Fluxnet/TCO Global Synthesis Proposal

Understanding the Environmental Controls on Net and Gross Light-Use Efficiency and Their Temporal Patterns: A Circumboreal Study.

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Abstract

Several global-scale productivity models use the light-use efficiency (LUE) approach to estimate net or gross productivity (i.e., NEP or GEP, respectively). Operationally, these models constrain the LUE parameter using biome-specific values along with satellite and meteorological data. However, these satellite-derived inputs are available at levels of temporal and spatial aggregation that may not be optimal for reliable large-scale estimates of vegetation productivity because of the spatio-temporal variability that exists within biomes that is not accounted for in these models.

We propose to use multi-year datasets of gross and net LUE and environmental variables from several flux towers (Table 1a-b) located in the circumpolar boreal zone (1) to identify and describe the main environmental factors affecting gross and net LUE in circumboreal forest ecosystems, their interactions, and the timescales and lags associated with each of the identified drivers, (2) to characterize the functional responses, at different timescales, between LUE and the main drivers identified, (3) to compare the drivers and functional relationships found in the first two sections across and within the biomes of the circumboreal region.

The goal of this paper is to gain improved understanding of the main processes influencing gross and net light-use efficiency (LUE) across the circumboreal region, and the timescales at which they operate. Since any estimates of LUE that we might be able to develop using remote sensing will likely not be continuous, understanding temporal patterns of LUE should enhance our ability to detect variations in LUE from space.

Objectives and Analyses

Characterize gross and net LUE, environmental and biophysical variables at the study sites, and identify and quantify the main frequencies in LUE, and the relationships to its environmental drivers. This will be done using descriptive statistics and spectral analysis techniques (co-spectral and coherence analyses, etc.).

Determine to what extent a single LUE measurement acquired at a particular moment in time (e.g., the time of a clear satellite overpass) is indicative of its state in previous or following days, weeks, months, etc. This is achieved with autocorrelation analyses on time series of LUE at different temporal integration levels.

Identify and characterize the functional relationships between LUE and its environmental drivers at different time scales using cross-correlation analyses.

Develop functional relationships between LUE and its drivers at time scales identified using non-linear and linear regression analyses.

Compare results from the previous analyses, between (a) species, (b) stages of stand development, (c) continents, and (d) biomes.

Policy for Co-Authorship

Our policy will be to provide co-authorship only to those people who made a significant intellectual contribution to the article. People responsible only for collecting and providing the data used in the proposed analyses will be enthusiastically acknowledged in the appropriate section of the article.

Table 1a. Confirmed flux towers that will be used in the proposed study of circumboreal light-use efficiency.

Latitude	**Longitude**	**Site ID**	**ORNL ID**
48.217	-82.156	CA-Gro	ca.groundhogriver.01
45.407	-75.484	CA-Mer	ca.mer_bleue.01
46.474	-67.099	CA-Na1	ca.nashwaak1.01
55.879	-98.484	CA-NS1	ca.nsa_burn_1850.01
53.629	-106.198	CA-Oas	ca.oldaspen.01
53.987	-105.118	CA-Obs	ca.oldblackspruce.01
53.916	-104.692	CA-Ojp	ca.oldjackpine.01
49.267	-74.037	CA-Qcu	ca.quebeccutover.01
49.692	-74.342	CA-Qfo	ca.quebecforest.01
54.485	-105.818	CA-SF1	ca.saskfire77.01
54.254	-105.878	CA-SF2	ca.ssa_fire_1989.01
54.092	-106.005	CA-SF3	ca.ssa_fire_1998.01
53.908	-104.656	CA-SJ1	ca.ssa_jackpine_1994.01
53.945	-104.649	CA-SJ2	ca.ssa_jackpine_2002.01
53.876	-104.645	CA-SJ3	ca.ssa_yngjackpine.01
54.954	-112.467	CA-WP1	ca.westernpeatland.01
61.848	24.295	FI-Hyy	fi.hyytiala.01
69.141	27.295	FI-Kaa	fi.kaamanen.01
67.362	26.638	FI-Sod	fi.sodankyla.01
68.615	161.339	RU-Che	ru.cherskii.01
56.462	32.924	RU-Fyo	ru.ffedorovskoje_new.01
68.362	-18.795	SE-Abi	se.abisko.01
64.113	19.457	SE-Fla	se.flakaliden.01
60.083	17.483	SE-Nor	se.norunda.01
60.125	17.918	SE-Sk1	se.skyttorp_yng.01
60.130	17.840	SE-Sk2	se.skyttorp.01
63.923	-145.744	US-Bn3	us.ak_bonanza_1999.01
45.204	-68.740	US-Ho1	us.howland.01
63.833	-20.217	IS-Gun	is.gunnarsholt.01

Table 1b. Additional flux towers to be confirmed depending on data availability.

Lat	**Lon**	**SiteID**	**ORNL ID**
55.880	-98.481	CA-Man	ca.manitoba.01
55.906	-98.525	CA-NS2	ca.nsa_burn_1930.01
55.912	-98.382	CA-NS3	ca.nsa_burn_1964.01
55.912	-98.382	CA-NS4	ca.nsa_burn_1964_wet.01
55.863	-98.485	CA-NS5	ca.nsa_burn_1981.01
55.917	-98.964	CA-NS6	ca.nsa_burn_1989.01
56.636	-99.948	CA-NS7	ca.nsa_burn_1998.01
55.898	-98.216	CA-NS8	ca.nsa_burn_2003.01
70.617	147.883	RU-Cho	ru.chokurdakh.01
65.595	171.053	RU-Chu	ru.chukotka.01
56.448	32.902	RU-Fy2	ru.ffedorovskoje_old.01
72.373	126.498	RU-Sam	ru.samoylov.01
50.150	94.450	RU-Tuv	ru.tuva.01
62.241	129.651	RU-Ya2	ru.yakutsk_pine.01
62.255	129.619	RU-Yak	ru.yakutsk_larch.01
60.750	89.383	RU-Zbo	ru.zotino_bog.01
60.750	89.383	RU-Zfw	ru.zotino_forest.01
60.801	89.351	RU-Zo2	ru.zotino.01
64.183	19.550	SE-Deg	se.degero.01
60.998	16.217	SE-Kno	se.knottasen.01
68.350	19.033	SE-St1	se.stordalen_birch.01
68.354	19.047	SE-St2	se.stordalen.01
56.250	13.550	SE-Faj	se.fajemyr.01
69.133	-148.833	US-HVa	us.happy_valley.01
68.486	-155.750	US-Ivo	us.ak_ivotuk.01
70.281	-148.885	US-Upa	us.prudhoe.01