

Eddy Covariance (EC) tower instruments

The EC system was comprised of an open path infrared gas analyzer (LI-7500DS; LICOR Biosciences) for atmospheric gas concentration and a 3D sonic anemometer (GILL WindMaster, Hampshire, UK) for wind speed and direction, all recorded at 10 Hz. Supporting meteorological measurements included air temperature (T_{air}) and relative humidity (R_h) (HMP-155 Campbell Scientific, Logan, UT, USA) and soil temperature (T_{soil}) and soil water content (SWC) at 10 cm (Hydra Probe II, Stevens Water Monitoring Systems, Portland, OR, USA), and incoming and outgoing short- and long-wave radiation (CNR4 net radiometer; Kipp & Zonen) and photosynthetically active radiation (LI-190 quantum sensor; LICOR Biosciences), soil heat flux at 10 cm (HFP01SC soil heat flux plate; Hukseflux).

EC Data Process

The 10 Hz flux data were processed to 30-minute averages using EddyPro (v7.0.8; LICOR Biosciences). EddyPro settings included block averaging for flux de-trending, a double rotation to correct for instrument tilt, time lag correction using covariance maximization, Webb–Pearman–Leuning flux density correction (Webb et al., 1980), spike identification and removal from Vickers and Mahrt (1997), quality check by Mauder and Foken (2004) flag system, and a footprint calculation from Hsieh et al. (2000). The 30-minute flux and meteorological data were then quality screened to remove spikes and remove Flagged #2 from flux data using TOVI (LICOR Biosciences). Meteorological gaps were filled using TOVI with an external data source that is closest weather station (Ames Municipal Airport, latitude: 41.99, longitude: -93.62, 6.9 km away from the EC tower). Multiple sensors data like SWC, T_{soil} , and Soil heat plates were averaged using TOVI. Next, the u^* threshold was calculated with Moving Point Test (MPT), and CO_2 fluxes were filtered above the threshold u^* using TOVI. The CO_2 , H_2O , and energy fluxes gaps were filled with the Marginal distribution Sampling (MDS) technique using TOVI. Finally, net ecosystem exchange (NEE) was partitioned into ecosystem respiration (ER) and gross primary productivity (GPP) with the nighttime method (Reichstein et al., 2005) using TOVI.

Evapotranspiration (ET) data calculation from EC tower:

Latent heat flux (LE , W/m^2) was measured by Eddy Covariance technique. Then, ET is estimated from gapfilled continuous LE with the following Equation

$$\text{ET (mm/day)} = LE (\text{W m}^{-2})/28.9$$

factor ($28.94 \text{ W m}^{-2}/\text{mm day}^{-1}$) for converting daily average LE to ET in mm day^{-1}