

Supplementary dataset

Table S1 contains the global field LAI data that were used in the paper below:

Fang, H., S. Wei, and S. Liang, 2011. Validation of MODIS and VEGETATION LAI products using global field measurement data. *Remote Sensing of Environment* (accepted for publication).

Table S1. Global validation sites from major field campaigns (Total 28) and the literature (Total 62)^a. Blank references cells follow the upper one.

Country	Lat	Lon	Biome	Dates	Methods	L_t/L_e	Mean LAI	References
USA	38.41	-120.78	Grass	2002/1/25-4/15	LAI meter	T	1-2.4	AmeriFlux ^b
Germany	51.08	10.45	MF	2001/3/15-11/11	LAI2000	E	0.86-4.81	FluxNet
Israel	31.35	35.05	ENF	2000;2001/Mar;2002/Aug; 2003/Mar,Aug,Nov;2005	LAI2000/DHP/ TRAC/Destructive	T/E	0.89-2.5	
USA	40.01	-88.29	Crop-B	2000/7/14,8/11;	Destructive	T	2.47-3.6	BigFoot ^c
USA	42.54	-72.17	DBF	2000/7/26;2001/8/24	LAI2000	E	5.37	
USA	39.08	-96.56	Grass	2000/7/6,8/25,10/13; 2001/7/18,8/16	LAI2000	T	1.96-2.89	
USA	34.34	-106.67	Shrubs	2002/7/26,8/22,9/9,11/15; 2003/6/23,7/28,9/15,11/21	Harvest/LAI2000	T/E	0.10	
USA	71.27	-156.61	Grass	2002/7/7,8/15	LAI2000	T	0.35	
Argentina	-36.99	-60.55	Grass	2002/10/18-19	DHP	T	1.94	VALERI ^c
Bolivia	-18.24	-68.19	Shrubs	2002/8/25-30;2003/4/12-18	DHP	E	0.07	
Canada	45.38	-75.22	ENF	2003/8/3-5	DHP	T	3.68	
Chile	-37.47	-73.47	MF	2003/1/7-10	DHP	E	3.12	
Chile	5.34	-53.24	EBF	2002/10/7-18	DHP	E	4.4	

Indonesia	2.63	99.58	EBF	2001/5/1-9	LAI2000	E	3.81	
Estonia	58.30	27.26	MF	2000/7/3-8;2001/6/12-16, 6/24-30;2003/7/7-11	LAI2000	E	2.29-4.54	
Finland	62.64	27.01	ENF	2003/8/7-20;2004/6/24-7/22; 2005/5/24-6/22	LAI2000	E	1.66-2.18	
Finland	66.45	25.34	ENF	2004/5/31-6/18; 2005/6/13-17	LAI2000	E	1.53	
France	43.81	4.74	Crop-C	2001/2/26-3/15	LAI2000	T	1.85	
France	43.81	4.71	Crop-C	2002/2/22-23	DHP	T	2.24	
France	43.94	3.12	Grass	2002/7/1-3	DHP	T	0.74	
France	44.57	-1.04	ENF	2000/7/17-8/10	LAI2000	T	1.59	
France	43.72	3.65	MF	2001/6/11-15	LAI2000	T	2.9	
France	48.44	3.77	Crop-C	2000/6/5-9	LAI2000	T	4.3	
France	43.51	1.24	Crop-B	2002/7/7-8	DHP	T	2.47	
Germany	48.08	11.32	Crop-c	2002/7/17-19	DHP	T	5.62	
Mali	15.32	-1.55	Grass	2000/8/27-9/3;2001/9/28-10/6	LAI2000	T	0.71	
Romania	44.41	26.59	Crops	2001/3/26-27;2002/5/24; 2003/5/31 ^d	LAI2000/ DHP	T	1.22-1.59	
Spain	39.07	-2.10	Crops	2003/7/3 ^d	DHP	T	2.7	
Argentina	-34.03	-67.97	Shrubs	2001	LAI2000	E	1.4	Asner et al. (2003)
Australia	-35.75	148.25	DBF	2001/Feb	LAI2000/DHP/ Point-Quadrat	T	1.38	Coops et al. (2004)
Australia	-35.66	148.13	DBF	2001-2003	DHP	E	2.4	Leuning et al. (2005)
Australia	-19.88	146.55	Savanna	2001-2003	Estimate	T	0.8	
Australia	-19.70	146.22	Savanna	2003/Jun	TRAC	E	1.46	Johansen and Phinn (2006)
Belgium	51.31	4.52	ENF	1999-2001/Sum/Win	Na	E	1.7/3.6	Carrara et al. (2003)

Brazil	-15.96	-47.88	Shrubs	2002/Aug	Destructive	T	0.4	Hoffmann et al. (2005)
Brazil	-15.96	-47.87	Savanna	2002/9/25	LAI2000	T	1.41	
Brazil	-15.95	-47.89	Savanna	2002/10/27;2003/2/2-11/3	LAI2000	T	1.44-2.59	
Brazil	-15.93	-47.87	Shrubs	2002/Jun	Destructive	T	0.59	
Brazil	-3.38	-55.58	EBF	1999/Nov	LAI2000	E	6.2	Williams et al. (2002)
Brazil	-3.21	-54.99	EBF	2002/Oct	LAI2000	E	4.32	Aragão et al. (2005)
Canada	45.40	-75.50	Shrubs	2000/5/14	Destructive	T	0.7	Admiral et al. (2006)
Canada	49.91	-125.37	ENF	2004/Aug; 2005/Oct	LAI2000/TRAC	T	3.38-3.83	Chen et al. (2006)
				2000/5/16-9/5; 2001/5/17;				
Canada	53.70	-106.20	DBF	2002/6/10-7/20;2003/5/17-8/29;	LAI2000	T	1.2-4.9	Barr et al. (2004)
				2004/6/1-8/4				
China	29.54	101.97	ENF	1999/7/14	SLA	T	10.21	Luo et al. (2004)
China	29.58	102.00	ENF	1999/8/11-8/15	SLA	T	7.78-10.17	
China	29.59	102.02	EBF	1999/8/5	SLA	T	6.23	
China	29.60	102.06	EBF	1999/8/7	SLA	T	4.55	
China	29.65	94.41	ENF	2000/7/22-7/26	SLA	T	4.54-12.41	
China	29.72	92.87	Shrubs	2000/7/21-7/29	SLA	T	1.85-3.83	
China	30.00	93.50	DBF	2000/7/27	SLA	T	5.69	
China	31.57	91.93	Grass	2000/8/2	SLA	T	1.66	
China	32.45	92.01	Grass	2000/7/29-8/3	SLA	T	0.63-1.64	
China	37.48	101.20	Grass	2001/8/20	LAI meter	T	3.1	Kato et al. (2004)
China	37.75	101.38	Grass	2002/7/16	LAI meter	T	3.8	
Congo	-4.25	11.75	Savanna	2002/Sum	LAI2000	E	6	Favier et al. (2004)
Costa Rica	9.59	-83.74	EBF	2000/Feb	LAI2000	E	4.25	Hölscher et al. (2003)
Costa Rica	10.81	-85.62	EBF	2002/9/1-12/15; 2003/1/4-3/3	LAI2000	T	1.3-3.3	Kalácska et al. (2005)
Ethiopia	7.42	38.92	EBF	2001/3/17-4/2	LAI2000	E	1.78	Lemenih et al. (2004)

Ethiopia	7.50	35.50	DBF	2000/Jul	SLA	T	9.7	Embaye et al. (2005)
Finland	61.32	28.43	ENF	2000/6/14-21	LAI2000	T	1.631	Wang et al. (2004)
Finland	61.53	28.71	ENF	2000/Jul	LAI2000	E	1.87	Stenberg et al. (2004)
Finland	62.68	27.48	ENF	2001/Jul	LAI2000	E	2.23	
Finland	69.60	27.00	ENF	2004/Jul	SLA	T	0.76	Heiskanen (2006)
France	38.42	2.67	DBF	2000/Sum	LAI2000	E	3.59	Gascon et al. (2004)
Germany	49.75	7.17	ENF	2000/Sum; 2000/Aut	LAI2000	T	3.24	Schlerf et al. (2005)
Germany	52.18	14.06	ENF	2003/5/19-6/17	LAI2000	E	5.91	Heret et al. (2006)
Germany	53.78	10.60	DBF	2002/Aug-Oct	SLA	T	4.82	Kutsch et al. (2005)
Greenland	76.53	-68.83	Shrubs	2004/Jul	Destructive	T	0.23	Steltzer and Welker (2006)
India	16.88	79.71	Crop-C	2003/1/28-30	DHP	T	1.32	Jonna et al. (2006)
India	22.82	72.80	Crop-C	2002/1/30	LAI2000	T	2.7	Chaurasia et al. (2006)
India	22.82	72.80	Crop-C	2002/1/15	LAI2000	T	2.2	
India	23.03	72.27	Crop-C	2002/1/8	LAI2000	T	1.3	
Indonesia	-1.50	120.04	EBF	2005/Apr	DHP	E	5.46	Dietz et al. (2006)
Japan	39.00	141.00	Crop-C	2000/221	LAI meter	T	4.47	Anten et al. (2003)
Mongolia	47.20	108.73	Grass	2003/5/5-22,8/8-30	Destructive	T	0.07-0.56	Li et al. (2006)
Netherlands	51.97	5.63	Grass	2002-2003	Leaf tracing ^e	T	2.9	Jacobs et al. (2003)
New Zealand	-44.23	170.15	Grass	1998/Oct-1999/Apr	Estimate	T	0.5	Hunt et al. (2002)
New Zealand	-43.10	172.33	EBF	2004	LAI2000	E	3.5	R. Dungan (2006) ^f
Norway	60.68	12.30	ENF	2005/May;2005/Jul;2005/Aug	LAI2000/ DHP	E	0.80-0.84	Solberg et al. (2006)
Senegal	15.37	-15.44	Savanna	2001/9/6,9/13	LAI2000	T	2.1-2.42	Fensholt et al. (2004)
Senegal	15.41	-15.43	Savanna	2002/8/17-9/22	LAI2000	T	0.11-0.79	
Senegal	15.82	-15.06	Savanna	2002/7/21-9/22	LAI2000	T	0.05-0.56	
Senegal	15.90	-15.06	Savanna	2002/7/22-9/27	LAI2000	T	0.03-0.68	
Sweden	68.35	18.82	Shrubs	2002/7/15-30	LAI meter	T	0.72	van Wijk et al. (2005)

USA	38.91	-120.65	ENF	2001/8/10-11	LAI2000	E	2.12	Pu and Gong (2004)
USA	39.32	-86.42	DBF	2000/7/6	LAI2000	T	3.4	Oliphant et al. (2006)
USA	45.80	-90.12	DBF	1998-2002	Litter traps	T	4.95	Martin and Bolstad (2005)
USA	46.77	-100.92	Grass	1999-2001/Sum	Harvest	T	0.9	Frank (2004)
USA	48.35	-116.75	ENF	2000/Jul-Aug	Ceptometer/ Allometric	T	4.6/6.6	Duursma et al. (2003)
USA	64.87	-147.85	ENF	2004/5/5-11/12	LAI2000	E	0.33-2.43	Ueyama et al. (2006)

^a“Lat”, “Lon”, and “Lt/Le” refer to latitude, longitude, true (T)/effective (E) LAI, respectively. In the “biomes” column, Crop-C, Crop-B, Crops refer to the cereal crops, broadleaf crops and mixed croplands, respectively. EBF, DBF, ENF and MF stand for the evergreen broadleaf forest, deciduous broadleaf forest, evergreen needleleaf forest, and mixed (evergreen needleleaf + deciduous broadleaf) forest, respectively. In the “dates” column, “Sum”, “Aut”, and “Win” stand for summer, autumn, and winter, respectively. For the “Methods” column, “SLA” refers to the specific leaf area method and “DHP” refers to the Digital Hemispherical photograph (e.g. Hemiview) or a fisheye imager.

^b AmeriFlux (Xu and Baldocchi, 2004).

^c Also refer to Garrigues et al. (2008).

^d Date according to the corresponding SPOT image.

^e Procedure of a leaf tracing method.

^f Personal communication with Roger Dungan in 2006.

References

- Admiral, S.W., Lafleur, P.M., & Roulet, N.T. (2006). Controls on latent heat flux and energy partitioning at a peat bog in eastern Canada. *Agricultural and Forest Meteorology*, *140*, 308-321.
- Anten, N.P.R., Hirose, T., Onoda, Y., Kinugasa, T., Kim, H.Y., Okada, M., & Kobayashi, K. (2003). Elevated CO₂ and nitrogen availability have interactive effects on canopy carbon gain in rice. *New Phytologist*, *161*, 459-471.
- Aragão, L.E.O.C., Shimabukuro, Y.E., Espirito Santo, F.D.B., & Williams, M. (2005). Landscape pattern and spatial variability of leaf area index in Eastern Amazonia. *Forest Ecology and Management*, *211*, 240-256.
- Asner, G.P., Borghi, C.E., & Ojeda, R.A. (2003). Desertification in Central Argentina: Changes in ecosystem carbon and nitrogen from imaging spectroscopy. *Ecological Applications*, *13*, 629-648.
- Barr, A.G., Black, T.A., Hogg, E.H., Kljun, N., Morgenstern, K., & Nesic, Z. (2004). Inter-annual variability in the leaf area index of a boreal aspen-hazelnut forest in relation to net ecosystem production. *Agricultural and Forest Meteorology*, *126*, 237-255.
- Carrara, A., Yuste, J.C., Ceulemans, R., Kowalski, A.S., Neiryneck, J., & Janssens, I.A. (2003). Net ecosystem CO₂ exchange of mixed forest in Belgium over 5 years. *Agricultural and Forest Meteorology*, *119*, 209-227.
- Chaurasia, S., Parihar, J.S., Bhattacharya, B., & Dadhwal, V.K. (2006). Field-scale Leaf Area Index estimation using IRS-1D LISS-III data. *International Journal of Remote Sensing*, *27*, 637-644.
- Chen, J.M., Govind, A., Sonnentag, O., Zhang, Y., Barr, A., & Amiro, B. (2006). Leaf area index measurements at Fluxnet-Canada forest sites. *Agricultural and Forest Meteorology*, *140*, 257-268.
- Coops, N.C., Smith, M.L., Jacobsen, K.L., Martin, M., & Ollinger, S. (2004). Estimation of plant and leaf area index using three techniques in a mature native eucalypt canopy. *Austral Ecology*, *29*, 332-341.
- Dietz, J., Holscher, D., Leuschner, C., & Hendrayanto (2006). Rainfall partitioning in relation to forest structure in differently managed montane forest stands in Central Sulawesi, Indonesia. *Forest Ecology and Management*, *237*, 170-178.
- Duursma, R.A., Marshall, J.D., & Robinson, A.P. (2003). Leaf area index inferred from solar beam transmission in mixed conifer forests on complex terrain. *Agricultural and Forest Meteorology*, *118*, 221-236.

- Embaye, K., Christersson, L., Weih, M., & Ledin, S. (2005). Biomass and nutrient distribution in a highland bamboo forest in southwest Ethiopia: Implications for management. *Forest Ecology and Management*, 204, 159-169.
- Favier, C., De Namur, C., & Dubois, M.A. (2004). Forest progression modes in littoral Congo, Central Atlantic Africa. *Journal of Biogeography*, 31, 1445-1461.
- Fensholt, R., Sandholt, I., & Rasmussen, M.S. (2004). Evaluation of MODIS LAI, fAPAR and the relation between fAPAR and NDVI in a semi-arid environment using in situ measurements. *Remote Sensing of Environment*, 91, 490-507.
- Frank, A.B. (2004). Six Years of CO₂ Flux Measurements for a Moderately Grazed Mixed-Grass Prairie. *Environmental Management*, 33, 426-431.
- Garrigues, S., Lacaze, R., Baret, F., Morisette, J.T., Weiss, M., Nickeson, J.E., Fernandes, R., Plummer, S., Shabanov, N.V., Myneni, R.B., Knyazikhin, Y., & Yang, W. (2008). Validation and intercomparison of global Leaf Area Index products derived from remote sensing data. *Journal of Geophysical Research*, 113. doi: 10.1029/2007JG000635.
- Gascon, F., Gastellu-Etchegorry, J.P., Lefevre-Fonollosa, M.J., & Dufrene, E. (2004). Retrieval of forest biophysical variables by inverting a 3-D radiative transfer model and using high and very high resolution imagery. *International Journal of Remote Sensing*, 25, 5601-5616.
- Hölscher, D., Köhler, L., Leuschner, C., & Kappelle, M. (2003). Nutrient fluxes in stemflow and throughfall in three successional stages of an upper montane rain forest in Costa Rica. *Journal of Tropical Ecology*, 19, 557-565.
- Heiskanen, J. (2006). Estimating aboveground tree biomass and leaf area index in a mountain birch forest using ASTER satellite data. *International Journal of Remote Sensing*, 27, 1135-1158.
- Heret, C., Tittebrand, A., & Berger, F.H. (2006). Latent heat fluxes simulated with a non-hydrostatic weather forecast model using actual surface properties from measurements and remote sensing *Boundary-Layer Meteorology*, 121, 175-194.
- Hoffmann, W.A., Scholz, F.G., Goldstein, G., Meinzer, F.C., Da Silva Jr, E.R., Machado, G.C., & Bucci, S.J. (2005). Seasonal leaf dynamics across a tree density gradient in a Brazilian savanna. *Oecologia*, 145, 307-316.
- Hunt, J.E., Kelliher, F.M., McSeveny, T.M., & Byers, J.N. (2002). Evaporation and carbon dioxide exchange between the atmosphere and a tussock grassland during a summer drought. *Agricultural and Forest Meteorology*, 111, 65-82.
- Jacobs, A.F.G., Heusinkveld, B.G., & Holtslag, A.A.M. (2003). Carbon dioxide and water vapour flux densities over a grassland area in the Netherlands. *International Journal of Climatology*, 23, 1663-1675.

- Johansen, K., & Phinn, S. (2006). Mapping Structural Parameters and Species Composition of Riparian Vegetation Using IKONOS and Landsat ETM+ Data in Australian Tropical Savannas. *Photogrammetric Engineering and Remote Sensing*, 72, 71-80.
- Jonna, S., Amminedu, E., Badrinath, K.V.S., Chandrasekhar, G., & Kiran Chand, T.R. (2006). Crop canopy characterization in irrigation command areas using MODIS satellite data. *Geocarto International*, 21, 61-70.
- Kalácska, M., Calvo-Alvarado, J.C., & Sánchez-Azofeifa, G.A. (2005). Calibration and assessment of seasonal changes in leaf area index of a tropical dry forest in different stages of succession. *Tree Physiology*, 25, 733-744.
- Kato, T., Tang, Y., Gu, S., Cui, X., Hirota, M., Du, M., Li, Y., Zhao, X., & Oikawa, T. (2004). Carbon dioxide exchange between the atmosphere and an alpine meadow ecosystem on the Qinghai–Tibetan Plateau, China. *Agricultural and Forest Meteorology*, 124, 121-134.
- Kutsch, W.L., Liu, C., Hörmann, G., & Herbst, M. (2005). Spatial heterogeneity of ecosystem carbon fluxes in a broadleaved forest in Northern Germany. *Global Change Biology*, 11, 70-88.
- Lemenih, M., Gidyew, T., & Teketay, D. (2004). Effects of canopy cover and understory environment of tree plantations on richness, density and size of colonizing woody species in southern Ethiopia. *Forest Ecology and Management*, 194, 1-10.
- Leuning, R., Cleugh, H.A., Zegelin, S.J., & Hughes, D. (2005). Carbon and water fluxes over a temperate Eucalyptus forest and a tropical wet/dry savanna in Australia: measurements and comparison with MODIS remote sensing estimates. *Agricultural and Forest Meteorology*, 129, 151-173.
- Li, S.-G., Eugster, W., Asanuma, J., Kotani, A., Davaa, G., Oyunbaatar, D., & Sugita, M. (2006). Energy partitioning and its biophysical controls above a grazing steppe in central Mongolia. *Agricultural and Forest Meteorology*, 137, 89-106.
- Luo, T., Luo, J., Yu, Z., Lu, Q., Pan, Y., Ouyang, H., & Shi, P. (2004). Leaf area index and net primary productivity along subtropical to alpine gradients in the Tibetan Plateau. *Global Ecology and Biogeography*, 13, 345-358.
- Martin, J.G., & Bolstad, P.V. (2005). Annual soil respiration in broadleaf forests of northern Wisconsin: influence of moisture and site biological, chemical, and physical characteristics. *Biogeochemistry*, 73, 149-182.
- Oliphant, A., Susan, C., Grimmond, B., Schmid, H.-P., & Wayson, C.A. (2006). Local-scale heterogeneity of photosynthetically active radiation (PAR), absorbed PAR and net radiation as a function of topography, sky conditions and leaf area index. *Remote Sensing of Environment*, 103, 324-337.
- Pu, R., & Gong, P. (2004). Wavelet transform applied to EO-1 hyperspectral data for forest LAI and crown closure mapping. *Remote Sensing of Environment*, 91, 212-224.

- Schlerf, M., Atzberger, C., & Hill, J. (2005). Remote sensing of forest biophysical variables using HyMap imaging spectrometer data. *Remote Sensing of Environment*, 95, 177-194.
- Solberg, S., Naesset, E., Hanssen, K.H., & Christiansen, E. (2006). Mapping defoliation during a severe insect attack on Scots pine using airborne laser scanning. *Remote Sensing of Environment*, 102, 364-376.
- Steltzer, H., & Welker, J.M. (2006). Modeling the effect of photosynthetic vegetation properties on the NDVI-LAI relationship. *Ecology*, 87, 2765-2772.
- Stenberg, P., Smolander, H., Rautiainen, M., Manninen, T., & Voipio, P. (2004). Reduced simple ratio better than NDVI for estimating LAI in Finnish pine and spruce stands. *Silva Fennica*, 38, 3-14.
- Ueyama, M., Harazono, Y., Ohtaki, E., & Miyata, A. (2006). Controlling factors on the interannual CO₂ budget at a subarctic black spruce forest in interior Alaska. *Tellus B*, 58, 491-501.
- van Wijk, M.T., Williams, M., & Shaver, G.R. (2005). Tight coupling between leaf area index and foliage N content in arctic plant communities. *Oecologia*, 142, 421-427.
- Wang, Y., Woodcock, C.E., Buermann, W., Stenberg, P., Voipio, P., Smolander, H., Häme, T., Tian, Y., Hu, J., Knyazikhin, Y., & Myneni, R.B. (2004). Evaluation of the MODIS LAI algorithm at a coniferous forest site in Finland. *Remote Sensing of Environment*, 91, 114-127.
- Williams, M., Shimabukuro, Y.E., Herbert, D.A., Lacruz, S.P., Renno, C., & Rastetter, E.B. (2002). Heterogeneity of soils and vegetation in an eastern Amazonian rain forest: Implications for scaling up biomass and production. *Ecosystems*, 5, 692-704.
- Xu, L., & Baldocchi, D.D. (2004). Seasonal variation in carbon dioxide exchange over a Mediterranean annual grassland in California. *Agricultural and Forest Meteorology*, 123, 79-96.