

Long-term Agroecosystem Research Network

Baseline Characterization of Field Sites

Overview

In preparation for the Long-term Agroecosystem Research (LTAR) network Common Experiment at NGPRL, two field sites on the Area IV SCD Cooperative Research Farm have been managed similarly since 2016 to assess previous land use effects on a range of vegetation, soil, and gas flux properties and processes. The sites – Fields H5 and I2 – have been managed under no-till continuous cropping since 2002, but under different crop rotations (Fig. 1). Prior to initiating the Common Experiment, normalizing differences in previous land use between fields will be important to ensure both fields are at the same ‘starting point’ prior to deploying ‘Business as usual’ (Field H5) and ‘Aspirational’ (Field I2) practices (reviewed in the site conceptual plan).

Though evaluations are ongoing, relatively few differences between fields have been observed.

Meteorological conditions appear similar between fields (Fig. 2). Baseline soil characterizations in 2016 found greater soil bulk density and pH in Field I2 than H5, but greater sum of cations and soluble salts in H5 than I2 (Table 3). Observed differences in soil properties were limited to the surface 10 cm (4 inches) of soil. Soil water content at 5 cm (2 inches) during both growing seasons was greater in Field I2 than H5, possibly due to greater near-surface soil bulk density in the former (Fig. 2). In 2017, biomass production and grain yield in Field H5 were negatively impacted by hail events in July (Table 1; Fig. 3). Accordingly, ecosystem respiration and carbon gain were greater in Field I2 than H5 in 2017 (Table 2; Fig. 4). Considerable variability in both fields led to similar outcomes in chamber-based gas fluxes of CO_2 , CH_4 , and N_2O (Fig. 5). Both fields appear to be a moderate source of N_2O and a minor sink for CH_4 during the growing season.

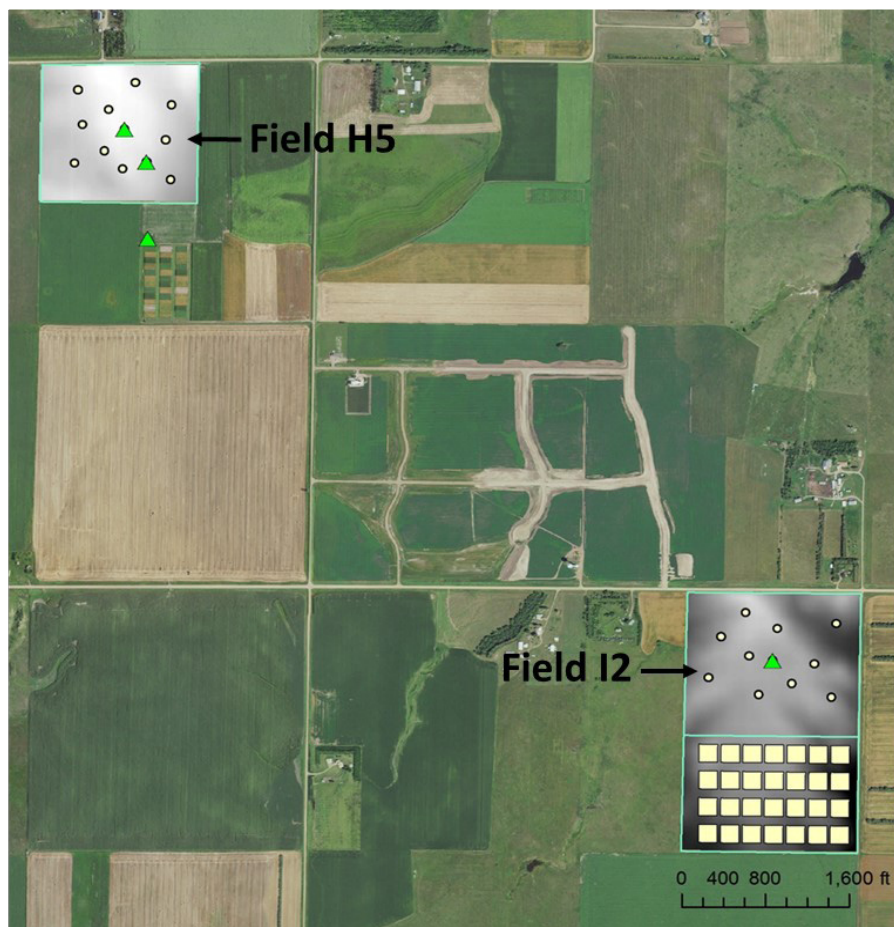


Fig. 1. Field site locations for LTAR Common Experiment at the Area IV SCD Cooperative Research Farm.

Table 1. Combine grain yields for spring wheat (2016) and corn (2017) for fields H5 and I2, Area 4-SCD Cooperative Research Farm.

Year / Crop	Field	Grain yield (bu/ac)
2016 / Spring wheat	H5	49
	I2	41
2017 / Corn	H5	88
	I2	120

Table 2. Annual totals (\pm standard error) of eddy covariance fluxes measured at the Area IV SCD Cooperative Research Farm (fields H5 and I2), representing Northern Plains (NP) ecoregion in the Long-Term Agroecosystem Research (LTAR) network.

Field	Year	Net ecosystem exchange	Ecosystem Respiration	Evapo-transpiration	Latent heat flux	Sensible heat flux
		$\text{g C m}^{-2} \text{yr}^{-1}$		mm yr^{-1}	$\text{MW m}^{-2} \text{yr}^{-1}$	
H5	2016	87 ± 38	813 ± 37	397 ± 24	979 ± 58	691 ± 45
	2017	-77 ± 35	845 ± 38	417 ± 26	1027 ± 65	696 ± 54
Mean		5	829	407	1003	693
SE		82	16	10	24	3
I2	2016	100 ± 37	537 ± 28	341 ± 21	840 ± 52	730 ± 48
	2017	-163 ± 40	949 ± 49	480 ± 30	1184 ± 74	745 ± 54
Mean		-32	743	411	1012	738
SE		132	206	70	172	7





Table 3. Select soil properties at five depths in fields I2 and H5 of the Area IV SCD Cooperative Research Farm, September 2016.

Variable	0-5 cm		5-10 cm		10-30 cm		30-60 cm		60-100 cm	
	I2	H5	I2	H5	I2	H5	I2	H5	I2	H5
Soil bulk density (Mg/m ³)	1.23 <i>(0.02)</i> †	1.12 <i>(0.01)</i>	1.48 (0.03)	1.43 (0.02)	1.32 (0.02)	1.29 (0.01)	1.28 (0.02)	1.27 (0.02)	1.37 (0.02)	1.41 (0.03)
Electrical conductivity (dS/m)	0.28 <i>(0.02)</i>	0.34 <i>(0.01)</i>	0.22 <i>(0.01)</i>	0.24 <i>(0.01)</i>	0.24 (0.03)	0.23 (0.01)	0.41 (0.03)	0.36 (0.03)	0.45 (0.01)	0.42 (0.01)
Soil pH	5.67 <i>(0.10)</i>	5.33 <i>(0.09)</i>	5.73 <i>(0.07)</i>	5.41 <i>(0.06)</i>	6.51 (0.13)	6.22 (0.05)	7.72 (0.11)	7.37 (0.13)	8.16 (0.06)	8.00 (0.04)
Sum of cations (cmol/kg)	18.6 <i>(0.6)</i>	21.2 <i>(0.4)</i>	19.2 <i>(0.4)</i>	20.8 <i>(0.5)</i>	17.3 (0.6)	17.1 (0.5)	29.9 (1.6)	24.2 (2.2)	33.5 (0.8)	31.9 (0.5)
Sand (g/kg)	185.8 (13.2)	185.6 (7.9)	196 (10.8)	183.4 (9.6)	199.4 (13.4)	209.4 (22.6)	233.5 (19.6)	251.7 (16.3)	294.9 (17.9)	305.6 (9.4)
Silt (g/kg)	539.3 (13.0)	553.1 (11.9)	509.6 (11.7)	514.5 (10.3)	493.7 (20.0)	481.3 (23.7)	416.1 (29.2)	408.3 (23.8)	332.0 (12.5)	330.9 (15.0)
Clay (g/kg)	274.9 (4.1)	261.3 (7.5)	294.4 (3.7)	302.1 (7.2)	306.9 (11.0)	309.3 (6.8)	350.3 (14.1)	340.0 (9.6)	373.1 (14.2)	363.5 (8.0)
Water-stable aggregates (%)	57.1 (4.5)	63.7 (2.8)	--	--	--	--	--	--	--	--
Sorptivity (cm/s ^{1/2})	0.34 (0.04)	0.33 (0.02)	--	--	--	--	--	--	--	--
Visual Estimate of Soil Structure (1-5)	2.3 (0.3)	2.3 (0.2)	--	--	--	--	--	--	--	--

† Values in parentheses represent standard error of the mean. Values bolded and italicized are significantly different at P≤0.05 for a soil property specified within a depth.

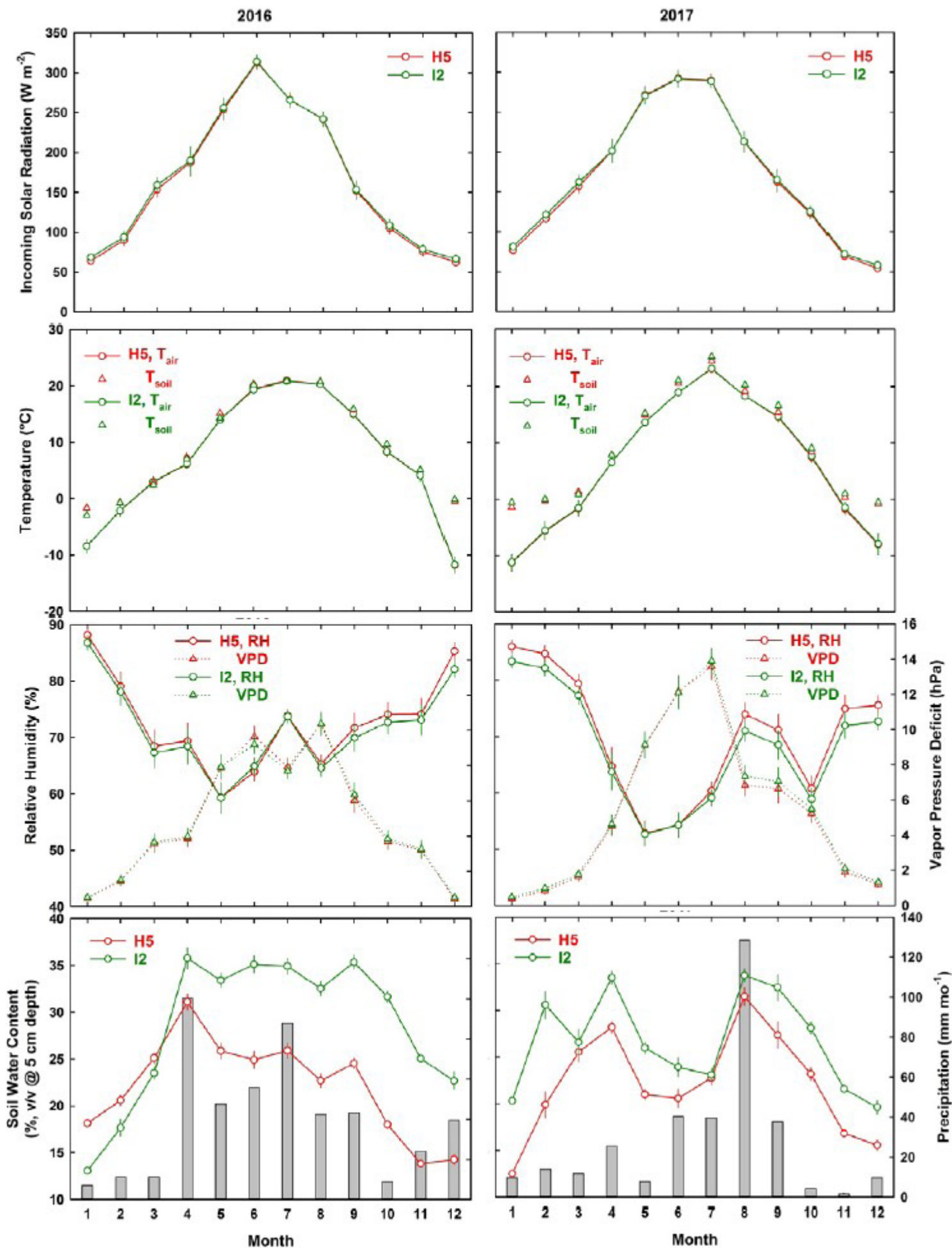


Fig. 2. Monthly means of solar radiation, T_{air} , T_{soil} , RH, VPD, SWC and total precipitation at fields H5 and I2 in Area IV SCD Cooperative Research Farm during two growing seasons, 2016 (spring wheat) and 2017 (corn).

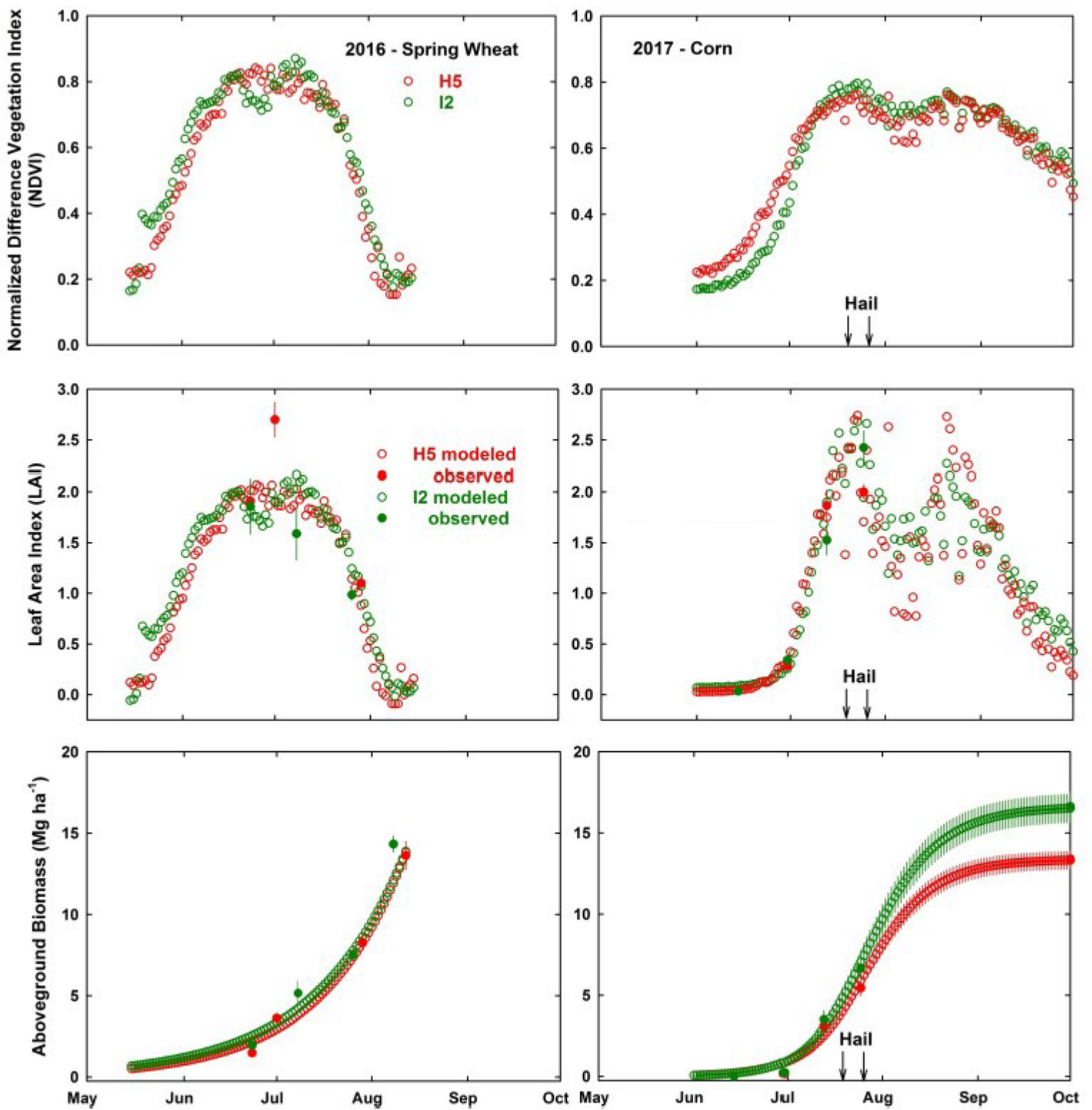


Fig. 3. Daily normalized difference vegetation index (NDVI), leaf area index (LAI) and aboveground biomass at fields H5 and I2 in Area IV SCD Cooperative Research Farm during two growing seasons, 2016 (spring wheat) and 2017 (corn).

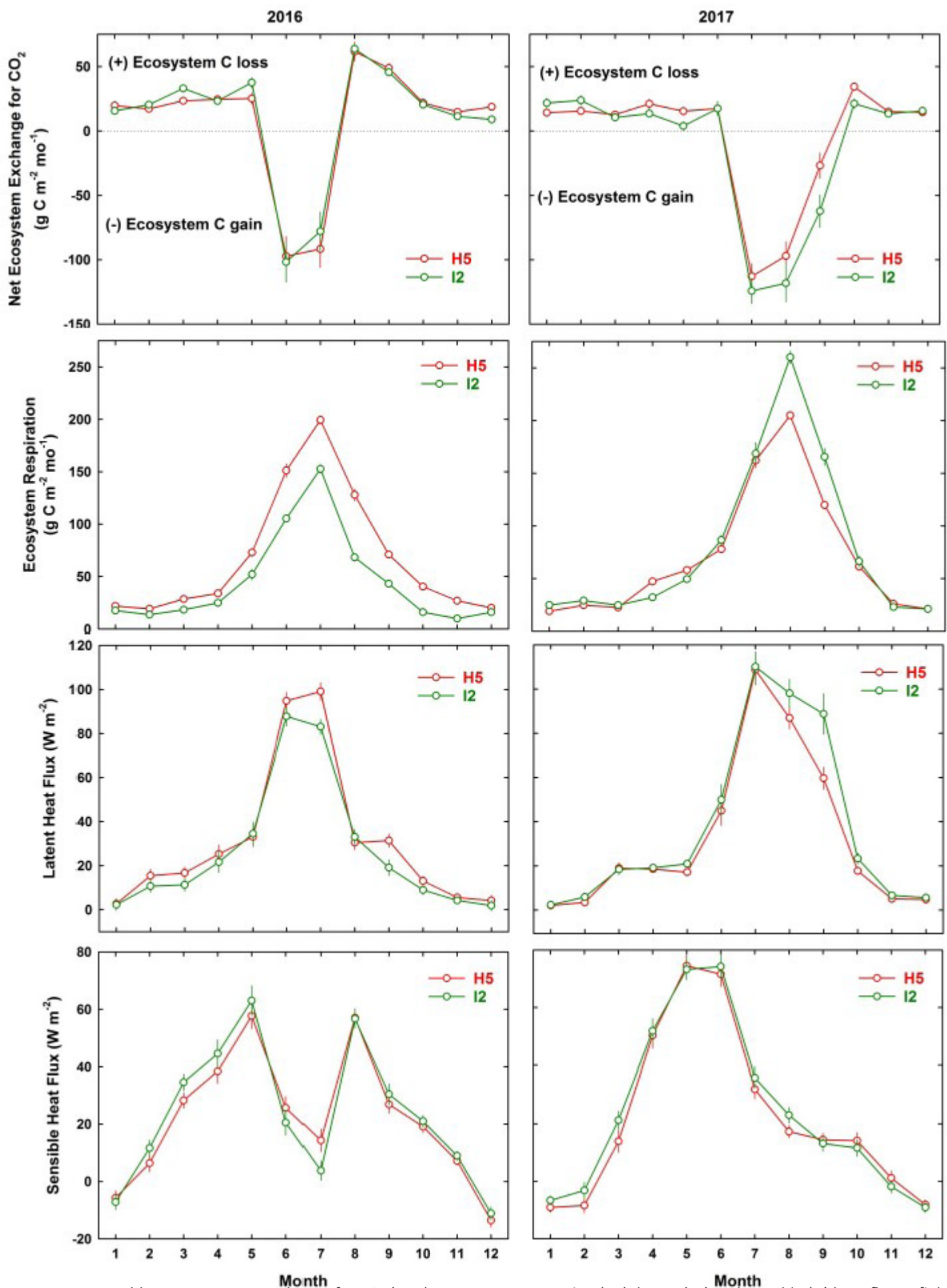


Fig. 4. Monthly net ecosystem exchange for CO₂ (NEE), ecosystem respiration (ER), latent (LE) and sensible (H) heat flux at fields H5 and I2 in Area IV SCD Cooperative Research Farm during two growing seasons, 2016 (spring wheat) and 2017 (corn).

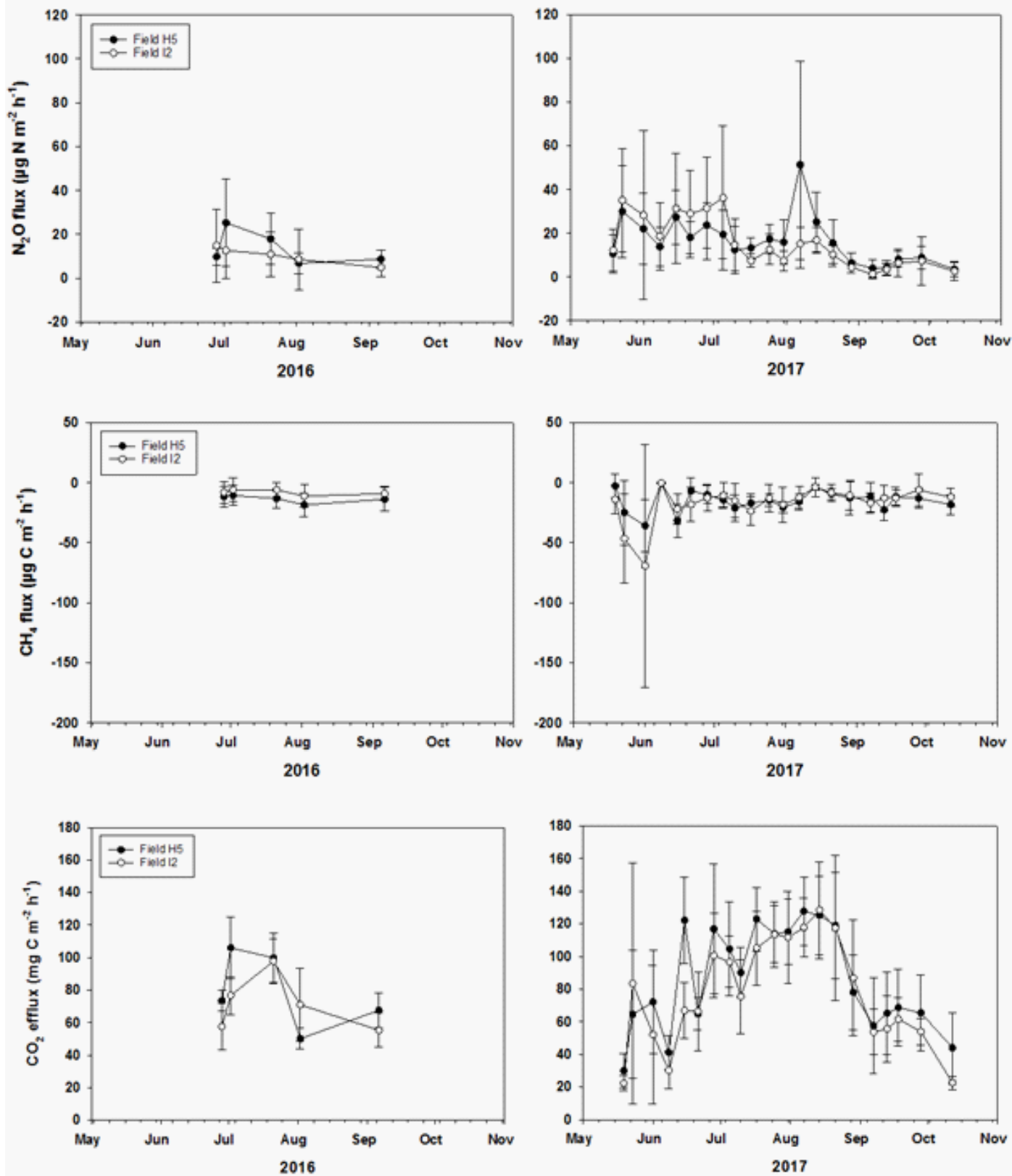


Fig. 5. Chamber-based fluxes of N_2O , CH_4 , and CO_2 for fields H5 and in Area IV SCD Cooperative Research Farm during two growing seasons, 2016 (spring wheat) and 2017 (corn).

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