

Landsat-scale observation and monitoring of global land cover: progress and experiences from China

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And

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April 15, 2013

3rd GOFC-GOLD Land Monitoring Symposium,
Wageningen, The Netherlands

Acknowledgements

- **Le Yu**, Yuanyuan Zhao, Luanyun Hu, Qinchuan Xin, Nicholas Clinton, Tsinghua University
- **Lu Liang**, Yanlei Chen, **Liheng Zhong**, UC Berkeley
- **Zhenguo Niu**, Jie Wang, **Lei Wang**, **Peng Zhu**, Wei Fu, Huabing Huang, Institute of Remote Sensing and Digital Earth, CAS
- **Congcong Li**, Yue Xu, Xueyan Li, **Jin Chen**, Beijing Normal University, China
- **Fangdi Sun**, Nanjing University
- Jun Chen, National Geomatics Center, China
- Zhiliang Zhu, US Geological Survey



Cropland



Validation



Algorithm



Wetland
Change



Forest



Settlement

Products Completed and in progress

		Scope of Work	Completion Time	Plan for Completion	People in Charge
	Wetland Change	China Global	2011 Global	2013	Niu ZG Zhu P
	Validation	China Global	2011 2012	Further Improvement	Liang L Zhao YY
	Algorithm	GA GM	2010 On going	2015	Wang Jie Clinton N
	Land cover	FROM-GLC FROM-SEG FROM-AGG	2011 2012 2012	2000 GLC In 2013	Gong P Yu L
	Cropland	FROM-GC	2013	China Global	Yu L Zhong LH
	Forest	China Global	2013 Global	2000 FC 2013 On going	Xin QC Li CC
	Settlement	China Global	2013 On going	2014	Gong P Wang L

Strategies

- Produce the best maps for China
- Develop environmental database for China in support of scientific applications
- From land cover to land use
- Focus research on hard to map areas – Russia, Africa and India
- Intensify international collaboration networks for validation, scientific application and policy assessment

From avian influenza research to China's wetland maps

2000 – Landsat TM

1990 – Landsat TM

1978 – Landsat MSS

2008 – CBERS

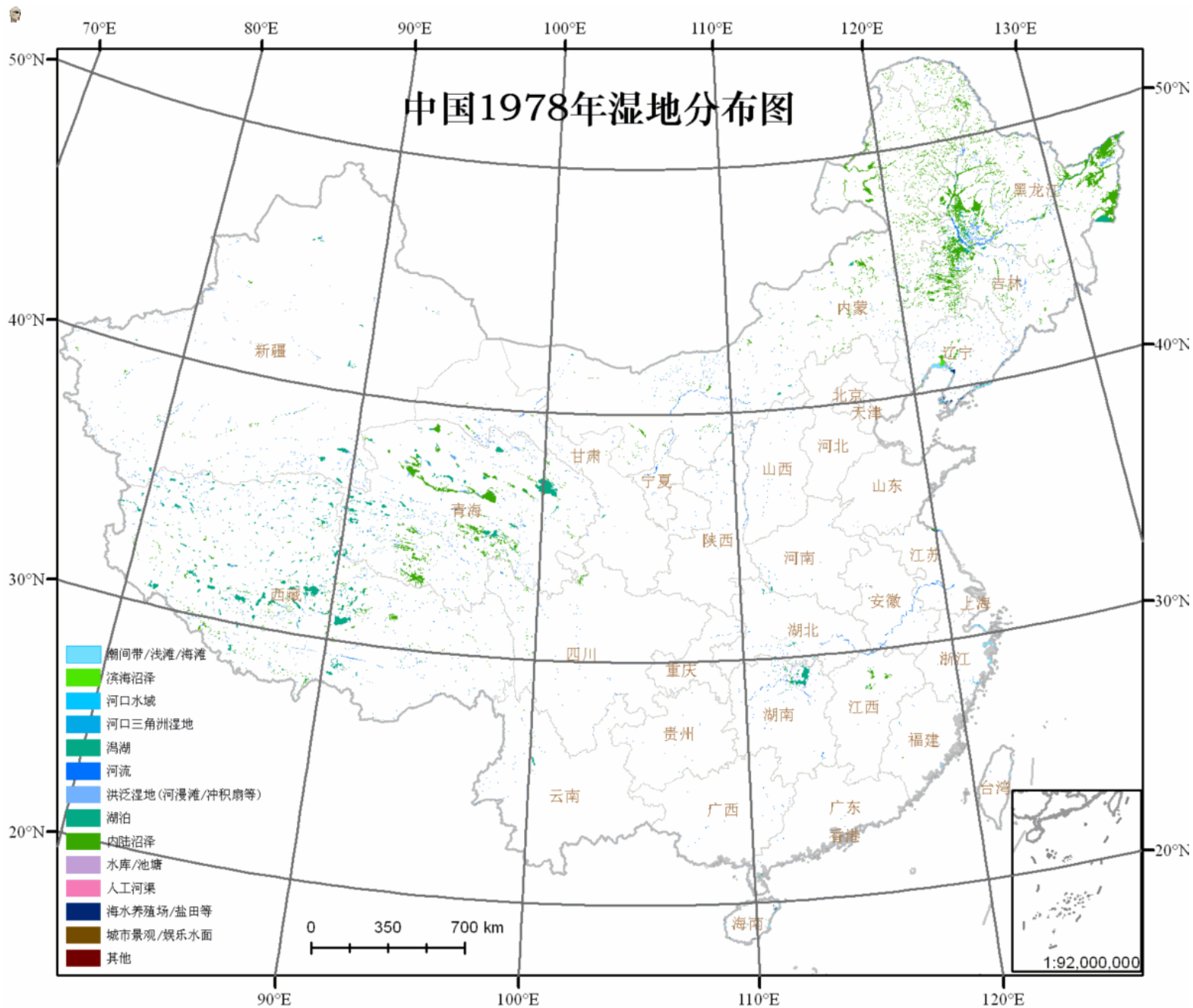
2010 – In progress (to be completed this month)

For references:

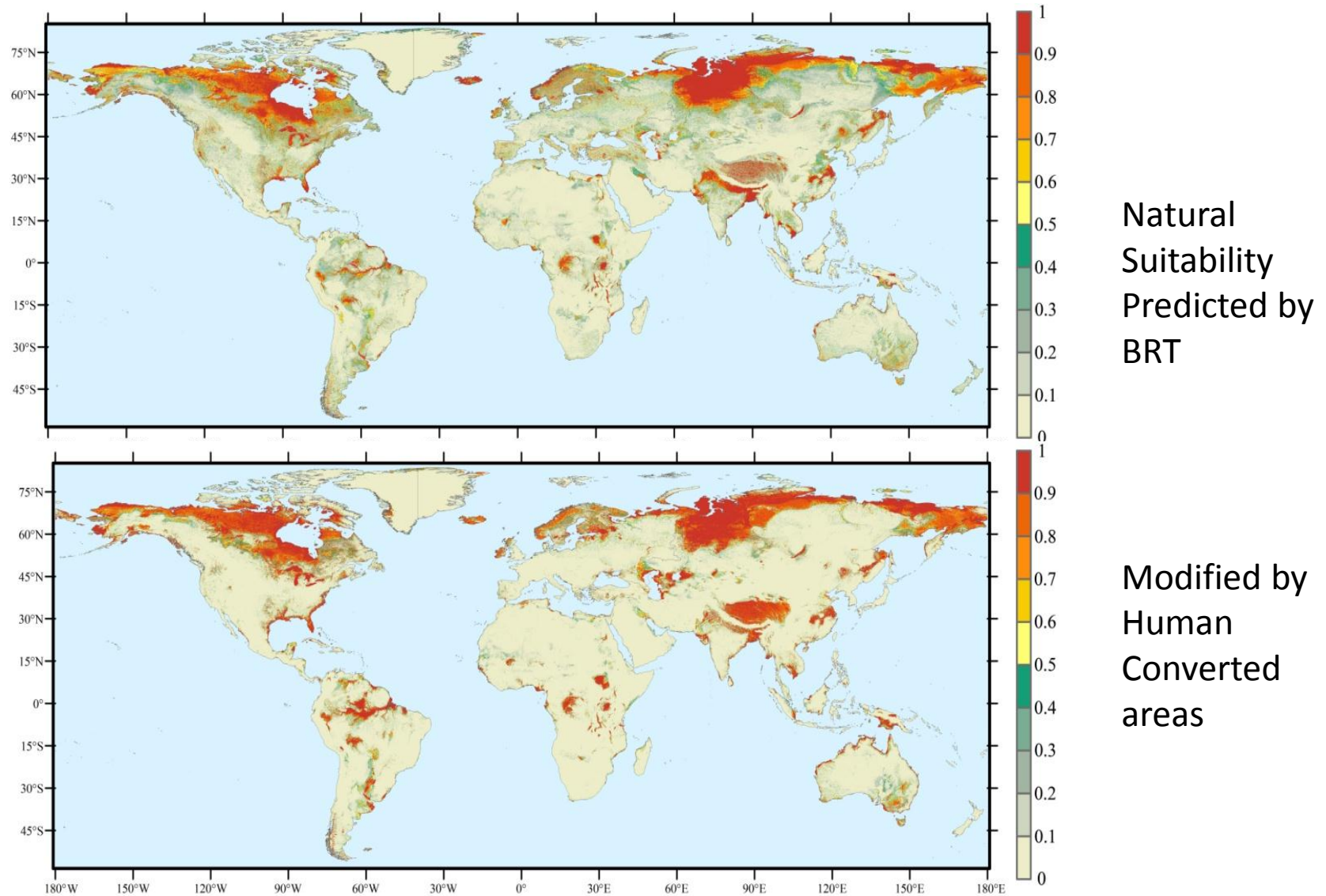
Niu, Gong, Cheng et al., 2009

Gong, Niu, Cheng et al., 2010

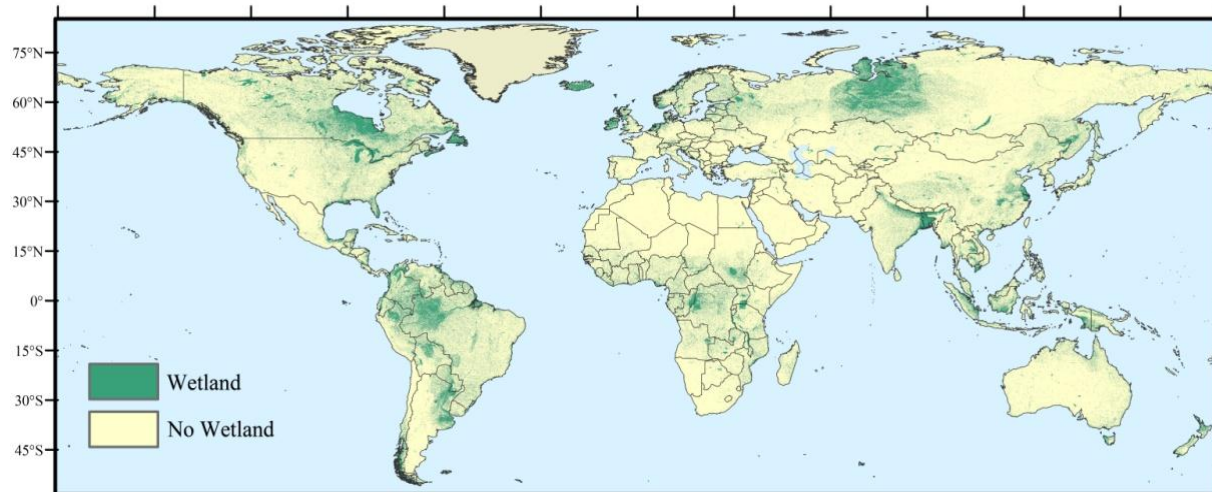
Niu, et al., 2012



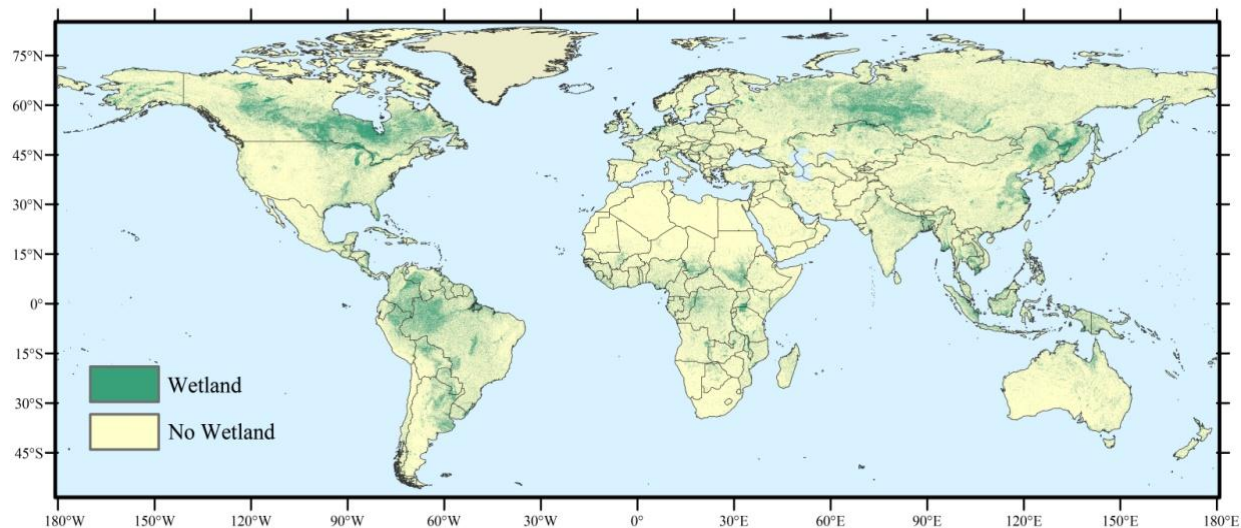
From 1 km global potential wetland mapping to 30 m wetland mapping



From 1 km global potential wetland mapping to 30 m wetland mapping



Modelled
Local
Water
Balance
methods



Interpolated
Modelled
Groundwater
Table
Method

Fan et al, 2013

From health research to China's urban expansion maps

1990 – Landsat TM

2000 – Landsat TM

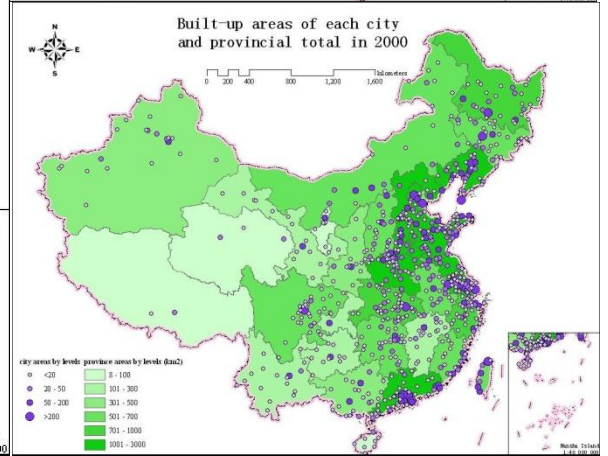
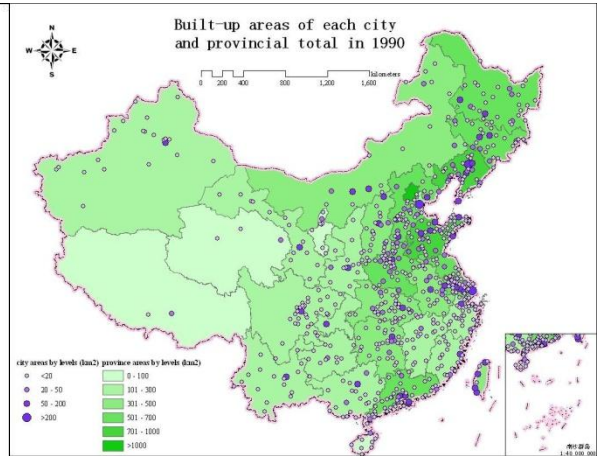
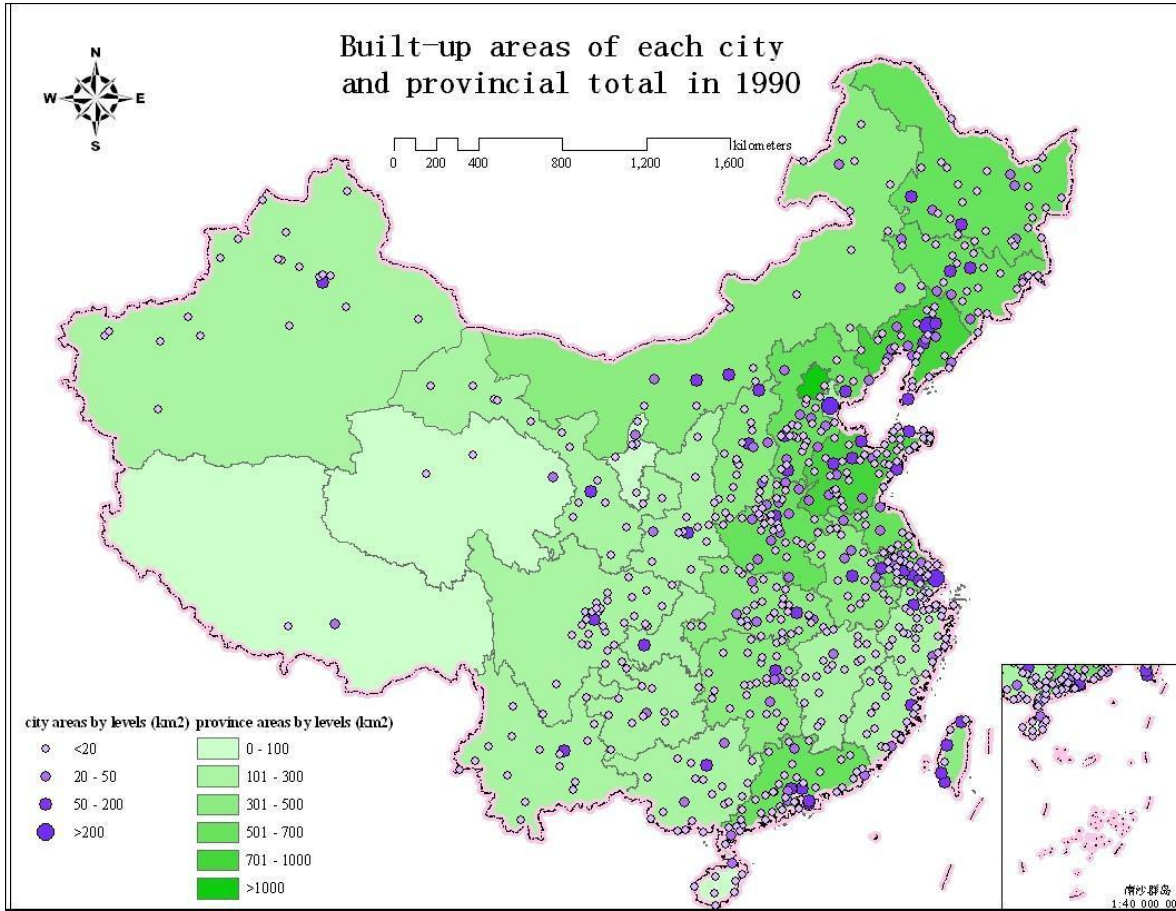
2010 – Landsat TM/ETM+

In progress all settlements that can be mapped in these three years (to be completed in May, 2013)

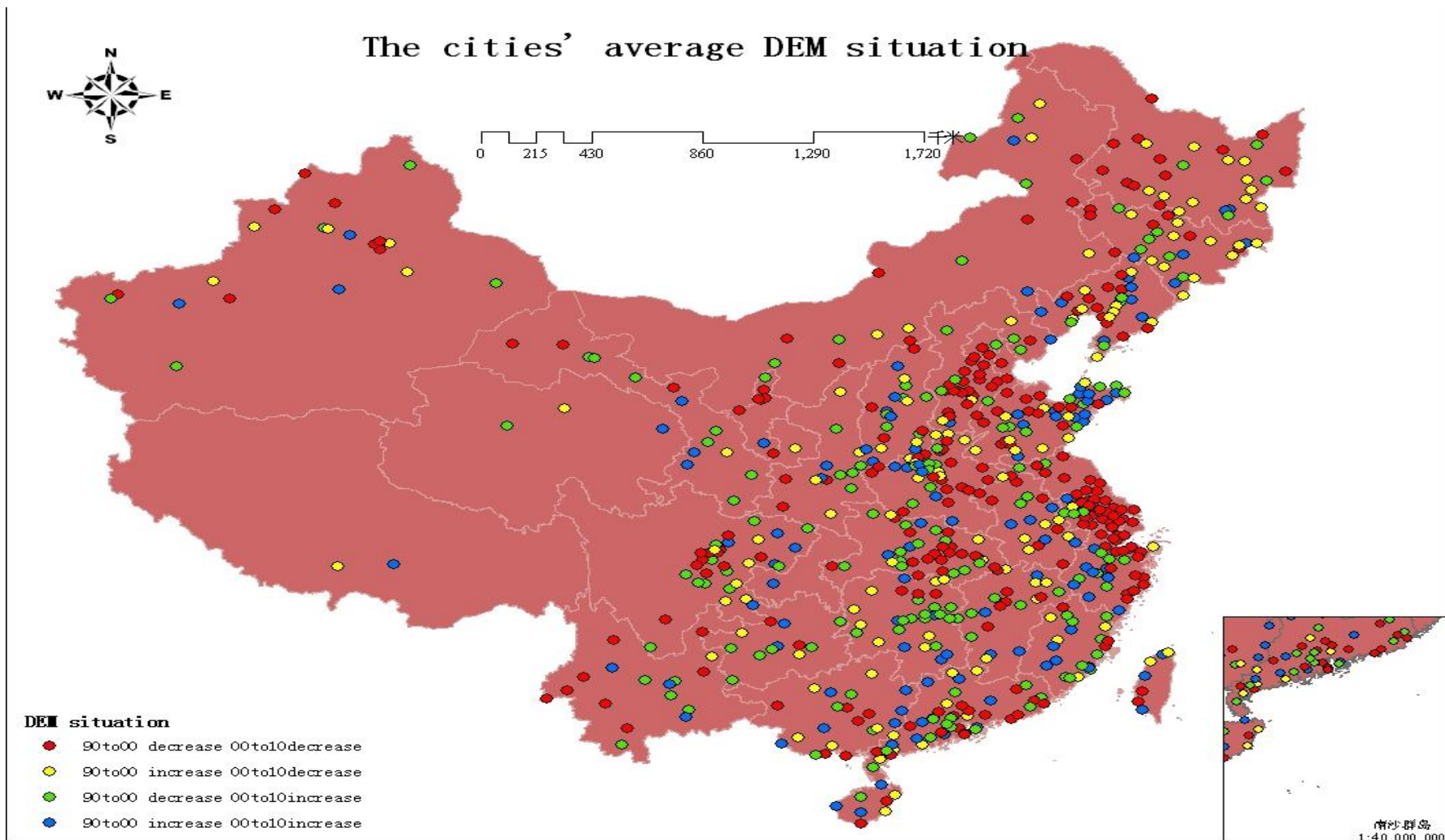
For references:

Wang, Li, Ying, et al., 2012. Chinese Science Bulletin

Gong et al., 2012. Lancet,



82% cities are developing downhill?



Color	90to00	00to10	Number of cities
Red	decrease	decrease	255
Yellow	increase	decrease	129
Green	decrease	increase	161
Blue	increase	increase	118

Three existing 30m land cover map products

FROM-GLC – only used Landsat TM or ETM+ data

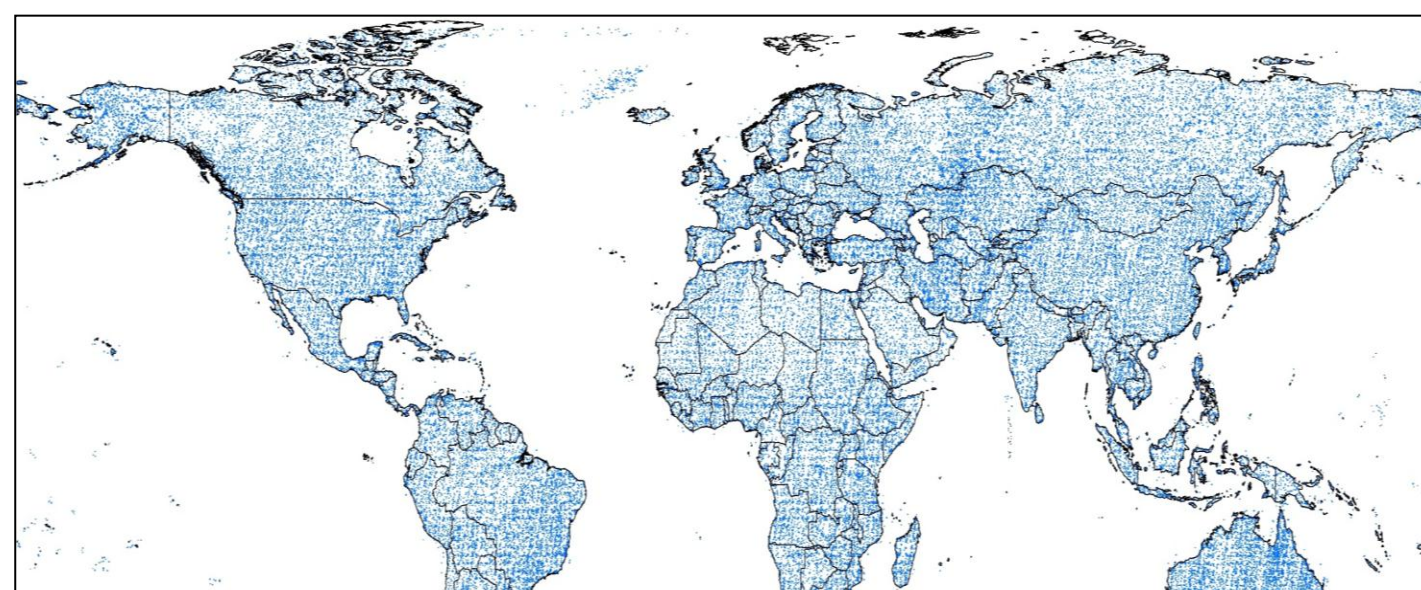
FROM-GLC-SEG used Landsat, 250m MODIS 16 day time series and other bioclimatic data products

FROM-GLC-AGG aggregates previous two products, NOAA night light impervious surface area and Boston/Wisconsin urban land products

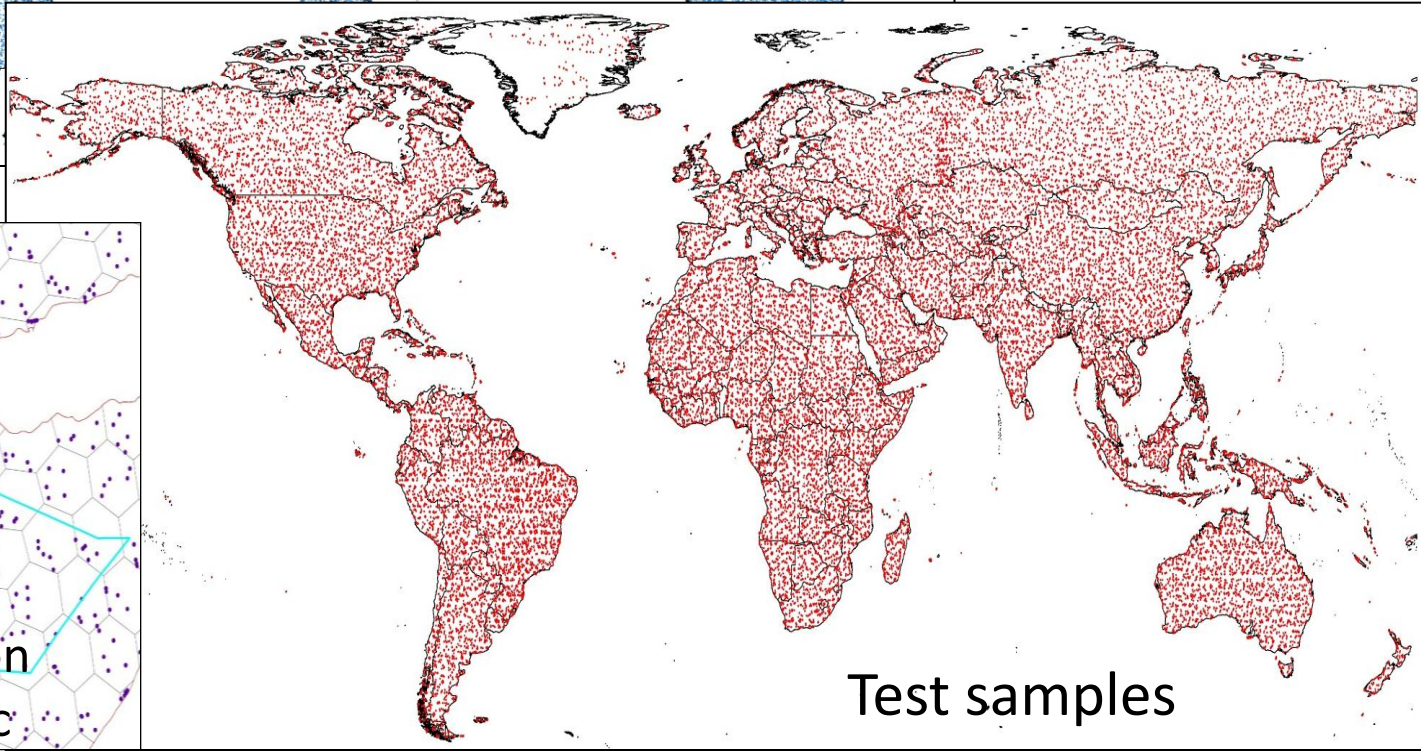
FROM-GLC-MetaPrediction in progress

(scheduled to complete in June 2013)

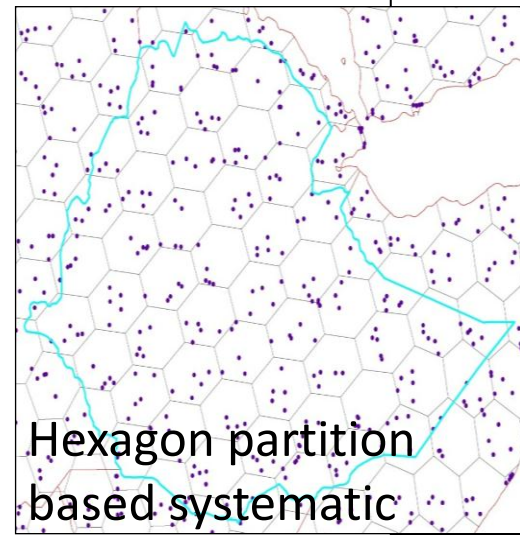
All three products downloadable from
data.ess.tsinghua.edu.cn



Training samples

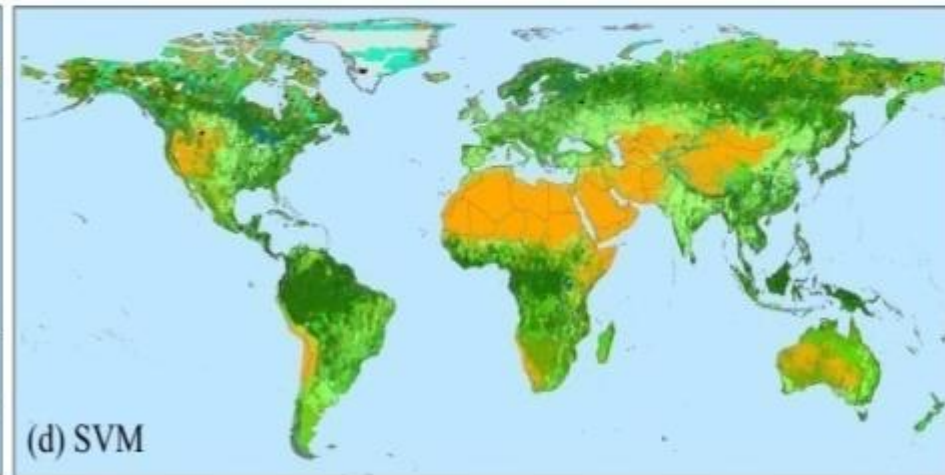
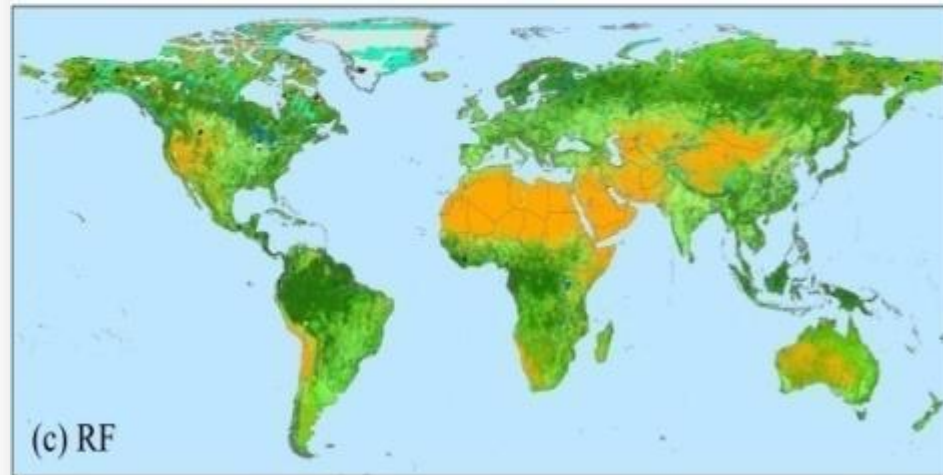
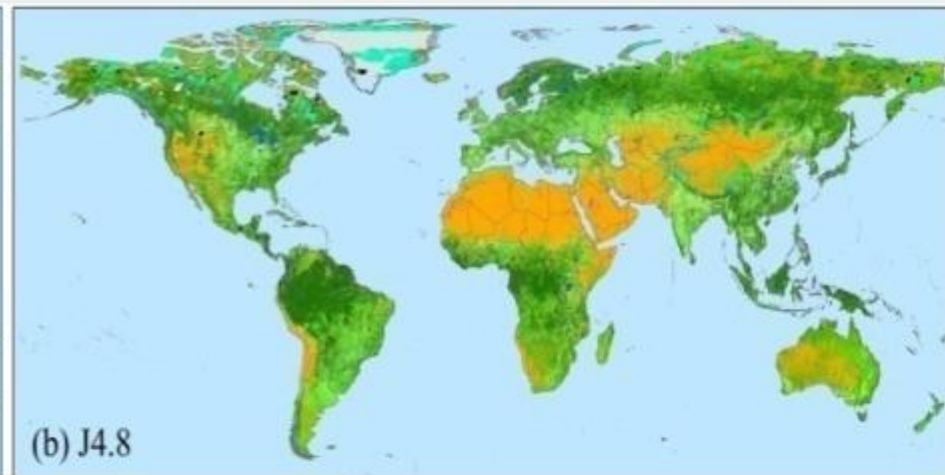
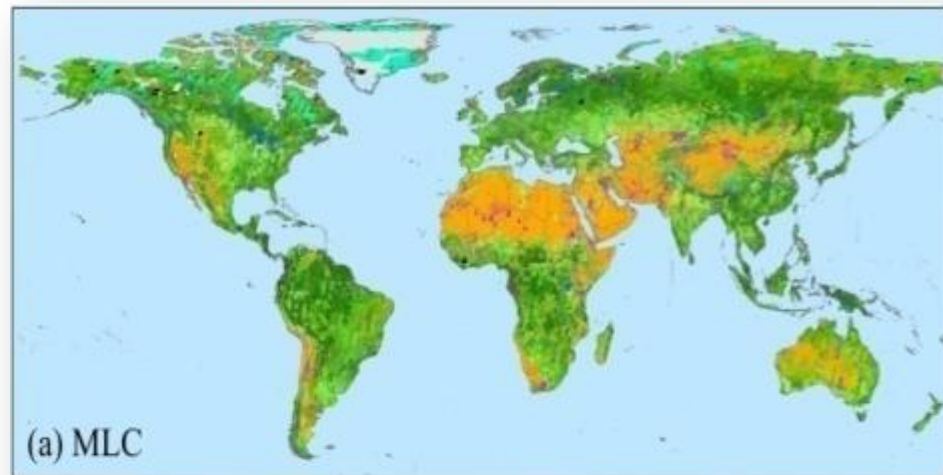


Test samples





Hexagon partition
based systematic
unaligned sampling

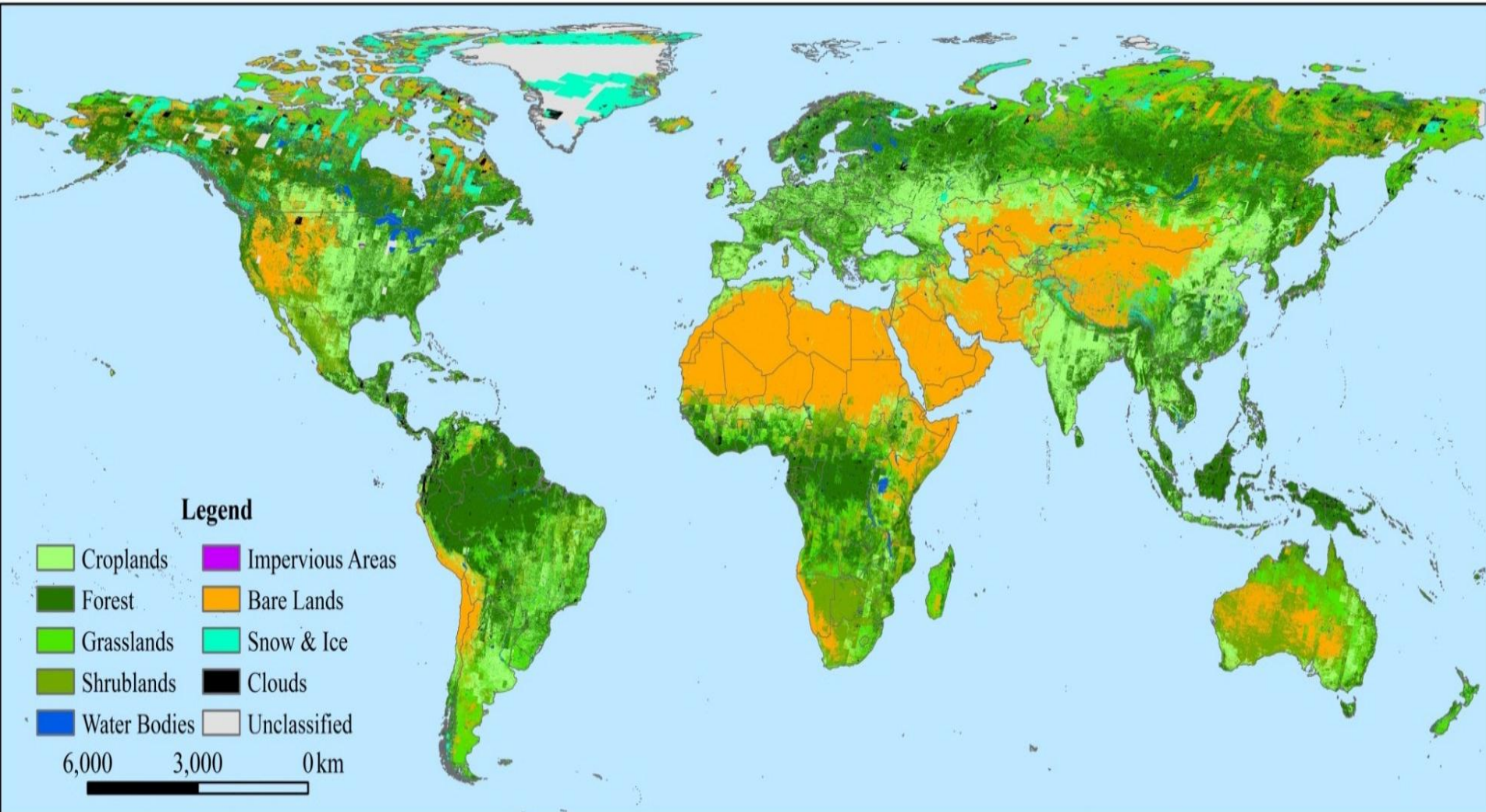
30 m resolution global land cover mapping



Legend

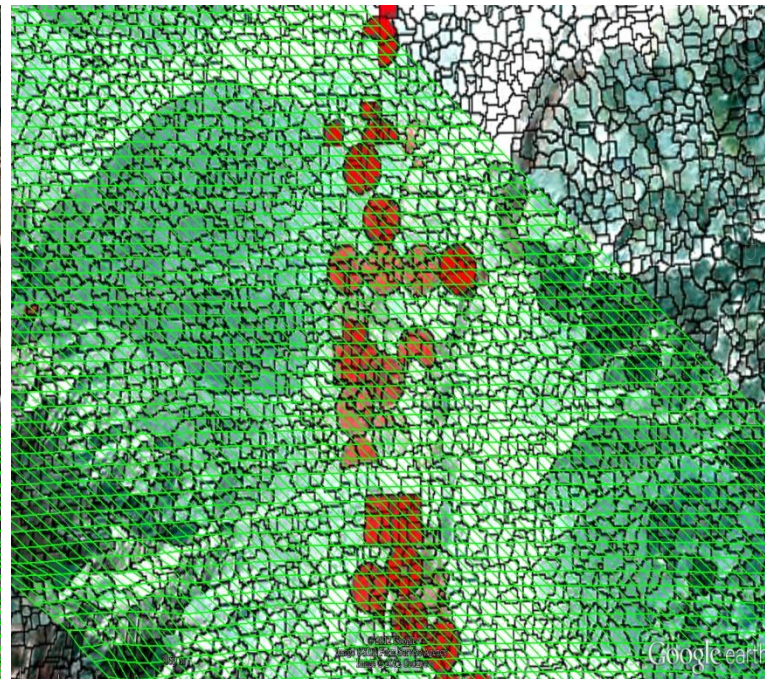
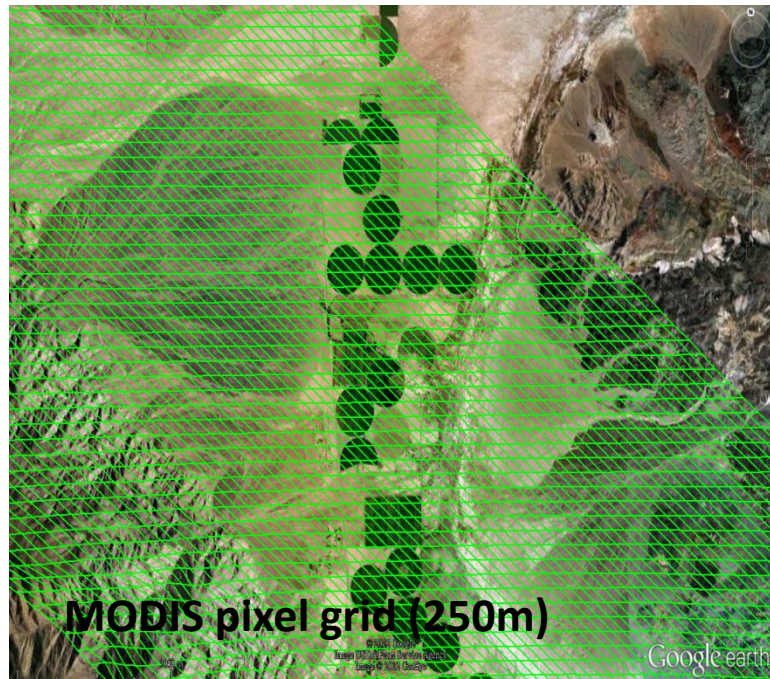
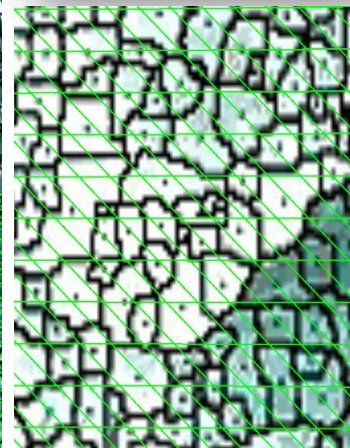
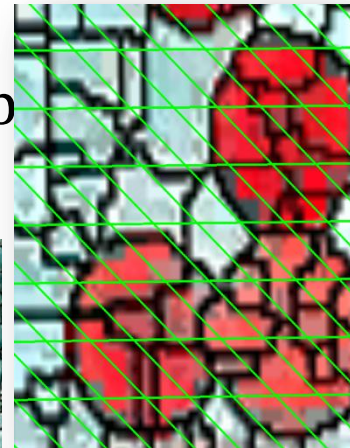
 Croplands  Forest  Grasslands  Shrublands  Water Bodies  Impervious Areas  Bare Lands  Snow & Ice  Clouds  Unclassified

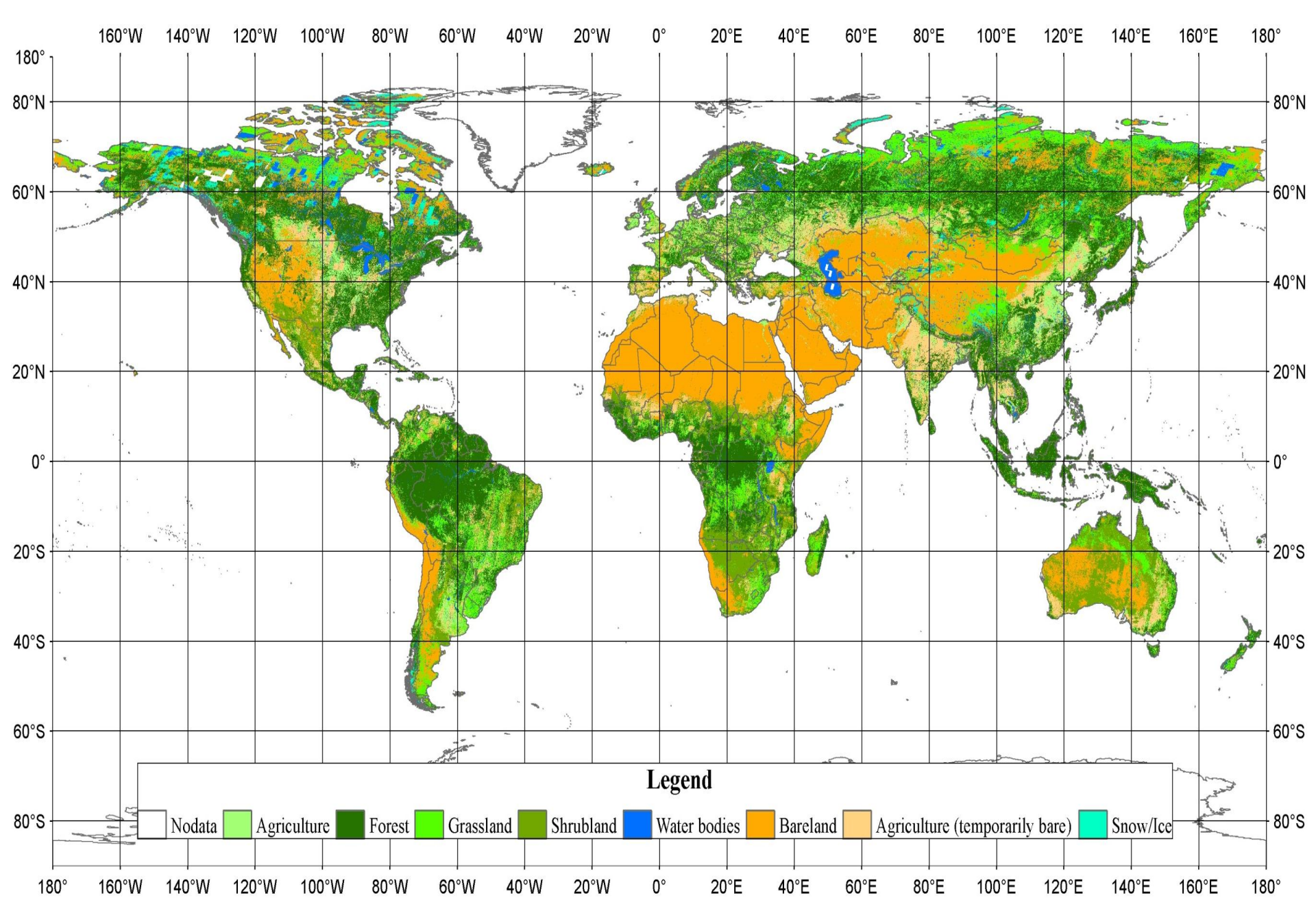
FROM-GLC (Accuracy: 63.72%)



FROM-GLC-SEG, a segmentation-based multi-resolution integration

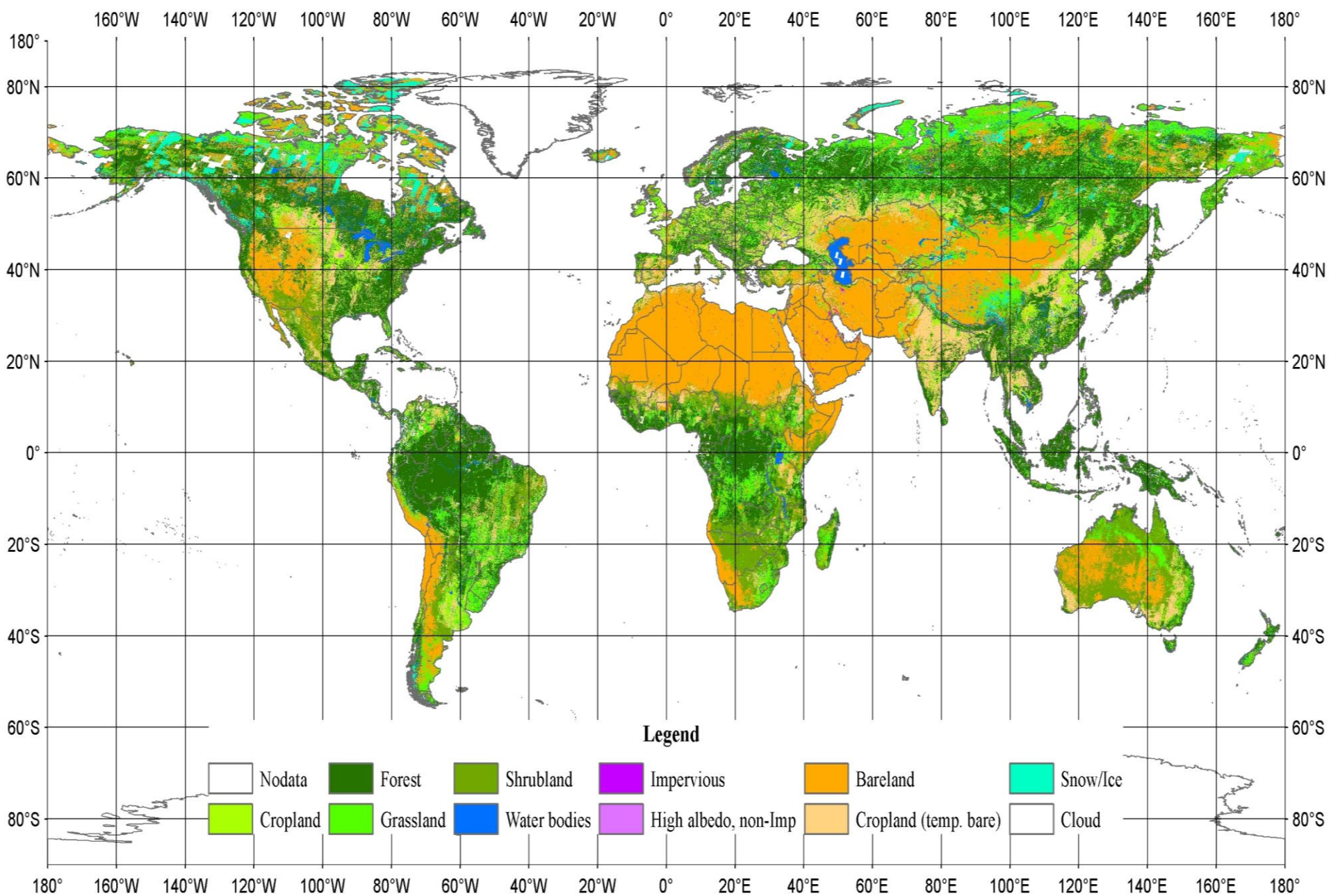
- Spatial down-scaling
 - TM/ETM 30m -> MODIS EVI 250m, Bio/DEM/Soil-Water1km
 - Homogeneous polygon (watershed segmentation)
- Extracting MODIS EVI (and other features) values by the center of segment polygon





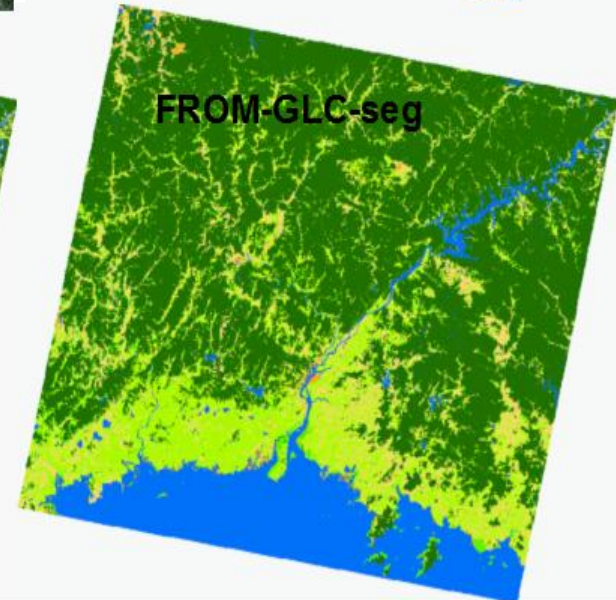
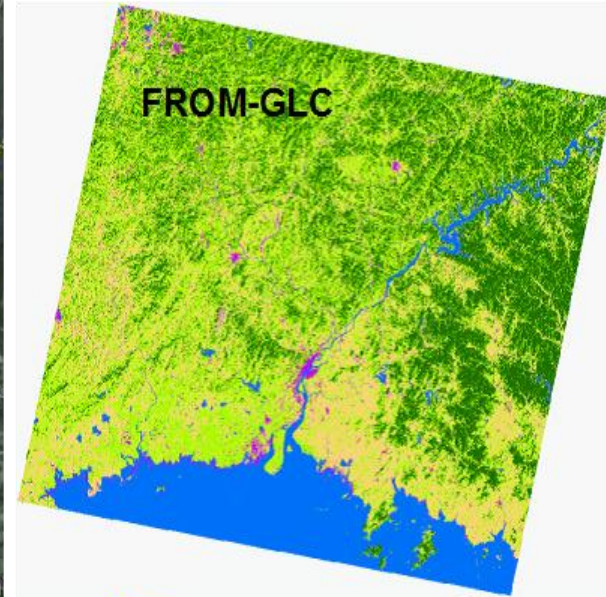
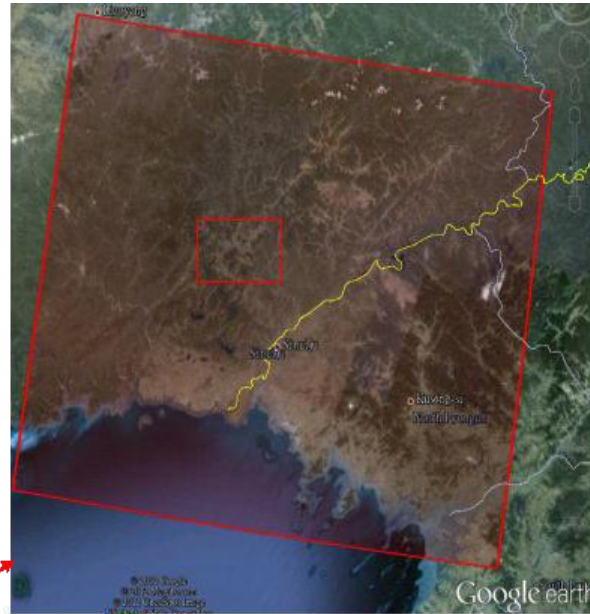
FROM-GLC-SEG (Accuracy: 64.63%)

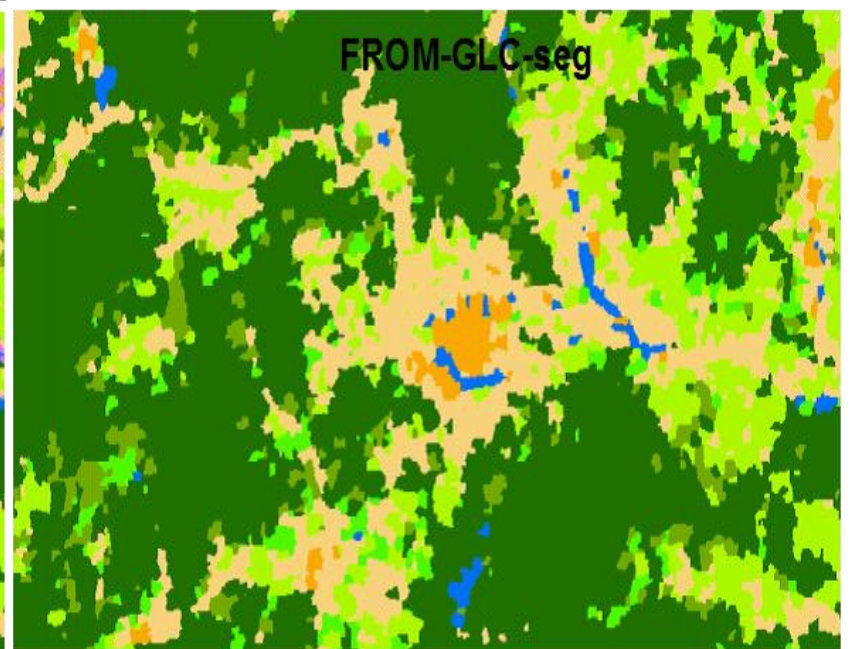
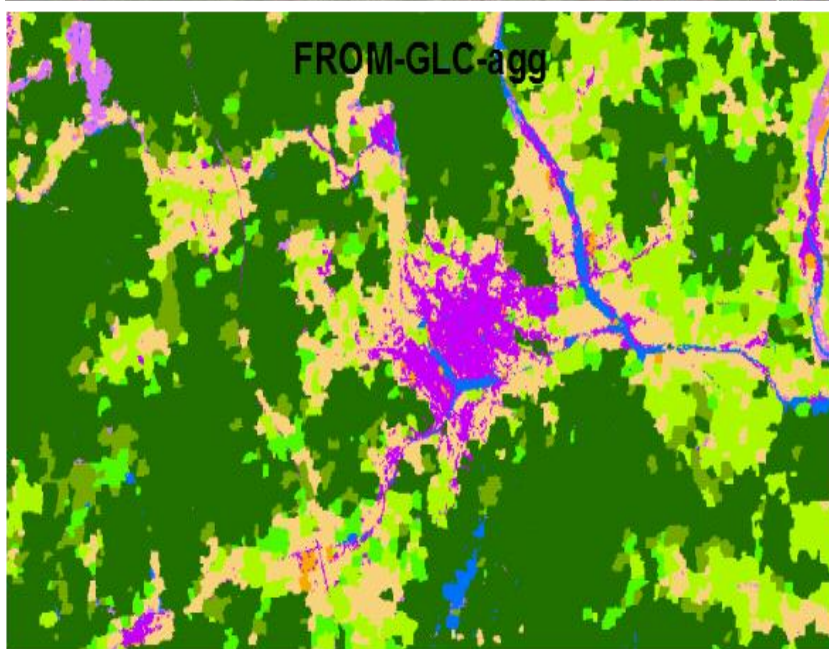
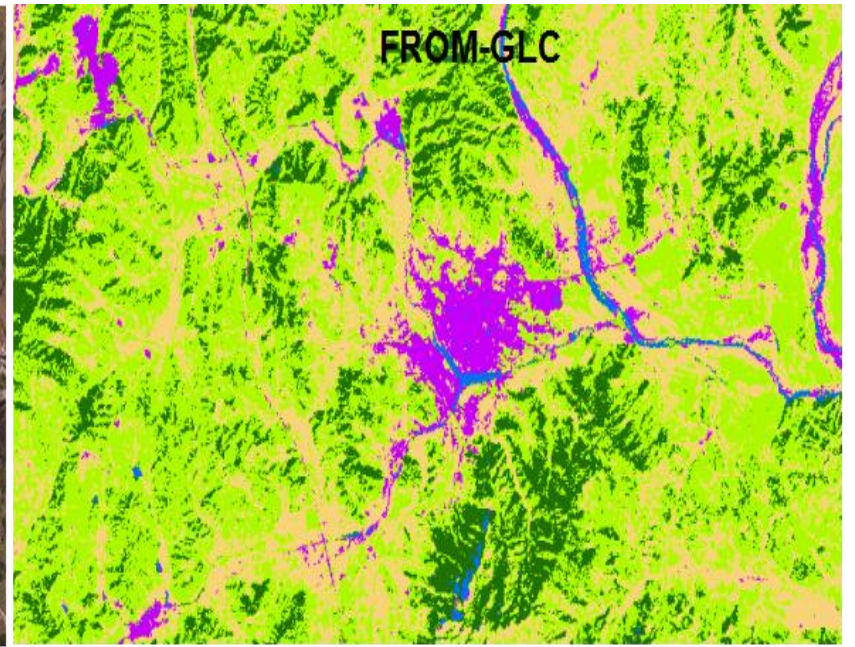
Yu et al., in press, IJRS



FROM-GLC-AGG (Accuracy: 66.00%) Yu et al., submitted

- P188r032(2001-10-05)





Three global land cover products

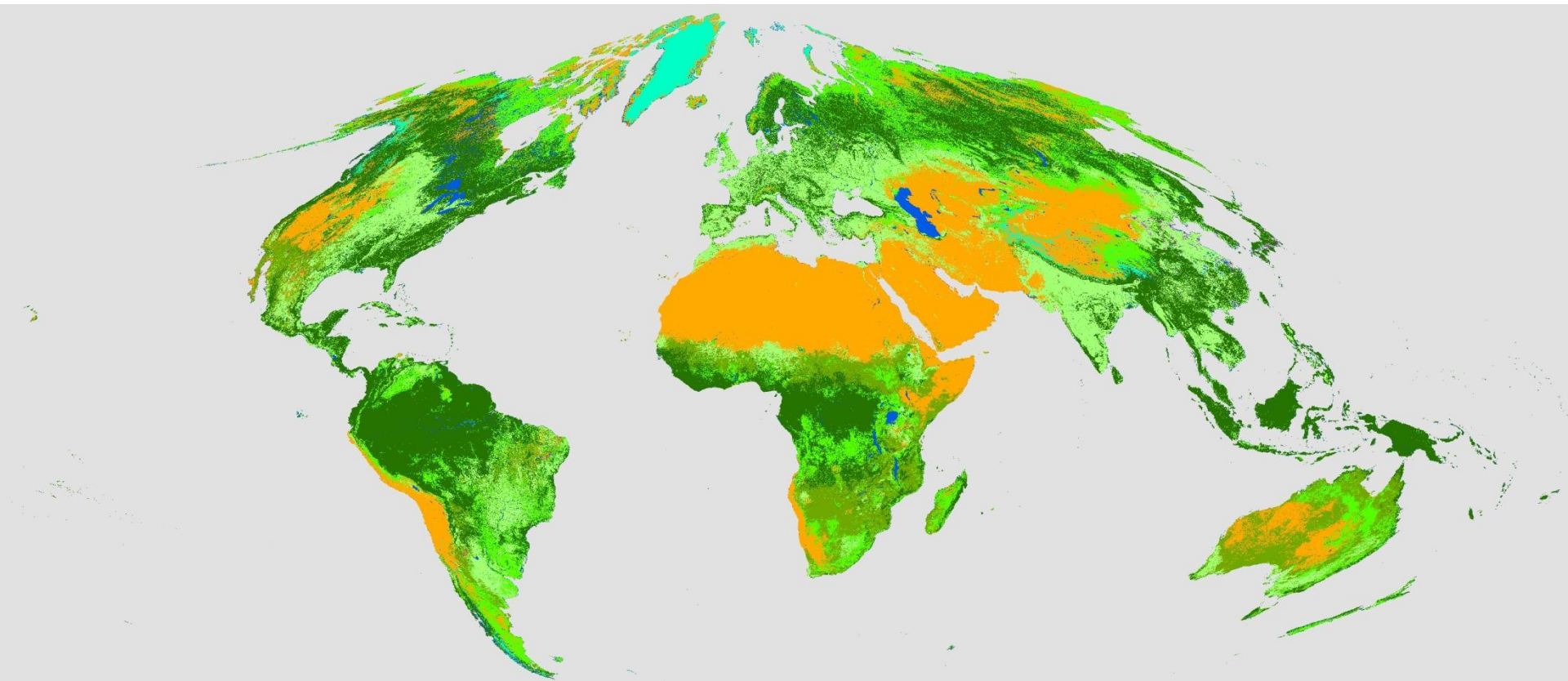


- FROM-GLC
 - Landsat TM/ETM+
- FROM-GLC-seg
 - Landsat TM/ETM+, Landsat TM/ETM+, MODIS EVI, Bioclimatic variables, DEM...
 - Segmentation based
- FROM-GLC-agg
 - Aggregation of FROM-GLC, FROM-GLC-seg, and two 1km global impervious products (Elvidge et al., 2007), Schneider et al., 2009, 2010)

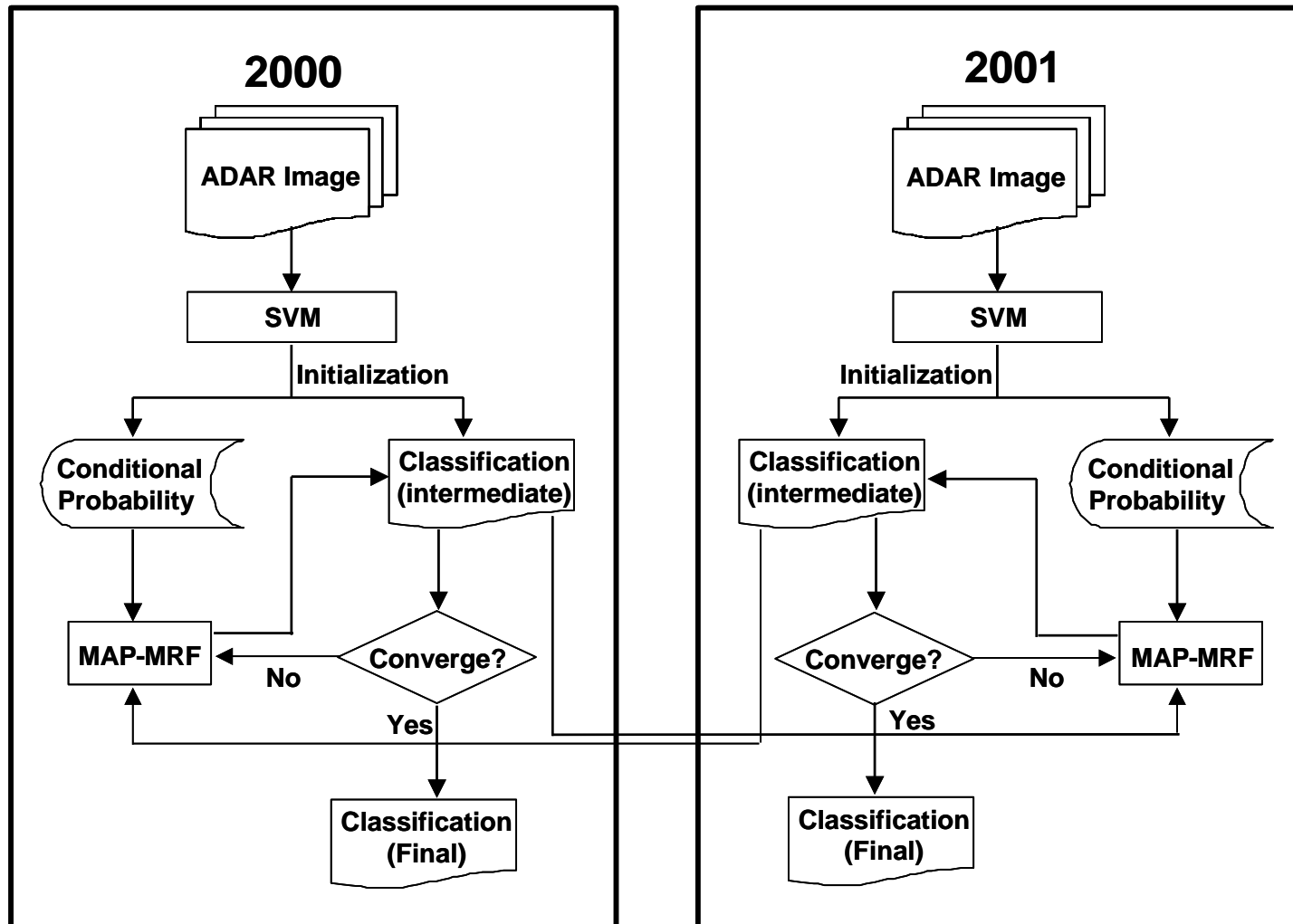
	FROM-GLC	FROM-GLC-seg	FROM-GLC-agg			
OA	63.69%	64.42%	65.51%			
K	0.5429	0.5562	0.5722			
K_{var}	9.2804e-6	9.2137e-6	9.1341e-6			
CI	[0.5370,0.5489]	[0.5502,0.5621]	[0.5663, 0.5781]			
	UA (%)	PA (%)	UA (%)	PA (%)	UA (%)	PA (%)
Cropland	43.24	37.59	55.21	67.63	57.60	66.62
Forest	80.16	77.10	79.13	80.09	80.07	79.06
Grasslands	53.66	34.18	52.43	34.57	53.14	34.42
Shrublands	49.11	34.73	48.89	38.45	48.31	37.93
Water Bodies	82.88	88.41	72.02	87.72	69.51	93.10
Impervious	34.88	10.53	-	-	40.59	25.00
Barelands	56.38	93.45	60.64	91.23	62.43	90.60
Snow & Ice	96.54	85.94	80.87	63.35	97.95	58.58
Cloud	65.82	83.63	-	-	66.97	83.50

250 m global land cover change maps

250 m global land cover using Random Forest classifier - overall accuracy = 75%

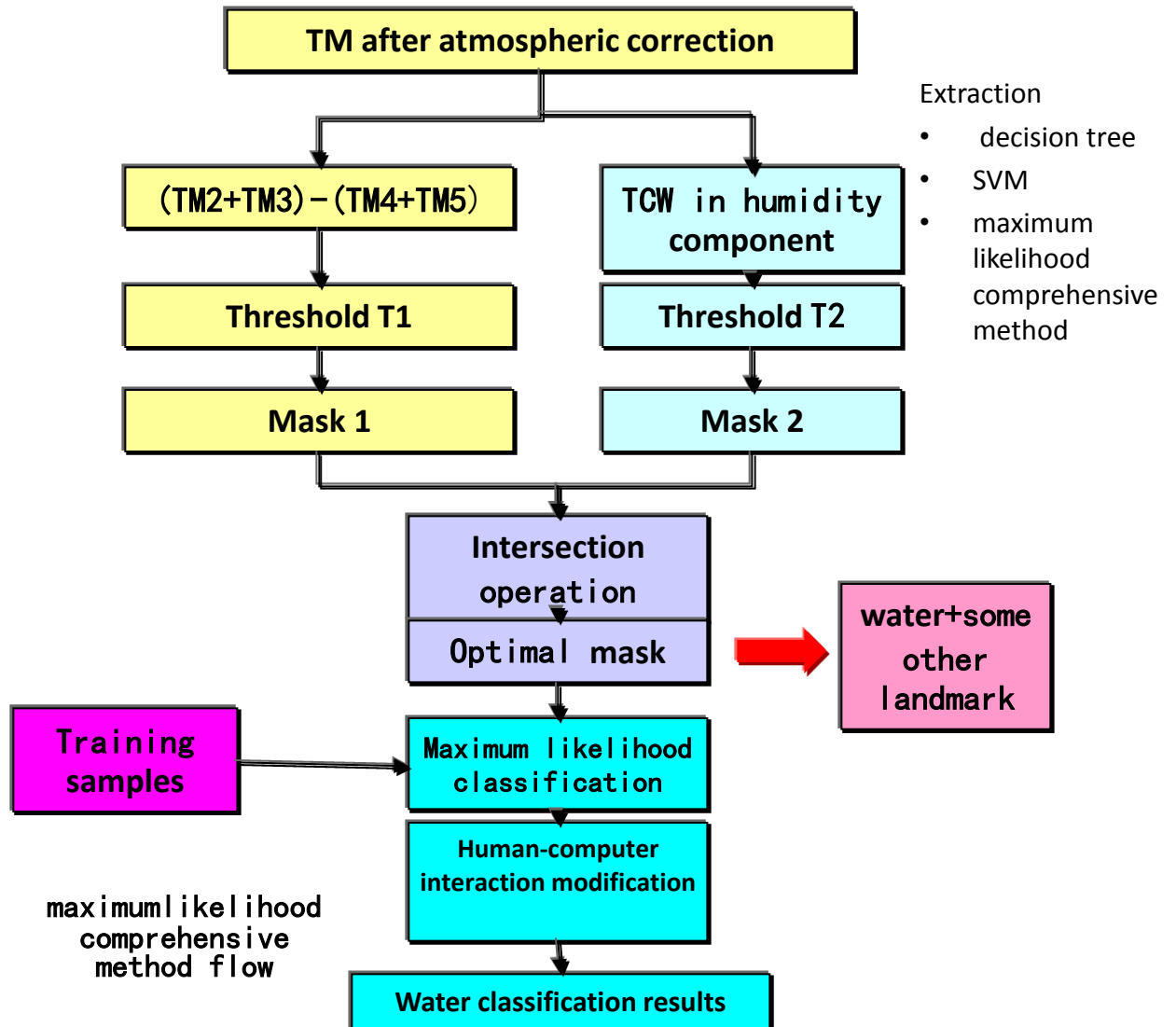
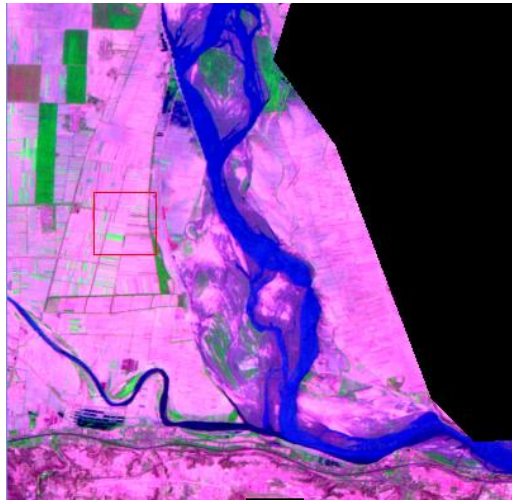


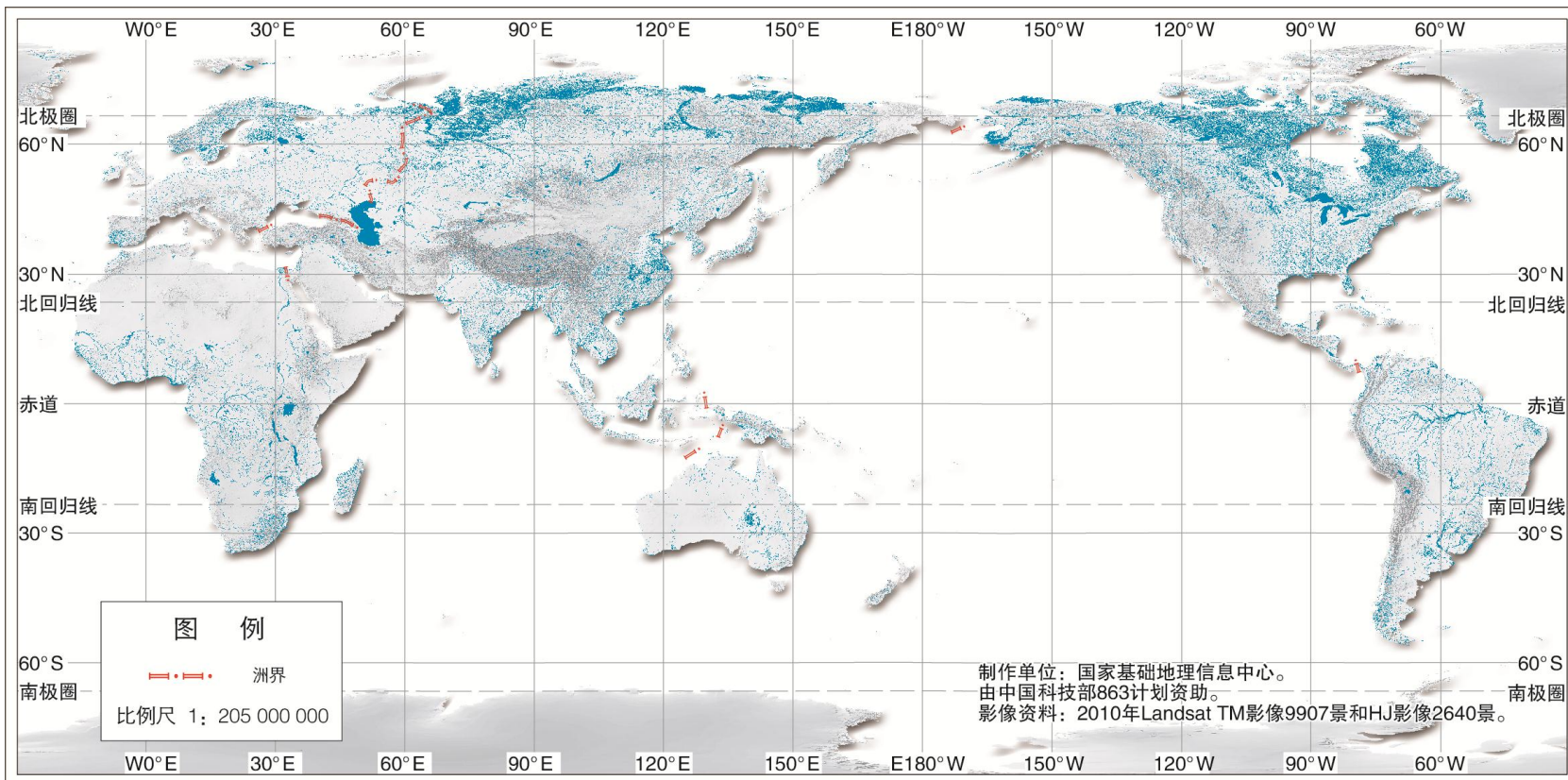
Improvements – by spatial temporal contextual classification – toward change

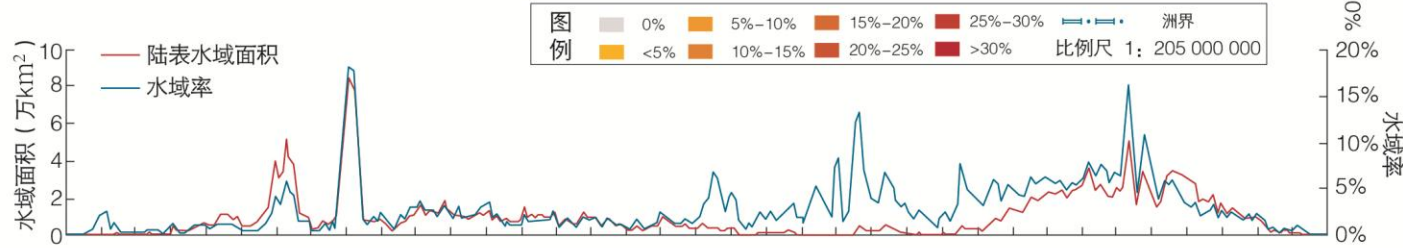
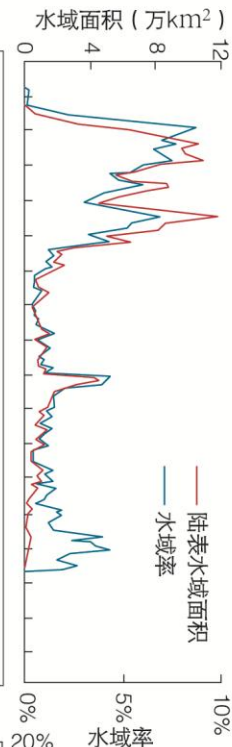
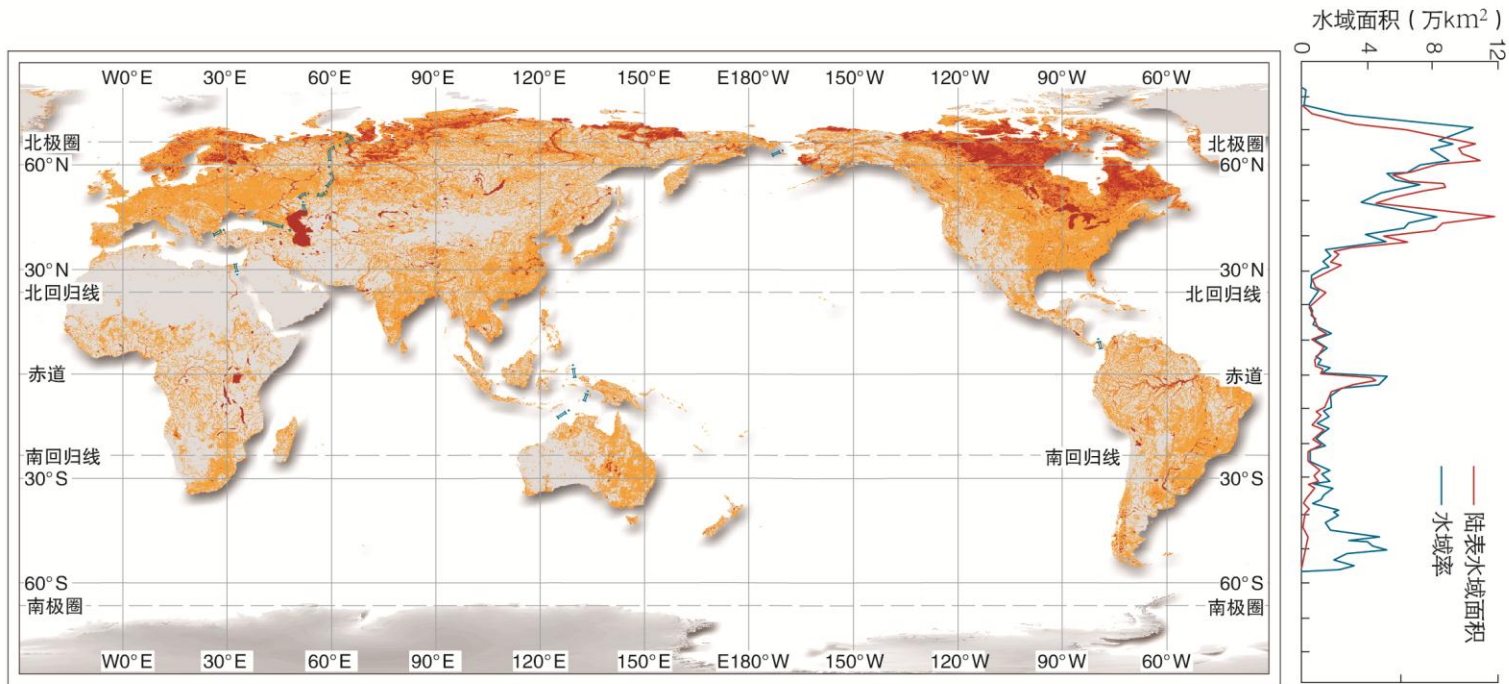


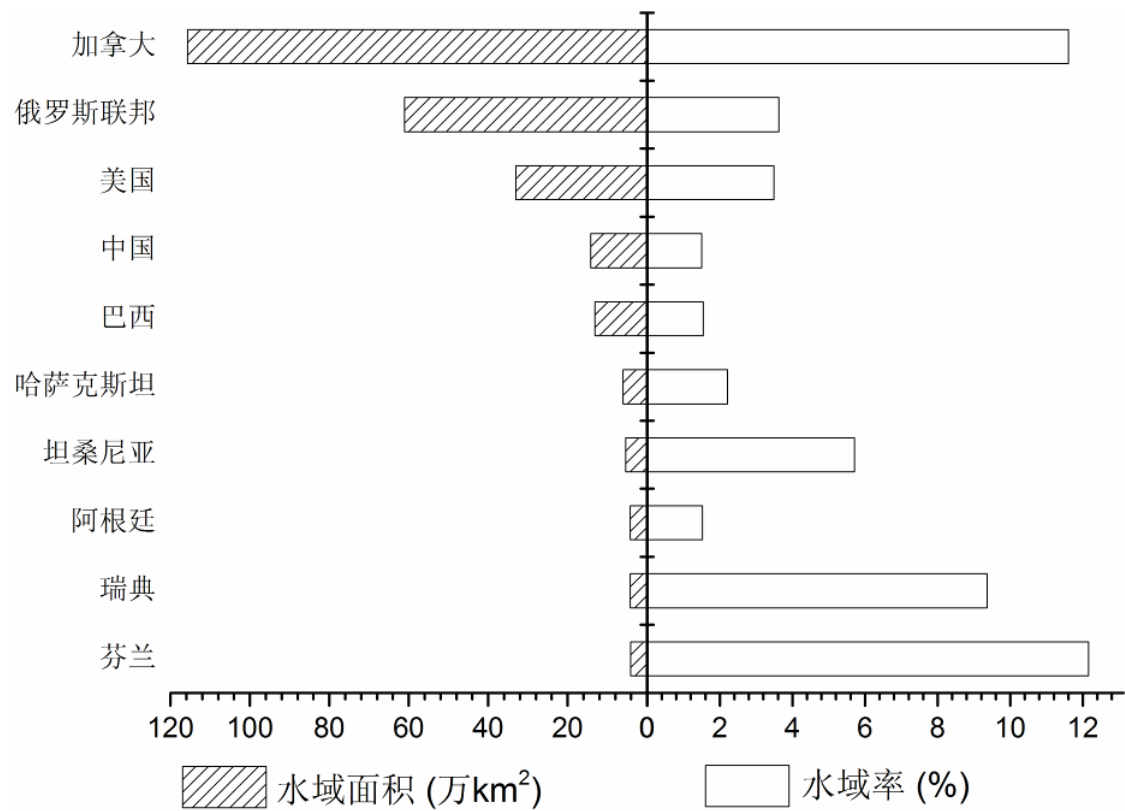
30 m global water masks, 2000, 2010

Extraction of Open Water

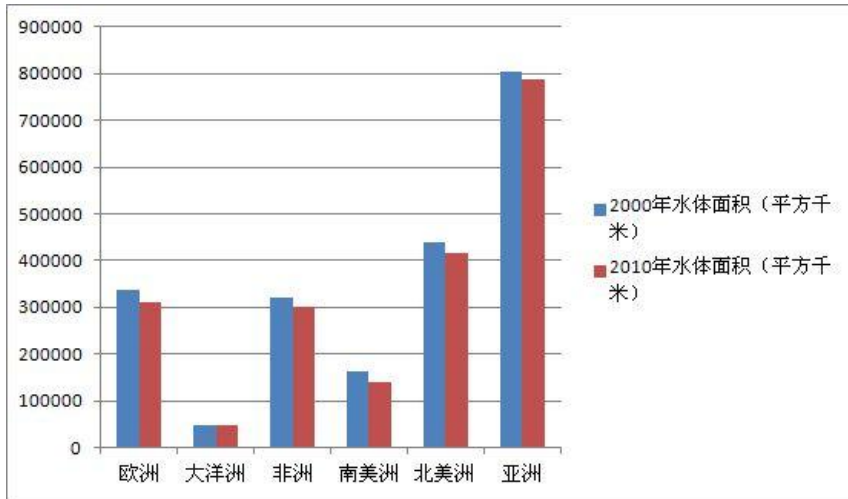








Global Land Surface Water (2000-2010)



- 2000 367.56 10^4km^2 ,
- 2010 367.67 10^4km^2

Continents name	2000 water area (10^4km^2)	2010 water srea (10^4km^2)
Europe	31.56	31.59
Oceania	4.61	4.82
Africa	27.23	27.19
South America	26.57	26.78
North America	153.05	153.02
Asia	124.55	124.28
Globe	367.56	367.67

Statistical Correction

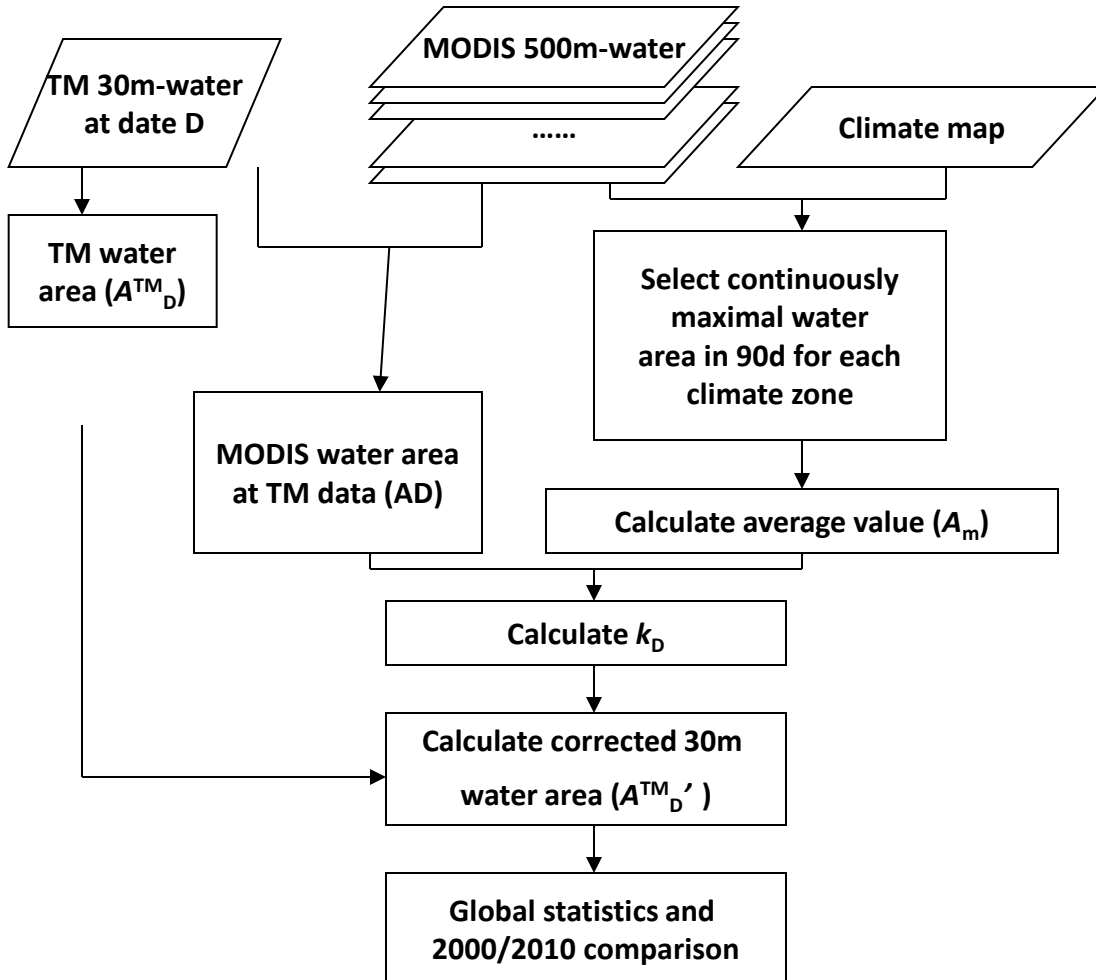
- At TM date (D), the correction coefficient (k_D) can be calculated as:

$$k_D = A_m / A_D$$

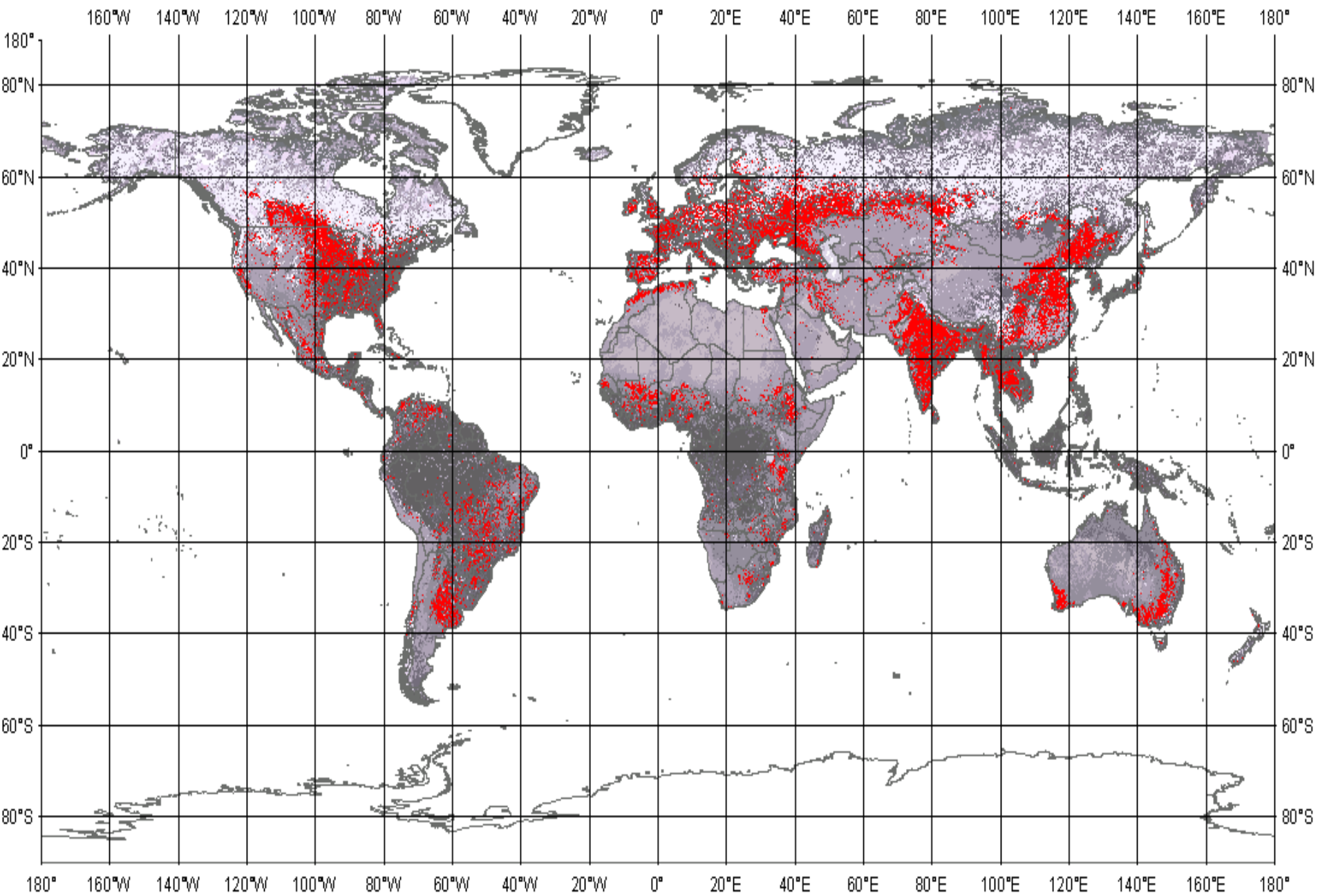
- The corrected 30m water area (A^{TM}_D') for each TM scene is calculated as:

$$A^{TM}_D' = A^{TM}_D * k_D$$

- Finally, we can carry out the global regional statistics and 2000/2010 comparison using the corrected 30m-water data.

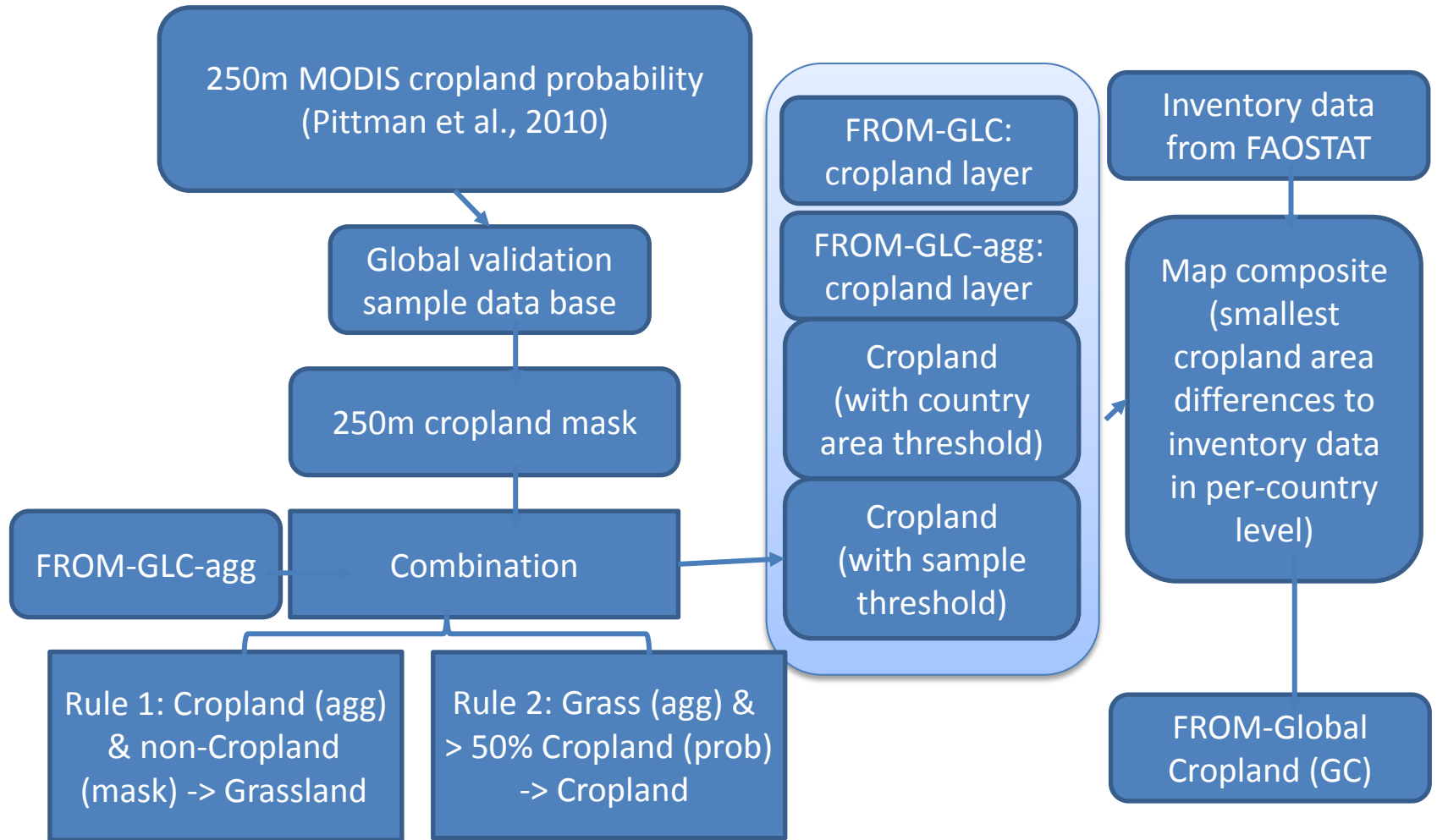


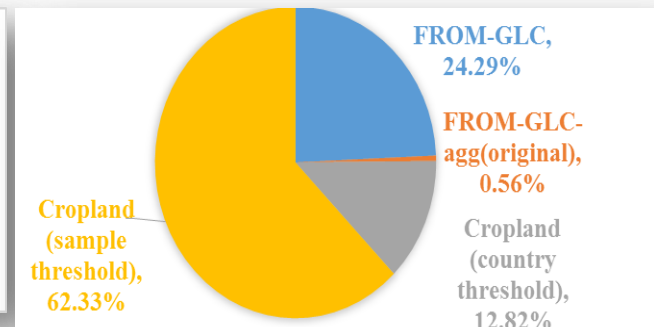
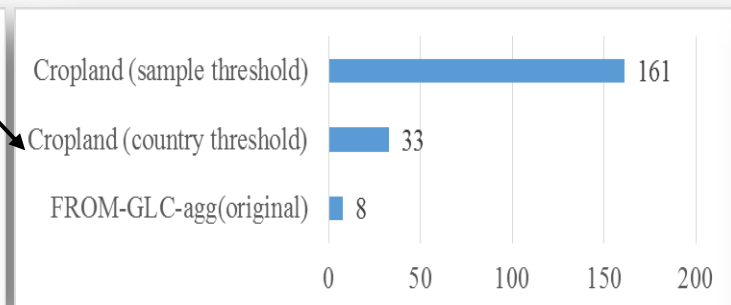
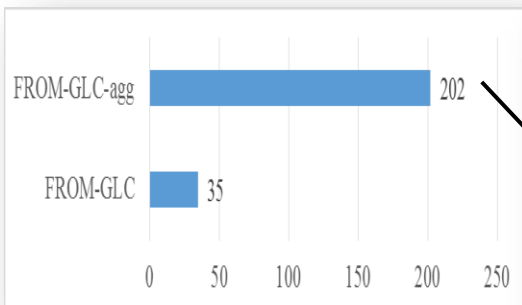
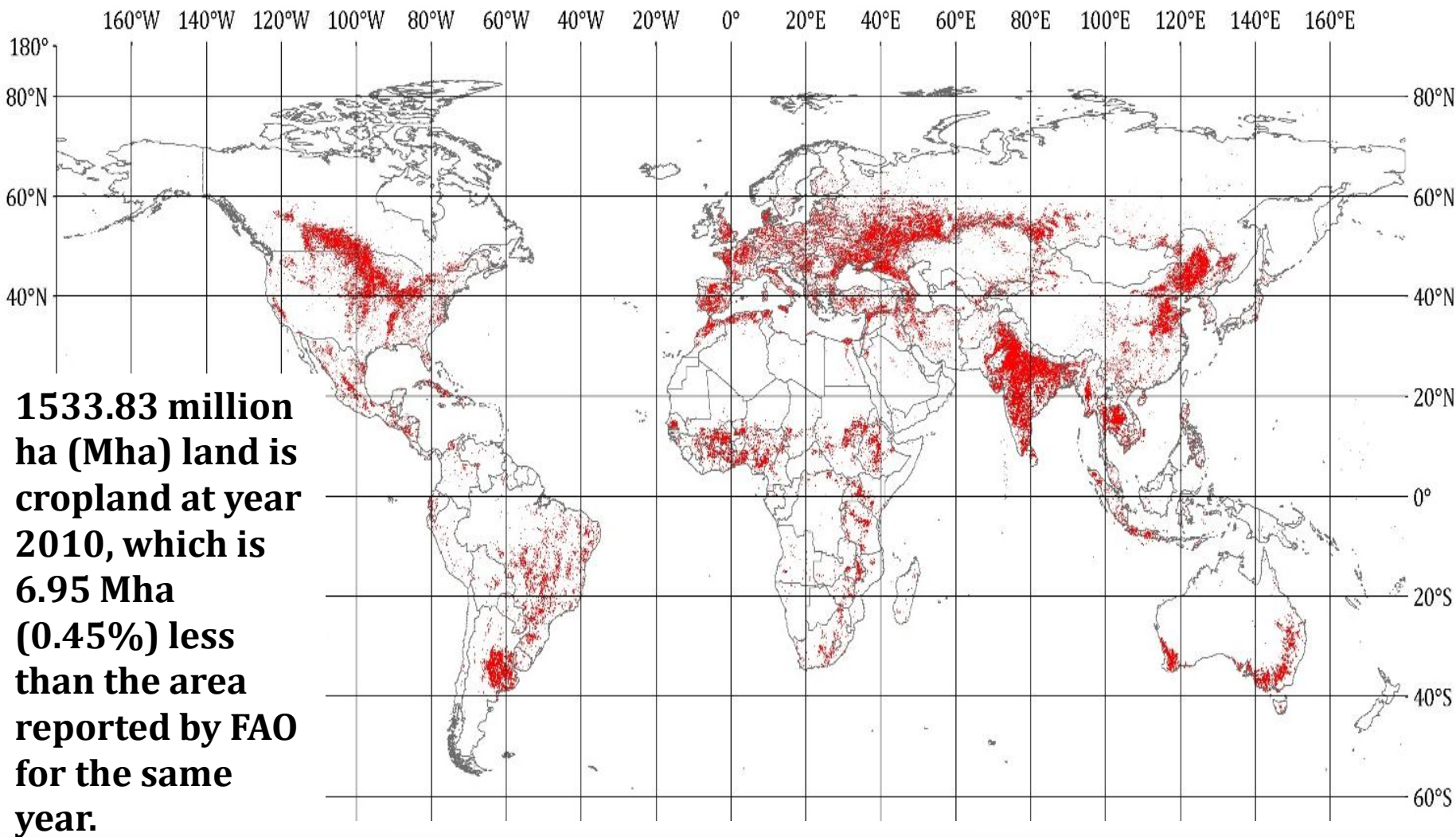
30 m global cropland mask – FROM-GC

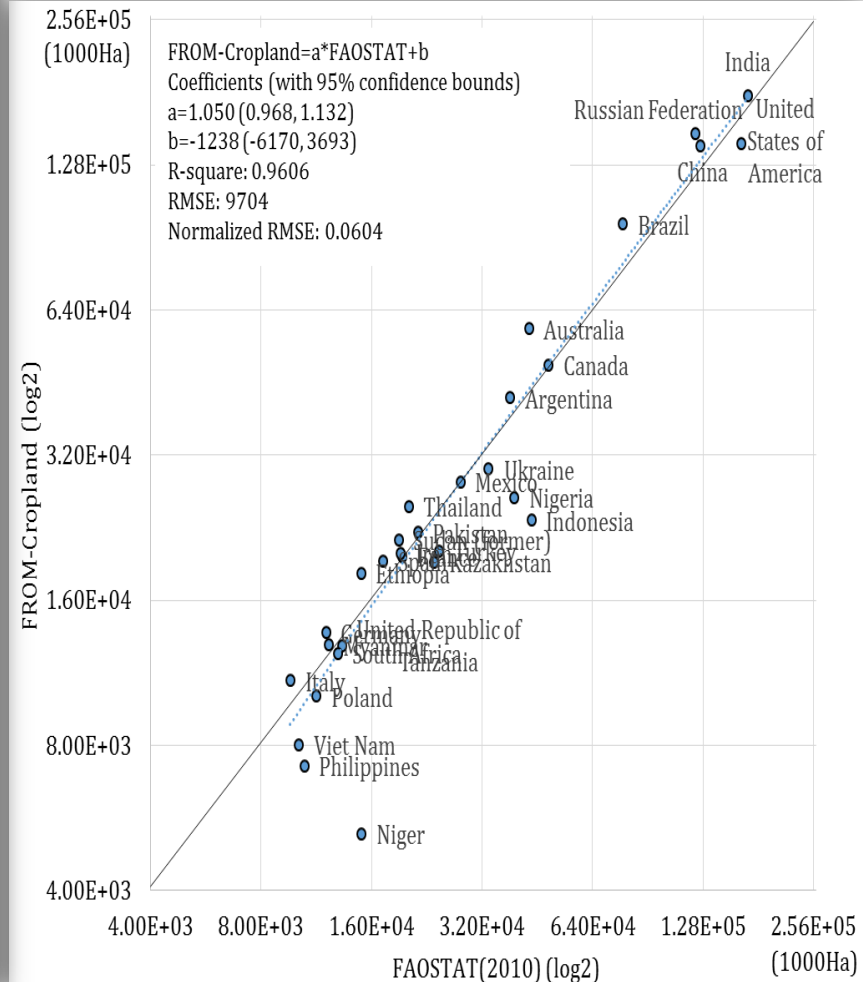
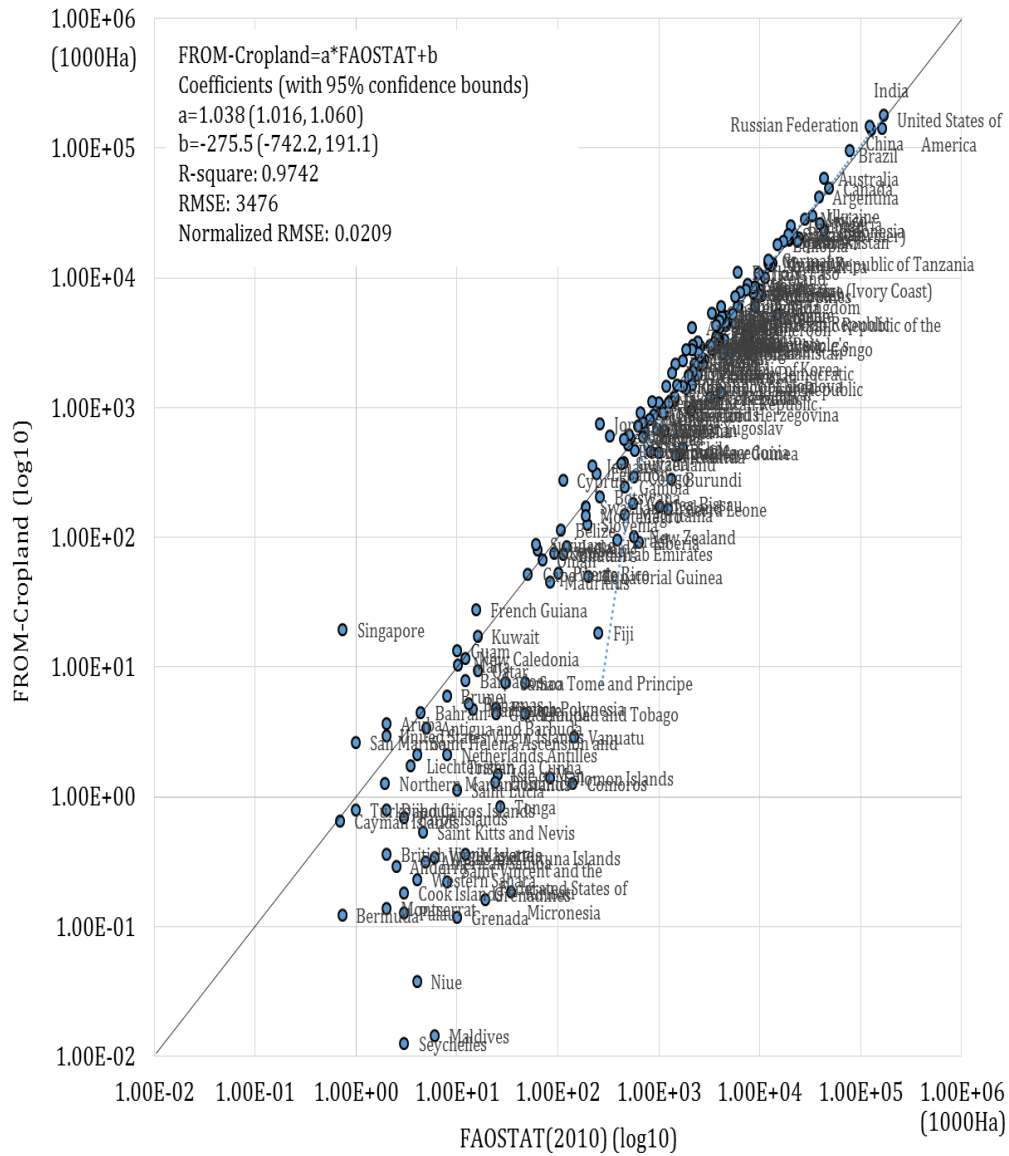


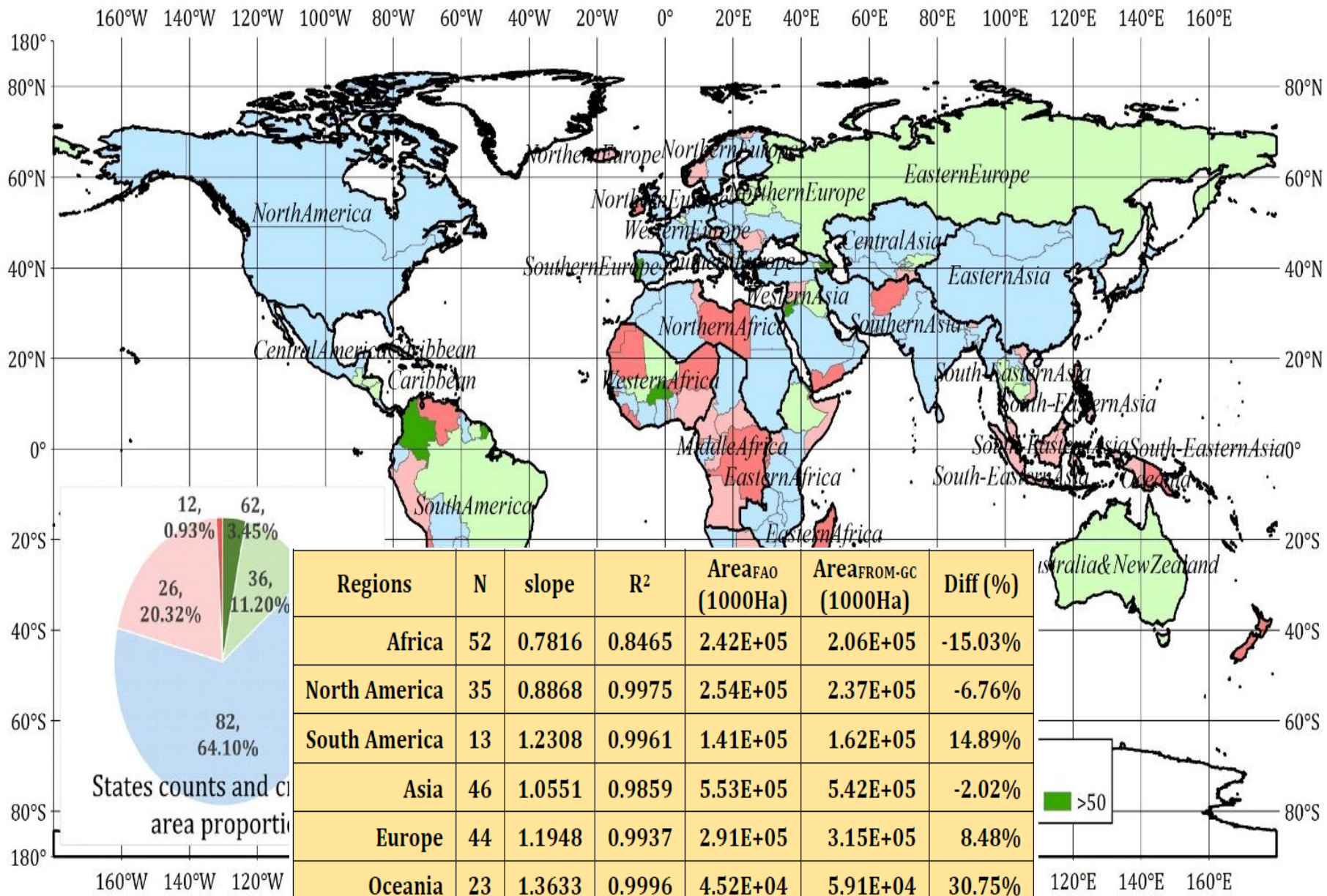
Global Cropland Distribution, UA/PA approx. 60%

FROM-Global Cropland





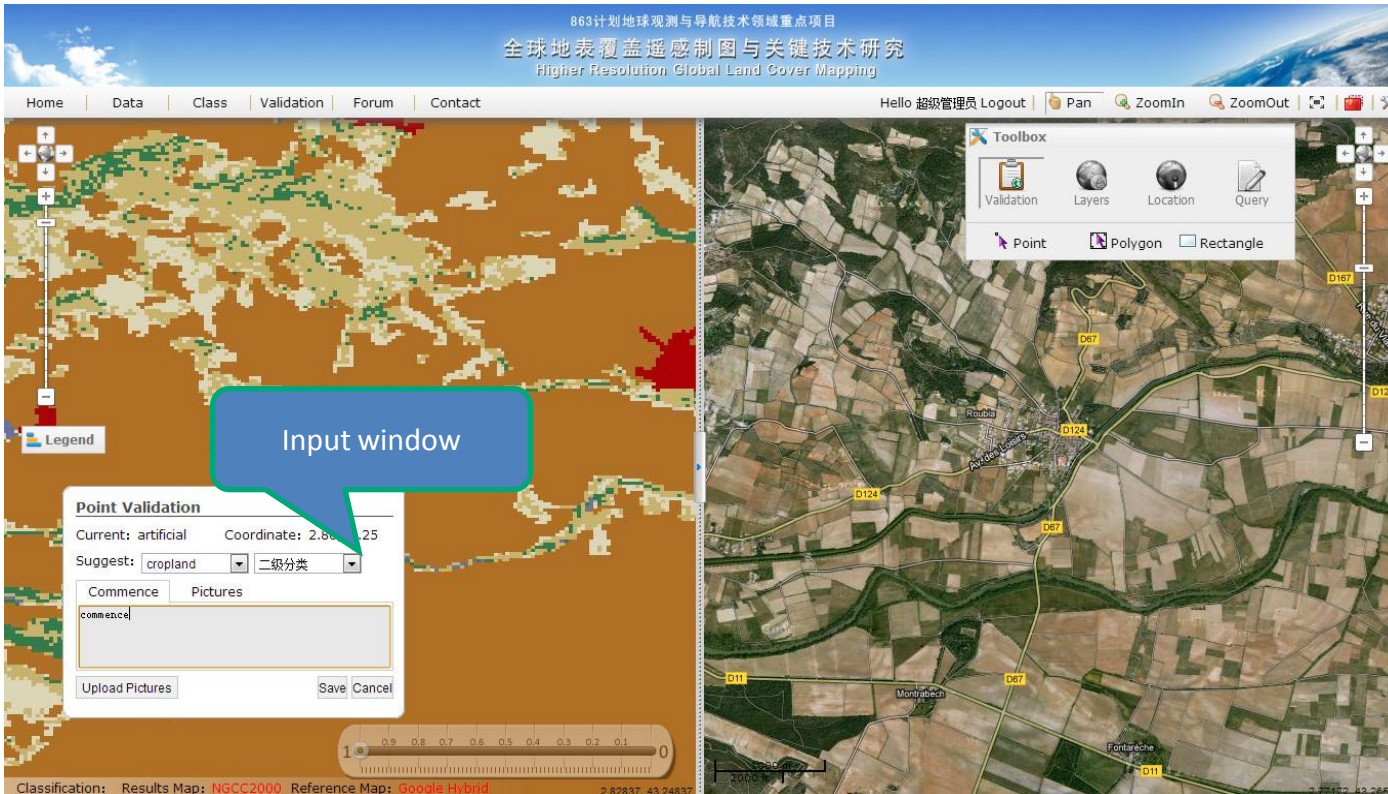




Finally

Web-based Validation

- Images and mapping results
- Convenient tools for on-line evaluation.
- Post-analysis and modification



30m Land Cover Data(left) and Google Images(Right)

Call for Participation to Validation

- More information
 - www.globallandcover.com.cn
- Contact: glc@ngcc.cn
- Future Mtg: April 29-30, 2013, Beijing
 - Presentation of the results of GLC mapping
 - Evaluation of the data products
- Future Mtg: June 25-27, 2013, Nairobi
 - Presentation of the results of GLC mapping
 - Contact: luliang@berkeley.edu

Thank you for your attention!

