Soil & Water Assessment Tool | SWAT

UNIVERSITÉ SIDI MOHAMMED BEN ABDELLAH
FACULTÉ DES SCIENCES ET TECHNIQUES
FÈS

Using SWAT to predict projected climate change impact on water resource within a Mediterranean watershed: the R'dom basin Case study, Morocco




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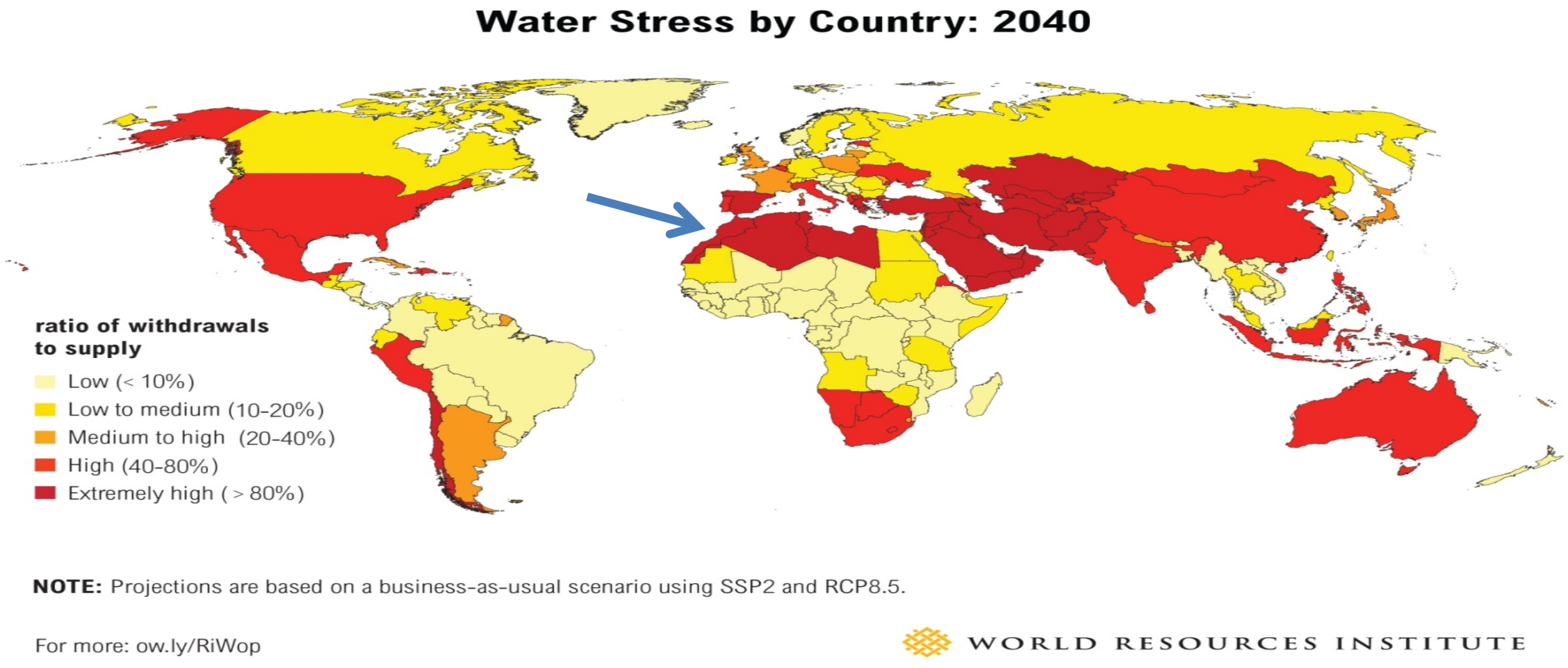
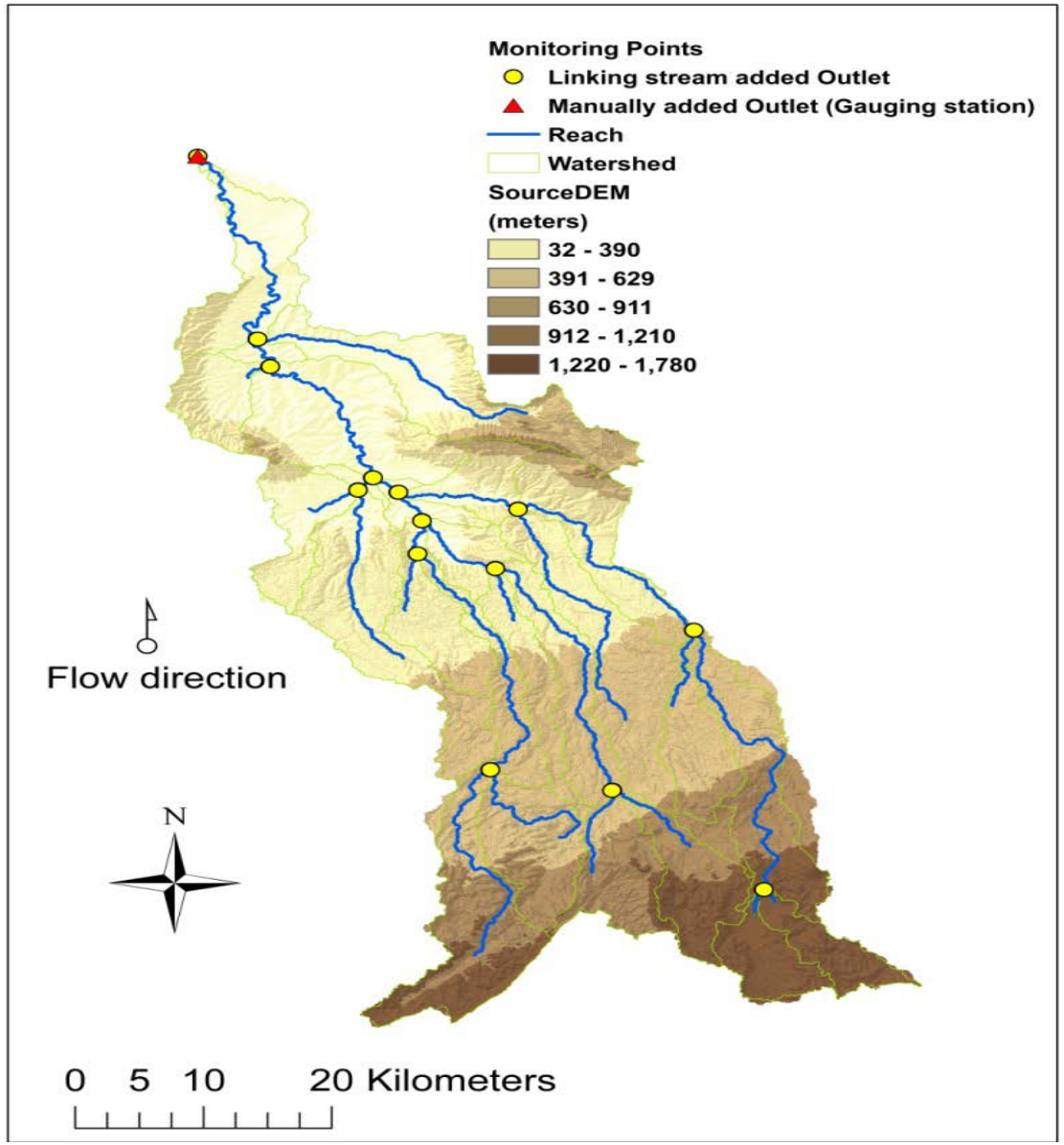
Climate change



Study case: R'dom Watershed, Morocco

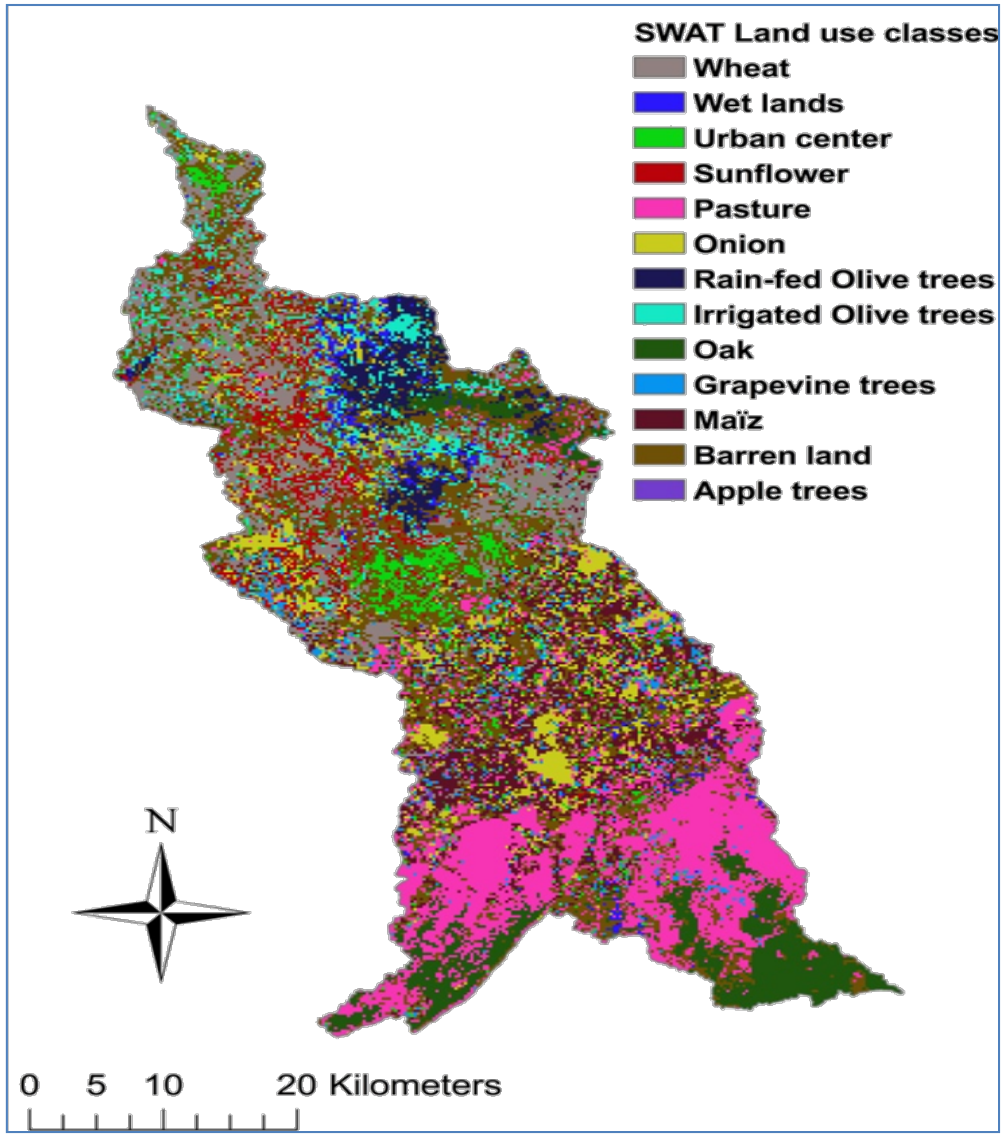
SWAT INPUTs: Digital Elevation Model



DEM

30m DEM SRTM3 Database (shuttle Radar topography Mission)

SWAT INPUTs: Landuse

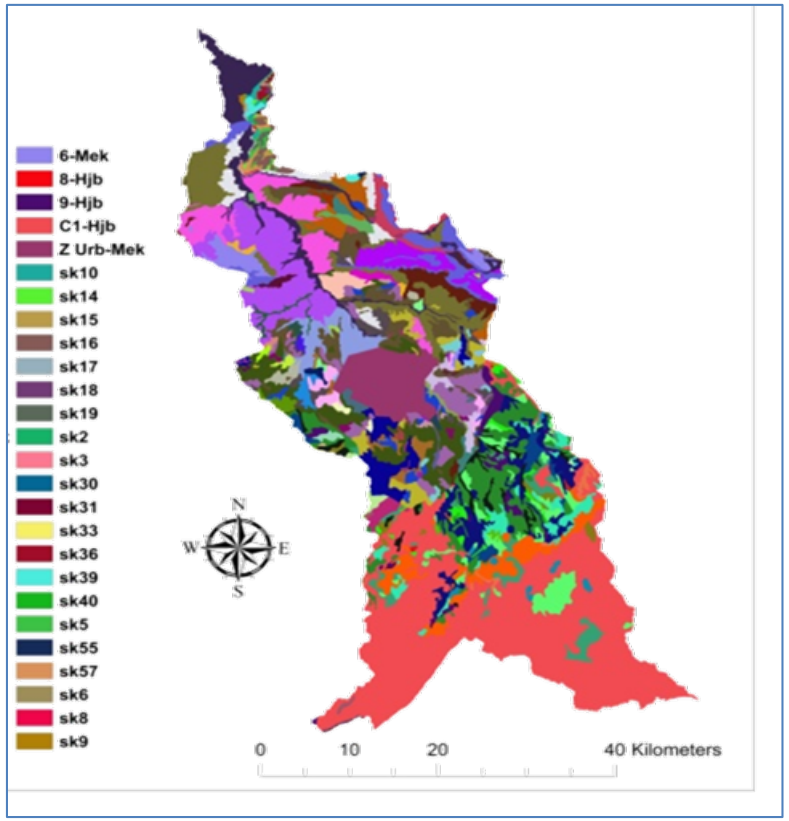


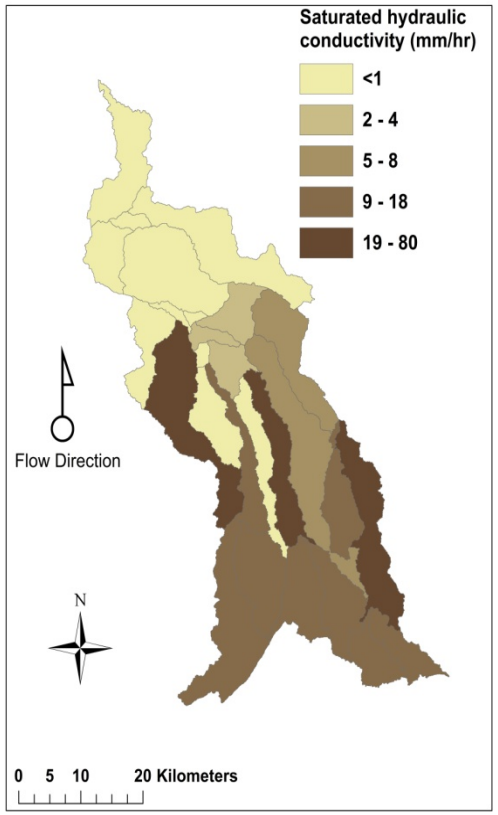
LANDUSE

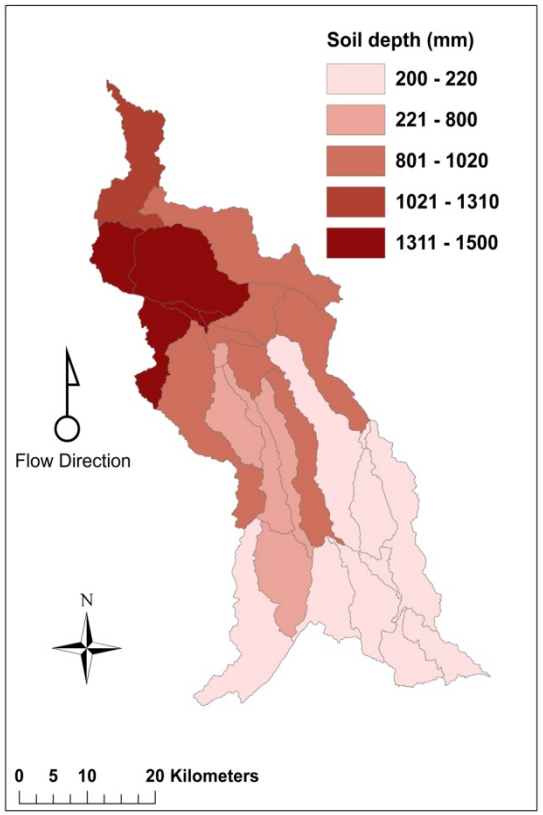
Images from landsat (u.s geological survey) were procecessed by ERDAS imagine 2014 softaware

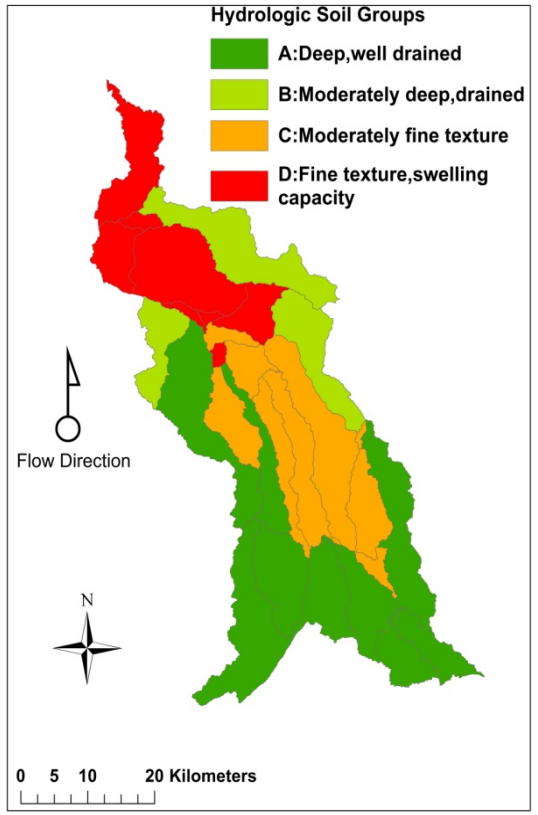
40% is either barren or pasture lands : south (upstream)
45% is covered by farming lands and located in center and Northern part.

SWAT INPUTs: Soil map









Soil map

Saturated hydraulic conductivity

Soil depth

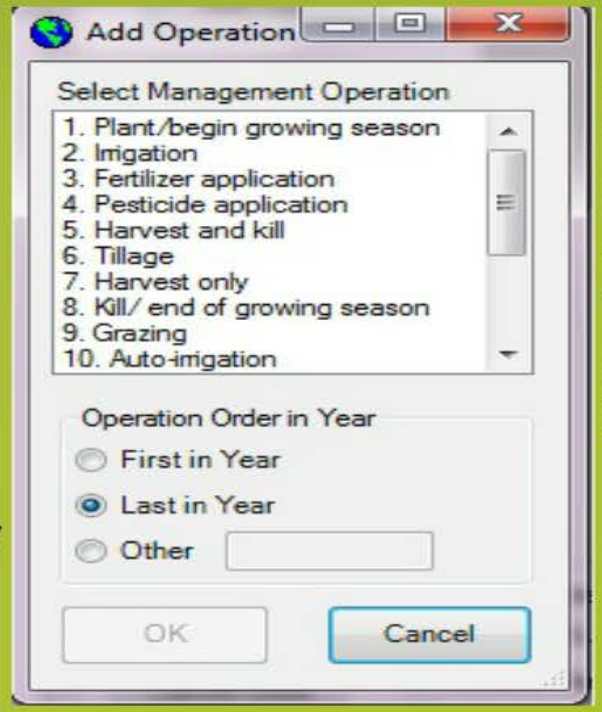
Hydrologic soil group

SWAT INPUTs: Crop Management Operations

Crop management operations

-In-field surveys around the watershed were carried out to study the crop management practices applied in the field

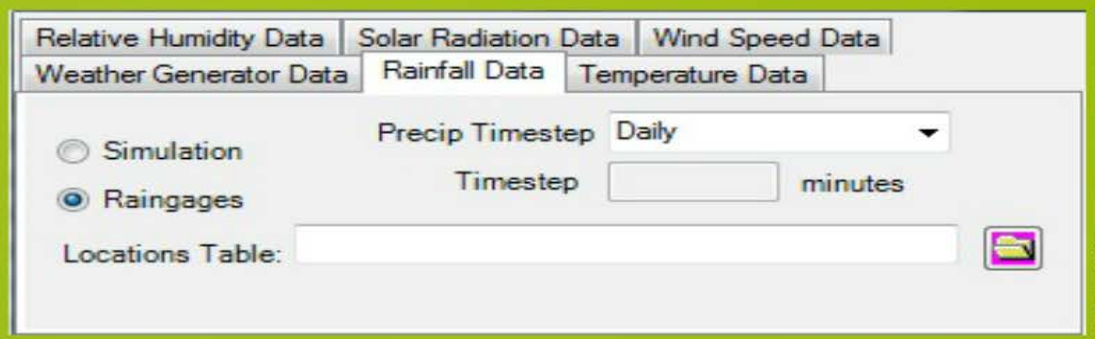
- All crop management operations were edited/added to match what is carried out in the field (Season calendars, fertilization amounts, type of machinery used for soil tillage, operations schedule, irrigation....etc



SWAT INPUTs: Weather data

Weather data

- Included daily temperature (max and min) records from 9 weather stations and daily rainfall from 4 recording stations in and around the watershed over a period of 2003 to 2010.



Sensitivity analysis

Relative sensitivity equation

$$S_r \cong [(O_{P+\Delta P} - O_{P-\Delta P}) / O_P] / (2\Delta P / P)$$

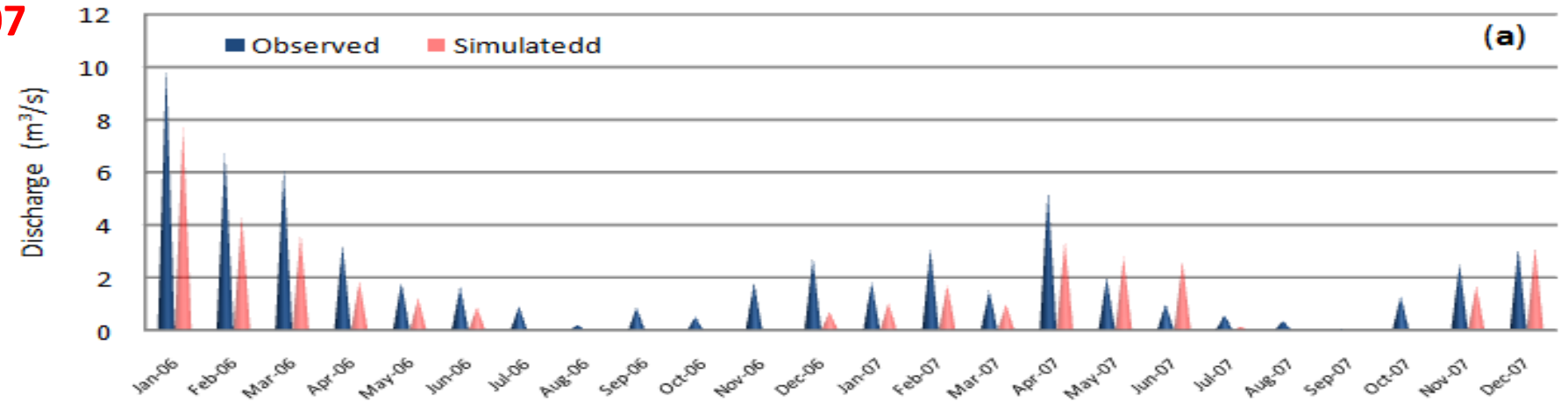
The most sensitive parameters

Surface response	CN	Curve Number
	ESCO	Soil evaporation compensation factor
	SOL_AWC	Available water capacity of the soil layer
Subsurface response	GWQMN	Threshold depth of water in the shallow aquifer required for return flow to occur

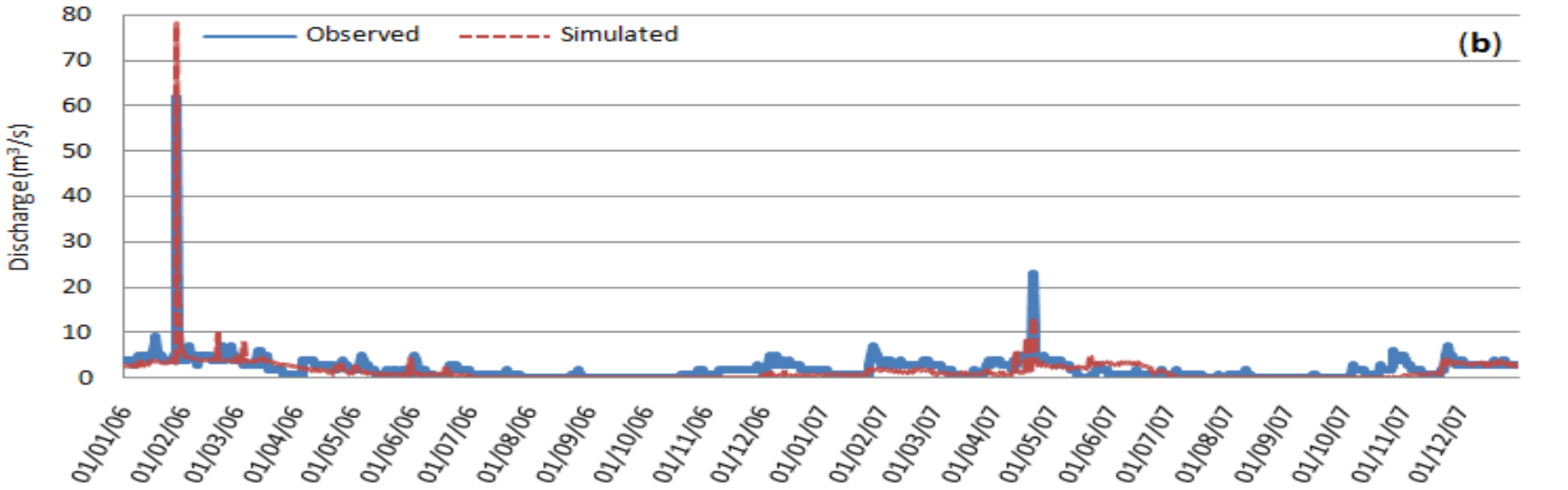
Model simulation: SWAT CALIBRATION

Calibration 2006-2007

Monthly
NSE: 0.68
R^2 : 0,85



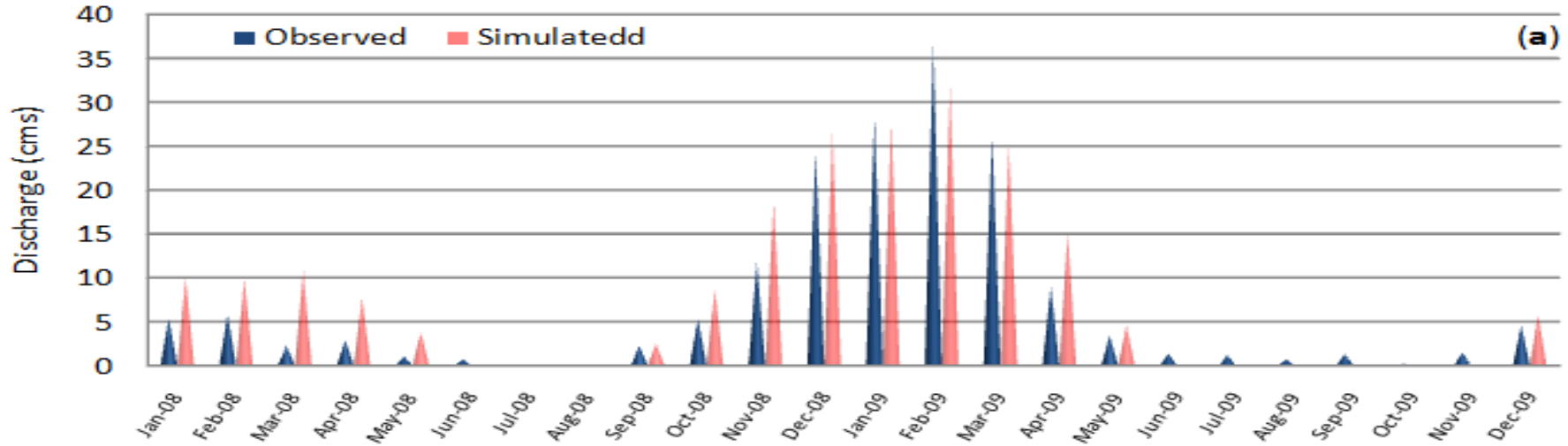
Daily
NSE: 0.58
R^2 : 0,79



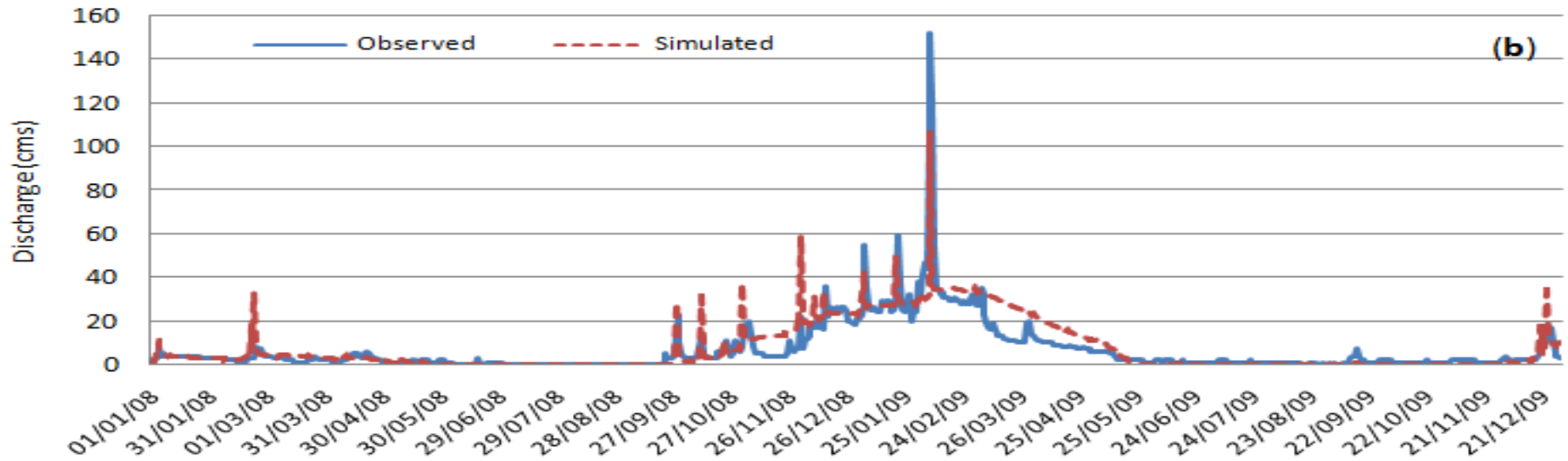
Model simulation: SWAT VALIDATION

Validation 2008-2009

Monthly
NSE: 0. 80
R^2 : 0,88



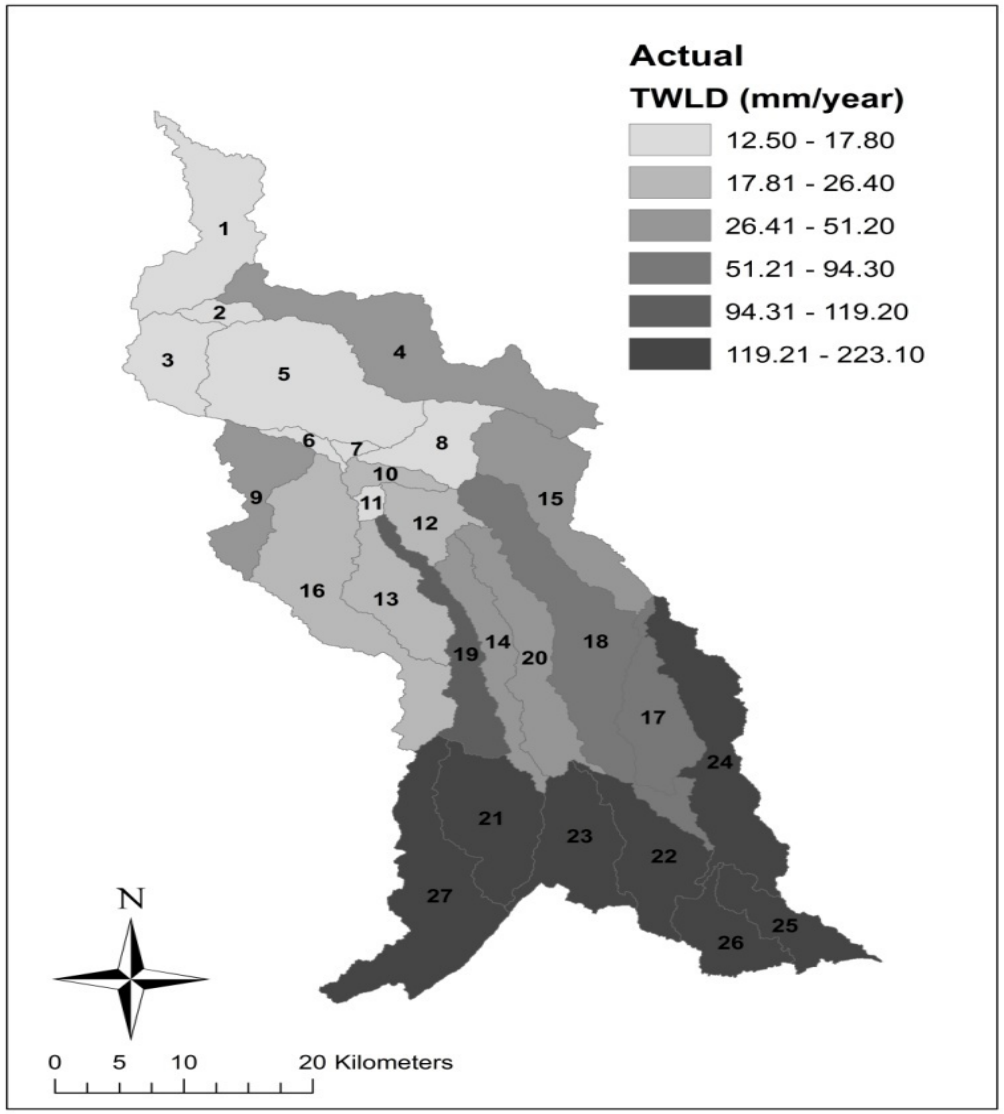
Daily
NSE: 0.65
R^2 : 0,73

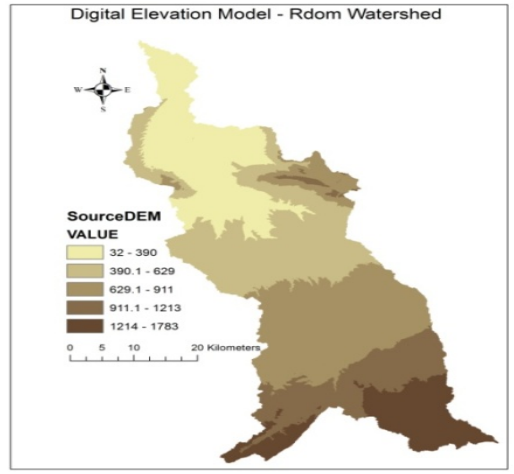


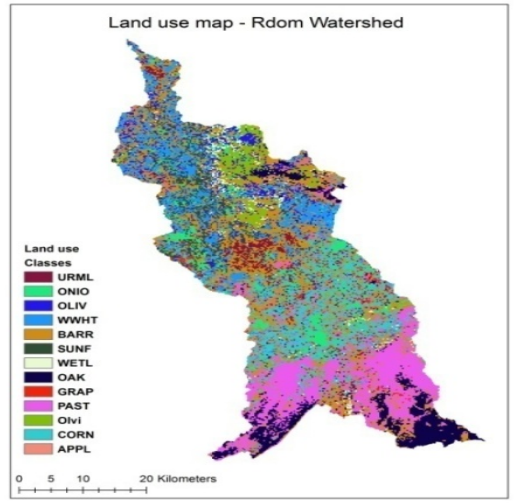
Water Balance: HYDROLOGIC COMPONENTS (2004 to 2009)

MONTH	RAIN (MM)	SURF (MM)	LAT (MM)	TWYD (MM)	ET (MM)	PET (MM)
1	71.15	7.96	3.17	19.28	11.43	48.48
2	37.75	4.28	1.13	13.92	16.15	59.86
3	29.5	3.98	1.14	9.44	15.68	99.07
4	20.35	1.78	0.1	7.9	32.5	120.09
5	15.79	0.5	0.1	1.27	33.86	209.49
6	5.38	0.14	0.08	0.73	25.52	223.91
7	4.75	0.04	0.04	0.43	14.47	233.49
8	2.19	0.38	0.06	0.65	14.15	201.98
9	20.32	0.7	0.13	0.98	16.31	137.78
10	33.47	0.97	0.13	4.28	12.62	100.13
11	49.28	1.74	0.09	13.06	12.7	49.34
12	56.33	6.85	3.1	17.22	10	41.08
Total	352.48	29.32	9.27	89.16	215.39	1524.7
Contribution in Water balance (%)		1.6	0.5	4.8	11.4	81.7

TWLD Distribution (2004 to 2009)







Model simulation: CROP YIELD CALIBRATION

yearly Sim Vs Obs yields:
Period: 2004 to 2009

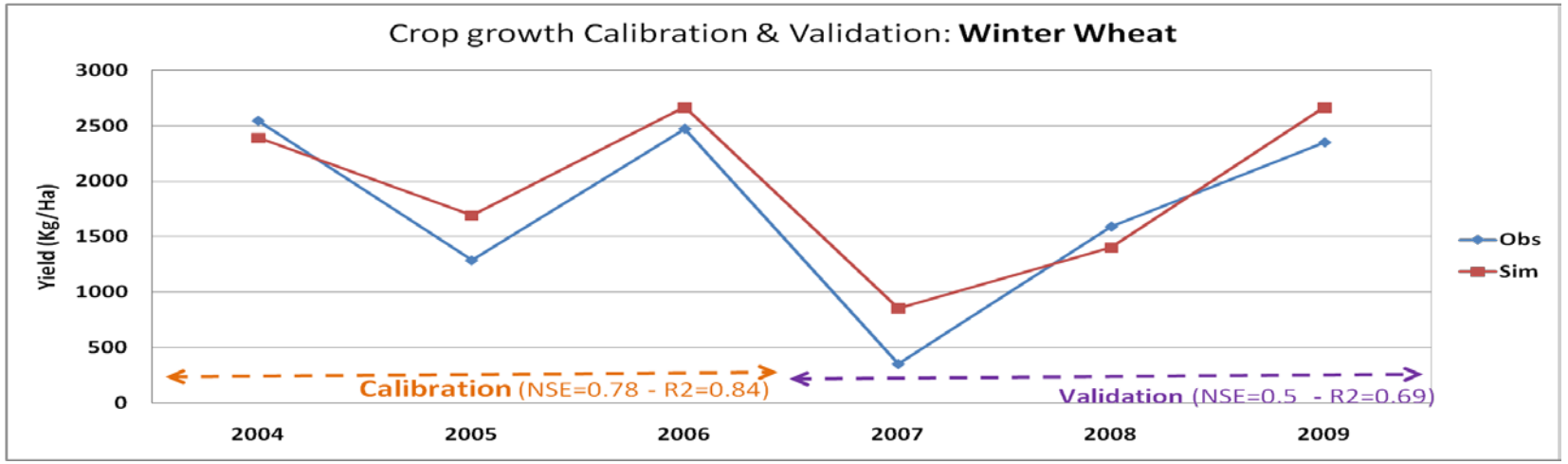
Monthly
NSE: 0. 78
R^2 : 0,84

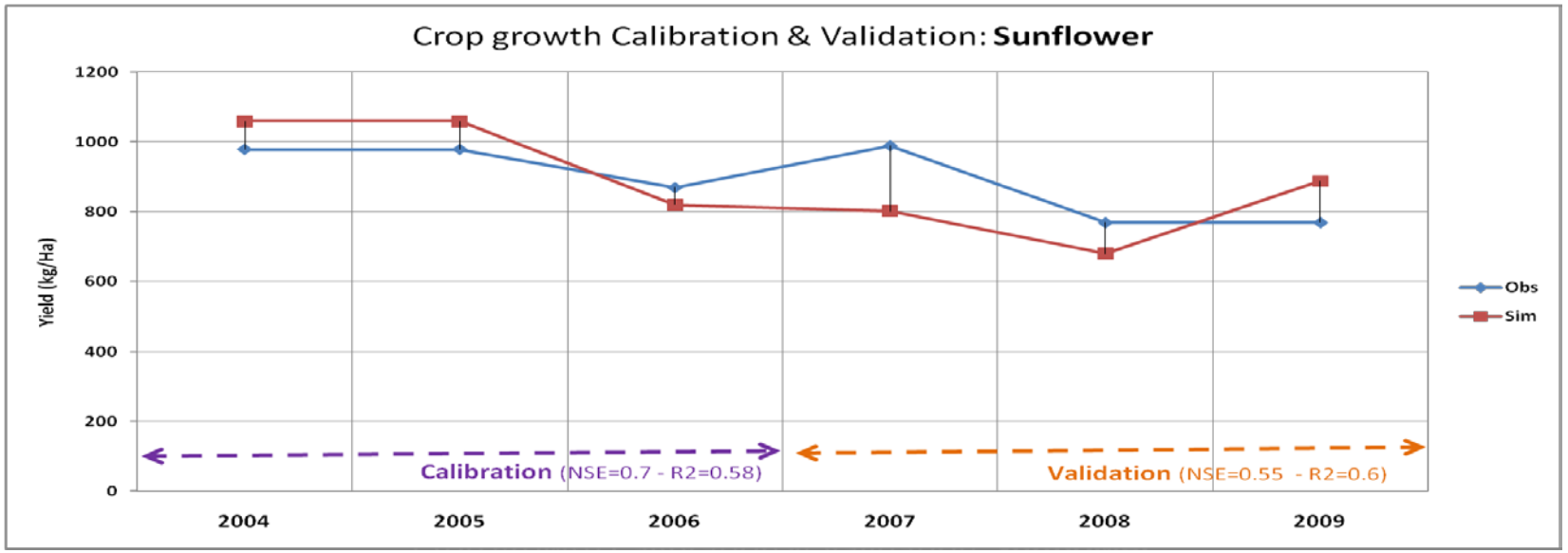
Parameters		Default value	Calibration value
HVSTI	Harvest index	0.4	0.5
WSYF	Lower limit of HVSTI	0.2	0.45
BLAI	Maximum potential leaf area index	4	4
BIO_E	radiation use effeciency	30	35
T base	Minimum T base	0	10
T opt	Optimal T for plant growth	18	20
EXT_COEF	Light extinction coeficient	0.65	0.6
RDMX	Maximum root depth	1.3	1
CHTMX	Maximum canopy height	0.9	1.8

Daily
NSE: 0.7
R^2 : 0,58

Parameters		default value	Calibration value
HVSTI	Harvest index	0.3	0.35
WSYF	Lower limit of HVSTI	0.2	0.2
BLAI	Maximum potential leaf area index	3	0.4
BIO_E	radiation use effeciency	46	42
T base	Minimum T base	6	10
T opt	Optimal T for plant growth	25	25
EXT_COEF	Light extinction coeficient	0.9	0.7
RDMX	Maximum root depth	2	2.2
CHTMX	Maximum canopy height	2.5	2.5

CROPs CALIBRATION : (yearly Sim Vs Obs yields – 2004 to 2009)



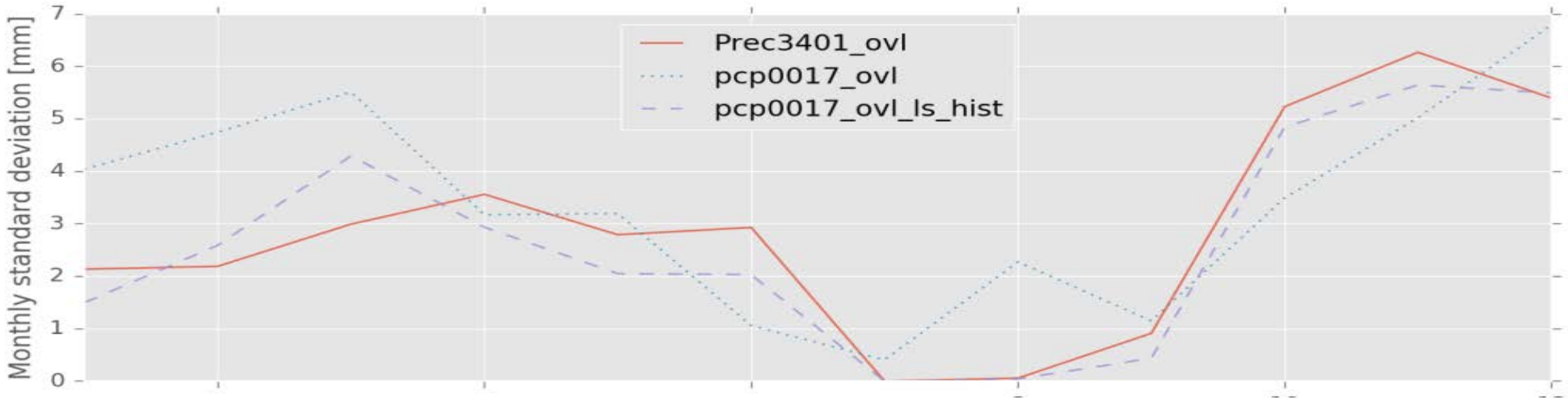


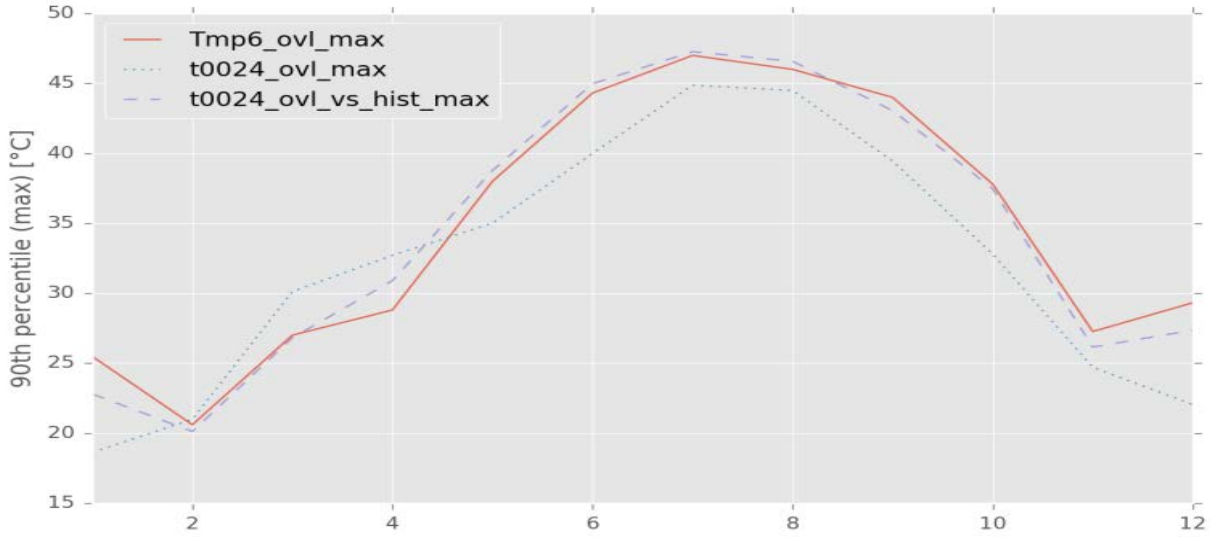
FUTURE PROJECTION (2031 to 2050)

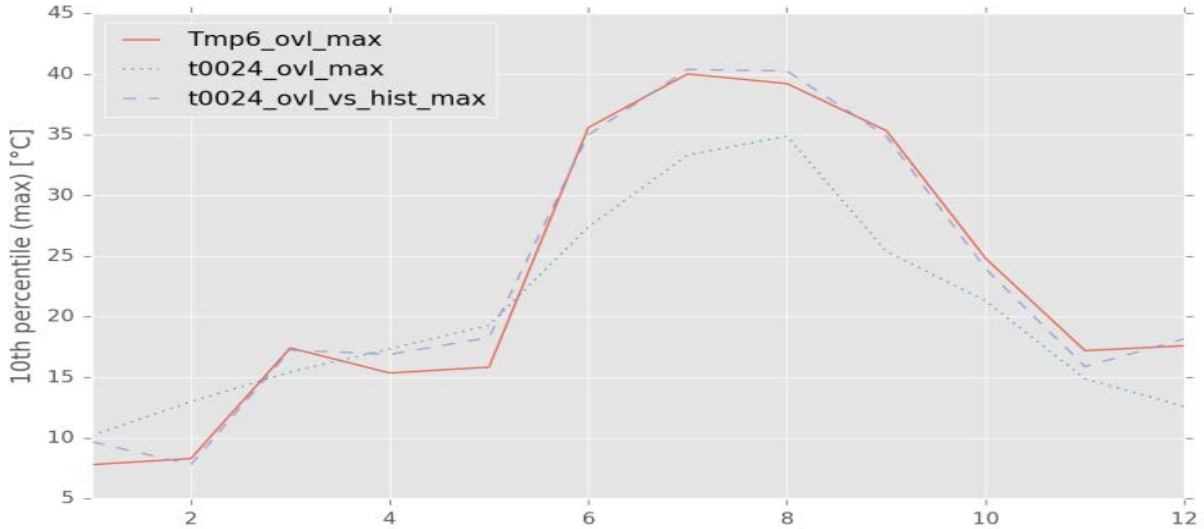
- **IPCC Assessment Report (AR5)**
- **Downscaled RCM:** CLMcom-CCLM
- **CNRM CM5**
- **Two RCPs (4.5 and 8.5)**
- **Grid size was 12.5 km**
- **Baseline (Tmp and Pcp) : from January 1981 to December 2005**
- **Future Projection (Tmp and Pcp): from January 2031 to December 2050**

Statistical Bias correction using CMhyd

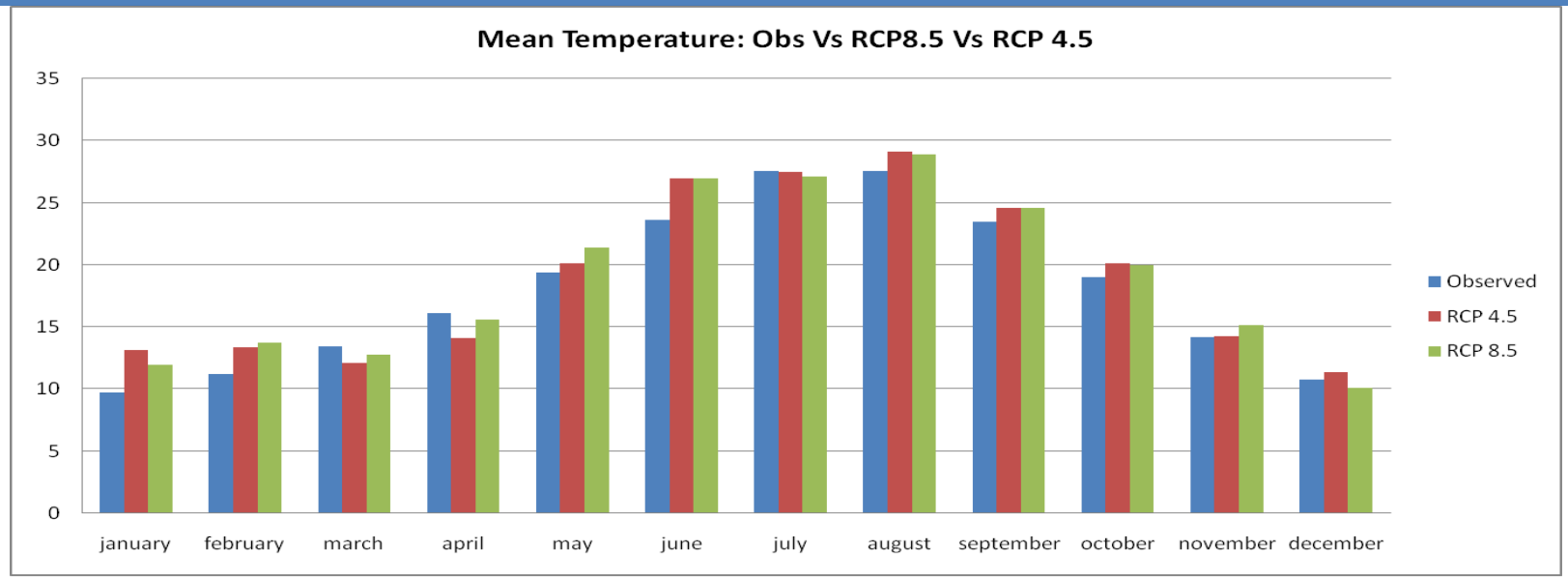
(Linear scaling pcp, Variance scaling T)

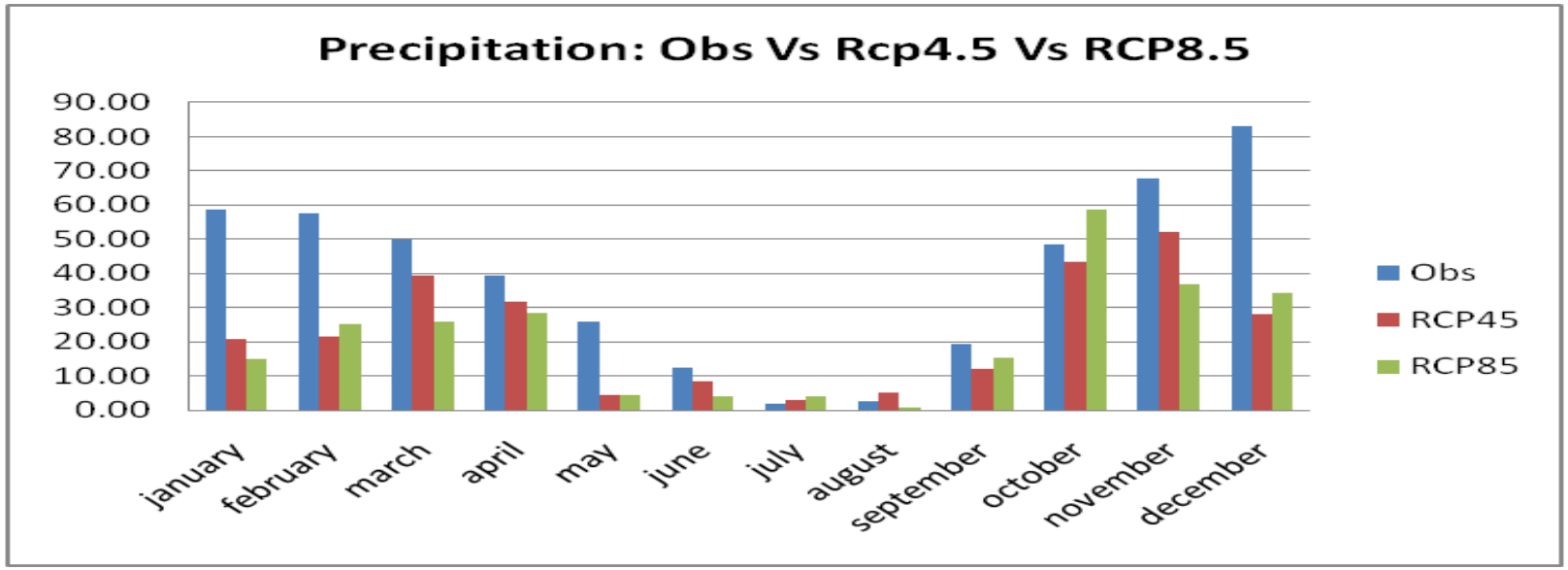




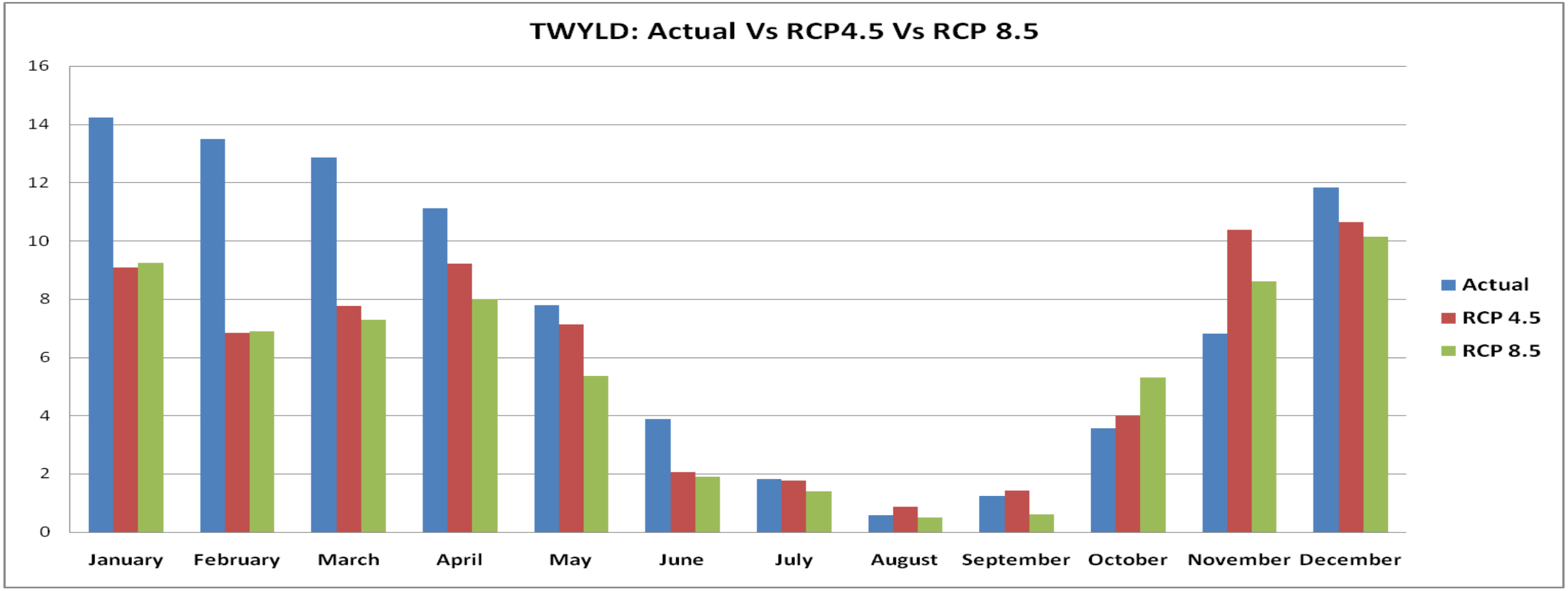


Current Vs Projected Climate

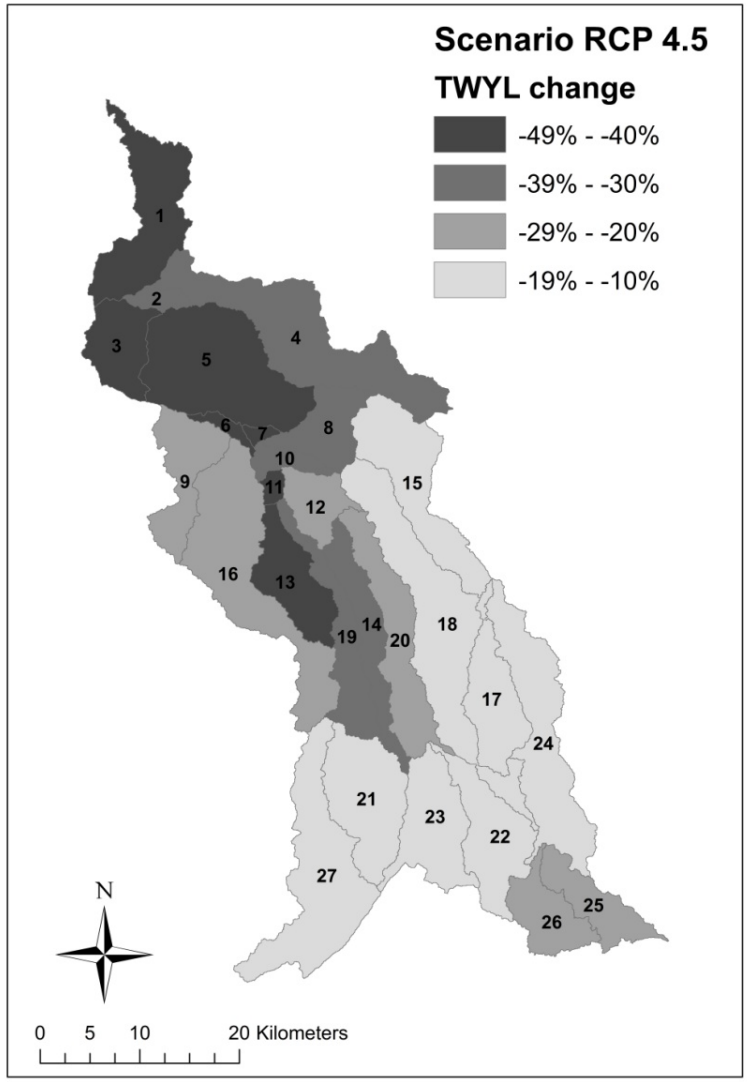


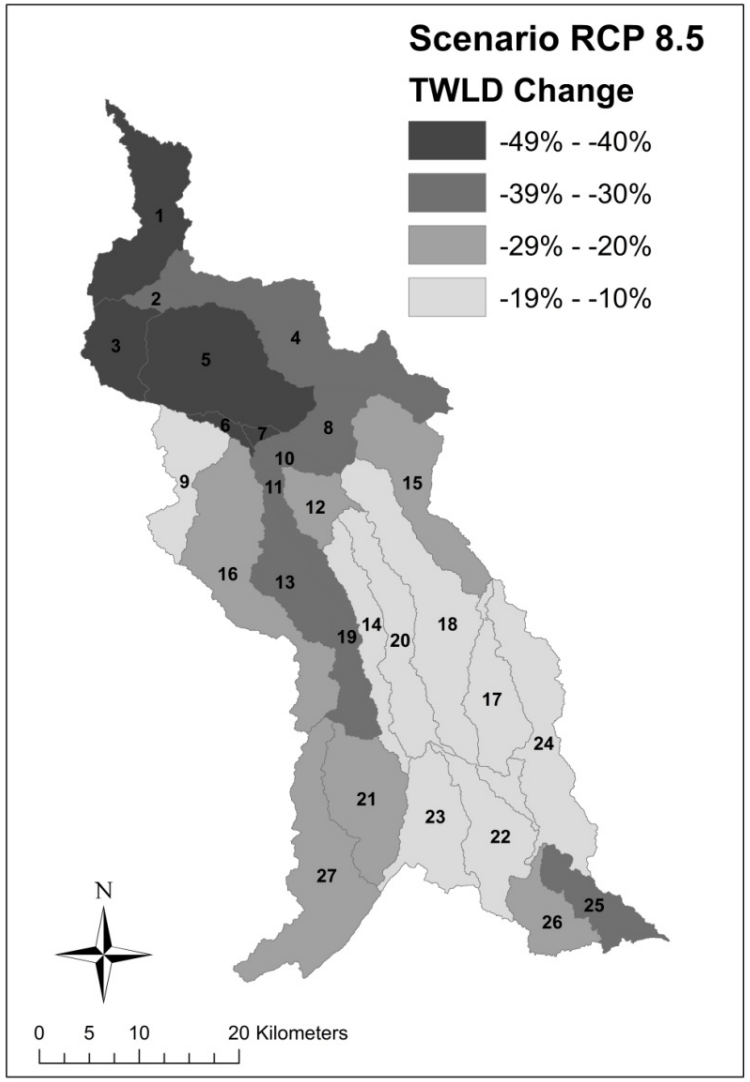


TWYL Distribution (2031 to 2050)

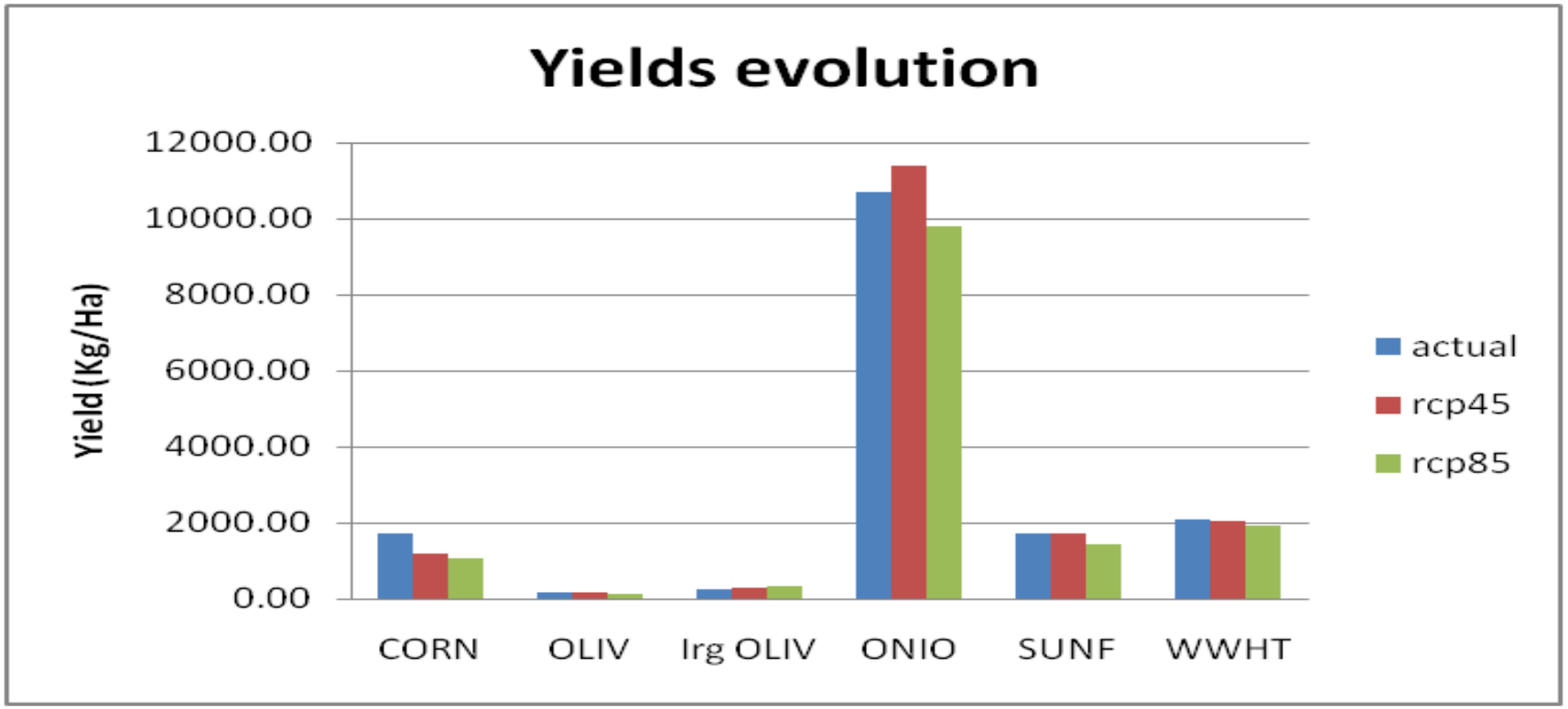


TWYL Distribution (2031 to 2050)





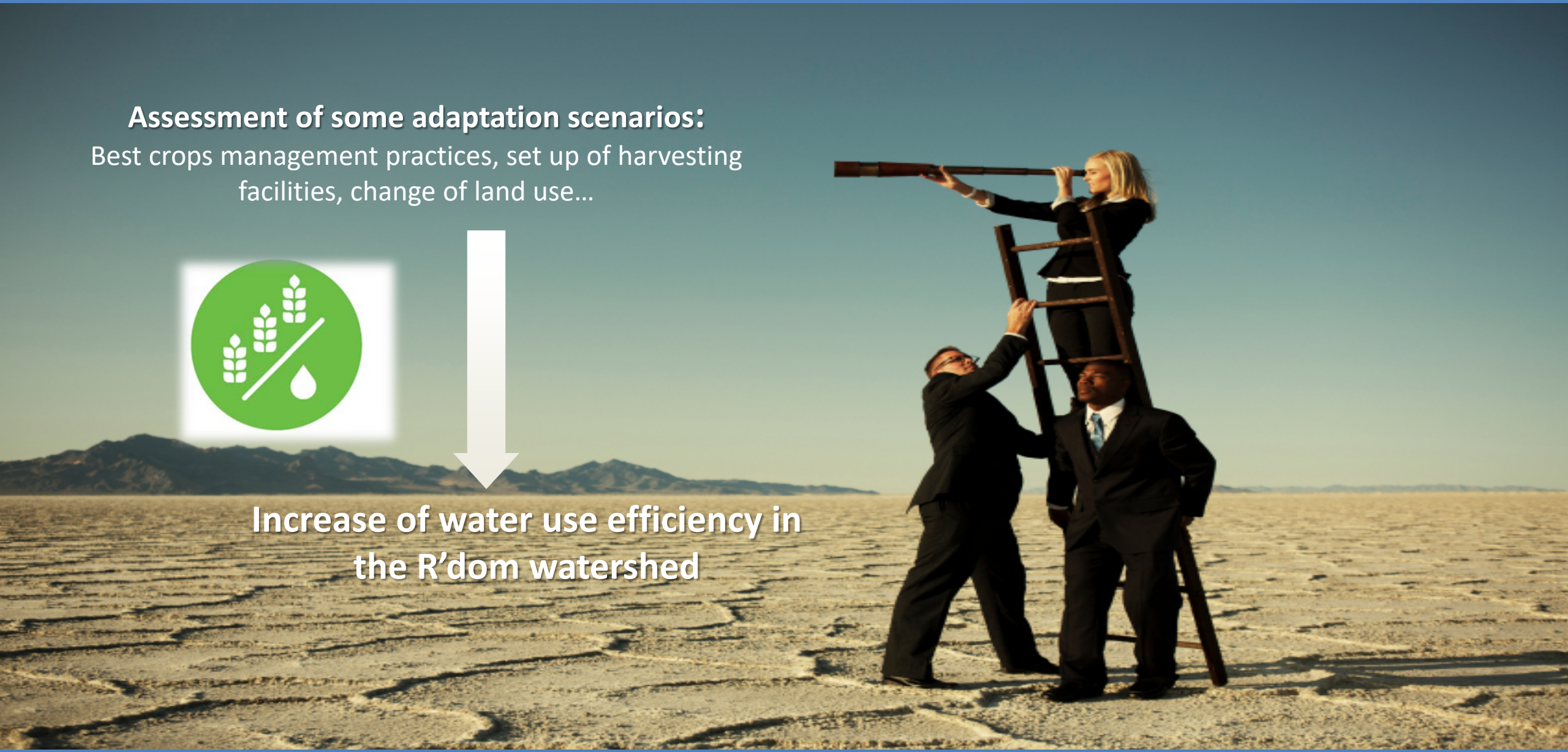
Crop yield projection



Next steps

Assessment of some adaptation scenarios:

Best crops management practices, set up of harvesting facilities, change of land use…



Increase of water use efficiency in the R'dom watershed

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