Synthesis of Inter-Annual Variability in Net Ecosystem Exchange at Long-Term North American Mature Boreal and North-Temperate Forest Flux-Tower Sites

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Outline: We plan a synthesis of inter-annual variability at long-term North American mature boreal and north-temperate forest flux-tower sites. The intent is to show that inter-annual variability in net ecosystem production NEP is controlled by the relative responses of gross ecosystem photosynthesis GEP and ecosystem respiration R to climatic, hydrologic, phenological and biophysical forcings, and to identify similarities and differences among contrasting ecosystems. Key questions: Is inter-annual variability in NEP dominated by GEP or R? What are the controlling factors? What commonalities and differences exist among sites? Are the responses spatially coherent?

Sample hypotheses:

1. Growing-season length GSL is a dominant factor at all sites. The start date of the growing season is more variable than the end date and has a greater impact on annual NEP. GSL impacts GEP more than R. The impact of GSL on GEP and NEP is greater for deciduous than coniferous sites.
2. The carbon and water cycles are tightly coupled at both seasonal and inter-annual time scales, but different ecosystems (well-drained versus poorly drained, coniferous versus deciduous) respond differently because of different impacts of water stress on GEP and R. Shallow drought affects R only whereas more severe drought also affects GEP; the net drought effect on NEP may be positive (shallow drought), negative (deep drought) or neutral. GEP and ET are tightly coupled at monthly and annual time scales; the ratio of GEP / ET is conservative at a given site but varies among species and climatic zones.
3. Deciduous and coniferous forest ecosystems have characteristic differences in the seasonality of GEP, NEP, and R, with greater inter-site differences in GEP than R. The same is true for north-temperate versus boreal forests. Differences in the seasonal cycles among sites are greater than differences among years at one site.
4. Among all sites, there is an observable coupling between GEP and R at both seasonal and inter-annual time scales, related to a conservative Ra/GEP ratio.

To date, our plans are limited to North American sites, under the umbrella of Fluxnet Canada. As part of the planned FLUXNET TCO synthesis, we will be glad to discuss international collaborations (a) to extend the scope and (b) to share and focus the activities.

Contributing Sites: Long-term North American mature boreal and north-temperate forest flux-tower sites, including Harvard Forest, Northern Old Black Spruce, Howland Forest, BERMS Southern Old Aspen, BERMS Southern Old Black Spruce, BC Douglas-Fir, and (perhaps) Camp Borden. The Mer Bleue peatland may also be added if we decide to extend the analysis to peatland sites. The list could be expanded to include other long-term sites in the TCO synthesis.

Co-authorship: Offers of co-authorship will be extended to all who make significant contributions of data, ideas, and analysis.