Geophysical Research Abstracts
Vol. 15, EGU2013-7265-1, 2013
EGU General Assembly 2013

How representative are instantaneous evaporative fraction measurements for daytime fluxes?

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Sun synchronous optical remote sensing is a promising technique to provide instantaneous ET (Evapotranspiration) estimates during satellite overpass. The common approach to extrapolate the instantaneous estimates to values for daily or longer periods relies on the assumption that the EF (Evaporative Fraction, defined as the ratio of latent heat flux to surface available energy) remains nearly constant during daytime. However, there is still no consensus on the validity of the self preservation of EF. To address this question, long term time series of data from a global network of EC (Eddy Covariance) stations (FLUXNET) were analyzed across a wide range of ecosystems and climates. It is found that the EF in different time periods of daytime under clear skies are in good agreement with daytime EF except the period of 8:00-9:00h and 16:00-17:00h. In 11:00-14:00h, the minimum R^2 value is higher than 0.75, and the maximum RMSD is less than 0.087. These statistics indicate that EF during these time periods is closer to daytime EF. The best correlation between instantaneous EF and daytime EF appears at midday (12:00-13:00h). The possible reason for such result is that energy fluxes change at a slower rate compared to early morning and late afternoon. However, the EF exhibited more unstable under partly cloudy situations compared with clear skies. The variability of EF increased with the increase in cloudiness. For total cloud cover the R^2 values between instantaneous EF in different time periods and daytime EF obviously went down as compared to clear skies. Poorer RMSD were also obtained at the same time. This is because cloudiness could induce a decrease in the available energy and the latent heat flux, which further causes the increase in both instantaneous EF and daytime EF. But these increases are probably in different degrees. Thus the EF constant hypothesis might only be true for clear skies. Nonetheless, the above results provide a basis for remote sensing-based estimation of EF based on sun synchronous satellite observations. The midday overpass satellites (e.g. MODIS and AVHRR) are supposed to give better results than other overpass time platforms. The important conclusion from the present study is that the EF constant assumption is valid over a wide range of ecosystems and climates.