

## Supplementary material

### Tables

**Table S1.** Missing data for each station and meteorological parameter. X = absence of meteorological data. “Produced by the authors”.

COUNTRY	STATION	≥10 days gap			
		TMAX	TMIN	PREC	QQ
SPAIN	MALAGA	-	-	-	06-08/87
	GRANADA	-	-	-	12/85, 01-02/86
	MELILLA	-	-	-	-
	LLEIDA	-	-	-	-
FRANCE	PERPIGNAN	-	-	-	09/2019
	MONTPELLIER	-	-	-	X
	MARSEILLES	-	-	-	09/2019
	NICE	-	-	-	12/90, 01-02/91
ITALY	CAGLIARI	-	09-12/13, 01-02/14, 11/14, 01/15, 09-12/15, 01-02/16	-	X
	BRINDISI	-	-	03-09/2004	-
GREECE	LARISA	-	-	-	X
	THESSALONIKI	01-03/82	01-03/82	-	01-12/82, 08/84, 09- 11/2006
CYPRUS	LARNACA	-	-	-	X

**Table S2.** Latitude (°), longitude (°), and altitude (m) of observations (OBS) and grid products (AGRI4CAST, EOBS-0.1 and EOBS-0.25). “Produced by the authors”.

COUNTRY	STATION	OBS		AGRI4CAST		EOBS-0.1		EOBS-0.25	
		Lat-Lon	ALTITUDE (m)	Lat-Lon	ALTITUDE (m)	Lat-Lon	ALTITUDE (m)	Lat-Lon	ALTITUDE (m)
SPAIN	MALAGA	36.66°N, -4.48°W	7	36.63°N, -4.61°W	69	36.74°N, -4.45°W	192	36.62°N, -4.62°W	259
	GRANADA	37.18°N, -3.78°W	567	37.17°N, -3.86°W	765	37.14°N, -3.75°W	679	37.12°N, -3.87°W	789
	MELILLA	35.27°N, -2.95°W	47	35.22°N, -2.98°W	250	35.24°N, -2.95°W	223	35.12°N, -2.87°W	187
	LLEIDA	41.62°N, 0.59°E	192	41.60°N, 0.61°E	193	41.64°N, 0.54°E	223	41.62°N, 0.62°E	204
FRANCE	PERPIGNAN	42.73°N, 2.87°E	42	42.69°N, 2.88°E	11	42.74°N, 2.84°E	45	42.62°N, 2.87°E	98
	MONTPELLIER	43.57°N, 3.96°E	2	43.56°N, 4.10°E	1	43.54°N, 3.94°E	5	43.62°N, 3.87°E	63
	MARSEILLES	43.43°N, 5.21°E	9	43.36°N, 5.02°E	14	43.44°N, 5.24°E	97	43.37°N, 5.12°E	56
	NICE	43.64°N, 7.20°E	2	43.62°N, 7.06°E	69	43.64°N, 9.86°E	57	43.62°N, 7.12°E	213
ITALY	CAGLIARI	39.23°N, 9.05°E	21	39.32°N, 9.03°E	39	39.24°N, 9.04°E	15	39.37°N, 9.12°E	186
	BRINDISI	40.63°N, 17.93°E	10	40.58°N, 17.84°E	25	40.64°N, 17.94°E	16	37.62°N, -3.12°E	41
GREECE	LARISA	39.65°N, 22.45°E	73	39.66°N, 22.42°E	100	39.64°N, 22.44°E	76	39.62°N, 22.37°E	136
	THESSALONIKI	40.52°N, 22.97°E	7	40.50°N, 22.93°E	110	40.44°N, 22.94°E	97	40.62°N, 22.87°E	89
CYPRUS	LARNACA	34.88°N, 33.63°E	1	34.97°N, 33.58°E	105	34.84°N, 33.54°E	61	34.87°N, 33.37°E	259

**Table S3.** Genetic coefficients for Iride variety (Mereu et al., 2019).

Coefficient	Value
P1D (Photoperiod response (% reduction in rate/10 h drop in pp))	62
P1V (Days,optimum vernalizing temperature,required for vernalization)	25
P5 (Grain filling (excluding lag) phase duration (oC.d))	777
G1 (Kernel number per unit canopy weight at anthesis (#/g))	29
G2 (Standard kernel size under optimum conditions (mg))	41
G3 (Standard,non-stressed mature tiller wt (incl grain) (g dwt))	2
PHINT (Interval between successive leaf tip appearances (oC.d))	97

**Table S4.** Scale of correlation coefficient and interpretation of its calculated values (Hinkle et al. 1994).

Scale of correlation coefficient	Value
$0 < r \leq 0.19$	Very Low Correlation
$0.2 \leq r \leq 0.39$	Low Correlation
$0.4 \leq r \leq 0.59$	Moderate Correlation
$0.6 \leq r \leq 0.79$	High Correlation
$0.8 \leq r \leq 1.0$	Very High Correlation

**Table S5.** Discrepancies of simulated with CERES-Wheat anthesis, maturity (expressed as Gridded (G) –Measured (M)) and harvested yield ((G–M)/M)× 100 (%) for the reference period. “Produced by the authors”.

Anthesis (days)																		
	AGRI4CAST-OBS						EOBS0.1-OBS						EOBS0.25-OBS					
STATION	N	Mean	Std	Q25	Q50	Q75	N	Mean	Std	Q25	Q50	Q75	N	Mean	Std	Q25	Q50	Q75
MALAGA AEROPUERTO, SP	40	1,0	1,8	0,0	1,0	2,0	40	7,1	4,4	4,0	7,0	11,0	40	10,9	5,0	8,0	11,0	14,5
GRANADA AEROPUERTO, SP	39	20,1	3,6	18,5	20,0	22,0	39	8,9	2,1	7,5	9,0	11,0	39	19,7	4,6	16,0	19,0	23,5
MELILLA, SP	40	2,5	4,9	-1,0	3,0	6,0	40	0,0	3,3	-2,5	1,0	2,0	40	-0,8	2,3	-2,5	0,0	0,0
LLEIDA, SP	29	-1,9	3,4	-3,3	-2,0	-0,8	29	3,5	1,2	3,0	3,0	4,0	29	0,8	1,1	0,0	0,5	2,0
PERPIGNAN, FR	39	-3,4	1,1	-4,0	-3,0	-3,0	39	0,8	0,6	0,5	1,0	1,0	39	3,9	1,5	3,0	4,0	5,0
MARSEILLES MARIGNANE, FR	39	-1,8	1,9	-3,0	-1,0	-0,5	39	8,4	1,4	7,0	8,0	9,0	39	3,1	1,1	2,0	3,0	4,0
NICE, FR	36	4,9	1,2	4,0	5,0	6,0	36	5,2	1,8	4,0	5,0	6,0	36	19,6	5,0	17,0	18,0	22,0
BRINDISI, IT	38	0,5	1,0	0,0	1,0	1,0	38	0,0	0,3	0,0	0,0	0,0	38	0,0	0,8	0,0	0,0	1,0
THESSALONIKI, GR	28	15,0	2,8	13,8	15,0	16,3	28	8,9	2,3	7,0	8,0	11,0	28	8,9	2,5	7,0	8,0	10,3
AVERAGE	9	4,1	8,1	-1,8	1,0	4,9	9	4,7	3,8	0,8	5,2	8,4	9	7,3	8,0	0,8	3,9	10,9

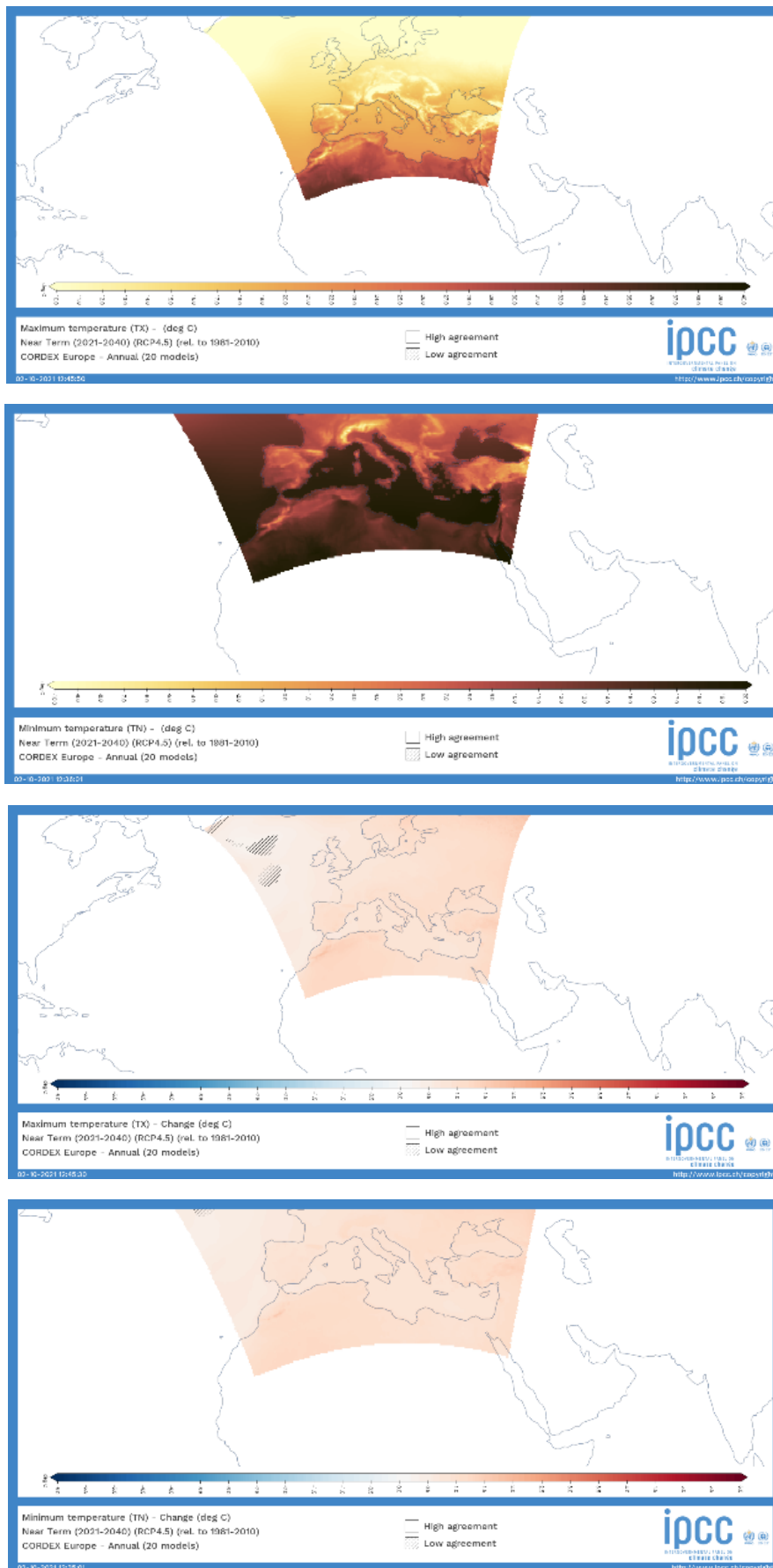
Maturity (days)																		
	AGRI4CAST-OBS						EOBS0.1-OBS						EOBS0.25-OBS					
STATION	N	Mean	Std	Q25	Q50	Q75	N	Mean	Std	Q25	Q50	Q75	N	Mean	Std	Q25	Q50	Q75
MALAGA AEROPUERTO, SP	40	2,6	1,6	1,5	3,0	4,0	40	10,9	3,4	8,0	11,0	14,0	40	15,7	3,7	13,0	16,0	18,0
GRANADA AEROPUERTO, SP	39	18,6	2,3	17,5	19,0	20,0	39	8,5	1,7	8,0	8,0	10,0	39	18,0	3,1	16,0	19,0	20,0
MELILLA, SP	40	9,0	4,0	6,5	10,0	11,5	40	5,3	2,9	3,0	6,0	6,5	40	3,1	2,1	1,0	3,0	4,0
LLEIDA, SP	29	-1,1	3,1	-2,3	-2,0	0,0	29	3,4	0,9	3,0	3,0	4,0	29	1,5	0,7	1,0	1,0	2,0
PERPIGNAN, FR	39	-3,3	0,7	-4,0	-3,0	-3,0	39	0,9	0,4	1,0	1,0	1,0	39	4,6	1,4	4,0	4,0	5,0
MARSEILLES MARIGNANE, FR	39	-1,0	1,9	-2,0	-1,0	0,0	39	8,4	1,2	7,5	8,0	9,0	39	4,1	1,0	3,0	4,0	5,0
NICE, FR	36	5,2	1,3	4,0	5,0	6,0	36	5,0	1,3	4,0	5,0	6,0	36	18,7	3,7	16,0	18,0	20,0
BRINDISI, IT	38	0,8	0,9	0,0	1,0	2,0	38	0,0	0,2	0,0	0,0	0,0	38	1,1	0,7	1,0	1,0	1,0
THESSALONIKI, GR	28	13,8	2,7	12,8	14,0	15,3	28	8,7	1,9	7,0	9,0	10,0	28	8,3	1,9	7,0	8,0	9,0
AVERAGE	9	4,9	7,5	-1,0	2,6	9,0	9	5,7	3,7	3,4	5,3	8,5	9	8,3	7,2	3,1	4,6	15,7

Harvesting (%)																		
	AGRI4CAST-OBS						EOBS0.1-OBS						EOBS0.25-OBS					
STATION	N	Mean	Std	Q25	Q50	Q75	N	Mean	Std	Q25	Q50	Q75	N	Mean	Std	Q25	Q50	Q75
MALAGA AEROPUERTO, SP	40	3,2	4,2	1,0	2,2	5,1	40	10,8	6,2	6,2	10,4	15,0	40	15,2	7,3	10,3	13,3	19,4
GRANADA AEROPUERTO, SP	39	13,7	9,4	7,9	13,4	19,4	39	6,7	4,9	3,6	6,6	10,1	39	12,5	8,9	6,7	11,3	19,6
MELILLA, SP	40	14,1	9,2	7,3	13,6	19,4	40	10,5	4,7	6,9	10,5	14,0	40	10,9	4,3	8,0	11,0	13,7
LLEIDA, SP	29	-2,2	3,8	-4,9	-2,2	0,6	29	0,4	3,3	-1,5	0,3	2,7	29	-0,5	2,3	-2,2	-0,9	0,5
PERPIGNAN, FR	39	6,5	68,6	-6,2	-4,6	-2,7	39	6,1	45,4	-3,7	-0,4	1,7	39	10,9	48,7	0,4	2,6	5,9
MARSEILLES MARIGNANE, FR	39	9,5	70,2	-3,6	-1,2	1,1	39	15,0	42,4	4,9	8,3	11,3	39	10,8	41,3	2,5	4,4	6,3
NICE, FR	36	6,9	3,8	4,2	6,3	9,4	36	4,0	5,8	0,1	2,9	7,3	36	19,7	9,0	13,9	19,0	24,3
BRINDISI, IT	38	7,4	9,8	0,0	5,6	13,6	38	5,1	8,2	-2,4	5,0	13,4	38	5,3	8,1	-2,5	5,0	13,5
THESSALONIKI, GR	28	38,6	29,3	17,3	36,0	49,3	28	26,7	22,4	8,4	21,4	38,0	28	24,5	21,8	7,2	20,6	35,9
AVERAGE	9	8,2	11,4	0,6	6,5	13,3	9	7,7	7,0	3,8	6,6	10,4	9	10,3	7,3	4,5	10,7	15,0

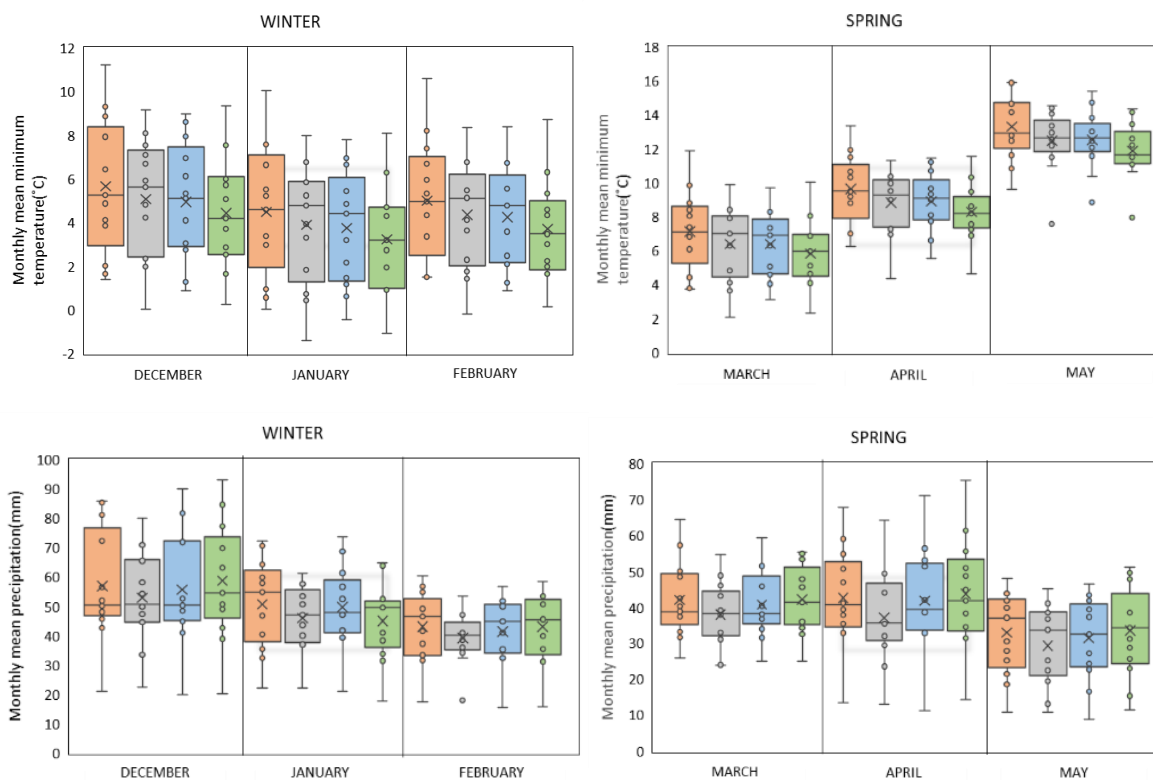
**Table S6.** rRMSE and r for anthesis, maturity and yield for the reference period. “Produced by the authors”.

Anthesis						
	RMSE			r		
STATION	Agri4Cast	EOBS-0.1	EOBS-0.25	Agri4Cast	EOBS-0.1	EOBS-0.25
MALAGA,SP	2,0	8,3	12,0	0,893	0,468	0,343
GRANADA,SP	20,4	9,2	20,2	0,899	0,961	0,827
MELILLA,SP	5,4	3,3	2,4	0,317	0,632	0,827
LLEIDA,SP	3,9	3,6	1,4	0,821	0,977	0,979
PERPIGNAN, FR	3,5	1,0	4,2	0,986	0,996	0,974
MARSEILLES, FR	2,6	8,5	3,3	0,966	0,981	0,990
NICE, FR	5,0	5,5	20,2	0,975	0,961	0,831
BRINDISI, IT	1,1	0,3	0,8	0,984	0,998	0,991
THESSALONIKI, GR	15,2	9,1	9,2	0,898	0,933	0,922
Maturity						
	RMSE			r		
STATION	Agri4Cast	EOBS-0.1	EOBS-0.25	Agri4Cast	EOBS-0.1	EOBS-0.25
MALAGA, SP	3,0	11,4	16,1	0,941	0,785	0,742
GRANADA, SP	18,7	8,6	18,3	0,947	0,968	0,904
MELILLA,SP	9,8	6,0	3,7	0,499	0,746	0,862
LLEIDA, SP	3,3	3,5	1,6	0,821	0,982	0,988
PERPIGNAN, FR	3,4	1,0	4,8	0,993	0,997	0,978
MARSEILLES, FR	2,1	8,5	4,2	0,968	0,986	0,989
NICE, FR	5,4	5,2	19,1	0,969	0,982	0,921
BRINDISI, IT	1,2	0,2	1,3	0,979	0,999	0,991
THESSALONIKI, GR	14,1	8,9	8,5	0,844	0,925	0,921
Harvesting						
	(RMSE/mean*100)			r		
STATION	Agri4Cast	EOBS-0.1	EOBS-0.25	Agri4Cast	EOBS-0.1	EOBS-0.25
MALAGA, SP	5,0	12,1	16,4	0,846	0,734	0,655
GRANADA, SP	15,9	8,0	14,7	0,292	0,791	0,397
MELILLA,SP	16,3	11,2	11,5	0,557	0,833	0,857
LLEIDA, SP	4,4	3,2	2,3	0,831	0,885	0,942
PERPIGNAN, FR	14,4	9,7	11,0	0,299	0,786	0,761
MARSEILLES, FR	15,6	12,8	10,1	0,168	0,833	0,857
NICE, FR	7,7	6,6	20,8	0,919	0,787	0,576
BRINDISI, IT	11,0	9,0	9,0	0,774	0,834	0,838
THESSALONIKI, GR	37,7	27,6	25,7	0,423	0,563	0,589

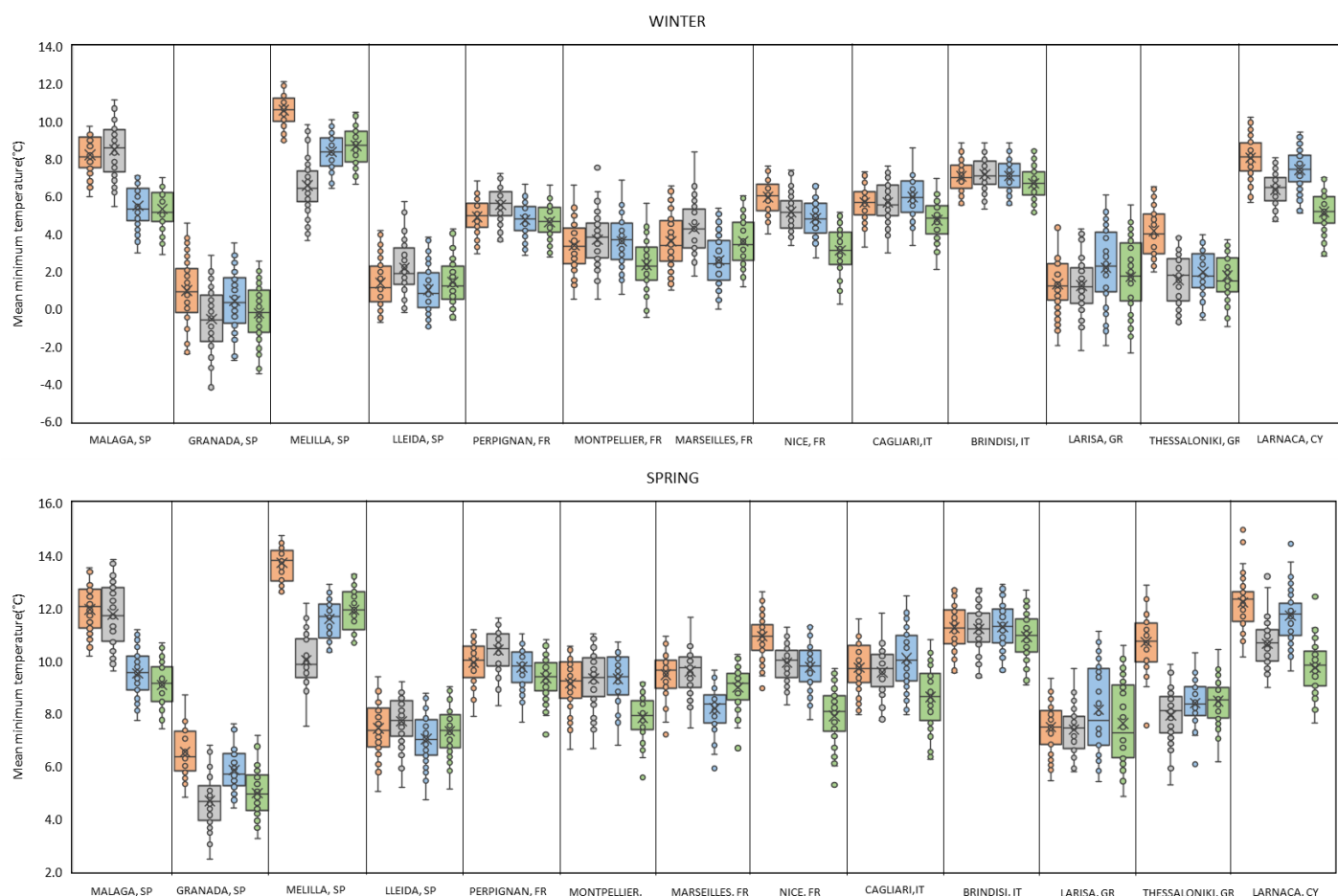
## Figures



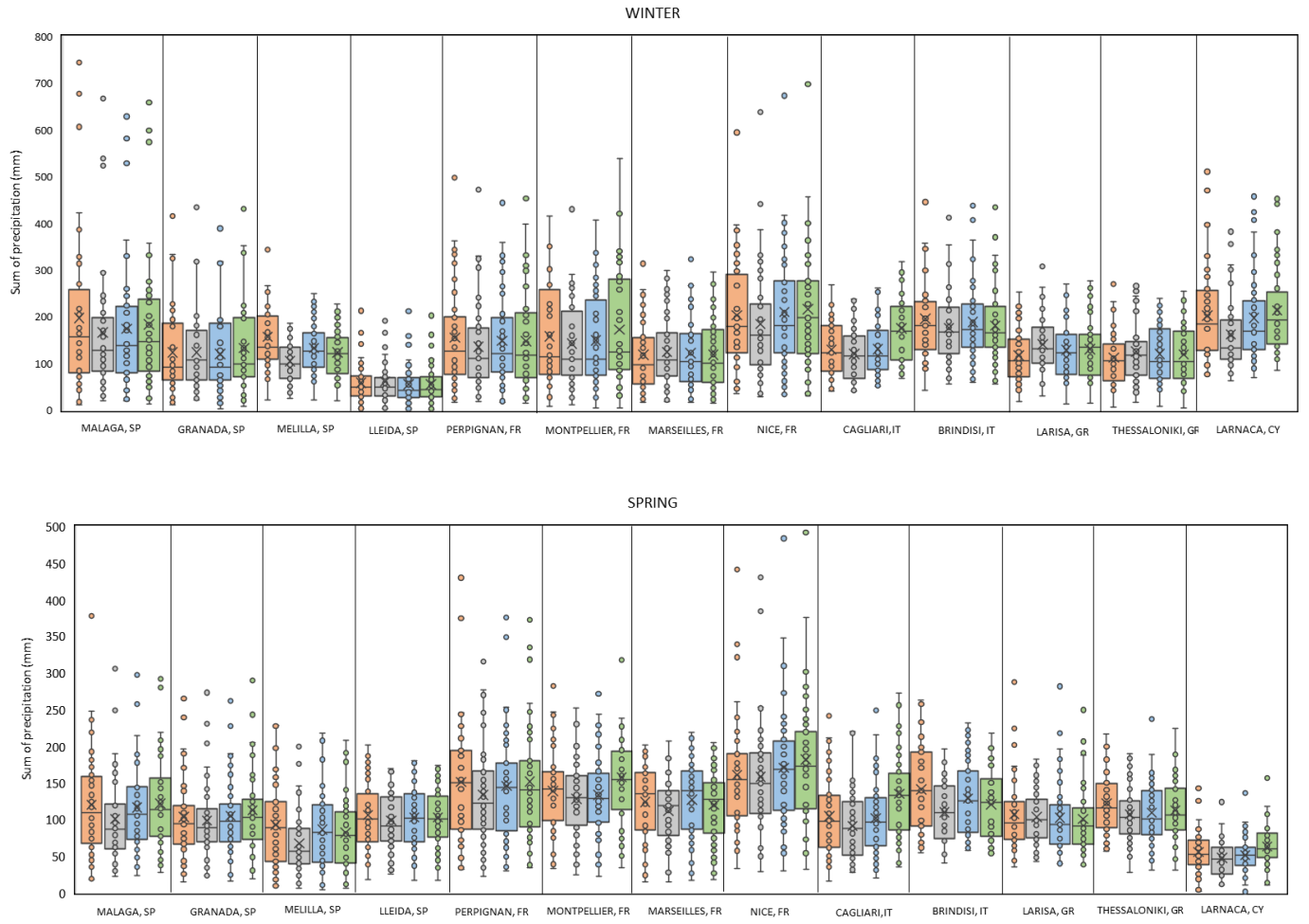
**Figure S1.** Illustrated maps for Tmax and Tmin (1<sup>st</sup> & 2<sup>nd</sup> row) and their variations (3<sup>d</sup> & 4<sup>th</sup> row) for the near future (2021-2040), for RCP 4.5 in continental Mediterranean regions according to IPCC (<https://interactive-atlas.ipcc.ch/>).



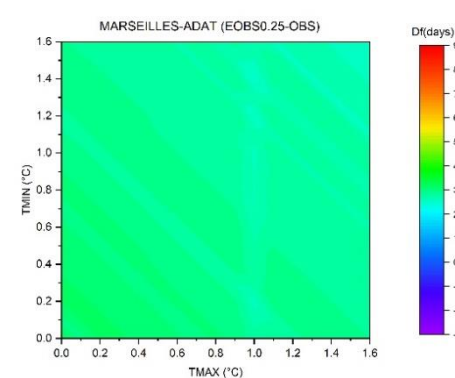
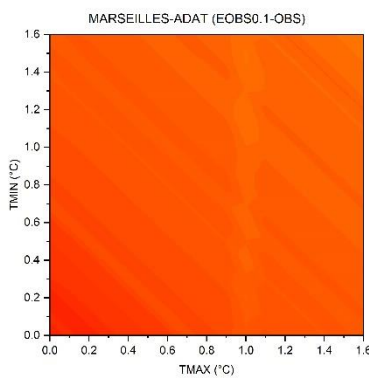
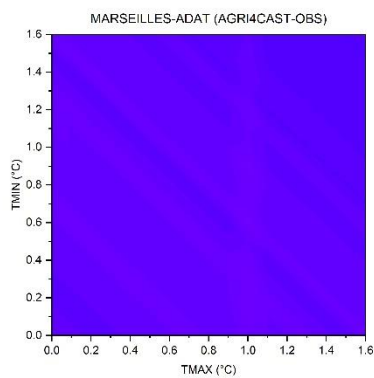
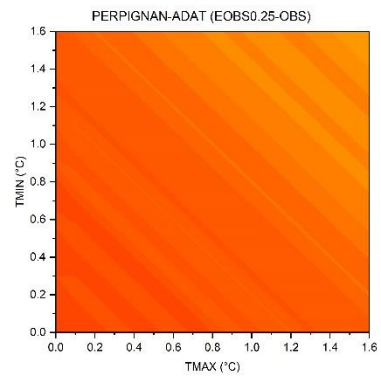
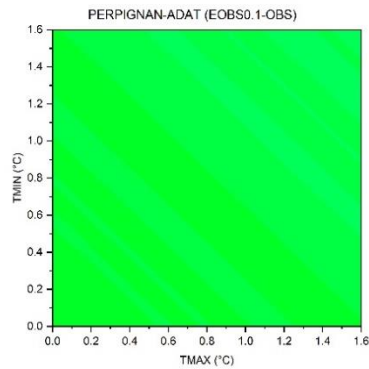
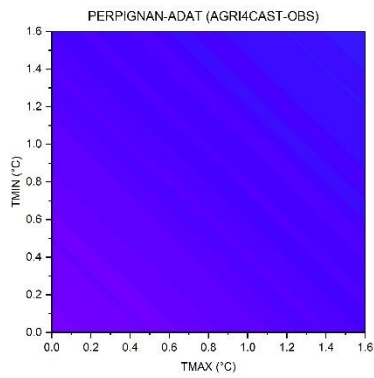
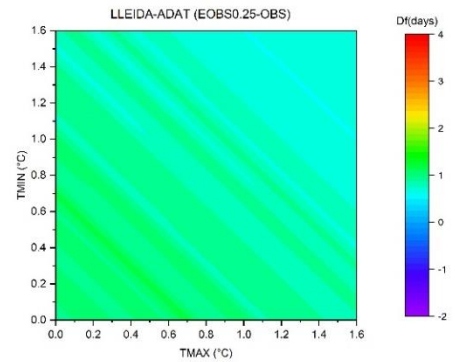
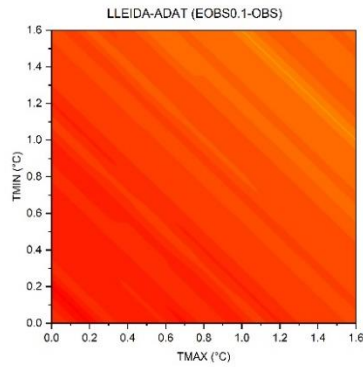
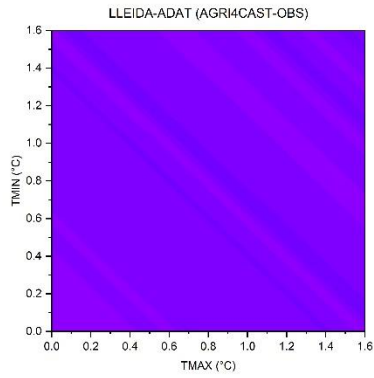
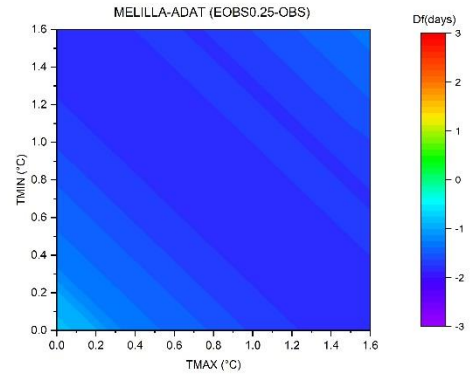
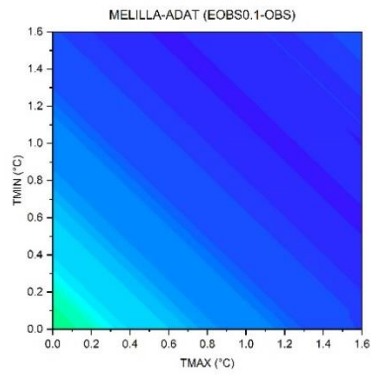
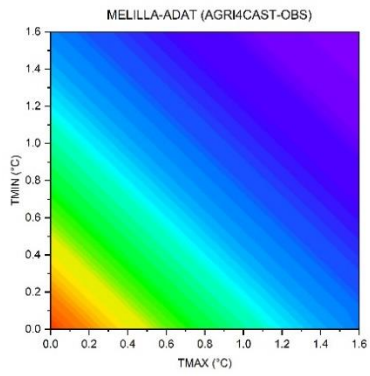
**Figure S2.** Comparison between gridded data and OBS for minimum temperature (13 stations) and Prec (13 stations) (1<sup>st</sup> and 2<sup>nd</sup> row, respectively) for the reference period. “Produced by the authors”.

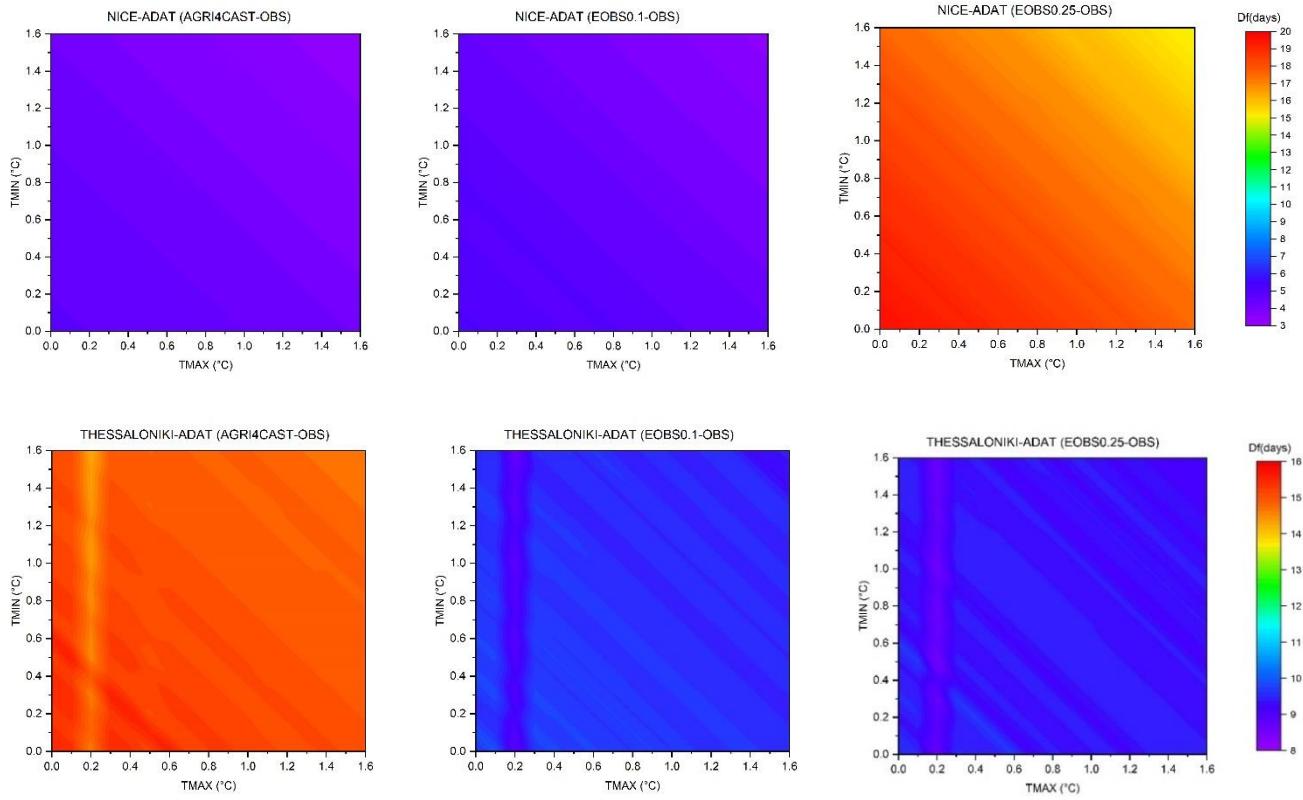


**Figure S3.** Seasonal comparison of Tmin between gridded data and OBS for each season (they were ranked from west to east) and the reference period. “Produced by the authors”.



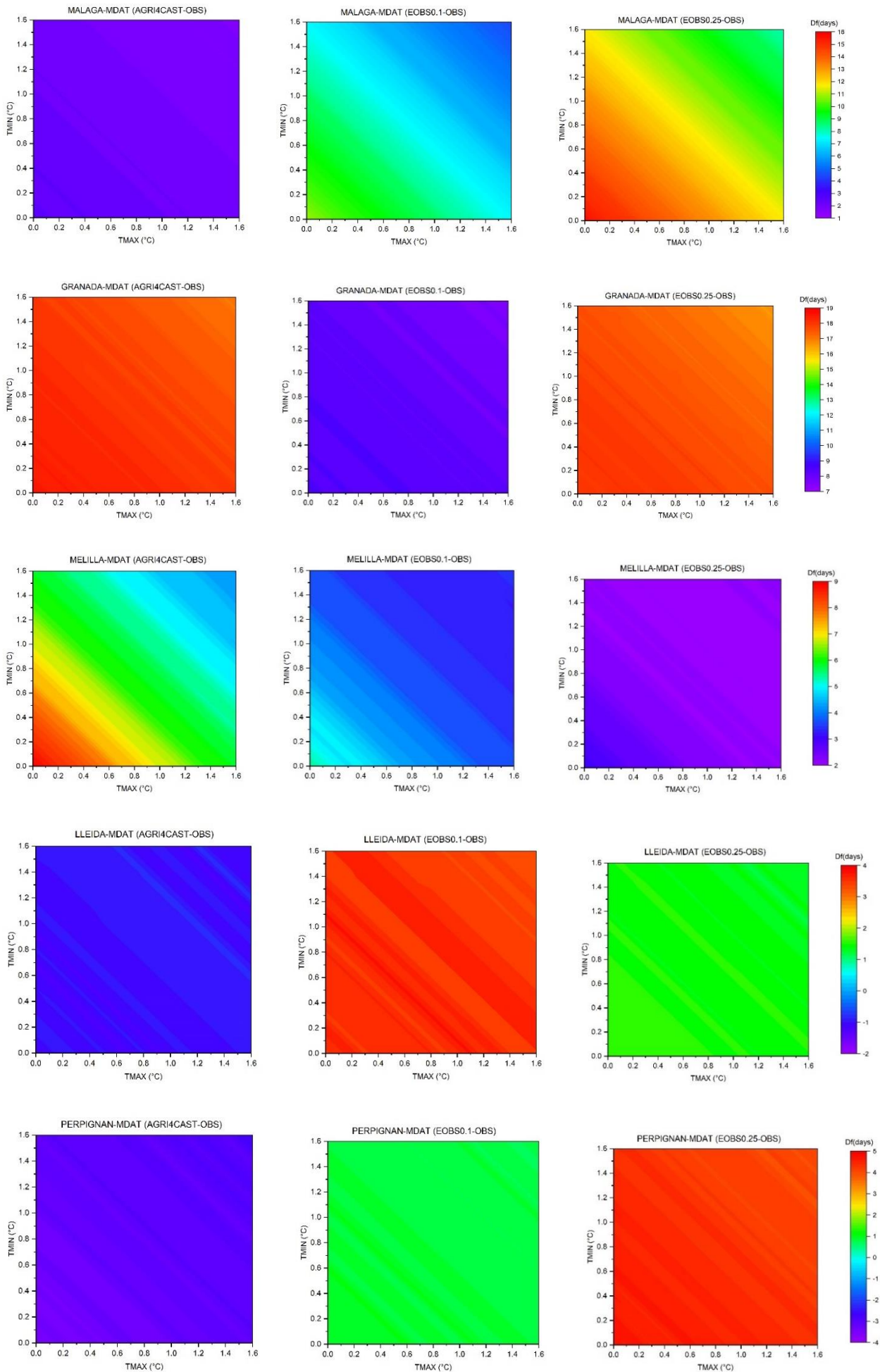
**Figure S4.** Seasonal comparison of Prec between gridded data and OBS for each season (they were ranked from west to east) and the reference period. “Produced by the authors”.

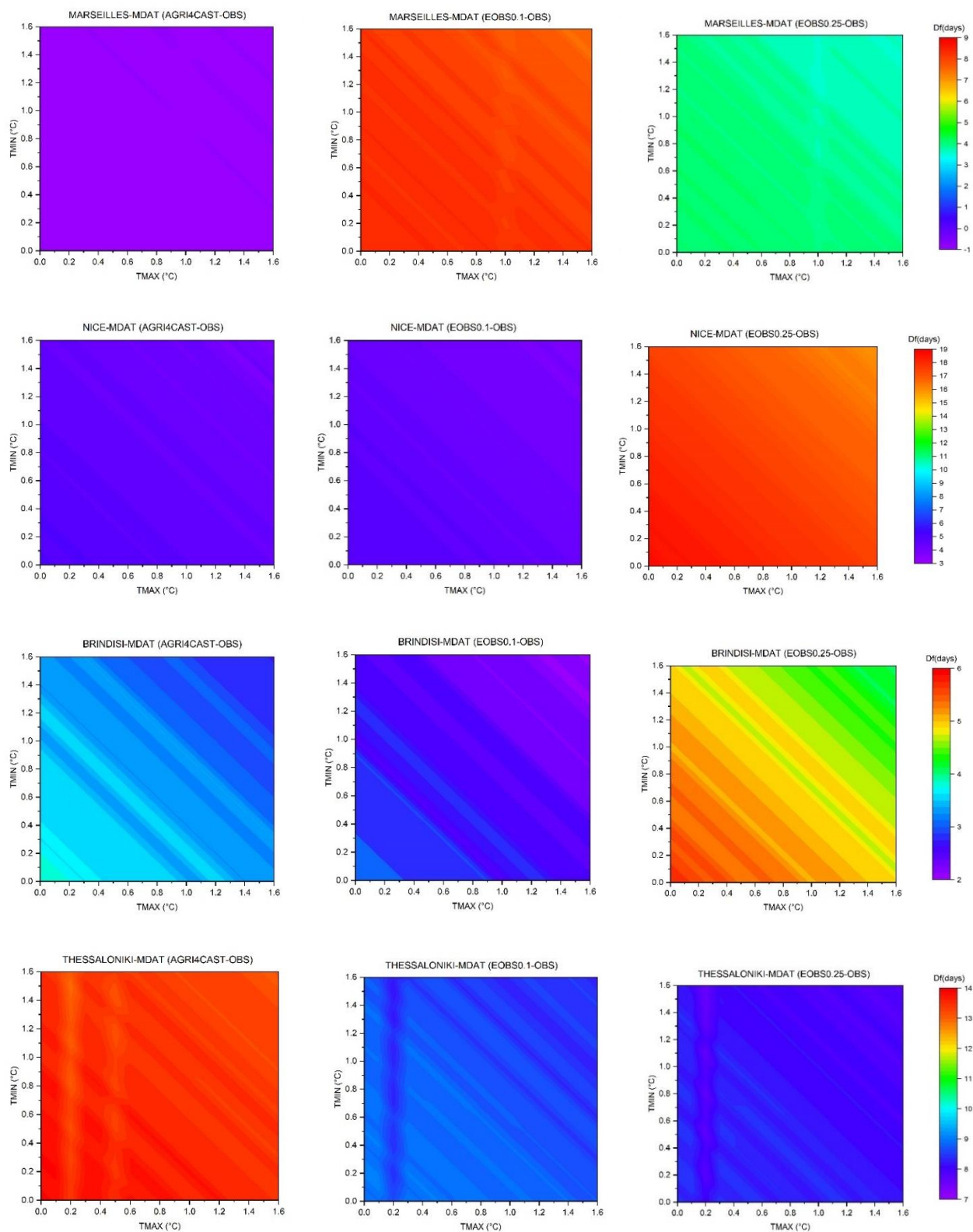




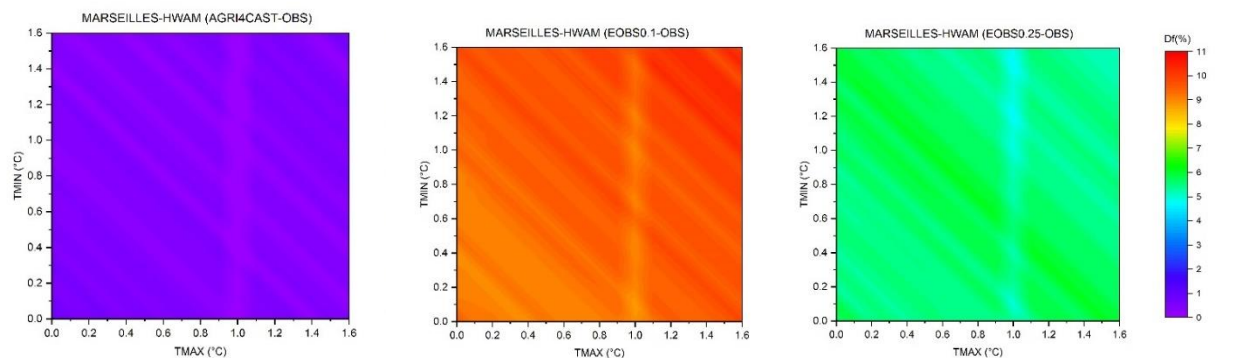
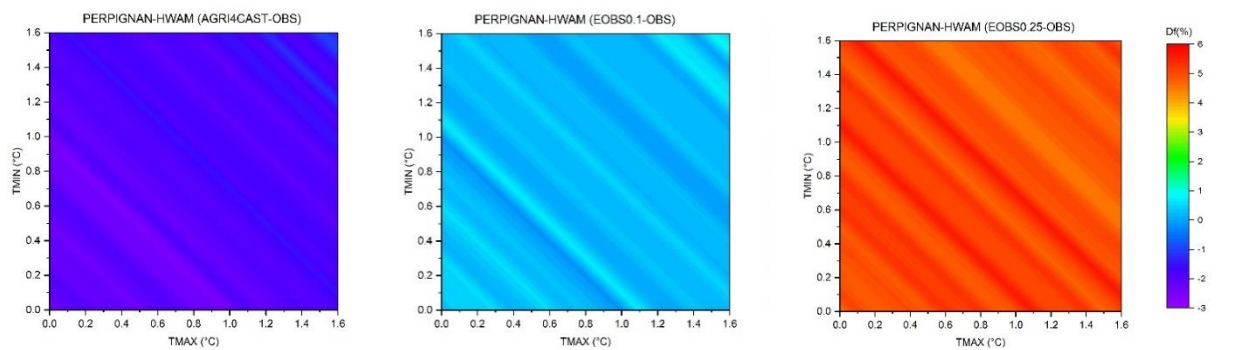
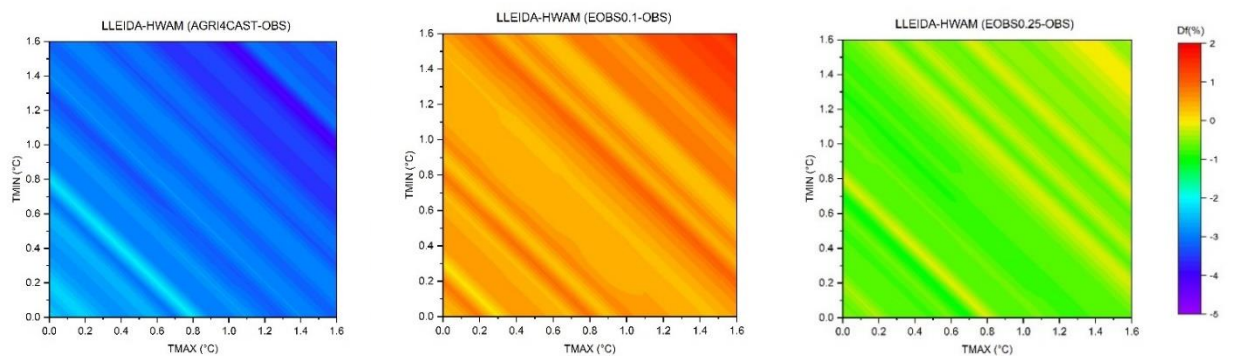
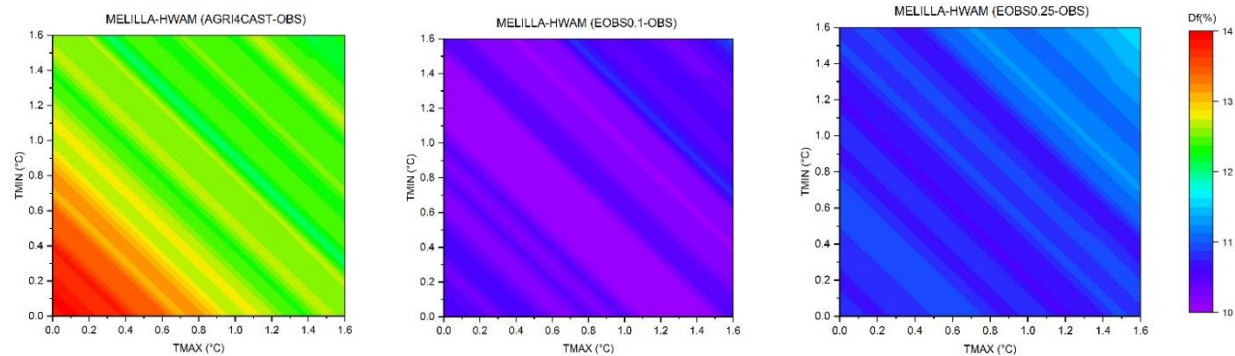
**Figure S5.** Discrepancies between gridded (EOBS-0.1, EOBS-0.25 and Agri4Cast) and measured (OBS) weather data of simulated with CERES-Wheat anthesis (expressed as Gridded –Measured (days)) for Melilla, Lleida, Perpignan, Marseilles, Nice and Thessaloniki to changes in maximum (Tmax) and minimum (Tmin) air temperature. “Produced by the authors”.



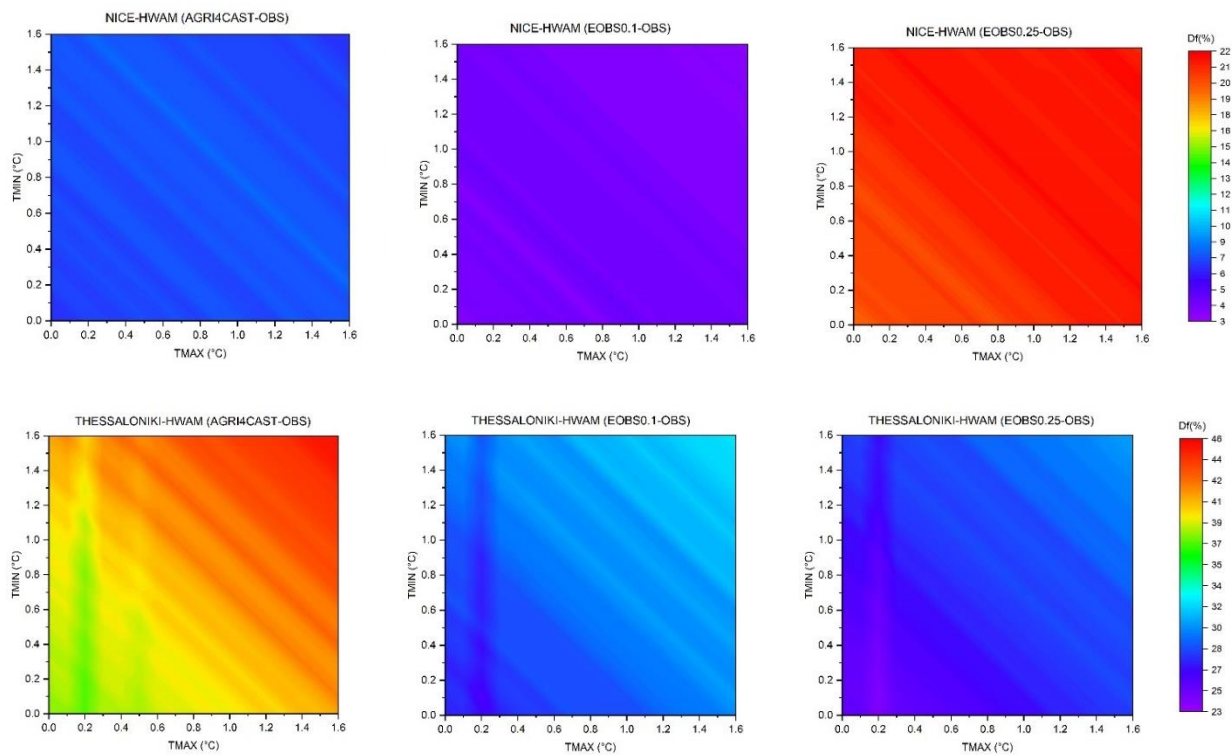




**Figure S6.** Discrepancies between gridded (EOBS-0.1, EOBS-0.25 and Agri4Cast) and measured (OBS) weather data of simulated with CERES-Wheat anthesis (expressed as Gridded - Measured (days)) for each station to changes in maximum (Tmax) and minimum (Tmin) air temperature. “Produced by the authors”.







**Figure S7.** As for Figure S5 but for grain yield (expressed as  $(\text{Gridded-Measured})/\text{Measured} \times 100$ ). “Produced by the authors”.