Eddy covariance flux observations at a semi-natural grassland on the Indo-Gangetic Plain

Ross Morrison[1], Hollie M. Cooper[1], Jonathan G. Evans[1], Geet George[2], Mithun Krishnan[2], Muddu Sekhar[3], Jenna Thornton[1], Sachi Tripathi[2], Christopher Taylor[1] and Andrew Turner[4]. Contact: Ross Morrison: rosrri@ceh.ac.uk

1. Centre for Ecology & Hydrology, UK. 2. Indian Institute of Technology, Kanpur, India; 3. Indian Institute of Science, Bangalore, India; 4. University of Reading, UK

Introduction

A new network of eddy covariance (EC) flux observation stations was established across India during the INCOMPASS project (Tuner et al., in prep.). EC stations were located to monitor surface-atmosphere fluxes at a variety of semi-natural and managed ecosystems across different climatic regions. Here, we showcase EC flux observations obtained at a semi-natural grassland on the Indo-Gangetic Plain. The objectives of the current work were: (i) to characterise diurnal and seasonal flux variability at site scale; (ii) and to explore the influence of flooding and wildfire on energy and carbon dioxide (CO_2) fluxes.

Site description

The flux measurement site (26° 30′ 34″ N; 80° 13′ 24″ E; 130 m absl) is a semi-natural *Phragmites-Saccharum-Imperata* grassland located at the Indian Institute of Technology, Kanpur (Fig. 1). Mean annual air temperature and precipitation are 26˚C and 820 mm year^{-1}, respectively. Soils are Fluvisols (alluvium) that experience periodic flooding by surface water from an irrigation canal that borders the site. The majority of the aboveground biomass was removed from the site during an overnight wildfire event on 15th May 2017.

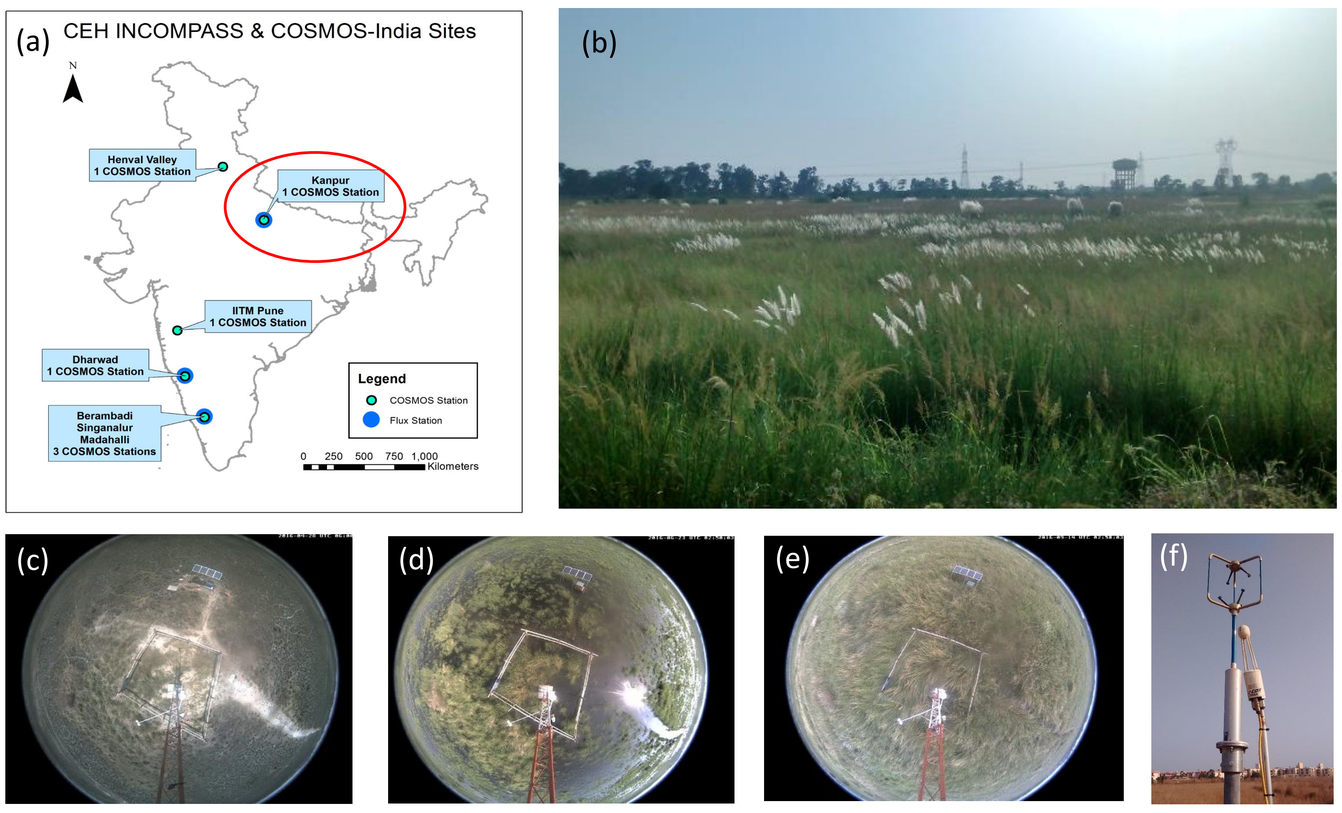

Figure 1. (a) Location and images (b to f) of the eddy covariance observation site at the Indian Institute of Technology, Kanpur. PhenoCam images were obtained during (c) April, (d) June and (e) September. Panel (f) shows eddy covariance instrumentation (sonic anemometer and infrared gas analyser).

Main findings

- The grassland was characterised by distinct periods of active plant growth during Monsoon and a dormant phase in winter (Figs. 2 & 3).
- Latent heat dominated the turbulent energy flux during the Monsoon, whereas sensible heat (H) was dominant during winter (Figs 2 & 3).
- The daily evaporative fraction (Fig. 3c) ranged from ~0.2 during winter and was close to 1 at the time of maximum plant growth (Fig. 3).
- H increased, and LE and net C gain decreased immediately after wildfire. The magnitude of LE and NEE and EF attained pre-disturbance levels within a month of the fire (Fig 3).
- Additional flood waters did not have a strong influence on turbulent energy fluxes during inundation periods (Fig. 3).
- Energy balance closure (Fig. 4) was within the range reported for EC sites, globally (Wilson et al. 2002), and improved when evaluated using daily averages (Fig. 4b).

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References: Reichstein et al. (2005). Glob. Chang. Biol. 11, 1424–1439; Tuner et al. (in prep) Q. J. Roy. Met. Soc.; Wilson et al. (2002). Agric. For. Met. 113, 223–243

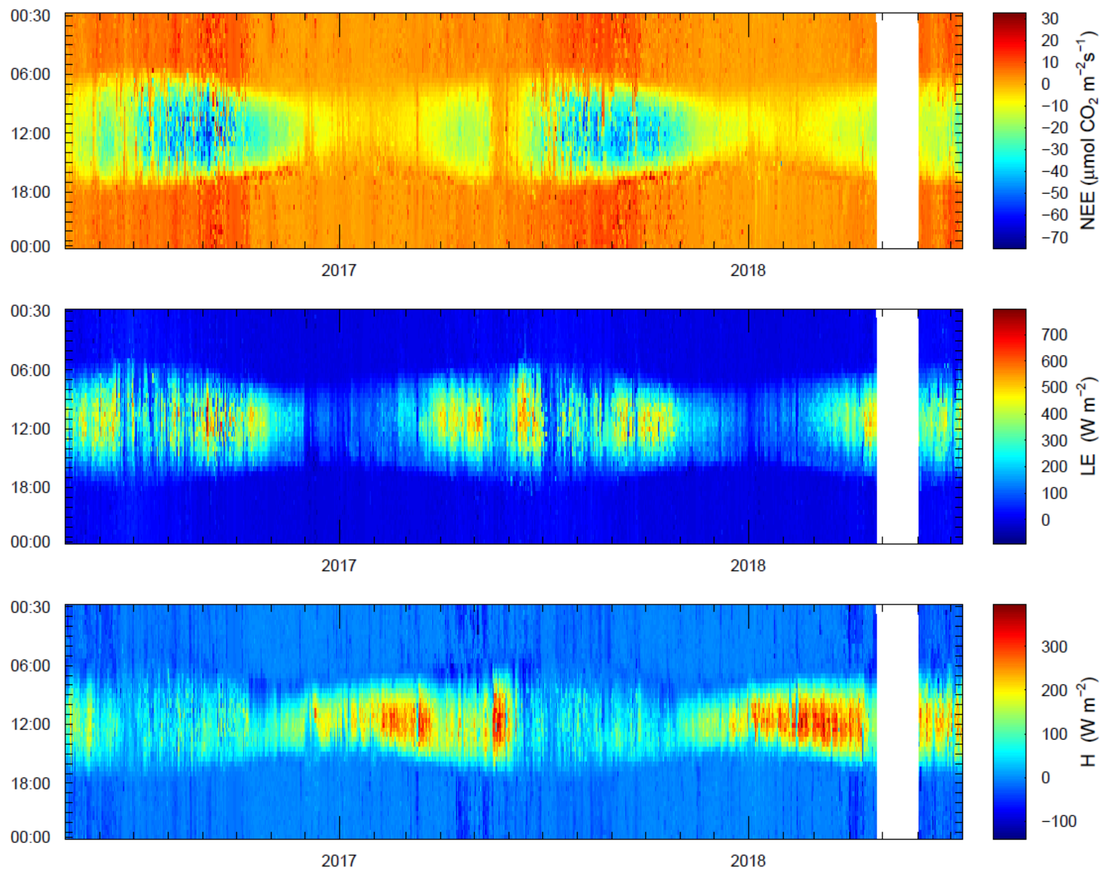

Figure 2. Diurnal and seasonal variation in thirty minute flux densities of net ecosystem CO_2 exchange (top), latent heat (centre) and sensible heat (bottom). Panels show a combination of observed (55%) and gap-filled (44%) flux data. Data gap-filling was performed according to Reichstein et al. (2005).

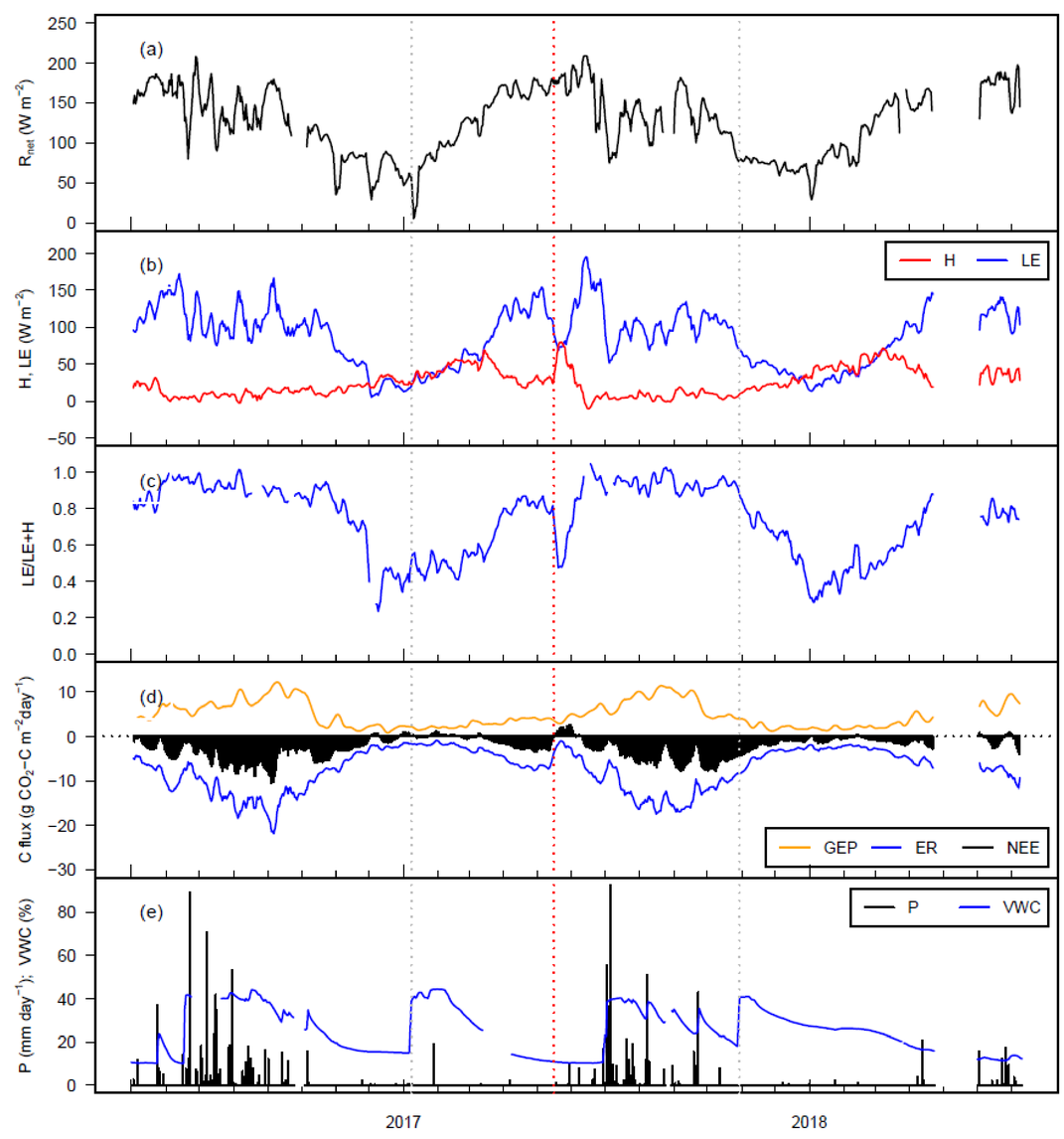

Figure 3. Seasonal variation in daily mean (a) net radiation, (b) sensible and latent heat flux, (c) evaporative fraction, (d) net ecosystem CO_2 exchange, gross ecosystem production and ecosystem respiration (flux partitioning according to Reichstein et al. (2005)); and (e) total daily rainfall and mean soil volumetric water content. Dashed red and grey vertical lines show the timings of wildfire and the start of inundation events, respectively. Data are presented as 5-day running means.

Figure 4. Surface energy balance closure evaluated using (a) thirty minute and (b) daily mean flux observations.