ANEXOS

ÍNDICE DE ANEXOS

1. Calibración de LEACHM por subperíodos y validación mediante estadísticos

A continuación, se detalla el proceso seguido en la calibración de LEACHM para el período de la coliflor:

➢ ***Período antes del cultivo (15 julio 2013- 10 septiembre 2013)***

Alternativas utilizadas:

En SG	REFERENCIA	Alternativa 1	Alternativa 2	Alternativa 3
K humus	9,25E-02	5.088E-4	**7.169E-4**	9.250E-4
K manure	58,58	8.000E-3	**8.000E-3**	8.000E-3

Las que tienen un mayor ajuste son las Alternativas 1 y 2, por lo que una vez seleccionado esos valores de Khumus el siguiente paso es variar la Kmanure:

EN CG

	Alternativa 1.1	Alternativa 1.2	Alternativa 1.3	Alternativa 2.1	Alternativa 2.2	Alternativa 2.3
K humus		5.088E-4			7.169E-4	
K manure	5.858E-4	3.222E-2	8.000E-3	5.858E-4	3.222E-2	**8.000E-3**

La alternativa que mejor se ajusta tras realizar las distintas simulaciones es la Alternativa 2.3, por lo que finalmente es la que utilizamos en este período.

Los estadísticos de N_{min} y C_{rd} obtenidos para distintas profundidades de suelo en capas de 15 cm y para la capa total de 0-45 cm se utilizaron para seleccionar la mejor alternativa, tomando como criterio de selección los mejores valores de NRMSE (valores cercanos a 0).

SG Nmin

0-15 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	19,80	0,44	12,33	-1,96
Alternativa 1	13,92	0,31	-1,01	-0,03
Alternativa 2	15,63	0,34	-7,63	-0,96
Alternativa 3	19,76	0,44	-14,21	-0,68
15-30 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	12,08	0,283	-0,91	-0,71
Alternativa 1	12,97	0,304	-5,69	-2,00
Alternativa 2	14,84	0,347	-8,12	-0,11
Alternativa 3	17,19	0,402	-10,52	0,01
30-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	12,43	0,378	-6,48	-0,32
Alternativa 1	13,18	0,400	-8,92	-0,08
Alternativa 2	13,96	0,424	-10,13	0,31
Alternativa 3	14,94	0,454	-11,32	0,43
0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	28,41	0,235	4,94	0,66
Alternativa 1	27,15	0,224	-15,62	0,15
Alternativa 2	**33,14**	**0,274**	**-25,89**	**0,33**
Alternativa 3	41,43	0,342	-36,06	0,51

Crd

0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	13,66	0,698	12,65	-10,78
Alternativa 1	7,27	0,371	4,29	-6,31
Alternativa 2	6,31	0,322	0,19	-5,70
Alternativa 3	7,73	0,395	-3,87	-5,48

CG **Nmin**

0-15 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	147,55	0,886	-118,46	-5,72
Alternativa 1.1.	85,58	0,514	84,72	0,49
Alternativa 1.2.	94,11	0,565	-72,51	0,69
Alternativa 1.3.	38,56	0,232	32,73	0,53
Alternativa 2.1.	79,05	0,475	78,16	0,52
Alternativa 2.2.	100,26	0,602	-79,14	0,44
Alternativa 2.3	34,17	0,205	26,09	0,52
15-30 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	86,42	1,019	-35,43	-6,02
Alternativa 1.1.	39,52	0,466	25,93	-1,23
Alternativa 1.2.	76,11	0,897	-25,45	0,01
Alternativa 1.3.	42,81	0,505	7,64	-0,42
Alternativa 2.1.	38,86	0,4581	23,50	-1,03
Alternativa 2.2.	79,17	0,933	-27,81	-0,20
Alternativa 2.3	44,50	0,525	5,23	-0,38
30-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	48,38	0,920	-23,91	-1,30
Alternativa 1.1.	20,18	0,384	6,40	-0,41
Alternativa 1.2.	42,06	0,800	-19,61	0,38
Alternativa 1.3.	22,31	0,424	-2,97	0,21
Alternativa 2.1.	19,85	0,378	5,17	-0,26
Alternativa 2.2.	43,87	0,835	-20,89	0,37
Alternativa 2.3	23,29	0,443	-4,20	0,24
0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	213,74	0,703	-177,80	-16,01
Alternativa 1.1.	124,87	0,411	117,05	-0,50
Alternativa 1.2.	161,98	0,533	-117,57	0,03
Alternativa 1.3.	73,61	0,242	37,39	-0,18
Alternativa 2.1.	115,82	0,381	106,82	-0,44
Alternativa 2.2.	172,29	0,567	-127,85	-0,13
Alternativa 2.3	**72,36**	**0,238**	**27,12**	**-0,15**

Crd

0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
REFERENCIA	35,31	0,826	-11,59	-0,02
Alternativa 1.1.	14,88	0,348	0,35	0,84
Alternativa 1.2.	21,69	0,507	0,51	-0,13
Alternativa 1.3.	11,25	0,263	9,13	-0,83
Alternativa 2.1.	11,50	0,269	9,28	-0,77
Alternativa 2.2.	24,70	0,578	-19,27	-0,15
Alternativa 2.3.	**8,50**	**0,199**	**5,06**	**-0,8**

➢ ***Período durante el cultivo (10 septiembre 2013- 04 marzo 2014)***

SG **Nmin**

0-15 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2.3.	36,11	0,669	7,98	0,27
15-30 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2.3.	13,85	0,504	-1,59	0,19
30-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2.3.	18,34	0,608	-5,91	-0,28
0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2.3.	**17,05**	**0,129**	**0,07**	**0,82**

Crd

0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2.3.	10,99	0,739	-8,53	-2,93

EN CG

	Alternativa 1	**Alternativa 2**	**Alternativa 3**	**Alternativa 4**	**Alternativa 5**
K humus	7.169E-4	7.169E-4	7.169E-4	7.169E-4	**7.169E-4**
K manure	8.000E-3	4.000E-3	2.000E-3	9.000E-4	**8.000E-4**

Se parte de las constantes utilizadas en el pdo. Antes de coliflor pero como no se ajusta, se prueban varias alternativas modificando la Kmanure. En este período la alternativa que conlleva un mejor ajuste es la Alternativa 5.

CG Nmin

0-15 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa 1	33,40	0,468	-30,25	0,75
Alternativa 2	23,50	0,330	-18,87	0,82
Alternativa 3	16,42	0,230	-9,31	0,90
Alternativa 4	13,26	0,186	-2,39	0,94
Alternativa 5	13,02	0,183	3,14	0,95
15-30 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa 1	43,92	1,035	-33,94	-3,98
Alternativa 2	34,23	0,806	-24,00	-1,45
Alternativa 3	26,89	0,633	-16,21	-0,15
Alternativa 4	22,40	0,5277	-10,83	0,36
Alternativa 5	17,58	0,414	-3,15	0,73
30-45 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa 1	55,42	1,546	-43,06	-9,78
Alternativa 2	44,64	1,246	-33,04	-5,71
Alternativa 3	36,81	1,027	-25,47	-2,46
Alternativa 4	31,66	0,883	-20,18	-1,01
Alternativa 5	25,14	0,701	-11,52	0,26
0-45 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa 1	126,67	0,836	-105,43	-1,68
Alternativa 2	97,02	0,641	-74,08	-0,55
Alternativa 3	74,10	0,489	-49,17	0,23
Alternativa 4	59,74	0,394	-31,58	0,57
Alternativa 5	**45,98**	**0,304**	**-9,71**	**0,82**

Crd

0-45 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa 1	18,76	0,936	-14,78	-2,61
Alternativa 2	15,03	0,750	-10,36	-4,25
Alternativa 3	12,89	0,643	-7,32	-4,88
Alternativa 4	11,68	0,583	-5,37	-5,03
Alternativa 5	11,58	0,578	-5,16	-4,97

➢ ***Período incorporación de los residuos (4 marzo 2014- 15 mayo 2014)***

	Alternativa 1	Alternativa 2	Alternativa 3
K humus	7.169E-4	**9.250E-5**	9.500E-4
K manure	8.000E-4	**8.000E-4**	8.000E-4

Se parte de las constantes utilizadas en el pdo. Durante coliflor pero como no se ajusta se prueban varias alternativas modificando Khumus. Finalmente se selecciona la Alternativa 2.

SGSR Nmin

0-15 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa1	23,19	1,441	-20,94	0,92
Alternativa2	3,66	0,228	-0,14	-2,33
Alternativa3	32,02	1,990	-28,47	0,88
15-30 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa1	7,19	0,393	-2,03	0,05
Alternativa2	5,99	0,327	2,46	-0,31
Alternativa3	8,82	0,482	-3,67	0,08
30-45 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa1	6,38	0,472	-5,43	0,37
Alternativa2	5,36	0,397	-2,37	-3,53
Alternativa3	7,53	0,557	-6,55	0,57
0-45 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa1	29,93	0,600	-26,46	0,88
Alternativa2	**7,46**	**0,150**	**1,90**	**0,27**
Alternativa3	42,35	0,849	-36,74	0,84

Crd

0-45 cm				
Tipo	RMSE	NRMSE	d	R^2
Alternativa1	46,98	0,919	7,65	-4,66
Alternativa2	54,93	1,074	18,22	-7,8
Alternativa3	44,33	0,867	3,84	-4,26

SGCR **Nmin**

0-15 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2	33,26	0,690	-27,033	0,71
15-30 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2	27,67	0,724	10,644	-0,52
30-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2	7,03	0,338	-6,107	0,93
0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2	30,64	0,272	-19,312	0,63

Crd

0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2	0,29	0,294	2,177	0,86

CGSR **Nmin**

0-15 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	23,69	0,689	-21,05	0,44
Alternativa 2	10,03	0,292	-0,24	-0,92
Alternativa 3	32,05	0,932	-28,58	0,49
15-30 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	6,00	0,226	0,31	0,53
Alternativa 2	9,04	0,340	4,81	-0,45
Alternativa 3	6,28	0,237	-1,35	0,60
30-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	7,21	0,393	-5,06	0,23
Alternativa 2	7,58	0,413	-2,00	-2,05
Alternativa 3	7,85	0,428	-6,16	0,47
0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	25,17	0,306	-22,86	0,84
Alternativa 2	**18,85**	**0,229**	**5,51**	**-2,40**
Alternativa 3	36,48	0,444	-33,16	0,87

Crd

0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2	27,19	1,084	17,71	-36,80

CGCR **Nmin**

0-15 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	58,37	0,931	-50,38	0,51
Alternativa 2	38,42	0,613	-30,97	0,67
Alternativa 3	36,50	0,582	-29,16	0,65
15-30 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	12,03	0,306	-1,56	0,59
Alternativa 2	12,06	0,307	3,71	0,62
Alternativa 3	12,48	0,317	2,86	0,48
30-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	8,49	0,315	-7,62	0,95
Alternativa 2	5,46	0,203	-4,39	0,93
Alternativa 3	5,86	0,217	-4,66	0,90
0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 1	61,86	0,461	-54,35	0,81
Alternativa 2	**33,24**	**0,248**	**-26,44**	**0,78**
Alternativa 3	32,38	0,241	-25,75	0,77

Crd

0-45 cm				
Tipo	**RMSE**	**NRMSE**	**d**	**R^2**
Alternativa 2	42,52	0,620	26,02	0,53

2. Fichero de entrada de datos de LEACHM.

El fichero corresponde a la parcela con incorporación de gallinaza y de residuos de la coliflor:

```
PATERNA   < DOS Filename, 8 characters with no extension. Used in batch runs (started as LEACHF<filename).
-------------------------------------------------------------------------
                LEACHN NITROGEN AND PHOSPHORUS DATA FILE.
A value must be present for each item, although it may not be used in the
simulation.  The file is read free format with blank delimiters. Preserve
division and heading records.  The number of depth segments may be changed.
*************************************************************************************************************************
 2      <Date format (1: month/day/year;  2: day/month/year).  Dates must be 6 digits, 2 each for day, mo, yr.
 150713 <Starting date.  No date in the input data should precede this date.
 150514 <Ending date or day number.  The starting date is day 1. (A value <010101 is treated as a day number).
 0.05   <Largest time interval within a day (0.1 day or less).
 1      <Number of repetitions of rainfall, crop and chemical application data.
 450    <Profile depth (mm), preferably a multiple of the segment thickness.
  50    <Segment thickness (mm).  (The number of segments should be between about 8 and 30.
 2      <Lower boundary condition: 1:fixed depth water table; 2:free drainage, 3:zero flux 4:lysimeter.
 1300   <If the lower boundary is 1 or 4: initial water table depth (mm).
-------------------------------------------------------------------------
The steady-state flow option uses constant water fluxes during the application
periods specified in the rainfall data table, and a uniform water content
specified here.  Steady-state flow implies a lab column, and crop and evaporation data are ignored.
-------------------------------------------------------------------------
  1     < Water flow: 1: Richards; 2: Addiscott tipping bucket; 3: steady-state.
  0.4   < Steady-state flow water content (volume fraction); 999: saturated column.
*************************************************************************************************************************
*************************************************************************************************************************
 1     <Number of output files: 1: OUT only; 2: OUT + SUM; 3: OUT + SUM + BTC
---------------------------------------
--- For the *.OUT file :
 4      <Units for depth data: 1: mg/kg, 2: mg/m2 per segment, 3: g/m2, 4: kg/ha
 1      <Node print frequency (print data for every node (1), alternate nodes (2).
 1      <Print option: Select one of the following two (enter 1 or 2)
 1      <Option 1: Print at fixed time intervals (days between prints). 999 for monthly print.
 1      <Option 2: No. of prints (the times for which are specified below)
 2      <Tables printed: 1: mass balance; 2: + depth data; 3: + crop data
 0      <Reset cumulative values in .OUT after each print? 0: No, 1: Yes
---------------------------------------
--- For the *.SUM file :
 1      <Summary print interval (d) (for calendar months use 999)
 300    <Surface to [depth 1?] mm     ( Three depth segments for the
 600    <Depth 1 to [depth 2?] mm      summary file. Zero defaults to nodes
 900    <Depth 2 to [depth 3?] mm      closest to thirds of the profile)
   3    <4th segment: Root zone (1); profile (2); Depth 3 to lower boundary (3); Surface to shallowest of lower boundary or water table (4)
---------------------------------------
--- For the *.BTC (breakthrough) file :
 10.0    <Incremental depth of drainage water per output (mm)
-------------------------------------------------------------------------
-- List here the times at which the *.OUT file is desired for print option 2.
-- The number of records must match the 'No. of prints' under option 2 above.
        Date or    Time of day          (At least one must be specified,
        Day no.  (to nearest tenth)      even if print option is 1)
        --------  ----------------
        221086         .2        (These dates can be past the last day)
*************************************************************************
*************************************************************************
                SOIL PHYSICAL PROPERTIES
-------------------------------------------------------------------------
-- Retentivity model 0 uses listed Campbell's retention parameters, otherwise
-- the desired particle size-based regression model is used.
-------------------------------------------------------------------------------
 Soil  |                    |Retention|   Starting    |   Roots    | Starting
 layer | Clay  Silt  Organic |  model  |theta or  potl|  (for no   | temperature (C)
 no.   |             carbon  |         |(one is used) |  growth)   | (not read in
       |   %     %     %     |                  kPa  | (relative)|  LEACHC)
   ---    ----  ----   ----      ------    -----   -----     ------     -----------
    1      32.0 43.0   0.97        0     .1866  -20.0      .20          24.35
    2      32.0 43.0   0.97        0     .1866  -20.0      .20          24.35
    3      32.0 43.0   0.97        0     .1866  -20.0      .15          24.35
    4      34.0 39.0   0.94        0     .2623  -20.0      .15          25.52
    5      34.0 39.0   0.94        0     .2623  -20.0      .10          25.52
    6      34.0 39.0   0.94        0     .2623  -20.0      .10          25.52
    7      40.0 40.0   0.78        0     .3239  -20.0      .05          21.99
    8      40.0 40.0   0.78        0     .3239  -20.0      .05          21.99
    9      40.0 40.0   0.78        0     .3239  -20.0      .00          21.99
```

```
 ------------------------------------------------------------------------------
    1  < Use water contents (1), potentials (2)
  Particle density:  Clay    Silt and sand    Organic matter
                     2.65         2.65            1.10
**********************************************************
For a uniform profile: Any non-zero value here will override those in
the table below.
------------------------------------------------------------------------
  0.0   0.0 <Soil bulk density and particle density (kg/dm3) .
 -0.0       <'Air-entry value' (AEV) (kPa).
  0.0       <Exponent (BCAM) in Campbell's water retention equation.
  0.0  -0.0 <Conductivity (mm/day) and corresponding matric potential (kPa) (for potential-based version of eq. 2.5).
  0.0       <Pore interaction parameter (P) in Campbell's conductivity equation.
  0.0       <Dispersivity (mm).
  0.0       <For Addiscott flow: Matric potential (kPa) at field capacity
  0.0       <                  : Division between mobile and immobile water (kPa)
*************************************************************************************************************
 Soil   |  Soil retentivity |   Bulk  |  Match K(h) curve at: | Dispersivity |  For Addiscott flow option:
 segment      parameters    | density |   K    Matric  using  |              |  Field     Mobile/immobile
 no.    |    AEV     BCAM  |         |         potl      P    |              | capacity      threshold
        |    kPa           |  kg/dm3 |  mm/d    kPa          |     mm       |   kPa           kPa
 -------  ------  -------    ------    ----  -----  -------      -----        ------         ---------
    1     -3.278   3.904      1.158    500.00  0.0     1.0       100.0        -10.0          -200.0
    2     -3.278   3.904      1.158    500.00  0.0     1.0       100.0        -10.0          -200.0
    3     -3.278   3.904      1.158    500.00  0.0     1.0       100.0        -10.0          -200.0
    4     -5.074   12.936     1.628    250.00  0.0     1.0       100.0        -10.0          -200.0
    5     -5.074   12.936     1.628    250.00  0.0     1.0       100.0        -10.0          -200.0
    6     -5.074   12.936     1.628    250.00  0.0     1.0       100.0        -10.0          -200.0
    7     -5.048   14.467     1.591     75.00  0.0     1.0       100.0        -10.0          -200.0
    8     -5.048   14.467     1.591     75.00  0.0     1.0       100.0        -10.0          -200.0
    9     -5.048   14.467     1.591     75.00  0.0     1.0       100.0        -10.0          -200.0
*************************************************************************************************************
*************************************************************************************************************
Runoff according to the SCS curve number approach.  Curve number listed here will be
adjusted by slope. During periods of crop growth, CN2 replaced by value for crop.
(Procedure according to J.R. Williams (1991). Runoff and Water Erosion.
Chap 18, Modeling Plant and Soil Systems, Agronomy 31.)
----------------
 75    <Curve number (CN2).  In LEACHM, water content use to adjust CN2 based on top 20 cm.
  0    <Slope, %. Used to adjust CN2 according to equation of Williams (1991).
** (Set slope to 0 to bypass the runoff routine.  Runoff owing to profile saturation will still be accumulated)
**************************************************************************
**************************************************************************
                          CROP DATA
------------------------------------------------------------------------
  Data for at least one crop must be specified, even if no crop desired.
  For fallow soil, set flag below to 0, or germination past the simulation end date.
------------------------------------------------------------------------
  1      <Plants present: 1 yes, 0 no.
  1      <No. of crops (>0)
  -1500  <Wilting point (soil) kPa.
  -3000  <Min.root water potl(kpa).
  1.1    <Maximum ratio of actual to potential T.
  1.00   <Root resistance.
------------------------------------------------------------------------
Growth  Perennial  N_uptake              Date or day of          Rel.   Crop    Pan    |  Crop    Min   Harvested
1: No   1: Yes   1:to maturity                Maturity          root   cover  factor | uptake    N    fraction
2: Yes  2: No    2:to harvest  Germ. Emerg.   Root  Cover  Harv. depth fraction       |  N   P   fixed
------  -------  ------------  ------------------------------ -----  ------  ----    -----kg/ha---- ----------
   2       2        2         160913 160913 301113 301113 150214  .9     1.0     1.50   250. 80.  0.     0.8   Al
*************************************************************************************************************
*************************************************************************************************************
    INITIAL NITROGEN, PHOSPHORUS AND CARBON POOLS (excluding soil humus)
-------------------------------------------------------------------------------------------------------------
      |          NITROGEN POOLS       | CARBON POOLS   |   PHOSPHORUS POOLS    | (Humus C, N, & P calculated from org.C)
 SOIL | Cl  NH4    NO3 Residue Manure| Residue Manure | Labile Residue Manure | (Fertilizer P absent at start)
LAYER |   ----mg N/kg dry soil----    | -- mg C/kg --  |   mg P/kg dry soil    | (Bound P pool in equilibrium with labile P.
-------------------------------------------------------------------------------------------------------------
   1   24.9   0.32  17.89  0.      0.0     0.      0.       000.    0.     000.
   2   24.9   0.32  17.89  0.      0.0     0.      0.       000.    0.     000.
   3   24.9   0.32  17.89  0.      0.0     0.      0.       000.    0.     000.
   4   29.9   0.32  17.89  0.      0.0     0.      0.       000.    0.     000.
   5   29.9   0.32  17.89  0.      0.0     0.      0.       000.    0.     000.
   6   29.9   0.32  17.89  0.      0.0     0.      0.       000.    0.     000.
   7   38.2   0.84  13.04  0.      0.0     0.      0.       000.    0.     000.
   8   38.2   0.84  13.04  0.      0.0     0.      0.       000.    0.     000.
   9   38.2   0.84  13.04  0.      0.0     0.      0.       000.    0.     000.
 -------------------------------------------------------------------------------
```

```
 ---------------------------------------------------------------------------
 Concentration (mg/l) below profile, used with lower boundary 1.
         0         0         0   (NH4, NO3 and P)
  0    < Depth (mm) of water in mixing cell.  Enter 0 for no mixing cell.
*****************************************************
*****************************************************
    CHEMICAL PROPERTIES
    -------------------
                 Kd
       Name     L/kg
      ---------- --------
     '       Cl'    0
     '    NH4-N'    4.99
     '    NO3-N'    0
     'Residue-N'         (Plant 'residues' and 'manure' pools representing
     '  Humus-N'           added organic sources of N, P and C.  They
     ' Manure-N'           differ in that the plant residue pool is supplied
     'Residue-C'           by the non-harvested portion of annual crops,
     '  Humus-C'           and the non-harvested, non-perrenial portion of
     ' Manure-C'           perennial crops)
     '    CO2-C'
     '   Fert-P' 10000  .693         <Solubility; Dissolution rate (d**-1)
     ' Labile-P'     1   100  .6     <1: Freundlich or 2: Langmuir; [Freundlich Kd; Exponent  OR  Langmuir
     'Residue-P'
     '  Humus-P'
     ' Manure-P'
     '  Bound-P' 300  0.4  .05  .50  <Freundlich sorption: Kd; Exponent; Phase transfer: Dissolution rate,
*****************************************************
Diffusion
---------------------------------------------------
  91.50    <Molecular diffusion coefficient
*****************************************************
```

```
      NITROGEN TRANSFORMATIONS
-----------------------------------------------------
  0.52    <Synthesis efficiency factor.
  0.33   <Humification fraction.
 10.0   <C/N ratio:biomass and humus.
 50.0   <C/P ratio:biomass and humus.
  ------Temperature and water content adjustments------
    1  <Temperature subroutine? yes(1), no(0). If no, base temperature used.
   20  <Base temperature, degrees C
  2.3  <Q10: rate constant adjustment factor per 10C temperature change.
  .08  <High end of optimum water content range, air-filled porosity.
 -300  <Lower end of optimum water content, kPa
-2500  <Minimum matric potential for transformation, kPa
  0.6  <Relative transformation rate at saturation (except denitrification), days^(-1)
*****************************************************
    RATE CONSTANTS  [days^(-1)]
-----------------------------------------------------
          Urea  NH4->NO3 NO3->N              Mineralization
 Layer  hydrolysis                         Residue    Manure    Humus
 -------    -----  ------   -----          -----     -----     -----
    1    .0000e-0 7.768e-1 6.0e-2         8.816e-2   4.400e-3  4.05e-4
    2    .0000e-0 7.768e-1 6.0e-2         8.816e-2   4.400e-3  4.05e-4
    3    .0000e-0 7.768e-1 6.0e-2         8.816e-2   4.400e-3  4.05e-4
    4    .0000e-0 .100E-0  .10e-2         8.250e-2  .00010e-0  9.250e-5
    5    .0000e-0 .100E-0  .10e-2         8.250e-2  .00010e-0  9.250e-5
    6    .0000e-0 .100E-0  .10e-2         8.250e-2  .00010e-0  9.250e-5
    7    .0000e-0 .100E-0  .10e-2         8.250e-2  .00010e-0  9.250e-5
    8    .0000e-0 .100E-0  .10e-2         8.250e-2  .00010e-0  9.250e-5
    9    .0000e-0 .100E-0  .10e-2         8.250e-2  .00010e-0  9.250e-5
   -----------------------------------------------------
 Additional rates and constants used for calculating N transformations:
 0.6 <Ammonia volatilization from the surface, days^(-1)
  10 <Denitrification half-saturation constant (mg/l).
   8 <Limiting NO3/NH4 ratio in solution for nitrification
*************************************************************************
```

```
*************************************************************************
          NITROGEN, PHOSPHORUS AND CARBON APPLICATIONS (kg/ha)
          ----------------------
 3   < No. of nutrient applications
-----------------------------------------------------------------------------------------------------
Date or   Incorp n              NITROGEN                CARBON              PHOSPHORUS
day no.   segments     Cl    NH4    NO3 Residue Manure  Residue Manure  Fertiliser Residue  Manure
-------   ---------   -----  ---   ---  ------ ------  ------- ------     ------   ------  ------
150713       3         76     40     8     0     658       0    4792         00       0       00
161013       3         00     90    00     0       0       0       0         00       0       00
040314       3         00     00    00   258       0    3380       0         00       0       00
*****************************************************************************************************
*****************************************************************************************************
          CULTIVATIONS
          ------------
 1   < Number of cultivations.  At least one must be specified.  Can be past last day.
-------------------------------------------------
 Date or   Depth of cultivation
 day no.        mm
 -------      -----
 040312        150
*****************************************************************************************************
```

```
*****************************************************************************************************
      RAIN AND RAIN WATER COMPOSITION  (Include irrigation here, or specify
      -------------------------------    in a separate file.)
  44  < Number of water applications.  Some or all can be past last day. (See manual on setting automated irrigation thresholds)
  0  < For a separate irrigation file, set to 1 and edit and rename NITRTEST.SCH.
-------------------------------------------------------------------------
      Start      Amount  Surface flux      Dissolved in water (can be 0)
Date/day  Time             density         Cl    NH4-N  NO3-N    P
-------  --day-  --mm--  ---mm/d----     ----------  mg/l  ---------
 030813    .5     0.40      100.0           20.20  00.00  2.00  00.00
 200813    .5     1.00      100.0           20.20  00.00  2.00  00.00
 210813    .5     0.20      100.0           20.20  00.00  2.00  00.00
 260813    .5     4.00      100.0           20.20  00.00  2.00  00.00
 270813    .5     0.40      100.0           20.20  00.00  2.00  00.00
 280813    .5    14.60      100.0           20.20  00.00  2.00  00.00
 290813    .5     6.40      100.0           20.20  00.00  2.00  00.00
 300813    .5     0.20      100.0           20.20  00.00  2.00  00.00
 020913    .3   146.00      100.0          137.50  00.00  5.31  00.00
 160913    .5   110.30      100.0          121.56  00.00  3.94  00.00
 230913    .5    61.70      100.0          111.42  00.00  3.38  00.00
 031013    .5     0.20      100.0           20.20  00.00  2.00  00.00
 041013    .5     1.10      100.0           20.20  00.00  2.00  00.00
 071013    .5    77.00      100.0          108.60  00.00  3.22  00.00
 221013    .5     0.20      100.0           20.20  00.00  2.00  00.00
 281013    .5    99.10      100.0          111.26  00.00  3.46  00.00
 291013    .5     0.40      100.0           20.20  00.00  2.00  00.00

 111113    .5    67.30      100.0          116.24  00.00  4.18  00.00
 161113    .5     0.40      100.0           20.20  00.00  2.00  00.00
 251113    .5    67.80      100.0          130.69  00.00  5.25  00.00
 271113    .5     4.80      100.0           20.20  00.00  2.00  00.00
 281113    .5     1.80      100.0           20.20  00.00  2.00  00.00
 191213    .5     5.80      100.0           20.20  00.00  2.00  00.00
 201213    .5     0.80      100.0           20.20  00.00  2.00  00.00
 251213    .5     3.00      100.0           20.20  00.00  2.00  00.00
 020114    .5     1.00      100.0           20.20  00.00  2.00  00.00
 040114    .5     0.40      100.0           20.20  00.00  2.00  00.00
 060114    .5    89.60      100.0          138.00  00.00  6.47  00.00
 130114    .5     1.00      100.0           20.20  00.00  2.00  00.00
 140114    .5     0.20      100.0           20.20  00.00  2.00  00.00
 160114    .5     0.80      100.0           20.20  00.00  2.00  00.00
 170114    .5     0.20      100.0           20.20  00.00  2.00  00.00
 180114    .5     0.40      100.0           20.20  00.00  2.00  00.00
 220114    .5     2.80      100.0           20.20  00.00  2.00  00.00
 030214    .5    93.50      100.0          119.68  00.00  5.41  00.00
 090214    .5     3.00      100.0           20.20  00.00  2.00  00.00
 100214    .5     3.00      100.0           20.20  00.00  2.00  00.00
 160214    .5     5.60      100.0           20.20  00.00  2.00  00.00
 170214    .5     0.20      100.0           20.20  00.00  2.00  00.00
 310314    .5     0.5       100.0           20.20  00.00  2.00  00.00
 030414    .5     7.5       100.0           20.20  00.00  2.00  00.00
 140414    .5   151.0       100.0          121.97  00.06  5.41  00.00
 210414    .5     3.3       100.0           20.20  00.00  2.00  00.00
 130514    .5     1.2       100.0           20.20  00.00  2.00  00.00
 *****************************************************************************************************
*************************************************************************
      POTENTIAL ET (WEEKLY TOTALS, mm), DEPTH TO WATER TABLE (mm)
      MEAN WEEKLY TEMPERATURES AND MEAN WEEKLY AMPLITUDE (degrees C)
-------------------------------------------------------------------------
    Week        ET   Water table  Mean temp  Amplitude
    ------      ----  -----------  ---------  ---------
    150713     40.76       2000      26.81      12.68
    220713     39.66       2000      27.66      12.78
    290713     37.42       2000      26.42      13.32
    050813     35.34       2000      32.60      13.18
    120813     33.62       2000      26.61      11.72
    190813     30.26       2000      26.21       9.75

    260813     18.47       2000      22.21       9.18
    020913     26.63       2000      23.87      12.87
    090913     25.06       2000      23.42      10.69
    160913     24.47       2000      23.30      11.71
    230913     22.28       2000      23.98      10.77
    300913     21.98       2000      24.04      11.08
    071013     16.96       2000      20.29      11.42
    141013     18.67       2000      21.96      14.93
    211013     13.24       2000      21.48      14.44
    281013     15.20       2000      17.47      14.87
    041113     18.42       2000      20.11      13.40
    111113     10.52       2000      13.65      11.89
    181113     13.68       2000      11.45      13.57
    251113      7.68       2000       8.19      12.38
    021213      6.71       2000       9.61      14.89
    091213      6.13       2000       9.96      13.04
    161213      7.46       2000      11.01      11.21
    231213     14.17       2000      11.98      10.32
    301213     15.96       2000      14.64       9.88
```

```
060114      7.16      2000      10.74      10.58
130114     11.91      2000      11.77      10.17
200114     16.78      2000      13.94      11.05
270114     16.71      2000      11.51      10.98
030214     18.77      2000      13.55       8.61
100214     17.68      2000      13.96       9.34
170214     15.79      2000      12.39      12.95
240214     21.87      2000      14.08      11.22
030314     24.49      2000      13.60      14.23
100314     17.42      2000      12.31      13.84
170314     22.53      2000      14.89      14.54
240314     23.36      2000      13.89      11.18
310314     26.22      2000      17.06      12.76
070414     24.15      2000      17.28      12.86
140414     30.39      2000      18.82      14.66
210414     32.14      2000      19.18      15.43
280414     33.54      2000      18.91      15.43
050514     29.41      2000      19.58      12.74
120514     30.46      2000      18.96      10.51
```

3. Fichero de entrada de datos de EU-Rotate_N.

El fichero corresponde a la parcela con incorporación de gallinaza y de residuos de la coliflor:

```
Site properties
    Detailed    (String) Print out control
    39.00           Latitude
    12.0            Altitude
    9.0             Annual N deposition (kg/ha)
Simulation period
        2013196         Date when simulation starts (95:1995, 100:Julian day)
        2014135         Date when simulation ceases (see the above)
Weather file
        clima_manises.txt   Filename of weather data
        3               No of weather data year
    clima_manises.txt   Optimization weather data
Switch for snow simulation
    No              (string) Snow-frost simulation
Soil properties
    No              Runoff simulation
        8.0             REW
        0.1             Ze
        0.0             maximum rooting depth
        15              layer size sampled cm
        3               no of layers sampled
        0.349           FC  (1st soil layer sampled)
        0.114           PWP (1st soil layer sampled)
        0.451           SAT (1st soil layer sampled)
        0.000           drainage coefficient (=0.0 if unknown)
        0.286           FC  (2nd soil layer sampled)
        0.185           PWP (2nd soil layer sampled)
        0.435           SAT (2nd soil layer sampled)
        0.000           drainage coefficient (=0.0 if unknown)
        0.300           FC  (3rd soil layer sampled)
```

```
        0.195           PWP (3rd soil layer sampled)
        0.375           SAT (3rd soil layer sampled)
        0.000           drainage coefficient (=0.0 if unknown)
        0.32            Clay content (1st soil layer sampled)
        0.25            Sand content (1st soil layer sampled)
        1158            Bulk density (1st soil layer sampled)
        7.8             soil ph value
        0.0288          OM content
        0.34            Clay content (2nd soil layer sampled)
        0.27            Sand content (2nd soil layer sampled)
        1628            Bulk density (2nd soil layer sampled)
        7.8             soil ph value
        0.01835          OM content
        0.40            Clay content (3rd soil layer sampled)
        0.20            Sand content (3rd soil layer sampled)
        1591            Bulk density (3rd soil layer sampled)
        7.8             soil ph value
        0.0078          OM content
        10.3            C/N ratio
Initial conditions
        0.1866          Soil moisture content (1st soil layer sampled)
        0.2623          Soil moisture content (2nd soil layer sampled)
        0.3239          Soil moisture content (3rd soil layer sampled)
        31.5            Mineral soil_N kg N/ha (1st soil layer sampled)
        44.3            Mineral soil_N kg N/ha (2nd soil layer sampled)
        30.5            Mineral soil_N kg N/ha (3rd soil layer sampled)
Soil Mineral N Updates (EXPERIMENTAL FEATURE: USE WITH CAUTION)
    0             (int) number of soil N updates
Residues incorporation
    2013196         (int)    Time of incorporation of previous crop debris
    Mix             (string) Method of incorporation
    0.0             (int)    Depth of incorporation cm
    0.0             Residue DM (kg/ha)
    15              OM type
    0.              N content
Data for crop rotation (from fertilisation to residues incorporation)
    1               (int)    No of crops in rotation
Fertilisation
    1       (int) Number of organic fertilisation events
    Fixed   (String) Event type (Fixed, KNS or Target)*
```

```
    2013196 (int) Fertilisation date
    27610   (real) Amount of fresh weight to apply (kg/ha)
    22      (int) Organic fertiliser type (from organic fertilisers table)**
    1.0     (real) Cost of fertiliser (currency unit/kg)
    10.0    (real) Cost of applying fertiliser (currency unit/ha)
    Plough  (String) Incorporation Method*
    0       (int) Incorporation delay (number of days after fertilisation)
    15.0    (real) Incorporation depth (cm)
    1       (int) Number of inorganic fertilisation events
    Fixed       (String) Event type (Fixed, Model or Target)
    2013289     (int) Fertilisation Date
    100.0       (real) Amount of fertiliser to apply (kg/ha)
    3       (int) Inorganic fertiliser type (from inorganic fertilisers table)
    0.0     (real) Cost of fertiliser (currency unit/kg)
    0.0     (real) Cost of applying fertiliser (currency unit/ha)
    Mix     (String) Incorporation Method
    0       (int) Incorporation delay (number of days after fertilisation)
    5.0     (real) Incorporation depth (cm)
Irrigation
    10      (int) Number of irrigation events
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2013245     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    146     (real) Amount (mm)
    0.0053      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2013259     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    110     (real) Amount (mm)
    0.0039      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2013266     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    62      (real) Amount (mm)
    0.0034      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2013280     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
```

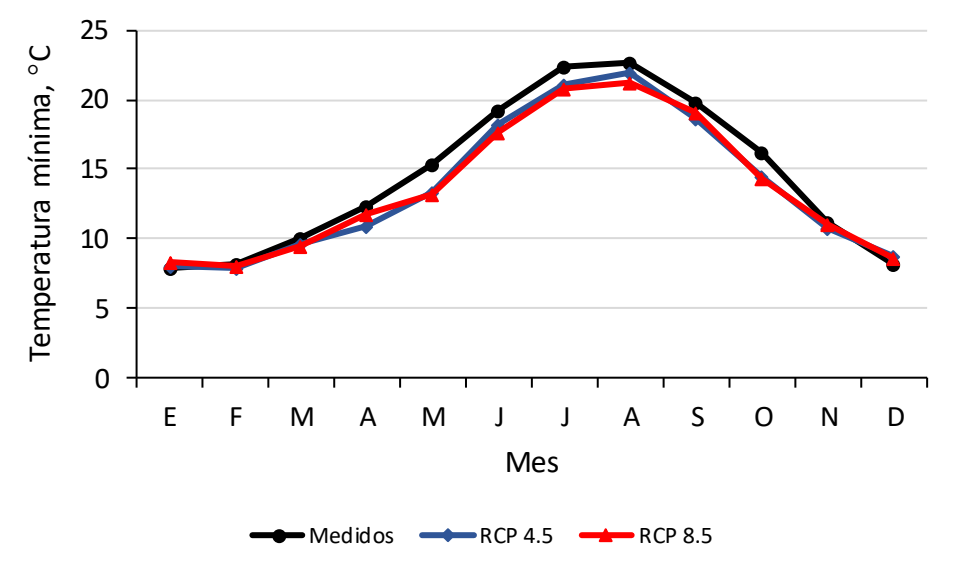
```
    77      (real) Amount (mm)
    0.0032      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2013301     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    99      (real) Amount (mm)
    0.0035      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2013315     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    67      (real) Amount (mm)
    0.0042      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2013329     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    68      (real) Amount (mm)
    0.0053      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2014006     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    89      (real) Amount (mm)
    0.0065      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2014034     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    94      (real) Amount (mm)
    0.0054      (real) N conc in irrigation water (g/l)
    Fixed       (String) Event type (Fixed, Content or Evapo)
    2014104     (int) Irrigation date
    Furrow      (String) Irrigation method
    1       (real) Fraction of wetted soil surface
    151     (real) Amount (mm)
    0.0054      (real) N conc in irrigation water (g/l)
Crop data
    8           CROP:- cauliflower
       64.0             Row width (cm)
       73.9             plant spacing
       2013259          Time of planting
       2.9          Dry weight at planting kg/ha
       5.0              %N in transplant
    1               no of harvests
    2014046         harvest date
       10.4         Dry weight of total plant t/ha
    100.            weight for DM reduction due to water stress (0.-100.)
       0.           (real) Marketable max fresh weight per head (g/head)
       0.           (real) Marketable min fresh weight per head (g/head)
       0.           (real) CV - variability of marketable product wt
       0.           (real) Price for marketable yield (currency unit/t)
       130.             (real) Variable costs independent of DW (currency unit/ha)
       40.              (real) Variable costs dependent on DW (currency unit/t)
Residues incorporation
       2014053          Time of incorporation of crop debris
       Plough           Method of incorporation
       15.              Depth of incorporation cm
       0.               Percentage of crop residues removed (0.-100.)
```

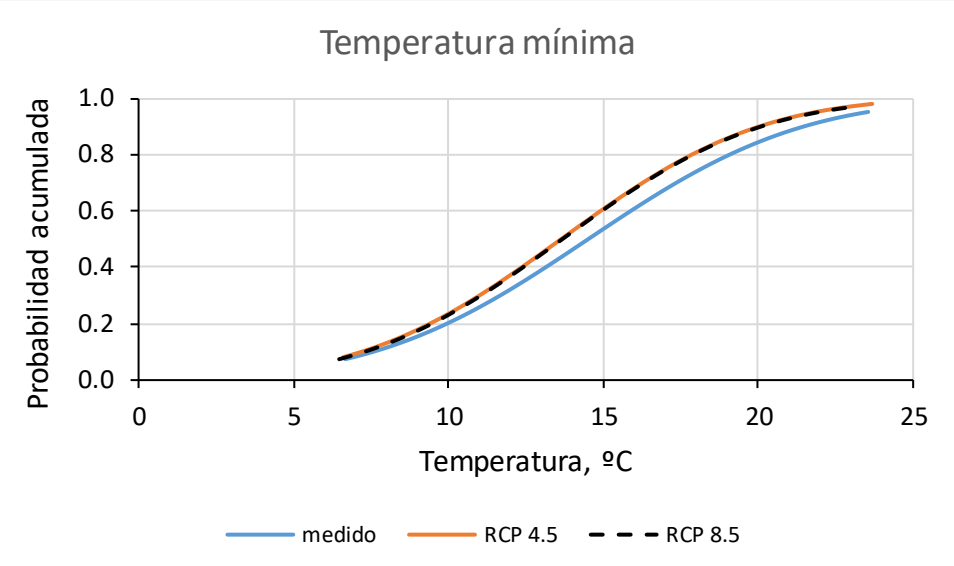
4. Resumen de valores mensuales para los diferentes escenarios climáticos

Partiendo de los valores diarios obtenidos con el modelo MPI-ESM-LR-CSC-REMO2009 bajo los dos escenarios de emisiones (RCP 4.5 y RCP 8.5) para cada una de las variables, se han obtenido los valores mensuales en cada período considerado.

4.1. Temperatura mínima

Valores medios mensuales de temperatura mínima y distribución de probabilidad acumulada de la temperatura mínima diaria durante el período de validación 2006-2018 para los valores medidos y simulados por el modelo climático:





Valores medios mensuales de temperatura mínima durante la rotación y para cada uno de los períodos catalogados como corto, medio y largo plazo en los dos escenarios de emisiones.

Tmin °C

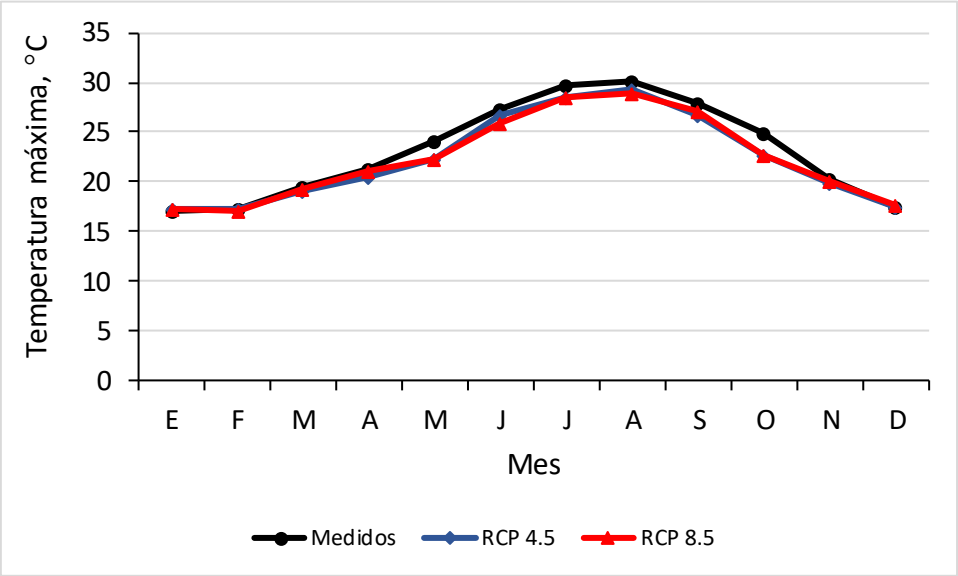
				Escenario RCP 4.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	5.8	7.9	2.9	6.4	8.3	6.6	8.6	9.8	9.2	7.9	8.8	8.2
F	6.4	7.7	4.6	9.4	10.2	9.1	9.3	9.8	8.7	9.7	8.7	7.4
M	9.6	7.3	7.4	10.4	9.1	10.9	9.4	10.4	9.2	11.7	10.4	10.9
A	9.4	11.7	8.8	10.4	10.3	14.5	12.3	11.9	10.9	12.2	12.7	11.6
M	11.3	13.3	12.4	15.6	13.3	13.9	15.3	14.7	12.0	13.3	13.2	12.9
J	15.3	17.2	16.1	17.8	17.5	17.3	20.4	20.2	18.2	19.7	18.7	20.6
J	19.6	18.8	21.2	21.0	21.5	21.1	24.0	21.6	21.3	22.7	24.3	24.1
A	20.1	21.3	20.6	24.0	21.3	23.4	24.7	22.8	21.8	24.3	22.6	23.8
S	17.9	19.6	16.2	19.3	20.0	16.1	21.7	20.3	19.5	20.2	22.1	19.1
O	15.5	13.7	13.3	13.5	13.5	12.1	16.6	15.5	16.0	16.9	15.5	13.4
N	8.2	8.9	8.3	11.7	11.0	10.9	12.3	11.7	12.7	11.5	13.4	12.5
D	4.9	4.2	6.2	8.8	8.8	8.9	9.4	9.6	11.0	10.7	9.4	9.9
Año	**12.0**	**12.6**	**11.5**	**14.0**	**13.7**	**13.7**	**15.3**	**14.9**	**14.2**	**15.1**	**15.0**	**14.5**

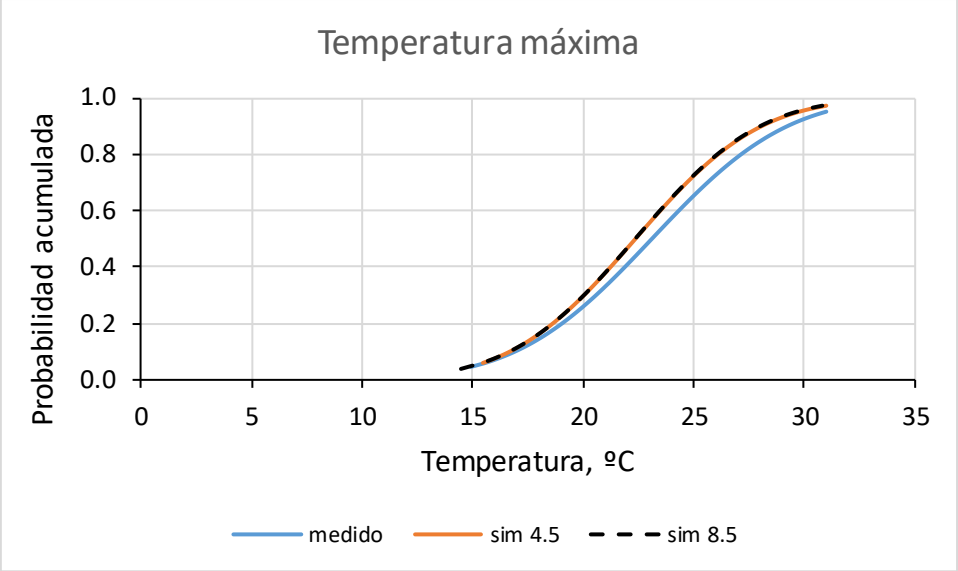
Tmin °C

				Escenario RCP 8.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	5.8	7.9	2.9	7.8	7.7	8.3	9.8	8.1	8.6	9.5	9.9	9.9
F	6.4	7.7	4.6	8.3	8.3	7.8	10.4	9.4	8.6	10.5	10.8	9.2
M	9.6	7.3	7.4	10.0	10.4	10.5	12.0	10.5	9.6	10.8	10.2	11.2
A	9.4	11.7	8.8	12.0	12.5	10.7	11.1	13.9	9.5	14.8	14.7	11.5
M	11.3	13.3	12.4	14.1	14.1	12.8	14.4	16.8	14.1	13.0	17.8	16.6
J	15.3	17.2	16.1	19.0	20.1	18.6	17.3	19.4	20.0	23.9	22.3	21.8
J	19.6	18.8	21.2	22.4	21.5	20.2	24.5	26.2	23.4	26.5	21.7	24.6
A	20.1	21.3	20.6	23.3	22.0	21.6	23.9	25.4	22.8	24.7	24.8	26.3
S	17.9	19.6	16.2	19.9	18.6	18.8	18.1	20.0	20.1	23.6	21.6	21.9
O	15.5	13.7	13.3	15.3	14.4	14.3	15.4	16.0	16.4	16.9	15.0	18.3
N	8.2	8.9	8.3	12.3	11.4	10.1	13.5	10.1	11.6	12.5	12.4	14.5
D	4.9	4.2	6.2	9.2	9.2	9.0	9.8	9.6	9.8	8.7	11.1	12.0
Año	**12.0**	**12.6**	**11.5**	**14.5**	**14.2**	**13.6**	**15.0**	**15.4**	**14.5**	**16.3**	**16.0**	**16.5**

4.2. Temperatura máxima

Valores medios mensuales de temperatura máxima y distribución de probabilidad acumulada de la temperatura máxima diaria durante el período de validación 2006-2018 para los valores medidos y simulados por el modelo climático:





Valores medios mensuales de temperatura máxima durante la rotación y para cada uno de los períodos catalogados como corto, medio y largo plazo en los dos escenarios de emisiones.

Tmax °C

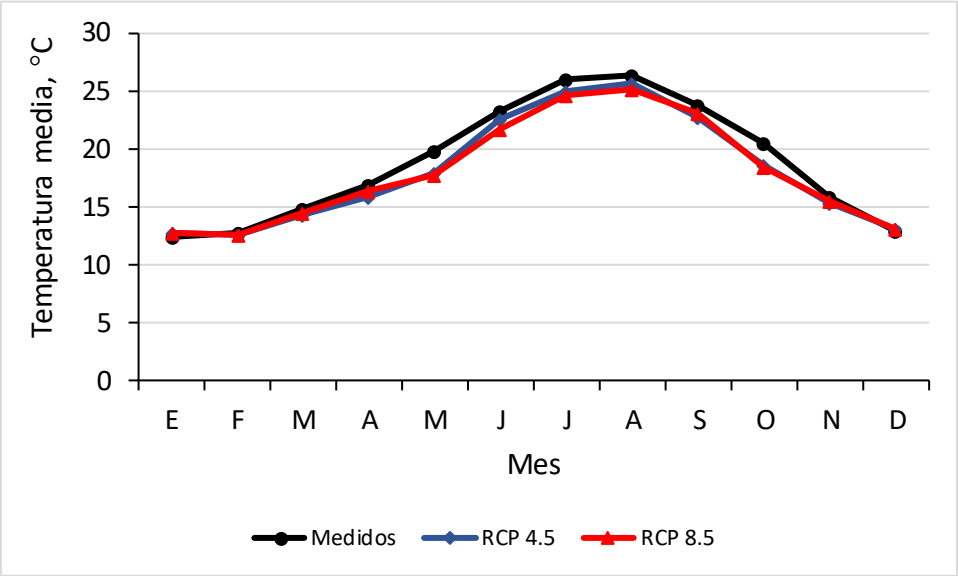
				Escenario RCP 4.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	19.0	18.1	18.2	15.6	19.7	17.5	18.8	18.0	18.2	17.5	18.6	18.0
F	17.3	18.6	16.0	18.6	20.8	19.8	18.9	18.6	19.1	18.8	17.3	16.6
M	20.3	20.7	19.4	20.2	18.5	22.1	19.0	21.1	18.5	21.9	19.7	20.9
A	21.0	25.7	21.4	19.4	20.8	23.6	22.3	20.4	19.4	22.4	22.3	20.8
M	24.9	25.9	26.8	23.9	22.5	22.5	24.0	23.5	21.8	22.3	22.4	22.6
J	28.5	29.9	29.1	26.0	25.2	25.6	27.0	27.1	25.8	27.3	26.8	28.5
J	32.6	31.4	32.1	28.6	27.4	28.6	31.0	29.1	28.5	30.2	31.9	30.8
A	31.1	32.0	31.0	30.3	28.6	30.3	30.8	29.7	28.6	31.3	30.8	30.9
S	29.5	30.7	27.4	27.0	27.0	24.5	29.9	28.8	27.4	28.5	29.8	28.5
O	28.5	27.7	23.5	22.5	21.3	20.4	24.7	24.8	24.2	25.7	25.1	22.3
N	21.4	19.8	21.2	21.8	19.8	19.6	21.8	19.5	22.8	21.6	22.3	20.6
D	17.4	19.2	19.0	16.3	18.7	20.1	19.6	18.3	18.3	18.5	19.3	17.6
Año	**24.3**	**25.0**	**23.8**	**22.5**	**22.5**	**22.9**	**24.0**	**23.2**	**22.7**	**23.8**	**23.8**	**23.2**

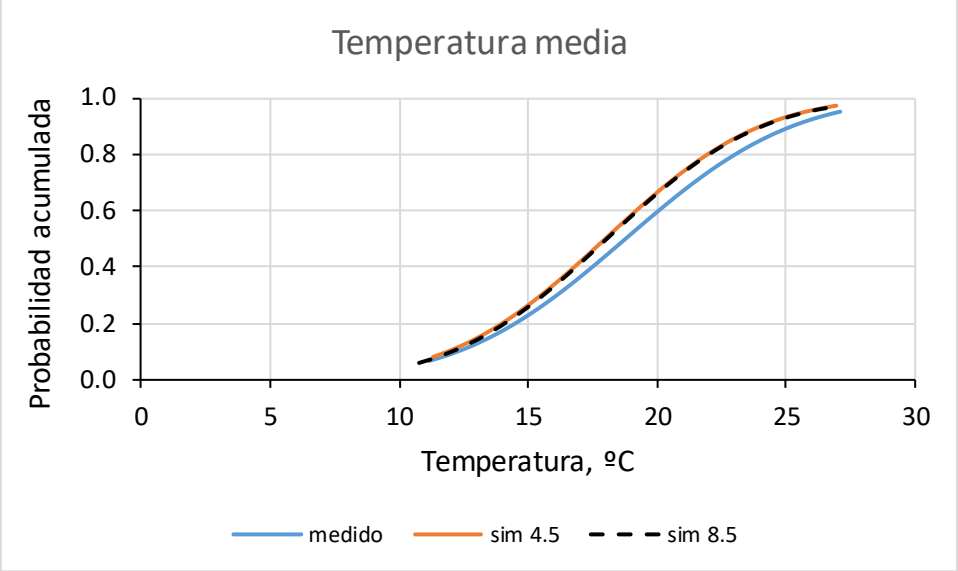
Tmax °C

				Escenario RCP 8.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	19.0	18.1	18.2	15.8	16.2	17.2	19.1	17.0	17.0	20.4	18.5	19.3
F	17.3	18.6	16.0	16.8	16.3	17.0	20.3	20.0	17.4	19.2	20.1	19.2
M	20.3	20.7	19.4	20.0	19.4	20.4	21.3	19.5	18.4	20.1	19.7	20.7
A	21.0	25.7	21.4	20.6	22.6	20.5	19.8	24.4	18.5	24.2	23.5	20.8
M	24.9	25.9	26.8	22.5	22.5	22.8	23.4	25.4	23.5	22.4	26.7	24.8
J	28.5	29.9	29.1	27.3	27.4	26.5	25.5	27.0	28.0	30.4	30.2	30.4
J	32.6	31.4	32.1	29.3	29.1	27.6	31.7	33.2	31.2	33.7	29.7	32.3
A	31.1	32.0	31.0	30.0	31.2	29.5	30.7	33.3	29.9	32.3	31.5	33.3
S	29.5	30.7	27.4	27.9	26.0	27.1	26.9	28.3	28.4	31.9	29.1	30.1
O	28.5	27.7	23.5	24.1	23.3	24.1	24.4	25.3	25.7	25.1	23.8	27.7
N	21.4	19.8	21.2	21.3	18.7	19.7	21.8	19.9	19.7	22.0	21.1	23.2
D	17.4	19.2	19.0	17.1	18.2	18.8	19.8	17.4	17.3	18.7	20.1	20.1
Año	**24.3**	**25.0**	**23.8**	**22.7**	**22.6**	**22.6**	**23.7**	**24.2**	**22.9**	**25.0**	**24.5**	**25.1**

4.3. Temperatura media

Valores medios mensuales de temperatura media y distribución de probabilidad acumulada de la temperatura media diaria durante el período de validación 2006-2018 para los valores medidos y simulados por el modelo climático:





Valores medios mensuales de temperatura media durante la rotación y para cada uno de los períodos catalogados como corto, medio y largo plazo en los dos escenarios de emisiones.

Tmed °C

				Escenario RCP 4.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	12.1	12.7	9.7	11.0	14.0	12.0	13.7	13.9	13.7	12.7	13.7	13.1
F	11.6	13.0	10.3	14.0	15.5	14.4	14.1	14.2	13.9	14.2	13.0	12.0
M	14.5	13.9	13.2	15.3	13.8	16.5	14.2	15.8	13.9	16.8	15.1	15.9
A	15.2	18.2	15.2	14.9	15.6	19.1	17.3	16.2	15.1	17.3	17.5	16.2
M	17.9	19.6	20.2	19.7	17.9	18.2	19.6	19.1	16.9	17.8	17.8	17.8
J	22.3	23.5	23.1	21.9	21.3	21.4	23.7	23.7	22.0	23.5	22.7	24.5
J	26.5	25.3	27.0	24.8	24.4	24.9	27.5	25.3	24.9	26.4	28.1	27.5
A	25.5	26.4	25.9	27.2	24.9	26.9	27.7	26.3	25.2	27.8	26.7	27.3
S	23.7	24.7	21.8	23.2	23.5	20.3	25.8	24.6	23.4	24.3	25.9	23.8
O	21.4	20.0	18.2	18.0	17.4	16.2	20.6	20.1	20.1	21.3	20.3	17.9
N	14.3	13.8	14.1	16.8	15.4	15.2	17.1	15.6	17.7	16.6	17.8	16.6
D	10.6	10.8	11.5	12.6	13.8	14.5	14.5	13.9	14.7	14.6	14.3	13.8
Año	**18.0**	**18.5**	**17.5**	**18.3**	**18.1**	**18.3**	**19.7**	**19.1**	**18.5**	**19.4**	**19.4**	**18.9**

Tmed °C

				Escenario RCP 8.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	12.1	12.7	9.7	11.8	12.0	12.7	14.5	12.6	12.8	15.0	14.2	14.6
F	11.6	13.0	10.3	12.6	12.3	12.4	15.4	14.7	13.0	14.8	15.4	14.2
M	14.5	13.9	13.2	15.0	14.9	15.5	16.7	15.0	14.0	15.5	14.9	15.9
A	15.2	18.2	15.2	16.3	17.5	15.6	15.4	19.2	14.0	19.5	19.1	16.1
M	17.9	19.6	20.2	18.3	18.3	17.8	18.9	21.1	18.8	17.7	22.2	20.7
J	22.3	23.5	23.1	23.1	23.8	22.5	21.4	23.2	24.0	27.2	26.3	26.1
J	26.5	25.3	27.0	25.8	25.3	23.9	28.1	29.7	27.3	30.1	25.7	28.5
A	25.5	26.4	25.9	26.7	26.6	25.5	27.3	29.3	26.4	28.5	28.1	29.8
S	23.7	24.7	21.8	23.9	22.3	23.0	22.5	24.2	24.2	27.7	25.4	26.0
O	21.4	20.0	18.2	19.7	18.8	19.2	19.9	20.6	21.1	21.0	19.4	23.0
N	14.3	13.8	14.1	16.8	15.1	14.9	17.7	15.0	15.6	17.2	16.8	18.9
D	10.6	10.8	11.5	13.2	13.7	13.9	14.8	13.5	13.6	13.7	15.6	16.1
Año	**18.0**	**18.5**	**17.5**	**18.6**	**18.4**	**18.1**	**19.4**	**19.8**	**18.7**	**20.7**	**20.3**	**20.8**

4.4. Amplitud térmica

Valores medios mensuales de amplitud térmica durante la rotación y para cada uno de los períodos catalogados como corto, medio y largo plazo en los dos escenarios de emisiones.

Amplitud térmica °C

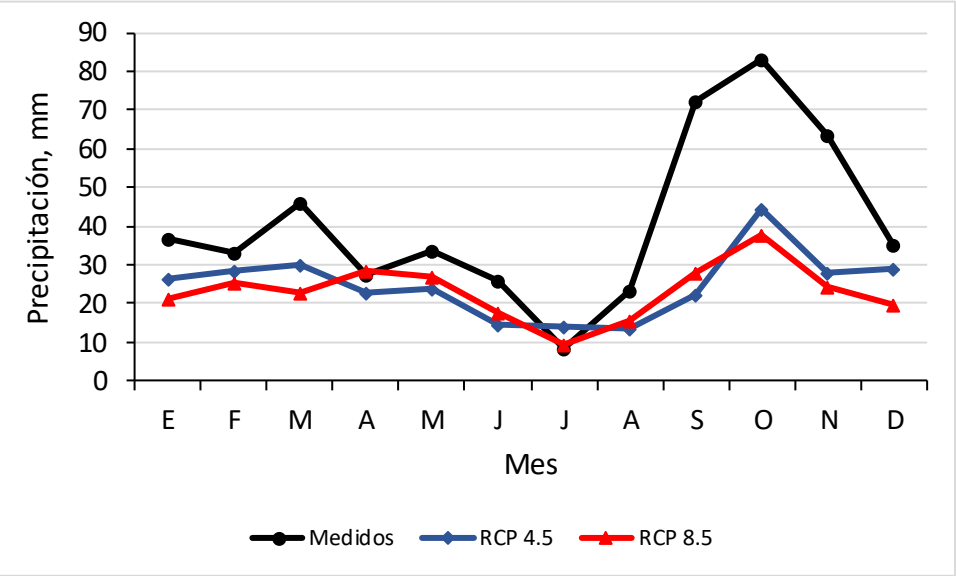
				Escenario RCP 4.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	13.2	10.1	15.4	9.2	11.3	10.9	10.2	8.2	9.0	9.6	9.7	9.8
F	10.9	10.9	11.5	9.2	10.6	10.7	9.6	8.7	10.4	9.1	8.4	9.2
M	10.7	13.4	12.0	9.8	9.4	11.2	9.6	10.6	9.4	10.2	9.3	10.0
A	11.6	14.0	12.5	9.0	10.2	9.1	9.7	8.5	8.6	10.1	9.6	9.2
M	13.6	12.6	14.4	8.3	9.1	8.6	8.7	8.7	9.9	9.0	9.2	9.7
J	13.2	12.7	13.0	8.2	7.6	8.4	6.6	6.8	7.5	7.6	8.0	7.9
J	13.0	12.6	10.9	7.6	6.0	7.5	7.0	7.5	7.2	7.5	7.5	6.6
A	11.0	10.7	10.4	6.2	7.3	6.9	6.1	7.0	6.8	6.9	8.2	7.1
S	11.6	11.1	11.2	7.6	7.0	8.4	8.2	8.5	7.9	8.3	7.7	9.5
O	13.0	14.0	10.2	9.0	7.8	8.3	8.1	9.3	8.2	8.8	9.6	8.8
N	13.2	10.9	12.9	10.1	8.8	8.6	9.5	7.8	10.1	10.1	8.9	8.0
D	12.5	15.0	12.9	7.5	9.9	11.3	10.2	8.7	7.3	7.8	9.9	7.8
Año	**12.3**	**12.3**	**12.3**	**8.5**	**8.8**	**9.2**	**8.6**	**8.4**	**8.5**	**8.8**	**8.8**	**8.6**

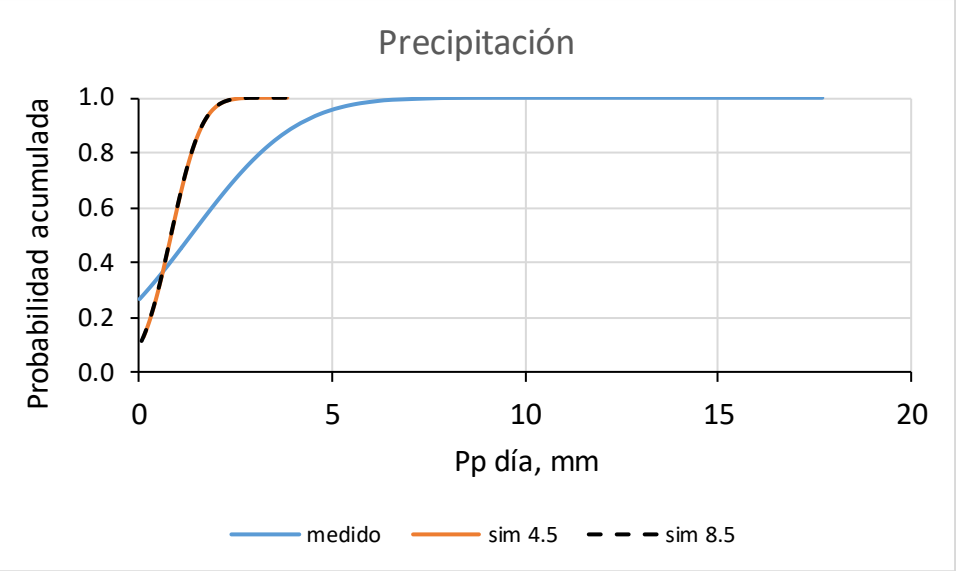
Amplitud térmica °C

				Escenario RCP 8.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	13.2	10.1	15.4	8.0	8.5	8.9	9.4	9.0	8.4	10.9	8.6	9.4
F	10.9	10.9	11.5	8.5	8.1	9.1	9.9	10.6	8.8	8.7	9.1	10.0
M	10.7	13.4	12.0	10.1	9.0	9.9	9.3	9.0	8.8	9.4	9.4	9.5
A	11.6	14.0	12.5	8.6	10.1	9.9	8.7	10.5	9.0	9.4	8.7	9.3
M	13.6	12.6	14.4	8.4	8.4	10.0	9.0	8.6	9.4	9.3	8.9	8.2
J	13.2	12.7	13.0	8.3	7.2	8.0	8.3	7.6	8.0	6.6	7.9	8.6
J	13.0	12.6	10.9	6.9	7.6	7.4	7.2	7.0	7.7	7.1	8.0	7.8
A	11.0	10.7	10.4	6.7	9.1	7.9	6.9	8.0	7.1	7.6	6.8	7.0
S	11.6	11.1	11.2	8.0	7.4	8.3	8.8	8.3	8.3	8.3	7.5	8.2
O	13.0	14.0	10.2	8.8	8.9	9.8	9.0	9.3	9.4	8.2	8.7	9.4
N	13.2	10.9	12.9	9.0	7.3	9.6	8.3	9.9	8.1	9.5	8.7	8.6
D	12.5	15.0	12.9	8.0	9.1	9.7	10.0	7.7	7.5	10.0	9.0	8.2
Año	**12.3**	**12.3**	**12.3**	**8.3**	**8.4**	**9.0**	**8.7**	**8.8**	**8.4**	**8.7**	**8.5**	**8.7**

4.5. Precipitación

Valores medios mensuales de precipitación y distribución de probabilidad acumulada de la precipitación media diaria durante el período de validación 2006-2018 para los valores medidos y simulados por el modelo climático:





Valores mensuales de precipitación durante la rotación y para cada uno de los períodos catalogados como corto, medio y largo plazo en los dos escenarios de emisiones.

Precipitación mm

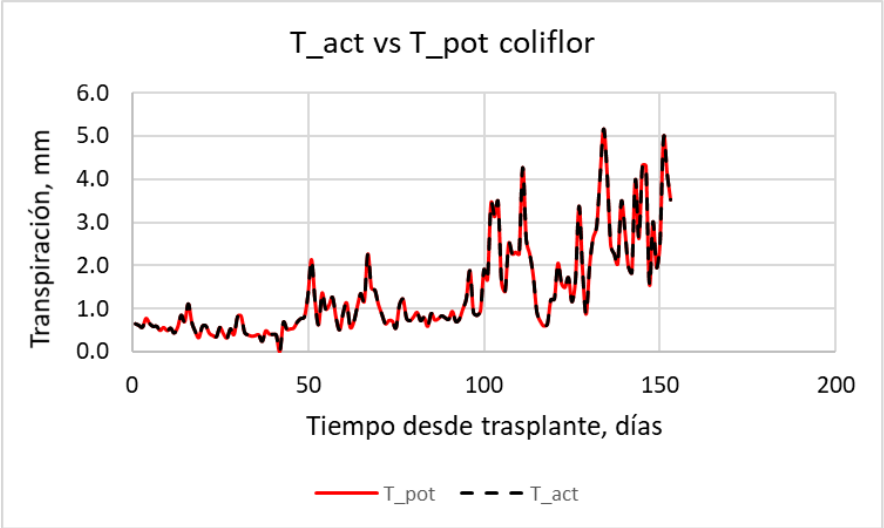
				Escenario RCP 4.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	6.8	1.5	5.3	32.3	3.3	3.6	5.2	36.5	5.5	22.7	17.8	0.3
F	49.0	0.0	4.9	14.0	9.9	0.8	49.1	17.5	6.2	15.4	8.2	16.0
M	51.4	0.5	121.4	6.4	10.5	3.7	34.8	8.1	41.2	11.7	5.2	29.4
A	91.6	10.9	2.8	47.3	9.9	5.7	29.0	38.7	80.6	93.9	21.7	36.6
M	14.8	7.5	11.5	53.1	32.9	4.7	39.7	26.4	7.8	55.5	22.5	18.5
J	8.4	24.3	61.6	6.3	9.5	38.6	13.5	21.3	27.1	21.1	42.3	39.5
J	4.4	36.9	9.6	7.6	9.4	12.9	12.1	2.8	3.0	33.1	10.5	3.4
A	27.2	0.1	15.5	8.5	14.2	15.8	5.1	8.2	10.4	17.2	11.1	24.8
S	0.0	38.7	32.1	40.4	17.1	25.7	3.9	10.5	87.4	43.9	7.3	2.3
O	0.8	10.1	30.6	36.2	116.8	38.8	3.3	35.9	14.3	40.8	3.9	46.4
N	7.0	50.8	53.3	3.3	17.7	26.9	28.0	106.3	16.2	4.2	10.0	37.8
D	9.6	8.0	0.2	40.9	11.1	0.7	16.2	5.7	59.2	49.2	12.7	52.7
Año	**271**	**189**	**349**	**296**	**262**	**178**	**240**	**318**	**359**	**409**	**173**	**308**

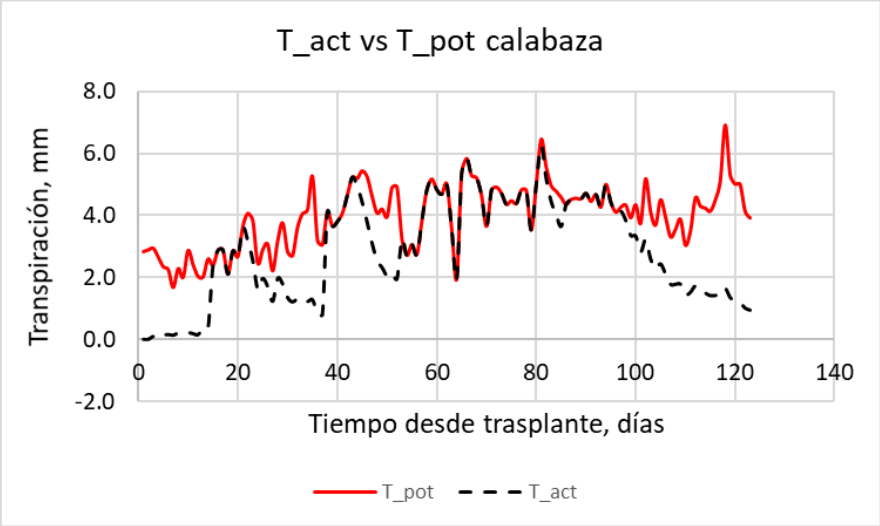
Precipitación mm

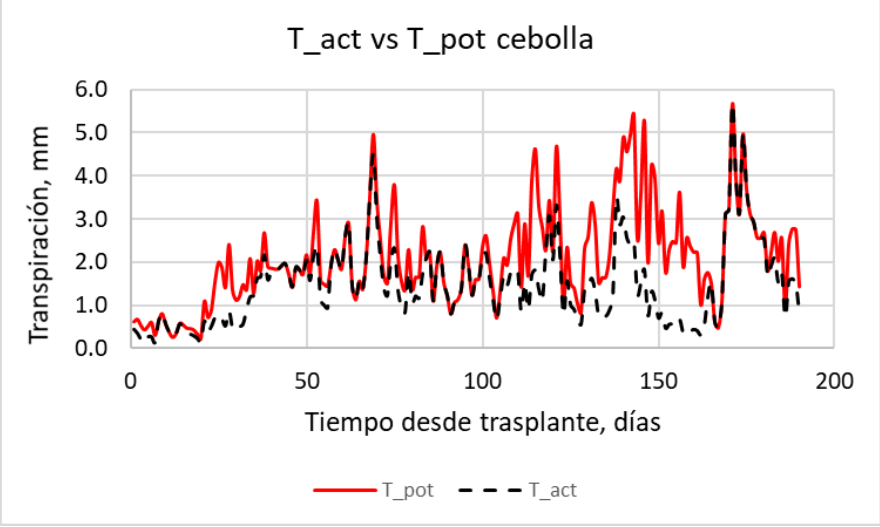
				Escenario RCP 8.5								
	Rotación			Corto plazo			Medio plazo			Largo plazo		
Mes	**2013**	**2014**	**2015**	**2023**	**2024**	**2025**	**2043**	**2044**	**2045**	**2073**	**2074**	**2075**
E	6.8	1.5	5.3	22.4	31.1	8.1	2.0	36.2	5.9	13.9	5.1	5.8
F	49.0	0.0	4.9	24.6	26.3	21.7	3.2	1.7	13.4	9.3	4.1	3.1
M	51.4	0.5	121.4	9.5	52.0	10.0	9.2	34.4	68.5	30.1	28.6	10.3
A	91.6	10.9	2.8	22.6	19.7	16.3	34.4	2.2	60.3	8.1	9.4	41.1
M	14.8	7.5	11.5	22.5	32.1	6.0	26.0	11.2	18.6	26.0	15.0	19.5
J	8.4	24.3	61.6	2.3	3.2	19.2	22.7	4.7	11.0	7.2	15.1	7.5
J	4.4	36.9	9.6	31.8	6.9	49.3	4.4	4.9	7.5	6.1	13.2	6.8
A	27.2	0.1	15.5	9.8	7.0	9.0	38.9	4.0	13.5	42.5	4.4	24.2
S	0.0	38.7	32.1	19.7	31.3	24.4	52.1	24.0	10.9	5.7	26.1	40.9
O	0.8	10.1	30.6	29.4	40.6	13.2	9.3	18.5	2.6	49.3	27.9	5.0
N	7.0	50.8	53.3	11.1	86.8	6.1	2.8	4.9	63.1	5.2	48.0	8.9
D	9.6	8.0	0.2	54.3	80.8	1.5	3.9	67.1	31.2	4.7	9.0	14.6
Año	**271**	**189**	**349**	**260**	**418**	**185**	**209**	**214**	**307**	**208**	**206**	**188**

5. Transpiración para la rotación 2013-2015 en función de las mejoras realizadas

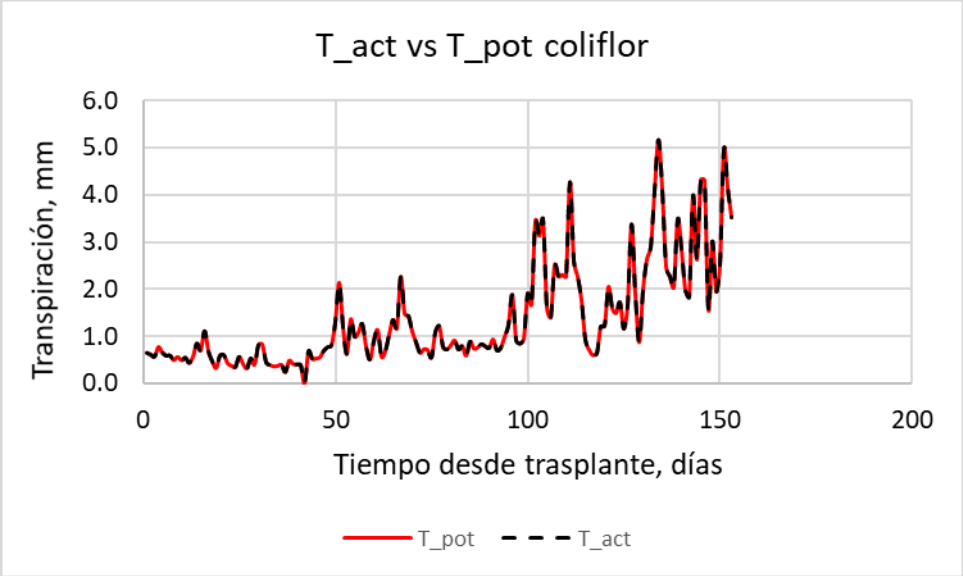
- **INICIAL**, sin mejoras

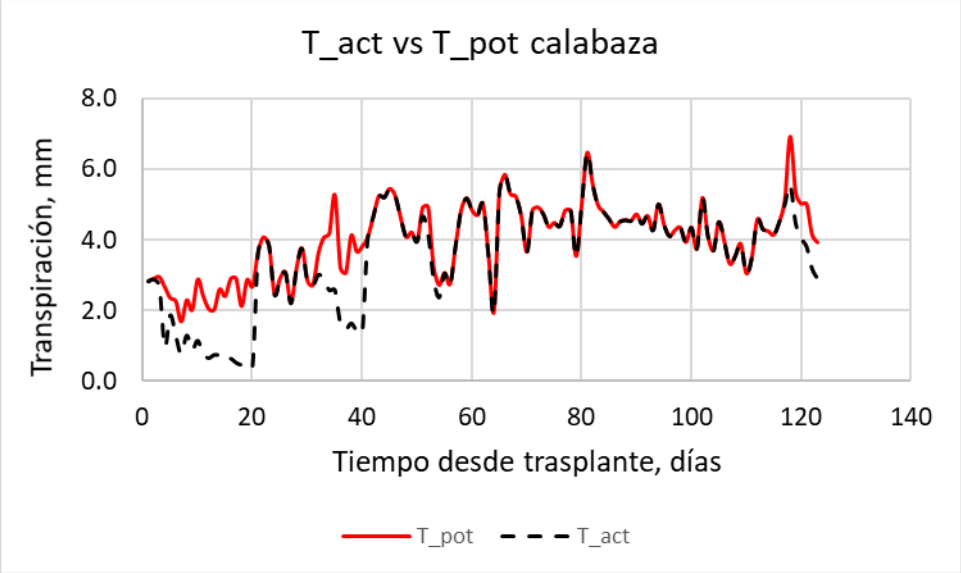


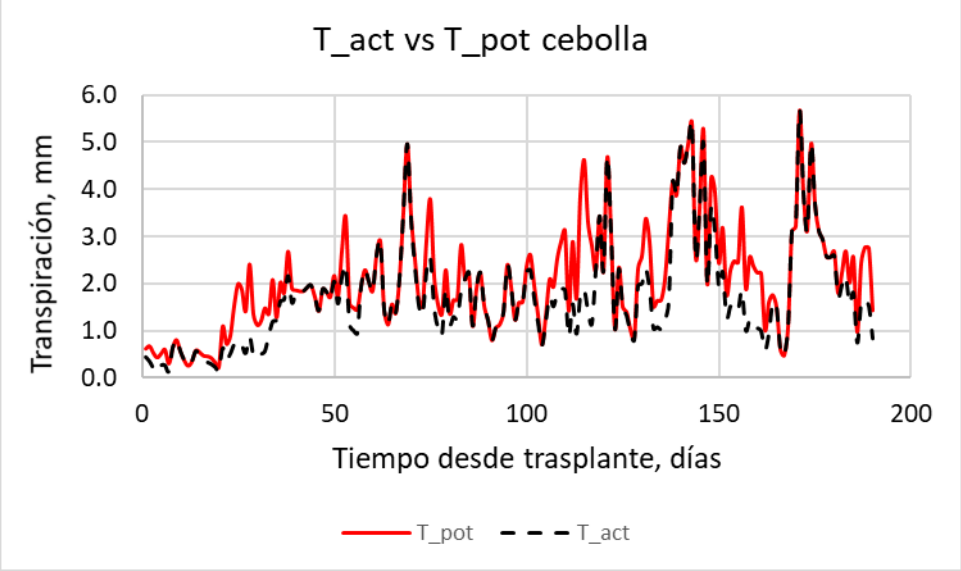




➢ **PRIMERA MEJORA RELACIONADA CON EL AGUA** (aumento de la dosis de riego)







➢ **SEGUNDA MEJORA RELACIONADA CON EL AGUA** (aumento de la frecuencia de riego)