Managing water ressources within Mediterranean agrosystems bu accounting for spatial structures and connectivities - ALTOS

KOM ALTOS-Tunisie

WP4
Simulating fluxes and storages for structure modulations

October 26, 2020

WP4
Simulating fluxes and storages for structure modulations

Work package number	WP4		Lead beneficiary				UCAM & INRGREF				
Work package title	Simulating fluxes and storages for different scenarios of structure modulations										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	LISAH	CESBIO	IRTA	UNICA	CNRS-L	LARI	UCAM	INAT	INRGREF	SUPCOM	CERTE
Person months per participant	80	9	0	0	8	4.5	15	32	35	0	8.5
Start month	12			End month				36			

WP4

Task 4.2: Simulating fluxes and storages for structure modulations

Selection of integrated modelling schemes	All partners except IRTA and UNICA
Simulations on the basis of scenarios	
Indicator design and production	
Scenarios ranking with decision makers	

ALTOS KoF meeting

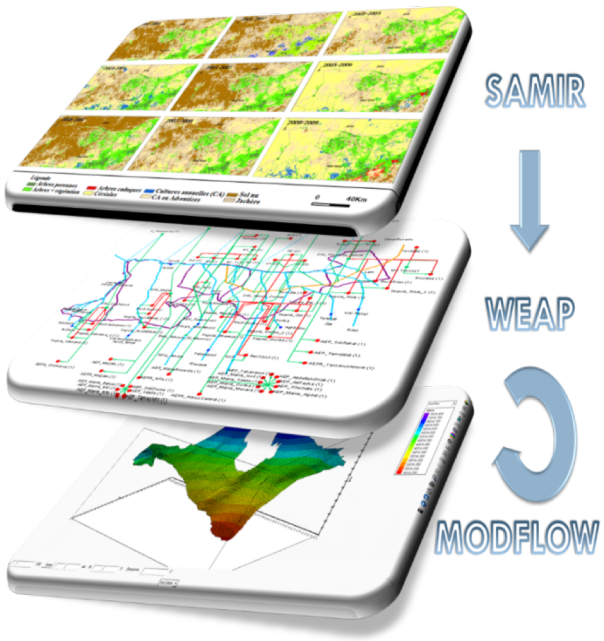
- Cadi Ayyad University UCA -

Tensift Site

WP4

April 20-21, 2020

Task4.2 INTEGRATED MODELLING & SCENARIOS



Objectives:

- Update of the water modelling system (SAMIR-WEAP-MODFLOW)
- Projection of current trajectories based on narrative and quantitative approaches.
- Elaboration of indicators to assess the impact of alternative management policies.

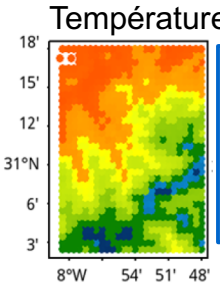
Tools :

- Numerical modeling, time series analyses, participative workshops.

Chaîne de prévision hydrométéorologique SAFRAN-ISBA-RAPID

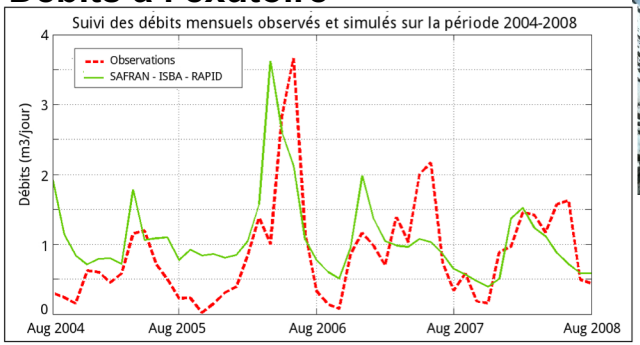
The main goal:

This study aims to set up the SAFRAN re-analysis system on the Tensift catchment, by using all the meteorological measurements acquired on the site from 2004 to 2018.



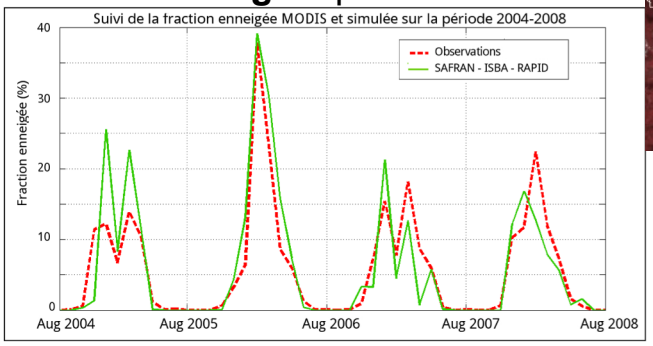
Forçage météo
(ré-analyse SAFRAN)
Quintana-Segui et al., 2008

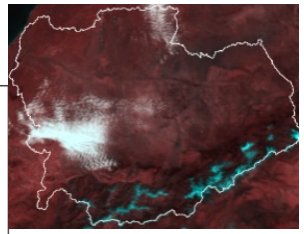
Débits à l'exutoire



Modèle SVAT et neige
(ISBA et ISBA-ES)
Noilhan et Mahfouf, 1996

Surface enneigée: produits MODIS





RAPID
(routage)
David et al., 2011

PHD: Ahmed Moucha

Contribution

Impact assessment and scenario ranking / LISAH

Objectives: conducting simulations of ecosystem services for given panels of scenarios, to next rank these scenarios on the basis of durability.

Method: using well known modelling tools (e.g., SWAT) and innovative tools (e.g., MHYDAS + DHAM-reservoir + SAFYE / AqYield within OpenFLUID integrated platform). Using a panel of indicators, in relation to spatial and temporal scales, and to targeted ecosystems services, to be analysed with stakeholders.

Impact assessment and scenario ranking / LISAH

Means

- 1 PhD (MESRS / IRD)
- 1 PhD (CHAAMS granted)
- 1 ALTOS granted post-doc
- NAILA stakeholder committee

Partnership

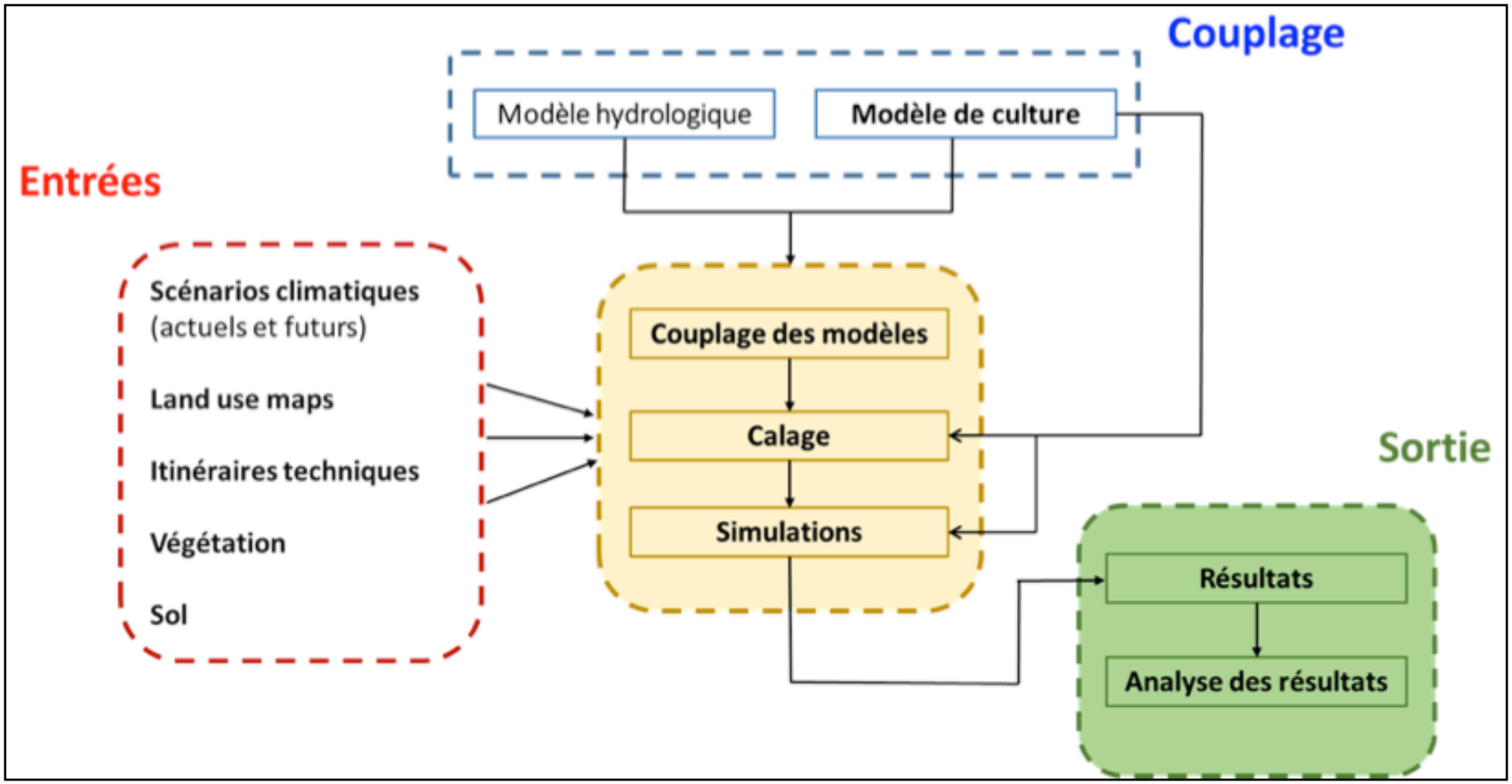
- INRGREF, INAT, UCA, CESBIO

Impact assessment and scenario ranking / LISAH

Table 1.6: overview of scenario impacts along with the involved partners. WUE stands for water use efficiency.

Site	Partners	Modelling schemes	Structures to be modulated						Services				
			Land use	Reservoirs	Benches	Irrigation	Pest management	Climate	Yield & WUE	Catchment outflow	Aquifer refill	Silting	Mitigating pollution
Cap Bon	INRGREF LISAH INAT	MHYDAS & Crop model	X	X				X	X	X	X		
		SWAT	X				X	X	X	X	X	X	X

Impact assessment and scenario ranking / LISAH



Impact assessment and scenario ranking / LISAH

Roadmap

- Nothing up to now.
- Maybe to be addressed in 12 months ?

See also works on SWAT by INRGREF

Impact assessment and scenario ranking / LISAH

Difficulties

- Difficulty to brainstorm internally at LISAH because of the confinement and individual situation of many of the key colleagues in the project.
- Risk of rushing into action on the wrong track.
- If brainstorming with only a few people, risk of non-adherence/ incomprehension of others about the choices made.
- Postponement of the brainstorm until the resumption of activities (May-June?).
- Means postponing the recruitment of the post doc until the beginning of the school year at best, probably in the autumn.

Task 4.2: impact assessment and scenario ranking (leader: INRGREF).

PI : Aouissi Jalel

Zohra Lili Chabaane, Sihem Benabdallah, Zeineib Kassouk, Ines Oueslati, Hanene Chaabane, Adel Zghibi

Stage 1

- Modelling schemes with improved SWAT model results (landuse, hydraulic conductivity, Zoning of agroforestry area)

Stage 3

- impact assessement of diffrent scenarios using SWAT model according to efficient criterea and reduction rate of sediement yields and in the diffrent hydrological components on daily, monthly and annual values .

Stage 4

- impact assessment of structure modulation scenarios using SWAT model

- Ranking scenarios with national and regional directorates on the level of acceptance and their faisability

PhD student : Ines Gharnouki started in February 2020
Study area : Merguellil
Partener : UNICA, CESBIO

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Managing water resources within Mediterranean agrosystems by accounting for spatial structures and connectivities.

WP3: Simulating fluxes and storages for different scenarios of structure modulations

Task 4.2 : : impact assessment and scenario ranking (leader: INRGREF).

CERTE contribution

Impact of upstream land use and climate forcing on the downstream aquifer recharge within Cap Bon

CERTE Proposition

Goals:

- Geologic characterization of Dam and aquifer recharge
- 3-D aquifer characterization
- Quantification of Dam infiltration for aquifer
- Modeling aquifer recharge according to the land use scenarios of Lebna watershed up stream using SWAT and MODFLOW

Team: Master

Period: 2021-2022

Methodology

Up Stream

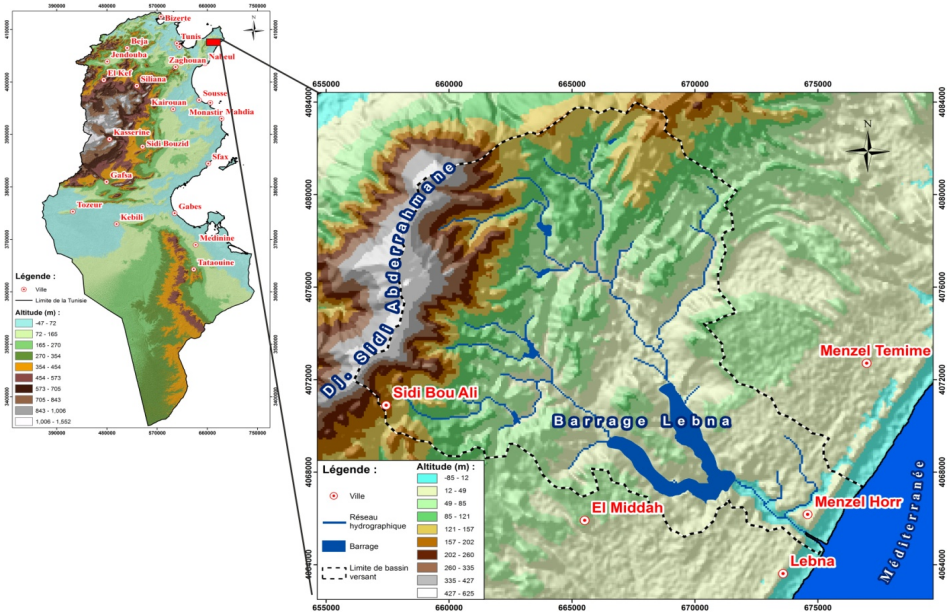
Scenario of land use SWAT

Up Stream / Down Stream

Down Stream

Scenario of dam-aquifer recharge MODFLOW

Geophysics, Dam budget, Isotopic groundwater monitoring



Geologic map

Partnership ???: INRGREF, LISAH and CERTE

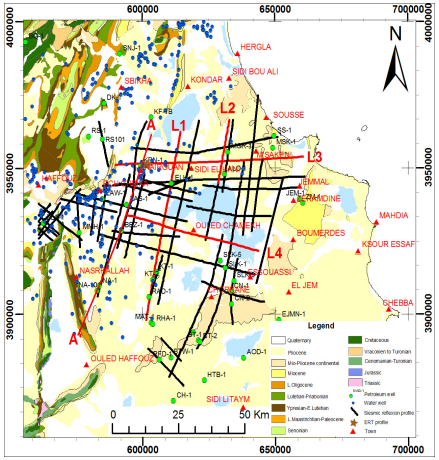
Project: LMI-NAILA (Axe 2 and transversal action)
Aquifer recharge, LGR, CERTE

SWAT and WEAP simulations for land use / irrigation / bench modulation scenarios within Merguellil

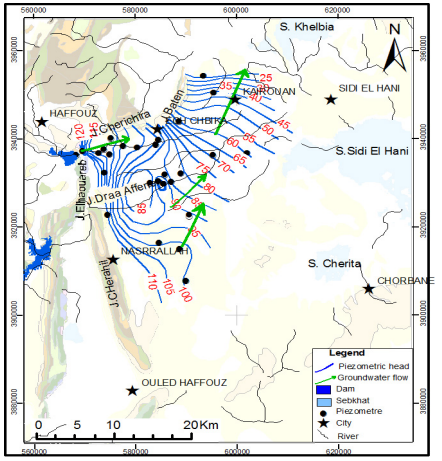
Proposition

CERTE contribution:

- Geologic and 3D aquifer characterization
- integrated and sustainable water resources management (WEAP);
- Modeling land use scenarios (SWAT) / aquifer recharge using and WEAP and MODFLOW

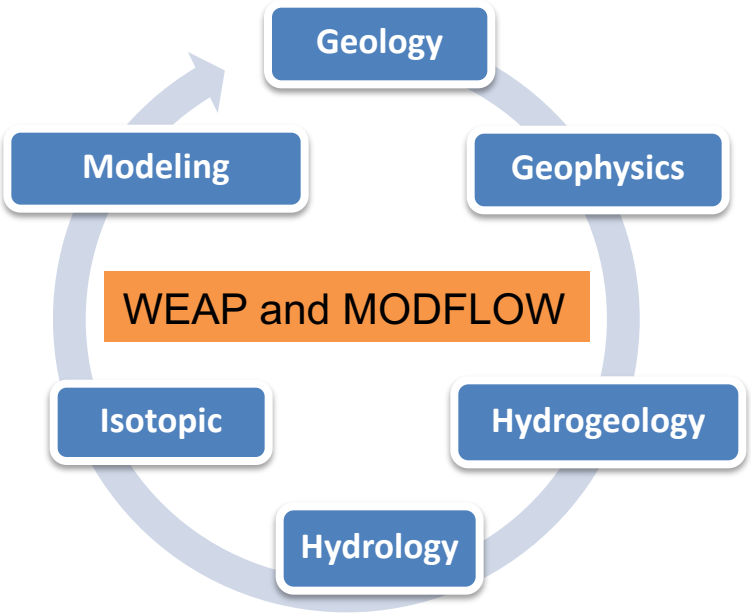


Geophysics data and geologic map



Piezometric map

Methodology



Team: Master

Period: 2021-2022

Partnership: INAT, CESBIO and CERTE

Project: Aquifer recharge, LGR, CERTE

INRGREF Contribution

Partnership

- Lisah,

Goals

- Explore the use of Soil and Water Assessment Tool (SWAT) in order to predict the hydrologic response in a small agricultural catchment context,

- Simulation of provisioning and regulating services; yields of water, sediments transport, and agricultural production (crop biomass, yield).

ANR TRANSMED ALMIRA

SWAT modelling

Implementation SWAT: 30 years (1986-2016), daily discharge at the outlet of Lebna catchment and Kamech sub-basins

4 years warm up (1986-1989)

16 years calibration (1990-2005)

10 years validation (2006-2016)

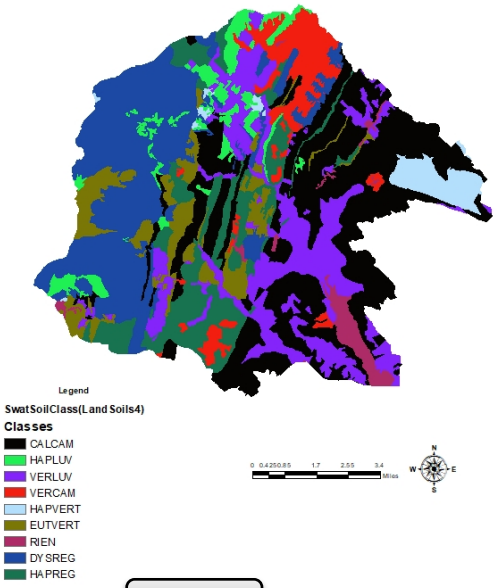
ANR TRANSMED ALMIRA

ALMIRA
LANDSCAPE MOSAICS & AGROSYSTEM SERVICES

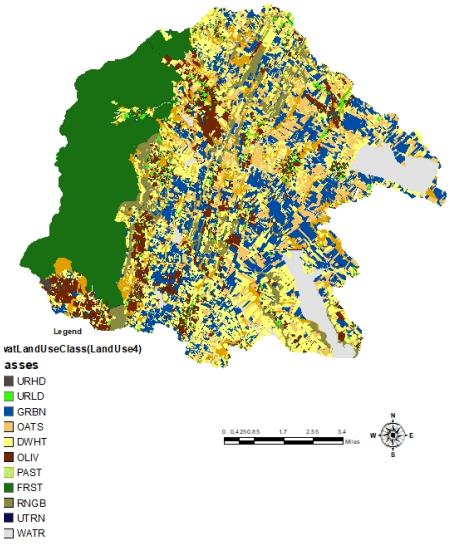
SWAT modelling

Landscape discretization : *HRUs*

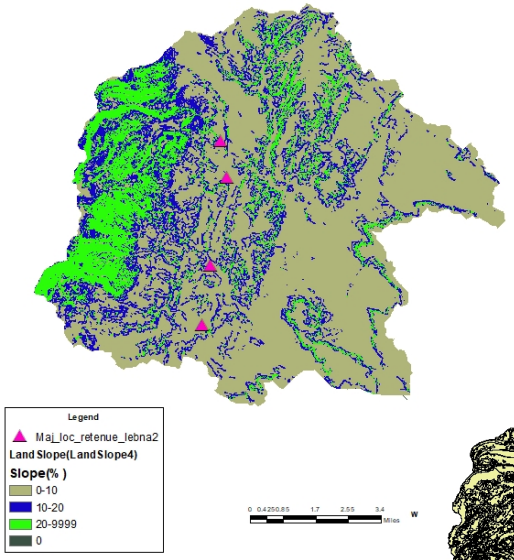
107 subasins



Soils

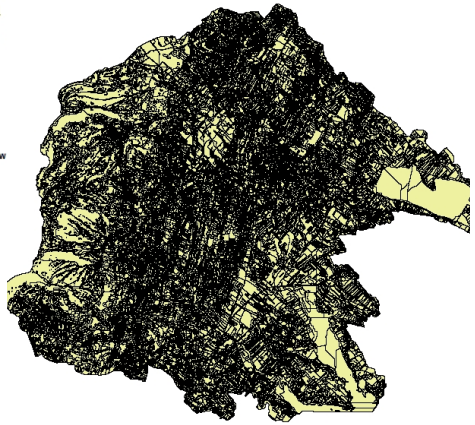


Land use



Slope

2499 HRU

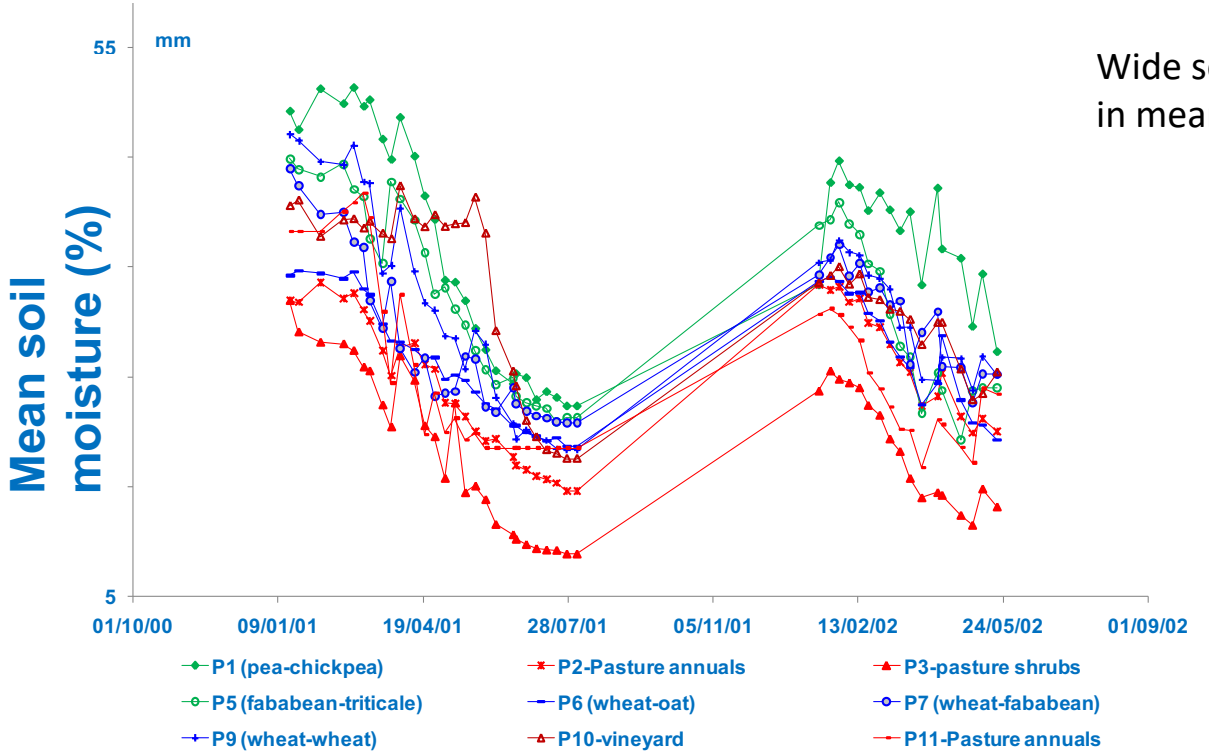


SWAT modelling

Services	Indicators
Surface water production	Flow at the outlet of the basin (monthly time step) Annual water balance at the catchment level: Precipitation, flow, actual evapotranspiration and stock variation
Agricultural production	YLD (.hru) : Harvested yield (metric tons/ha). The model partitions yield from the total biomass on a daily basis
Soil loss preservation	Average flow of TSS (t/ha) at the outlet at monthly time step Average MES flow (t/ha/year) at HRU level at annual time step

Results

Impact of spatiotemporal distribution of land use and crop rotation on SWC and ETa



Wide seasonal and annual fluctuations in mean soil water content

Similar trends in relation to the infiltration-evaporation-infiltration cycle

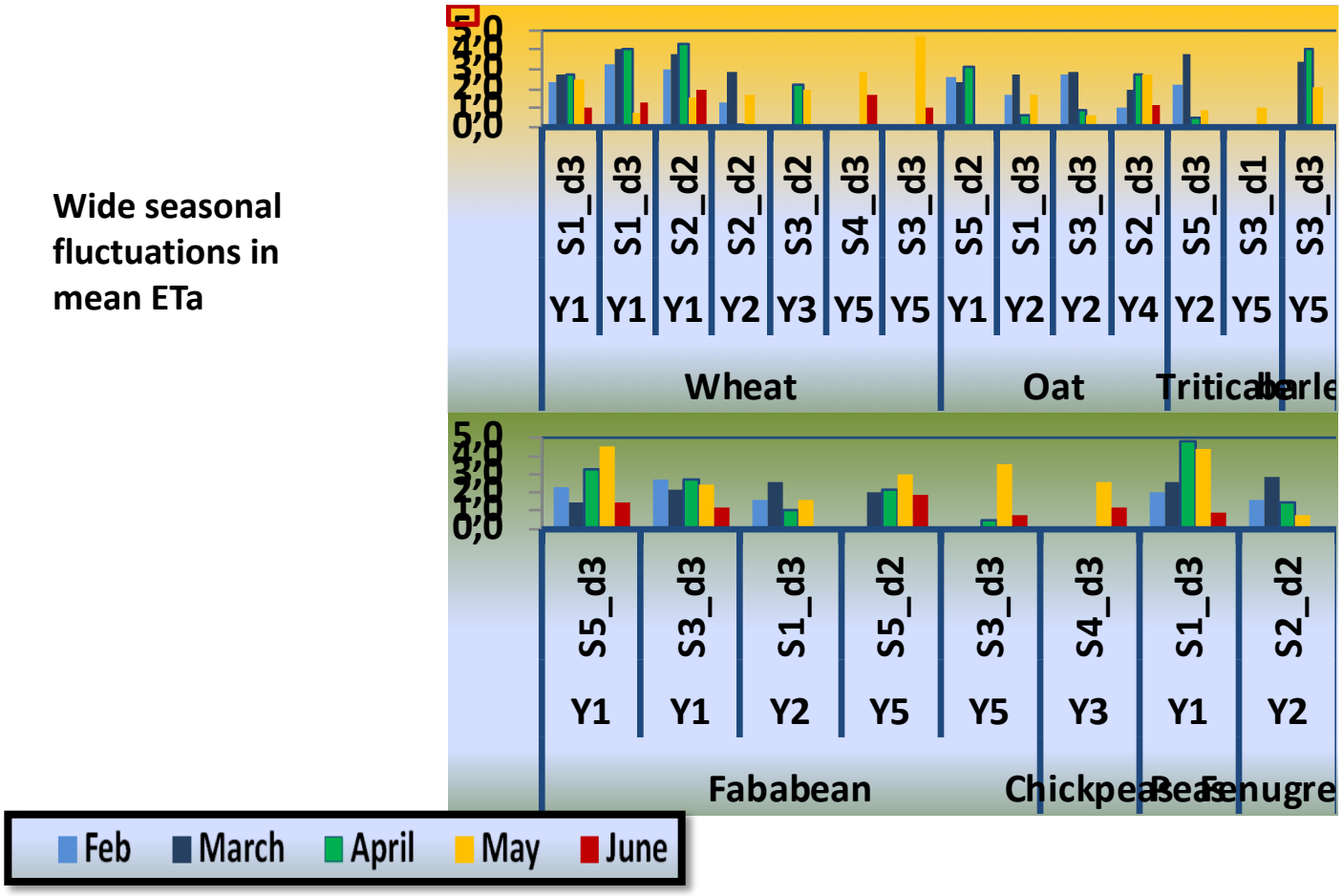
Pea and chickpea crops keep a good water content

Cereals show lower mean water content than legumes

Results

Impact of spatiotemporal distribution of land use and crop rotation on SWC and ETa

Wide seasonal fluctuations in mean ETa



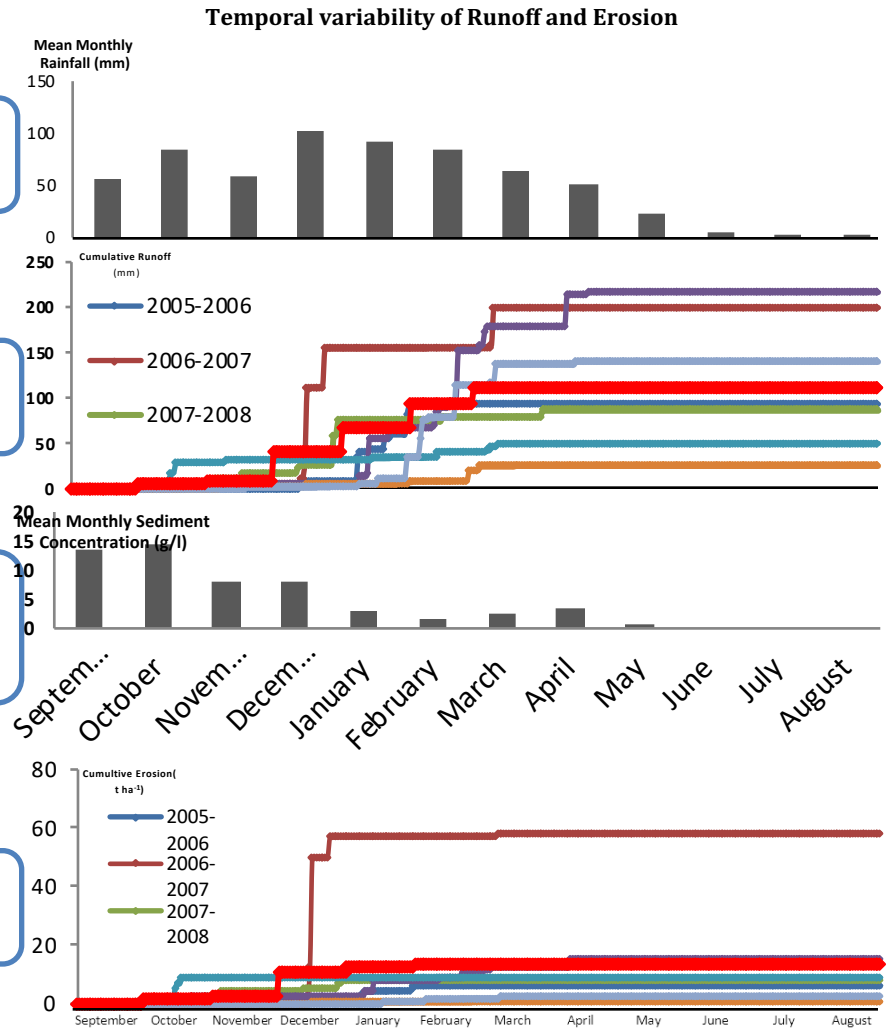
Results

Monthly Rainfall

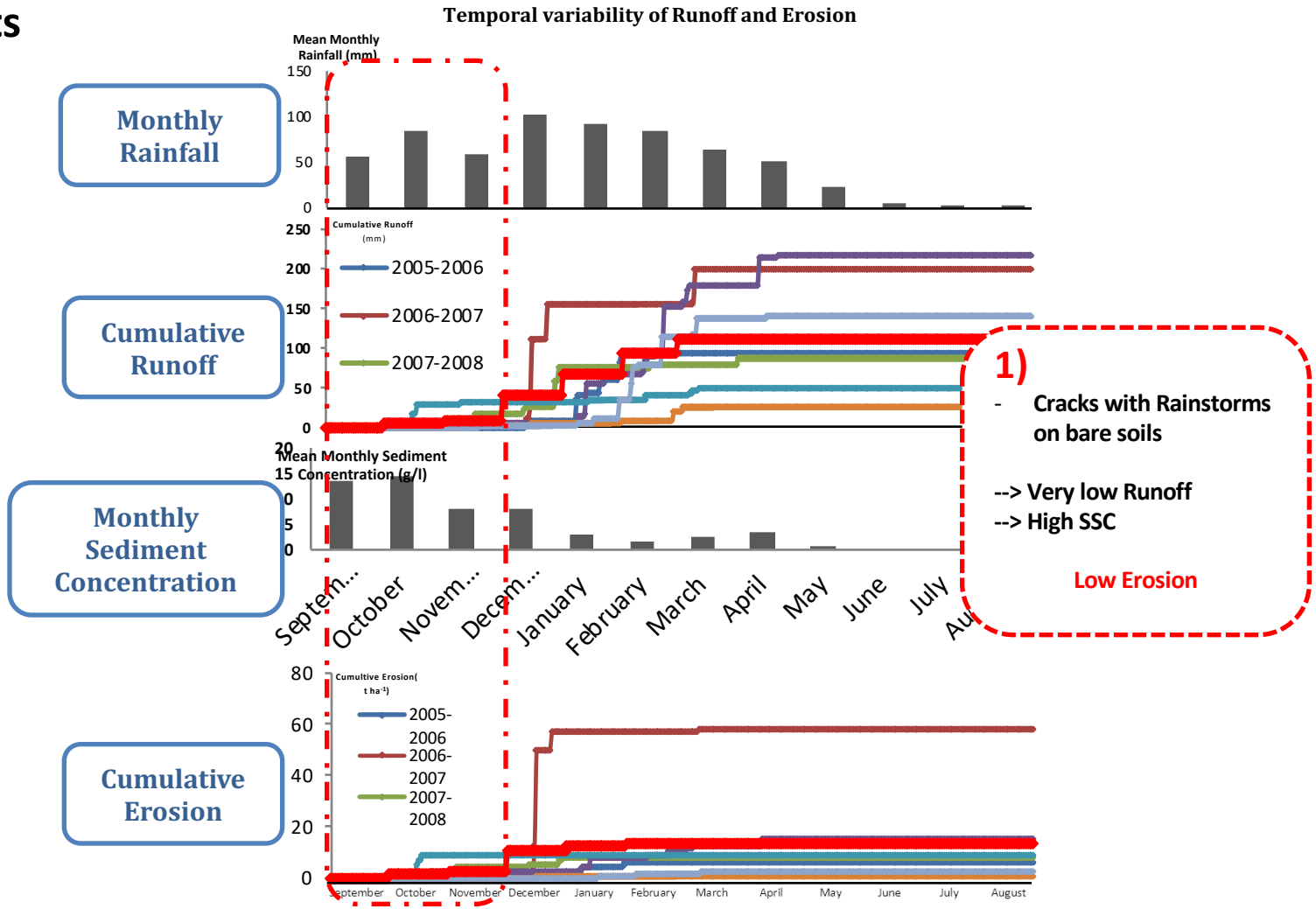
Cumulative Runoff

Monthly Sediment Concentration

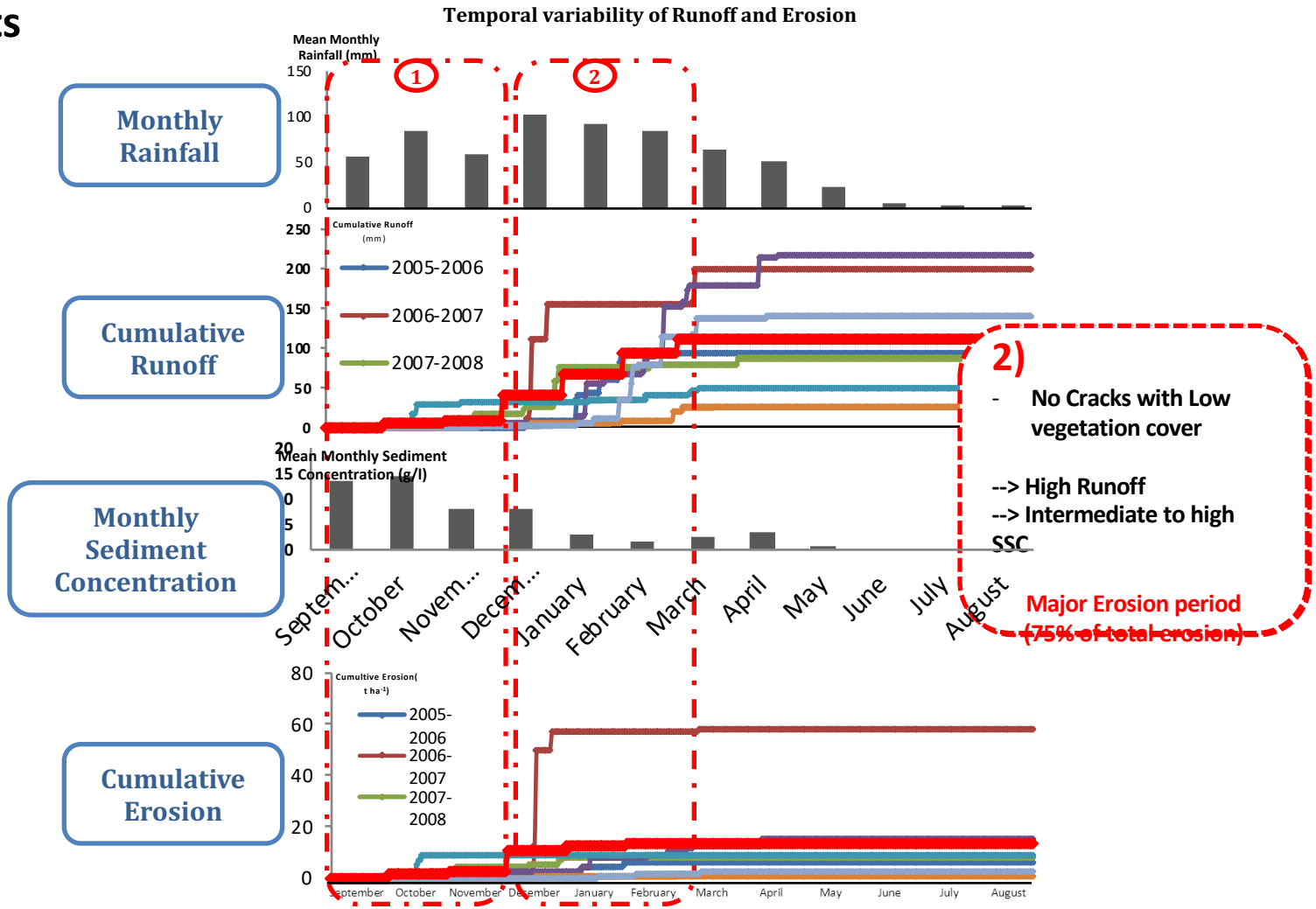
Cumulative Erosion



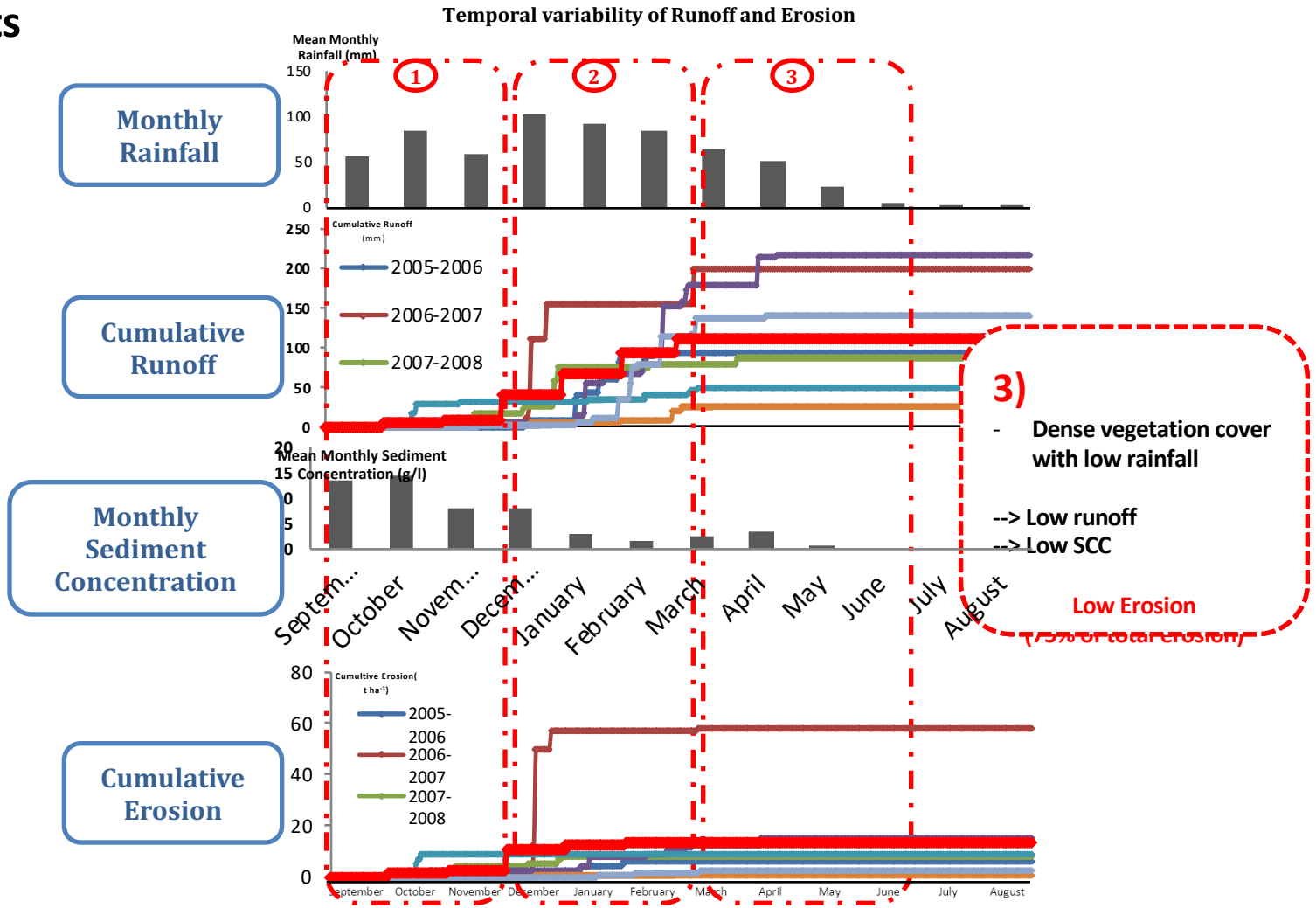
Results


Temporal variability of Runoff and Erosion
Monthly Rainfall
Cumulative Runoff
Monthly Sediment Concentration
Cumulative Erosion
Mean Monthly Rainfall (mm)
Cumulative Runoff (mm)
2005-2006
2006-2007
2007-2008
Mean Monthly Sediment Concentration (g/l)
Septem...
October
Novem...
Decem...
January
February
March
April
May
June
July
Au
Cumultive Erosion(t ha-1)
2005-2006
2006-2007
2007-2008
September
October
November
December
January
February
March
April
May
June
July
August
1)
- Cracks with Rainstorms on bare soils
--> Very low Runoff
--> High SSC
Low Erosion

Results


Temporal variability of Runoff and Erosion
Monthly Rainfall
Cumulative Runoff
Monthly Sediment Concentration
Cumulative Erosion
Mean Monthly Rainfall (mm)
1
2
Cumulative Runoff (mm)
2005-2006
2006-2007
2007-2008
Mean Monthly Sediment Concentration (g/l)
Septem...
October
Novem...
Decem...
January
February
March
April
May
June
July
August
Cumultive Erosion(t ha-1)
2005-2006
2006-2007
2007-2008
2)
- No Cracks with Low vegetation cover
--> High Runoff
--> Intermediate to high SSC
Major Erosion period
(75% of total erosion)

Results


Temporal variability of Runoff and Erosion
Monthly Rainfall
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Mean Monthly Rainfall (mm)
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2005-2006
2006-2007
2007-2008
Mean Monthly Sediment Concentration (g/l)
Cumultive Erosion(t ha-1)
2005-2006
2006-2007
2007-2008
1
2
3
Septem...
October
Novem...
Decem...
January
February
March
April
May
June
July
August
3)
- Dense vegetation cover with low rainfall
--> Low runoff
--> Low SCC
Low Erosion
(75% of total erosion)

Results

For the Kamech catchment

- The winter period is considered as the active period in term of erosion loads with a contribution about 75% of the total erosion loads.

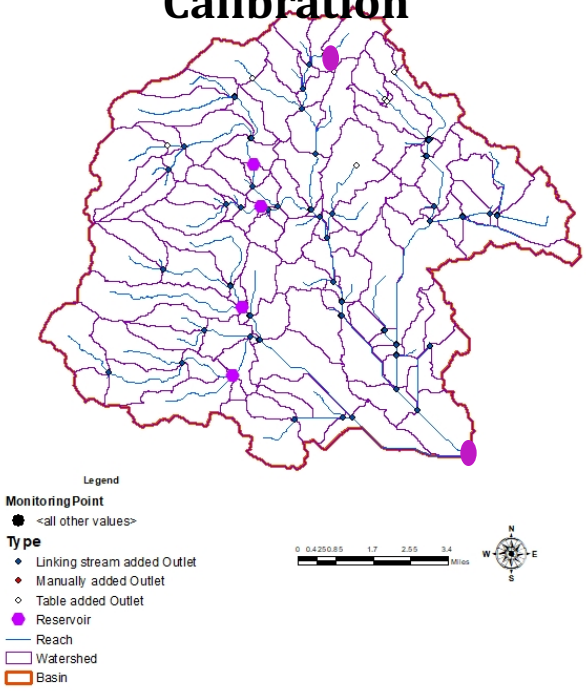
- **Specific erosion rates**
  - $E_{Cultivated\ topsoil}$= 17t ha^{-1} $year^{-1}$
  - E_{Gully} = 80 t ha^{-1} $year^{-1}$

- **Sediment source at catchment scale**
  - 75% of sediment trapped in the lake come from cultivated topsoil

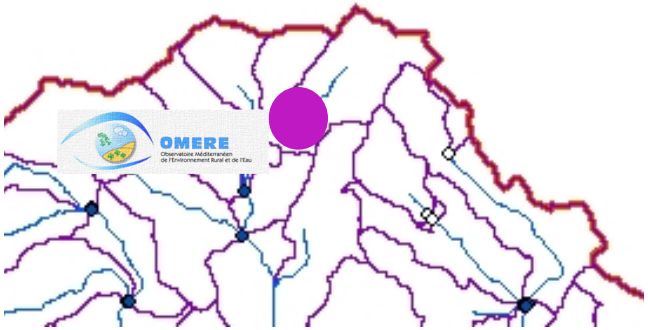
=> Protection of cultivated land must be favoured

Results

Calibration



Runoff (m^3/s)



Sediment yield (t/ha)

Agricultural yield (t/ha)

	Parameter	Limites	Ajusted value
1	Alpha_Bf	0-1	**0.53**
2	CN2	0- 100	**52**
3	Surlag	0-10	**8.5**
4	GW_REVAP	0-150	**0.0079**
5	GWQMN	0 – 1	**0.7**
6	Esco	-10 – 10	**0.99**

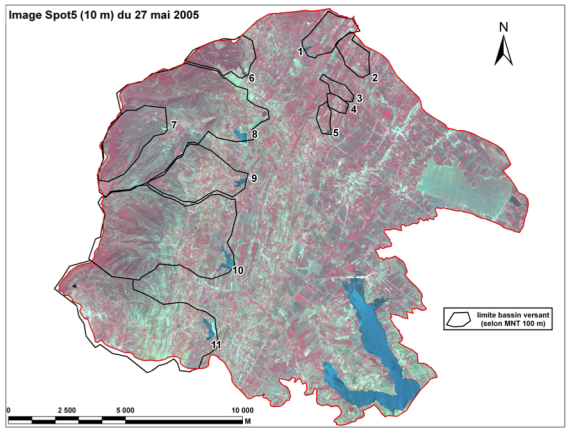
Results

- Land use change is a very important driver of the hydrologic response, the soil and water management in the catchment,
- Implementation of SWAT model,
- Uncertainties that may exist in the form of processes simplification and the important gap relative to the lack of attention that is given to the vegetation and crop growth processes, and cracks distribution across different land uses on vertisols and the soil and water conservation management structures,

Perspectives

TPhD A. Abdelghaffar

Future work

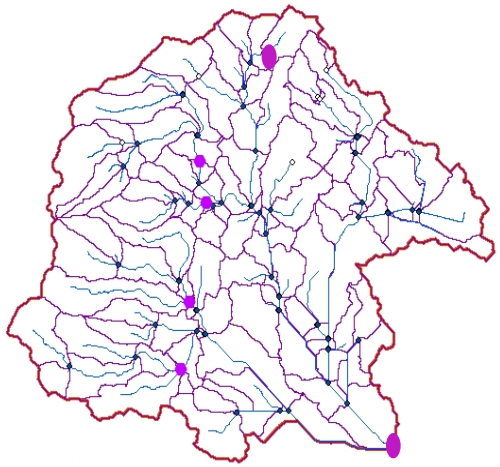


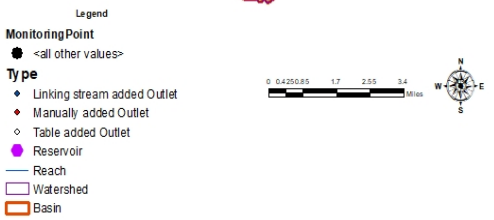
High anthropization

Multi-criteria (ETa, SWC, TSS

- Multisite Calibration

On-going





Impacts of reservoirs

cracks

On-going

- Enhance the SWAT vegetation dynamics using remotely sensed leaf area index (LAI),
- The availability of a reliable set of sub-daily data is likely to increase the capability of SWAT to serve a useful tool for optimizing ecosystem services water, conservation, agricultural production, and soil loss preservation,
- Simulation of Land use scenarios and climate change impacts,
- Scenarios ranking.