Synthesis of long-term remote sensing LAI for applications in Land Surface and Earth System Models

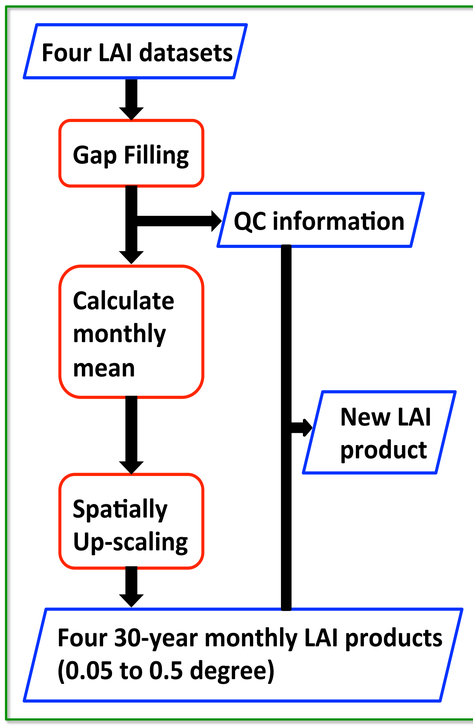
Jiafu Mao[1*], Binyan Yan[2], Xiaoying Shi[1], Peter E. Thornton[1], Forrest M. Hoffman[3] and David M. Lawrence[4]

[1]*Climate Change Science Institute/Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA*
[2]*Jackson School of Geosciences, the University of Texas, Austin, TX, USA*
[3]*Climate Change Science Institute/Computer Science and Mathematics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA*
[4]*National Center for Atmospheric Research, Boulder, Colorado, USA*

Overview: There is growing interest in employing large-scale long-term remote sensing Leaf Area Index (LAI) products to evaluate responses and feedbacks of terrestrial ecosystem dynamics to climate change. However, the multiple LAI products were derived from different satellites, produced using different algorithms and global land cover classifications, developed at different spatial and temporal resolutions, and released with different data gaps and map projections. Understanding and resolution of the inter-LAI dataset differences are critical if these datasets are to be used to quantify the response of vegetation phenology and variability to climate, to force biogeophysical land models and to evaluate biogeochemical land models. Here, we demonstrate the homogenization and intercomparison of four different satellite datasets at 0.5 degree spatial resolution between 1982 and 2010. Also, we evaluate the Community Land Model (CLM) simulated LAI against these standardized products.

LAI	Length	Organization	Reference
GLASS	1982/01 ~ 2000/12 (AVHRR) 2001/01 ~ 2010/12 (MODIS)	Beijing Normal University, University of Maryland	Xiao et al., 2013
GLOBMAP	1981/07 ~ 2000/02 (AVHRR) 2000/03 ~ 2011/12 (MODIS)	IGSNRR, Chinese Academy of Sciences	Liu et al., 2012
GIMMS LAI3g	1981 ~ 1999 (AVHRR) 2000 ~ 2011 (MODIS)	Boston University	Zhu et al., 2013
GEOLAND2	1982/01 ~ 2000/12 (AVHRR) 1999/01 ~ present (SPOT/ VEGETATION, MODIS, CYCLOPES)	Europe	Baret et al., 2013

LAI data sets used in this study



✧ ***Gap filling***

- Short gaps shorter than 6 months: using a moving window method to find a local optimal time series for spline fitting
- Long gaps: average of a previous period and a following period that are the same length of the gap

✧ ***QC information***

- Based on the percentage of gaps
- Similar QC information as MODIS LAI product
- Supplementary information of the status of each grid for users

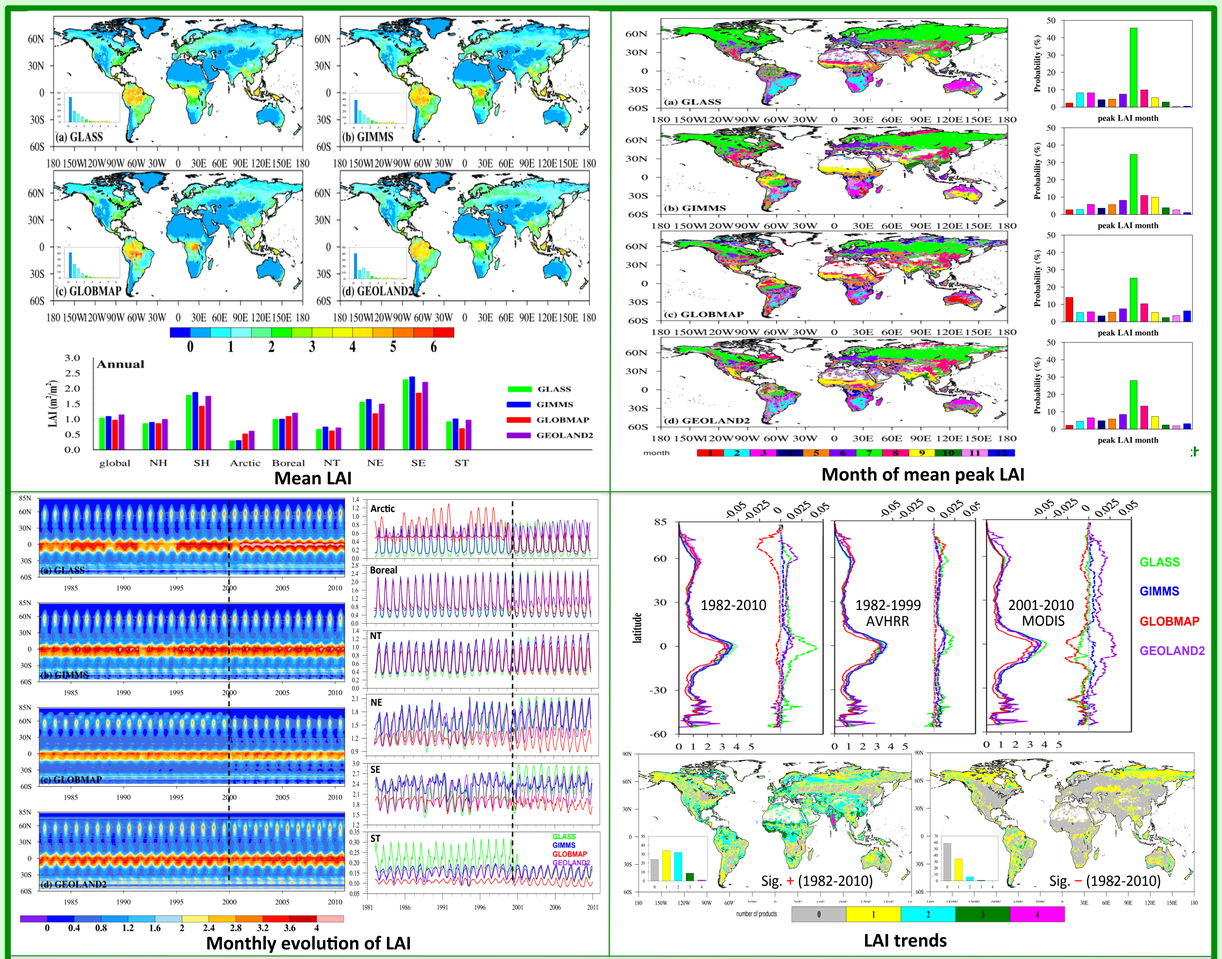
✧ ***Spatially up-scaling***

- Spatial average weighted by grid areas

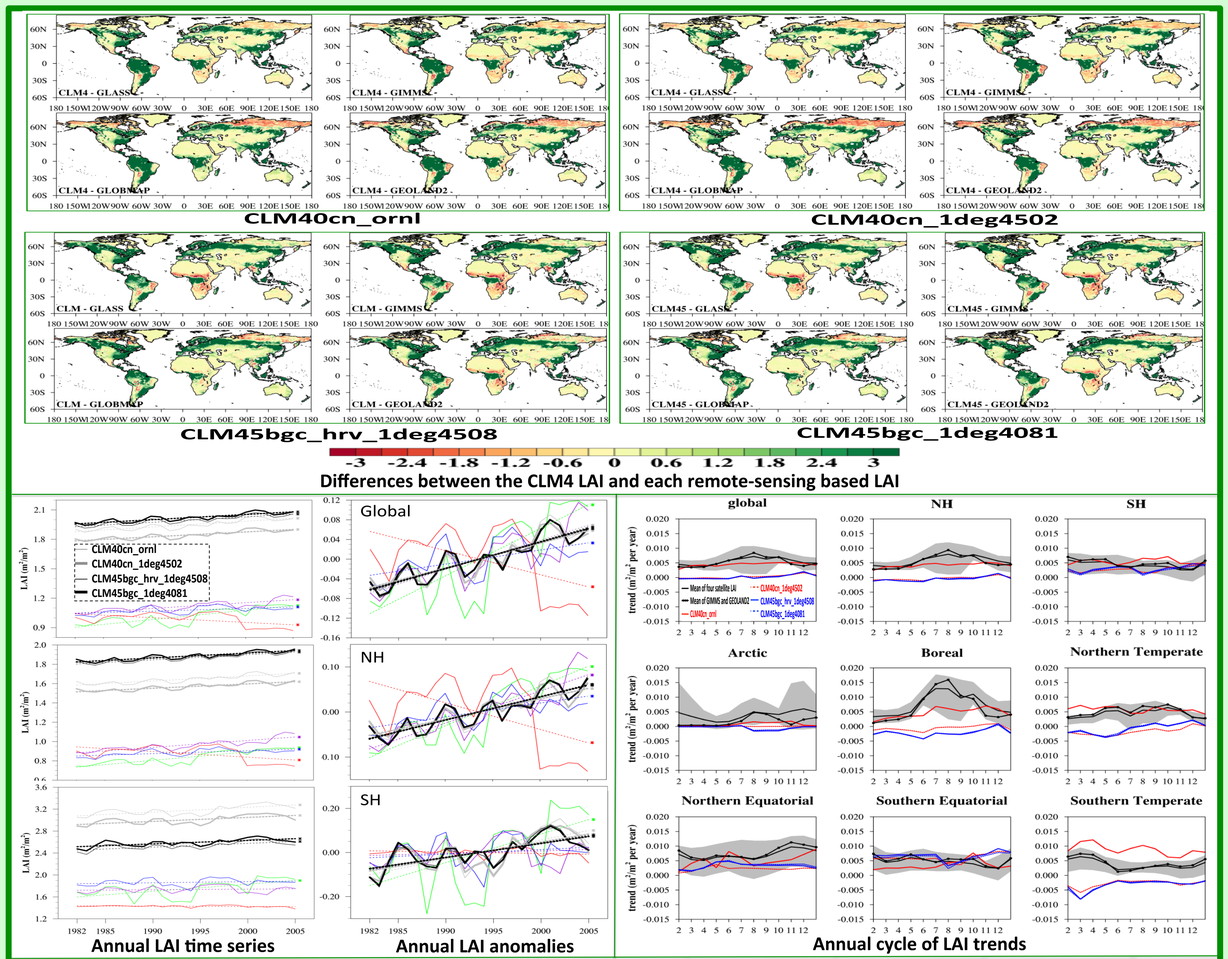
✧ ***LAI synthesis***

- According to different uncertainties

Homogenization methods



Intercomparisons among the four processed LAI products (1982-2010)



Evaluations of the simulated LAI from different versions of CLM4 (1982-2005)

- Magnitude and phenology of multi-year mean LAI are comparable among different products;
- Mismatches between the pre- and post-2000 period are found in the four products, and this mismatch problem is particularly significant in the GLOBMAP and GLASS LAI;
- The GEOLAND2 LAI and the GIMMS LAI3g are relatively consistent in the temporal changes and the increasing trends from 1982 to 2010;
- Weak agreement in long-term trends among satellite-based LAI implies the importance of using multiple products to reduce the uncertainties spatially and temporally;
- LAI trend and interannual variability are better simulated by CLM4 than the magnitude;
- More analysis and understandings are needed for further applications in the LSMs and ESMs.

Sponsored by the U.S. Department of Energy, Office of Science, Biological and Environmental Research (BER) programs, and performed at Oak Ridge National Laboratory (ORNL). ORNL is managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract DE-AC05-00OR22725. Please contact maoj@ornl.gov for further information.