Performance Evaluation of SWAT Model for Groundwater variability analysis in Venna river basin of central India

Presented by

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CONTENT

INTRODUCTION

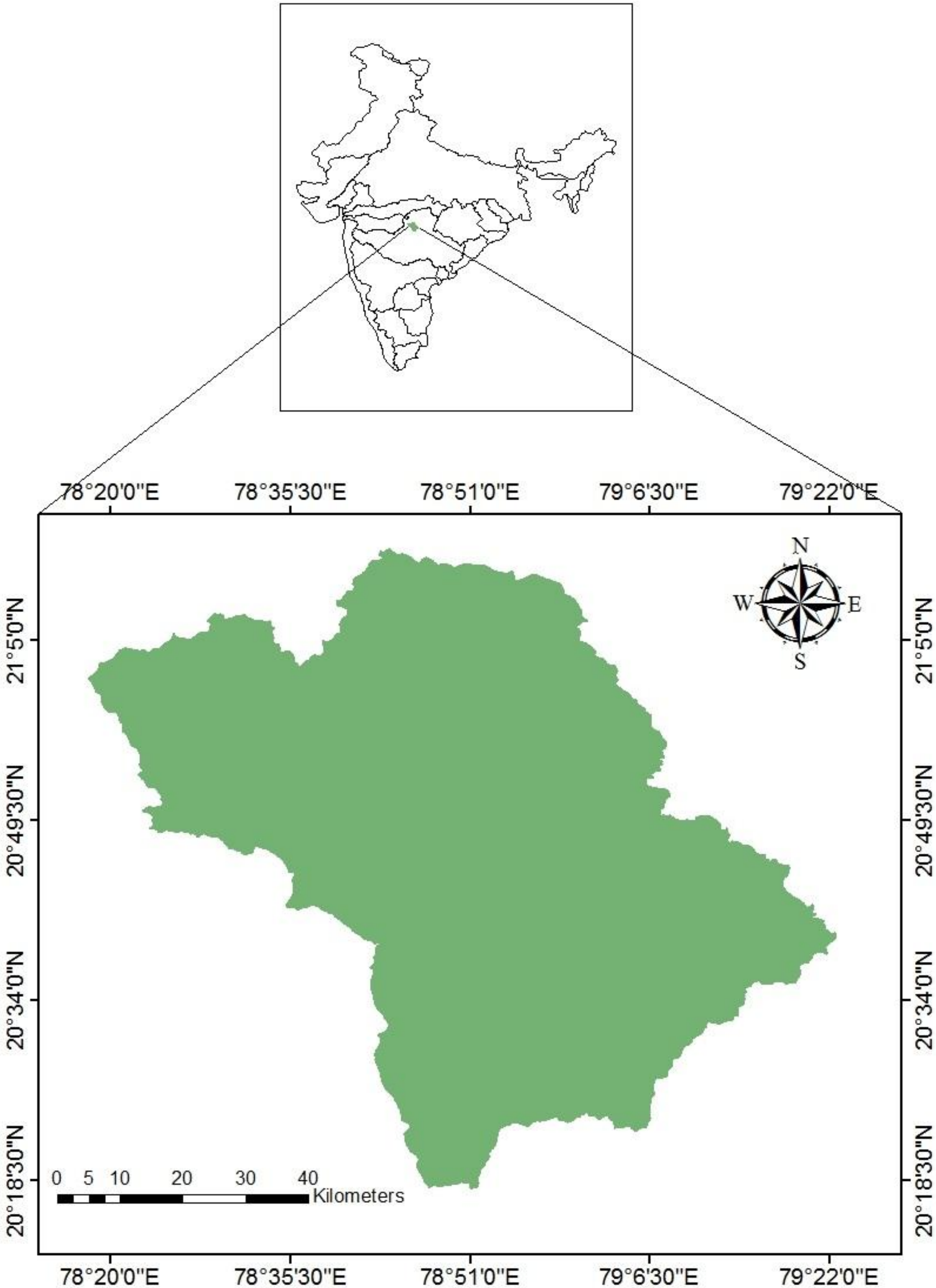
- Water scarcity has posed serious challenges to food security, ecosystem sustenance, and economic prosperity in many parts of the world today, particularly triggered by population growth and climate variability [Schewe et al., 2013].
- Indian subcontinent has become a water-stressed region with a sharp drop in per capita water availability, from a surplus level of 5410 m3 in 1951 to 1614 m3 in 2011 for its population of 1.2 billion [Jain, 2011; UNICEF et al., 2013].
- Indian agriculture, leading the world in total irrigated land by consuming 85% of the utilizable water resources of 1123 billion m3 (i.e., 28% of 4000 billion m3 total fresh water availability) [Douglas et al., 2006].
- Terrestrial water storage (TWS), an important component of the hydrological cycle that integrates both the surface and subsurface water (i.e., sum of surface water in lakes and reservoirs, groundwater storage (GWS), soil moisture (SM), snow and ice, and water in biomass), reflects natural and anthropogenic changes of the terrestrial component of the Earth's water cycle [Syed et al., 2008; Yeh and Famiglietti, 2008].

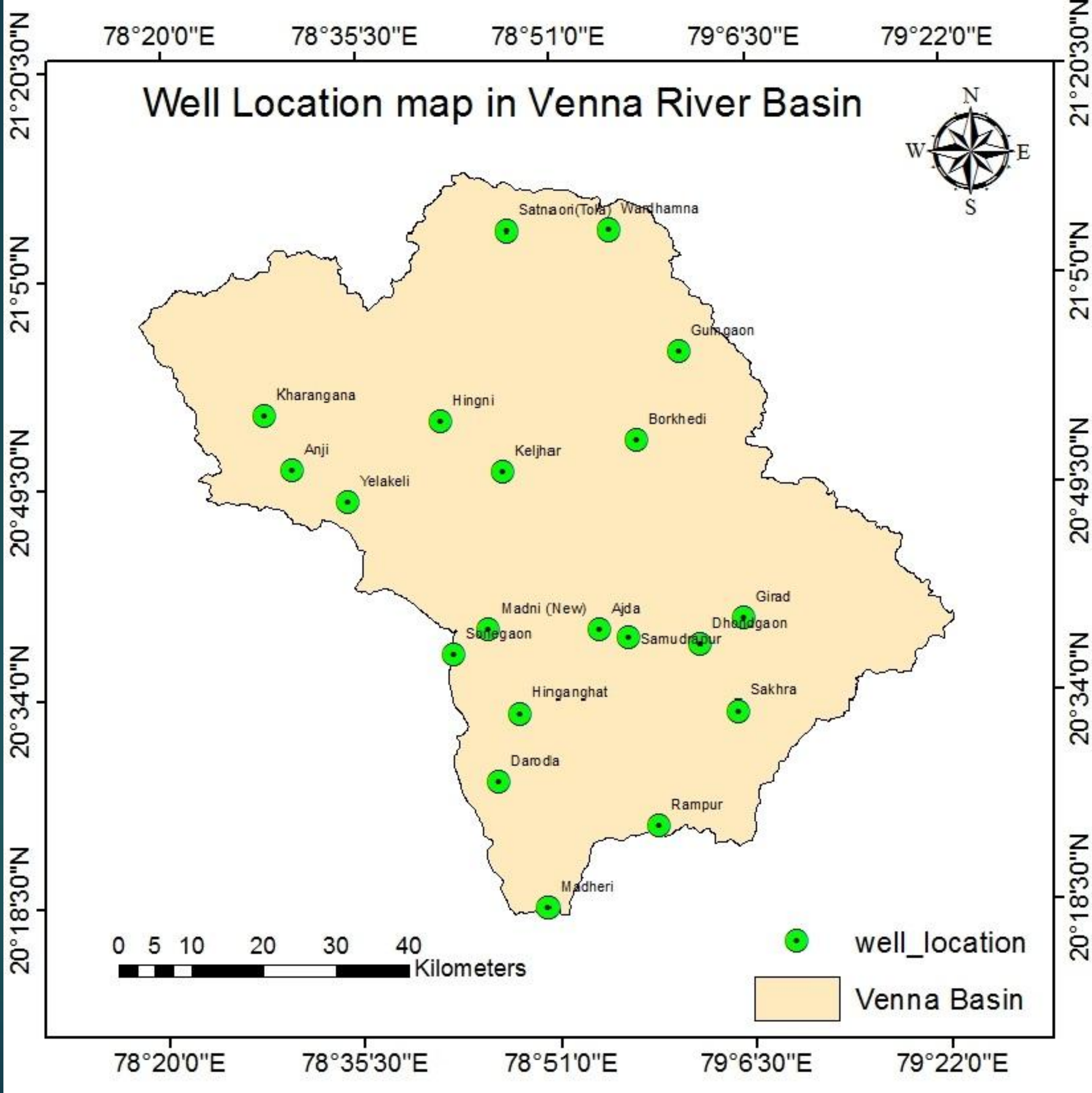
OBJECTIVE

- **Calculation of well levels anomalies for different seasons for each well.**
- **Determination of groundwater depth from SWAT-MODEL.**
- **Establishing the correlation between observed groundwater variability and SWAT-MODEL output data.**

STUDY AREA

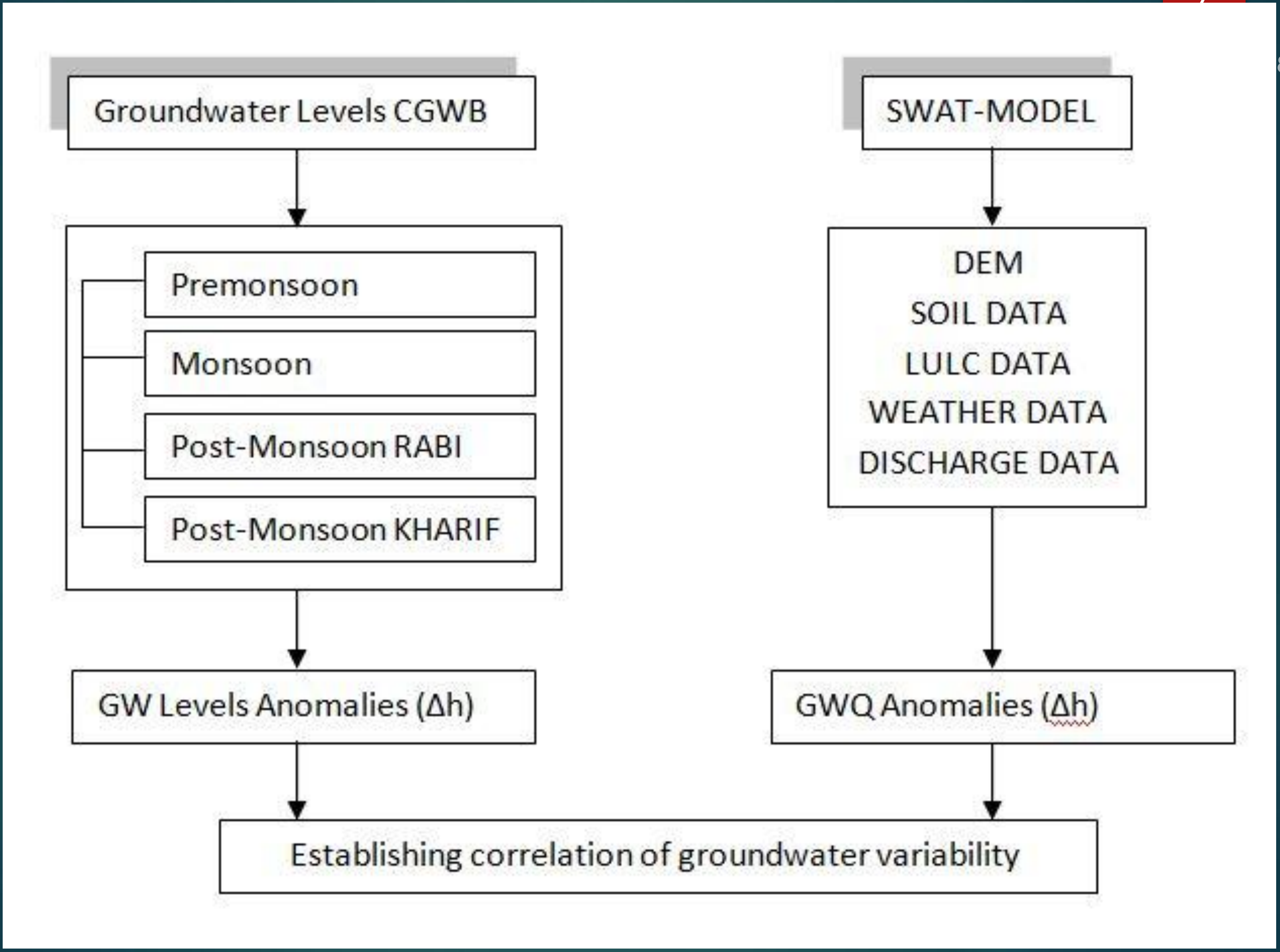
- State – Maharashtra
- Latitude – 20˚ 23'0.59'' N
- Longitude –79 ˚06'12.23''E
- Area – 5675 km^2



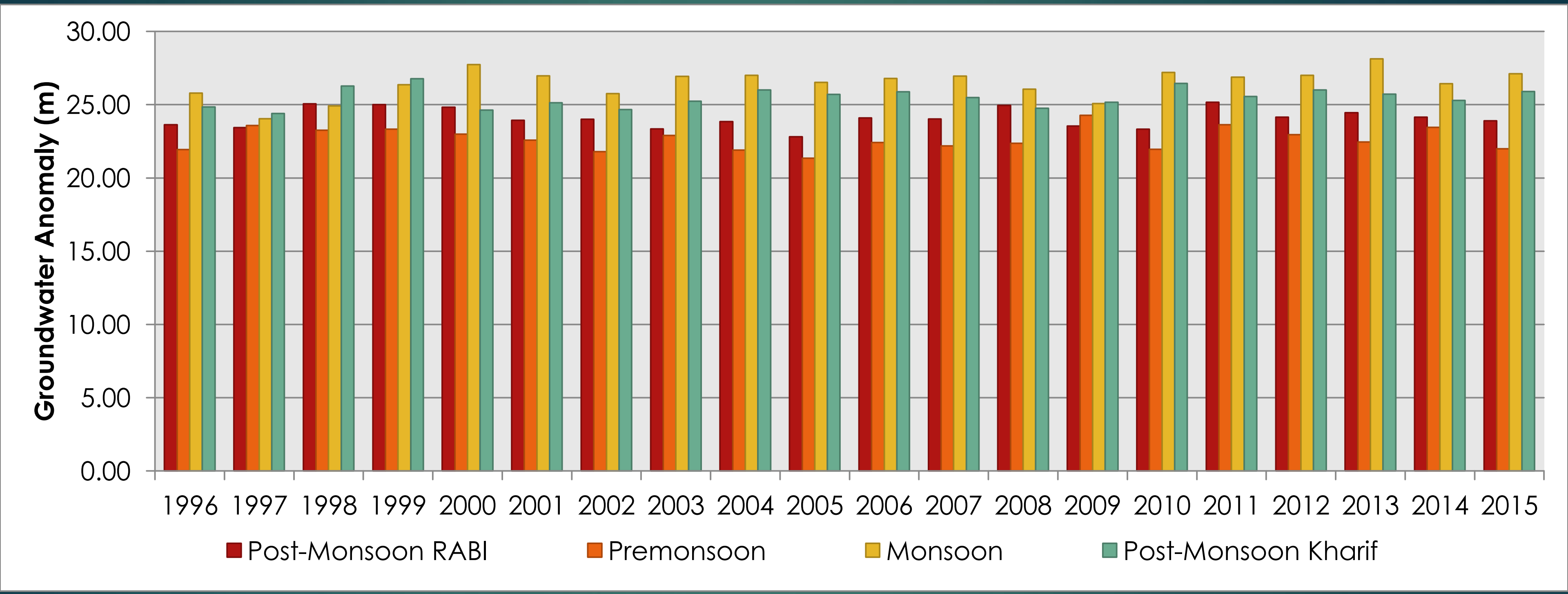


Well Location map in Venna River Basin
78°20'0"E
78°35'30"E
78°51'0"E
79°6'30"E
79°22'0"E
21°20'30"N
21°5'0"N
20°49'30"N
20°34'0"N
20°18'30"N
N
S
W
E
Satnaori(Tola)
Wardhamna
Gumgaon
Kharangana
Hingni
Borkhedi
Anji
Keljhar
Yelakeli
Madni (New)
Ajda
Girad
Dhondgaon
Sonegaon
Samudrapur
Hinganghat
Sakhra
Darodia
Rampur
Madheri
0 5 10 20 30 40
Kilometers
well_location
Venna Basin

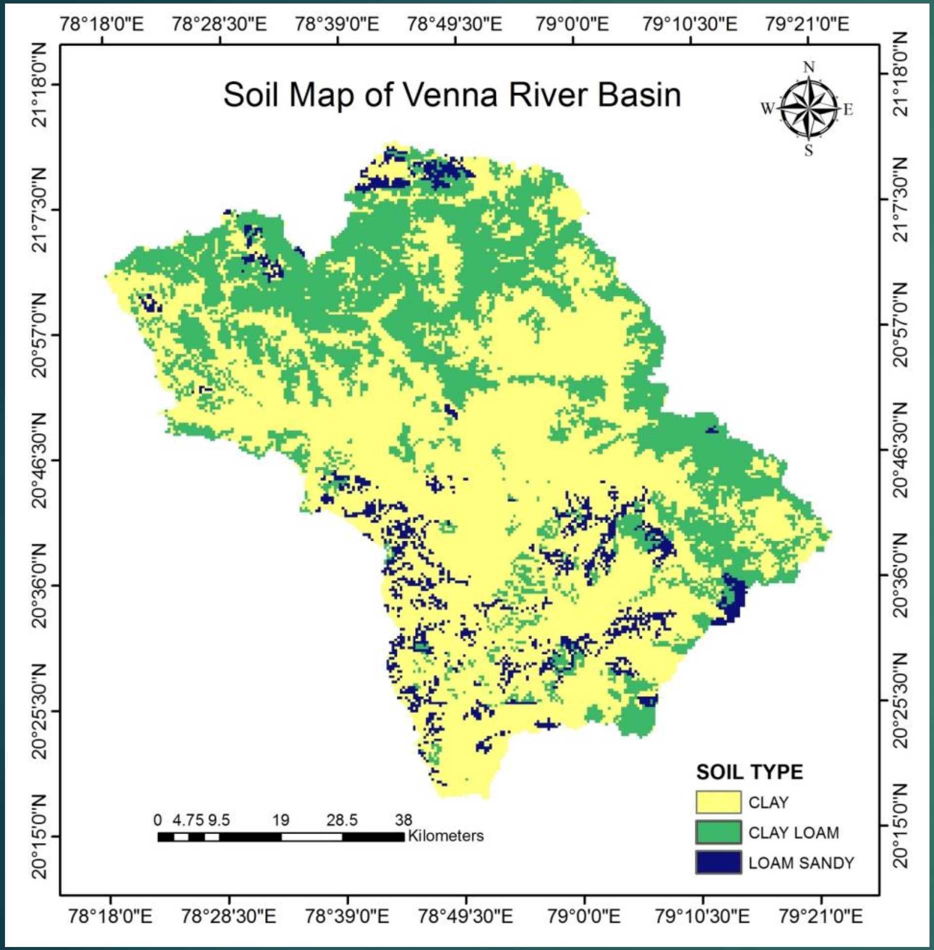
METHODOLOGY

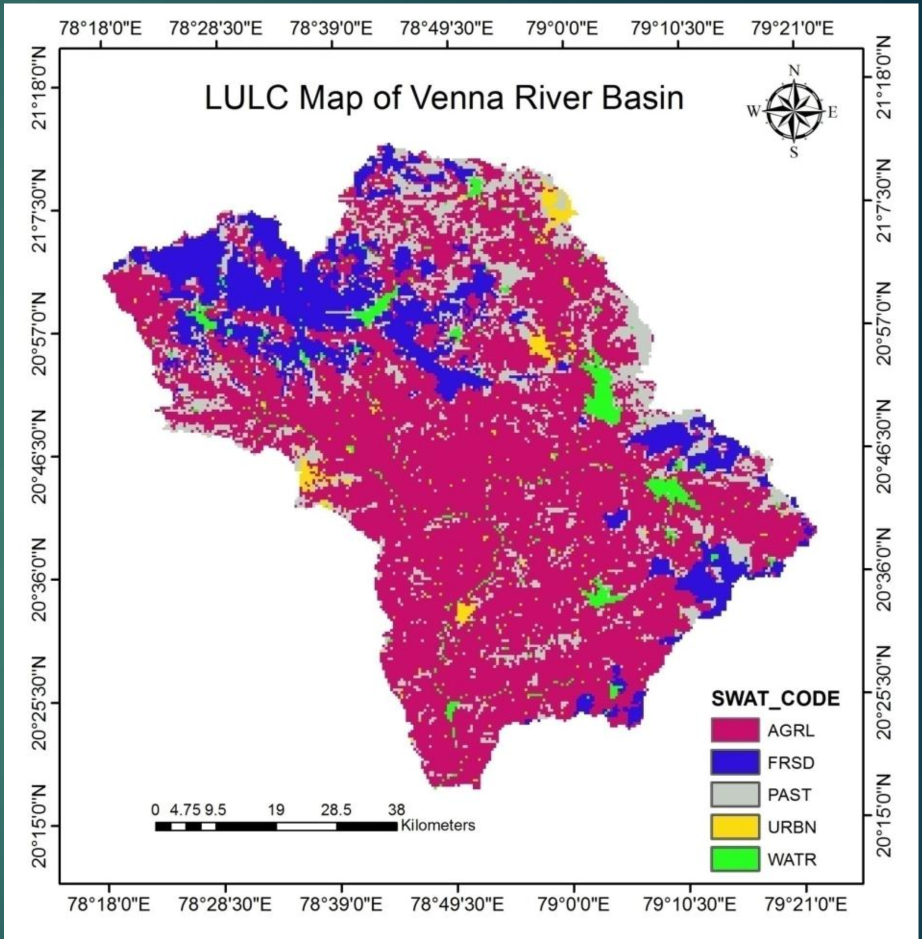


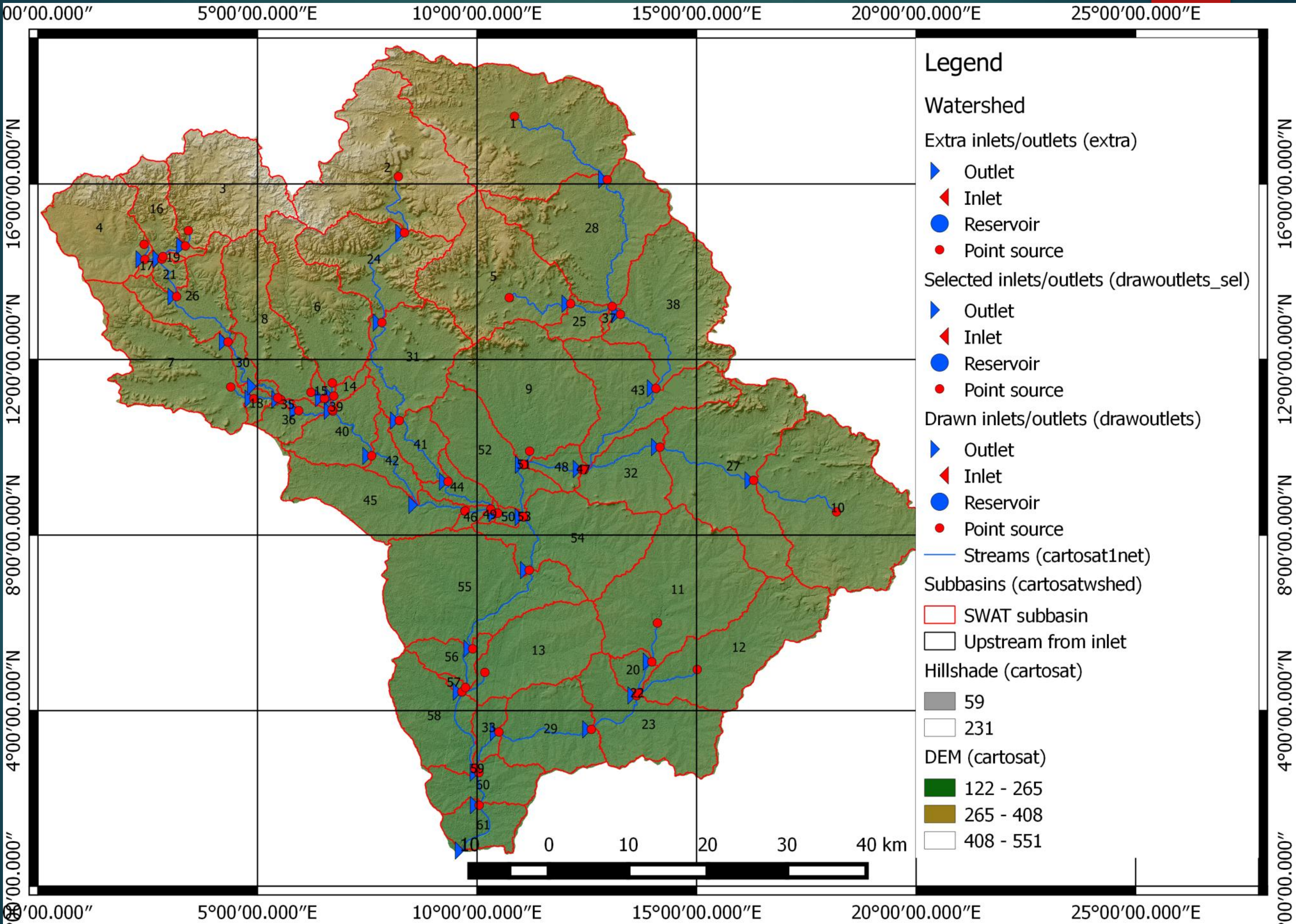
Seasonal Groundwater level anomaly



Development of SWAT–model for groundwater depth estimation

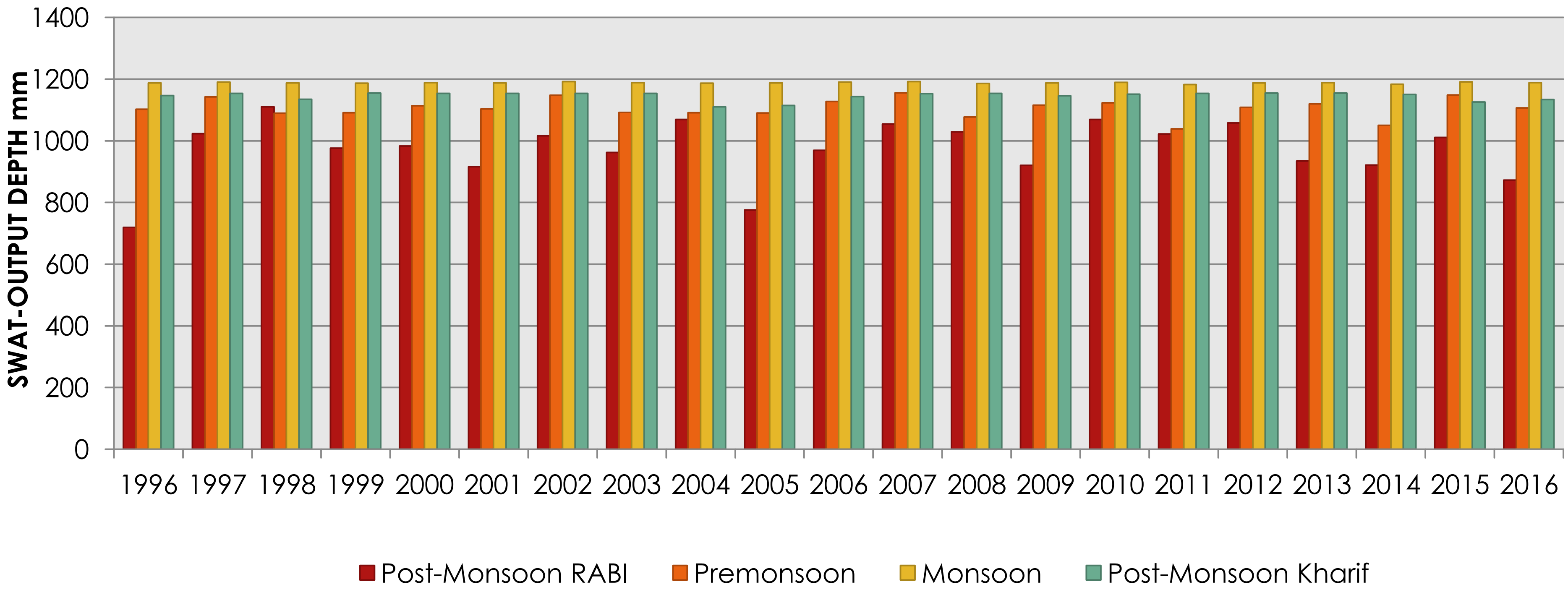

Soil Map of Venna River Basin
SOIL TYPE
CLAY
CLAY LOAM
LOAM SANDY
0 4.75 9.5 19 28.5 38 Kilometers


LULC Map of Venna River Basin
SWAT_CODE
AGRL
FRSD
PAST
URBN
WATR
0 4.75 9.5 19 28.5 38 Kilometers



Legend
Watershed
Extra inlets/outlets (extra)
Outlet
Inlet
Reservoir
Point source
Selected inlets/outlets (drawoutlets_sel)
Outlet
Inlet
Reservoir
Point source
Drawn inlets/outlets (drawoutlets)
Outlet
Inlet
Reservoir
Point source
Streams (cartosat1net)
Subbasins (cartosatwshed)
SWAT subbasin
Upstream from inlet
Hillshade (cartosat)
59
231
DEM (cartosat)
122 - 265
265 - 408
408 - 551
0 10 20 30 40 km
5°00′00.000″E
10°00′00.000″E
15°00′00.000″E
20°00′00.000″E
25°00′00.000″E
16°00′00.000″N
12°00′00.000″N
8°00′00.000″N
4°00′00.000″N

SWAT OUTPUT FOR GROUND WATER DEPTH



RESULTS

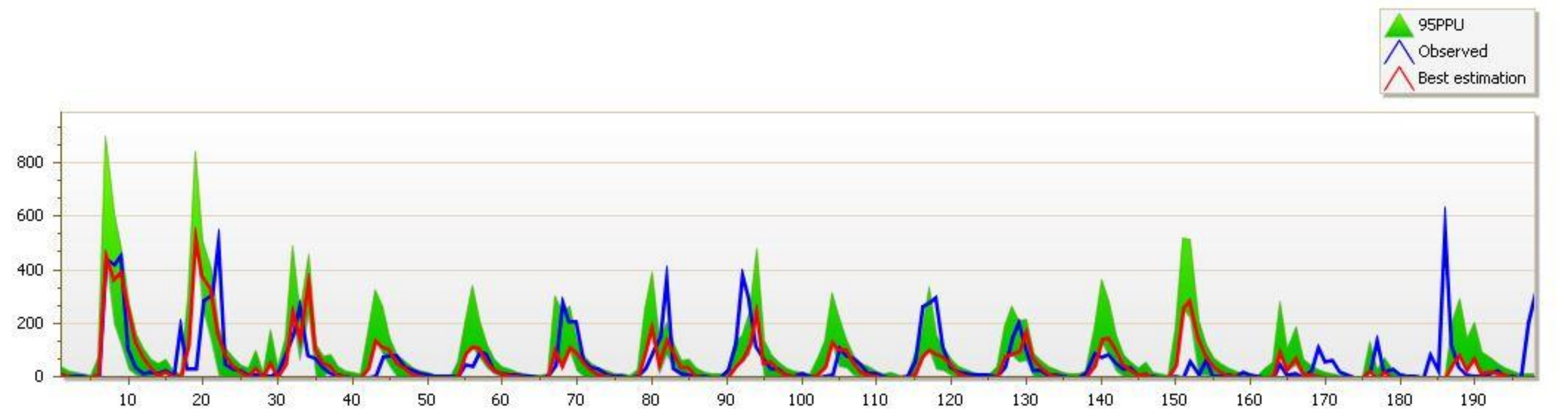
YEAR	Premonsoon		Monsoon		Post-Monsoon RABI		Post-Monsoon KHARIF	
	SWAT	WELL	SWAT	WELL	SWAT	WELL	SWAT	WELL
1996	1102.41	657.87	1188.12	773.48	719.68	708.96	1146.94	745.11
1997	1142.66	707.26	1190.66	721.40	1023.37	702.91	1154.22	731.92
1998	1089.19	697.72	1187.61	747.51	1110.03	751.70	1134.39	787.96
1999	1090.82	699.78	1186.94	790.72	975.76	750.11	1154.54	803.31
2000	1114.02	689.94	1188.63	831.89	983.38	744.67	1154.04	738.83
2001	1103.35	677.20	1187.33	808.98	916.22	718.06	1154.07	754.01
2002	1147.47	653.78	1191.83	772.56	1015.98	720.41	1153.73	740.20
2003	1091.93	687.20	1188.23	807.82	962.66	700.30	1153.83	757.19
2004	1091.50	656.94	1186.85	810.00	1069.21	715.29	1109.95	780.00
2005	1089.94	640.57	1187.80	795.76	776.33	684.08	1114.24	770.94
2006	1127.96	672.49	1190.28	803.60	969.53	722.62	1143.38	776.29
2007	1155.16	665.43	1192.40	808.28	1054.94	720.86	1152.76	764.44
2008	1077.06	670.96	1186.20	781.68	1029.16	748.38	1153.46	742.42
2009	1115.09	728.39	1188.13	752.14	920.82	706.11	1146.38	755.22
2010	1123.40	658.63	1189.59	815.83	1069.27	699.68	1151.29	793.60
2011	1038.89	708.98	1182.48	806.33	1022.70	754.82	1153.81	766.79
2012	1108.58	688.82	1187.96	810.00	1057.59	724.47	1154.43	780.00
2013	1119.78	673.49	1188.78	843.88	934.35	733.49	1154.89	771.83
2014	1050.12	703.55	1183.61	793.12	921.46	724.73	1149.95	758.99
2015	1148.81	659.93	1191.65	813.19	1011.05	717.23	1126.22	777.16

YEAR	Premonsoon (mm)		Monsoon(mm)		Post-Monsoon RABI(mm)		Post-Monsoon KHARIF(mm)	
	SWAT	WELL	SWAT	WELL	SWAT	WELL	SWAT	WELL
1996	661.45	657.87	772.28	773.48	503.78	708.96	745.51	745.11
1997	685.60	707.26	773.93	721.40	716.36	702.91	750.24	731.92
1998	653.51	697.72	771.95	747.51	777.02	751.70	737.35	787.96
1999	654.49	699.78	771.51	790.72	683.03	750.11	750.45	803.31
2000	668.41	689.94	772.61	831.89	688.37	744.67	750.13	738.83
2001	662.01	677.20	771.76	808.98	641.35	718.06	750.15	754.01
2002	688.48	653.78	774.69	772.56	711.19	720.41	749.92	740.20
2003	655.16	687.20	772.35	807.82	673.86	700.30	749.99	757.19
2004	654.90	656.94	771.45	810.00	748.45	715.29	721.47	780.00
2005	653.96	640.57	772.07	795.76	543.43	684.08	724.26	770.94
2006	676.78	672.49	773.68	803.60	678.67	722.62	743.20	776.29
2007	693.10	665.43	775.06	808.28	738.46	720.86	749.29	764.44
2008	646.24	670.96	771.03	781.68	720.41	748.38	749.75	742.42
2009	669.05	728.39	772.28	752.14	644.57	706.11	745.15	755.22
2010	674.04	658.63	773.23	815.83	748.49	699.68	748.34	793.60
2011	623.33	708.98	768.61	806.33	715.89	754.82	749.98	766.79
2012	665.15	688.82	772.17	810.00	740.31	724.47	750.38	780.00
2013	671.87	673.49	772.71	843.88	654.05	733.49	750.68	771.83
2014	630.07	703.55	769.35	793.12	645.02	724.73	747.47	758.99
2015	689.29	659.93	774.57	813.19	707.74	717.23	732.04	777.16
	0.6		0.65		0.7		0.65	

Vazquez-Amábile, et all. (2005)

STATICAL	Calibration (1992-1994)			Validation (1995-1996)		
	RMSE	NSE	R	RMSE	NSE	R
RMSE	0.42	0.61	0.88	0.79	0.1	0.68
NSE	0.59	0.36	0.71	0.84	-0.51	0.45
R	0.65	0.4	0.64	0.65	0.38	0.67

SWAT-CUP OUTPUT



STATICAL	Calibration (1996-2005)			Validation (2006-2015)		
	RMSE	NSE	R	RMSE	NSE	R
RMSE	0.31	0.16	0.65	0.58	0.13	0.59
NSE	0.48	0.26	0.50	0.69	0.18	0.39
R	0.45	0.30	0.49	0.54	0.29	0.58

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THANK YOU