TAMSAT-ALERT v1: A new framework for agricultural decision support (Supplementary information)

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Table S1. GLAM–maize parameter values used for the simulation of maize yield in Ghana

Parameter	**Explanation**	**Value**	**Reference**
Leaves			
DLDTMX	Maximum daily increase in LAI	0.1	(Watson et al., 2015)
MASPA	Minimum daily increase in senesced LAI during leaf senescence.	0.03	(Bergamaschi et al., 2013)
SWF_THRESH	Critical value of soil water stress factor for leaves	0.7	(Bergamaschi et al., 2013)
NDSLA	Specific Leaf Area control	5 days	(Challinor and Wheeler, 2008)
SLA_INI	Specific leaf area control (see Challinor and Wheeler 2008)	350 $cm^2\ g^{-1}$	(Ashraf and Hafeez , 2004)
MAX_ISTG_SLA	Max development stage for SLA control	2 (until flowering)	
Evaporation and transpiration			
ALBEDO	Albedo	0.25	(Oguntunde and van de Giesen, 2004)
CRIT_LAI_T	LAI below which transpiration is physiologically limited	2.7	(Al-Kaisi et al., 1989; Bergamaschi et al., 2013)
P_TRANS_MAX	Max value of potential transpiration	0.73 cm day^{-1}	(Al-Kaisi et al., 1989)
VPD_CTE	Used to calculate vapour pressure deficit	0.7	(Tanner and Sinclair, 1983)
VPD_REF	Used to calculate Priestly–Taylor coefficient	1kPa	(Steiner et al., 1991)
SHF_CTE	Used to calculate soil heat flux	0.4	(Choudhury et al., 1987)
EXTC	Extinction coefficient	0.5	(Bergamaschi et al., 2013)

Soil and roots			
RLL	Lower limit of volumetric soil water (m^3 m^{-3})	0.083 m^3 m^{-3}	
DUL	Drained upper limit of volumetric soil water (m^3 m^{-3})	0.195 m^3 m^{-3}	
SAT	Saturated volumetric soil water (m^3 m^{-3})	0.409 m^3 m^{-3}	
ASWS	Initial soil water (fraction of water holding capacity)	0	
NWBDAYS	Number of days water balance is run before start of planting window	30 days	
NSL	Number of soil layers	25	(Challinor et al., 2004)
ZSMAX	Maximum rooting depth	150 cm	
RKCTE	Used to calculate saturated hydraulic conductivity of the soil	75 cm day^{-1}	(Suleiman and Ritchie, 2001)
UPDIFC	Uptake diffusion coefficient	0.25 cm^2 day^{-1}	(Jamieson and Ewert, 1999; Robertson and Fukai, 1994).
EFV	Extraction front velocity	2 cm day^{-1}	(Dardanelli et al., 1997; Bergamashi et al., 2013)
DLDLAI	Increase in root length density at surface with LAI	1 cm cm^{-3}	(Bergamaschi et al., 2013)
RLVEF	Root length density at the extraction front	0.3 cm cm^{-3}	(Watson et al., 2015)
Biomass and yield			
TE	Transpiration efficiency	7 Pa (1994–2006) 8 Pa (2007–2014)	(Walker, 1986; Adamtey et al., 2010)
TEN_MAX	Max transpiration efficiency	10 g kg^{-1}	(Walker, 1986; Adamtey et al., 2010)
RUE	Radiation Use Efficiency	3.4 g MJ^{-1}	(Kiniry et al., 1989; Lindquist et al. , 2005)
DHDT	Maximum daily increase in harvest index	0.011 day^{-1}	(Birch et al., 1999)
MAX_HI_MAIZE	Maximum harvest index for maize	0.6	(Hay and Gilbert, 2001)
Development			
FSWSOW	Fractional soil moisture for intelligent planting and emergence	0.5	(Challinor et al., 2004)
IEMDAY	Number of days from planting to emergence	6 days	(Ashagre et al., 2014)

I_TTCALC	Shape of function to calculate thermal time	1 (flat top)	(Keating et al., 1992)
TBMAI	Base temperature for maize	10 °C	(Sanchez et al., 2014)
TOMAI	Optimum temperature for maize	30 °C	(Sanchez et al., 2014)
TMMAI	Maximum temperature for maize	40 °C	(Sanchez et al., 2014)
I_PHEN	Complex (I_PHEN=0) or simple (I_PHEN=1) simulation of phenology	1	
TLIMFLW	Thermal time from emergence to silking	680 °C days	
TLIMPFL	Thermal time from silking to start of grain filling.	145 °C days	(Tumbo et al., 2010)
TLIMGFP	Thermal time from start of grain filling to maturity	750 °C days	
Optional processes			
TETRS	Switch for temperature dependence of TE and RUE	1(on)	
TETR1	Temperature above which TE and RUE begin linear reduction	35 °C	(Yang et al., 2004; Carberry et al., 1989)
TETR2	Temperature above which TE and RUE are zero	47 °C	(Yang et al., 2004; Carberry et al., 1989)
TETR3	Temperature below which TE and RUE are zero	7 °C	(Yang et al., 2004; Carberry et al., 1989)
TETR4	Temperature below which TE and RUE begin linear reduction	18 °C	(Yang et al., 2004; Carberry et al., 1989)
HTS	Switch for high temperature stress around flowering	0(off)	(Gourdji et al., 2013)
TDS	Switch for terminal drought stress (TDS)	1(on)	
HIMIN	Minimum harvest index for TDS to occur	0.25	(Challinor et al., 2009)
SWC_FAC	Fraction of water holding capacity below which TDS occurs	0.05	(Challinor et al., 2009)
MIN_ISTG_TDS	Minimum ISTG for TDS to occur.	4 (start of grain filling)	
NMAXTDS	Number of days of TDS needed for the crop to be harvested.	8 days	(Jones and Thornton, 2003)
IEMER	Switch for intelligent emergence	–1 (off)	

TRKILL	Switch for lethal temperature parameterisation	–1 (off)	
WS	Switch for water stress around flowering	0 (off)	
TRLAI	Switch for temperature dependence of LAI growth	1 (on)	
TRLAIB	Base temperature below which leaf growth does not occur	7.3 °C	(Sanchez et al., 2014)
TRLAIO	Optimum temperature for leaf growth	31.1 °C	(Sanchez et al., 2014)
TRLAIM	Maximum temperature for leaf growth	41.3 °C	(Sanchez et al., 2014)

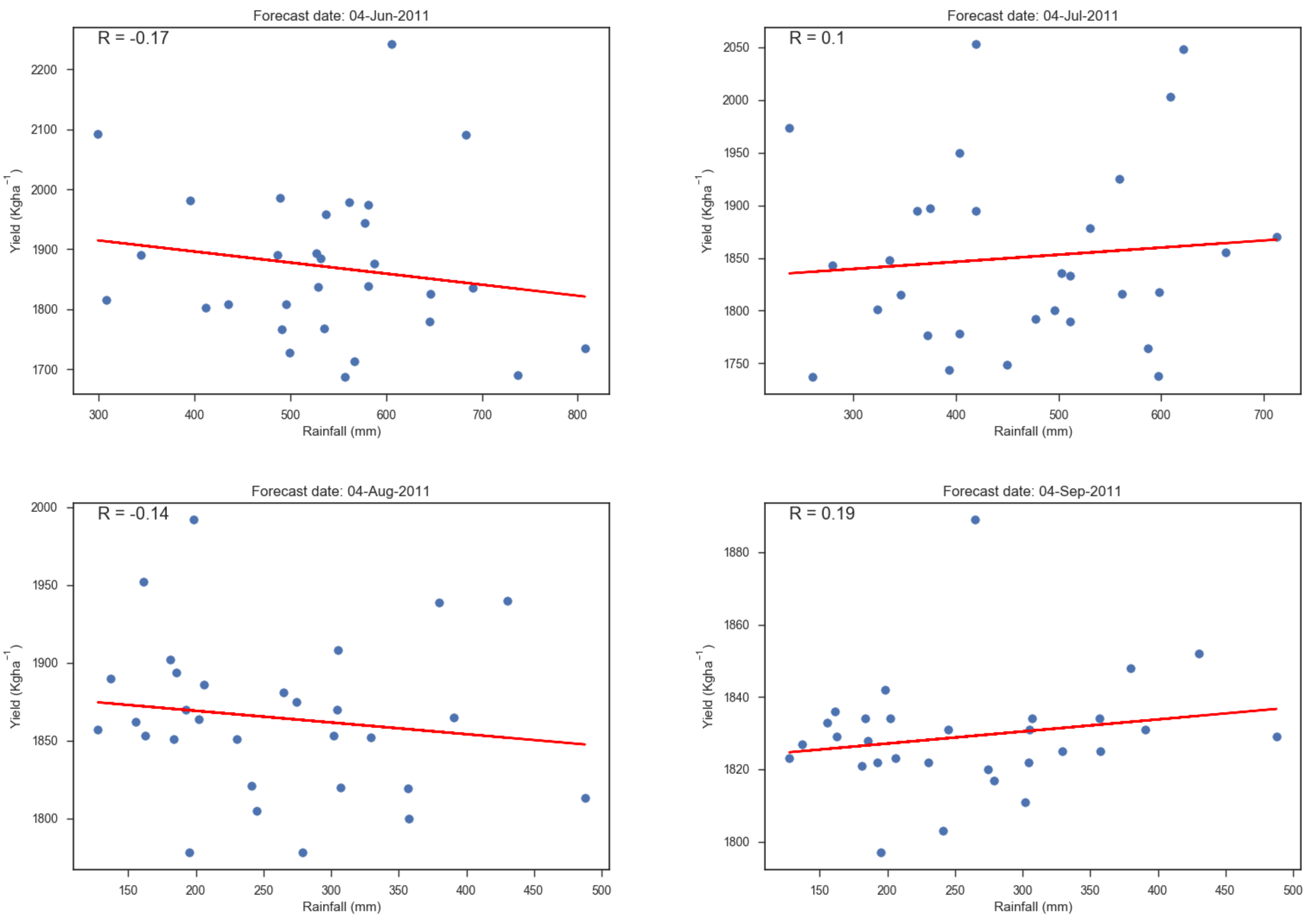

Figure S1: Correlation between Maize yield and 90 days total rainfall after forecast date.

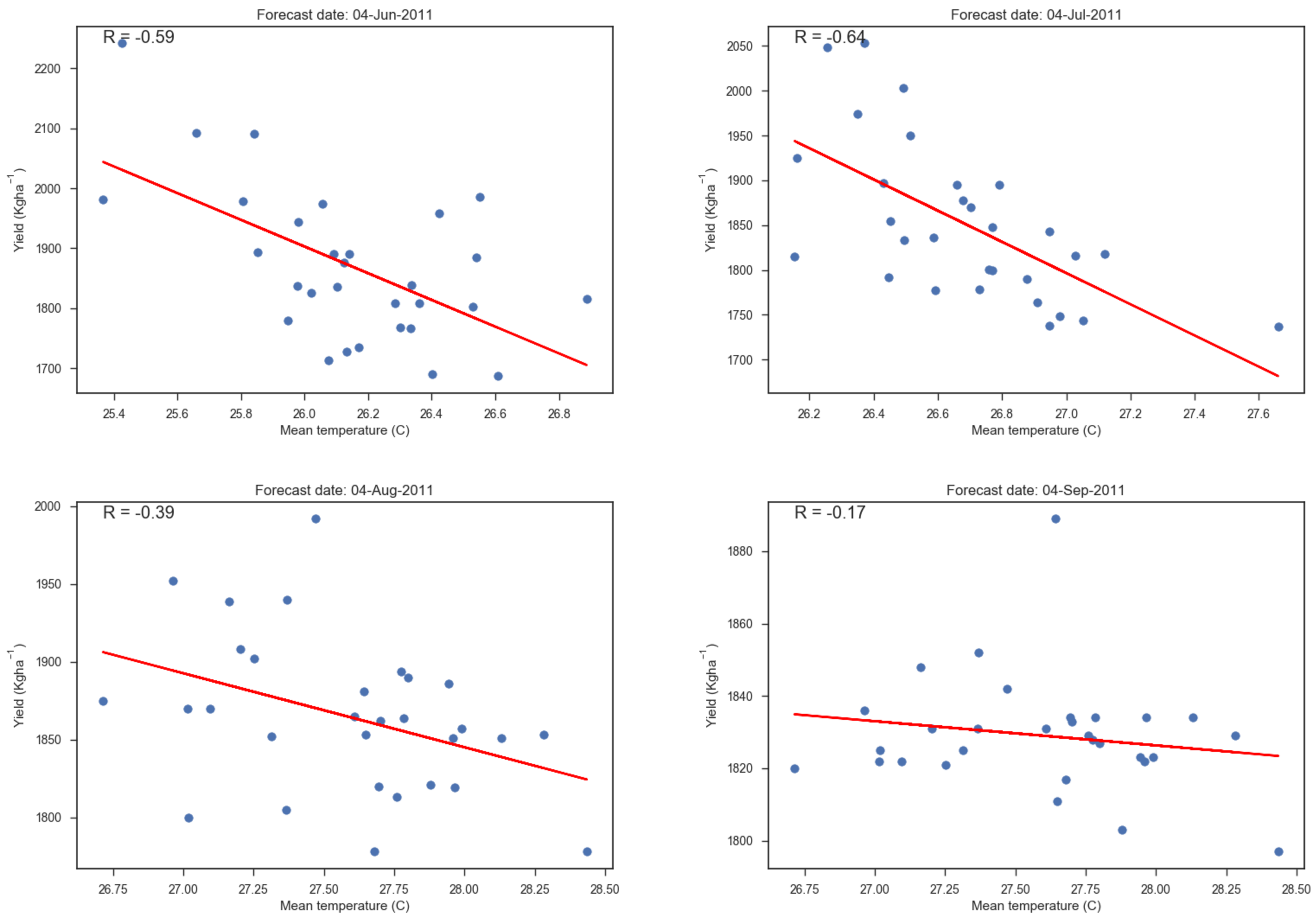

Figure S2: Correlation between Maize yield and the 90 days mean temperature after forecast date.

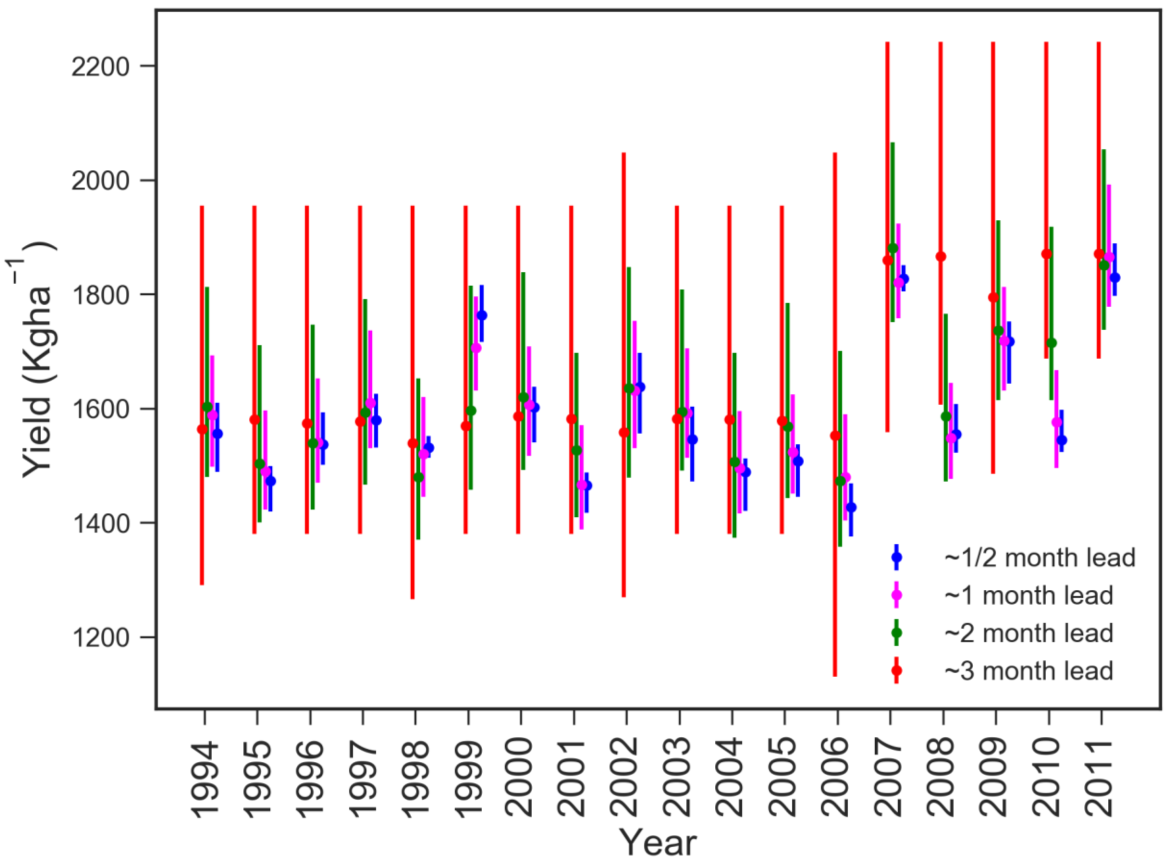

Figure S3: Time series of maize yield forecast in Ghana from 1994 to 2011 with four lead time of forecast. This is done using a hindcast for each year and comparing the plots of ~3–month lead time (red), ~2–month lead time (green), ~1–month lead time (magenta) and ~1/2–month lead time (blue). The shift in the period 1994 – 2006 and 2007 -2011 comes due to the change in the crop parameter Transpiration Efficiency (TE) which is implemented to account for the change in drought resistance variety of Maize introduced in Ghana.

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