AMICAF/MOSAICC seminar

ITCAF, Manila, 13-14 Sept. 2012

WABAL, one of the two crop model “engines” in MOSAICC, and PLD

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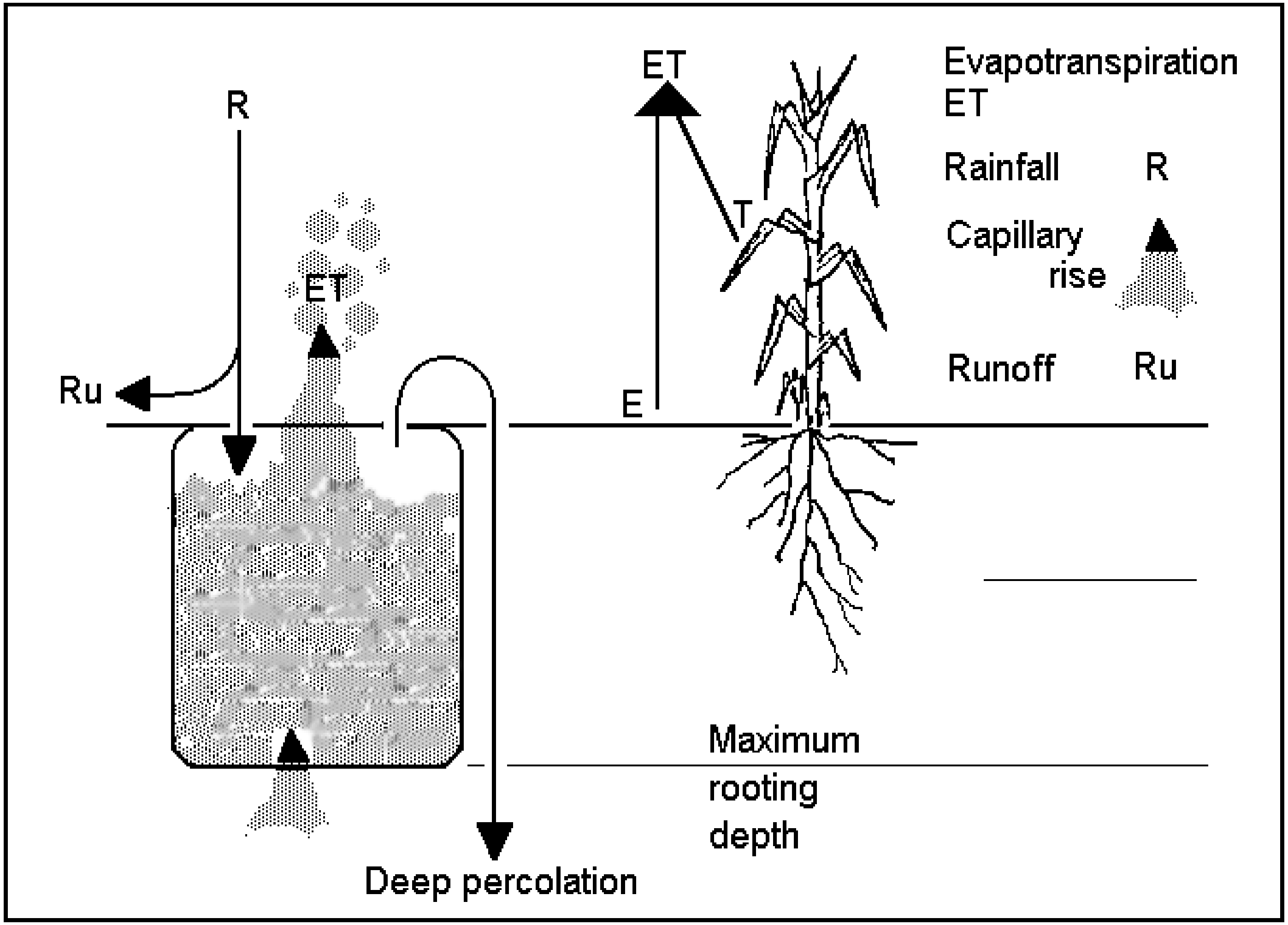
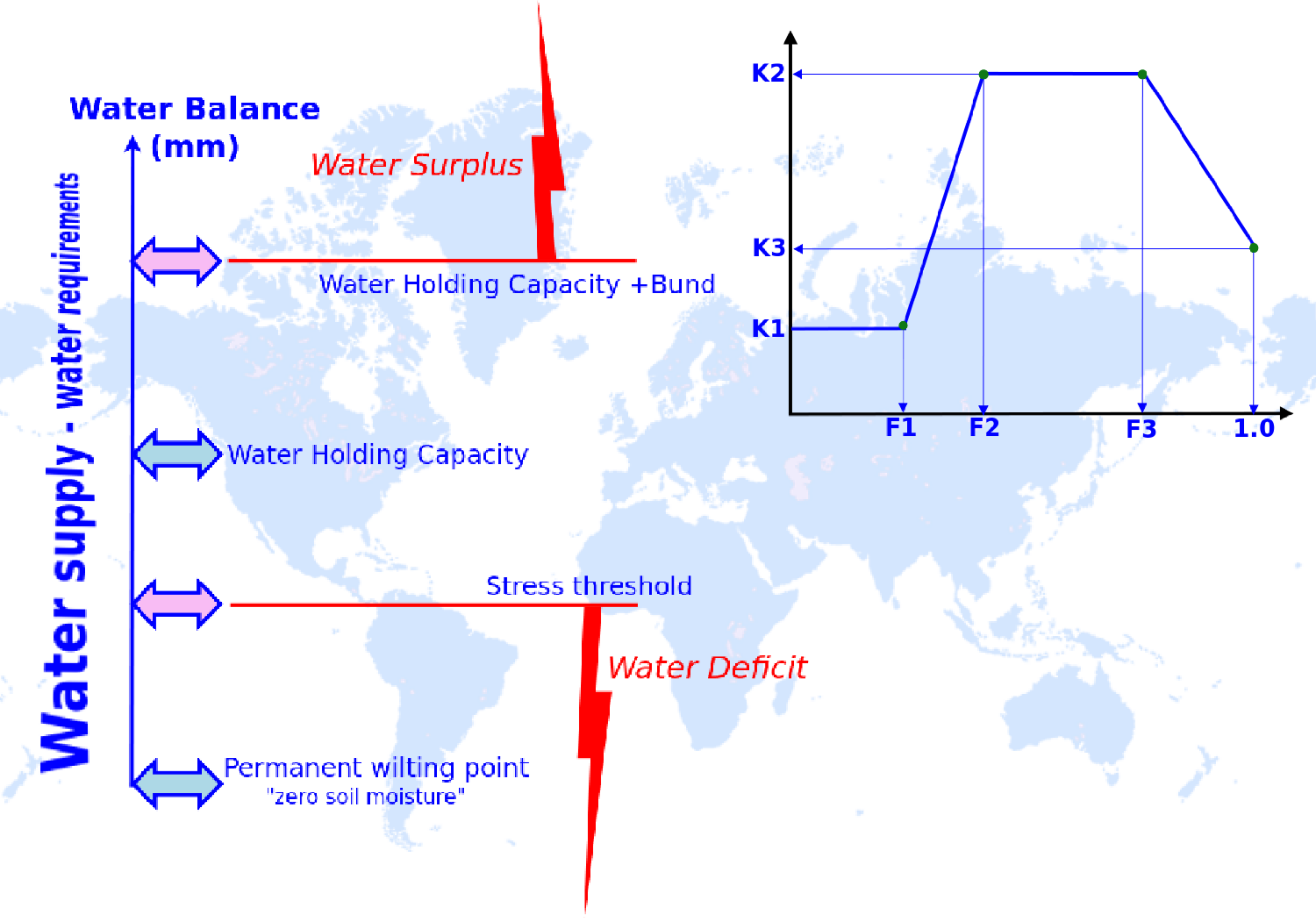
WABAL implements the "impressionistic" FAO CSSWB

CSSWB in two slides





Water Balance
(mm)
Water supply - water requirements
Water Surplus
Water Holding Capacity +Bund
Water Holding Capacity
Stress threshold
Water Deficit
Permanent wilting point
"zero soil moisture"
K2
K3
K1
F1
F2
F3
1.0

CSSWB characteristics

- Daily or 10-daily timestep
- One-layer soil with no root growth
- Fixed phenology through crop coefficients (Water requirement = KCr * ETP)
- ETa stays at potential rate unter all soil water is exausted
- Inputs: limited and compatible with many locations in developing countries (more below!)
- Outpouts: WSI, ET, surplus & deficit by phenophase

CSSWB illustrated with white maize planted in Muñoz at dekad 25, 1991

Run of 09-11-2012 at 13:05:27

Cycle length in dekads	12
# of preseason wabal dekads	5
Presseason Kcr	0.5
Water holding capacity in mm	100
Bund height in mm	0
Deficit threshold (0-1)	0.8
Excess water (Xi, mm) above which WSI_correction is applied	100
WSI_correction (%) when Excess>Xi (0 for no correction)	0
Irrigation ? Yes or No or Automatic I/N/A	N

CSSWB illustrated with white maize planted in Muñoz at dekad 25

Dek	phase	KCr	rain	ETP	WatReq	Soilwat	TwatReq	Def	Exc	ETA
1	0	0.500	114.5	47.9	24.0	90.6				
2	0	0.500	137.4	43.2	21.6	100.0				
3	0	0.500	66.5	40.5	20.3	100.0				
4	0	0.500	114.5	34.3	17.2	100.0				
5	0	0.500	218.9	45.6	22.8	100.0				
6	1	0.500	148.6	41.7	20.9	100.0	20.9	0.0	127.8	20.9
7	1	0.500	177.6	39.6	19.8	100.0	40.7	0.0	157.8	19.8
8	2	0.608	94.5	38.1	23.2	100.0	63.8	0.0	71.3	23.2
9	2	0.789	8.4	43.1	34.0	74.4	97.8	5.6	0.0	34.0
10	2	0.969	24.6	44.6	43.2	55.8	141.1	24.2	0.0	43.2
11	2	1.150	64.2	38.7	44.5	75.5	185.6	4.5	0.0	44.5
12	3	1.150	1.0	40.3	46.3	30.1	231.9	49.9	0.0	46.3
13	3	1.150	20.1	36.0	41.4	8.8	273.3	71.2	0.0	41.4
14	3	1.150	8.6	38.4	44.2	0.0	317.5	106.7	0.0	17.4
15	4	1.058	0.0	36.6	38.7	0.0	356.2	118.7	0.0	0.0
16	4	0.829	0.0	36.7	30.4	0.0	386.6	110.4	0.0	0.0
17	4	0.600	0.0	39.7	23.8	0.0	410.5	103.8	0.0	0.0

CSSWB illustrated with white maize planted in Muñoz at dekad 25

Total ETA	290.73
by phase	40.65
by phase	144.92
by phase	105.16
by phase	0.00
Total Surplus	356.87
by phase	285.55
by phase	71.32
by phase	0.00
by phase	0.00
Total Deficit	595.19
by phase	0.00
by phase	34.38
by phase	227.82
by phase	332.99
Total water requirement	410.46
WSI (raw)	70.83
WSI (corr. for surplus)	70.83

AMS water balance

WHCB=WHC+Bund

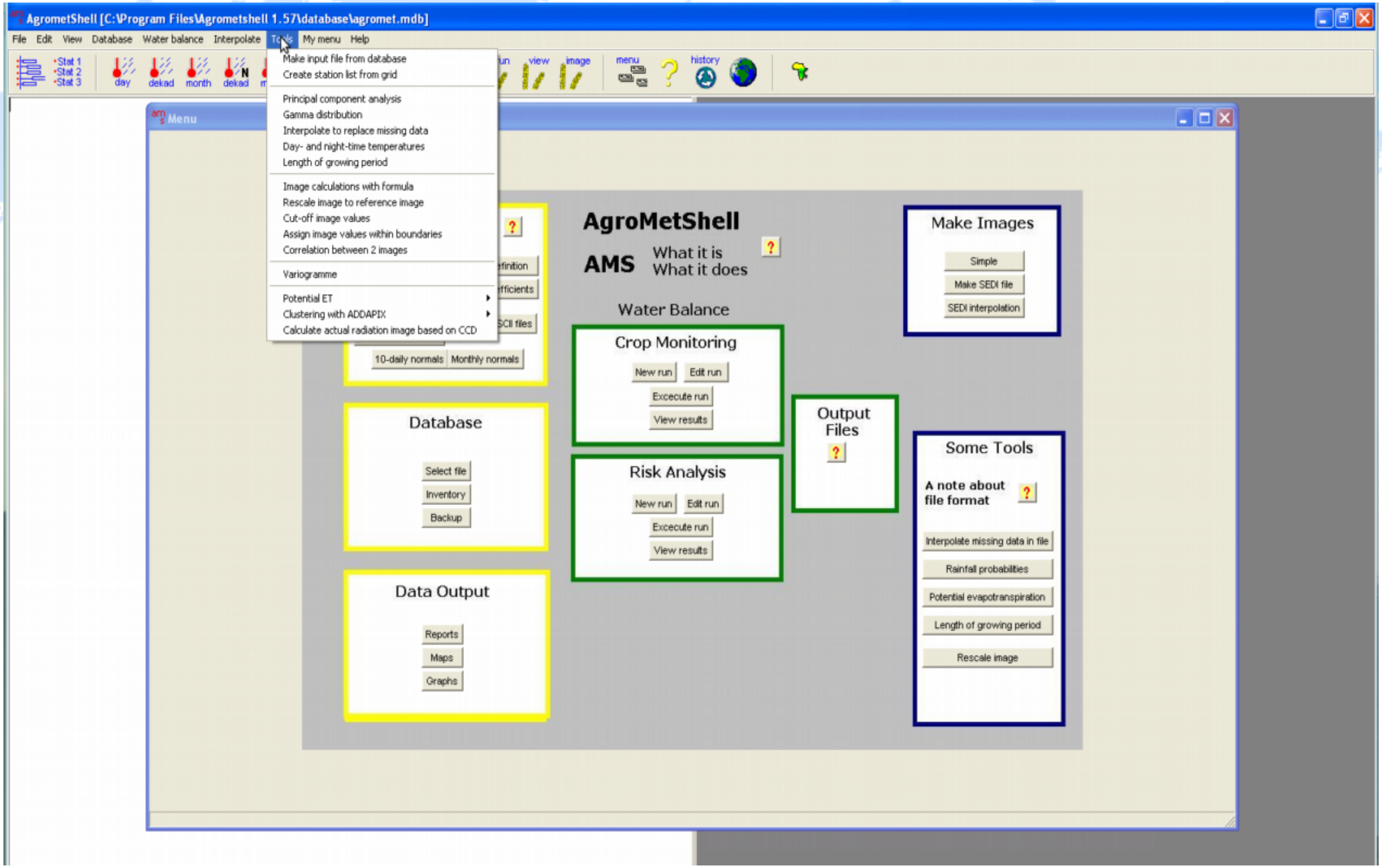
```
WatSup=WatSoil+Rain+Irrigation
WatBal=WatSup-WatReq
SELECT CASE WatBal
   CASE is >WHCB
      WExc=WatBal-WHCB
      WatSoil=WHCB
      WDef=0
   CASE WHC to WHCB
      WatSoil=WatBal
      WDef=0
      WExc=0
   CASE WHCstress to WHC
      WatSoil=WatBal
      WDef=0
      WExc=0
   CASE 0 to WHCstress
      WatSoil=WatBal
      WDef=WHCstress-WatBal
      WExc=0
   CASE is <0
      WatSoil=0
      Wdef=WHCstress-WatBal
      WExc=0
END SELECT

Eta=WatSup
IF WatSup>WatReq then Eta=WatREq

AutIrrig=0
IF AutIrrigOn and WatBal<WHCstress THEN
   AutIrrig=WDef
   Watsoil=WHCstress
end if
```

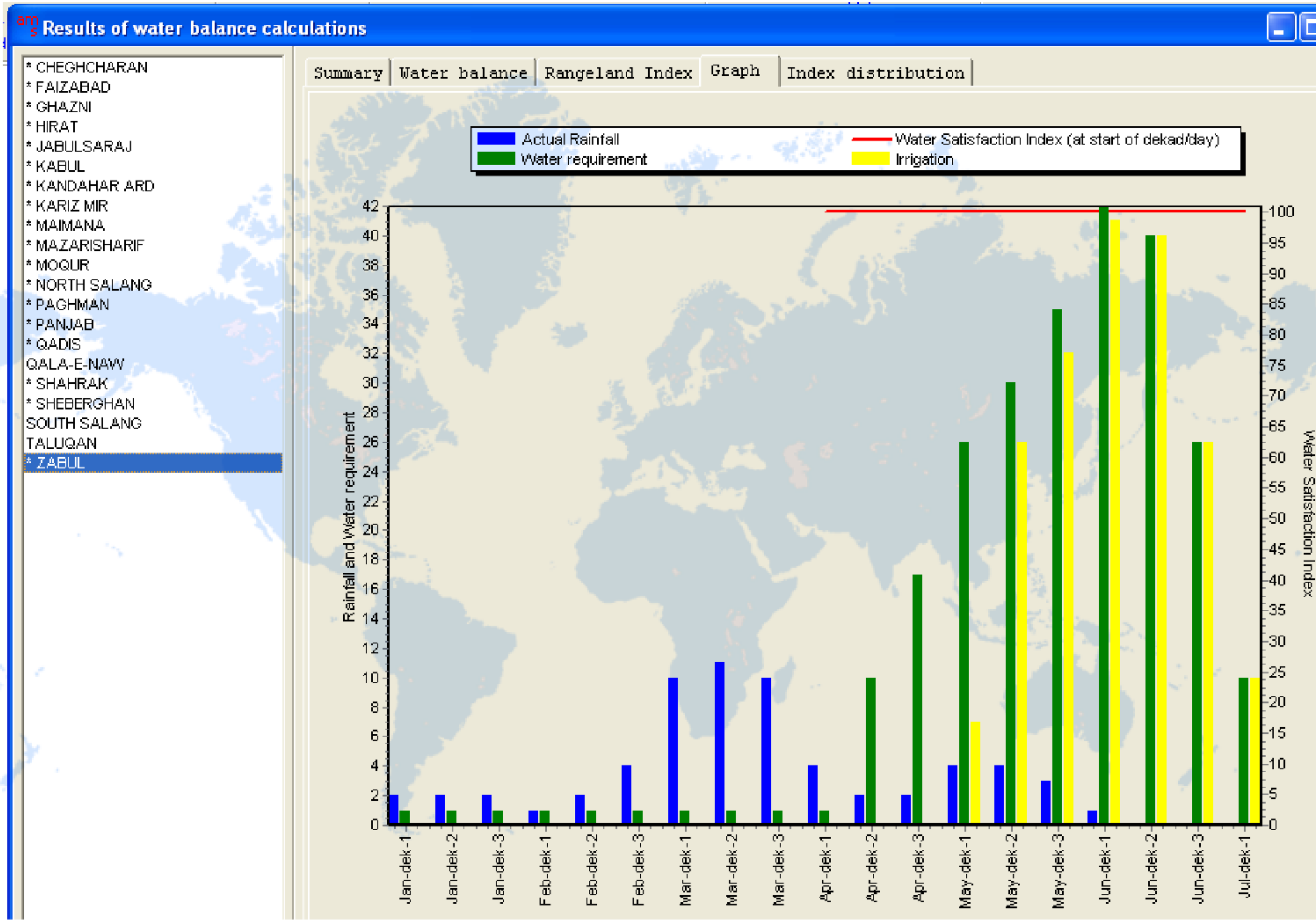
Required inputs

- Rainfall (mm), ten-daily
- "Evapotranspiration", (ETP), ten-daily
- Irrigation amounts (mm), ten daily
- Crop coefficients (KCr)
- Planting dates and cycle lengths

- Maximum soil moisture storage capacity
- "Evapotranspiration", (ETP), ten-daily
- Several very empirical parameters such as "index reduction for excess rain, pre-season Kcr,water stress threshold

AMS graphical User interface





Results of water balance calculations
* CHEGHCHARAN
* FAIZABAD
* GHAZNI
* HIRAT
* JABULSARAJ
* KABUL
* KANDAHAR ARD
* KARIZ MIR
* MAIMANA
* MAZARISHARIF
* MOQUR
* NORTH SALANG
* PAGHMAN
* PANJAB
* QADIS
QALA-E-NAW
* SHAHRAK
* SHEBERGHAN
SOUTH SALANG
TALUQAN
* ZABUL
Summary
Water balance
Rangeland Index
Graph
Index distribution
Actual Rainfall
Water requirement
Water Satisfaction Index (at start of dekad/day)
Irrigation
Rainfall and Water requirement
Water Satisfaction Index
Jan-dek-1
Jan-dek-2
Jan-dek-3
Feb-dek-1
Feb-dek-2
Feb-dek-3
Mar-dek-1
Mar-dek-2
Mar-dek-3
Apr-dek-1
Apr-dek-2
Apr-dek-3
May-dek-1
May-dek-2
May-dek-3
Jun-dek-1
Jun-dek-2
Jun-dek-3
Jul-dek-1

Use of CSSWB for yield impact assessments

- Semi-quantitatively assess weather factors relevant for crop production and express them as value-added agronomically meaningful indices (water balance variables, WBV)
- Regress yields against WBVs, and use empirical regression equation for simulation
- A detailed study was done in Morocco using the approach, without major difficulties

Overall philosophy of WABAL

- WABAL is an industrial version of AMS
- *Industrial* means:
    - Suitable for hundreds of thousands unattended CSSWB runs
    - Emphasis is on efficiency
    - Recyclability in different applications
    - No graphical user interface
    - Comes in three versions WB1, WB2 and WB3
    - Output can be absorbed directly in other application programmes

Sample WABAL input line

```
wb2 10 5 0.5 100 50 0.25 5 50 n v 0.2 0.5 0.8 0.5 1 0.5 21 22 231 24 25 10 11 12 13
14 15 161 171 18 19 23 22 21 120 19 18 17 16 151 141 131 12 11 10 9
```

CSSWB illustrated with white maize planted in Muñoz at dekad 25

```
Total ETA                           290.73
          by phase                      40.65
          by phase                     144.92
          by phase                     105.16
          by phase                       0.00

Total Surplus                       356.87
          by phase                     285.55
          by phase                      71.32
          by phase                       0.00
          by phase                       0.00

Total Deficit                       595.19
          by phase                       0.00
          by phase                      34.38
          by phase                     227.82
          by phase                     332.99

Total water requirement             410.46
WSI (raw)                            70.83
WSI (corr. for surplus)              70.83
```

CSSWB, as above (white maize, pl. in 1991, Muñoz, dekad 25): summary WABAL output & calibration matrix

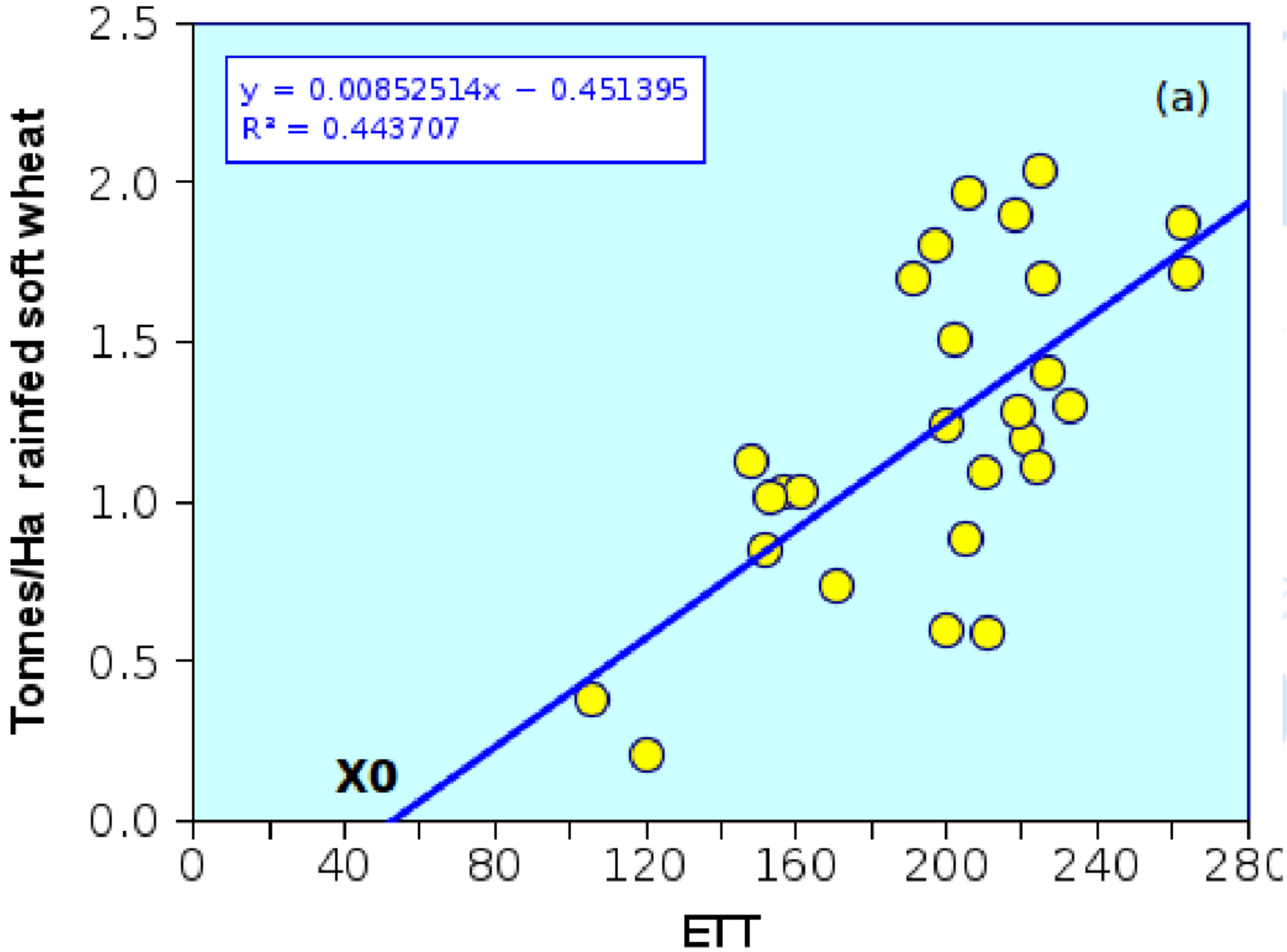
	A	B	C	D	E	F	G	H	I	J	K
1	#	cyc	pres	prkc	whc	bund	def	in-red%	ex-rain	n	v
2	#	12	5	0.5	100	0	0.8	0	100	N	f
3	year	eta-t	eta-i	eta-v	eta-f	eta-m	exc-t	exc-i	exc-v	exc-f	exc-m
4	1991	290.7	40.6	144.9	105.1	0	356.8	285.5	71.3	0	0
5	1992	280.5	38.5	149.4	92.5	0	150.5	150.5	0	0	0
6	1993	352.2	40.7	143.9	130	37.3	322	204.8	117.2	0	0
7	1994	257.9	42.5	158.9	43.1	13.3	169.9	133.9	36	0	0

K	L	M	N	O	P	Q	R	S
v	f1	f2	f3	k1	k2	k3	planted	
f	0.2	0.5	0.8	0.5	1.15	0.6	25	
exc-m	def-t	def-i	def-v	def-f	def-m	TWR	wsi	wsicorr
0	595.1	0	34.3	227.8	332.9	410	71	71
0	588	0	37.4	218	332.5	409	69	69
0	451.7	0	0	168.4	283.3	400	88	88
0	714.6	0	43.7	345	325.9	449	57	57

Most commonly occurring WABAL outputs in Morocco CC impact study

	FAV	DEF		INT	MONT	SAH	n
		or	sud				
ETt_rain	2	4	3	2			11
EXCf_rain	5		3	2			10
EXCt_rain	2	1	4		3		10
r_cyc_rain	2	1	2	1	2	2	10
DEFh_rain	4		1		1	3	9
smoist_cyc_irr	1	3	2		1	2	9
smoist_cyc_rain	2	1	1	2		2	8
ETf_rain	5			2			7
EXCv_rain		1	2		2	2	7
r_cyc_irr		2		5			7
ETi_rain	1	2	1	1		1	6
smoist_pres_irr	2	3				1	6

Soft wheat yield Vs ET
(Morocco 1980-2007)



Items for discussion: how does the CSSWB model...

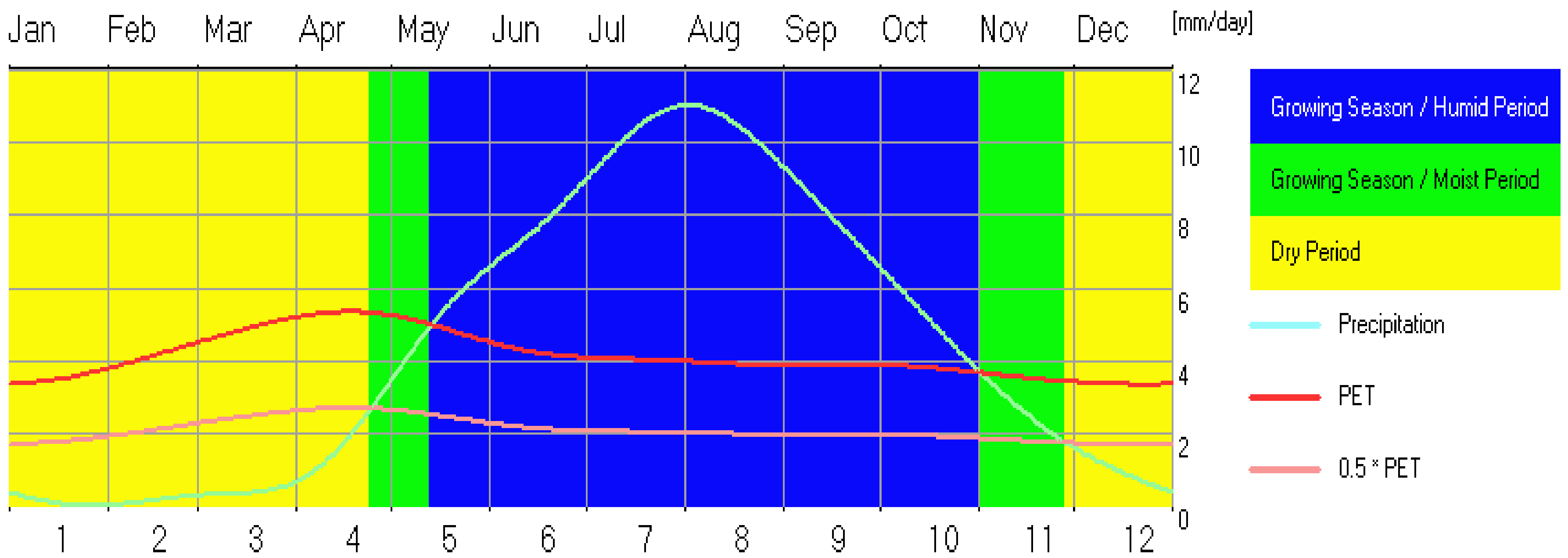
- Biomass accumulation (assimilation)?
- Phenology (or development) and biomass partitioning (incl. Respiration and root development) ?
- Nutrient budget ?
- Soil & plant water budget?

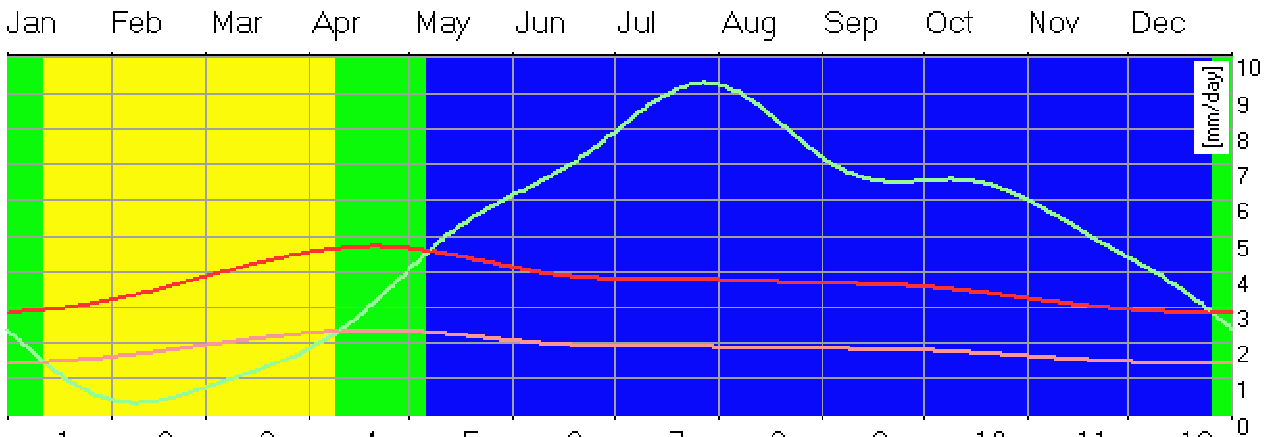
PLDEK

and Franquin's method

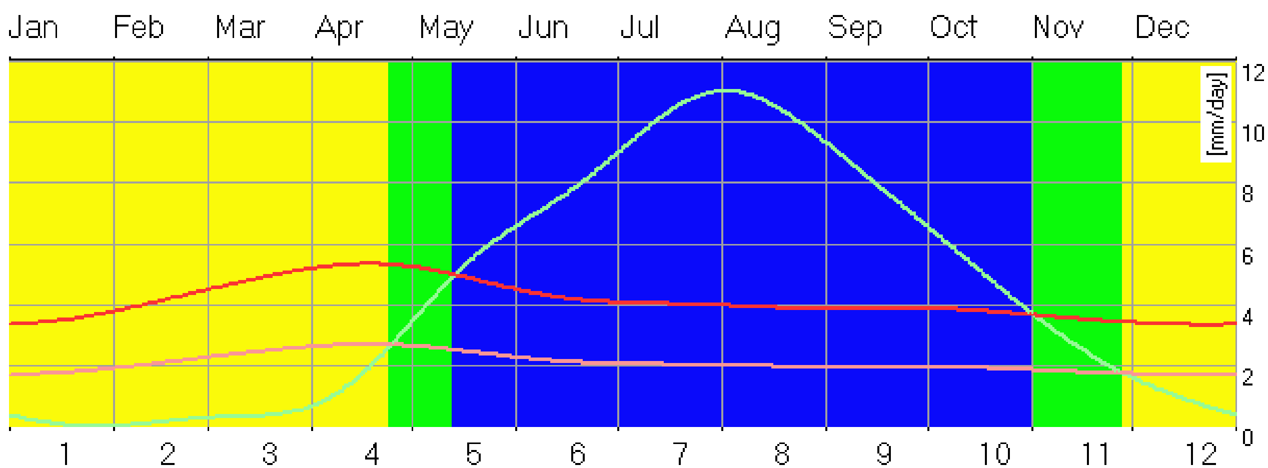
Franquin's method illustrated: Cabanatuan

(graph prepared with NewLOcClim)

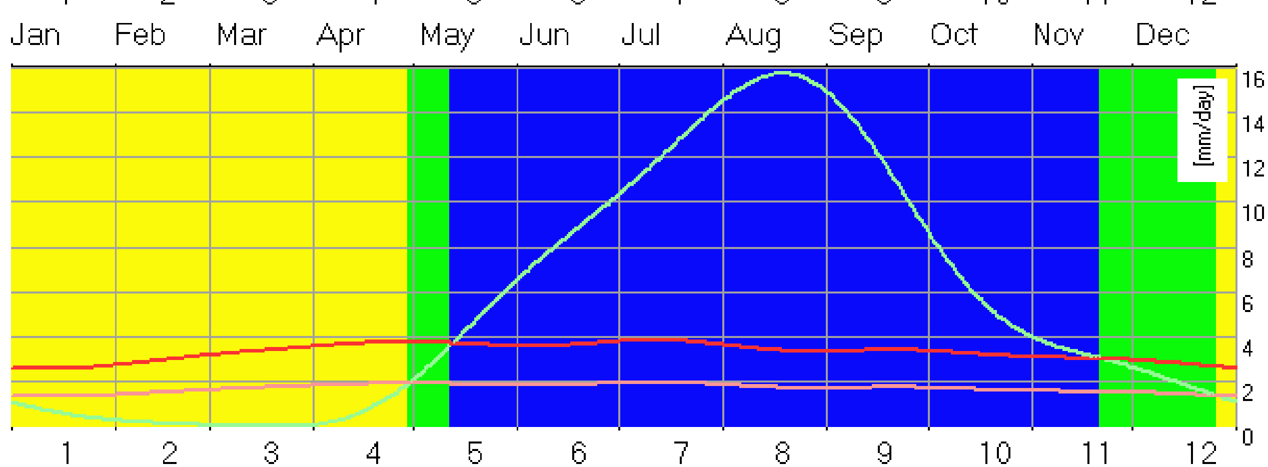




Carranglan

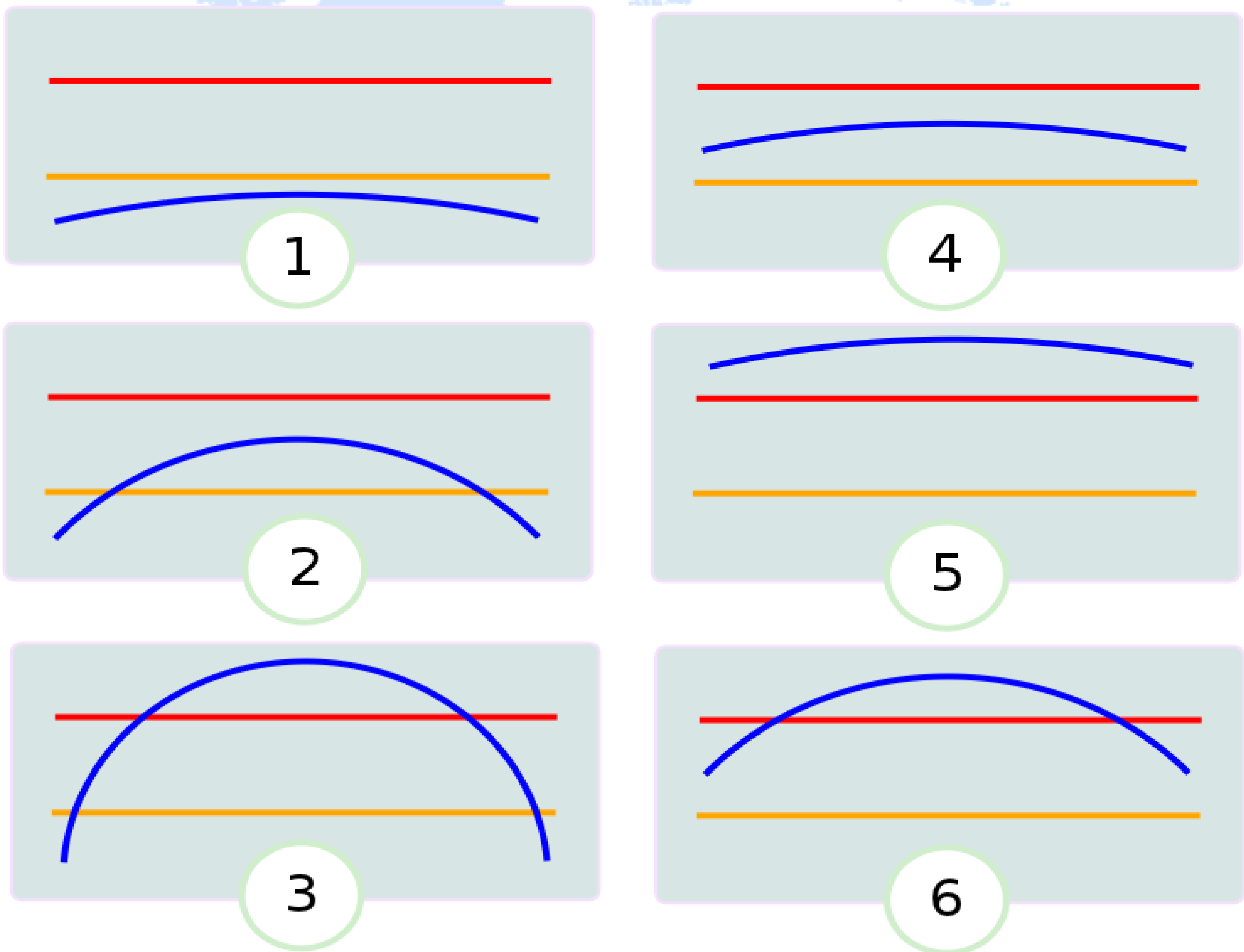


Guimba

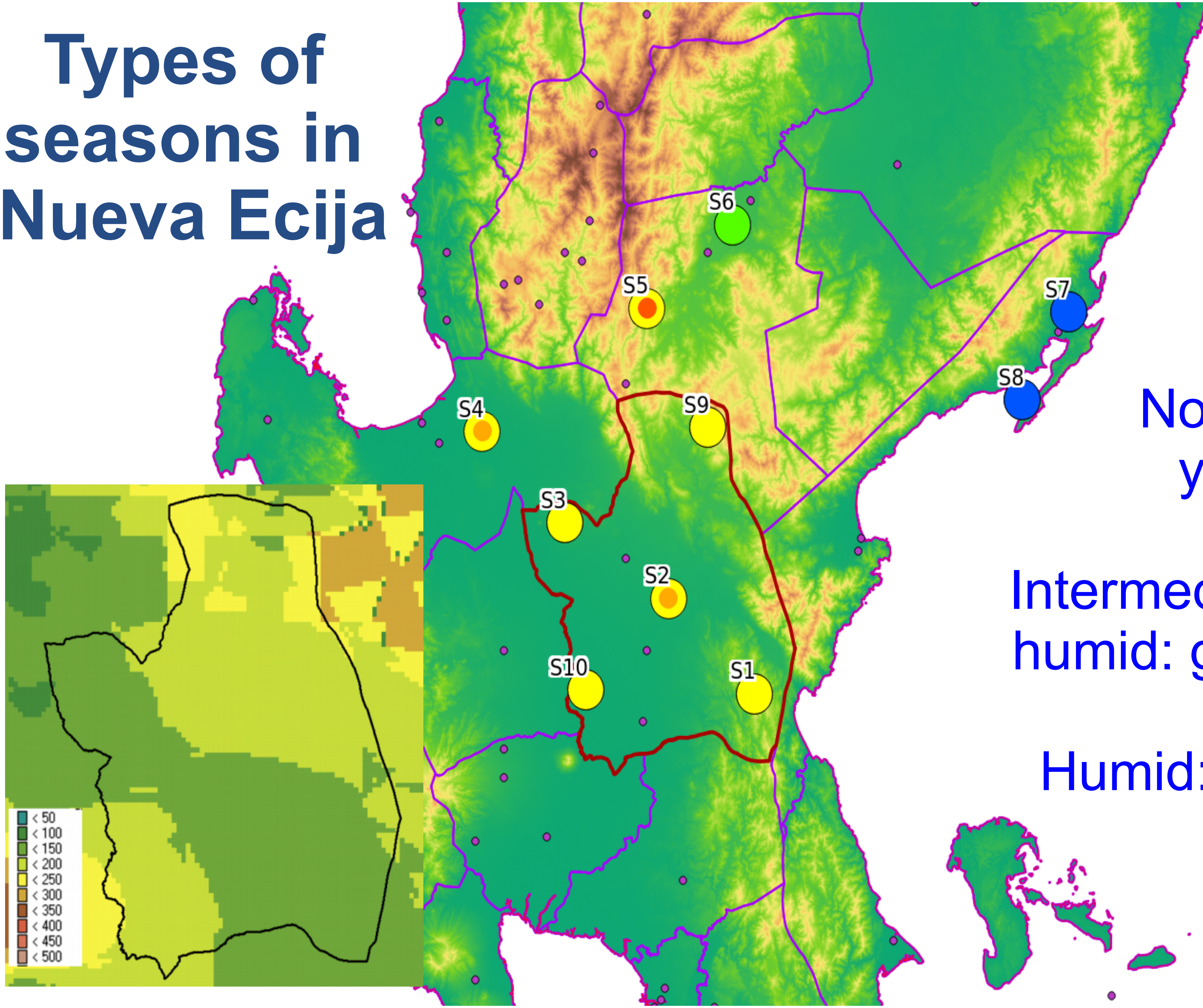


Zaragoza

Only six of seasons



Types of seasons in Nueva Ecija

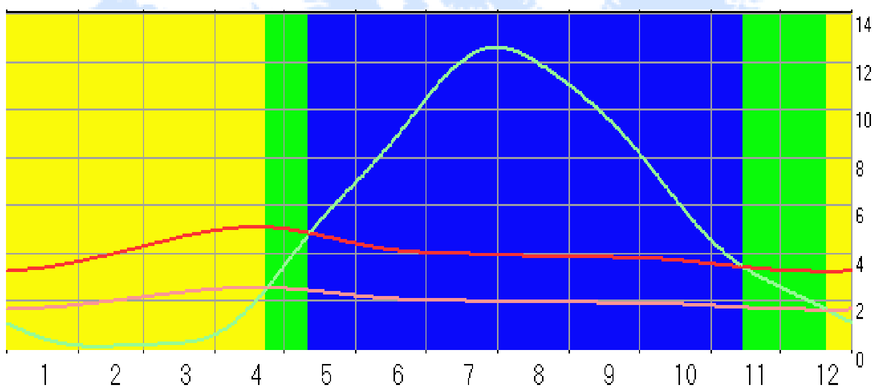


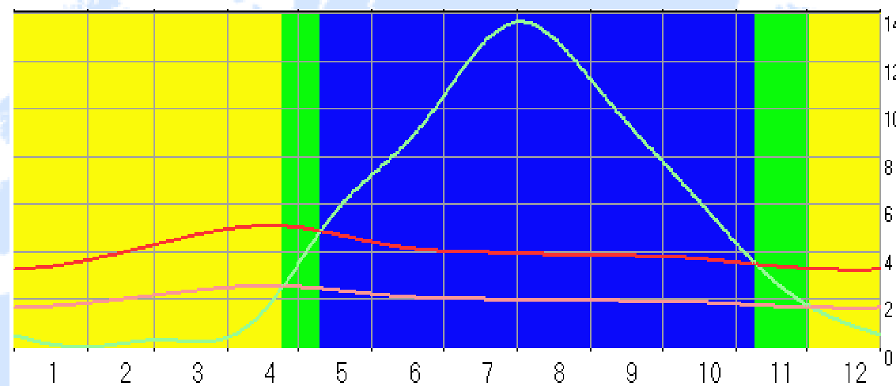
Normal: yellow

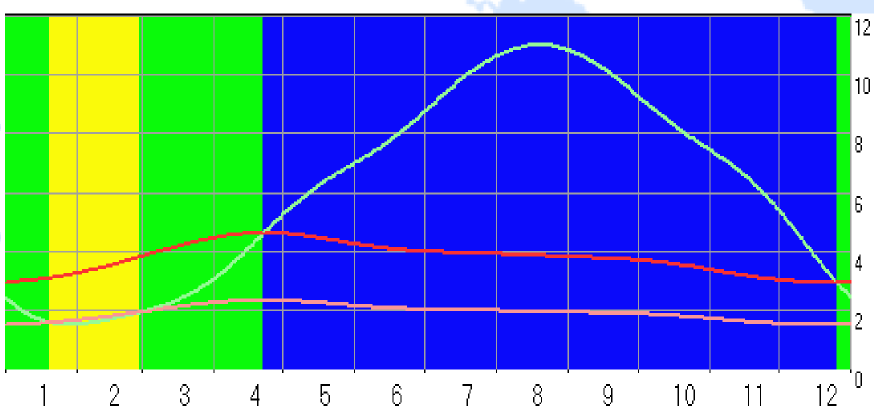
Intermediate-humid: green

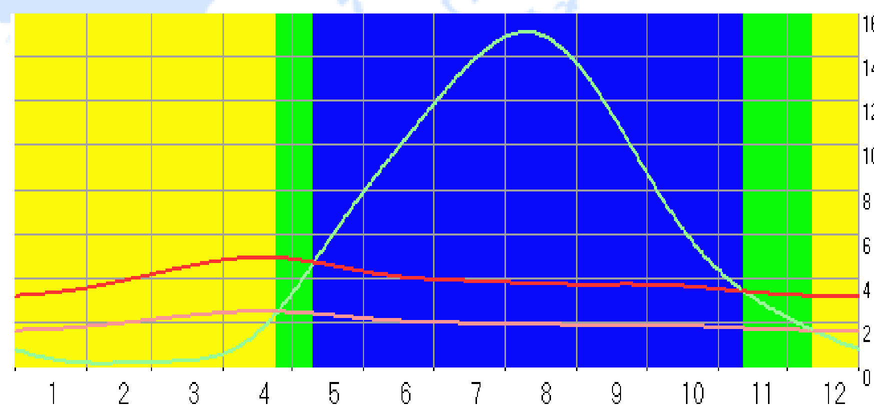
Humid: blue

“Plain” normal (= with dry season)
S1 S3
S9 S10

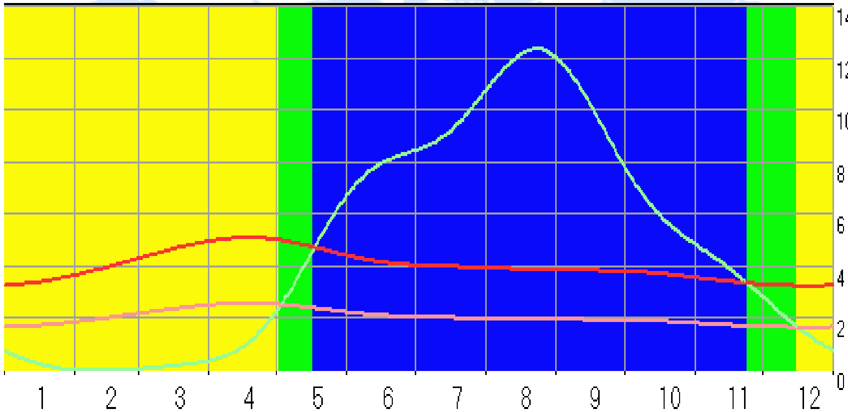


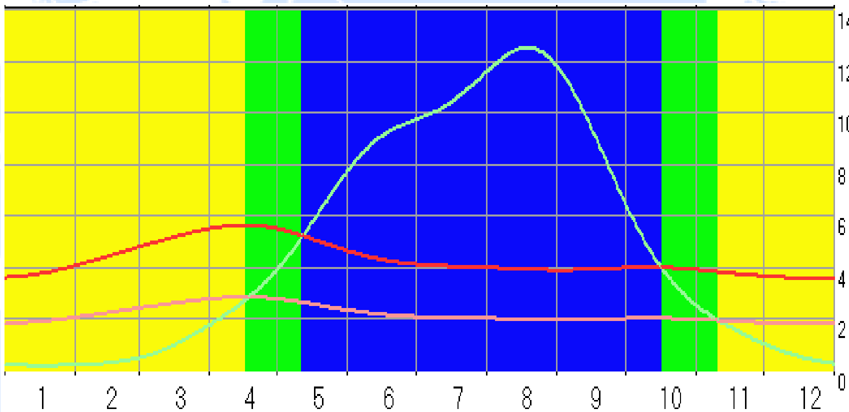


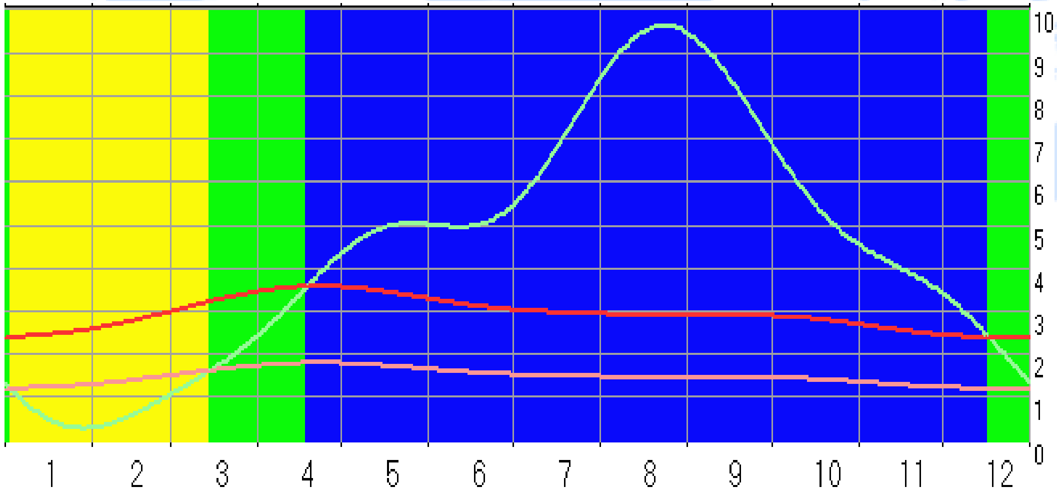




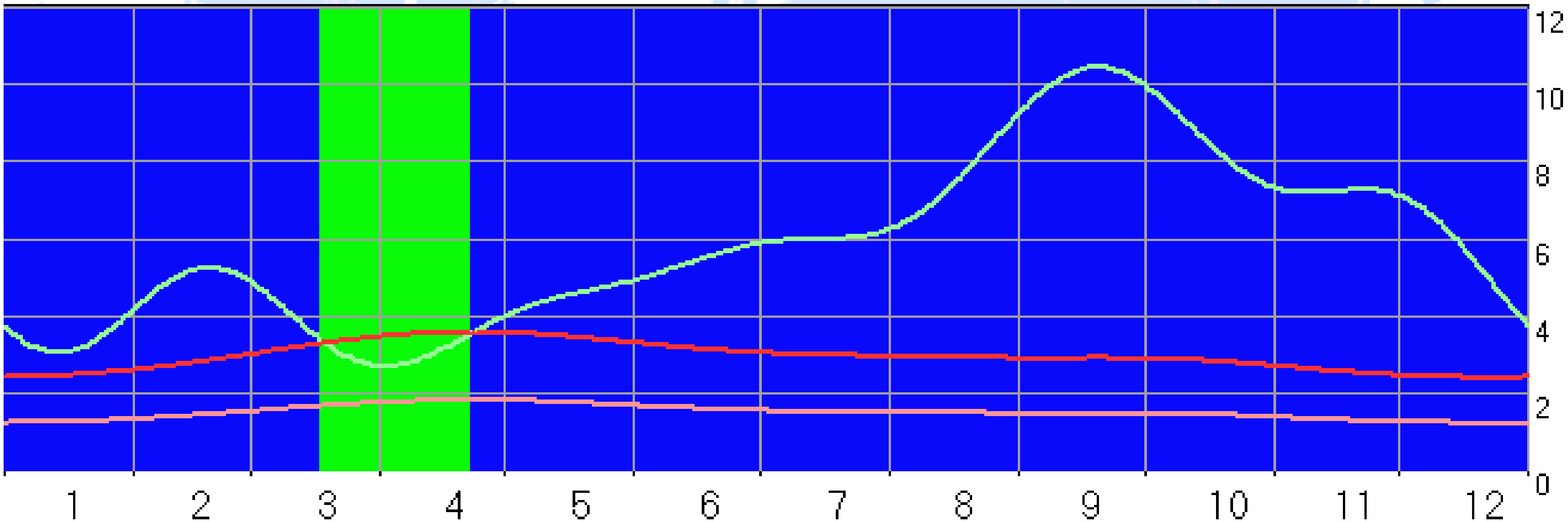
Normal (with bimodal tendency)
S2 S4
S5



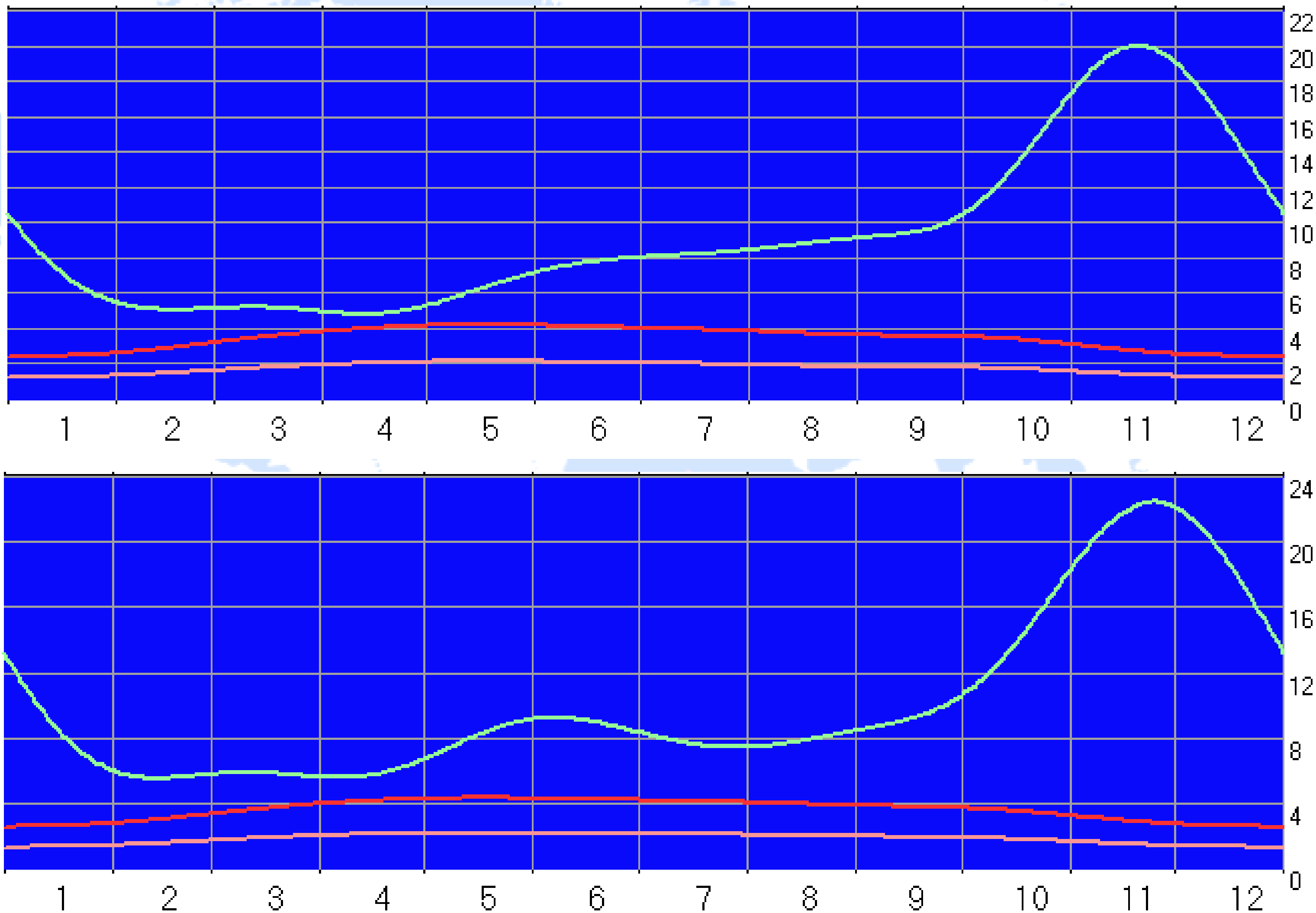




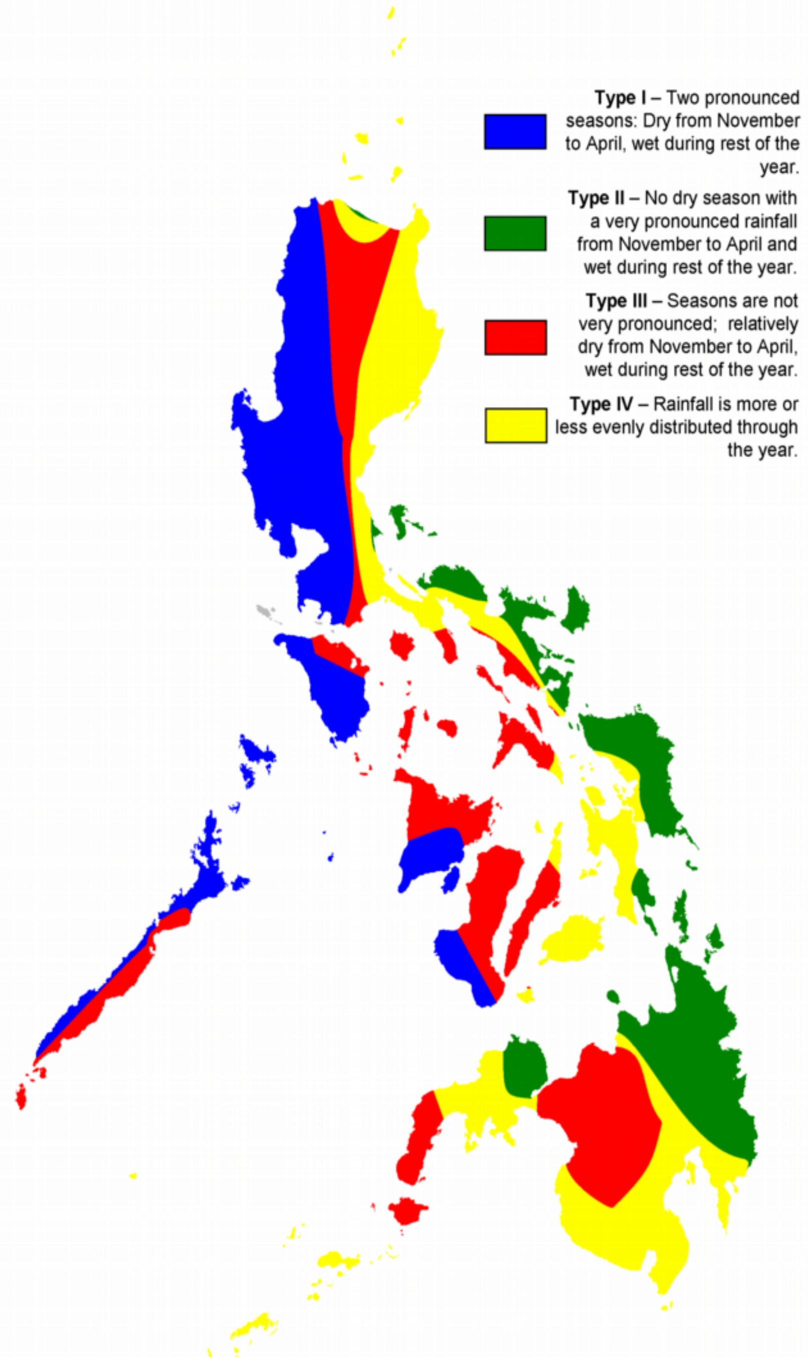
Intermediate-humid
S6



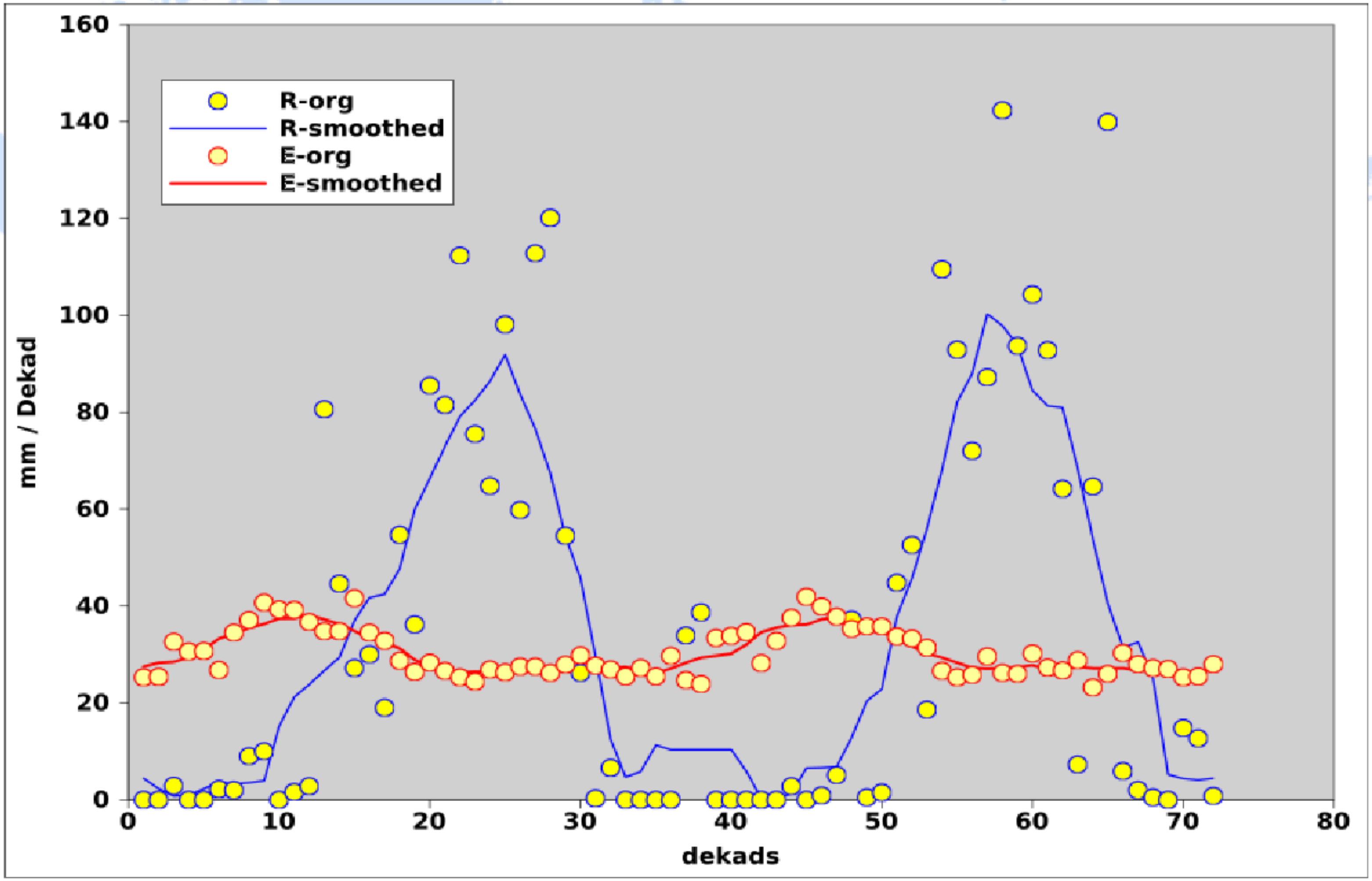
All-year-round humid
S7 (top) S8 (bottom)



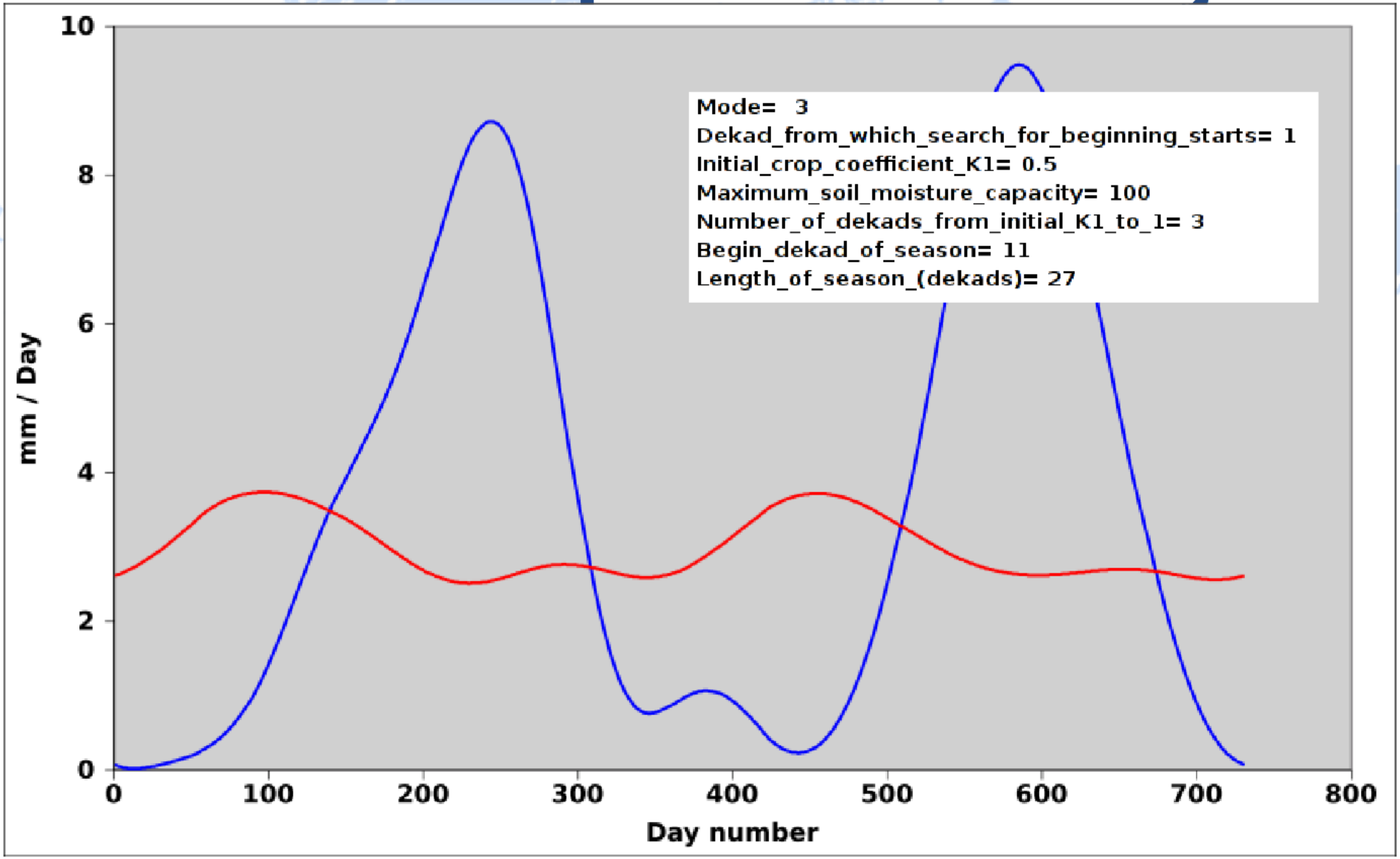
How compatible is this with...



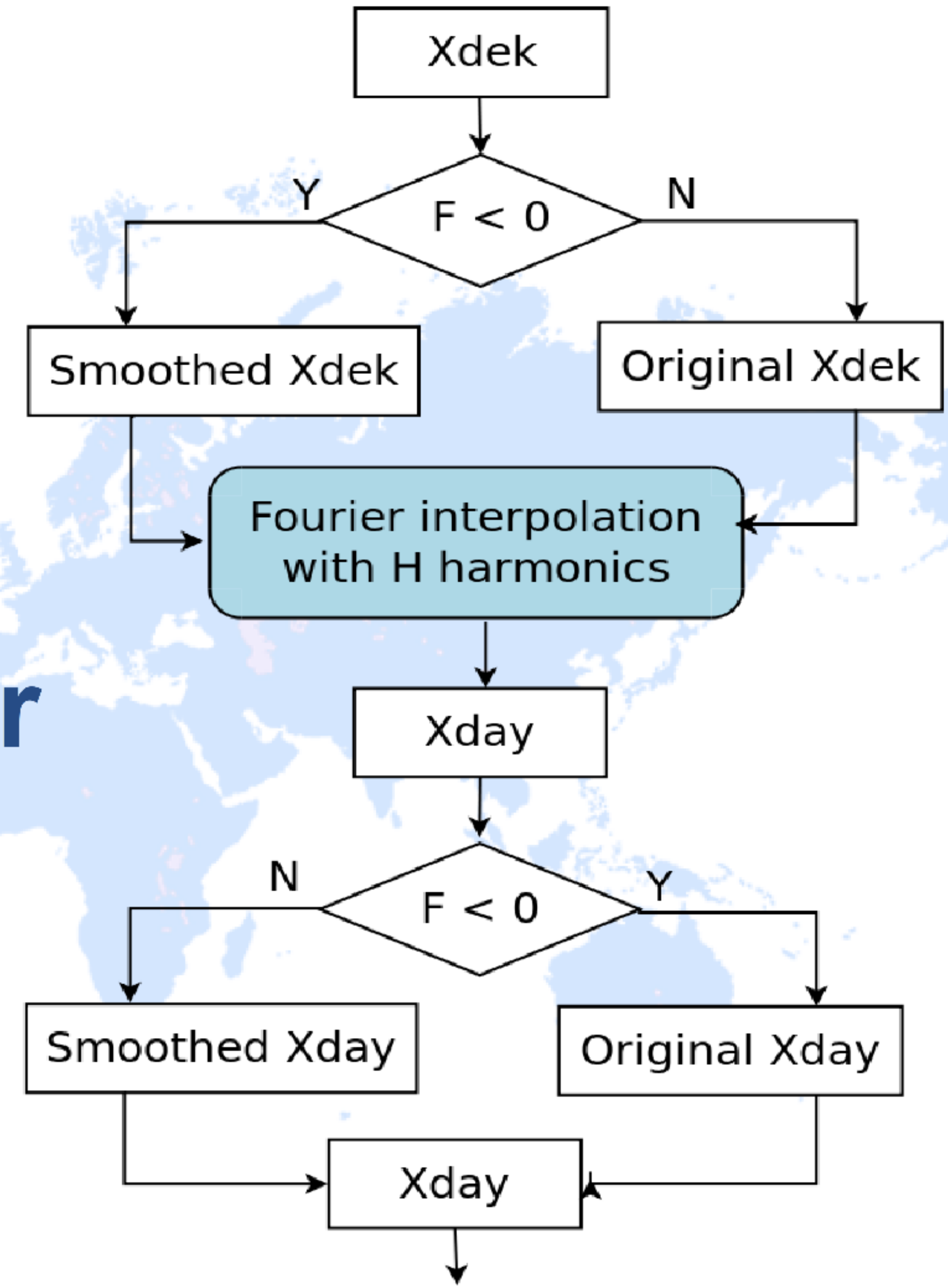
Reality and slightly "improved" reality!



More seriously "improved" reality!



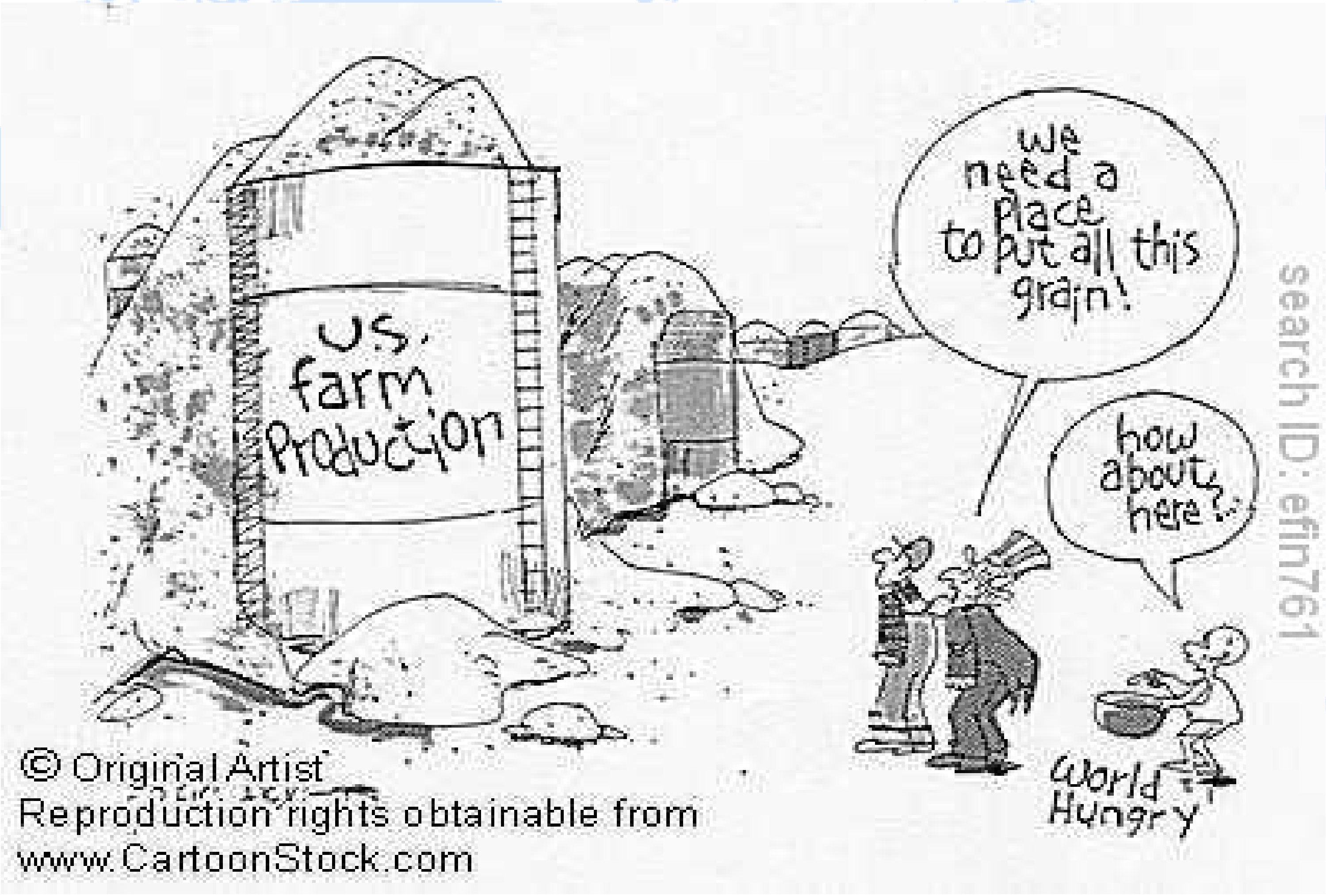
The improver



The "mode" explained

Mode	Definition
0	Beginning and end using the "*Simple method*": planting dekad is the first dekad from **dek_init** when R >= E***k_init**. Season ends when R<=E***k_init**.
1	Beginning and end using the "*Standard Franquin*": if **dint** is the value of **interval** expressed in days, beginning is on the first day i after the 5th day of **dek_init** when R(i-**dint**)<=E(i-**dint**)* **k_init** and R(i+**dint**)>E(i+**dint**)***k_init**; season ends when R(i-**dint**)>=E(i-**dint**)* **k_init** and R(i+**dint**)<E(i+**dint**)***k_init**.
2	Beginning as in mode 0; end based on soil water balance.
3	Beginning as in mode 1 ("*standard Franquin*"); end based on soil water balance.

Thank you!


U.S. farm Production
we need a place to put all this grain!
how about here?..
World Hungry
search ID: efin761
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  - Second level
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