Supplementary Material

The bootstrap approach was used through the R boot() package with 10000 correlation samples with the non-parametric ordinary method. For the confidence interval, the normal estimation was used within the boot.ci() function. The 95% confidence interval of the maximum correlation (r_max) was calculated using the boot.ci() function. The different correlation values for the different time lags (see Table S3) were matched against this confidence interval of the r_max, then the condition of whether they were statistically equal or not was accepted or rejected.
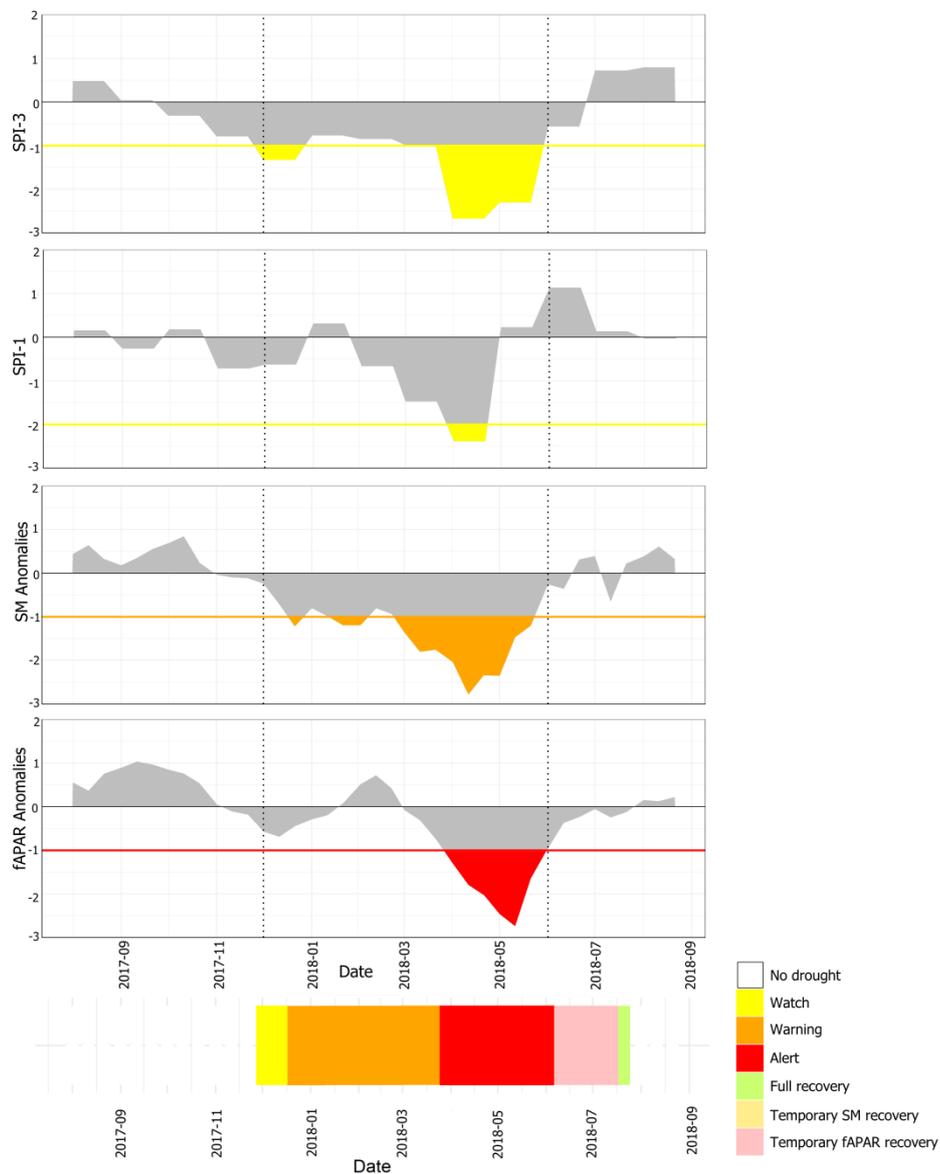

Figure S1. Temporal evolution from top-down of SPI-3, SPI-1, Soil Moisture anomalies and fAPAR anomalies, and the corresponding CDI category. Location of Rio Cuarto (-64.2°W, 33.1°S) for August 2017 – September 2018 period.

	Index		
	Standardized Precipitation Index (SPI-1 and 3)	Soil Moisture Anomaly	Vegetation "Health" Anomaly
Variable/s	Precipitation	LST and soil moisture anomalies	fAPAR
Sensor/Model/Data	GPCC	MODIS, ESA-CCI and LISFLOOD	MODIS
Type	Ground observations	Ensemble product: satellite+simulations	Satellite
Time frequency	monthly	10 days	10 days
Spatial resolution	1°x 1°	0.1°x 0.1°	0.08°x 0.08°
Source	GDO	GDO	GDO

Table S1. Main features of the datasets used in the CDI from the Copernicus GDO (Global Drought Observatory).

Location	Longitude	Latitude	Area km²	Corn harvested area (median, ha)	Soybean harvested area (median, ha)
RECONQUISTA	-59.7	-29.2	10,928	37,700	63,077
PILAR	-63.9	-31.7	4,970	59,800	145,113
PARANA	-60.5	-31.8	4,974	31,000	80,116
MARCOS JUAREZ	-62.2	-32.7	9,490	113,700	268,519
GUALEGUAYCHU	-58.6	-33.0	7,086	26,500	69,400
RIO CUARTO	-64.2	-33.1	18,394	296,258	307,735
LABOULAYE	-63.4	-34.1	8,228	91,275	127,454
JUNIN	-60.9	-34.6	2,253	22,350	52,663

9 DE JULIO	-60.9	-35.5	4,230	19,955		43,907
PEHUAJO	-61.9	-35.9	4,560	21,050		36,557
TANDIL	-59.3	-37.2	5,234	16,410		52,692
CORONEL SUAREZ	-61.9	-37.4	5,985	5,000		46,875
BENITO JUAREZ	-59.8	-37.7	5,334	4,560		26,489
TRES ARROYOS	-60.3	-38.3	5,861	24,250		47,473

Table S2. Geographical location of the 14 sites, ordered from north to south, spatial extent (km^2), and the median harvest area (ha) of corn and soybean for the corresponding sites departments (2nd administrative level).

				Correlation		
Variable	Date	Variable	Lag & Date	Median	Max.	Min.
SPI-3	M	Soil Moisture	lag-1d: (M, 2d)	**_0.60_**	0.67	0.41
SPI-3	M	Soil Moisture	lag 0: (M, 3d)	**0.64***	0.71	**0.49**
SPI-3	M	Soil Moisture	lag+1d: (M+1, 1d)	**_0.63_**	**0.72**	0.40
SPI-3	M	Soil Moisture	lag+2d: (M+1, 2d)	**_0.55_**	0.67	0.31
SPI-3	M	Soil Moisture	lag+3d: (M+1, 3d)	0.42	0.57	0.24
Soil Moisture	(M, 2d)	fAPAR	lag-1d: (M, 1d)	**_0.46_**	0.62	0.38
Soil Moisture	(M, 2d)	fAPAR	lag 0: (M, 2d)	**0.54***	**0.69**	**0.46**
Soil Moisture	(M, 2d)	fAPAR	lag+1d: (M, 3d)	**0.54***	0.68	0.43
Soil Moisture	(M, 2d)	fAPAR	lag+2d: (M+1, 1d)	**_0.50_**	0.64	0.36

				Median	Max	Min
Soil Moisture	(M, 2d)	fAPAR	lag+3d: (M+1, 2d)	0.43	0.57	0.27
SPI-3	M	fAPAR	lag-1d: (M, 2d)	**<u>0.33</u>**	0.53	0.24
SPI-3	M	fAPAR	lag 0: (M, 3d)	**<u>0.36</u>**	0.58	0.23
SPI-3	M	fAPAR	lag+1d: (M+1, 1d)	**<u>0.45</u>**	**0.67**	**0.31**
SPI-3	M	fAPAR	lag+2d: (M+1, 2d)	**0.46***	0.63	0.30
SPI-3	M	fAPAR	lag+3d: (M+1, 3d)	**<u>0.41</u>**	0.57	0.16
SPI-1	M	Soil Moisture	lag-1d: (M, 2d)	0.32	0.39	0.20
SPI-1	M	Soil Moisture	lag 0: (M, 3d)	**<u>0.50</u>**	0.54	0.36
SPI-1	M	Soil Moisture	lag+1d: (M+1, 1d)	**0.59***	**0.68**	**0.46**
SPI-1	M	Soil Moisture	lag+2d: (M+1, 2d)	**<u>0.50</u>**	0.61	0.34
SPI-1	M	Soil Moisture	lag+3d: (M+1, 3d)	0.34	0.51	0.25
SPI-1	M	fAPAR	lag-1d: (M, 2d)	-0.01	0.10	-0.10
SPI-1	M	fAPAR	lag 0: (M, 3d)	0.13	0.21	-0.03
SPI-1	M	fAPAR	lag+1d: (M+1, 1d)	**<u>0.33</u>**	0.45	0.17
SPI-1	M	fAPAR	lag+2d: (M+1, 2d)	**0.42***	**0.53**	**0.27**
SPI-1	M	fAPAR	lag+3d: (M+1, 3d)	**<u>0.35</u>**	0.50	0.25

Table S3. Pearson correlation between SPI-3 (SPI-1), soil moisture and fAPAR anomalies for different time lags, where M corresponds to a specific month and d to the dekad of that month. The median, maximum, minimum correlations values for the 14 locations. For the median the **bold** and (*) represents the highest value: **bold** and <u>underlined</u> represents correlation values not significantly different compared to the highest correlation value (95% confidence interval, based on bootstrap test, see supplementary section for details). For the correlation maximum and minimum columns, **bold** represent the highest values.

CDI Available	SPI	Soil Moisture Anomaly	fAPAR Anomaly
1st dekad January	December	2nd dekad December	3rd dekad December
2nd dekad January	December	3rd dekad December	1st dekad January
3rd dekad January	December	1st dekad January	2nd dekad January

Table S4. Operational CDI configuration, with the different time periods used for each variable and the corresponding deliverable date of the CDI. Based on Sepulcre-Canto et al. (2012).
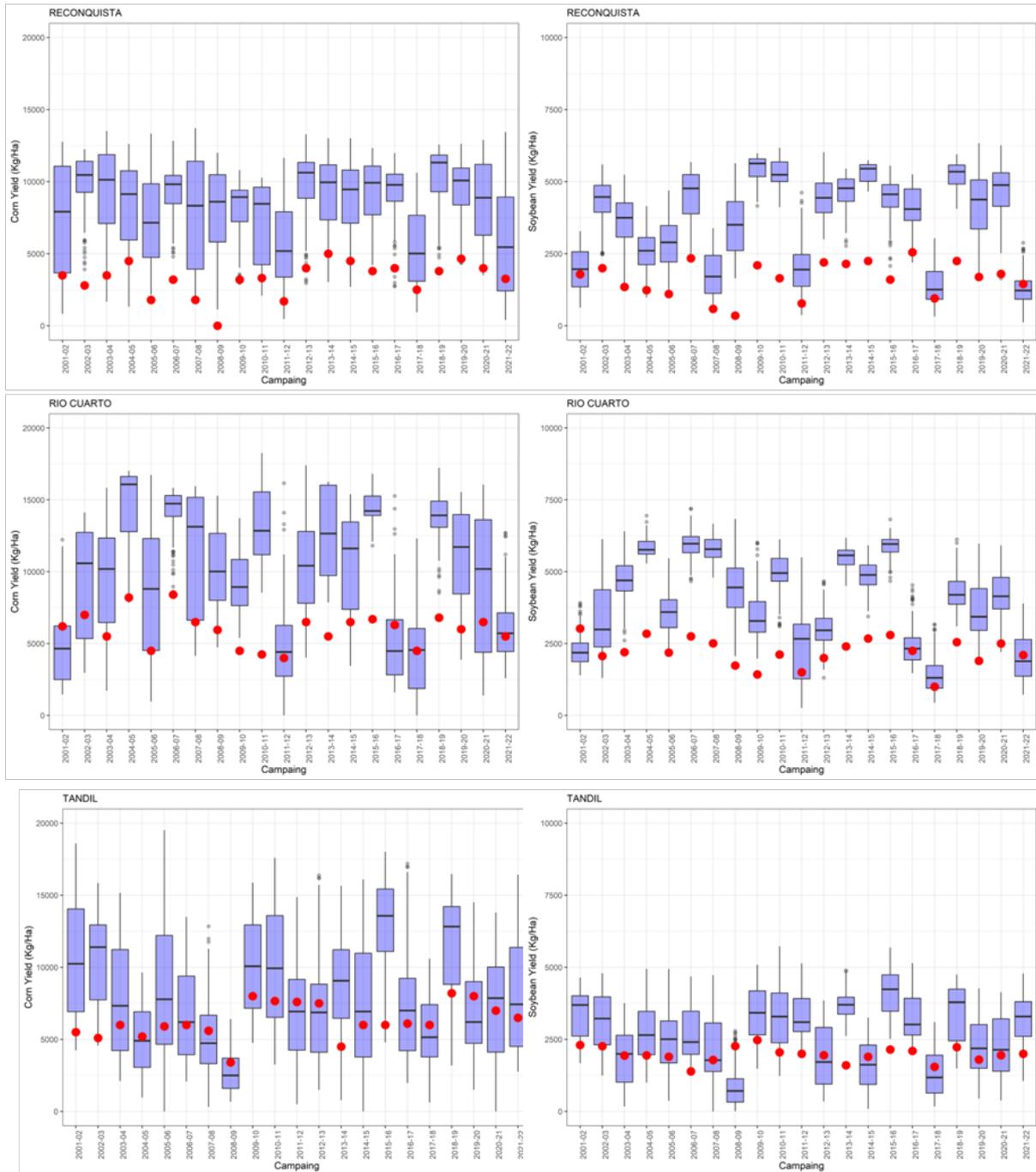
Figure S2. Corn (left panels) and Soybean (right panels) for yield estimations (red dots) and boxplots of the ensemble yield simulations for 3 locations: Reconquista, Rio Cuarto and Tandil.