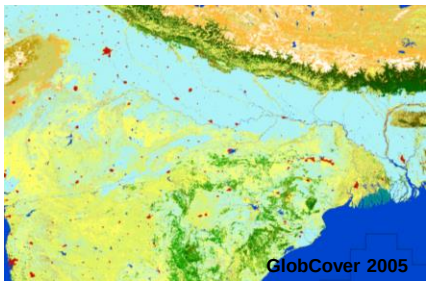


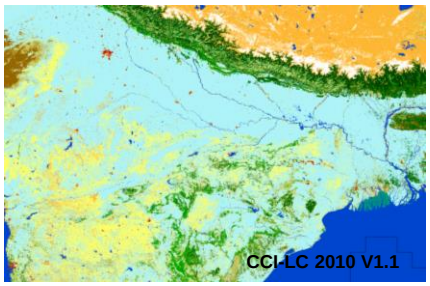
Improved spatial consistency

High level of spatial detail

2010 Epoch – South & Southeast Asia



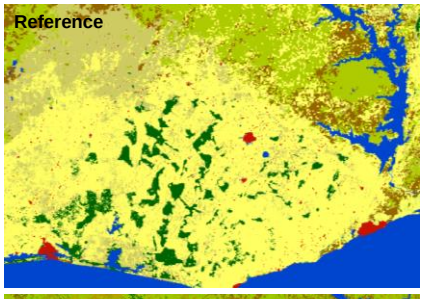


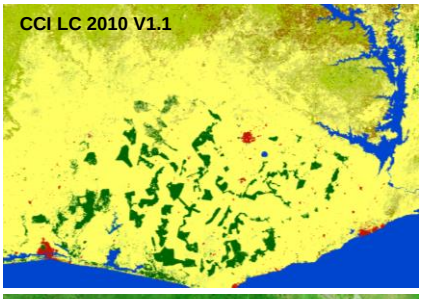


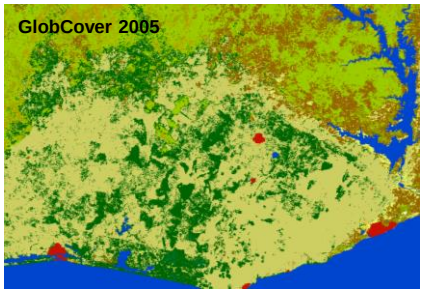
High contamination with irrigated cropland:

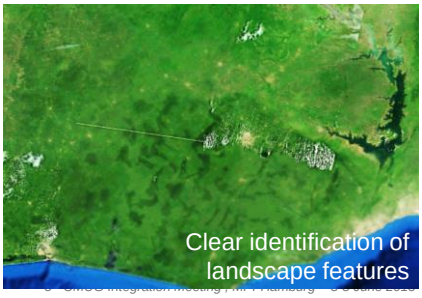
- **out-of-date reference data (GLC2000)**
- **absence of temporal classification**

2010 Epoch – Central Africa

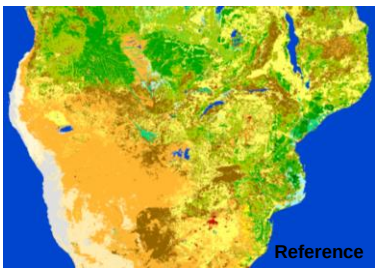


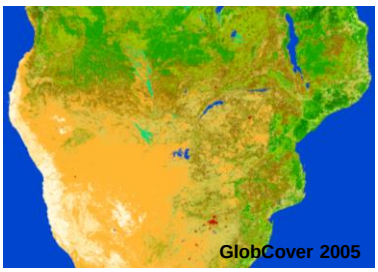






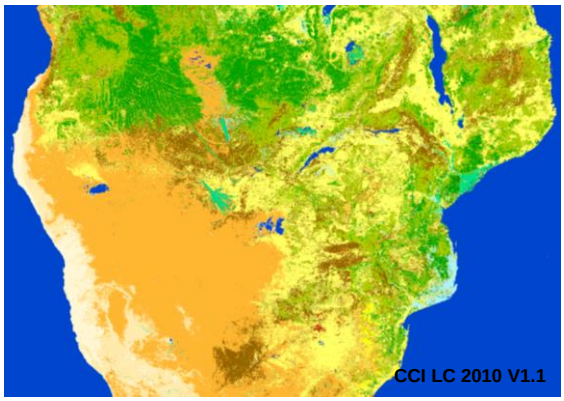
2010 Epoch – South Africa



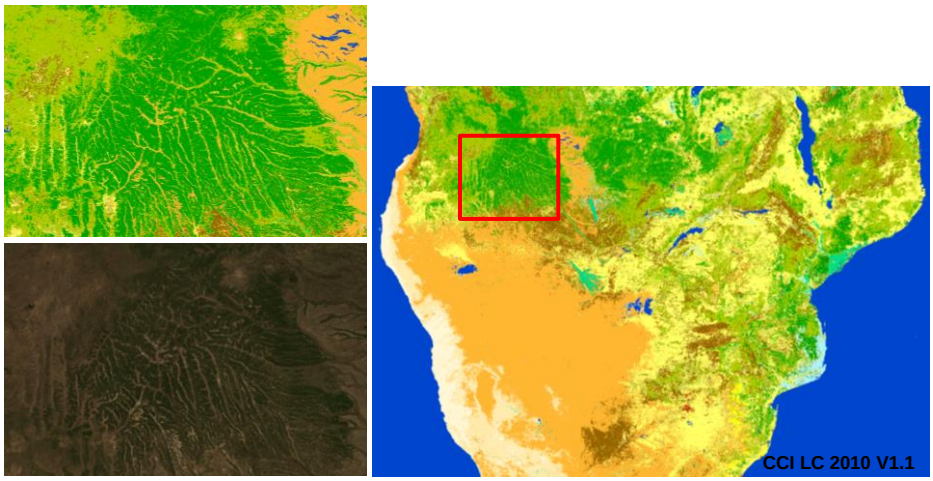


Improved spatial consistency and transition between ecosystems

Better detection of cropland (less mosaic classes)



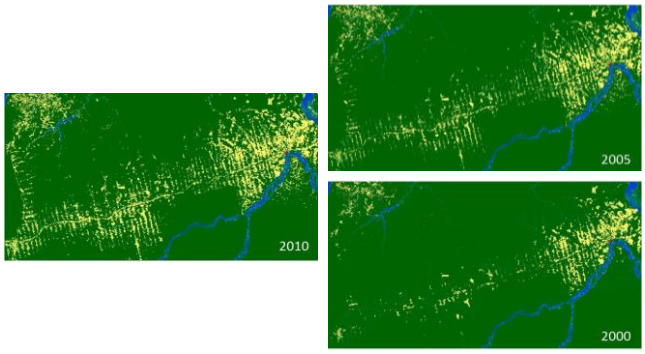
2010 Epoch – South Africa



High spatial accuracy of the mapping thanks to high quality of input data (pre-processing + multi-year approach)

2005 and 2000 epochs

- **Backdating from the « baseline » map**
- **Only applied to some classes yet**

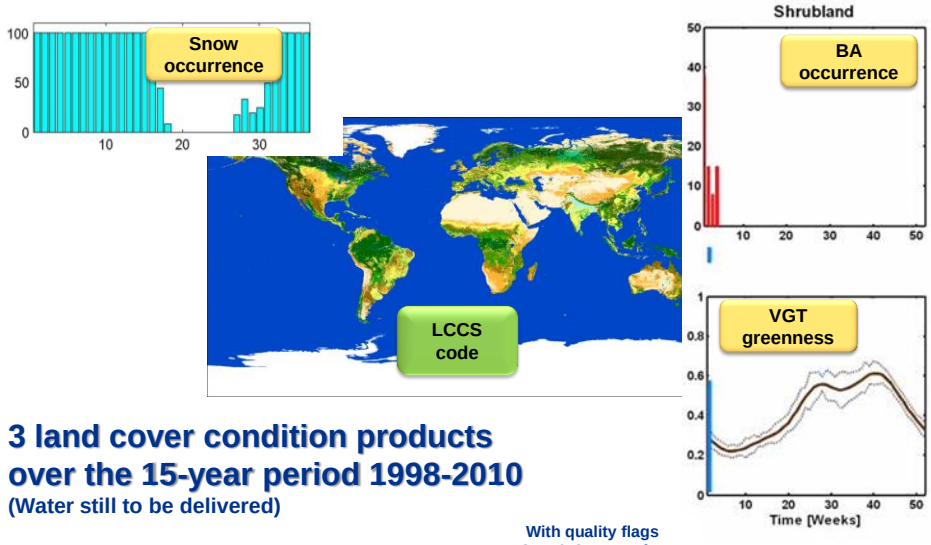


3rd CMUG Integration Meeting , MPI-Hamburg - 3-5 June 2013

LC state products: current status

- Clear improvement in some areas and for some thematic features but still to be validated quantitatively
- Unlike the fully automated approach GlobCover, the LC_CCI classification processing chain opens many possibilities in terms of input and method combinations
- Still room of improvement:
  - Classification parameters tuning (e.g. Asia)
  - Multi-year approach for backdating to be further applied
  - Multi-sensor integration

Delivery of CRDP (3/5) : LC conditions



3 land cover condition products over the 15-year period 1998-2010
(Water still to be delivered)

With quality flags
NetCDF & GeoTIFF format

LC condition concept

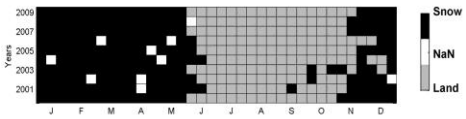
LC-state : forest and croplands

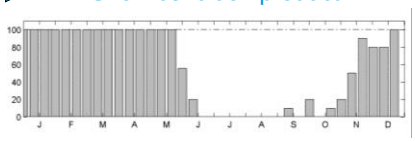
LC-condition : snow

July 2007

Nov 2007

Instantaneous observations → Snow condition product





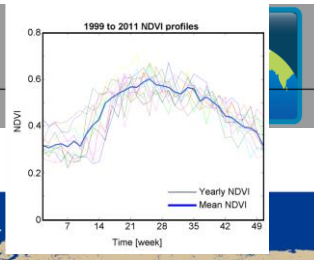
Sources for LC conditions

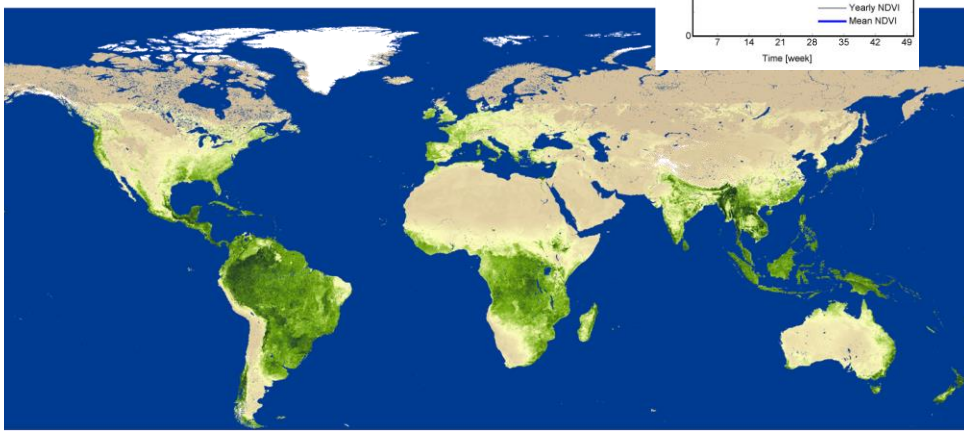
- **Built from existing global datasets with high temporal frequency and long-term data sets**
- **The condition is a compilation of time series to derive 'climatological records'** (average year and inter-annual variability) **from 13 years of 7-d composite time series**

Condition	Input dataset	Spatial resolution	Temporal coverage
NDVI	SPOT-VGT	1km	1999 – 2011
BA	MCD64A1	500m	2000 – 2012
Snow	MOD10A2	500m	2000 – 2012
Water	SPOT-VGT	1km	1999 – 2011

Not yet delivered

NDVI Condition



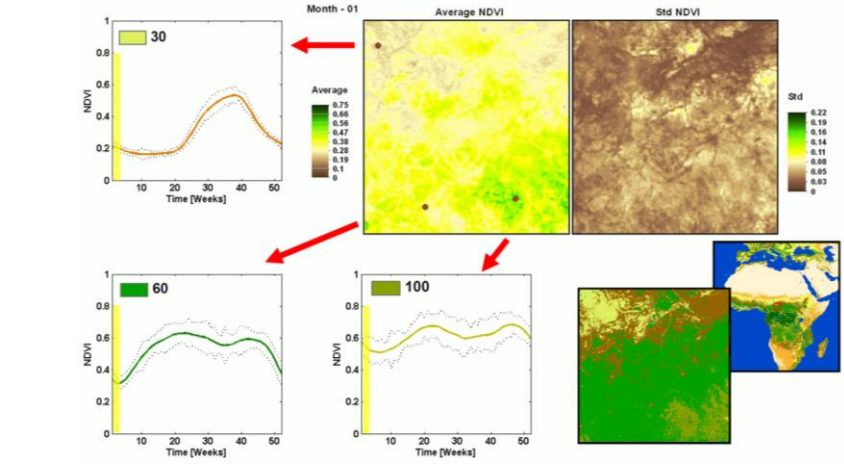


NDVI - 101

Verheggen et al. 2012

NDVI Condition

30 : Mosaic cropland (>50%)

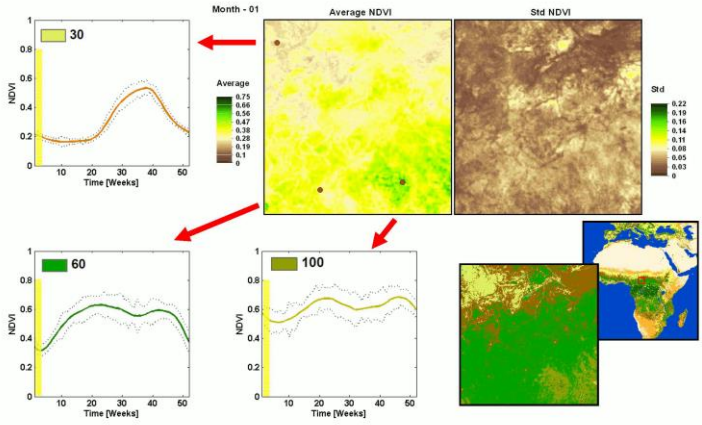


60 : Tree cover, broadleaved deciduous, closed to open (>15%)

100 : Mosaic tree and shrub (>50%)

NDVI Condition

30 : Mosaic cropland (>50%)

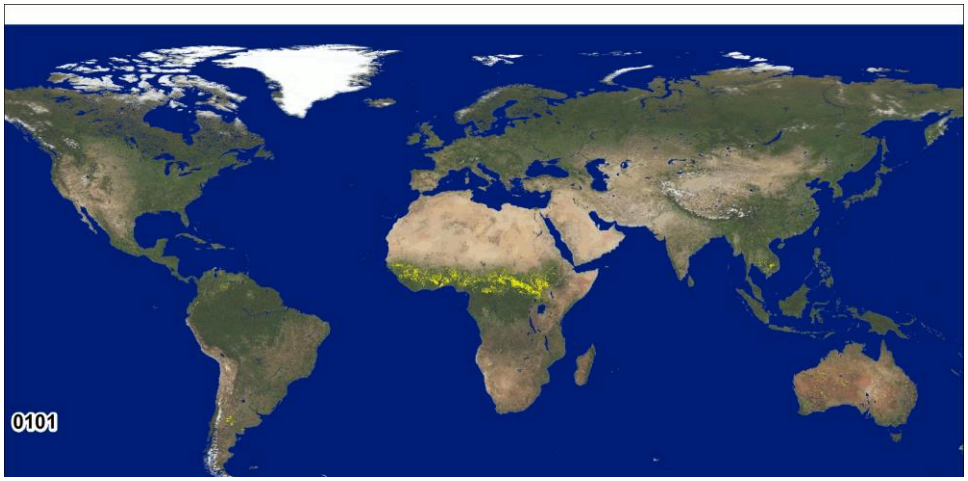


60 : Tree cover, broadleaved deciduous, closed to open (>15%)

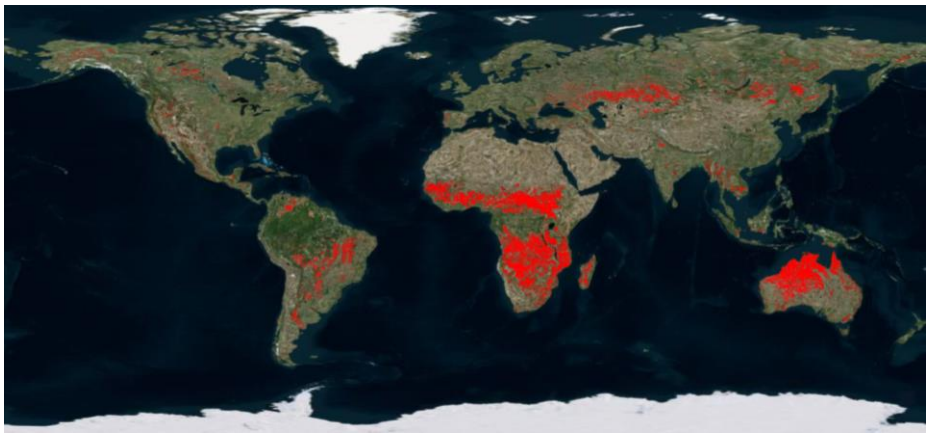
100 : Mosaic tree and shrub (>50%)

3

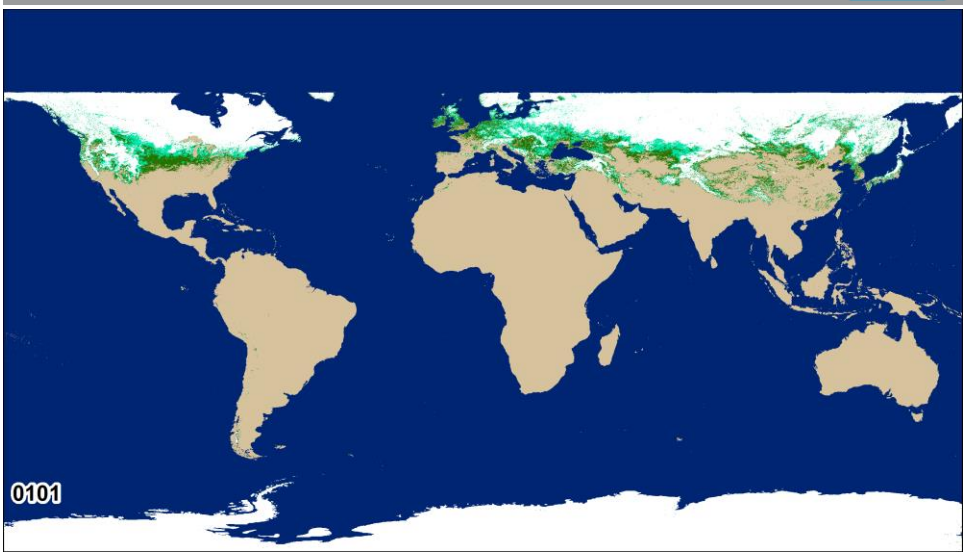
BA Area Condition



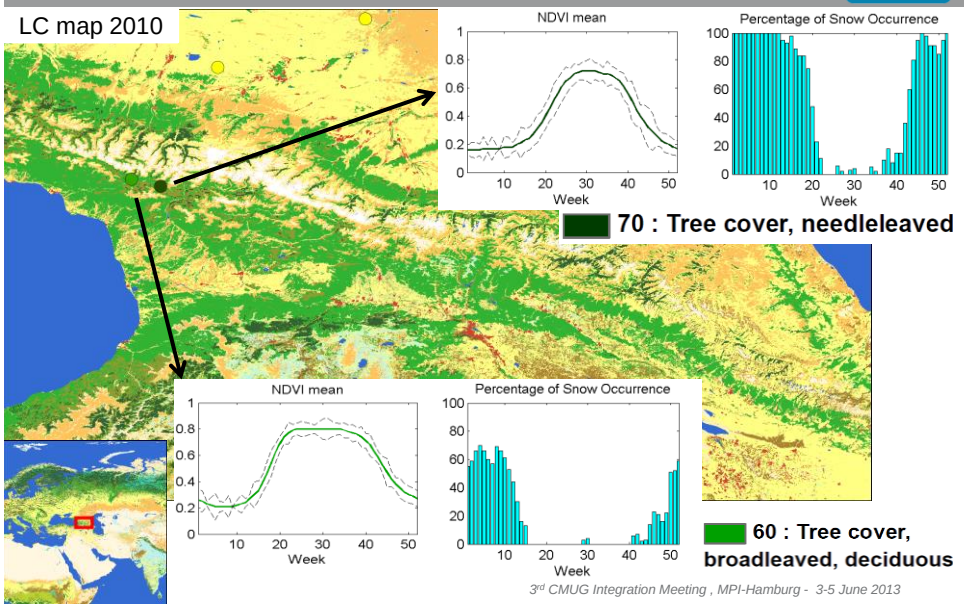
Maximum extent BA condition



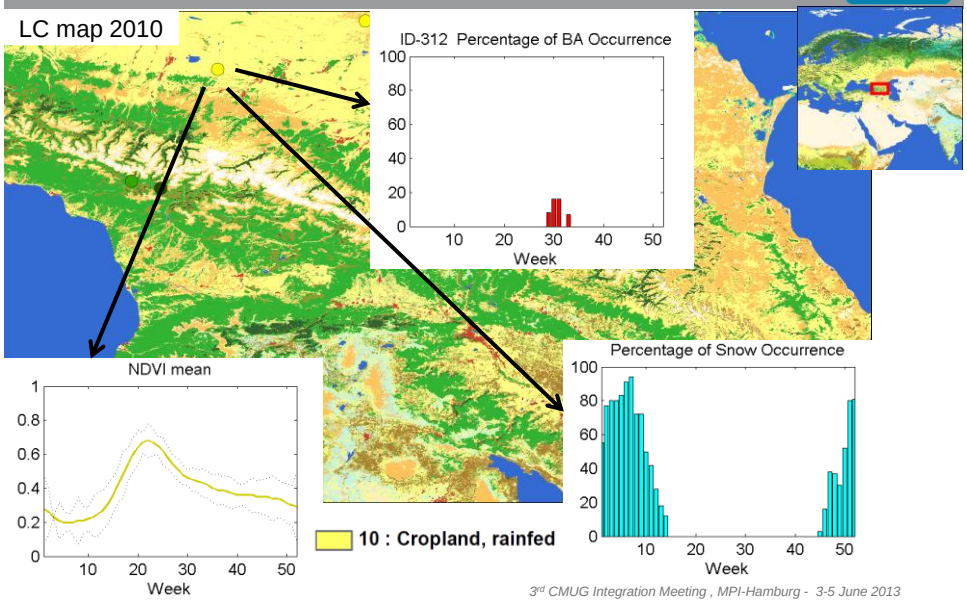
Snow condition



Variety of NDVI and Snow conditions
Caucase (1)

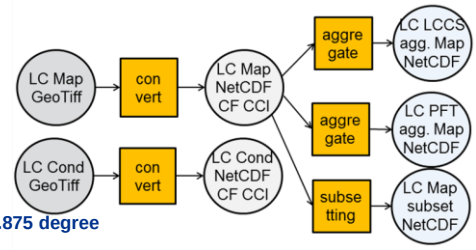


High condition seasonality
Caucase (2)

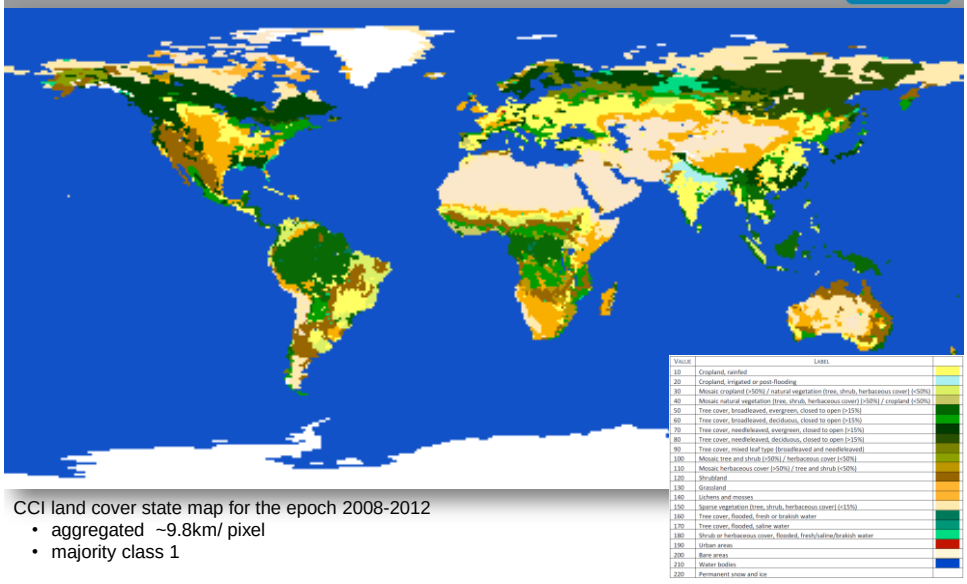


Delivery of Aggregation tool for Spatial conversion and PFT conversion

- **Subsetting**
  - **Free specification of regional subset (4 corner coordinates)**
- **Reprojection**
  - **Original projection (Plate-Carrée)**
  - **Gaussian grid**
  - **Rotated lat/lon grid**
- **Resampling**
  - **Original resolution**
  - **0.25 degree, 0.5 degree, 1 degree, 1.875 degree**
  - **1.875 x 1.25 degree**
  - **3.75 x 2.5 degree**
- **PFT conversion**
  - **with default table**
  - **with user-defined table**

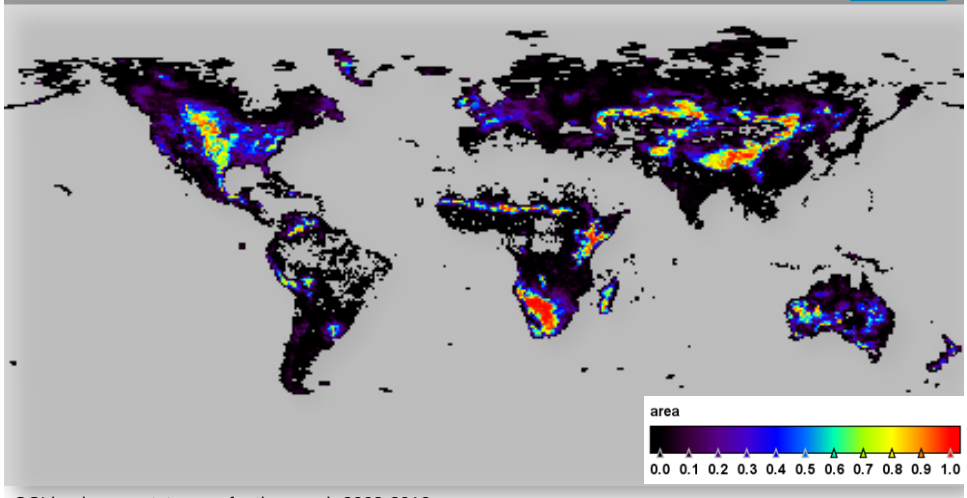


Output: CCI Land Cover state map @ 10km



CCI land cover state map for the epoch 2008-2012
- aggregated ~9.8km/ pixel
- majority class 1

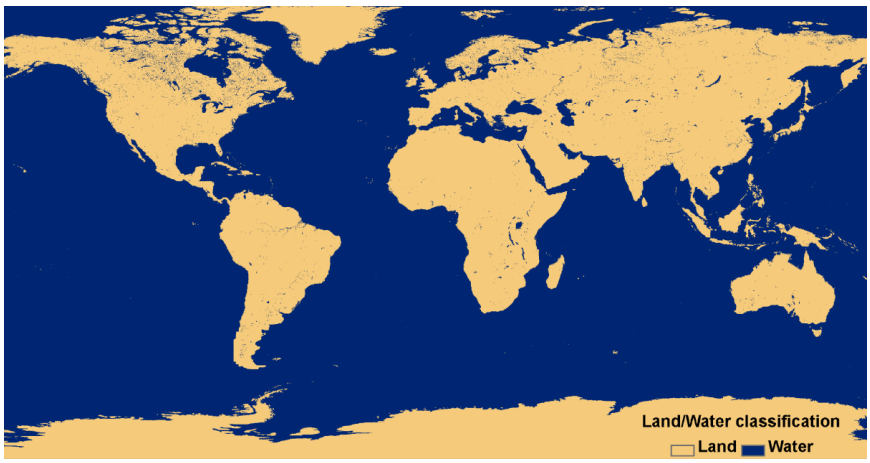
Output: CCI Land Cover state map @ 10km



CCI land cover state map for the epoch 2008-2012

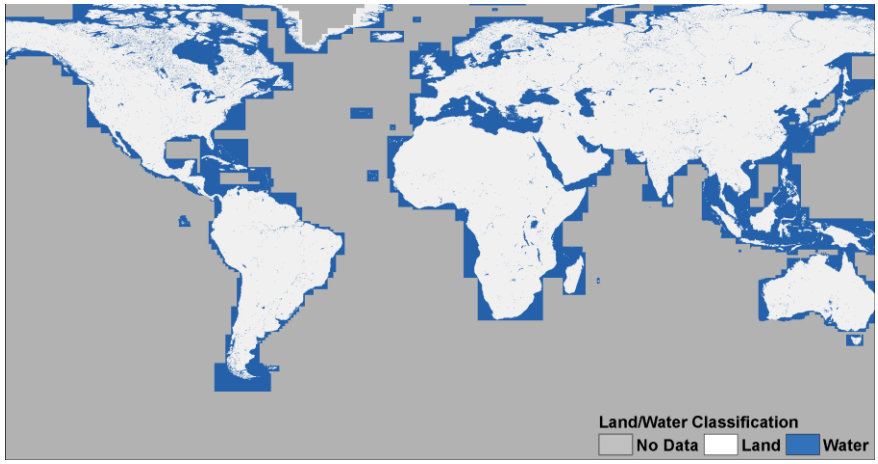
- aggregated ~9.8km/ pixel
- area of CCI LC class – 130 – grassland

Delivery of CRDP (5/5) : SAR-based Perm. Water Body product



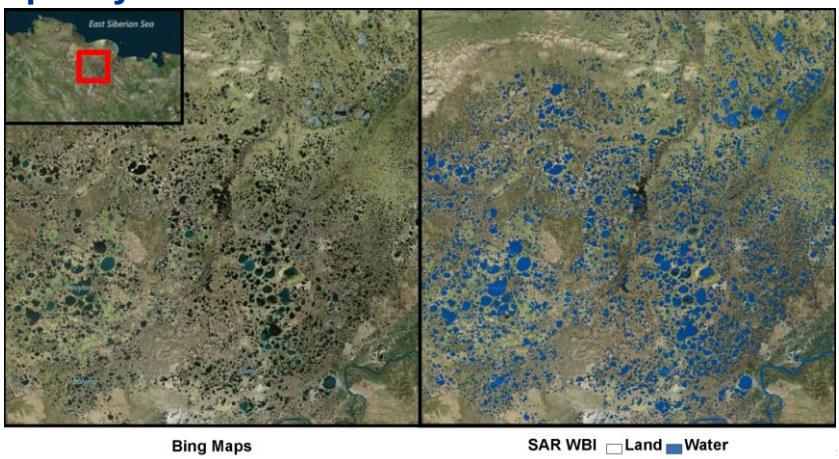
Global permanent water body product derived from Envisat ASAR archive between 2005 - 2010

SAR WB Indicator
a land/water classification layer



SAR WBI visual assessment (1)
based on a comparison against HR imagery

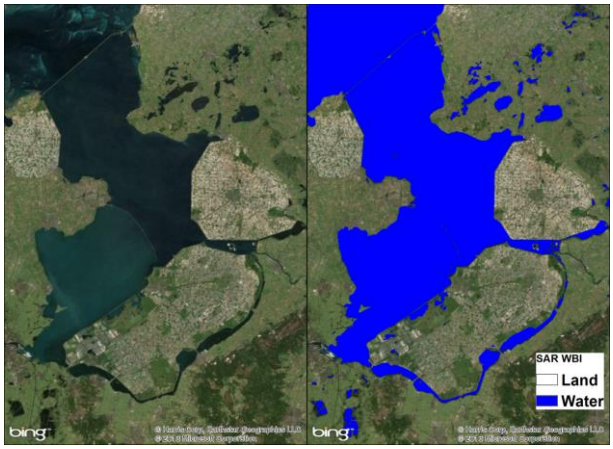
- **High density of SAR data (> 60°N) allows high quality classification**



SAR WBI visual assessment (2)

based on a comparison against HR imagery

- Great quality in many places – example in the Netherlands

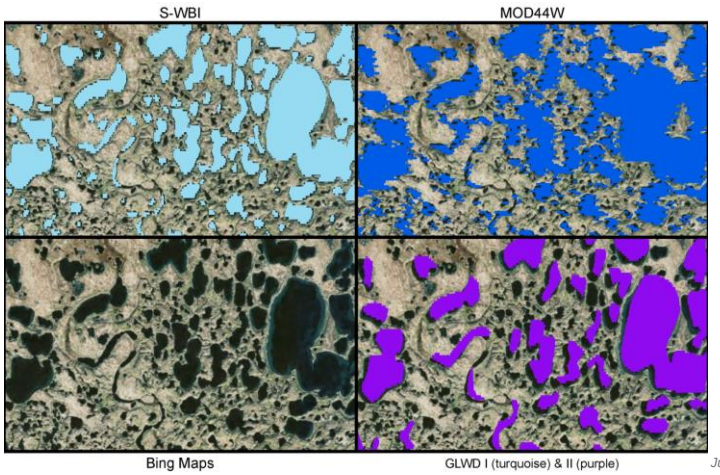


SAR WBI visual assessment (3)

based on a comparison against HR imagery

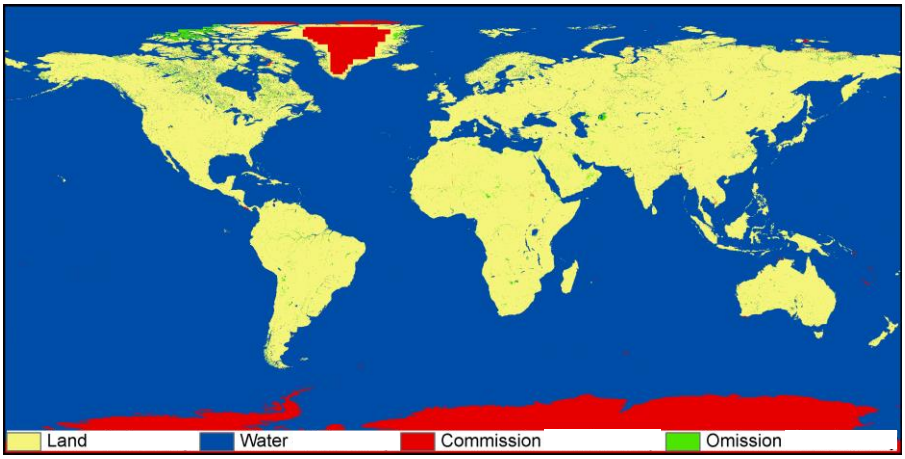
Eskimo Lakes - Northwest Canada

- Some issues, for instance where glaciers are considered as land
- Above 60° N SAR-WBI performs much better than MOD44W and GWLD



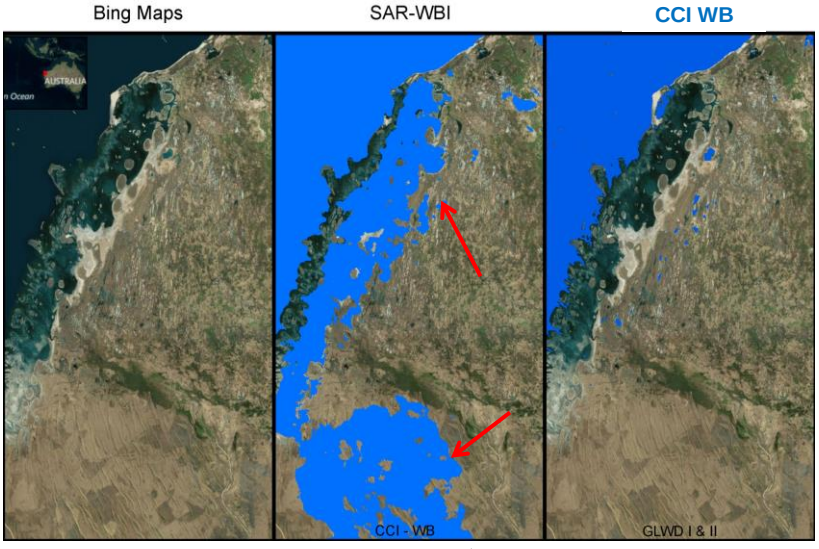
Discrepancy assessment (2)

- **Layer of potential discrepancies**



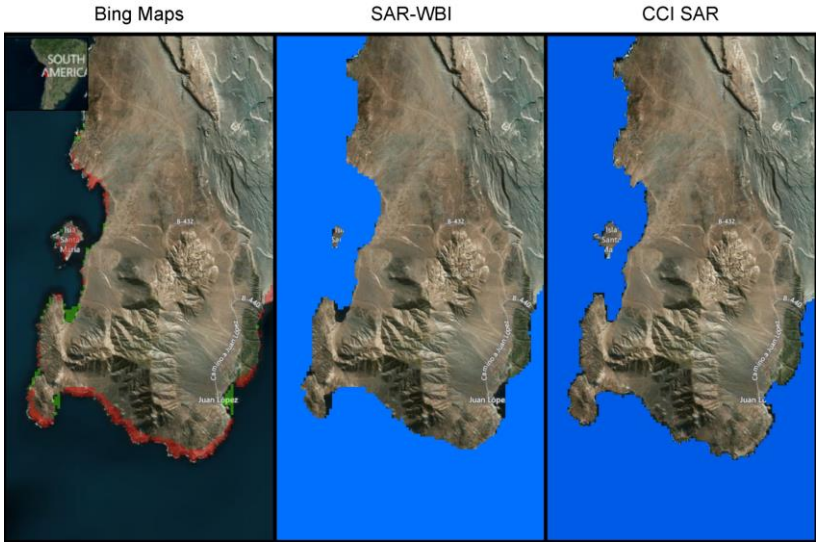
Consolidation examples

Improve coastline delineation



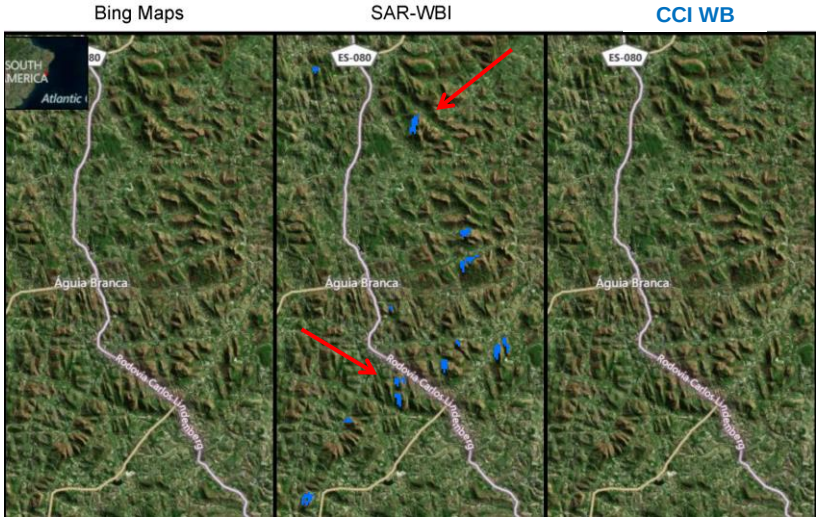
esa Consolidation examples

Improve coastline delineation



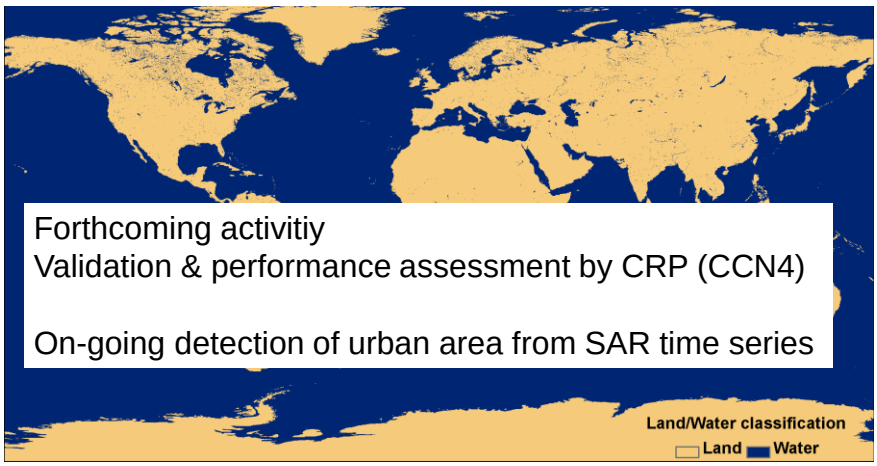
esa Consolidation examples

Remove false detection in mountain areas



LC_CCI WB Product

Consolidation
Spatial resampling to 300m



Forthcoming activitiy
Validation & performance assessment by CRP (CCN4)

On-going detection of urban area from SAR time series

Met Office
Hadley Centre

Modelling effects of land cover on climate and hydrology

Edward Pope, Michael Sanderson and Andrew Hartley

ECVLCOVER meeting, 29-30 May, ESRIN, Italy.

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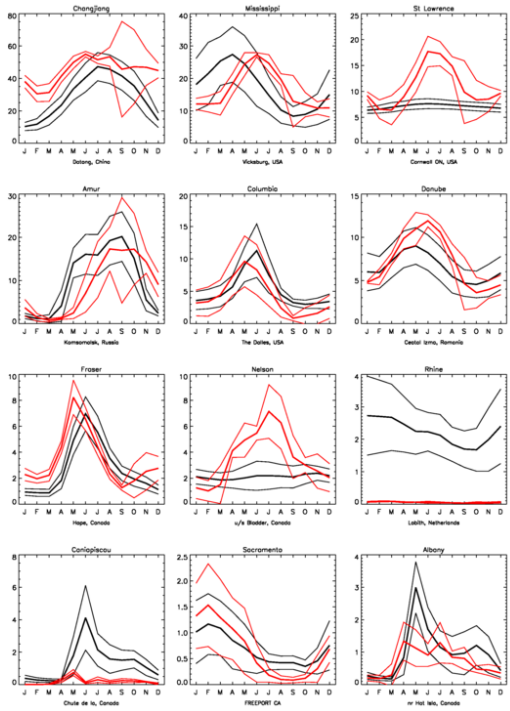
Met Office Hadley Centre

Medium Latitude

Modelled Flow

Observed Flow



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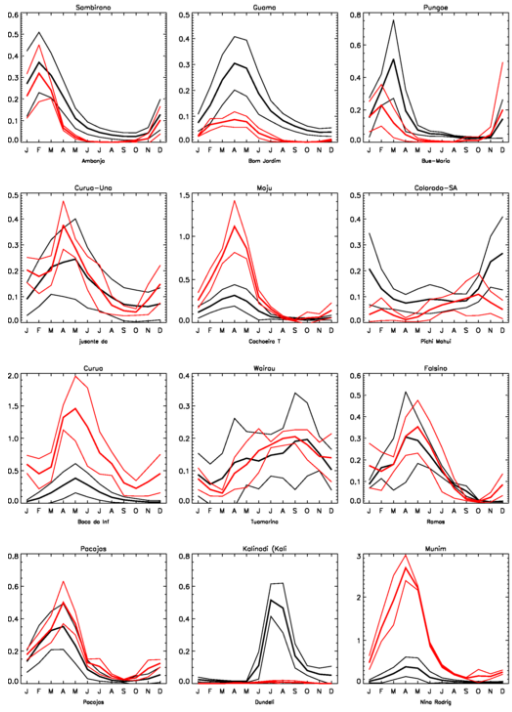
Met Office Hadley Centre

Low Latitude

Modelled Flow

Observed Flow



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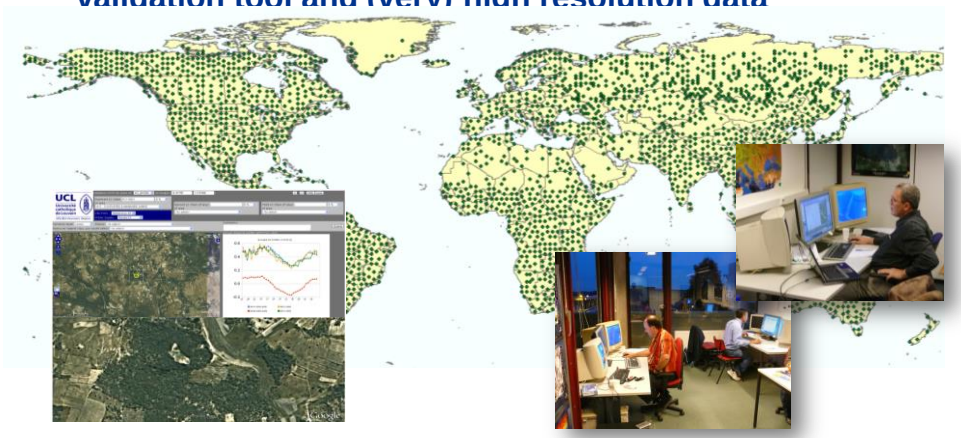
Global independent validation

- **2500 Primary Sampling Units globally distributed, and assessed by experts for 3 epochs using specific validation tool and (very) high resolution data**



Thank you for attention

→ CLIMATE CHANGE INITIATIVE | LAND COVER 2008-2012 | 300 m
GlobCover Evolution

European Space Agency