

THE LAND COVER COMPONENT OF THE ESA CLIMATE CHANGE INITIATIVE

GLOBAL MAPPING OF PERMANENT SURFACE WATER BODIES AT 300M



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(9) GAMMA Remote Sensing, Switzerland; (10) ESA-ESRIN, Italy, (11) LIST, Lux



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GAMMA REMOTE SENSING



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5 Terrestrial ECVs in the CCI



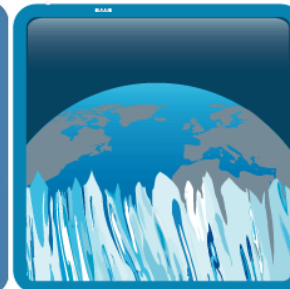
land cover

fire

ice sheets

glaciers

soil moisture



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Science Leaders



Met Office



Universidad
de Alcalá



UCL
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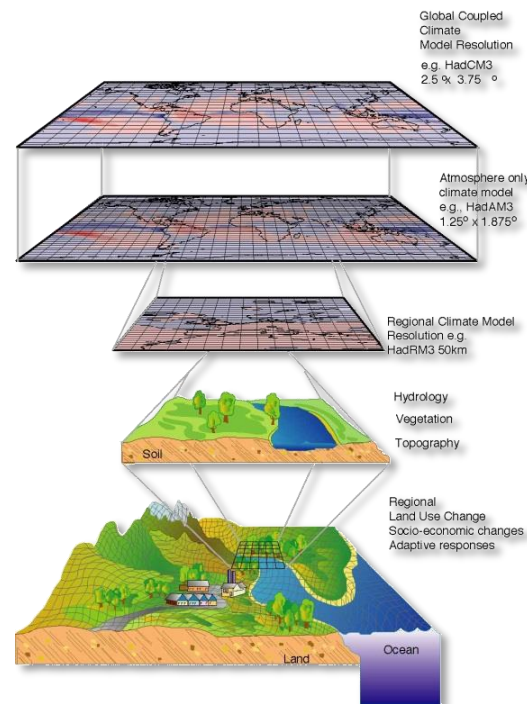
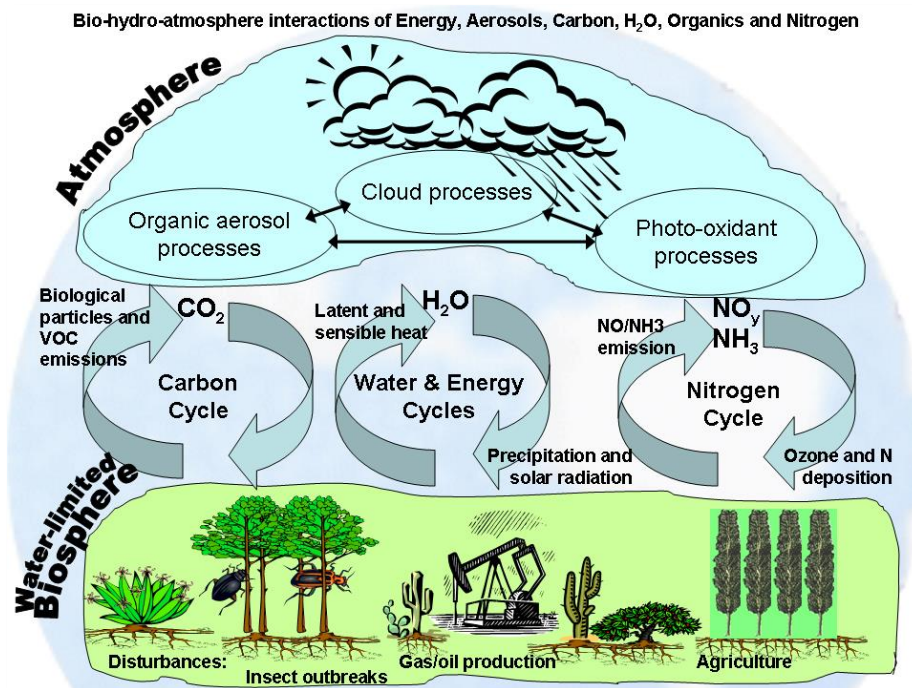


Why do climate modelers care about land surface ?

- Significant impact of terrestrial part to the climate system for:
 - fundamental climate understanding (fluxes of water, C and energy)
 - used in impact and mitigation assessments at various scales

(2010 GCOS Implementation Plan)

→ Requirements for a consistent long term time series of land cover



Land cover maps for 3 epochs

2010 (2008-2012), 2005 (2003-2007), 2000 (1998-2002)



- Input Earth Observation (EO) time series:
 - Envisat MERIS Full Resolution (near-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), 1999-2012)
 - Envisat ASAR WS, IMM & GM from 2005 to 2012

Satellite	Instrument	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ENVISAT	MERIS FR																									
ENVISAT	MERIS										2					2					2					
PROBA-V	VEGETATION-3										0					0					0					
Sentinel-3	OLCI										0					0					0					
SPOT-4	VEGETATION										0					0					1					
SPOT-5	VEGETATION-2										0					5					0					
METOP	AVHRR-3										0										0					

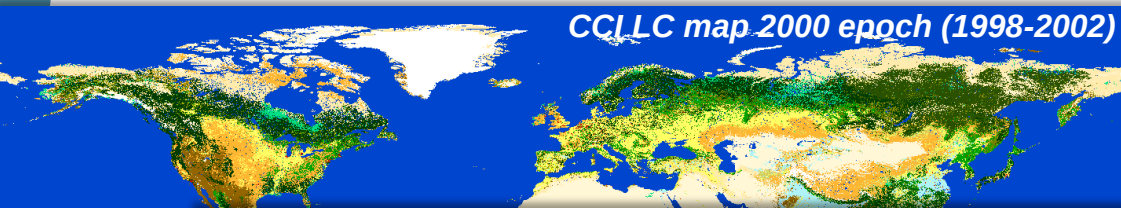
ESA

Europe

→ 3rd global full archive reprocessing of MERIS (160 TB) + VGT (10TB)



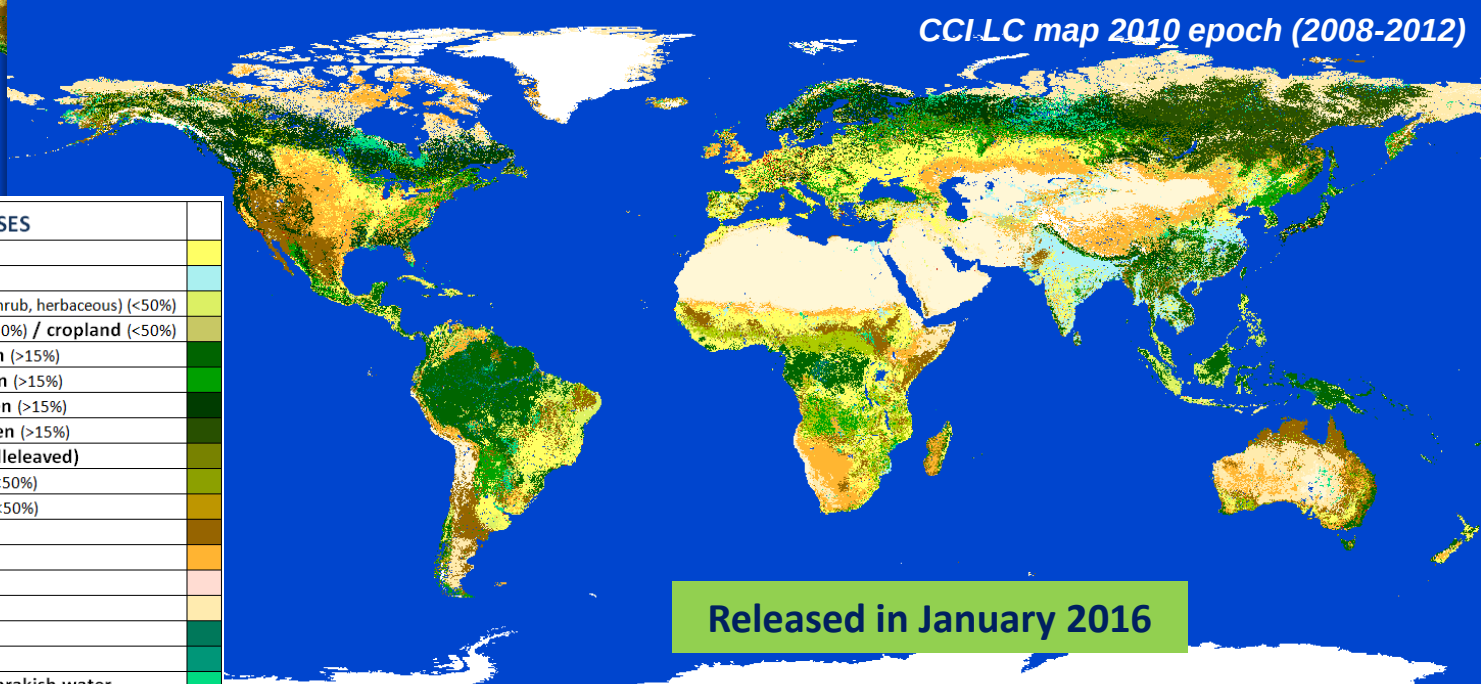
LC maps v1.6.1 currently available for 3 epochs at 300 m



CCI LC map 2000 epoch (1998-2002)



CCI LC map 2005 epoch (2003-2007)



CCI LC map 2010 epoch (2008-2012)

+ 4 quality & uncertainty
flags
and metadata

22 CCI LAND COVER CLASSES

Cropland, rainfed	
Cropland, irrigated or post-flooding	
Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous) (<50%)	
Mosaic natural vegetation (tree, shrub, herbaceous) (>50%) / cropland (<50%)	
Tree cover, broadleaved, evergreen, closed to open (>15%)	
Tree cover, broadleaved, deciduous, closed to open (>15%)	
Tree cover, needleleaved, evergreen, closed to open (>15%)	
Tree cover, needleleaved, deciduous, closed to open (>15%)	
Tree cover, mixed leaf type (broadleaved and needleleaved)	
Mosaic tree and shrub (>50%) / herbaceous cover (<50%)	
Mosaic herbaceous cover (>50%) / tree and shrub (<50%)	
Shrubland	
Grassland	
Lichens and mosses	
Sparse vegetation (tree, shrub, herbaceous cover) (<15%)	
Tree cover, flooded, fresh or brakish water	
Tree cover, flooded, saline water	
Shrub or herbaceous cover, flooded, fresh/saline/brakish water	
Urban areas	
Bare areas	
Water bodies	
Permanent snow and ice	

Released in January 2016

Interactive viewer on-line

<http://maps.elie.ucl.ac.be/CCI/viewer/index.html>

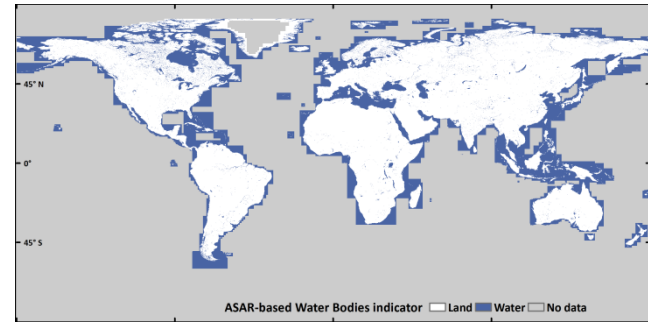
Input data for surface water bodies mapping



- Based on Earth Observation time series mainly at 150 m:

- Envisat ASAR WS, IMM & GM
from 2005 to 2012 → WB Indicator
(Santoro et al., 2014)

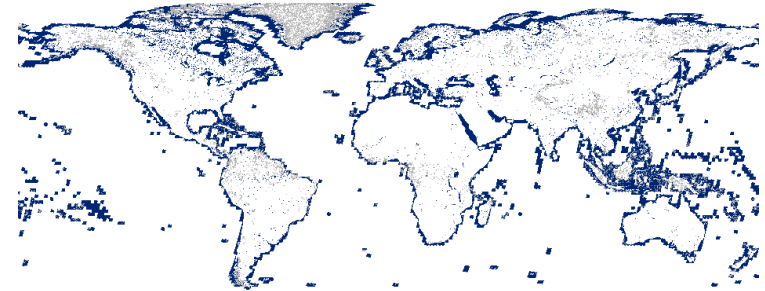
84° N - 60° S, no island



- Consolidated using existing water bodies (WB) datasets at 30 m:

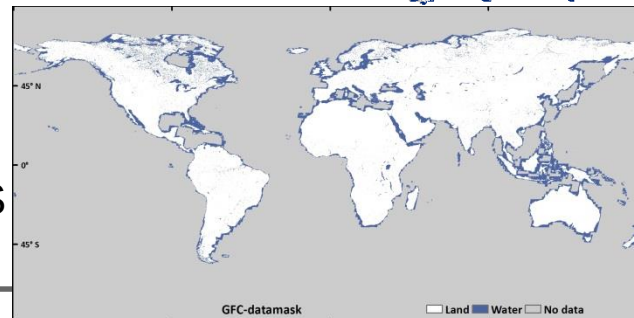
- The Global Inland Water (GIW) v1.0
(Feng et al., 2015)

90° N - 60° S



- The Global Forest Change
(Hansen et al., 2013)

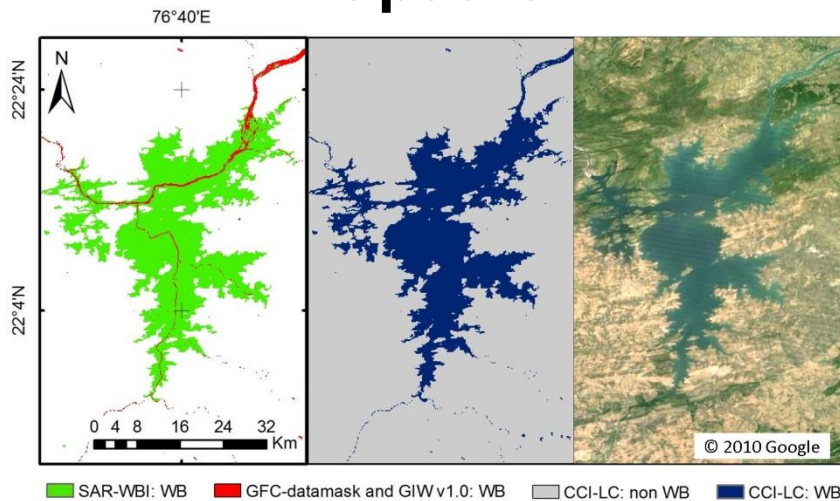
80° N - 57° S



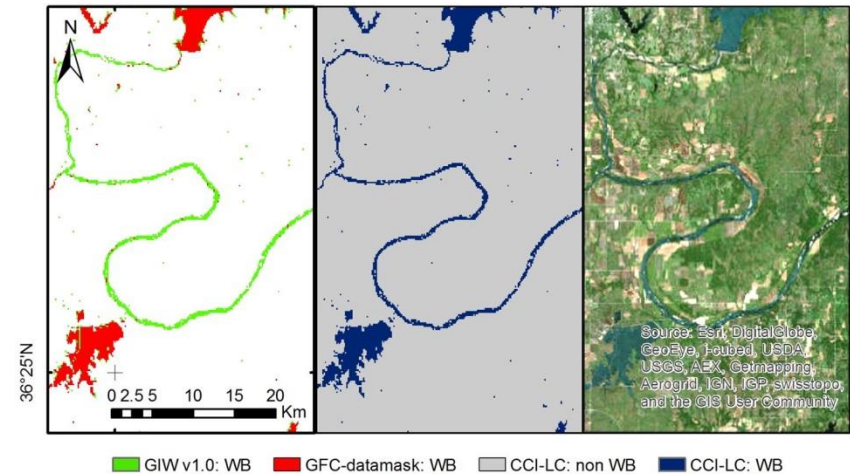
Consolidation taking advantage of synergies between 3 WB products



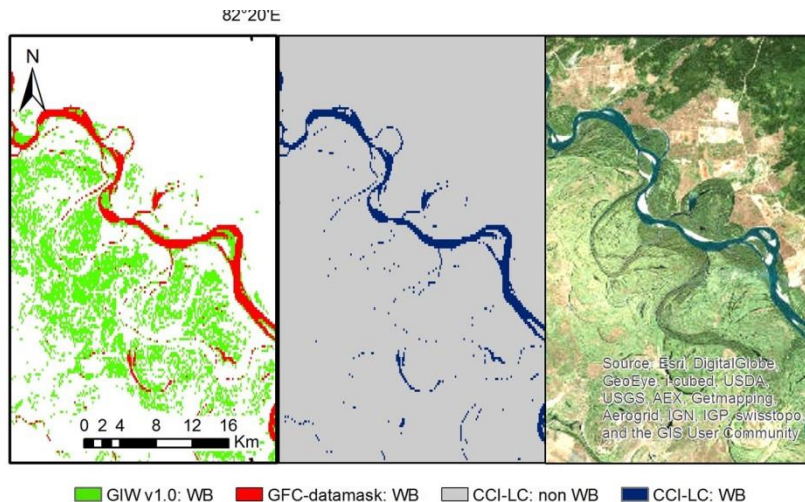
Update



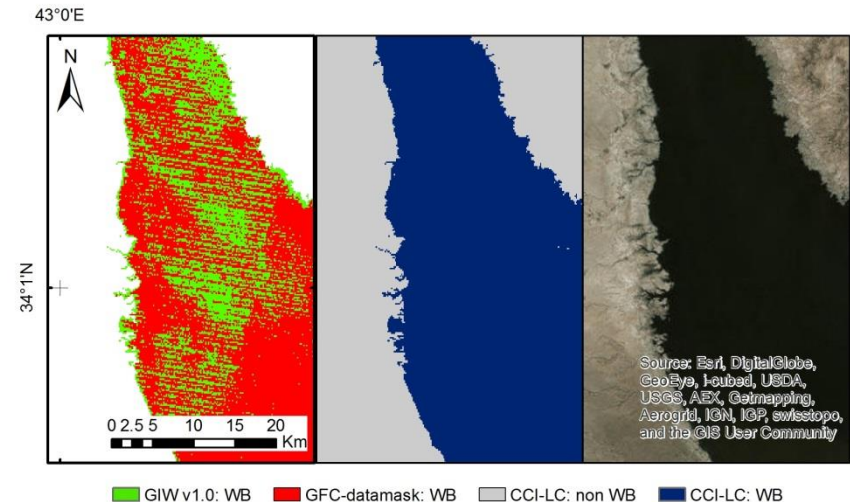
Spatial complementarity



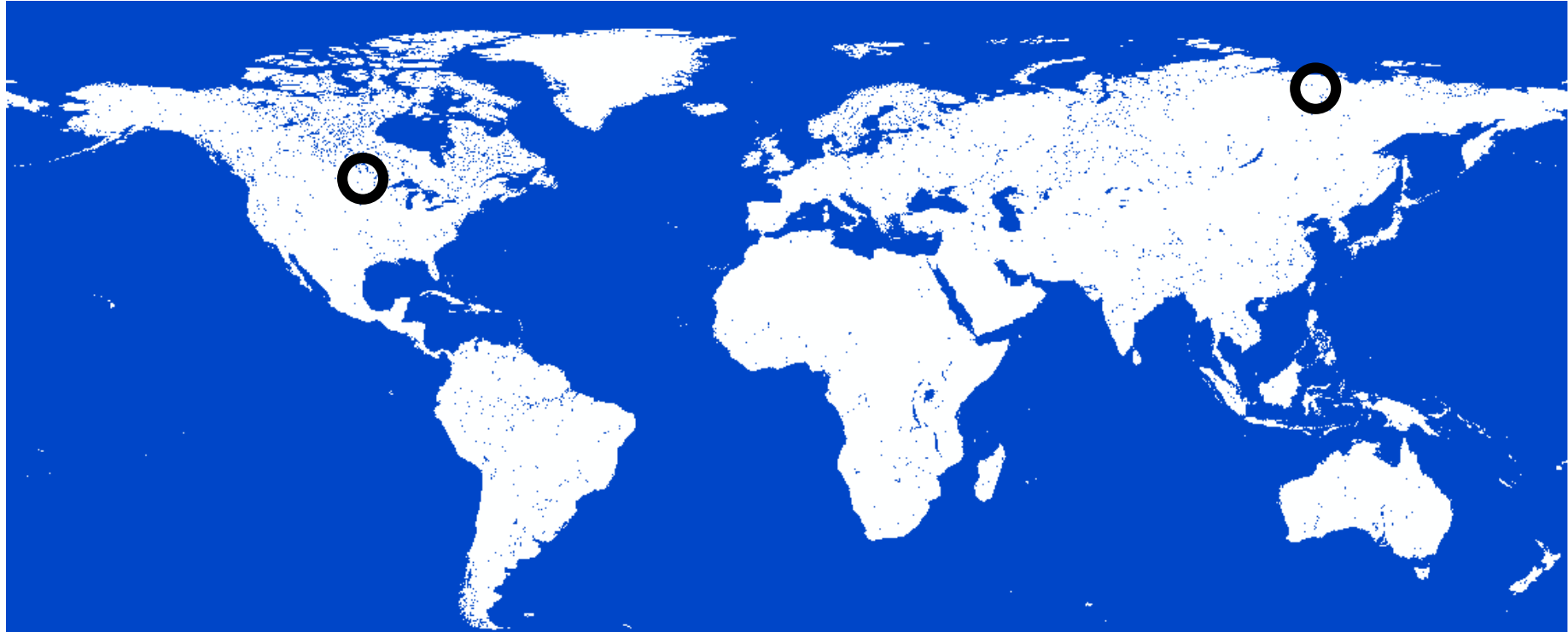
Permanent WB selection



Artefacts correction



Global map of permanent surface water bodies at 150 m



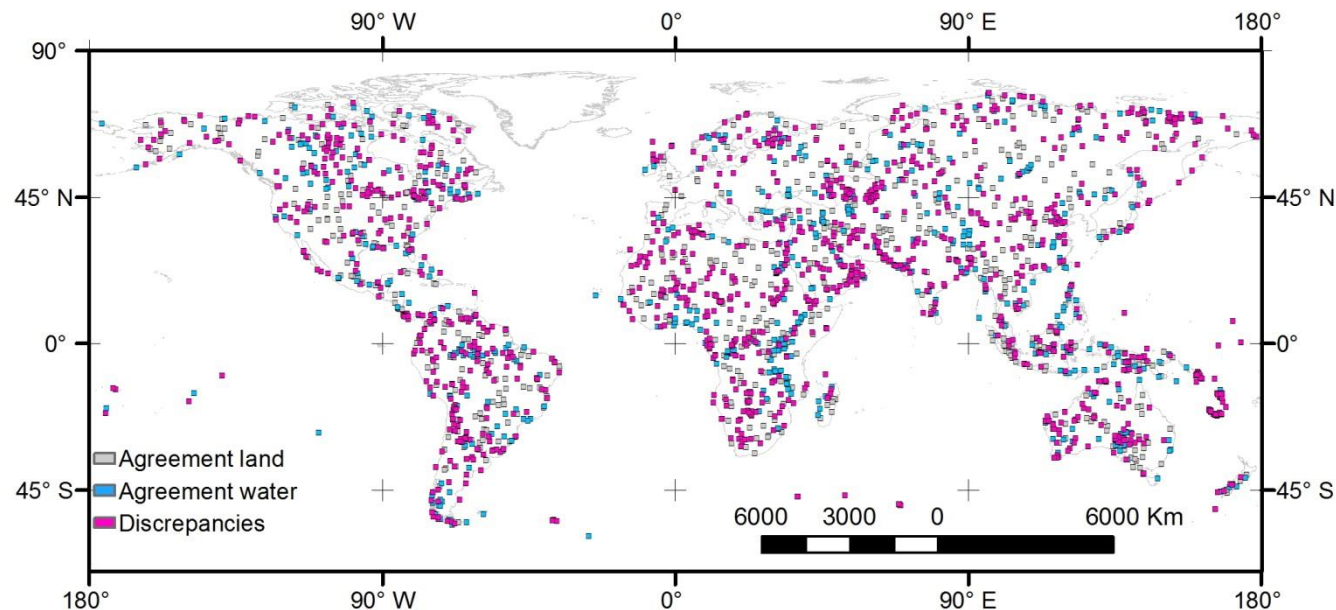
Specific validation database, biased towards error-prone areas



- 2110 samples of 150 x 150 m interpreted using Google Earth Imagery in areas known as error-prone wrt to WB mapping
- Stratified random sampling with
 - 1/2 of samples in error-prone areas wrt to WB mapping
 - 1/4 of samples in areas where land is expected
 - 1/4 of samples in areas where WB is expected

**Biased
Overall Accuracy
89%**

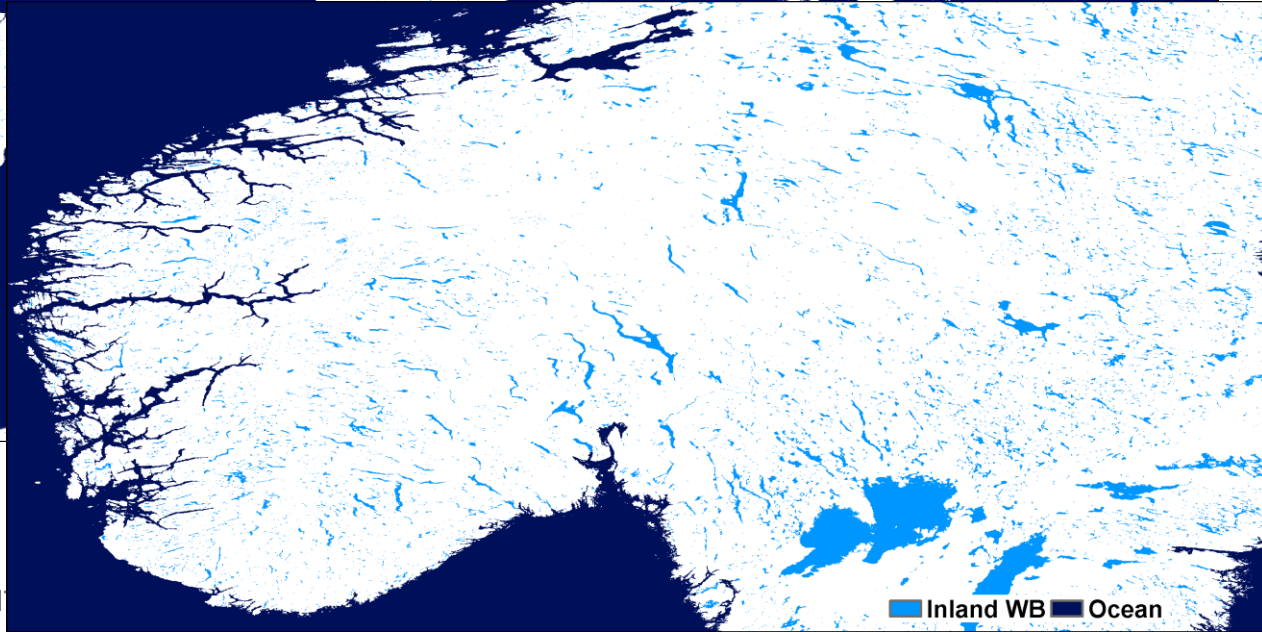
**Unbiased
Overall Accuracy
96%**



Next release: inland water/oceans



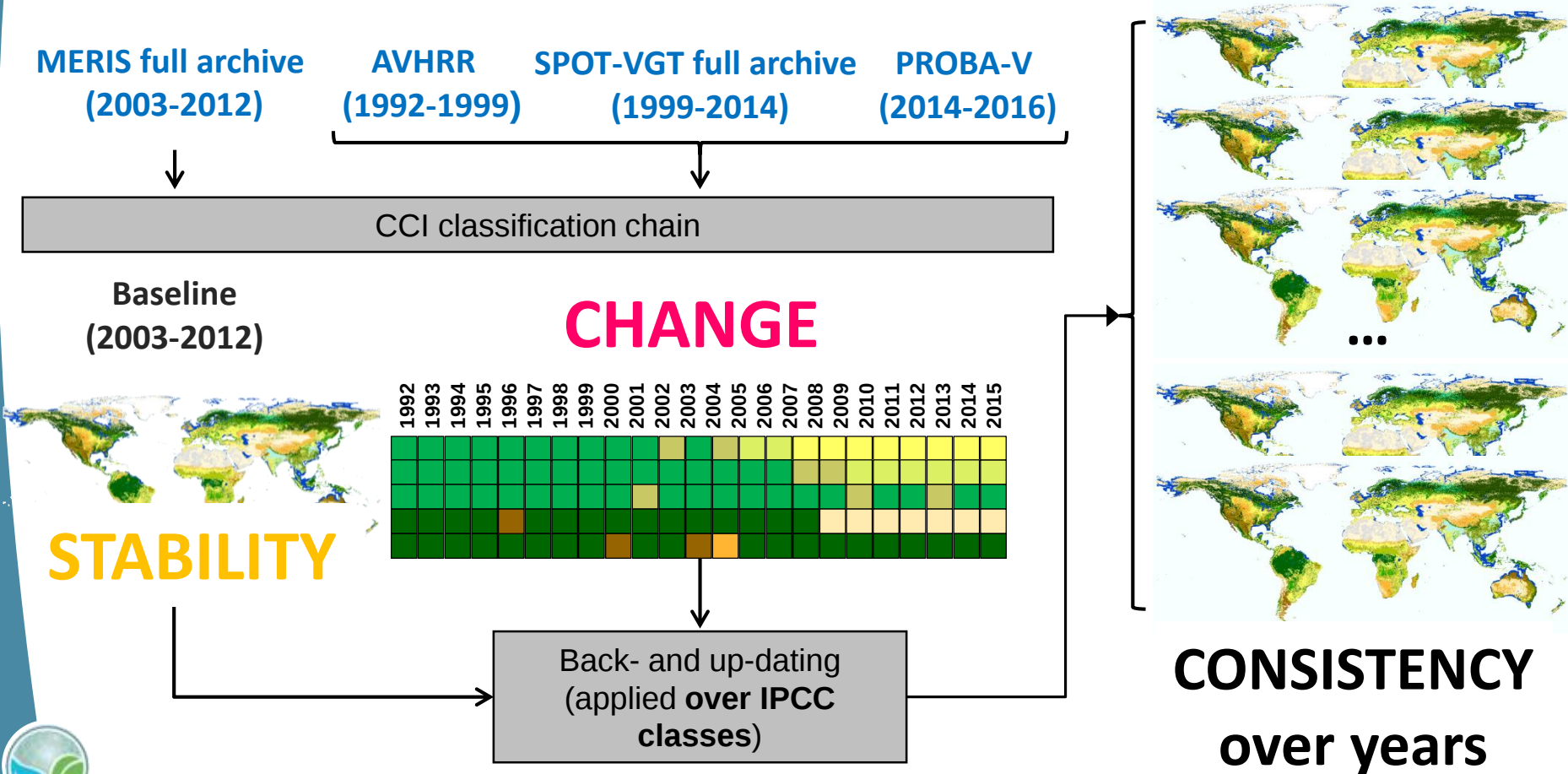
- Required by the climate modelling community of CCI



Next release: temporal extension to annual LC time series from 1992 to 2015

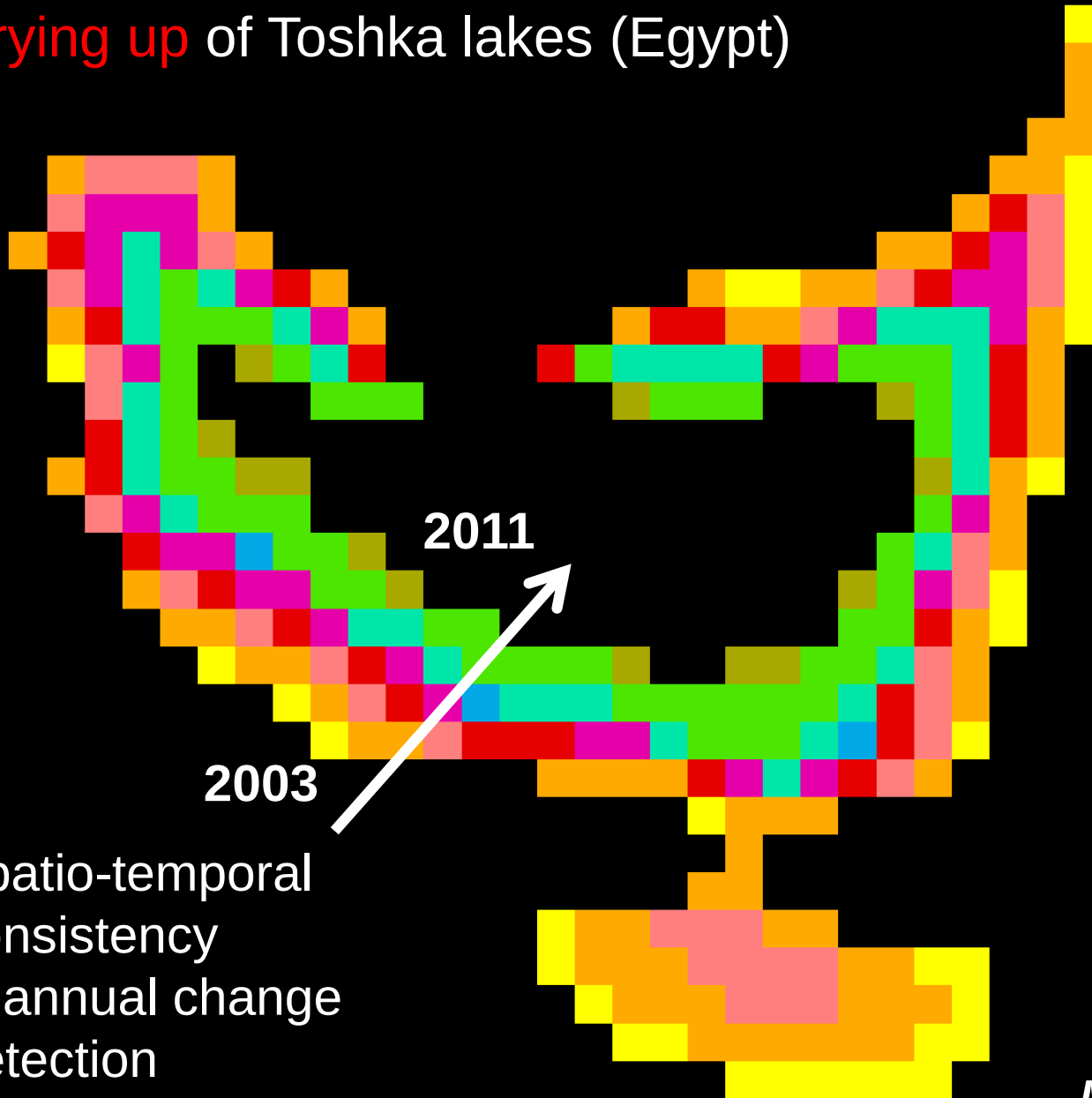
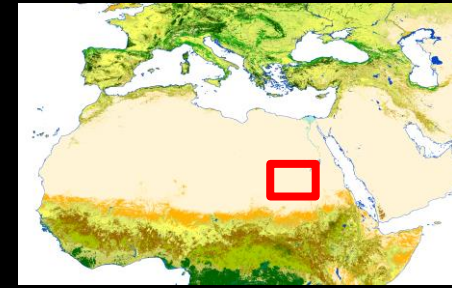


- **Temporal extension** based on AVHRR and PROBA-V
- **Annual change over IPCC classes** (agriculture, forest, grassland, wetland, settlement & other lands (shrubs, bare areas, water)



Water Loss:

Drying up of Toshka lakes (Egypt)



Year of
change

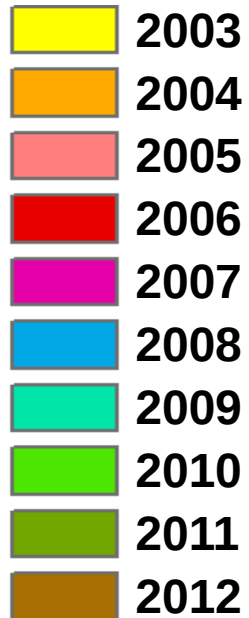


Spatio-temporal
consistency
in annual change
detection

Moreau I.

Water gain:
Hydroelectric project
(Canada)

Year of
change



2005



2006



Moreau I.



**Thank you
for your attention**

<http://maps.elie.ucl.ac.be/CCI/viewer/>

