Fluxnet/TCO Global Synthesis Proposal

Title: Contrasting the Seasonal Patterns of Fluxes and Environmental Responses Functions for the Circumboreal Forest

Hank Margolis[1], Guillaume Drolet[2], and Flux Tower Investigators Who Wish To Participate, *et al*.

1. Program Leader, Fluxnet-Canada & Canadian Carbon Program, Université Laval, Quebec City, Canada
2. PhD Student, Fluxnet-Canada & Canadian Carbon Program, Université Laval, Quebec City, Canada

Abstract
The vast area of boreal forest across North America, Scandinavia, and Asia plays a key role in the global carbon cycle and it is likely that there are both similarities and differences in the seasonal patterns of the major flux variables (NEP, GEP, R) as well as in how they respond to environmental drivers at various points in the growing season. This study will evaluate these similarities and differences across the circumpolar boreal zone. We will (a) examine the dynamics of the mid-summer depression in NEP, (b) quantify and analyze how environmental factors influence winter fluxes across the circumpolar boreal biome, (c) determine the extent to which photoperiod versus temperature influences autumn fluxes across the different parts of the biome, and, if not being addressed elsewhere, (d) analyze how springtime fluxes respond to environmental factors.

Objectives and Analyses
A comparison across three boreal black spruce flux sites in North America has shown that all three sites exhibited a marked depression in NEP during the mid-summer, typically in July (Bergeron *et al*. 2006) and that the timing of the depression can vary between years at the same site (Bergeron *et al*., in review). This depression is associated with different temporal patterns of GEP relative to R due to the lag in the warming of the soil relative to aboveground vegetation. We hypothesize that the mid-summer depression is a general phenomenon across the entire circumpolar boreal biome and the current study will compare and quantify the degree to which this occurs in different geographical regions (Table 1a and 1b). We will also examine how the main environmental response functions that describe these processes change when the depression is present. Changes in the timing, duration, or strength of the mid-summer NEP depression may be crucial to the response of the boreal C cycle to climate change.

We are also interested in conducting similar analyses for the other seasons, but we are not sure whether this will conflict with studies planned by other groups. If so, we could limit our additional analyses to winter and/or autumn. For the winter analysis, we would quantify the extent to which differences in snowpack and climate influence winter fluxes and the degree to which these differences influence the overall annual carbon balance. For the autumn analysis, we would try to build on the ideas suggested in the recent Nature submission from Piao *et al*. (in review) to analyze site level differences in the autumn cross-over date and the dynamics of autumn fluxes in determining the Carbon Uptake Period in different geographical regions of the circumpolar boreal zone. Similarly, our springtime analysis would focus on the different dynamics of the spring start-up for NEP, GEP, and R across different regions. We see this as an analysis paper, not a modeling paper. However, we expect it to be very pertinent to modeling efforts.

Policy for Co-authorship

Our policy will be to provide co-authorship only to those people who make 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.

References

Bergeron, O., Margolis, H.A., Black, T.A., Coursolle, C., Dunn, A.L., Barr, A.G., Wofsy, S.C. 2007. Comparison of CO_2 fluxes over three boreal black spruce forests in Canada. Global Change Biol. 13: 89-107, doi:10.1111/j.1365-2486.2006.01281.x.

Bergeron, O., Margolis, H.A., Coursolle, C., Giasson, M.-A. 2007. How does forest harvest influence carbon dioxide and water fluxes of black spruce ecosystems in eastern North America? Agric. Forest Meteorol. (in review).

Piao, S., Ciais, P., Friedlingstein, P., Peylin, P., Reichstein, M., Luyssaert, S., Margolis, H., Barr, A., Hollinger, D., Laurila, T., Lindroth, A., Vesala, T. 2007. Autumn warming shortens the seasonal carbon uptake period by northern ecosystems and enhances carbon losses. Nature (in review).

Table 1a. Confirmed flux towers that will be used in the proposed study.

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 for use in the study 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