On correcting overestimation of flux tower-derived estimates of ecosystem respiration and gross primary production

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It was demonstrated earlier that popular algorithms of post-processing CO2 exchange measurements lead to notable overestimation of ecophysiological parameters resulting in overestimation of ecosystem respiration (RE) and gross primary production (GPP) (J. Exp. Bot. 1980, 31:41-48; Glob. Biogeochem. Cycles 2003, 17:171; Agric. For. Meteorol. 2005, 130:13-25). Recently the case of overestimation of flux tower-derived RE and GPP was emphasized using a novel stable isotope tracer method (Nature 2016, 543:680-683). To look into the issue, we have compared RE and GPP estimates for a number of long-term grassland flux tower datasets from the FLUXNET database obtained using the nighttime (NT)-based (Global Change Biol. 2005, 11:1424-1439) and the daytime (DT)-based (Global Change Biol. 2010, 16:187-208) flux partitioning algorithms with estimates obtained using the alternative “light-soil temperature-VPD-based” (L-ST-VPD) partitioning method (Agric. Ecosystem. Envir. 2013, 164:162-175; Rangel. Ecology. Manage. 2016, 69:342-350). We found that, not surprisingly, the L-ST-VPD estimates of RE and GPP for individual days were up to 30% lower than the NT-based estimates. More interestingly, the L-ST-VPD estimates generally were up to 15% lower than the DT-based estimates, though on certain days the DT-based estimates turned out to be significantly higher. We discuss possible reasons for observed differences in the daily RE and GPP estimates using the three methods including the effects of the assumed models of light-response (e.g., hyperbolic vs., non-hyperbolic ), temperature and VPD response, the choice of factors-predictors (e.g., air temperature and VPD vs. soil temperature and VPD), and using single-day data vs. pooled data for several days.