2012

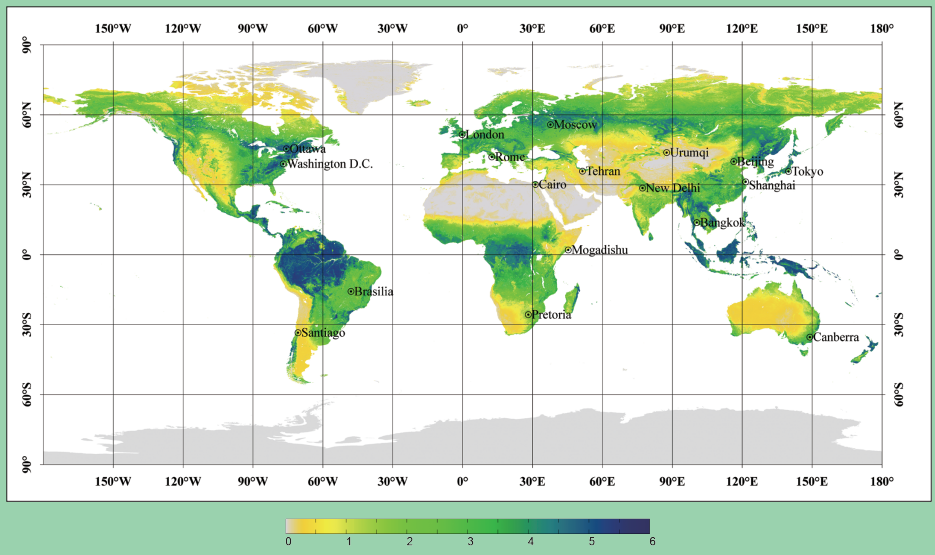
Report on Remote Sensing Monitoring of Global Ecosystem and Environment

Dynamics of Global Vegetation Leaf Area Index (LAI) from 1982 to 2011

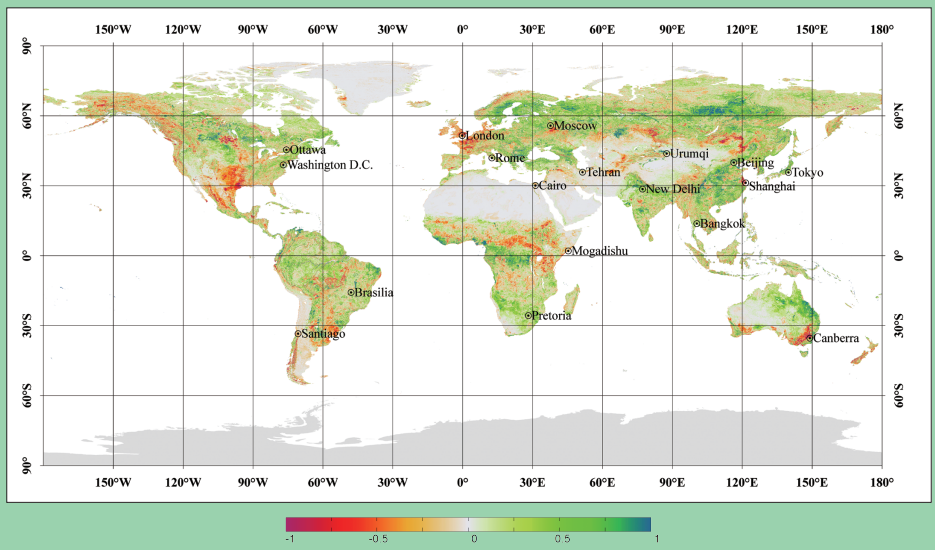
National Remote Sensing Center of China
Ministry of Science and Technology of the People's Republic of China

To support international cooperation on global change studies under the framework of the Group of Earth Observations and the Global Earth Observation System of Systems, the National Remote Sensing Center of China (NRSCC), Ministry of Science and Technology of the People's Republic of China launched the Program on Remote Sensing Monitoring of Global Ecosystem and Environment under the National High-tech R&D Program (863 Program). With common understanding of an integrated group of scientists, the aims of the program are: (1) making a series of global datasets on ecosystem and environment openly; (2) publishing a series of report and analysis based on these datasets; and (3) providing consultations and helping decision making for scientific research and the broader society.

The current report is based on one of the Global LAnd Surface Satelliate (GLASS) products, and developed by a joint team from Beijing Normal University and the National Satellite Methodological Center. The National Remote Sensing Center of China (NRSCC) played a lead role in the overall development. The data and report are published at the website of the China Spatial Data and Information Network (http://www.csi.gov.cn).



Global Thirty Years Average Maximum LAI



Global Maximum LAI Anomaly in 2011

1 Development of Global LAI Products

Vegetation Leaf Area Index (LAI) is defined as the one-sided green leaf area per unit of vegetated ground area in broadleaf canopies and as one-half the total needle surface area per unit of vegetated ground area in coniferous canopies. It is one of the essential parameters for global land ecosystem assessment and environmental change modeling.

The global LAI datasets are that of 8-day composites from 1982 to 2011 (46 datasets each year in 30 years), including Maximum LAI (MLAI), Minimum LAI (Min LAI) and Yearly Average LAI (ALAI), in which the datasets from 1982 to 1999 are based on NOAA-AVHRR with 5 km spatial resolution; the datasets from 2000 to 2011 are based on Terra/Aqua-MODIS with 1 km spatial resolution. In addition, using compatible methods, the global LAI dataset 2011 was also integrated with FY-3-MERSI with 1 km×1 km per pixel. The world administrative boundary data is provided by the National Geomatics Center of China (NGCC).

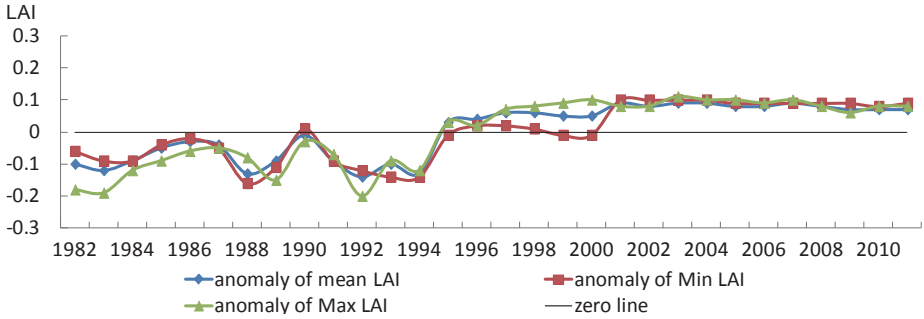
2 Analysis of Global LAI Dynamics from 1982 to 2011

Based on the Yearly Average LAI (ALAI), Minimum LAI (Min LAI), Maximum LAI (MLAI) from 1982 through 2011, the Average of ALAI, Min LAI and MLAI during the last 30 years are calculated. The Average ALAI (1982-2011) is 1.05, Average Min LAI (1982-2011) is 0.54, and Average MLAI (1982-2011) is 1.88. The Yearly LAI Values of the World from 1982 to 2011 are listed in Table 1.

Table 1 The Yearly LAI Values of the World from 1982 to 2011

Year	ALAI	Min LAI	MLAI	Year	ALAI	Min LAI	MLAI
1982	0.95	0.48	1.70	1983	0.93	0.45	1.69
1984	0.96	0.45	1.76	1985	1.00	0.50	1.79
1986	1.02	0.52	1.82	1987	1.01	0.49	1.83
1988	0.92	0.38	1.80	1989	0.96	0.43	1.73
1990	1.04	0.55	1.85	1991	0.96	0.45	1.81
1992	0.91	0.42	1.68	1993	0.95	0.40	1.79
1994	0.92	0.40	1.76	1995	1.08	0.53	1.91
1996	1.09	0.56	1.90	1997	1.11	0.56	1.95
1998	1.11	0.55	1.96	1999	1.10	0.53	1.97
2000	1.10	0.53	1.98	2001	1.14	0.64	1.96
2002	1.13	0.64	1.96	2003	1.14	0.64	1.99
2004	1.14	0.64	1.98	2005	1.13	0.63	1.98
2006	1.13	0.63	1.97	2007	1.14	0.63	1.98
2008	1.13	0.63	1.96	2009	1.12	0.63	1.94
2010	1.12	0.62	1.96	2011	1.12	0.63	1.96
				Average	**1.05**	**0.54**	**1.88**

In order to analyze the yearly changes during the last 30 years, the term of vegetation LAI anomaly is used, which means a departure of yearly value from that of 30 years average.



The Anomaly of Mean LAL, MLAI and Min LAI Changes from 1982 to 2011

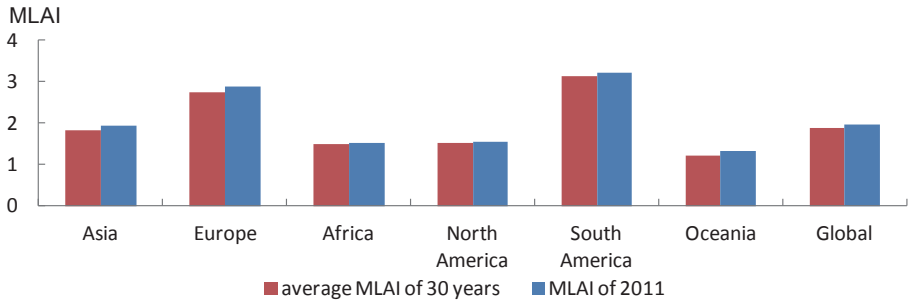
The similar trend of the three parameters of LAI, including anomaly of Mean LAI, MLAI and Min LAI, can be found. Furthermore, the anomaly of the three parameters are all positive after 1995; an increase of LAI from 1995 to 2001 is particularly evident, and remains stable with little increase from 2001 to 2011, the anomaly values reach 0.06-0.10. Thoughtful the climate change, the United Nations Conference on Environment and Development (1992) and the following up policies and actions on environment in both international and national levels could contribute to the trends.

3 LAI in Each Continent in 2011

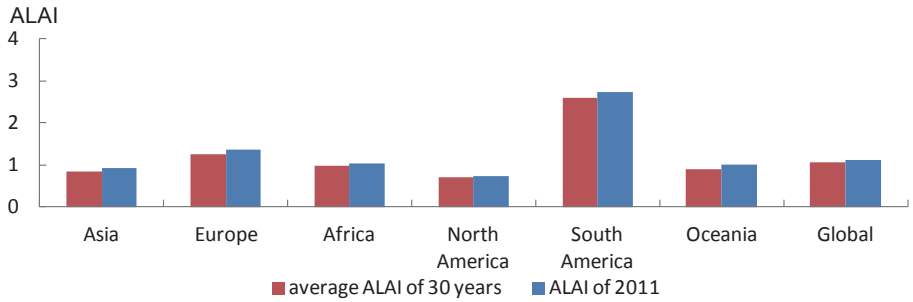
Based on statistics of the LAI in 2011, the global ALAI in that year is 1.12, which is higher 0.07 than that of the 30 years'average; and the MLAI is 1.96, higher 0.08 than that of the 30 years' average. However, the increased values are different in different continents. For example, the most increased continent of ALAI is South American, increasing 0.15, and the most increased continent of MLAI is Europe, where it goes to 0.16.

Table 2 Statistics of ALAI, MLAI and their anomaly Values in 2011 in Each Continent

	MLAI of 2011	MLAI of 30 Years	anomaly Value	ALAI of 20011	ALAI of 30 Years	anomaly Value
Asia	1.94	1.82	+ 0.12	0.92	0.85	+ 0.07
Europe	2.90	2.74	+ 0.16	1.36	1.26	+ 0.10
Africa	1.53	1.49	+ 0.04	1.04	0.98	+ 0.06
North America	1.56	1.53	+ 0.03	0.74	0.72	+ 0.02
South America	3.22	3.15	+ 0.07	2.73	2.58	+ 0.15
Oceania	1.32	1.22	+ 0.10	1.02	0.89	+ 0.13
Global Average	1.96	1.88	+ 0.08	1.12	1.05	+ 0.07



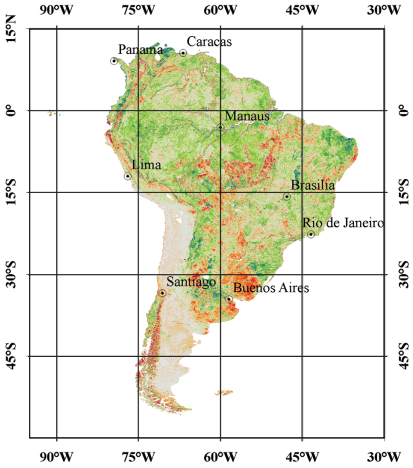
ALAI Anomaly of Each Continent in 2011



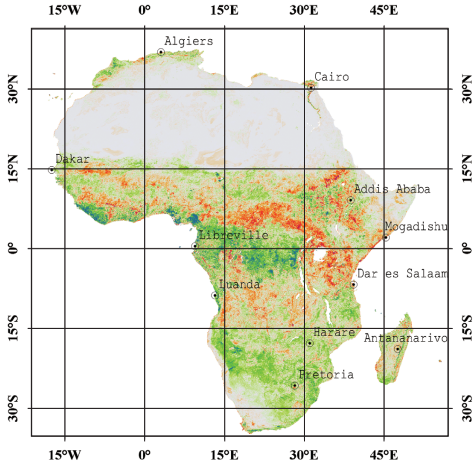
MLAI Anomaly of Each Continent in 2011

The global LAI change pattern in 2011 is uneven. For example, the Maximum LAI Anomaly in 2011 is much higher in the belt from 50°N to 70°N from Europe to Asia and to North America, it goes 0.25(ALAI)and 0.50(MLAI). Similar changes of LAI in 2011 are clearly observed in eastern China, Guinea Bay and the Congo basin in Africa, the northern Amazon region, and northeast of Australia.

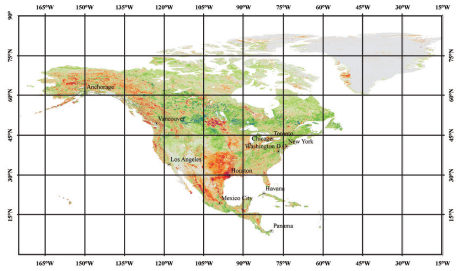
However, the Maximum LAI Anomaly in 2011 in some regions of the world is lower, it even goes to -0.25(ALAI)and -0.50(MLAI) These regions include western Europe, southern of North America, northeast of the Mongolia Plateau, south of the Amazon and southeast of South America, around area of the Congo basin in Africa, and southeast of Australia. The reasons for making these changes are complex, climate of the year could be one reason (for example in Europe), extensive fire could be another (for example in Australia), and intensive human activities could be major reason (for example in southern surrounding area of the Amazon basin , and surrounding area of the Congo basin).



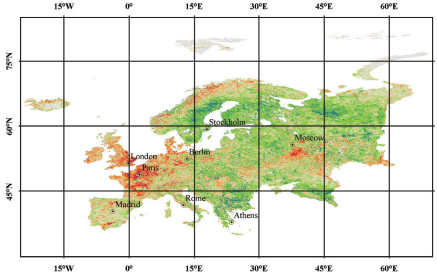
South America



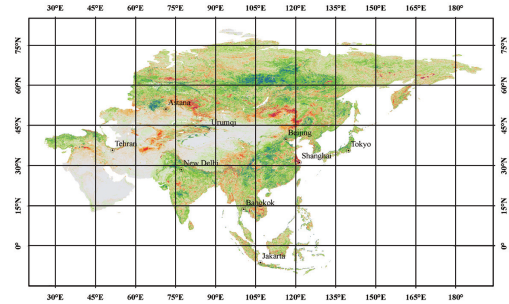
Africa



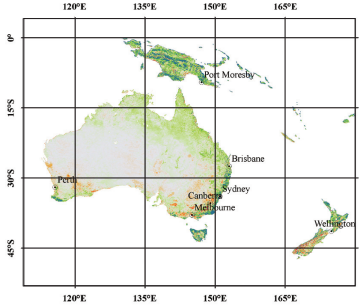
Nouth America



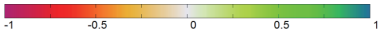
Europe



Asia

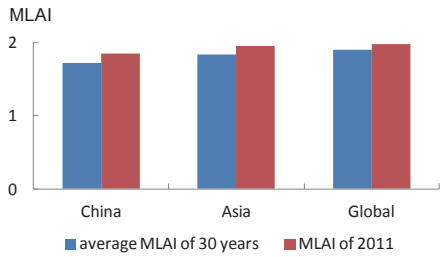


Oceania

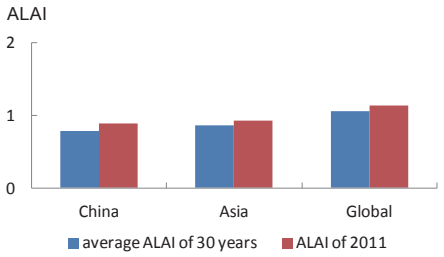


Global Maximum LAI Anomaly in 2011

4 LAI Change of China



Comparison of MLAI of 30 Years Average and 2011 among Global, Asia and China

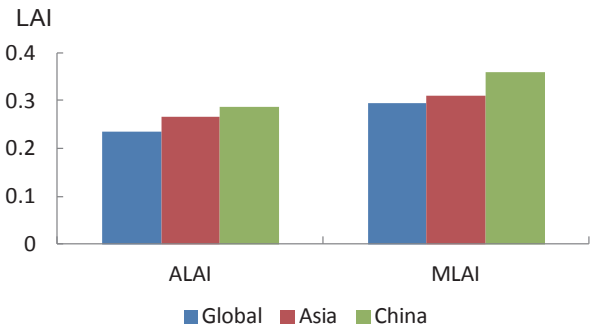


Comparison of ALAI of 30 Years Average and 2011 among Global, Asia and China

The statistics of LAI of China indicate that either the LAI of China in 30 years average and in 2011 is lower than that of the global average and Asia. The 30 years average ALAI of China is 0.77, which is less 0.28 than the global average. In 2011, the ALAI of China is growing to 0.88, which is still less 0.24 than the global average, and 0.04 less than that of Asia. Because of the geographical location and vegetation types, the distance of 30 years average MLAI between China and the global average is less than ALAI, which is 0.18, the distance of MLAI 2011 between China and the global average is 0.13.

Table 3 Comparison of LAI Anomaly 2011 among Global, Asia and China

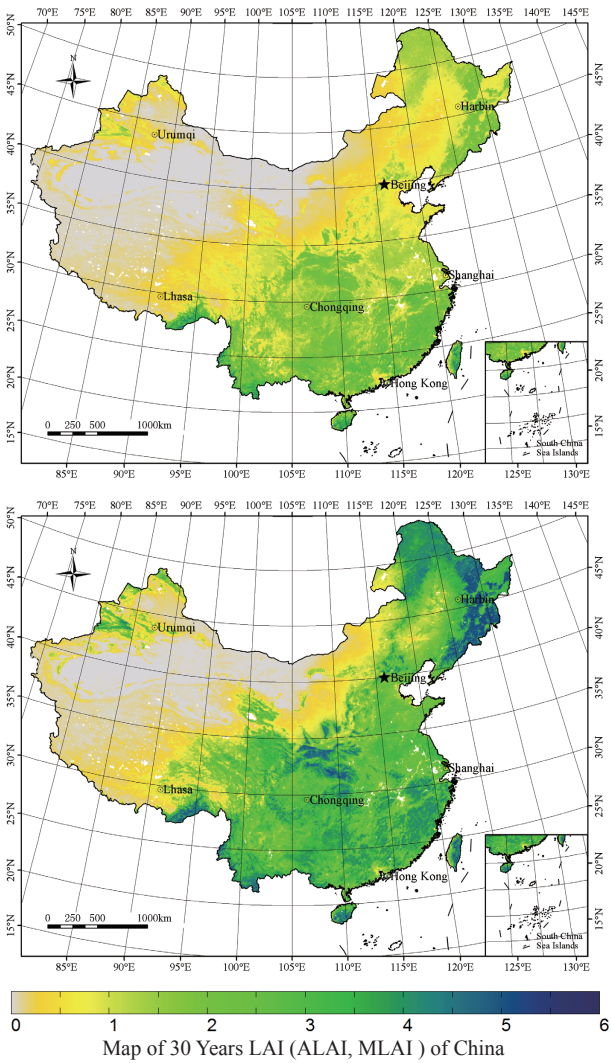
	ALAI					MLAI				
Region	Year of 2011	30 years average	Year of 1982	Anomaly of 2011	Distance between 2011and 1982	Year of 2011	30 years average	Year of 1982	Anomaly of 2011	Distance between 2011 and 1982
China	0.88	0.77	0.61	0.11	0.27	1.83	1.70	1.39	0.13	0.44
Asia	0.92	0.85	0.76	0.07	0.16	1.94	1.82	1.60	0.12	0.34
Global	1.12	1.05	0.95	0.07	0.17	1.96	1.88	1.70	0.08	0.26



Comparison of ALAI and MLAI increment from 1982 to 2011

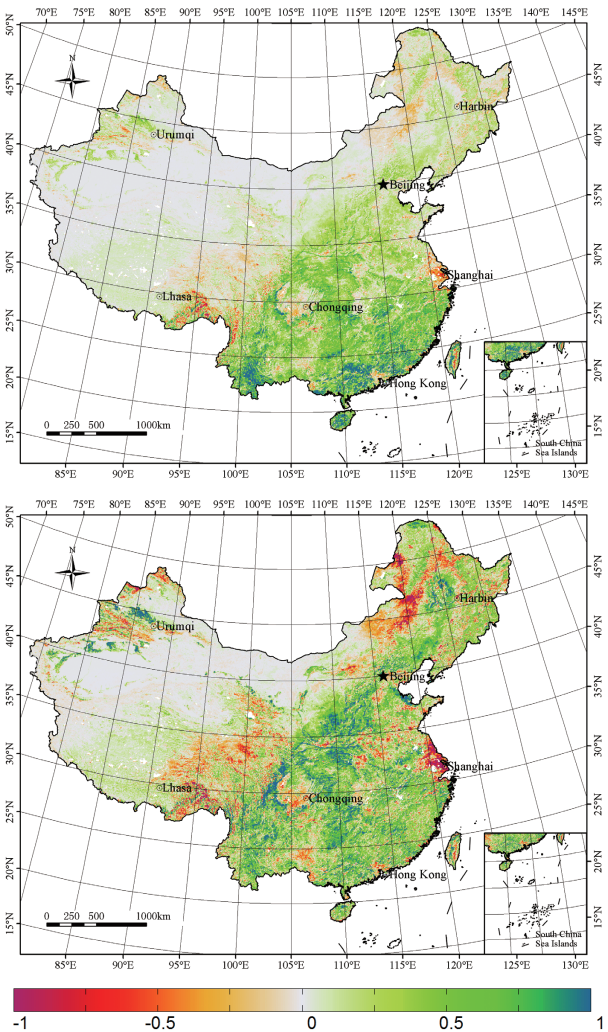
Compatible with the precipitation contours of 400 mm/year in China, which is specifically affected by climate and terrain, China is divided into two sections– eastern and western. The LAI of eastern China is much higher than that of western China, and the LAI is decreased from southeast to northwest gradually.

The highest 30 years ALAI is 4.72, in Wuzhi Mountain of Hainan province. Other regions with higher 30 years ALAI include eastern Tibet, south of Yunnan Province, and eastern Taiwan Island. The highest 30 Years MLAI is 5.35, located in Changbai Mountain, northeast of China. The Xing'anling Mountains, Qingling Mountains, Hills of Eastern China, Mountains in Hainan and Taiwan islands also exhibit a higher MLAI.



Map of 30 Years LAI (ALAI, MLAI) of China

In 2011, ALAI anomaly increased in most provinces of China. The provinces and regions with ALAI anomaly above 0.40 include Hong Kong (0.65), Hainan (0.59), Chongqing (0.48), Hunan (0.47), Jiangxi (0.47), Guangxi (0.44), Fujian (0.4) and Taiwan (0.42). The decreased areas include Shanghai (-0.30), Jiangsu (-0.02), eastern Mongolia, east of Qinghai-Tibet Plateau, as well as Tianshan and the Artai Mountains in western China.



LAI Anomaly of China in 2011 (ALAI, MLAI)