Supplement to

"Improving the representation of major Indian crops in Community Land Model (CLM) version 5.0 using site-scale crop data"

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Code changes to the CropType.F90 to include the latitudinal variation in base temperature for rice is:

```
Line no.
597      do p = begp,endp
598          if (this%croplive_patch(p)) then ! relative to planting date
599            ivt = patch%itype(p)
600            if ( (trim(this%baset_mapping) == baset_map_latvary) .and. &
601                ((ivt == nswheat) .or. (ivt == nirrig_swheat) .or. &
602                 (ivt == nrice) .or. (ivt == nirrig_rice) .or.&            !!Line added here!!
603                 (ivt == nsugarcane) .or. (ivt == nirrig_sugarcane)) ) then
604              rbufslp(p) = max(0._r8, min(pftcon%mxtmp(ivt), &
605              t_ref2m_patch(p)-(SHR_CONST_TKFRZ + this%latbaset_patch(p)))) &
606               * dtime/SHR_CONST_CDAY
607            else
608              rbufslp(p) = max(0._r8, min(pftcon%mxtmp(ivt), &
609              t_ref2m_patch(p)-(SHR_CONST_TKFRZ + pftcon%baset(ivt)))) &
610               * dtime/SHR_CONST_CDAY
611            end if
612            if (ivt == nwwheat .or. ivt == nirrig_wwheat) then
613              rbufslp(p) = rbufslp(p) * this%vf_patch(p)
614            end if
615          else
616            rbufslp(p) = accumResetVal
617          end if
618      end do
```

Table S1: Site scale data from Varma et al. (2023) used for base temperature sensitivity study (2000-2014)

Site name	Event IDs in PANGEA repository (Varma et al., 2024)	Latitude [ºN]	Longitude [ºE]	Altitude [m] (above sea level)
Anantapur	IND_RI_RED_2000, and IND_RI_RED_2001*	14.68	77.6	350
Cooch Behar	IND_SW_COB_2000, and IND_SW_COB_2001*	26.34	89.40	43
Faizabad	IND_SW_FAZ_2002, IND_SW_FAZ_2003, and IND_SW_FAZ_2004*	26.78	82.20	113
Hyderabad	IND_RI_HYD_2010	17.19	78.23	542
Jabalpur	IND_RI_JAB_2009, IND_RI_JAB_2010*, and IND_RI_JAB_2011*	24.49	80.58	412
Jobner	IND_SW_JOB_2013	26.08	75.34	427
Kaul	IND_RI_KAU_2008	29.51	76.41	241
Kuthulia	IND_RI_KUT_2013	24.30	80.15	366
Ludhiana	IND_SW_LUD_2011, and IND_SW_LUD_2012*	30.93	75.87	247
Meerut	IND_SW_MEE_2011, IND_SW_MEE_2012, and IND_SW_MEE_2013*	29.07	77.70	237
Nadia	IND_SW_NAD_2000, IND_SW_NAD_2001, IND_SW_NAD_2002, IND_SW_NAD_2008, IND_SW_NAD_2009*, and IND_SW_NAD_2013*	22.88	89.00	10
Pantnagar	IND_SW_PAN_2007, IND_SW_PAN_2008*, IND_RI_PAN_2011, and IND_RI_PAN_2012*	29.00	79.48	244
Parbhani	IND_SW_PAR_2001, IND_SW_PAR_2005, and IND_SW_PAR_2009*	19.27	76.78	409
Raipur	IND_RI_RAI_2009	21.40	81.39	293

* Site data used in validation. Remaining data is used in calibrating

Table S2: Sensitivity experiment values for CLM5_Mod1 case. The values in bold font are the best performing parameter values.

Parameter	Wheat		Rice	
	CLM5_Def	Tested values	CLM5_Def	Tested values
planting window [mmdd, mmdd]	[401, 615]	[1015, 1130]; [1101,1215]; **[1115,1231]**; [1130, 1231]	[101, 228]	[615, 731]; **[701,815]**; [715,831]; [731, 915]
grnfill	0.6	0.55, **0.6**, 0.65, 0.7, 0.75	0.4	0.45, 0.5, 0.55, 0.6, **0.65**, 0.7, 0.75
hybgdd	1700	1600, **1700**, 1800, 1900, 2000	2100	1900, 2000, **2100**, 2200, 2300

Table S3: Base temperature at lowest bias observed during the sensitivity studies for wheat and rice

Crop	Site Name	Latitude [ºN]	Base temperature @ lowest bias [ºC]
Wheat	Parbhani	19.16	8
	Nadia	22.95	7
	Faizabad	25.26	7
	Cooch Behar	26.19	7
	Jobner	26.51	5
	Pantnagar	29.02	5
	Meerut	29.40	5
	Ludhiana	30.54	6
Rice	Anantapur	14.68	12
	Hyderabad	17.19	11
	Raipur	21.04	12
	Jabalpur	23.90	9
	Kuthulia	24.30	8
	Pantnagar	29.02	9
	Kaul	29.51	8

Table S4: Calibration and validation of wheat and rice simulated by CLM5 against site scale observations

Parameter	Stage of model evaluation	Evaluation Metrics	Wheat				Rice			
			Obs	CLM5_Def	CLM5_Mod1	CLM5_Mod2	Obs	CLM5_Def	CLM5_Mod1	CLM5_Mod2
LAI (m²/m²)	Calibration	Mean of max. LAI	4.13	2.35	2.67	3.45	5.41	1.74	4.59	4.64
		MAB	--	0.81	0.51	0.45	--	0.73	0.45	0.36
		RMSE	--	2.48	1.70	1.44	--	3.25	2.15	1.71
		r	--	-0.18	0.17	0.27	--	0.05	0.33	0.47**
	Validation	Mean of max. LAI	4.38	2.38	2.73	3.52	4.96	1.50	4.29	4.12
		MAB	--	0.83	0.52	0.40	--	0.71	0.25	0.32
		RMSE	--	2.68	1.85	1.37	--	3.10	1.35	1.59
		r	--	-0.28*	0.03**	0.35**	--	0.13	0.45	0.41
Yield (t/ha)	Calibration	Mean	3.87	2.92	3.60	3.50	4.57	2.66	3.69	3.47
		MAB	--	0.29	0.16	0.17	--	0.70	0.26	0.29
		RMSE	--	1.30	0.85	0.90	--	3.72	1.52	1.57
		r	--	0.28	0.33	0.30	--	-0.59	-0.07	-0.07
	Validation	Mean	3.92	3.24	3.83	4.00	4.56	2.56	3.30	3.39
		MAB	--	0.17	0.13	0.22	--	0.70	0.34	0.30
		RMSE	--	1.00	0.69	0.99	--	3.93	1.88	1.71
		r	--	0.31	0.51	0.33	--	-0.96	-0.01	0.30
Growing season length (days)	Calibration	Mean	128	69	125	135	120	117	125	123
		MAB	--	0.46	0.11	0.09	--	0.09	0.10	0.12
		RMSE	--	61.72	15.60	15.30	--	13.64	14.62	18.13
		r	--	0.39	0.66*	0.62*	--	0.04	0.09	-0.67
	Validation	Mean	131	69	128	138	115	112	121	119
		MAB	--	0.48	0.10	0.11	--	0.05	0.05	0.07
		RMSE	--	64.76	15.66	15.68	--	7.81	8.09	11.04
		r	--	0.44	0.66	0.62	--	0.48	0.80*	0.51
--	Calibration	Overall bias	--	0.51	0.26	0.24	--	0.51	0.27	0.26
--	Validation	Overall bias	--	0.49	0.25	0.24	--	0.49	0.21	0.23
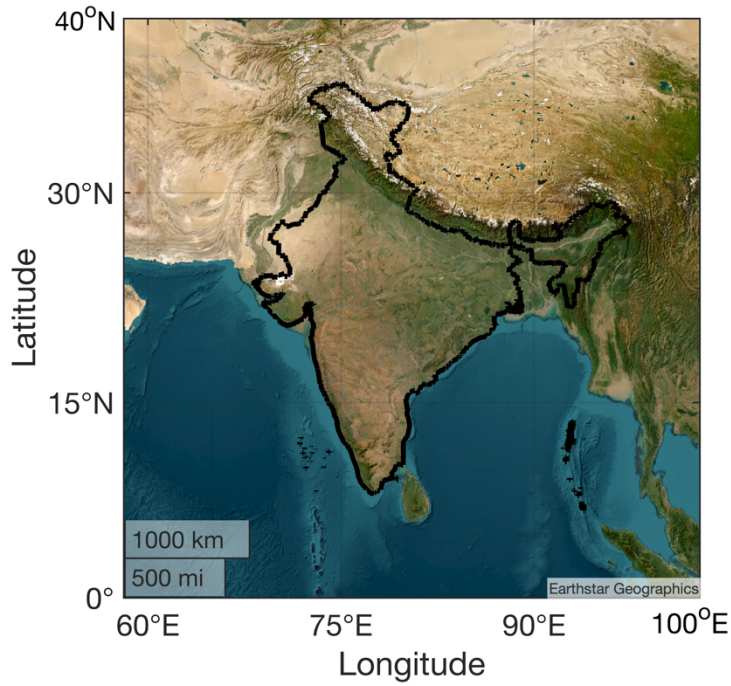
Figure S1: Domain used in simulations of CLM5 for regional experiments
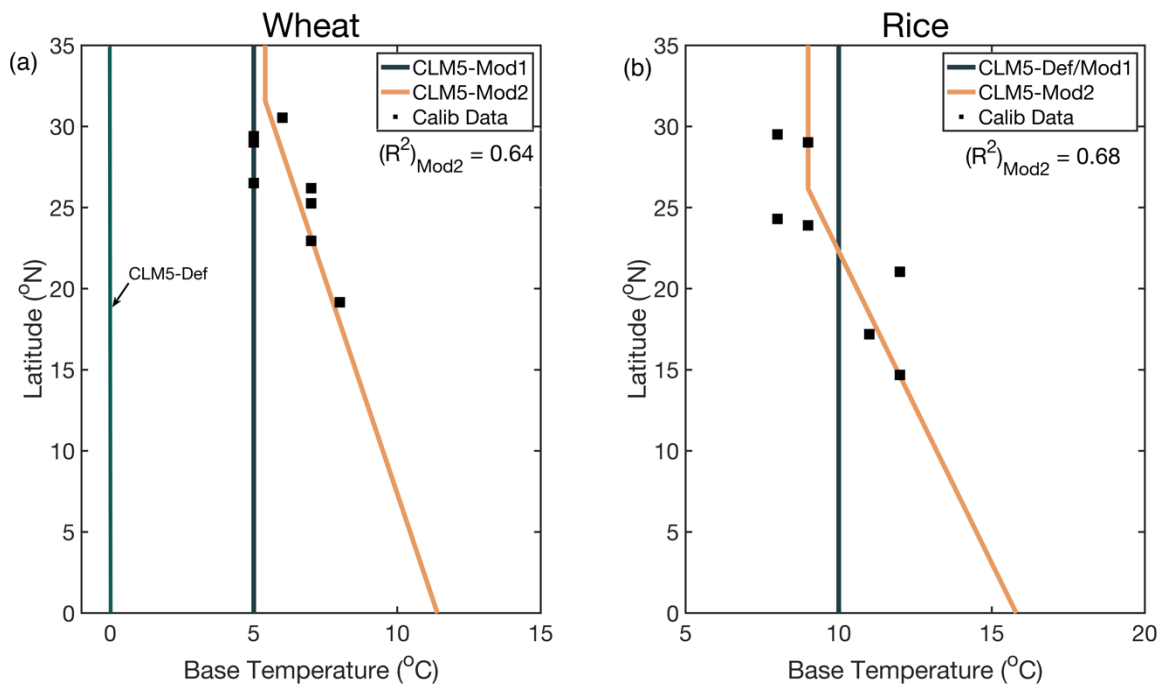
Figure S2: Latitudinal variation in base temperature calibration (a) Wheat, and (b) Rice
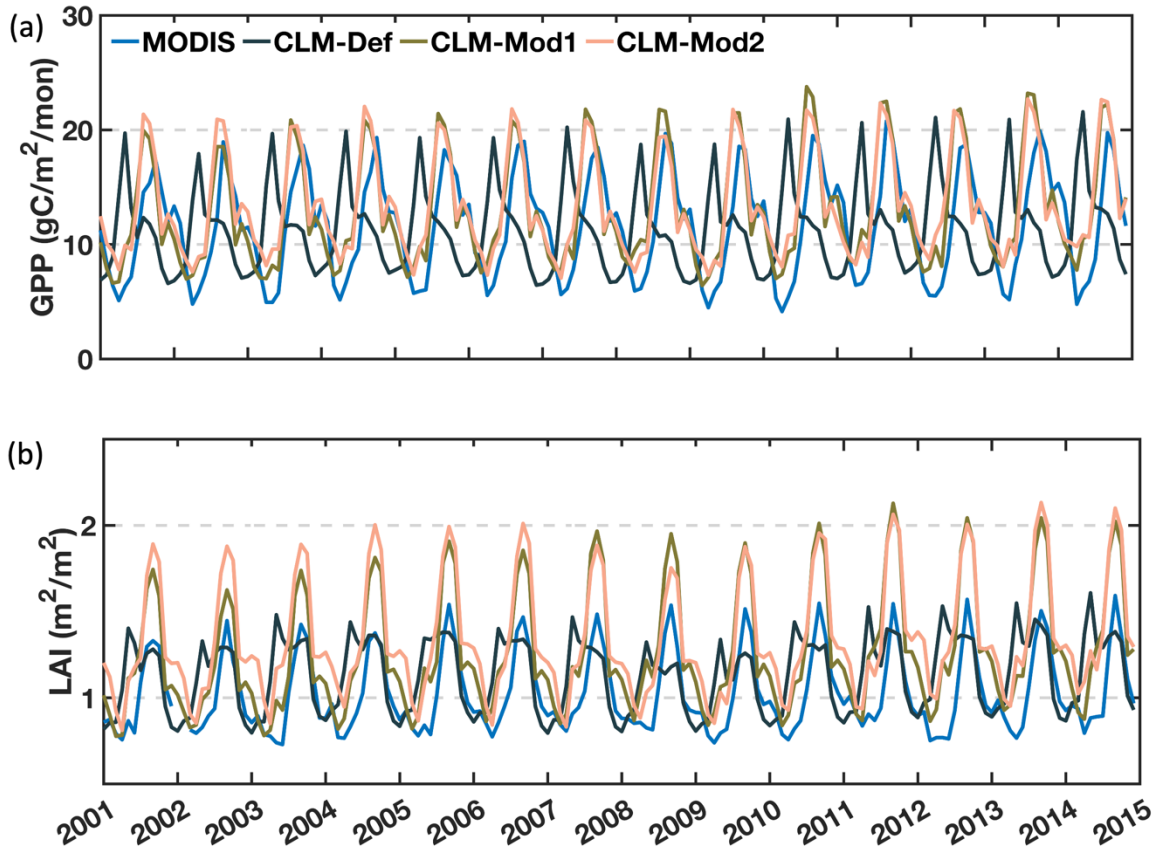
Figure S3: Comparison of MODIS (a) GPP and (b) LAI with CLM5 three setups over the period 2001 to 2014
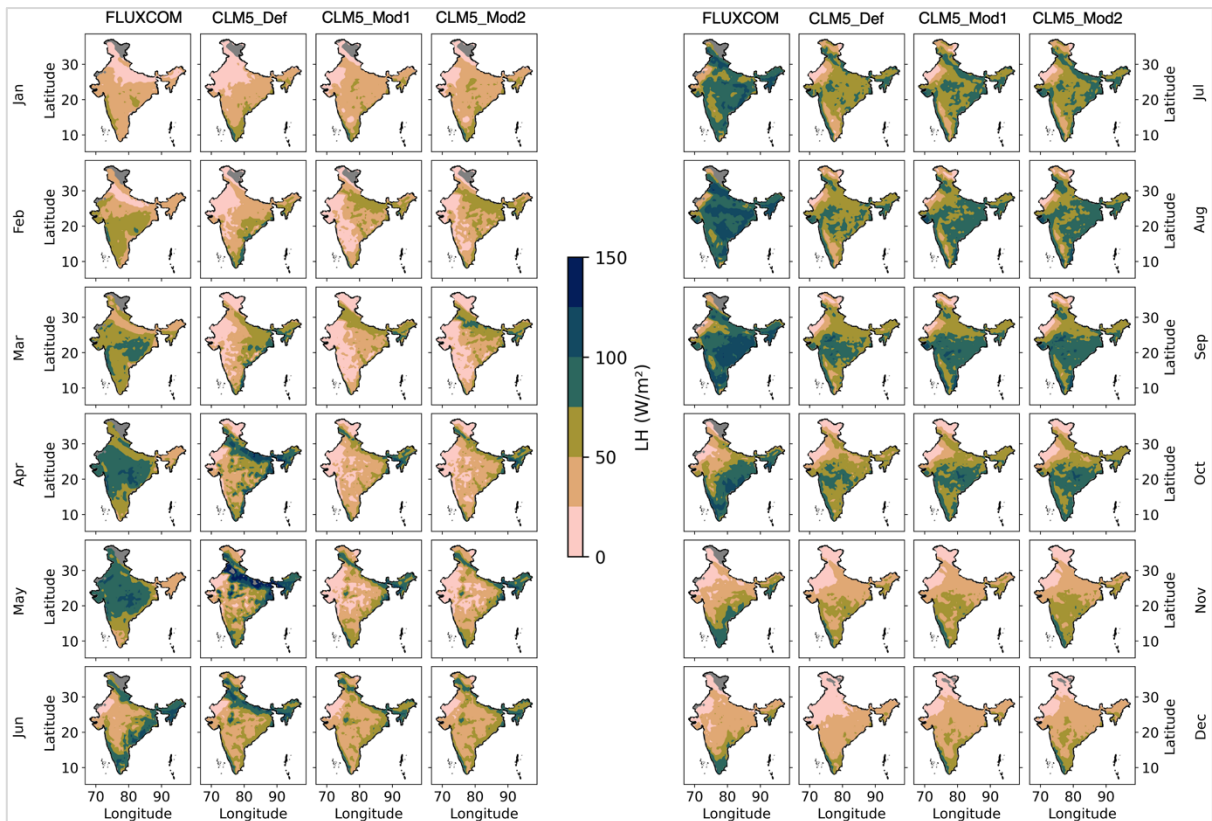
Figure S4: Comparison of FLUXCOM Latent Heat product against the three setups of CLM5. Data shown here is monthly average taken over the period 2001 to 2014
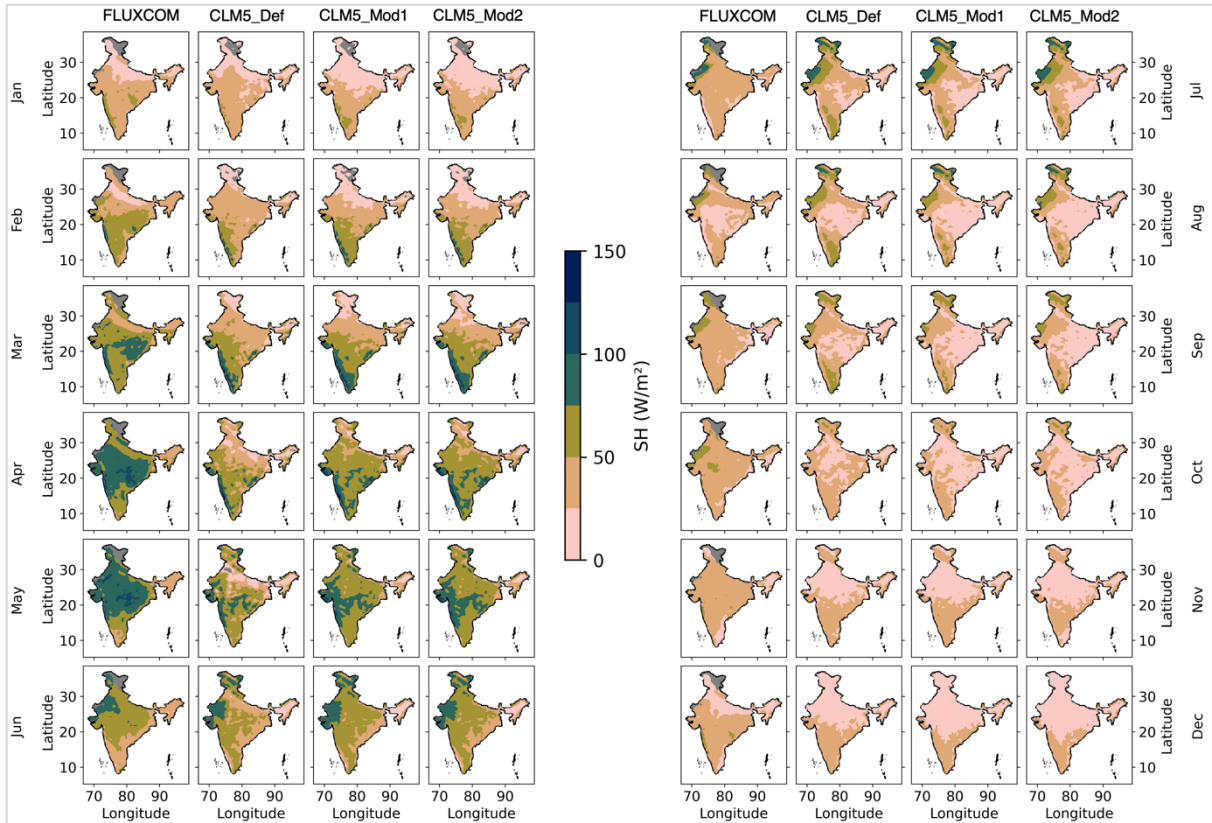
Figure S5: Comparison of FLUXCOM Sensible Heat product against the three setups of CLM5. Data shown here is monthly average taken over the period 2001 to 2014
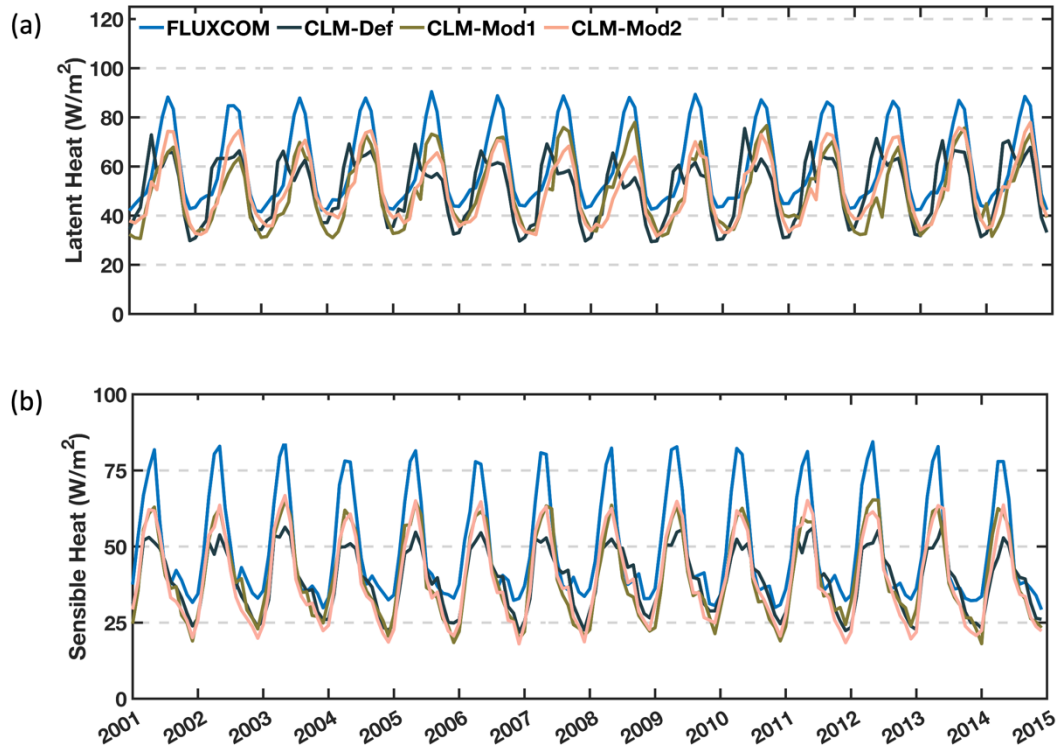
Figure S6: Comparison of FLUXCOM (a) Latent Heat and (b) Sensible Heat with CLM5 three setups over the period 2001 to 2014
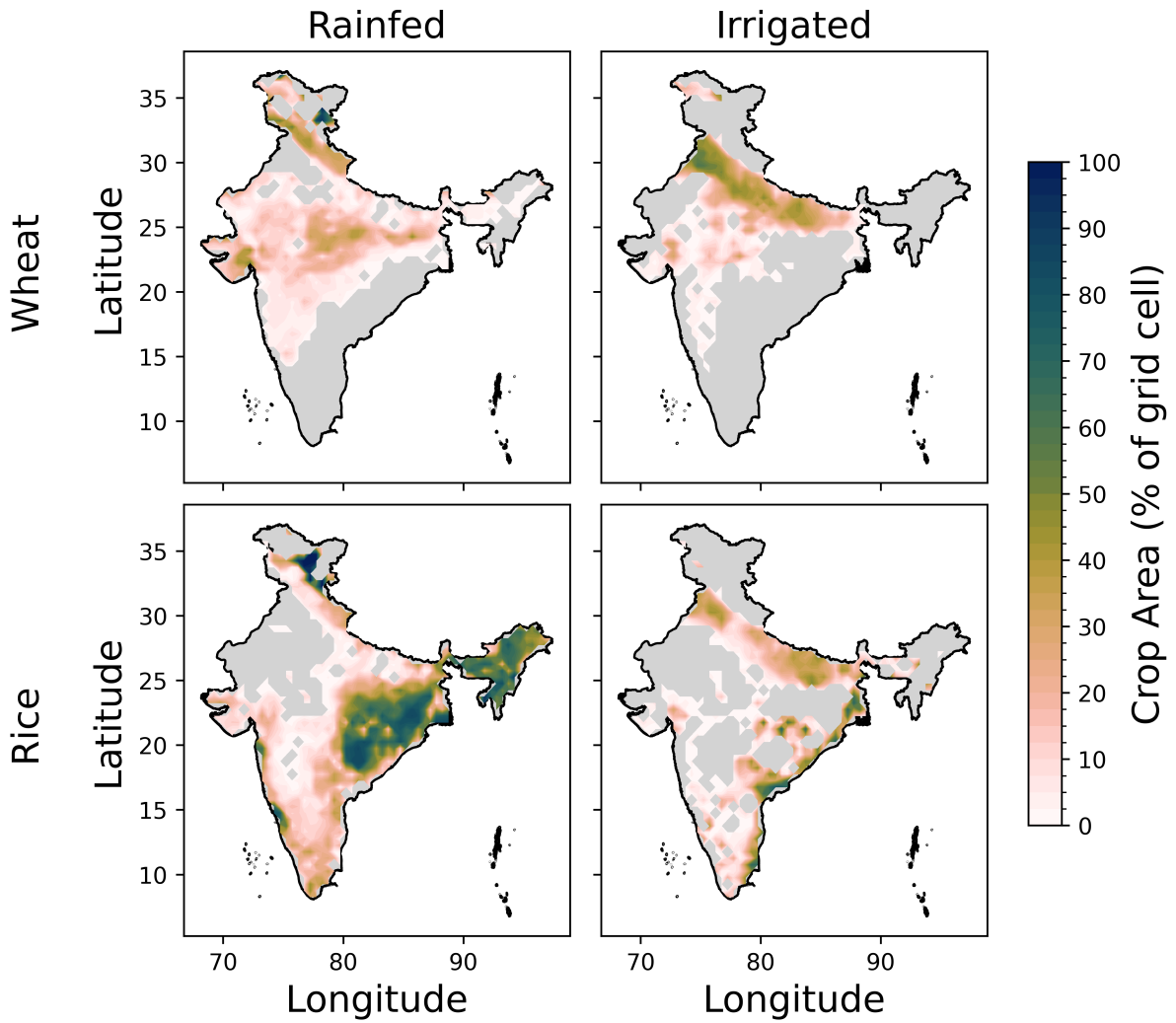
Figure S7: Crop areas of Wheat and Rice used in CLM5
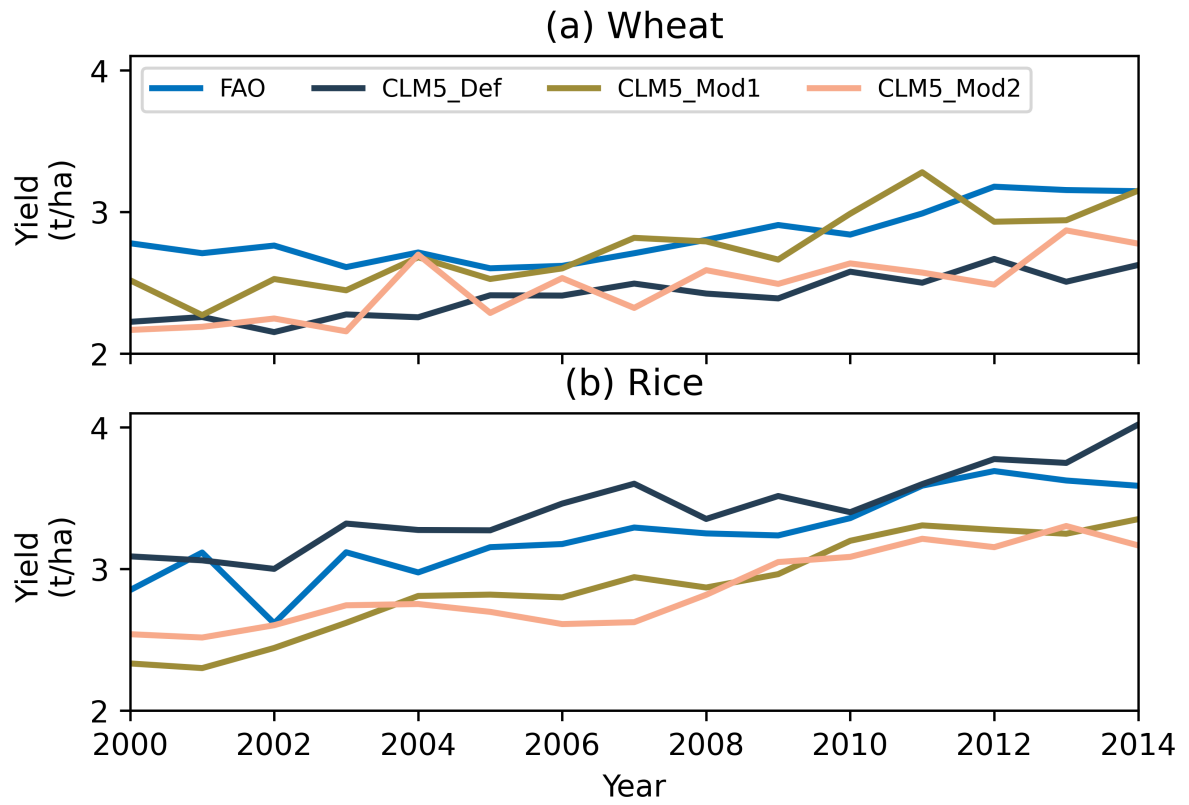
Figure S8: Comparing the total yield of (a) Wheat and (b) Rice against the FAO data from 2000 to 2014