Exploring spatial influence of agriculture residue burning and aerosols on land surface temperature

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Table S1. Year-wise area of the selected intensive fire zone

Year	Area (Sq. km)
2017	32433.66
2018	30658.67
2019	27403.99
2020	33374.95
2021	35938.03

NOTE. The area indicates the region selected as year-wise intensive fire zone for retrieval and processing all independent and dependent variables.

Table S2. Selection of *timeframe* for assessing FRP-AOD-LST association for scenario 1

a. Selection of initial date for scenario 1 window during October

	Day (-1)	Start Day	Day (+1)	Day (+2)	Day (+3)	Day (+4)
2017	13/10/2017	14/10/2017	15/10/2017	16/10/2017	17/10/2017	18/10/2017
	1678.45 (+13%)	2522.82 (+50%)	3359.19 (+33%)	2204.92 (-34%)	3695.82 (+67%)	4329.95 (+17%)
2018	18/10/2018	19/10/2018	20/10/2018	21/10/2018	22/10/2018	23/10/2018
	1445.37 (+22%)	1691.90 (+17%)	2595.33 (+53%)	3216.01 (+23%)	3104.38 (-3%)	3931.42 (+26%)
2019	19/10/2019	20/10/2019	21/10/2019	22/10/2019	23/10/2019	24/10/2019
	1018.48 (+483%)	2209.16 (+116%)	2743.40 (+24%)	2383.29 (-13%)	3410.25 (+43%)	5198.44 (+52%)
2020	13/10/2020	14/10/2020	15/10/2020	16/10/2020	17/10/2020	18/10/2020
	1103.68 (-3.33%)	1971.18 (+78%)	2954.47 (+49%)	3014.95 (+2%)	4092.78 (+35%)	4736.94 (+15%)
2021	14/10/2021	15/10/2021	16/10/2021	17/10/2021	18/10/2021	19/10/2021
	1246.49 (+64.91%)	2448.76 (+96%)	2283.20 (-6%)	52.84 (-97%)	489.59 (+826%)	2919.01 (+496%)

b. Selection of end date for scenario 1 window during November

	Day (-4)	Day (-3)	Day (-2)	Day (-1)	End Day	Day (+1)
2017	05/11/2017	06/11/2017	07/11/2017	08/11/2017	09/11/2017	10/11/2017
	9201.01 (-67%)	468.63 (-94%)	2392.36 (+410%)	11117.41 (+364%)	4637.93 (-58%)	7340.48 (+58%)
2018	05/11/2018	06/11/2018	07/11/2018	08/11/2018	09/11/2018	10/11/2018
	19991.52 (+250%)	26829.78 (+34%)	26039.96 (-2%)	25544.46 (-2%)	11772.71 (-54%)	8881.65 (-25%)
2019	03/11/2019	04/11/2019	05/11/2019	06/11/2019	07/11/2019	08/11/2019
	13909.38 *No previous day FRP*	34052.03 (+144%)	28821.18 (-15%)	30376.77 (+5%)	982.62 (-97%)	2600.87 (+164%)
2020	10/11/2020	11/11/2020	12/11/2020	13/11/2020	14/11/2020	15/11/2020
	24637.64 (+119%)	20058.38 (-18%)	12780.17 (-36%)	10412.35 (-19%)	2061.06 (-80%)	334.66 (-83%)
2021	13/11/2021	14/11/2021	15/11/2021	16/11/2021	17/11/2021	18/11/2021
	34296.76 (+11%)	23066.75 (-32%)	16233.17 (-29%)	10931.80 (-33%)	4842.95 (-56%)	5259.44 (+8%)

Table S3. Variations in monthly FRP aggregate, mean AOD and mean LST over extended geographical region for year 2017 to 2021

		FRP (MW)				AOD				LST (C)			
		FRP (sum)	Min	Max	St Dev	AOD	Min	Max	St Dev	LST	Min	Max	St Dev
2017	Oct	199333	303	22088	6487	0.68	0.32	1.39	0.26	32.02	29.95	33.91	1.21
	Nov	200242	98	30760	7119	0.98	0.40	1.58	0.36	28.70	20.40	31.50	2.74
	Oct. to Nov.	399575	98	30760	6749	0.83	0.32	1.58	0.35	30.47	20.40	33.91	2.65
2018	Oct	128657	12	18519	5282	0.59	0.35	1.16	0.20	30.18	26.95	32.42	1.48
	Nov	298093	225	30363	9731	0.78	0.28	1.51	0.34	30.55	24.32	33.67	2.07
	Oct. to Nov.	426750	12	30363	8286	0.68	0.28	1.51	0.29	30.36	24.32	33.67	1.78
2019	Oct	134642	5	25240	6239	0.70	0.31	1.30	0.26	30.58	25.13	32.36	1.73
	Nov	198923	2	37977	10780	0.69	0.33	1.43	0.29	28.18	23.53	32.60	3.29
	Oct. to Nov.	333565	2	37977	8775	0.70	0.31	1.43	0.27	29.50	23.53	32.60	2.80
2020	Oct	200407	581	32131	7442	0.51	0.27	1.12	0.20	32.43	30.18	34.31	1.17
	Nov	334532	87	35180	12722	0.79	0.33	1.95	0.37	28.85	22.52	32.93	2.99
	Oct. to Nov.	534939	87	35180	10560	0.65	0.27	1.95	0.33	30.83	22.52	34.31	2.80
2021	Oct.	100039	6	17701	4389	0.49	0.32	1.60	0.23	30.32	24.55	34.41	2.26
	Nov.	519148	70	44273	16564	0.84	0.44	1.31	0.26	30.63	28.88	31.76	0.74
	Oct. to Nov.	619187	6	44273	13878	0.67	0.32	1.60	0.30	30.47	24.55	34.41	1.67

Table S4. Year-specific change in LST and AOD due to residue-based fire over intensive fire zone

	Year 2017		Year 2018		Year 2019		Year 2020		Year 2021		Overall (2017-21)	
FRP (MW)	0 (9)	268.3 (265)	0 (3)	663.32 (330)	0 (2)	656.91 (284)	0 (16)	472.99 (346)	0 (6)	785.91 (376)	0 (36)	584.5 (1601)
AOD	1.47	1.54	0.91	1.19	0.53	0.78	0.75	1.02	0.68	0.83	0.92	1.05
LST (°C)	29.41	29.69	28.52	30.21	31.99	31.44	30.62	31.03	29.06	29.81	29.96	30.44

NOTE. Values in parenthesis indicates the grid number. A '0' FRP indicates no fire was retrieved in the grid. Values indicate the mean of variables retrieved in individual grid in 'fire' and 'no-fire' zone.

Table S5. Descriptive statistics during two selected fire intensity scenarios

Dates	FRP	AOD	LST	Sr	Pr	RH	At
Scenario 1							
2017 [2017-10-14 to 2017-11-09]	239197.38	1.05	30.91	16006825.19	0.02	59.37	23.28
2018 [2018-10-19 to 2018-11-09]	267352.65	0.89	30.27	15761927.68	0.22	57.70	21.64
2019 [2019-10-20 to 2019-11-07]	199252.05	0.79	31.09	14926739.21	1.04	61.34	22.98
2020 [2020-10-14 to 2020-11-14]	459783.90	0.85	31.55	16187920.97	0.00	52.07	21.51
2021 [2021-10-15 to 2021-11-17]	543407.67	0.80	30.34	15187415.18	0.24	62.84	21.94
Scenario 2							
2017 [2017-11-01 to 2017-11-07], r=0.77, p=0.072	75448.03	1.53	30.30	14313589.43	0.01	71.86	20.90
2018 [2018-10-30 to 2018-11-09], r=0.48, p=0.280	198591.01	1.19	30.00	14796390.88	0.41	59.99	20.61
2019 [2019-10-26 to 2019-11-07], r=0.66, p=0.051	175645.94	0.88	30.97	14227474.00	1.48	63.70	22.62
2020 [2020-11-01 to 2020-11-06], r=0.71, p=0.116	163623.50	0.90	31.12	15769817.81	0.00	51.12	20.08
2021 [2021-10-24 to 2021-11-07], r=0.58, p=0.037	256742.06	0.80	29.19	15363593.32	0.01	63.26	22.03

NOTE. FRP- Fire radiative power (MW), AOD- Aerosol optical depth, LST- Land surface temperature (°C), Sr- Solar radiation ($J.m^{-2}day^{-1}$), Pr- Precipitation (mm day^{-1}), RH- Relative humidity (%), At-Ambient temperature (°C). FRP indicates spatial sum while both AOD and LST indicates spatial average.

For scenario 2, consideration of high and positive correlation (r ~0.5) criteria between FRP and LST was included to select temporal window.

Table S6. Global Moran's I Summary for LST across intensive fire zone for year 2017-2021

Moran's Index	**0.224742**
Expected Index	-0.000002
Variance	0.000000
z-score	414.446736
p-value	0.000000

Table S7. GWR simulation criteria and model performance evaluation

Year 2017	Year 2018	Year 2019	Year 2020	Year 2021
Intercept: Mean = -0.0162, Std Dev = 0.7813 coef_FRP: Mean = 0.1533, Std Dev = 0.7089 Bandwidth used: 45.00 Global R^2: 0.7726 Adjusted R^2: 0.7464 Mean residual: -0.0026 Std residual: 0.4769 Min residual: -4.7163 Max residual: 2.6048 AIC: -25582.9326 AICc (corrected): -25582.9319	Intercept: Mean = -0.0049, Std Dev = 0.7660 coef_FRP: Mean = -0.0311, Std Dev = 0.6253 Bandwidth used: 66.00 Global R^2: 0.6530 Adjusted R^2: 0.6220 Mean residual: -0.0028 Std residual: 0.5891 Min residual: -2.7736 Max residual: 4.2196 AIC: -70633.7989 AICc (corrected): -70633.7987	Intercept: Mean = 0.0081, Std Dev = 0.6903 coef_FRP: Mean = 0.0694, Std Dev = 0.6876 Bandwidth used: 55.00 Global R^2: 0.6089 Adjusted R^2: 0.5660 Mean residual: 0.0023 Std residual: 0.6254 Min residual: -2.6132 Max residual: 3.4824 AIC: -59371.3839 AICc (corrected): -59371.3837	Intercept: Mean = 0.0240, Std Dev = 0.7039 coef_FRP: Mean = 0.0250, Std Dev = 0.6056 Bandwidth used: 88.00 Global R^2: 0.5265 Adjusted R^2: 0.4936 Mean residual: -0.0007 Std residual: 0.6881 Min residual: -2.8565 Max residual: 3.7710 AIC: -85962.7338 AICc (corrected): -85962.7337	Intercept: Mean = 0.0046, Std Dev = 0.6307 coef_FRP: Mean = 0.0866, Std Dev = 0.5083 Bandwidth used: 111.00 Global R^2: 0.5161 Adjusted R^2: 0.4908 Mean residual: 0.0006 Std residual: 0.6956 Min residual: -4.5485 Max residual: 6.5270 AIC: -84139.7770 AICc (corrected): -84139.7769

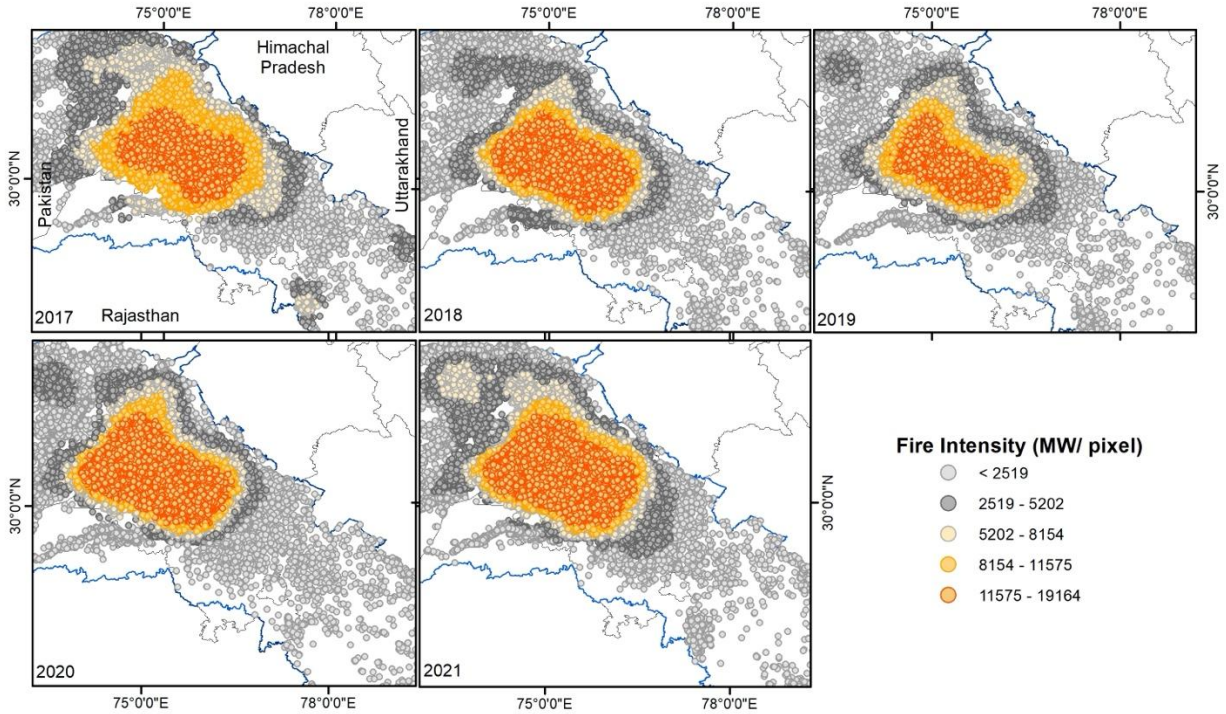

Fig. S1. Spatial variations in VIIRS FRP intensity across the northwest India during 2017 to 2021

NOTE. The pixel size is VIIRS VNP14IMG 375x375 m^2.

Fire intensity is measured as fire radiative power in MW per pixel (375x375 m2) while fire density is measured as fire radiative power in MW per square grid per day (2.25 Km^{-2} day^{-1}).

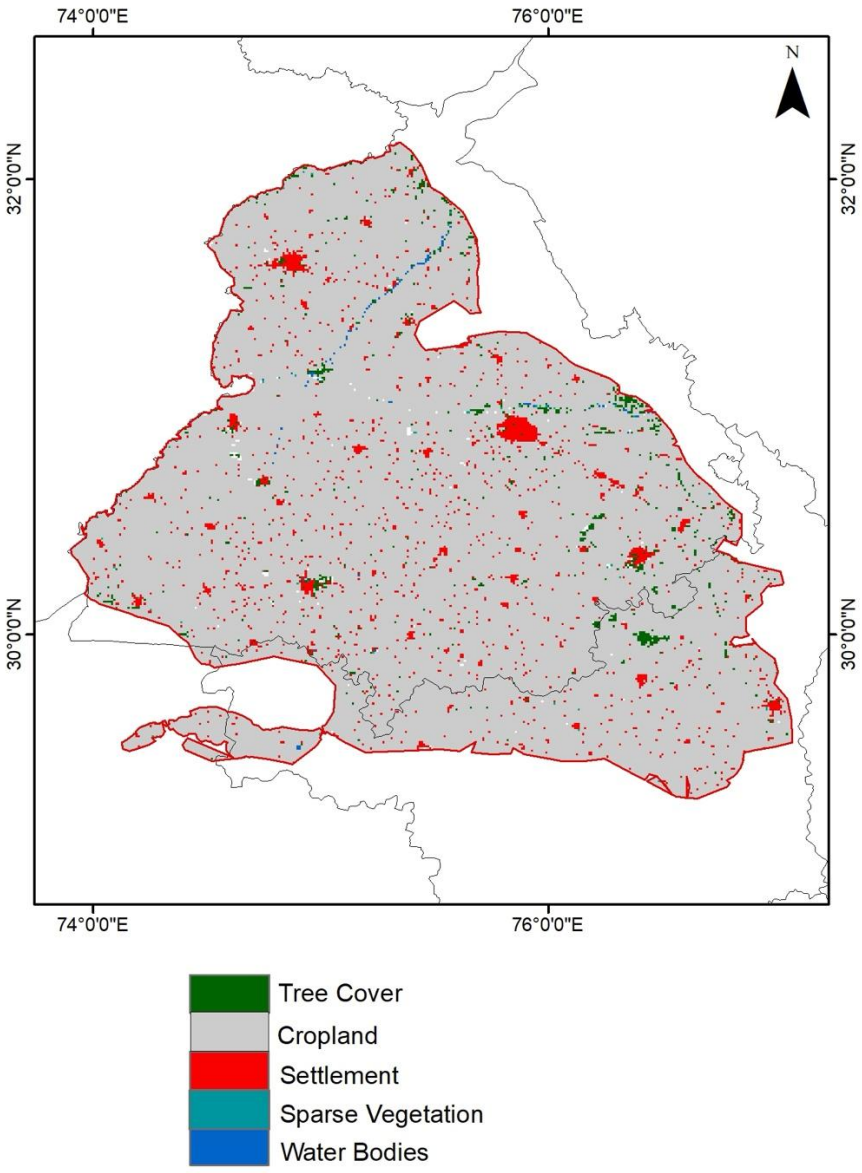

Fig. S2. Terra/Aqua MODIS land use land cover classification map of year 2017 over the extended geographical region in northwest India

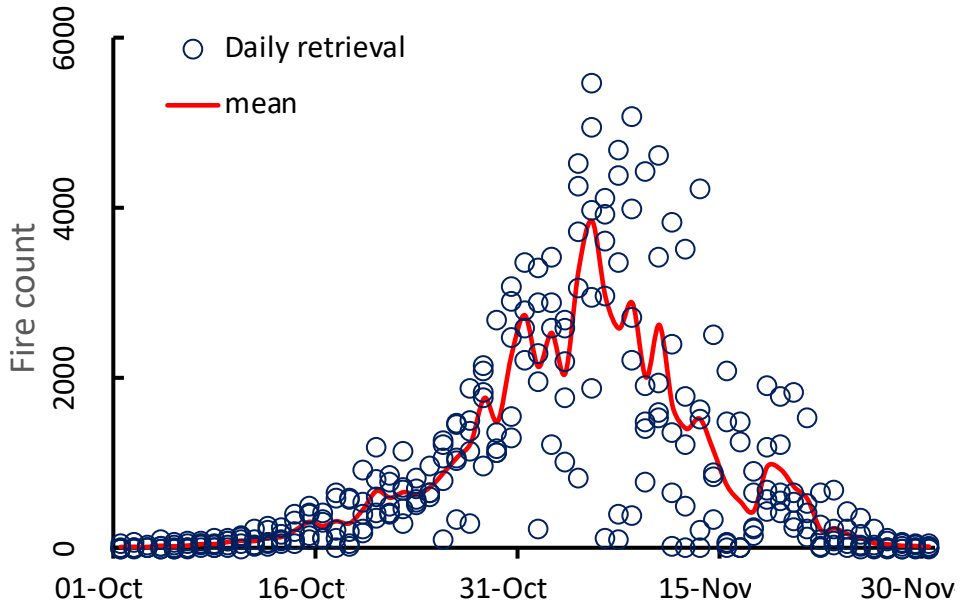

Fig. S3. Time series of five-year mean fire count against daily retrievals over intensive fire zone

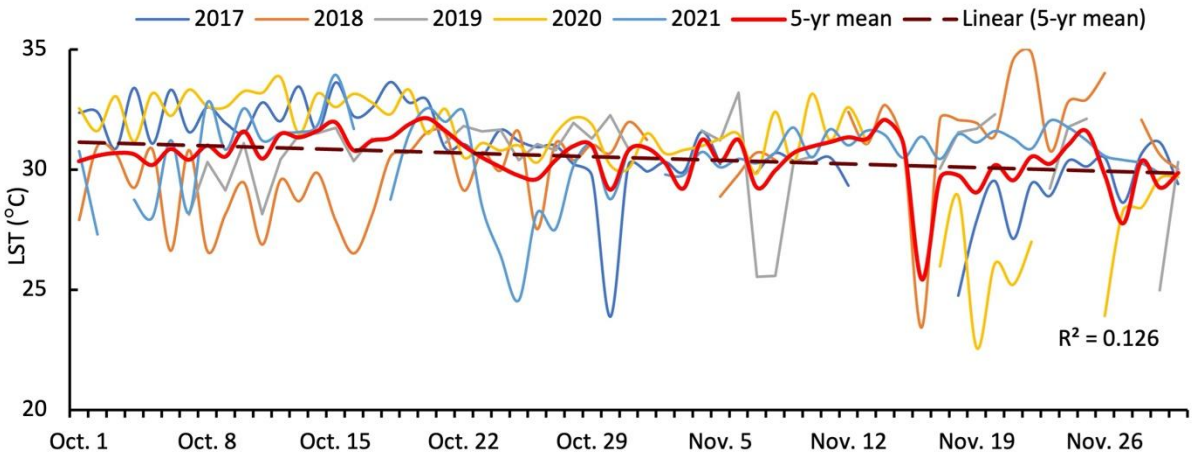

Fig. S4. Day-specific LST timeseries during 2017 to 2021 with linear trend in five-year mean LST over intensive fire zone

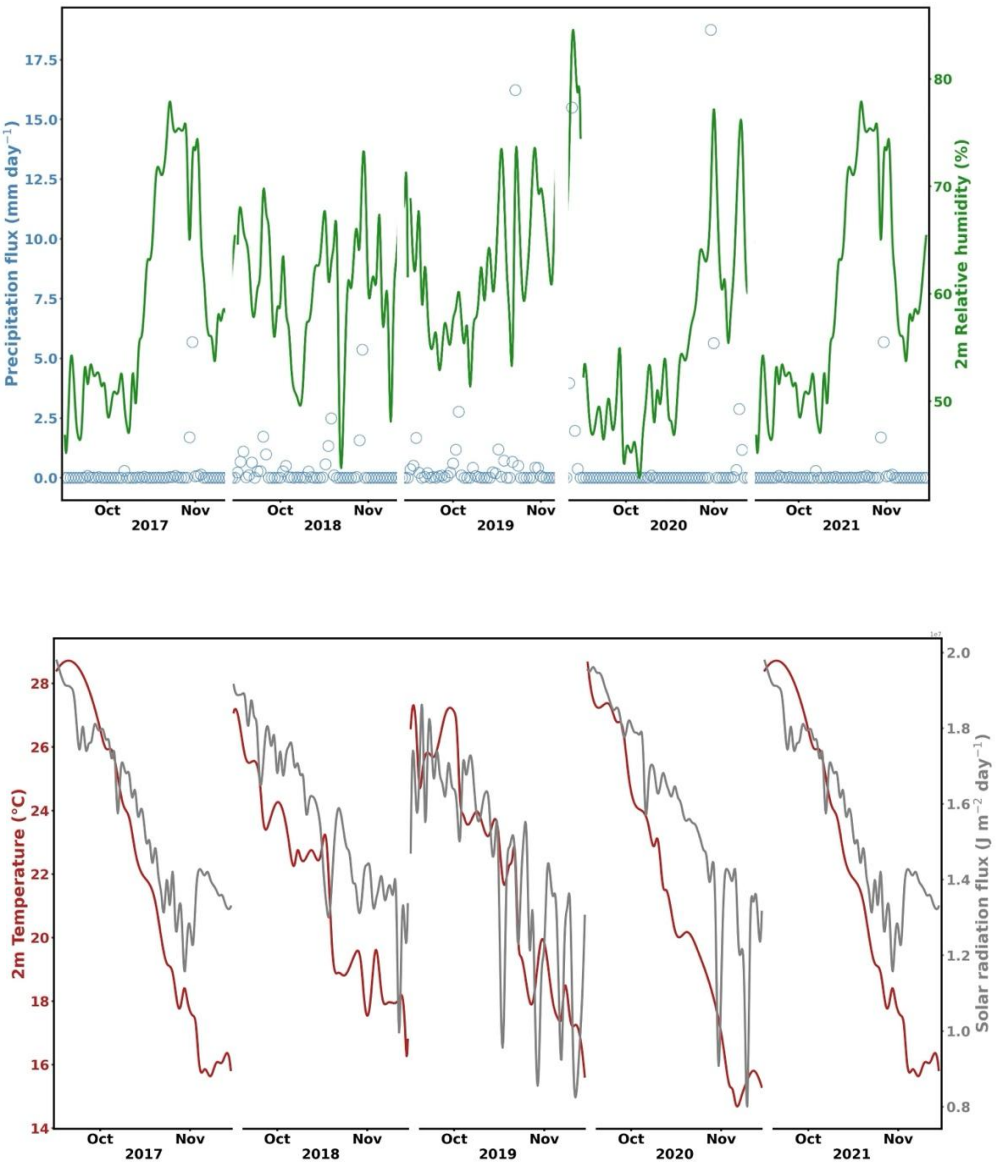

Fig. S5. Time series of predictor meteorological variables over crop residue-based fire zone