UK-SCAPE flux tower network

Monitoring terrestrial greenhouse gas, water and energy balance

Ross Morrison (rosrri@ceh.ac.uk), Nathan Callaghan, Hollie Cooper, Mhairi Coyle, Alex Cumming, Chris Evans, Phil Farrand, Carole Helfter, Matt Jones, Sarah Leeson, Will Lord, Niall McNamara, Neil Mullinger, Eiko Nemitz, Simon Oakley, Alan Radbourne, Rebecca Rowe, Pete Scarlett Alan Warwick & Peter Levy

Rationale & objectives

To predict, assess and mitigate the impacts of anthropogenic climate change, it is essential to (i) understand the drivers and dynamics of terrestrial carbon sequestration, greenhouse gas (GHG) emission and energy balance at site scale; and (ii) to deploy standardised observation networks to quantify flux variability in space and time. Under UK-SCAPE, CEH continuously monitors long-term GHG, water and energy balance across a network of eddy covariance (EC) sites (Fig. 1), using harmonised protocols, data processing and quality assurance, to quantify:

- Long-term trends and variability in terrestrial carbon, water and GHG balance;
- Environmental processes driving fluxes at site and network scales; and
- Impacts of land management, land use change and specific hydro-meteorological episodes (e.g. the 2018 heatwave).

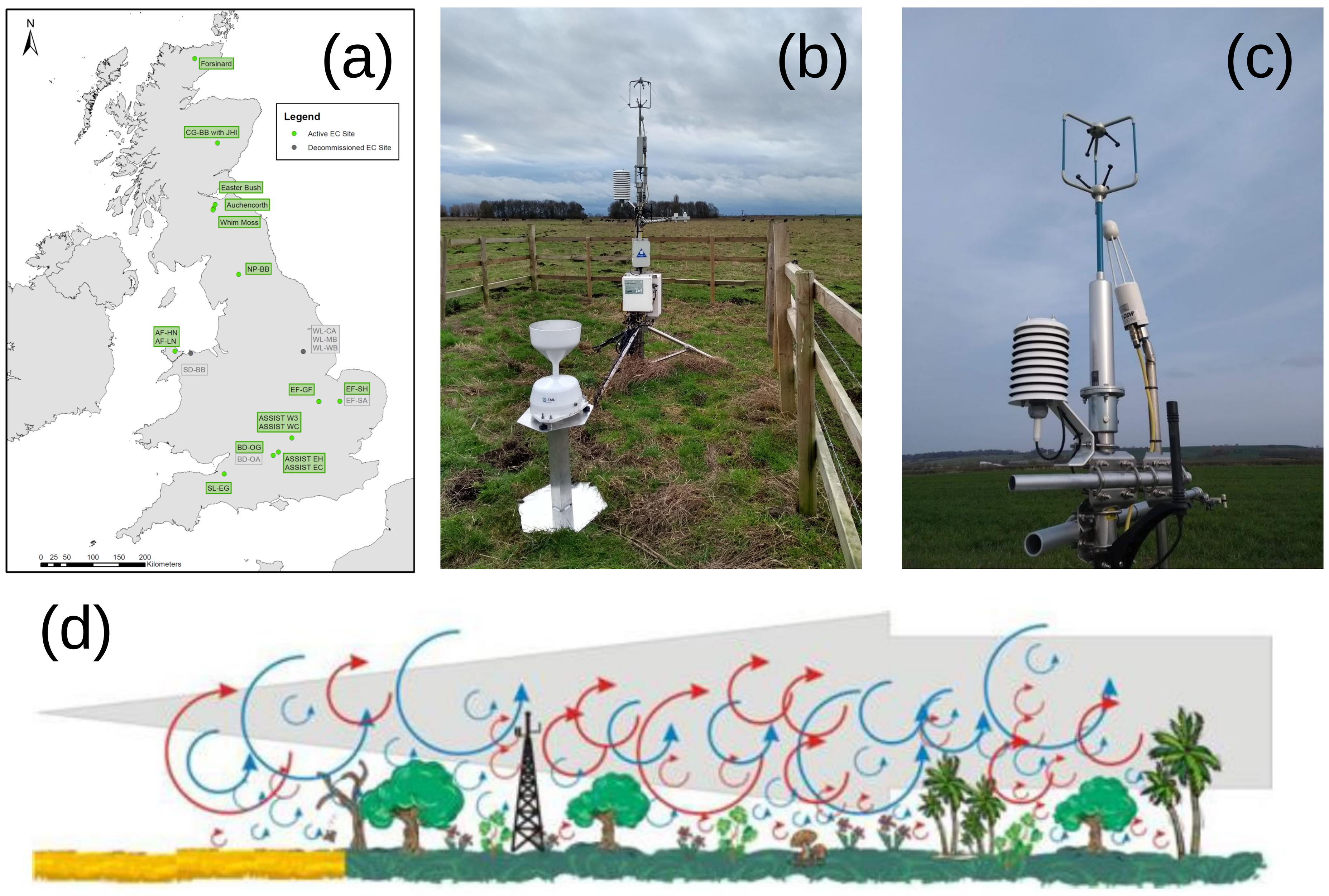

Figure 1. (a) National UK-SCAPE and ASSIST EC flux tower network; (b) EC tower at Great Fen (EF-GF), Cambridgeshire; (c) EC instrumentation; and (d) illustration of EC measurement principle. Image source: Global CCS Institute, https://hub.globalccsinstitute.com).

Research highlights

- Observations from bioenergy plantations (Fig.2), peatlands (Fig. 3), grasslands (Fig. 4) and croplands over multiple site-years
- Supports Defra and BEIS funded projects to derive GHG emission factors for UK peatlands (Evans et al., 2016)
- Delivered first full carbon budgets for willow (Morrison et al., 2019) and Miscanthus energy crops (Robertson et al., 2017)
- Four years of continuous N_2O eddy flux observations have provided accurate measurements of the emission factor (the fraction of nitrogen fertiliser released as N_2O) for grassland
- Auchencorth site now has 20-year CO_2 flux record and has joined ICOS, a pan-European GHG observation network
- Forthcoming analysis of impact of 2018 summer heatwave on terrestrial carbon (e.g. Fig 4), water and energy balance
- New network sites will target GHG evidence gaps for peatlands and climate-smart agriculture (e.g. no-till, cover crops, etc.).

References: Evans et al., 2016, Final report on SP1210; Morrison et al., 2019, https://doi.org/10.1111/gcbb.12608; Robertson et al., 2017, https://doi.org/10.1111/gcbb.12397

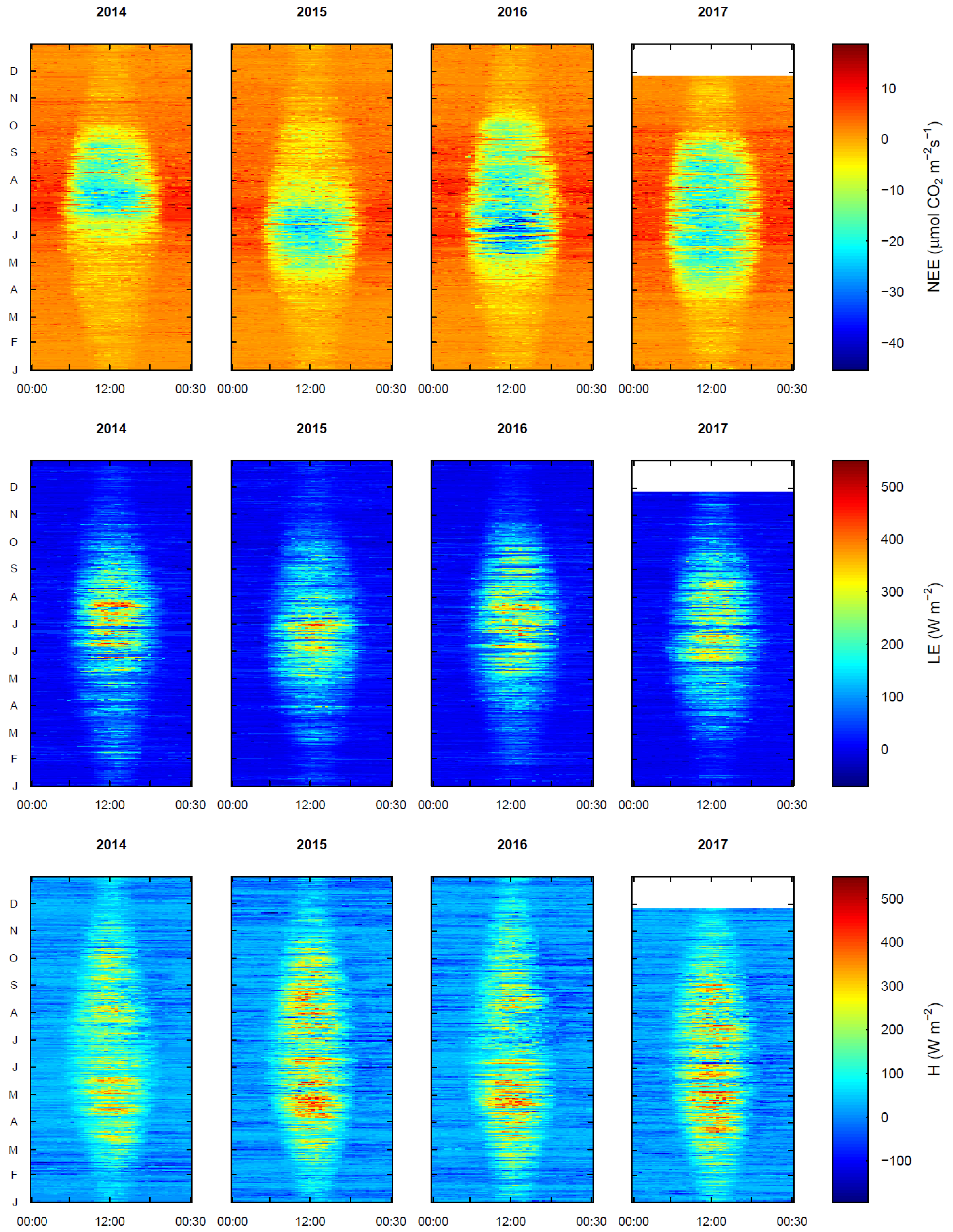

Figure 2. CO_2 (top) and latent (centre) and sensible heat (lower) fluxes measured at a bioenergy plantation in Lincolnshire (Morrison et al., 2019).

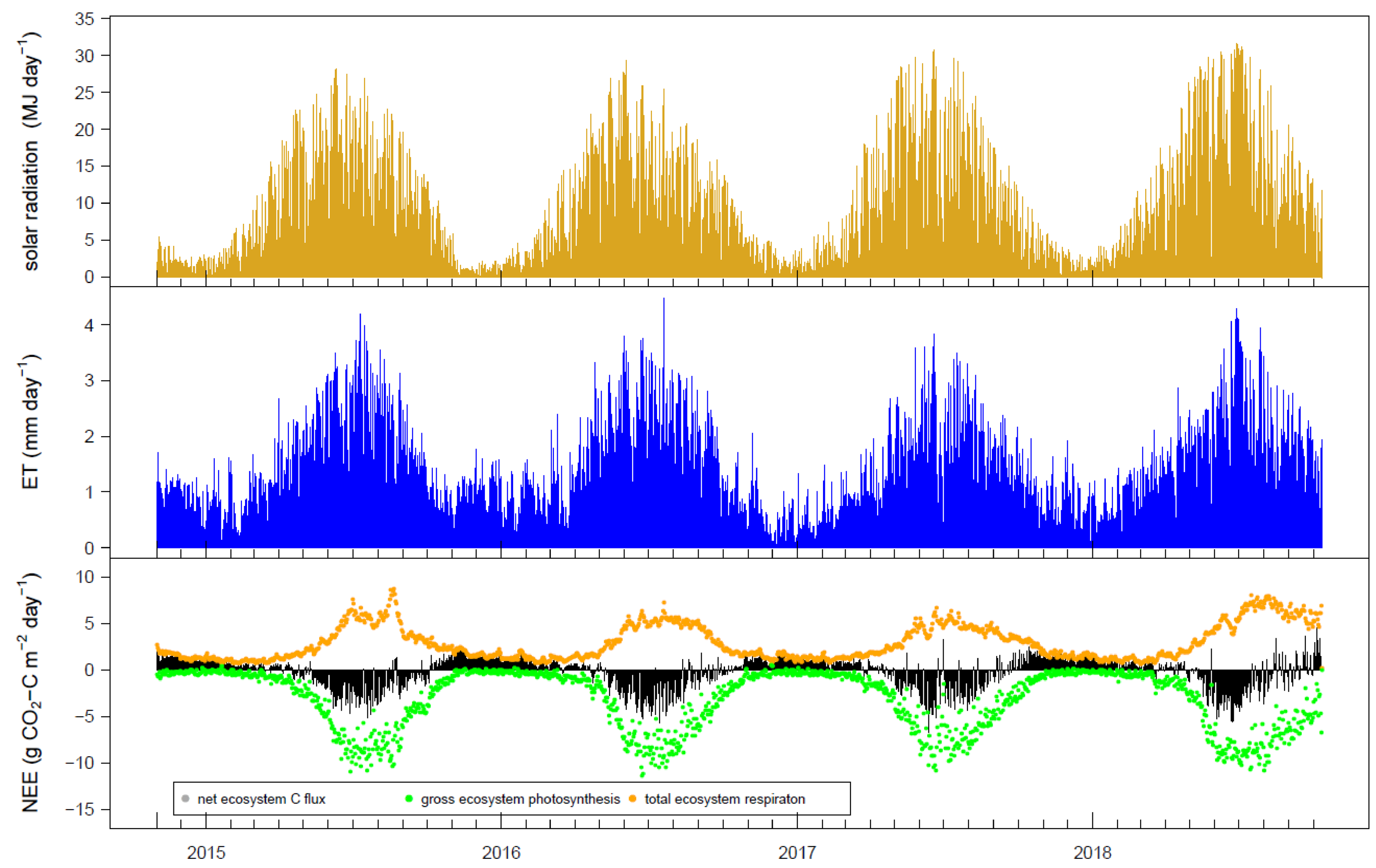

Figure 3. Total daily solar radiation (top), total daily evapotranspiration (centre); and photosynthesis, respiration and net C exchange (lower) measured at a fen peatland on Anglesey, North Wales (AF-LN).

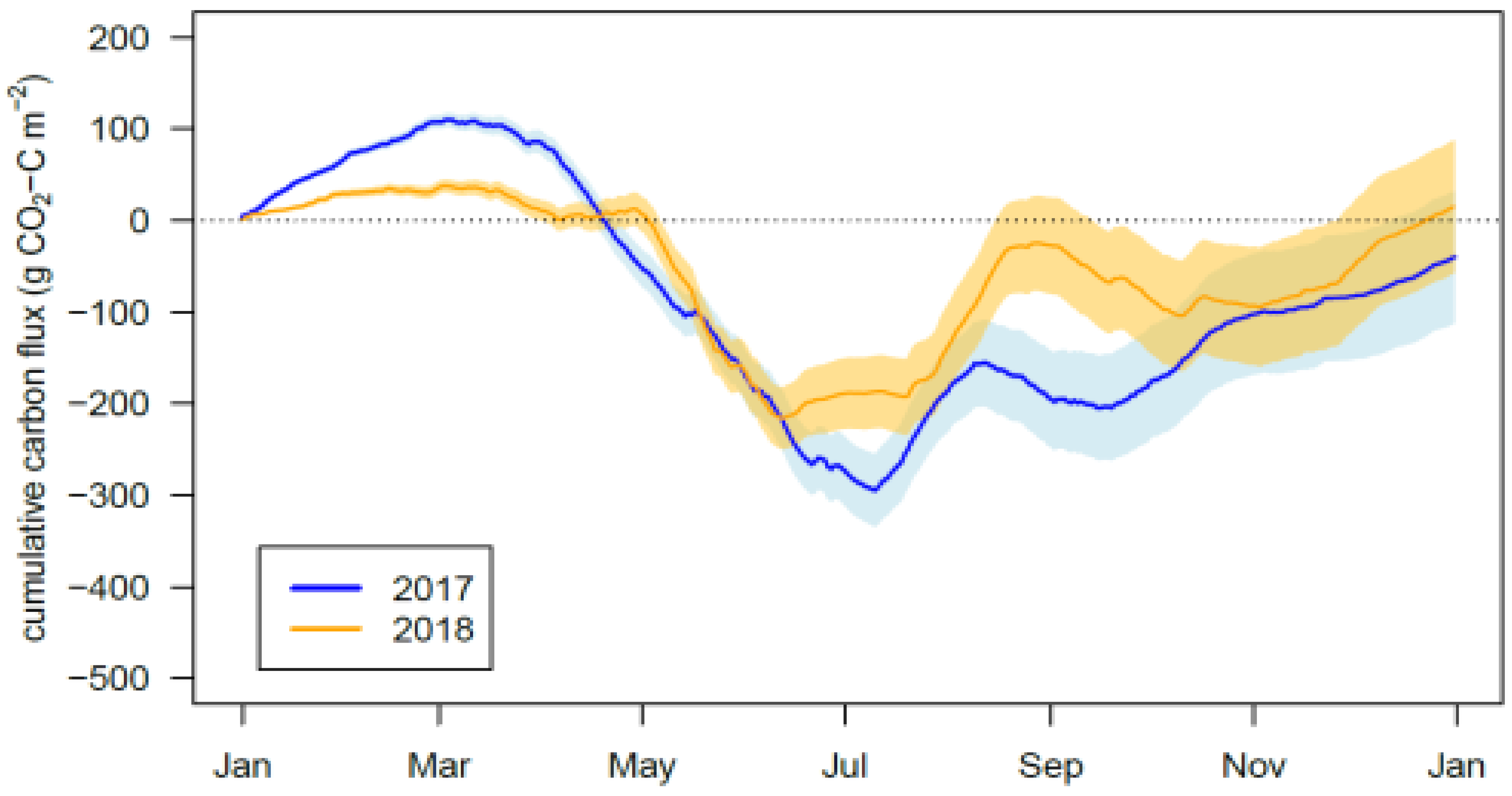

Figure 4. Cumulative net ecosystem C flux observed at an organically managed grassland on the Berkshire Downs (BD-EG) during 2017 and 2018.

UK-SCAPE

NERC SCIENCE OF THE ENVIRONMENT

Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL