Analysing net CO_2 exchanges over an arable crop across multiple scales

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There is a critical need to better understand and up-scale greenhouse gas fluxes from agricultural activities to support adaptation and mitigation activities at national scales. A major unknown is the intrinsic scale of variability in fluxes from chamber to field scales. This variation is linked to heterogeneity in management, soils and micro-climate. We made greenhouse gas fluxes measurements on a commercially operated rapeseed-oil field in the east of England for a month from the start of the growing season until the second fertiliser application (18th March to 16th April 2014). Our methods included using (1) sporadic box chamber measurements of light response curves of CO_2 exchanges; (2) a novel automated cable-operated chamber system (SkyLine) developed by the University of York to measure CO_2 fluxes continuously from 18 chambers in the field; (3) an Eddy covariance system measuring CO_2 fluxes from a larger area on another part of the same field. For each data set a simple model resolving gross primary production and ecosystem respiration, and using LAI, photosynthetically active radiation (PAR) and air temperature as drivers, was tuned to estimate net ecosystem exchange (NEE) for rapeseed oil. We assess the model performance and parameter estimates across the three methods and discuss the implications for scaling fluxes and correcting biases in upscaling.