Assessing the Influence of Climate Datasets for Quantification of Water Balance Components in Black Sea Catchment: Case Study for Melen Watershed, Turkey

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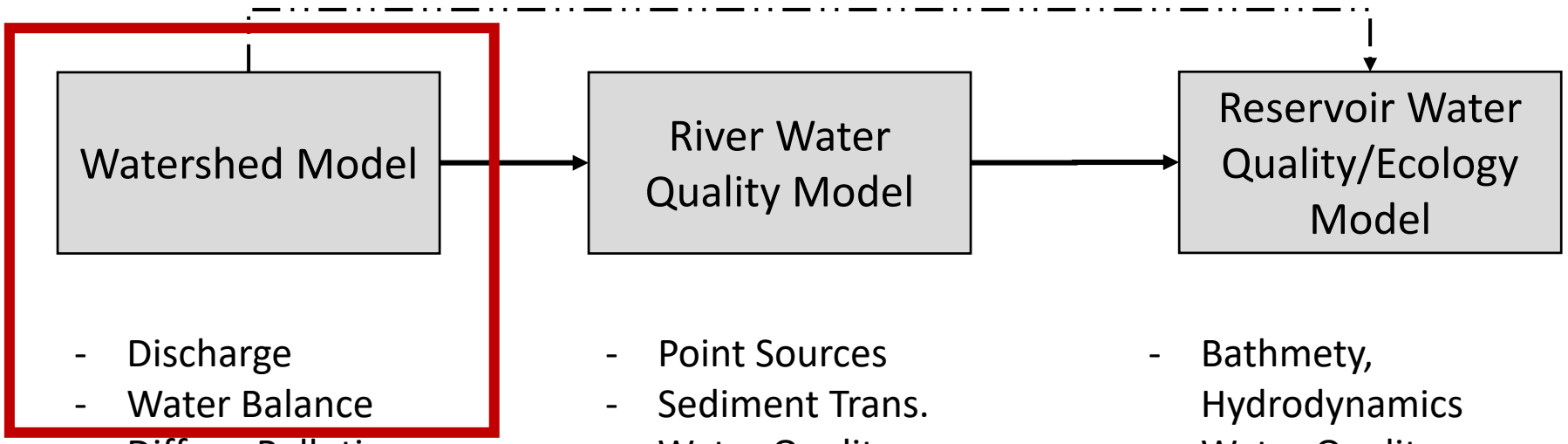
Outline

- Introduction
- Aim and Scope
- Study Area
- Model Setup
- Results
- Conclusion

Introduction

- Melen Watershed is the integral part of the Istanbul Water Resources System
- Quantification the water quantity and quality in Melen Watershed is important.



Aim and Scope

- Developing a hydrological model for Melen Watershed, Turkey
- Comparing of local data set with reanalysis data (CFSR)

  - Precipitation is one of the predominant input uncertainity sources
  - Data scarce region
  - Spatial distribution, measurement quality, missing data
  - Representative weather data for watershed
  - Ungauged mountainous region

Study Area (Istanbul, Turkey)

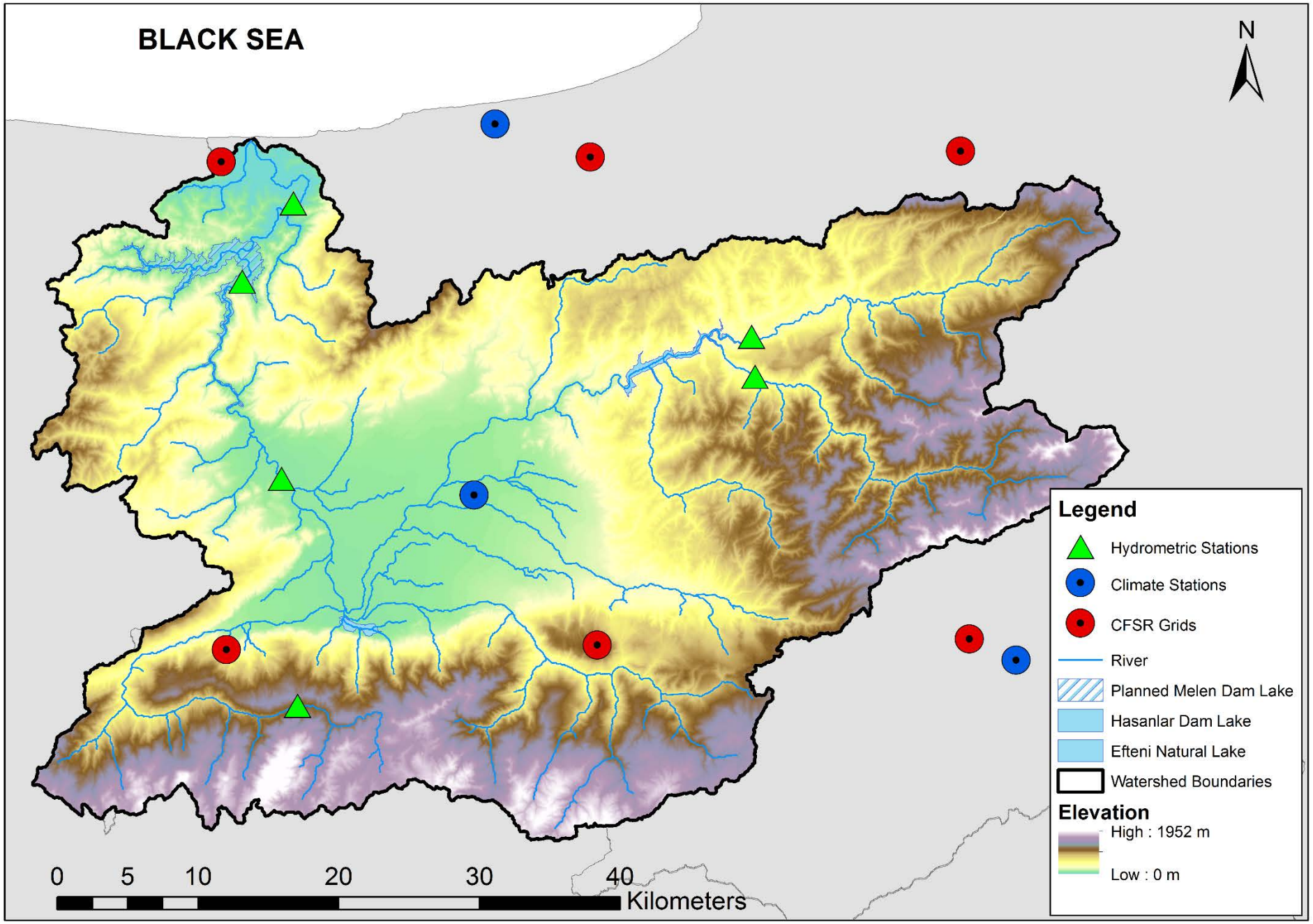
Study Area (Melen Watershed)

Water Treatment Plant

Area = 2444 km^2

Q_{ave} = 45.7 m^3 sec^{-1}

Precip = 823mm ???


BLACK SEA
N
Legend
Hydrometric Stations
Climate Stations
CFSR Grids
River
Planned Melen Dam Lake
Hasanlar Dam Lake
Efteni Natural Lake
Watershed Boundaries
Elevation
High : 1952 m
Low : 0 m
0 5 10 20 30 40
Kilometers

Model Setup (Data Sources)

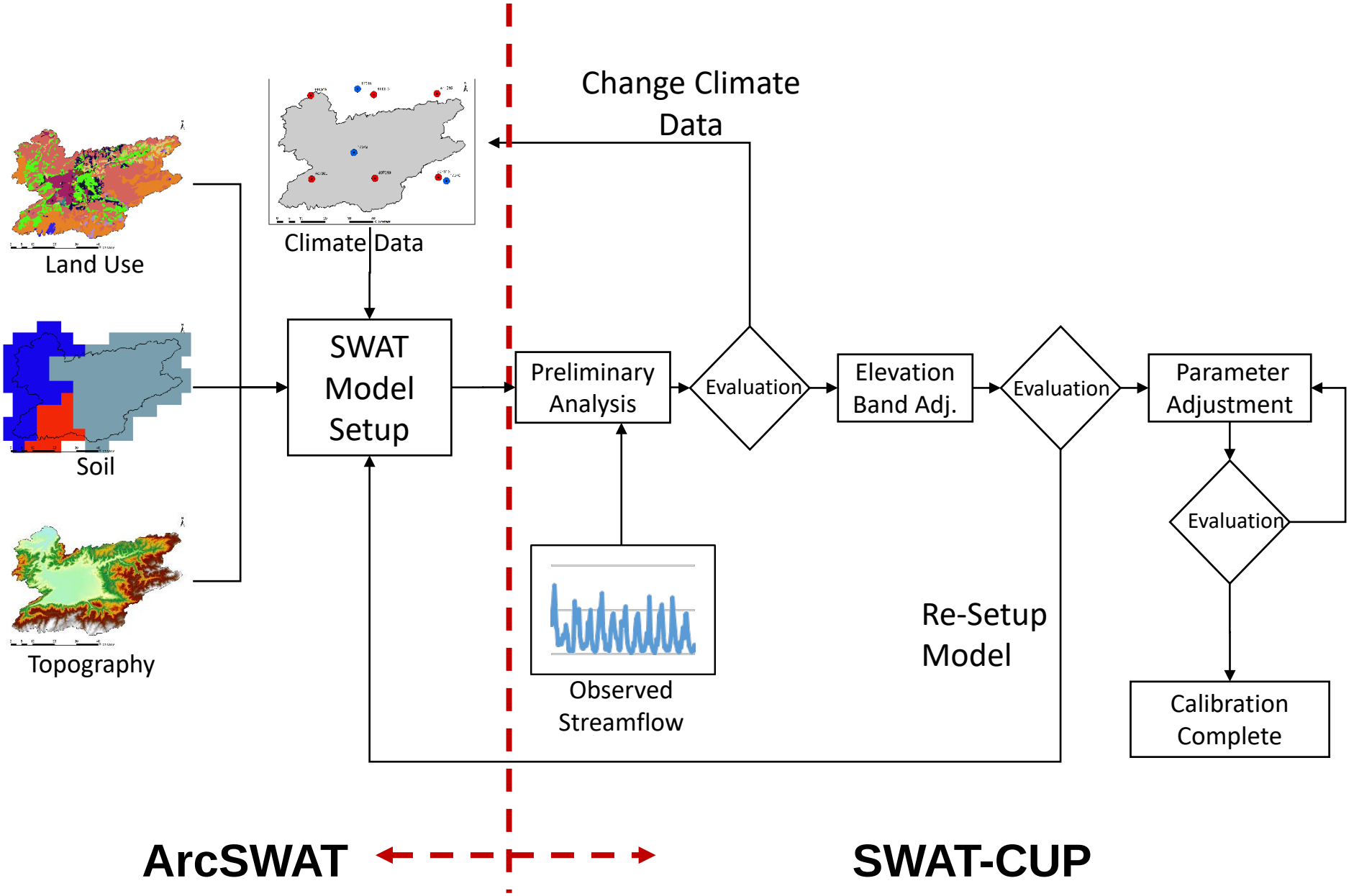
- Digital Elevation Map SRTM 90m
- Land Use CORINE
- Soil FAO
- Climate Data Set
  - CFSR (1979-2014)
  - Local Climate Datasets (1960-2013)
- Discharge Data
  - DSI (6 stations)

Model Setup

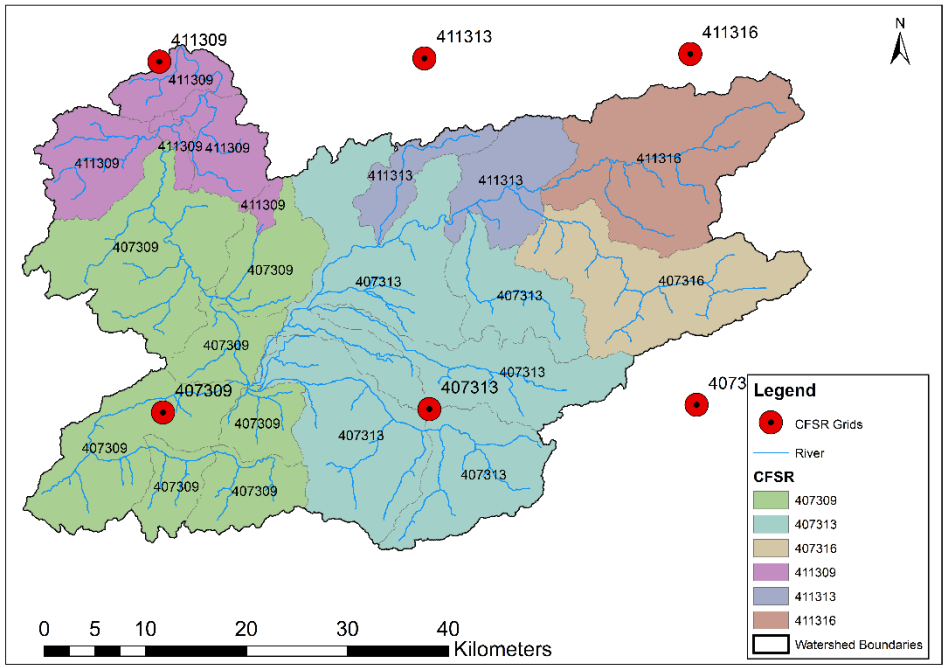
- Simulation period (1995) 2000 – 2012
- 5 years warmup
- 20 Subbasins
- Hargreaves Method

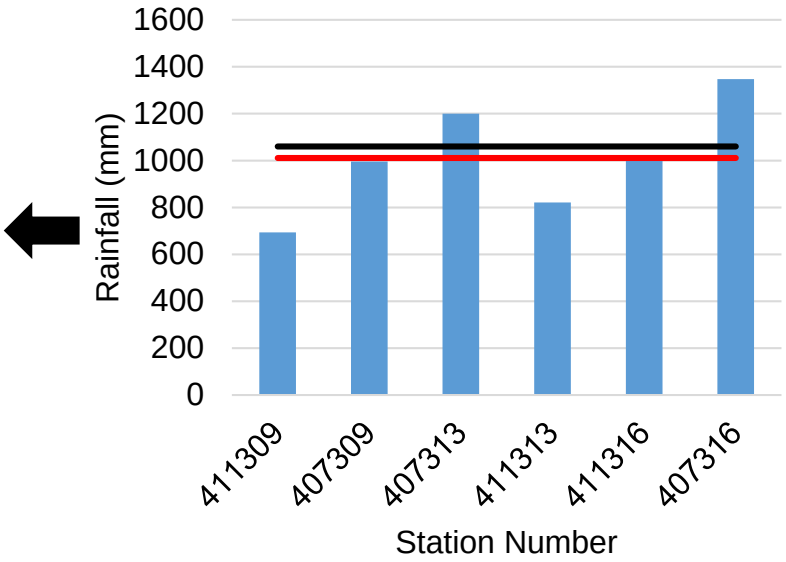
- SWAT-CUP using SUFI-2 algorithm
- 60% of streamflow used for calibration
- NSE as an objective function
- Performance criteria NSE, R2, PBIAS as well as P-factor and R-factor

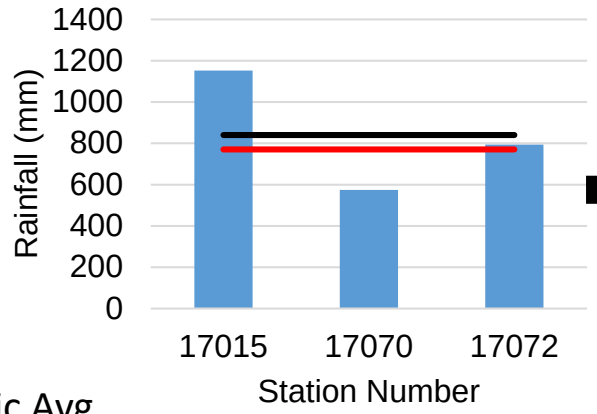
Methodology



Climate Data

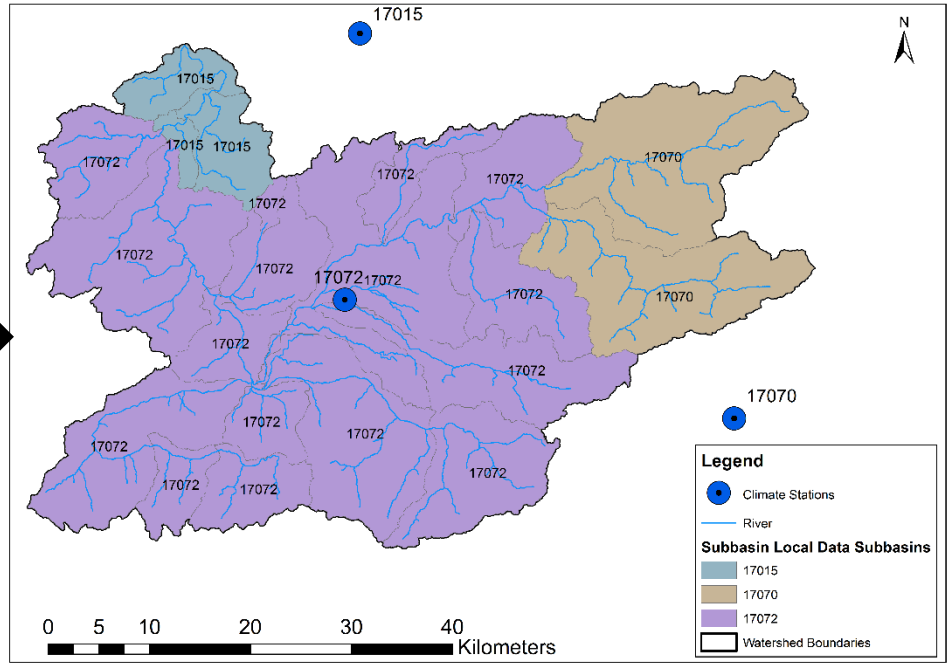


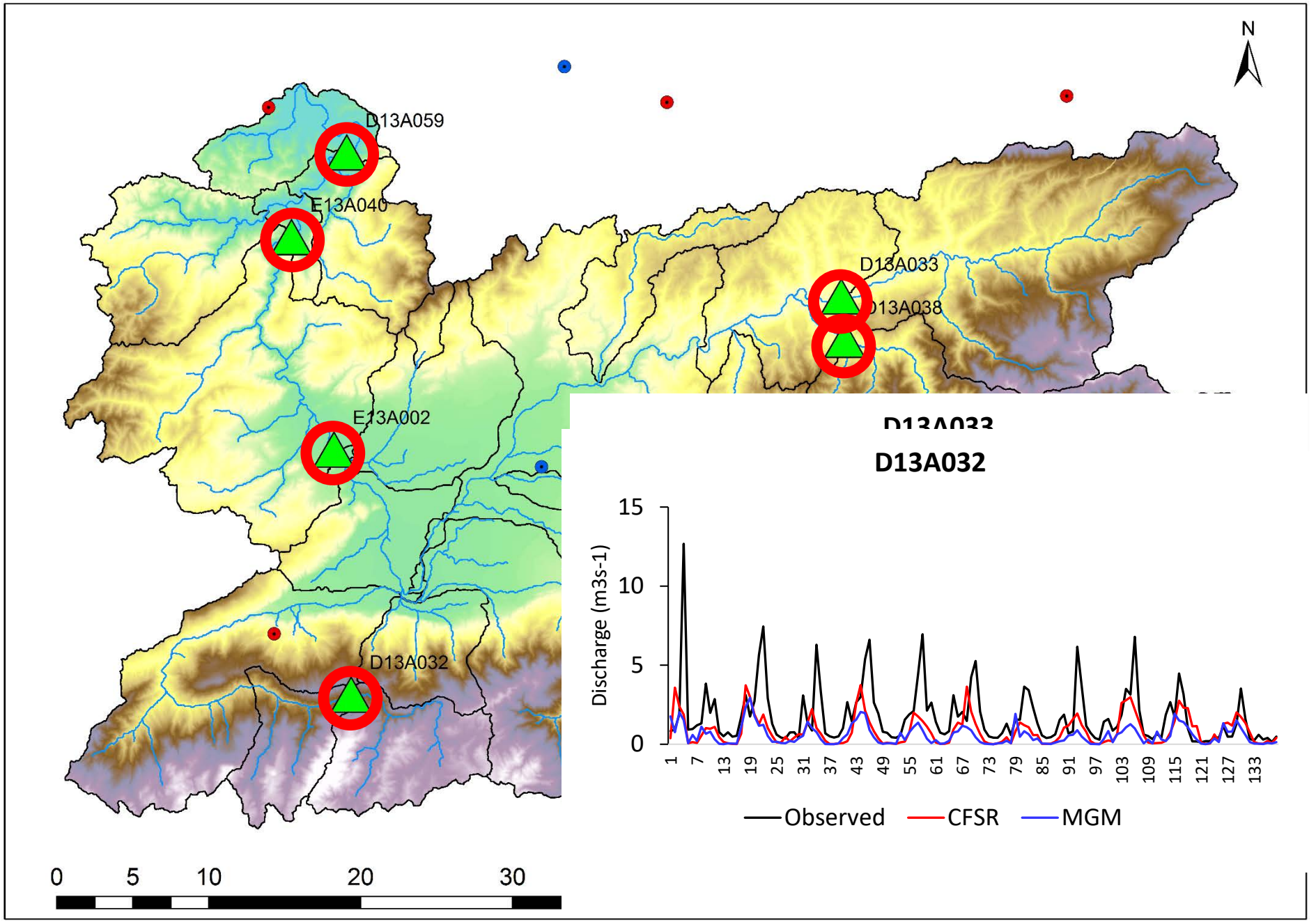




Arithmetic Avg.

Weighted Avg.



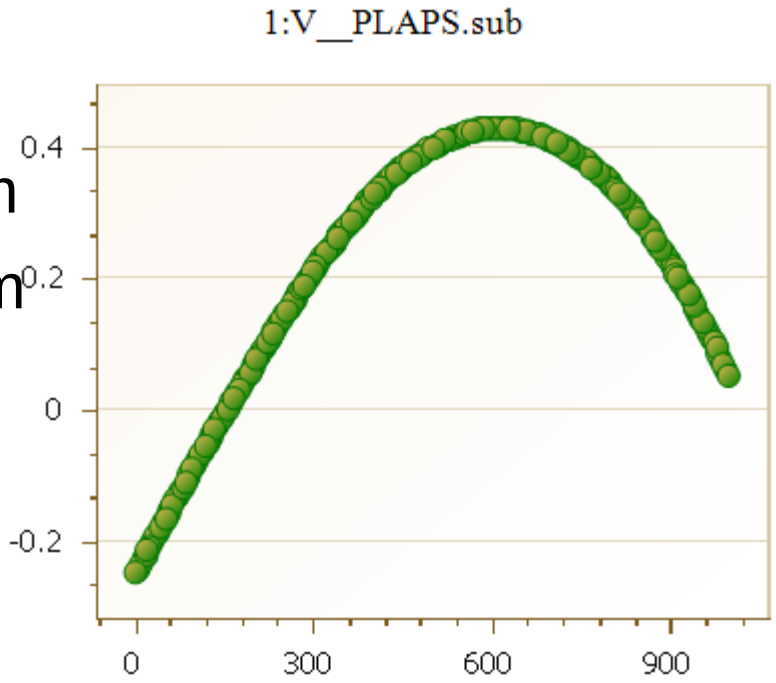

N
D13A059
E13A040
D13A033
D13A038
E13A002
D13A032
0 5 10 20 30
D13A032
Discharge (m3s-1)
15
10
5
0
1 7 13 19 25 31 37 43 49 55 61 67 73 79 85 91 97 103 109 115 121 127 133
Observed
CFSR
MGM

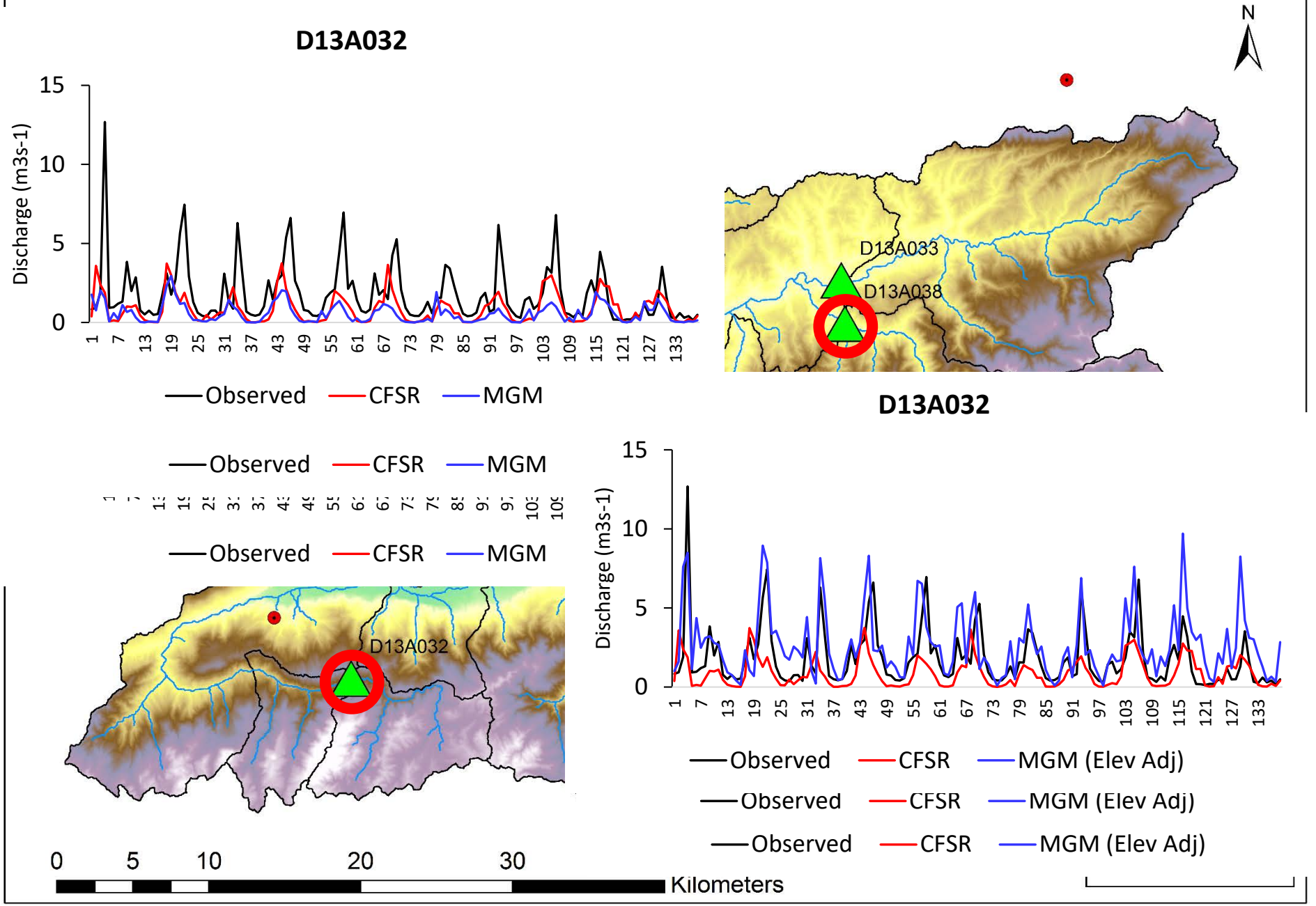
Elevation Band Adjustment

- To consider the orographic effects on precipitation and temperature in watershed,

  Five elevation bands have been applied to model developed by <u>local data (MGM)</u>

- **Tlapse** Rate is chosen as -6.5 C / km
- **Plapse** Rate is chosen as 600mm/km




D13A032
Discharge (m3s-1)
15
10
5
0
1 7 13 19 25 31 37 43 49 55 61 67 73 79 85 91 97 103 109 115 121 127 133
Observed CFSR MGM
N
D13A033
D13A038
Observed CFSR MGM
Observed CFSR MGM
D13A032
D13A032
Discharge (m3s-1)
15
10
5
0
1 7 13 19 25 31 37 43 49 55 61 67 73 79 85 91 97 103 109 115 121 127 133
Observed CFSR MGM (Elev Adj)
Observed CFSR MGM (Elev Adj)
Observed CFSR MGM (Elev Adj)
0 5 10 20 30
Kilometers

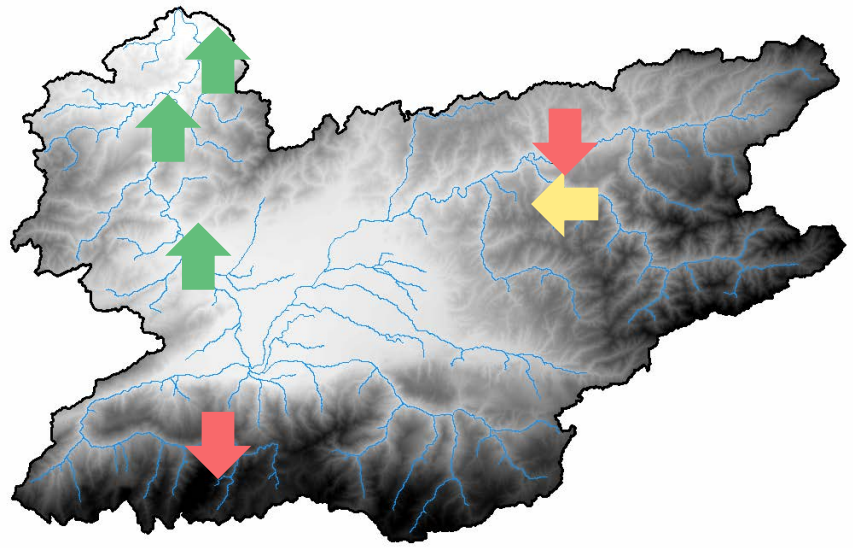
SWAT Model Parameters

		CFSR	MGM (Elev Adj.)
SWAT Parameters	**Initial Range**	**Final Range**	
r__CN2.mgt	-0.5 to 0.5	-0.92 to 0.02	-0.23 to 0.304
r__GWQMN.gw	-0.5 to 0.5	-0.44 to 0.18	-0.93 to 0.02
r__GW_REVAP.gw	-0.5 to 0.5	-0.98 to 0.004	-0.83 to 0.05
r__SOL_AWC().sol	-0.5 to 0.5	-0.86 to 0.04	-0.71 to 0.09
r__REVAPMN.gw	-0.5 to 0.5	-0.09 to 0.72	-0.82 to 0.05
r__ESCO.hru	-0.2 to 0.2	-0.05 to 0.22	-0.33 to 0.02
r__ALPHA_BF.gw	-0.5 to 0.5	-0.33 to 0.22	-0.07 to 0.78
r__SOL_K().sol	-0.5 to 0.5	-0.03 to 0.90	-0.23 to 0.28
r__SOL_BD().sol	-0.5 to 0.5	-0.09 to 0.70	-0.68 to 0.10

480 simulations has been done

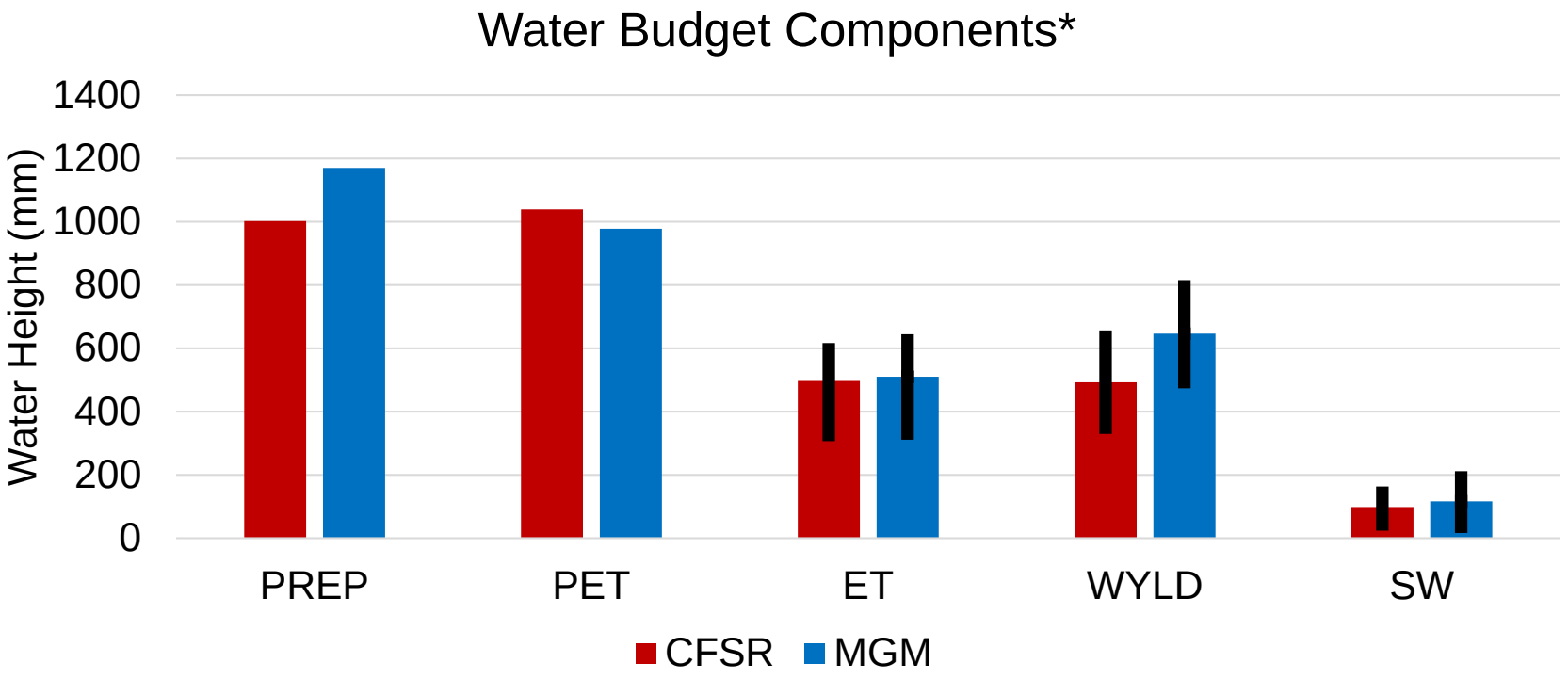
Calibration Results

Data Set	Station ID	Elevation (m)	Calibration					Validation				
			p-factor	r-factor	R2	NS	PBIAS	p-factor	r-factor	R2	NS	PBIAS
CFSR	D13A059	10	0.76	1.08	0.82	0.8	13.1	0.88	1.16	0.82	0.8	10.6
	E13A040	23	0.77	0.93	0.8	0.76	14.7	0.86	1.1	0.79	0.78	9.4
	E13A002	115	0.87	1.21	0.81	0.79	-6	0.89	1.19	0.8	0.79	-2.5
	D13A038	276	0.85	1.74	0.78	0.41	-27.5	0.82	1.59	0.76	0.44	-36
	D13A033	276	0.64	0.73	0.7	0.52	31.8	0.78	0.84	0.7	0.67	13.6
	D13A032	873	0.47	0.55	0.33	0.1	47.1	0.6	0.78	0.45	0.31	37
MGM (Adj. Elev)	D13A059	10	0.92	1.13	0.89	0.88	-4.2	0.88	1.14	0.85	0.83	-10.2
	E13A040	23	0.88	0.99	0.85	0.85	2.8	0.86	1.1	0.84	0.83	-3.9
	E13A002	115	0.88	1.27	0.85	0.76	-19.5	0.84	1.2	0.84	0.79	-18.8
	D13A038	276	0.77	1.48	0.74	0.59	22.6	0.89	1.5	0.71	0.69	9.4
	D13A033	276	0.54	0.58	0.6	0.04	64.6	0.74	0.8	0.46	0.25	43.2
	D13A032	873	0.64	0.99	0.63	0.48	-32.3	0.5	1.37	0.53	-0.17	-74.1



Moriasi et al. 2007
Krause et al. 2005
Abbaspour et al. 2015

Water Budget Components



*for all basin

U95ppu

L95ppu

Conclusion

- Effects of climate data input are investigated using local data (MGM) and CFSR data in Melen Watershed, Turkey.
- SWAT model has been succesfully applied to quantify water budget components of Melen Watershed.
- Global freely available gridded reanalysis data (CFSR) represents watershed better than local data (directly used) in Melen Watershed.
- After using elevation band features of SWAT model for local data, findings of model results has become quite satisfactory at outlet of watershed
- Model results for both data set in ungauged (climate stations) and mountainous region of watershed still poorly represented.
- Using different sources of model input (if possible) is very important to define and quantify of unceartinity sources

Thanks for your attention...