Use of SWAT for the Assessment of Water Productivity in Mediterranean Catchments a case study in Syria

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Objectives

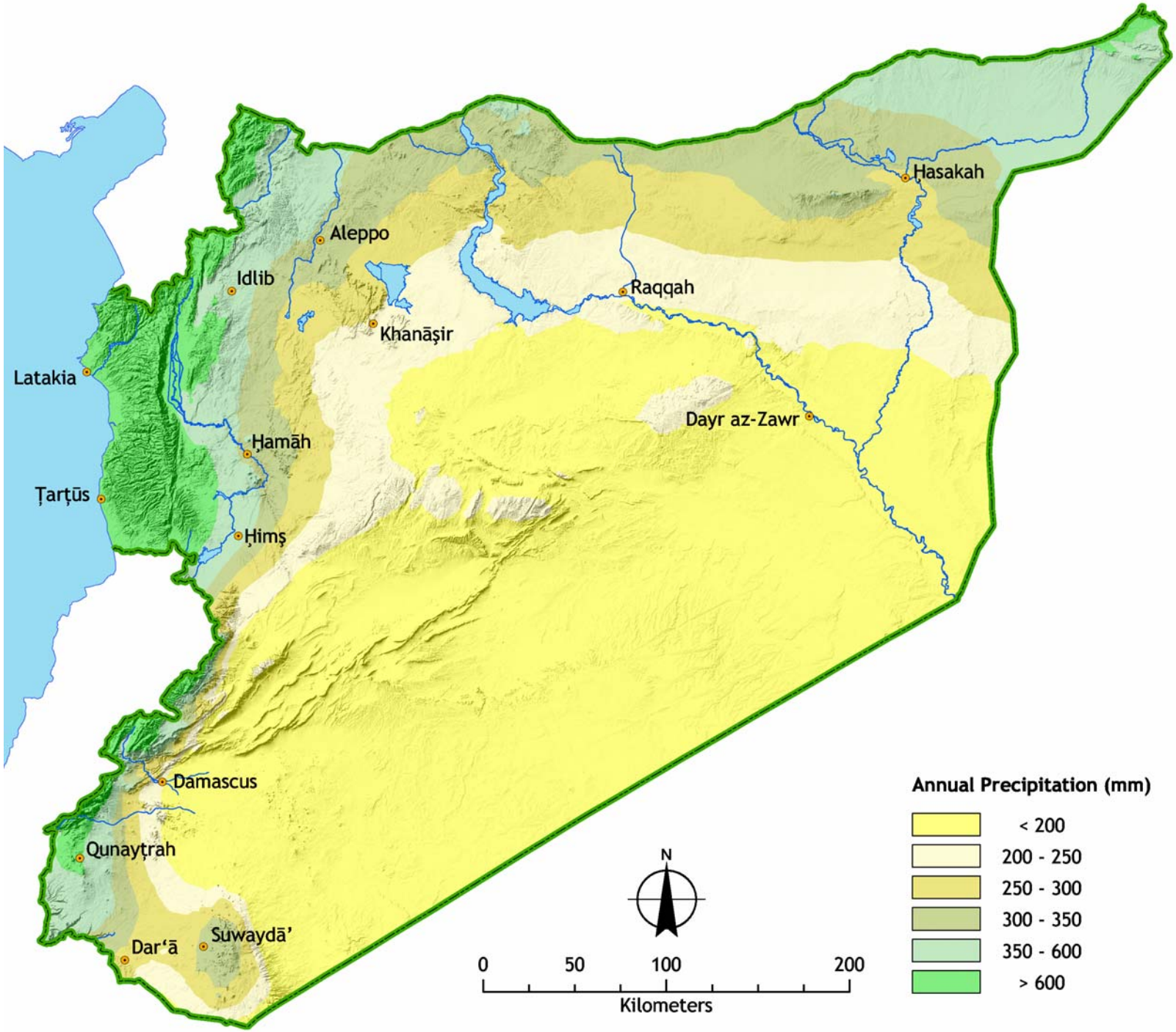
Goal:

To evaluate long-term water productivity under different land and water use scenarios in ungauged, arid and semi-arid, Mediterranean catchments.

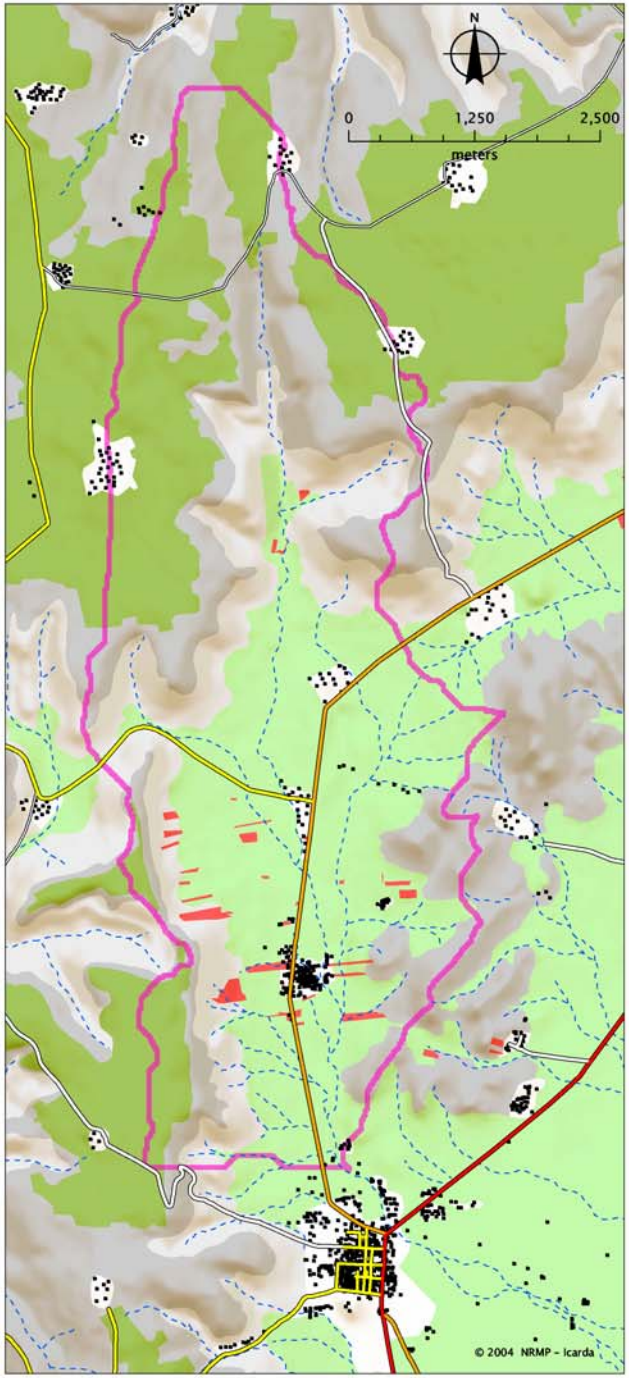
Specific objectives:

To test and adjust input parameters and SWAT2000 code for:

- Weather generation,
- Mediterranean crops and cropping practices,
- Changing surface conditions during the growing season,
- Micro-catchment water harvesting,
- Macro-catchment water harvesting.

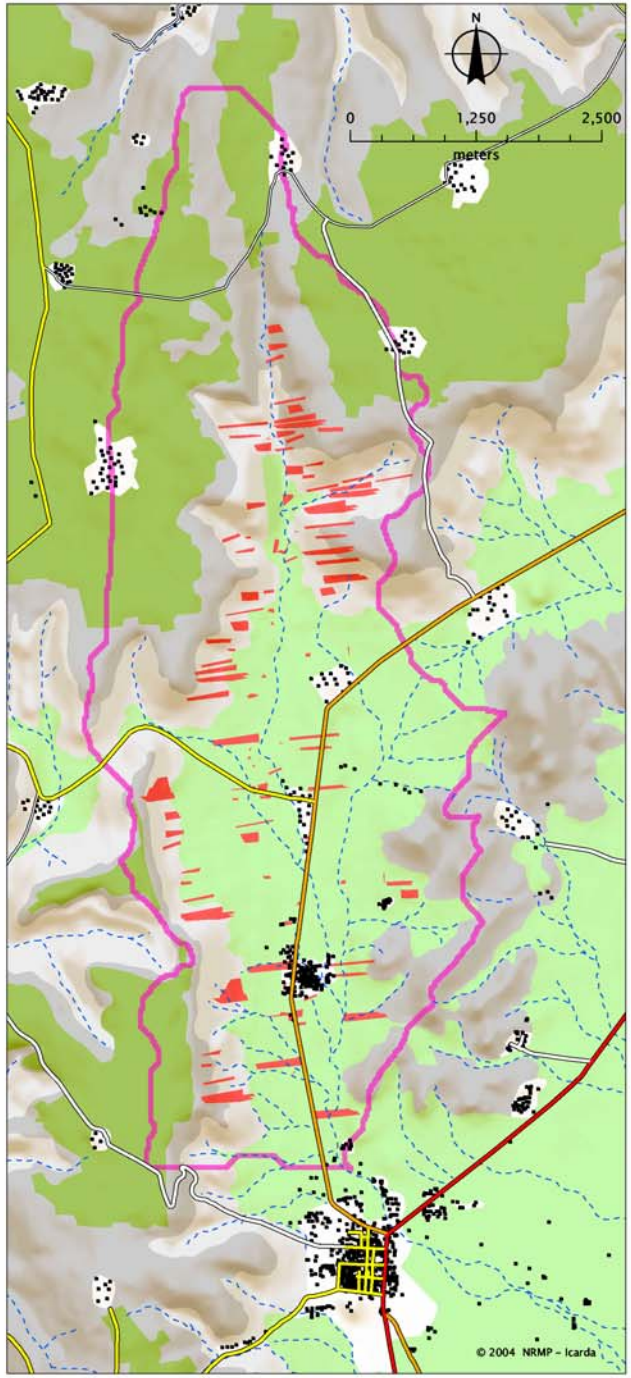

Ḥasakah
Aleppo
Idlib
Raqqah
Khanāṣir
Latakia
Dayr az-Zawr
Ḥamāh
Ṭarṭūs
Ḥimṣ
Damascus
Qunayṭrah
Dar'ā
Suwaydā'
N
0
50
100
200
Kilometers
Annual Precipitation (mm)
< 200
200 - 250
250 - 300
300 - 350
350 - 600
> 600

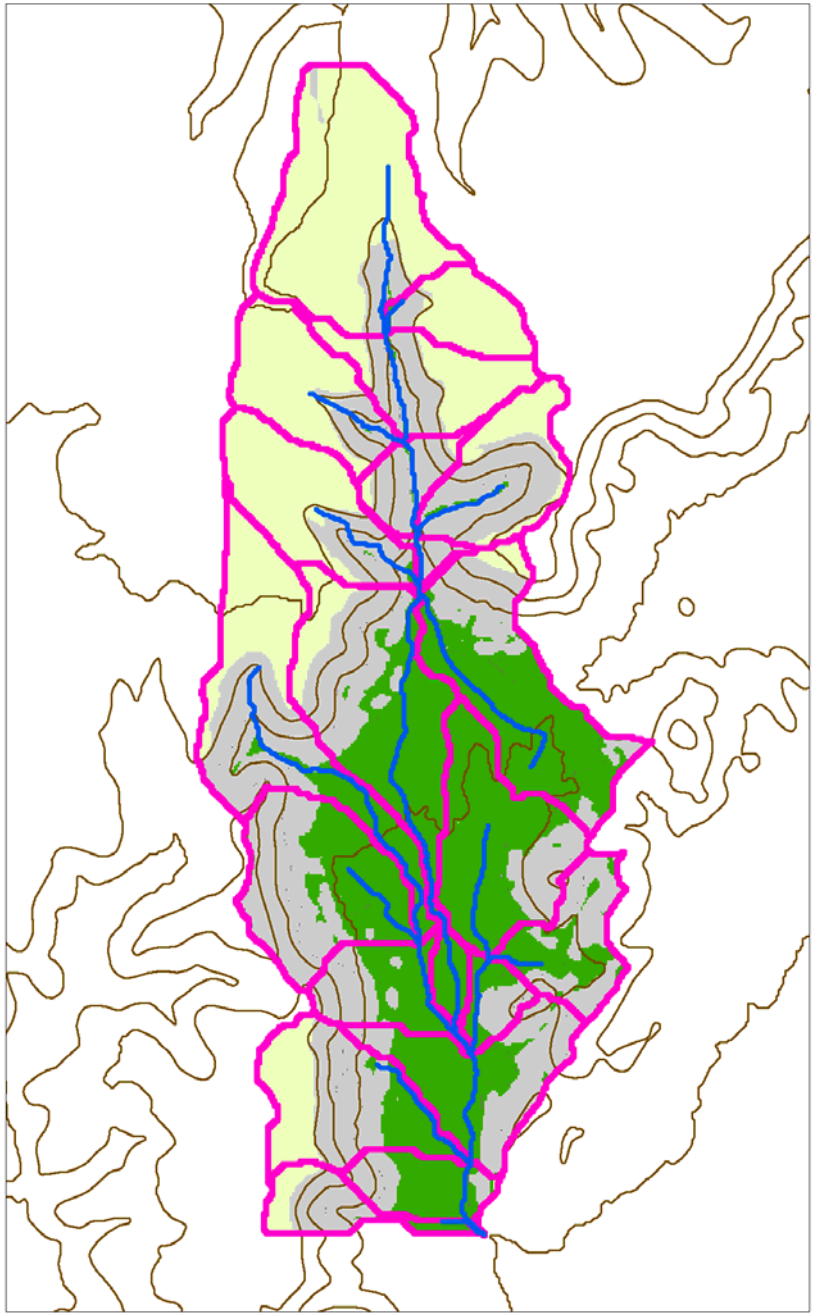
Habs - Harbakiyah Valley



Legend

- Arable land Plateau
- Arable land Zone 4
- Stony rangeland
- Stony hillslopes
- Village area
- Olive fields
- Buildings
- Paved roads
- Stabilized roads
- Habs and Harbakīyah Watershed
- Wadis





Legend

- Streams
- Subwatersheds
- Elevation contours (50m)
- Plain
- Plateau
- Slopes

Plain:
Calcisols
Loam (1500 mm)

Plateau:
Cambisols
Clay loam (600 mm)

Slopes:
Calcaric Leptosols and Calcisols
Clay loam (350 and 1000 mm)

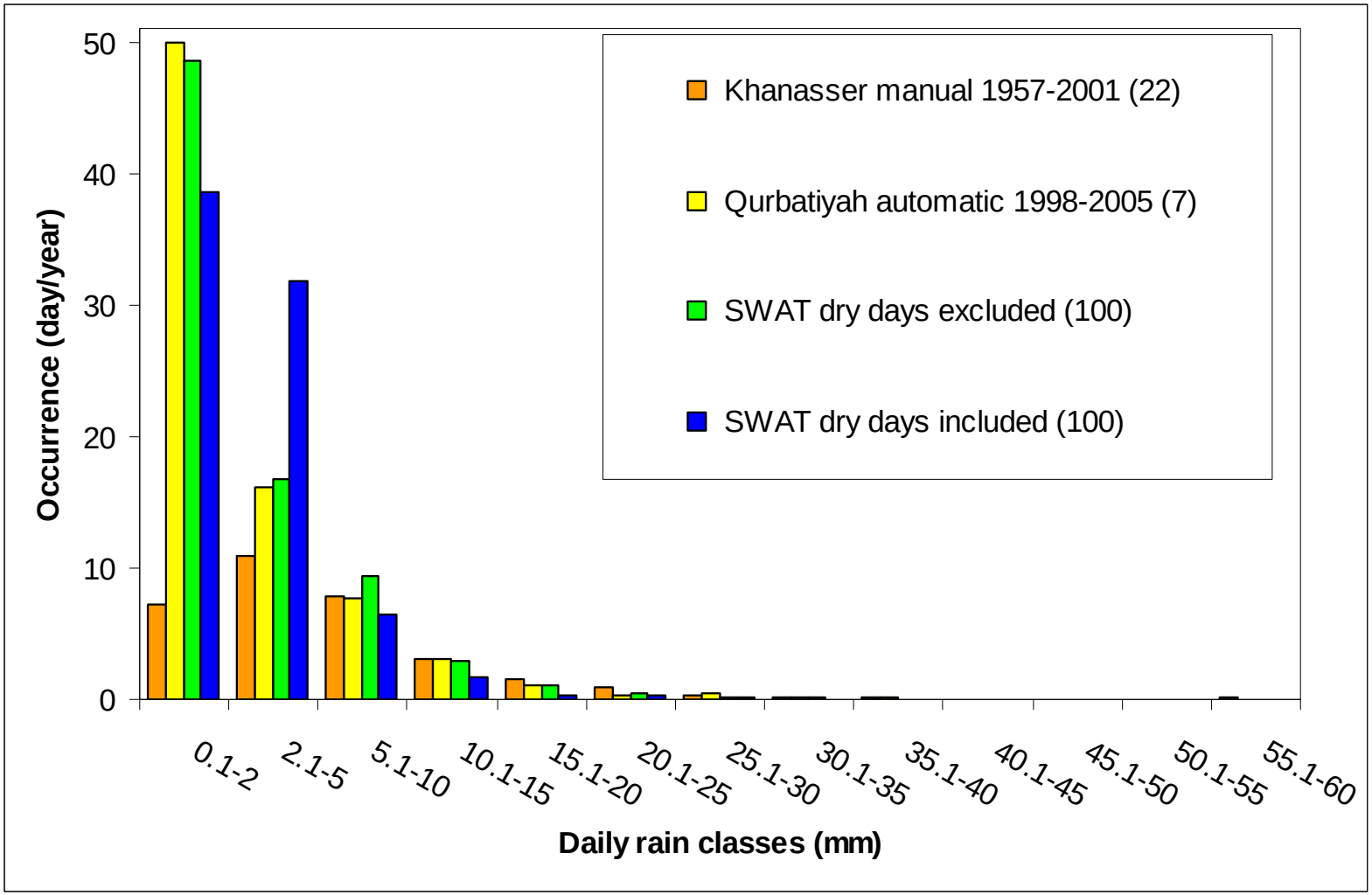
N

0 1,750 3,500

meters

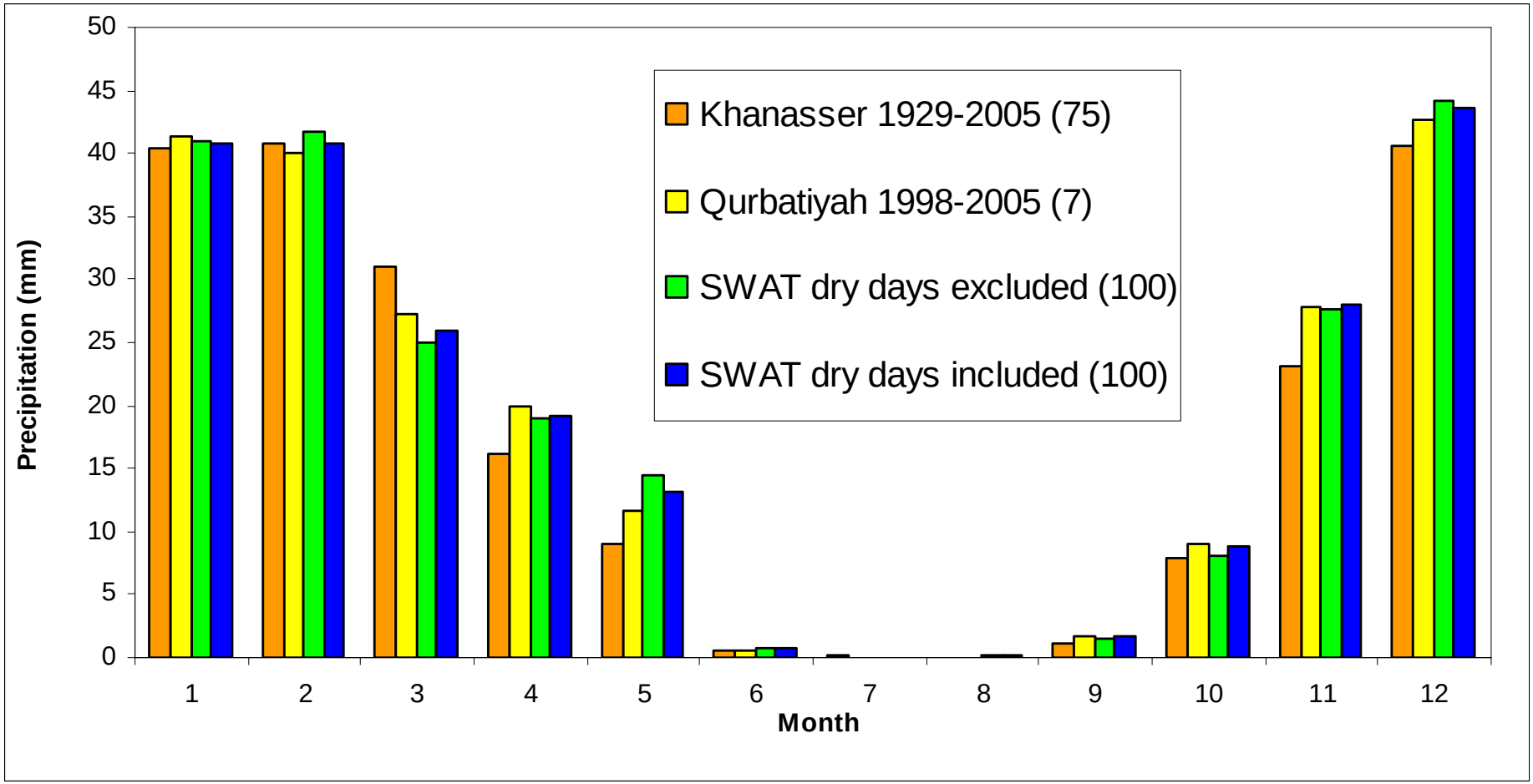
Weather Generation

Weather Generation – Daily Precipitation



PCPSTD and PCPSKW
SWAT User's Manual Version 2000 (p.128-129)
"daily precipitation values of 0 mm are included in the calculation."

Weather Generation - Monthly Precipitation



SWAT2000:
1900 has 366 days (in leap years, management operations are 1 day early!)
2000 has 365 days

Weather Generation - Snow

Mean Temperature	Day/yr		Rain day/yr	
°C	Observed	SWAT	Observed	SWAT
=< -1.0	0.45	0.22	0.05	0.22
< -1.0 - 0.0]	0.90	0.87	0.15	0.80
< 0.0 - 1.0]	0.55	1.00	0.05	0.97
Total			0.25	1.99

sbsday.f : pdvas(X1) = tmn(j), pdvas(X2) = tmx(j)
basins.bsn : SFTMP = -1.0 °C

Crops - Cereals

Crops - Cereals

- Cereals are planted in November-December
- Cereals are harvested in May-June
- Local cereal varieties do not go dormant
- Residues are grazed after harvest

basins.cod

starting date: IDAF = 1

crop.dat

Land cover classification: IDC = 5

dormant.f

case(2,5) → case(2)


Crops - Olives

Crops - Olives

- Olive trees go dormant, but do not loose leaves
- Olives are pruned in March, harvested in November - December

crop.dat

- Land cover classification: Olives, IDC = 8
- Fraction of growing season when leaf area declines: DLAI = 1.0
- Pruning controlled with max. potential leaf area index: BLAI

dormant.f

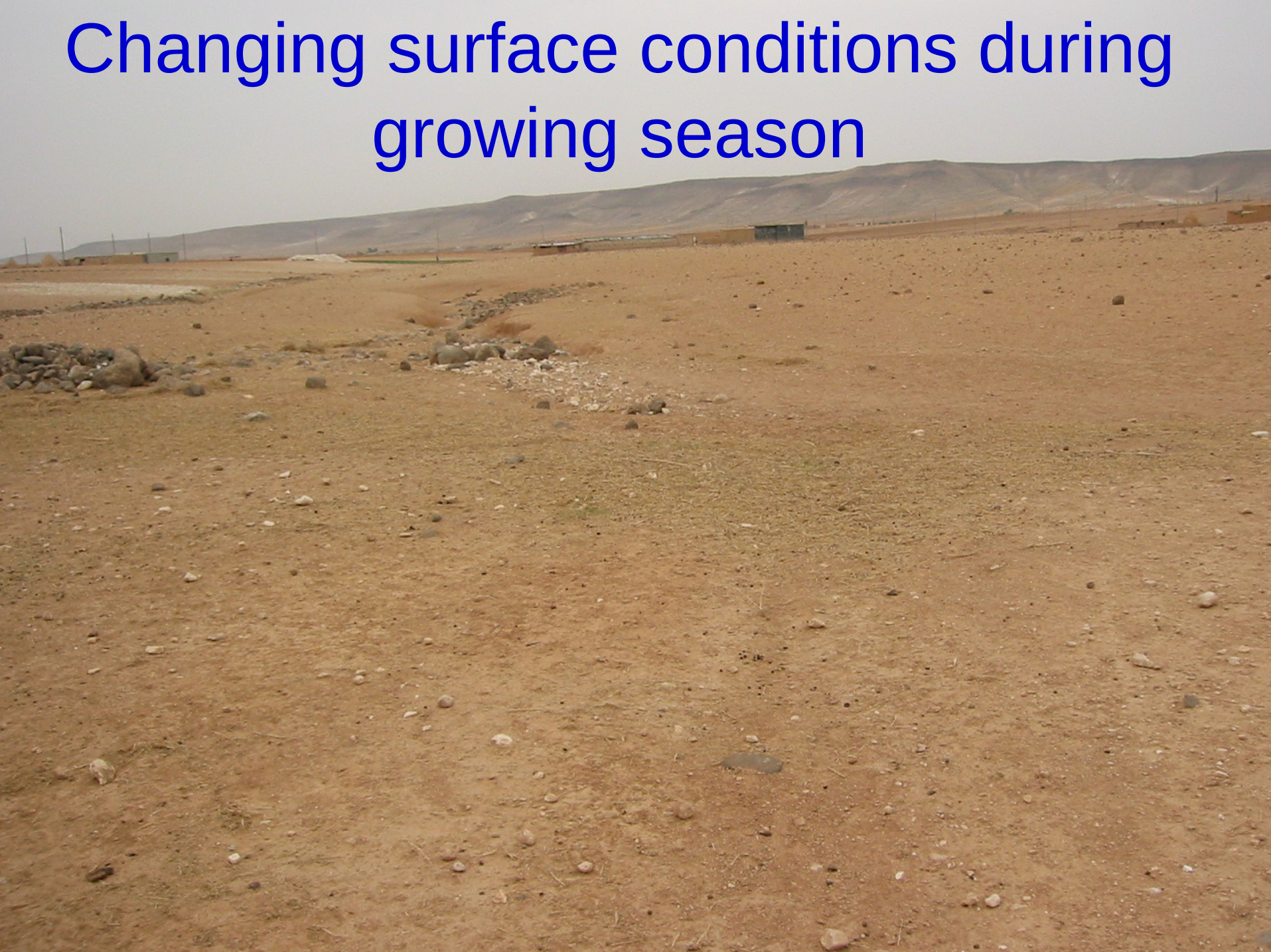
case(8)
idorm(j) = 1
phuacc(j) =0
strsw(j)=1

harvestop.f

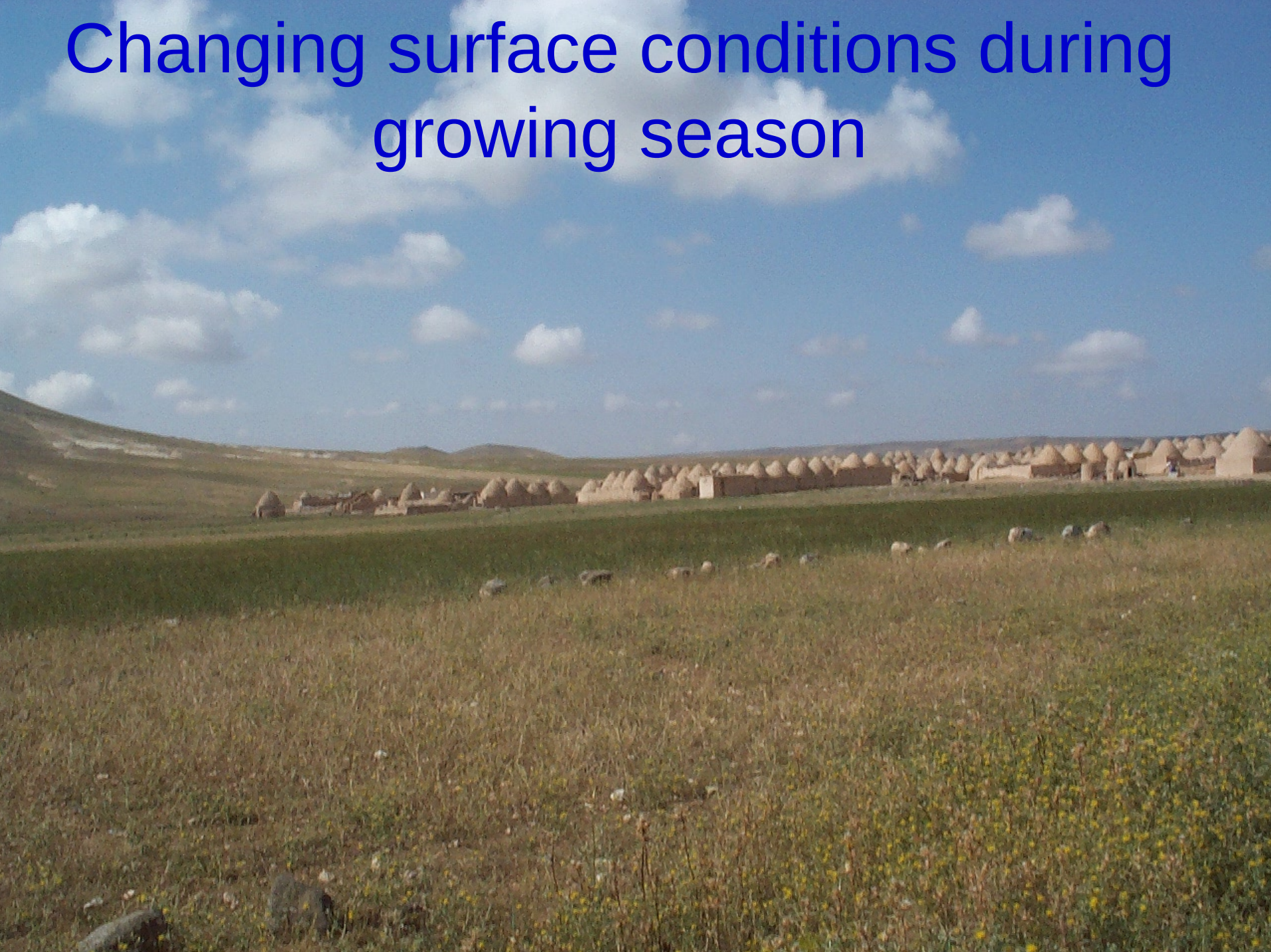
annual yield : yldanu(j) = yldanu + (yield + clip) / 1000
(clip is loss due to harvest efficiency)
annual biomass : dmanu(j) = dmanu(j) + bio_ms(j) / 1000

similar problem in dormant.f

Changing surface conditions during growing season



Changing surface conditions during growing season



Changing surface conditions during growing season

hruallo.f

!! calculate maximum number of crops grown in a year
mcr = Max(mcr,plt,kll,hkll) → mcr = 10

simulate.f

!! update sequence number for year in rotation to that of
!! the next year and reset sequence numbers for operations
nop(j) = 1 → nop(j) = 6

getallo.f

!! initialize variables
ma = 0 → ma = 10

zero0.f

nop = 1 → nop = 6

readmgt.f

inop = 0 → inop = 5
!! re-initialize annual counters
inop = 0 → inop = 5

till.dat

79 CN 0.000 0.000 CN-change

Micro-catchment Water Harvesting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Micro-catchment Water Harvesting

Surface runoff is collected from uncultivated catchment areas in between trees, shrubs or crop-strips and stored in the root zone.

SWAT2000

Water is harvested from within the HRU.

Crop growth and water use is a 1-dimensional process.

For LAI < 3.0 : $ET = (ET_o \ LAI) / 3.0$

CN	BLAI	SURQ mm	ET mm	W_STRS	YIELD ton/ha
70	1.5	0.3	223	186	1.43
92	3.0	9.4	215	239	1.31


Macro-catchment Water Harvesting

Macro-catchment Water Harvesting

Macro-catchment Water Harvesting

Macro-catchment Water Harvesting 1

Water is diverted from wadi

SWAT2000

irr_rch.f

!! remove water stress requirement

if (strsw(k) < auto_wstr(nro(k),nair(k),k)) flag = 2 → flag = 2

!! irrigate up to saturation instead of up to field capacity

vmxi = sol_sumfc(k) → vmxi = sol_sumul(k) - sol_sw(k)

irrigate.f

irrigate up to saturation instead of field cap.

fcx = sol_fc(k,jj) → fcx = sol_ul(k,jj)

Macro-catchment Water Harvesting 2

Water is harvested from upstream HRUs

SWAT2000

surface.f

```
!!  add overland flow from upstream routing unit
      precip = precip + ovrlnd(j)
```

does not work ?

virtual.f

```
      aird(j) = 0.  → move up
!!  apply runoff water from all HRUs in subbasin as irrigation
      rtwtr = wqd(sb) * sub_ha * 10
      rtwtr1 = rtwtr
      if (rtwtr > 0.1) call irr_rch
!!  rtwtr that comes back is the remainder, rtwtr2 is the irrigation applied
      rtwtr2 = rtwtr1 - rtwtr
      rtwtr2 = rtwtr2 / (sub_ha * 10)
      wqd(sb) = wqd(sb) - rtwtr2
      wwy(sb) = wwy(sb) - rtwtr2
      if (wwy(sb) < 0.) wwy(sb)=0.
      rtwtr = 0.
```

Thank you!

- **The SWAT development team**
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- **ICARDA scientists and staff**

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