Assessing GlobWat model sensitivity to climate forcing

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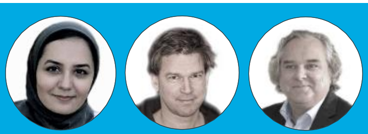


Introduction:

- Irrigation is crucial for sustaining food security for the growing population around the world.

- Irrigation affects the hydrological cycle both directly, during the process of water abstraction and irrigation, and indirectly, because of infrastructures that have been built in support of irrigation.

- For evaluating the availability of freshwater resources in the light of growing food demand, modeling the global hydrological cycle is vital.



Methods:

- The GlobWat model is one of the models that have been designed for large scale hydrological modeling, with specific focus on considering irrigated agriculture water use.

- In this study, we will compare the GlobWat model results using sample datasets provided by model developers including CRU precipitation and reference evaporation and those extracted from ERA5, ERA Interim datasets for Gavkhouni basin, Iran, in year 2004.

Methods:

GlobWat:

Table 1. Introducing GlobWat

Goal	Assessing the impact of irrigated agriculture on the global hydrological cycle
Type	Soil water balance model
Spatial resolution	5 arcmin (9.25 km by 9.25 km)
Temporal resolution	Day
Year of release	2015

Methods:

Case study:

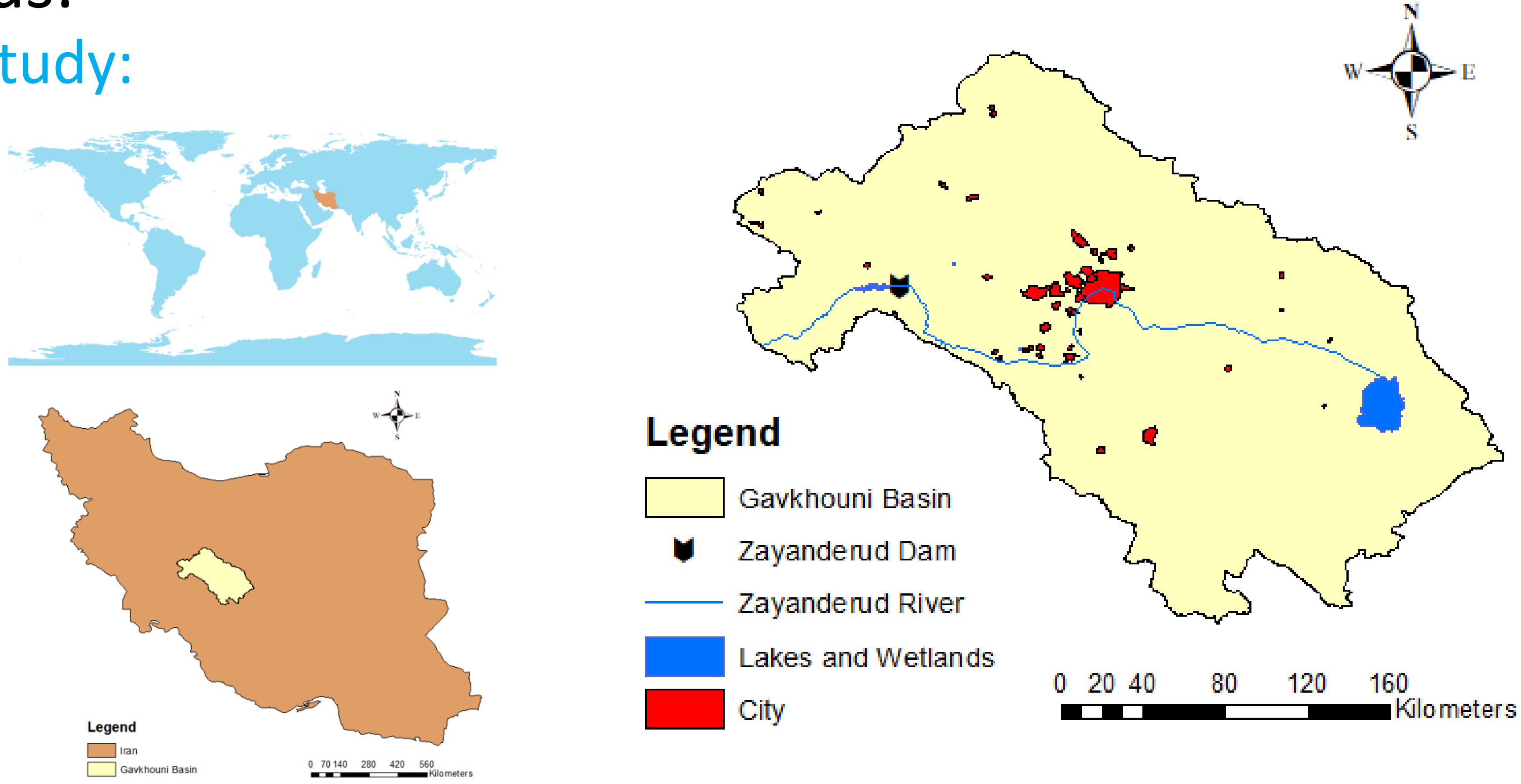


Figure 1. Gavkhouni basin, Iran

Methods:

Input climate datasets:

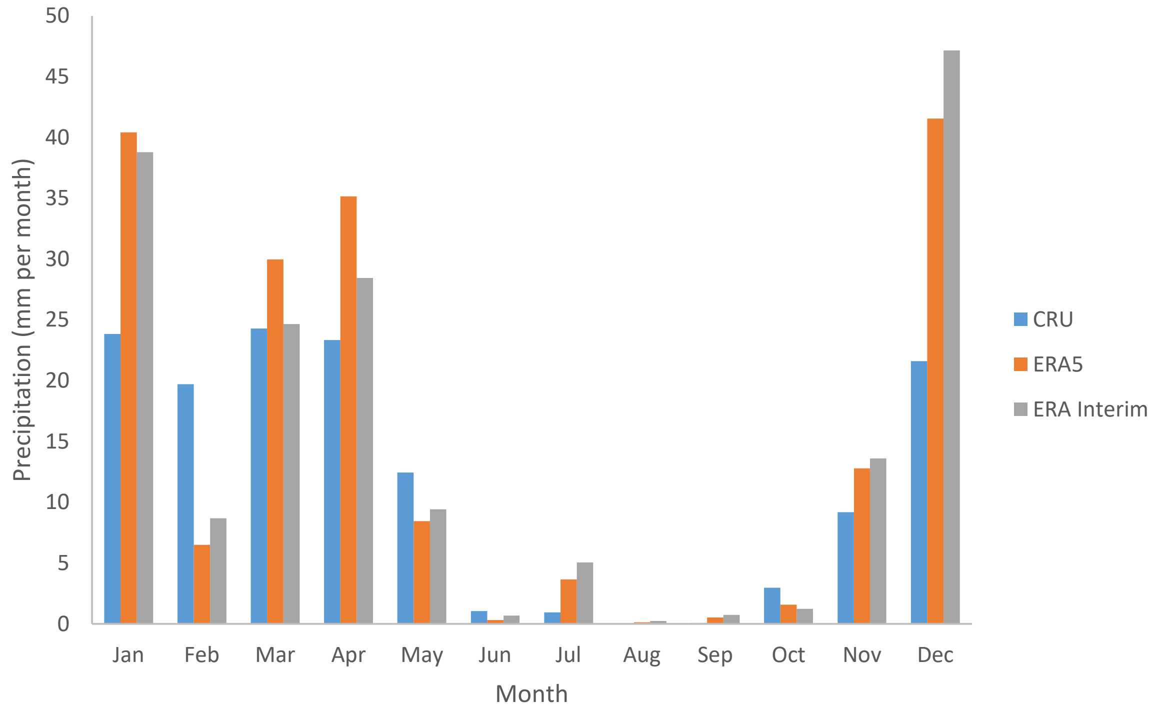


Figure 2. Precipitation over Gavkhouni basin in year 2004

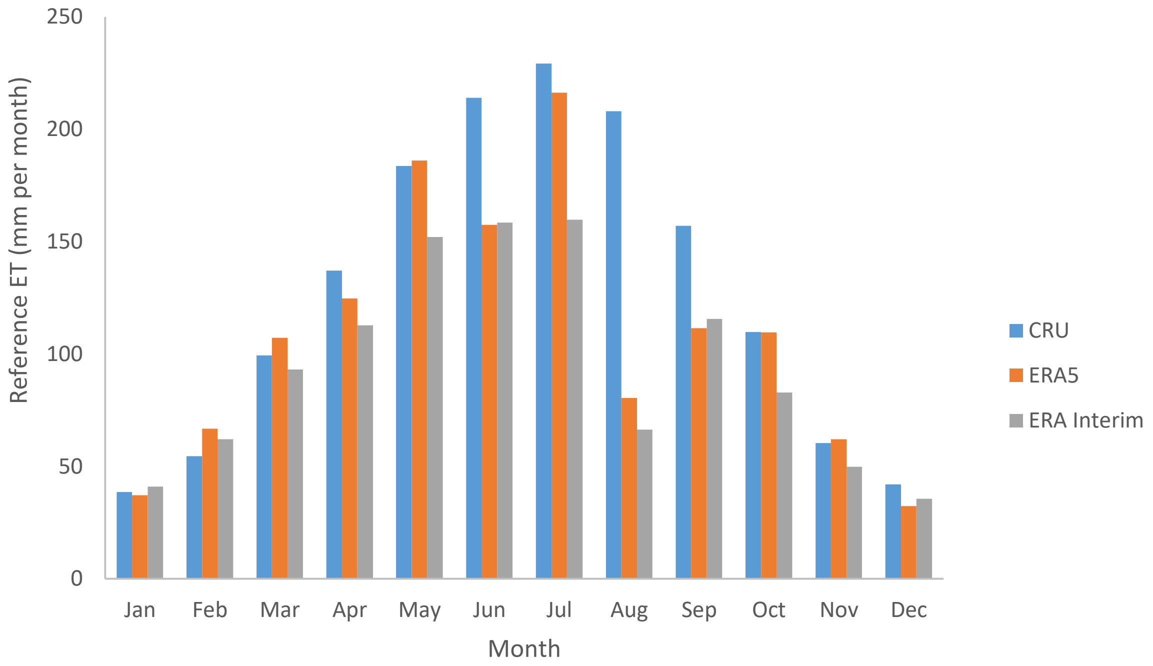


Figure 3. Reference evaporation over Gavkhouni basin in year 2004

Results:

Evaporation due to irrigation:

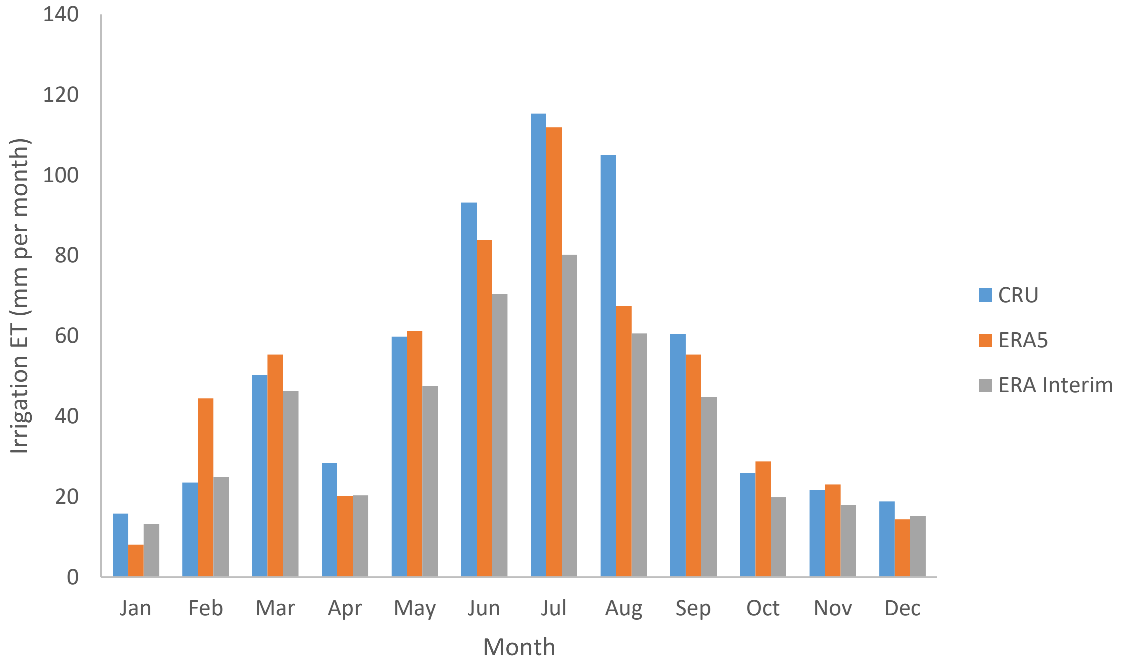


Figure 4. Estimated evaporation due to irrigation by GlobWat model over Gavkhouni basin in year 2004

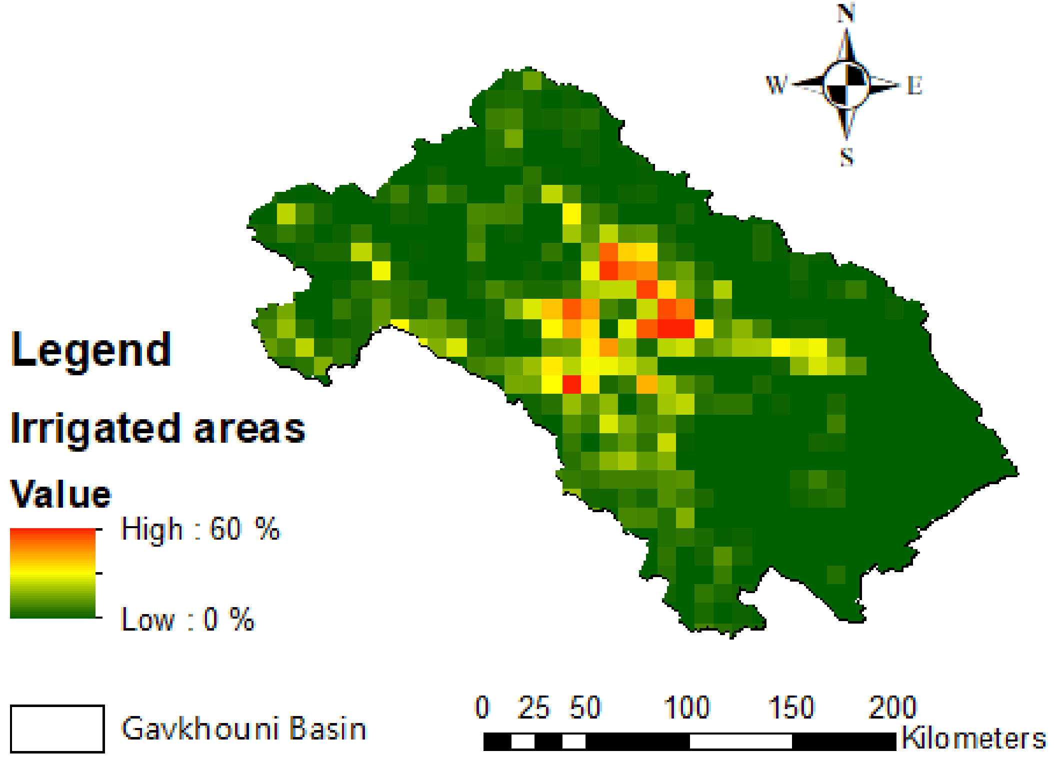


Figure 5. Map of irrigated areas as percentage of total area in Gavkhouni basin, Iran

Results:

Actual evaporation:

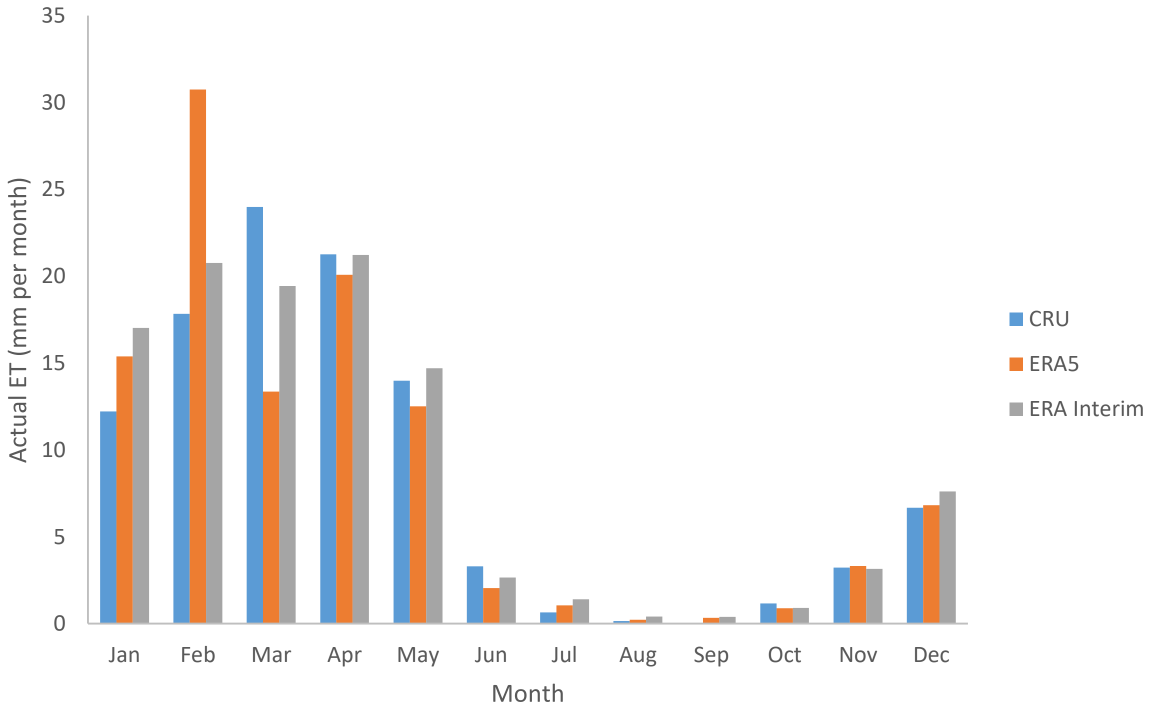


Figure 6. Estimated actual evaporation by GlobWat model over Gavkhouni basin in year 2004

Results:

BUDYKO curve:

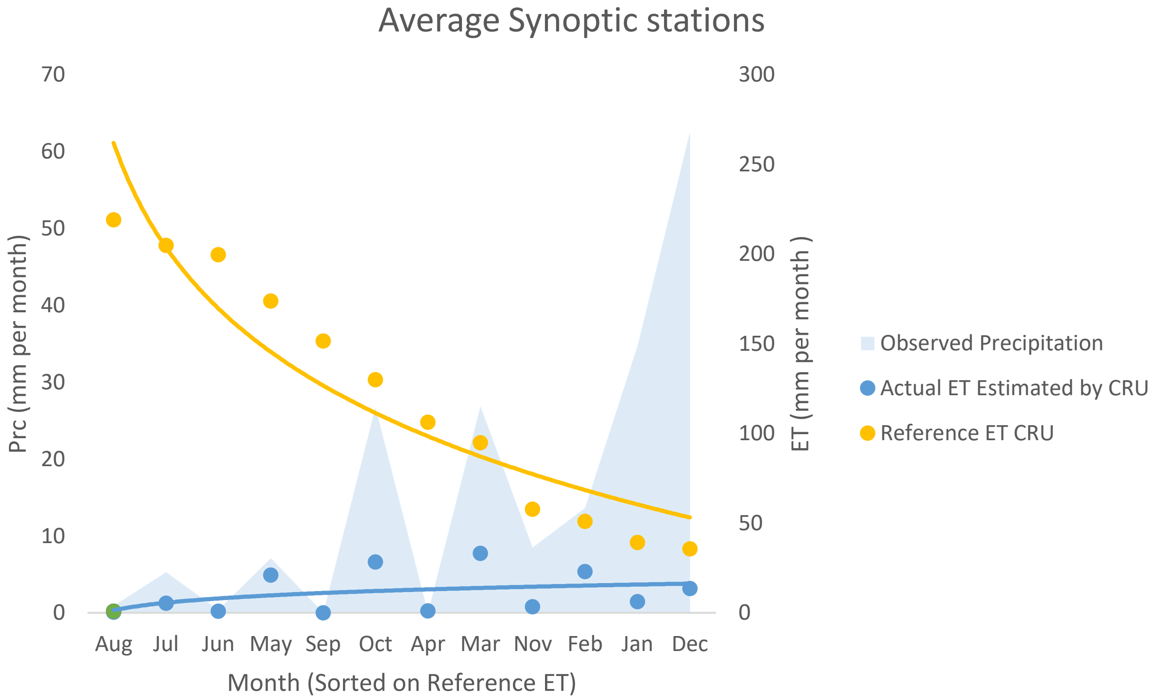


Figure 7. BUDYKO curve using CRU over Gavkhouni basin in year 2004

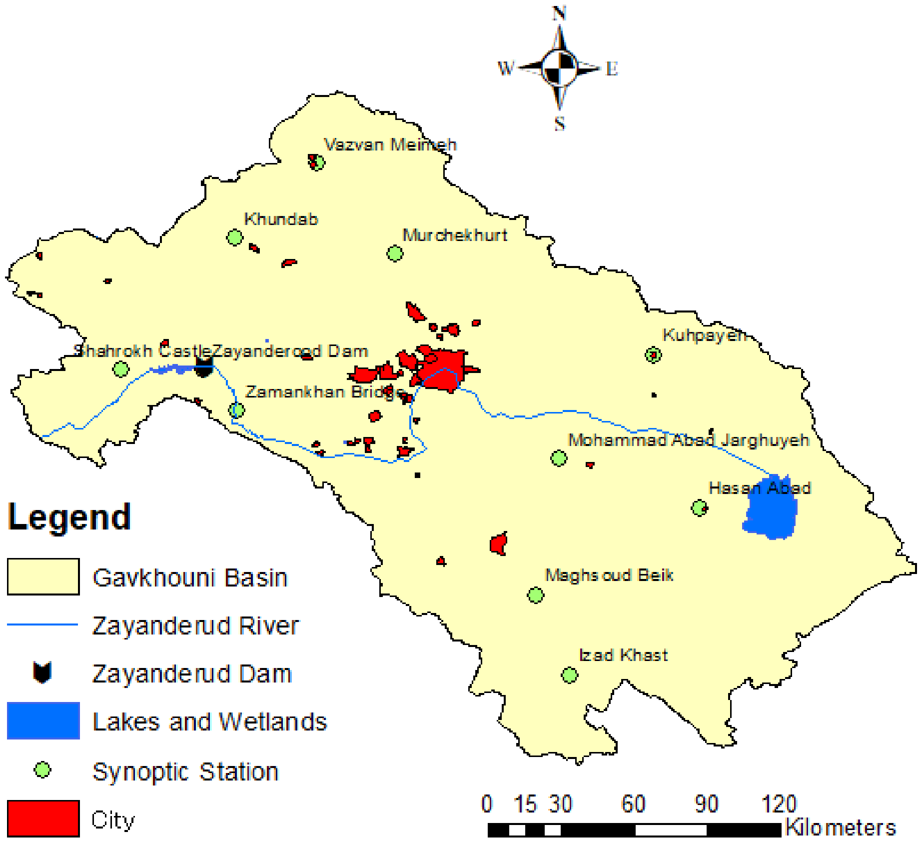


Figure 8. Map of synoptic stations in Gavkhouni basin, Iran

Results:

BUDYKO curve:

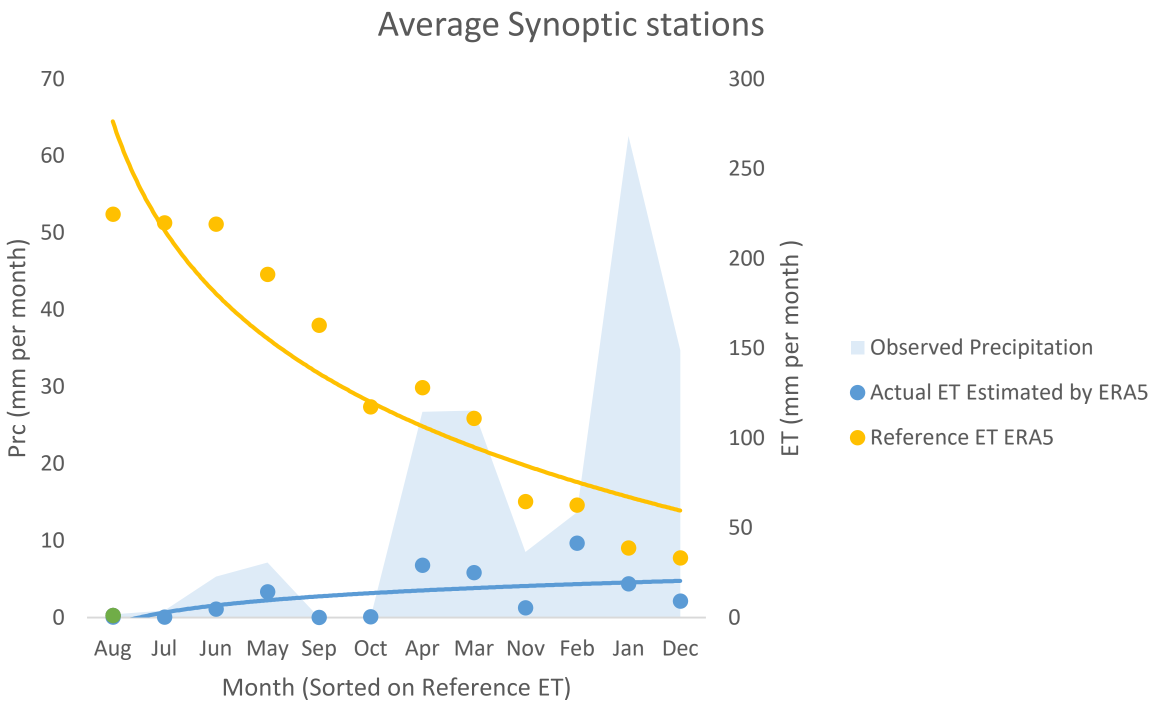


Figure 9. BUDYKO curve using ERA5 over Gavkhouni basin in year 2004

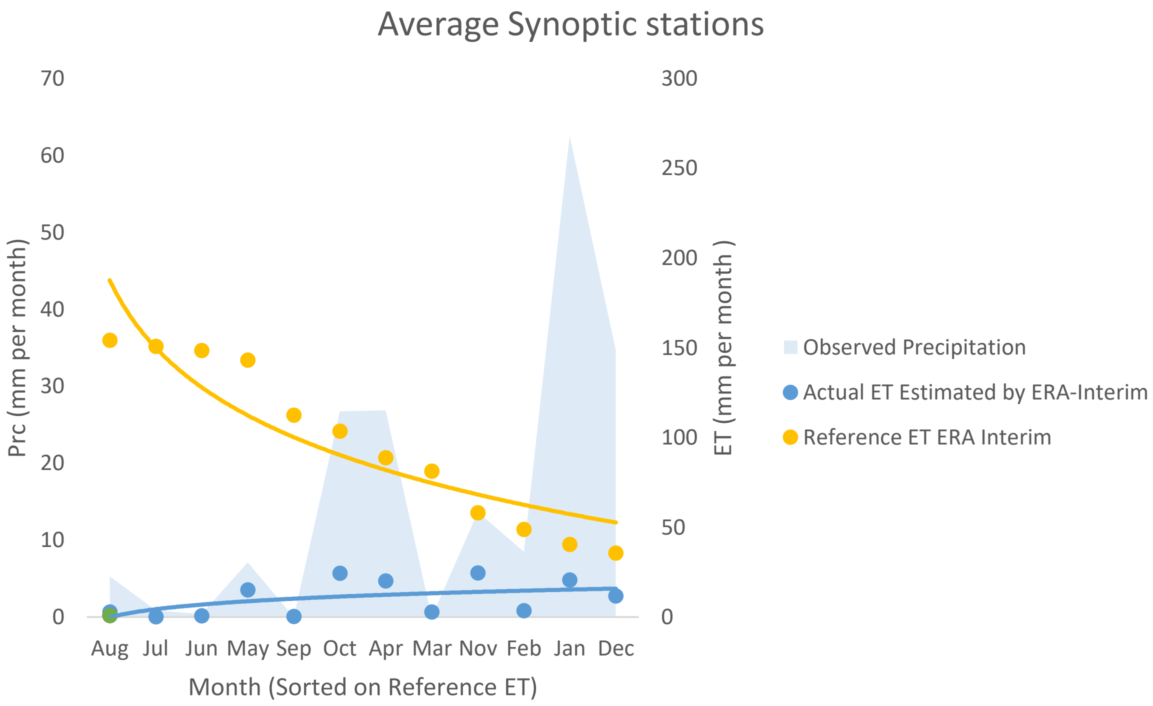


Figure 10. BUDYKO curve using ERA-Interim over Gavkhouni basin in year 2004

Results:

Drainage:

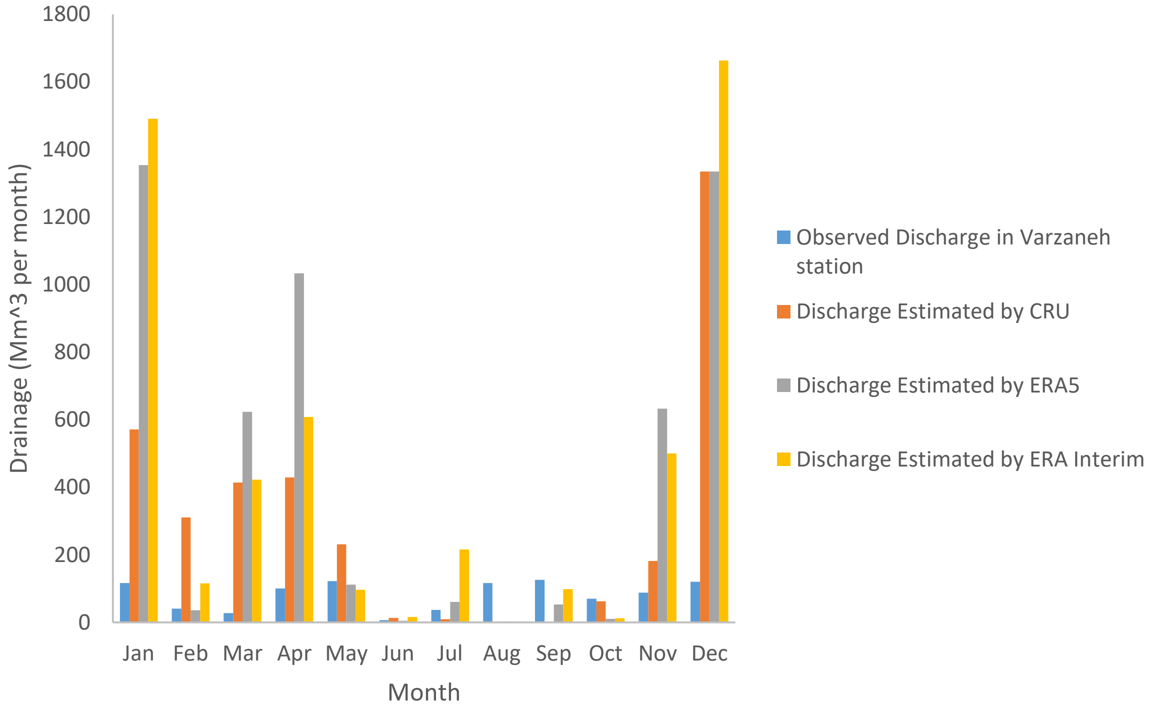


Figure 11. Observed and estimated Drainage by GlobWat over Gavkhouni basin in year 2004

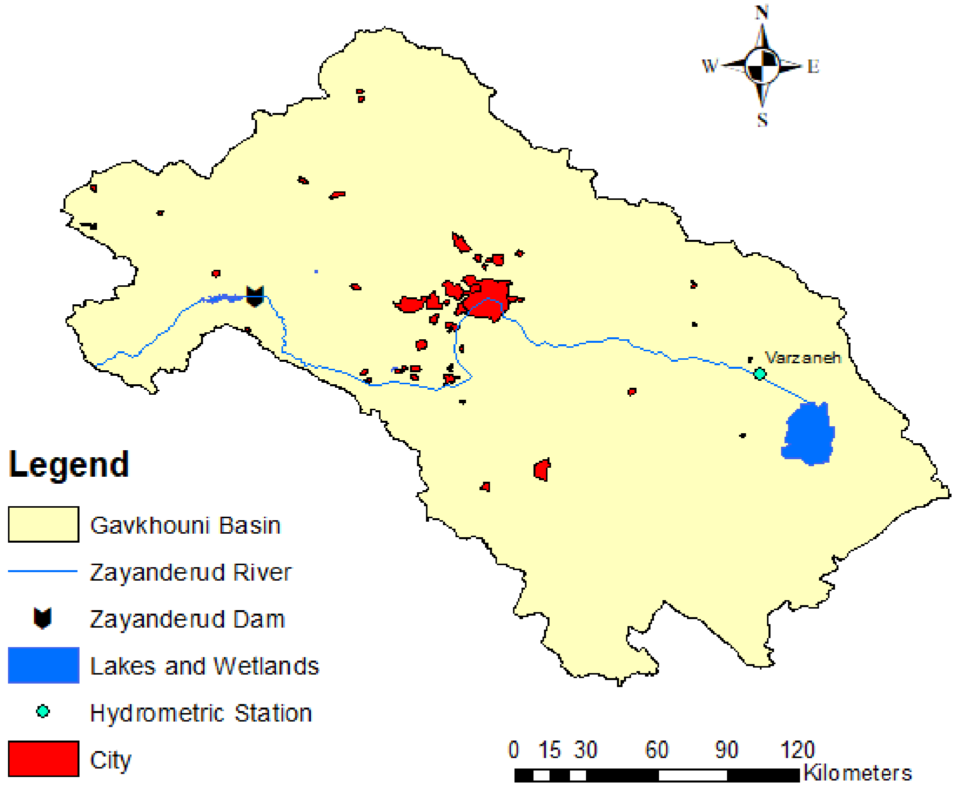


Figure 12. Location of Varzaneh station in Gavkhouni basin, Iran

Results:

Groundwater recharge :

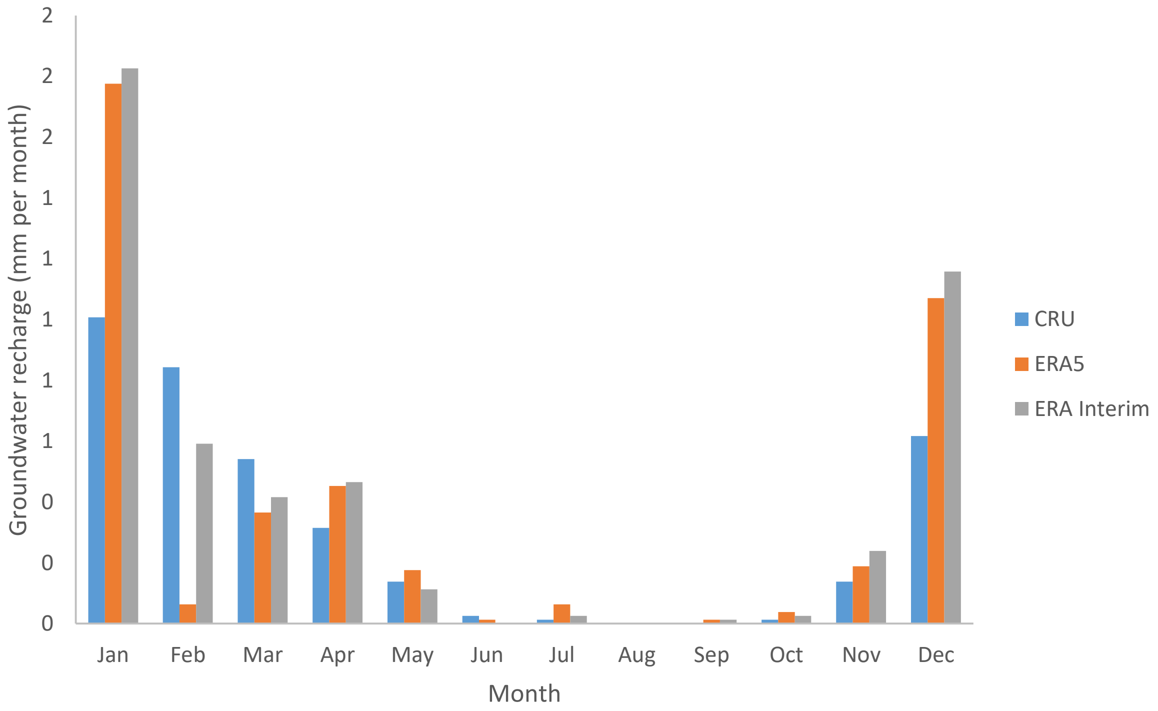


Figure 13. Estimated groundwater recharge by GlobWat over Gavkhouni basin in year 2004

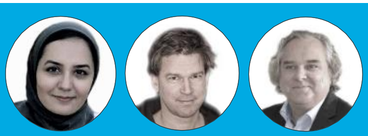
Results:

$$\Delta s/\Delta t = Prc - ET - R - RO \quad (1).$$

$\Delta s/\Delta t$ = Changes in soil moisture storage (mm/year)
P = Precipitation (mm/year)
ET = Rainfall dependent actual evaporation (mm/year)
R = Groundwater recharge (mm/year)
RO = Drainage (mm/year)

Table 2. Changes in soil moisture in Gavkhouni basin for 2004

Changes in soil moisture storage	Δs/Δt (mm/year)
Based on observations	4,38
Based on Globwat results using CRU dataset	-15,10
Based on Globwat results using ERA5 dataset	-2,20
Based on Globwat results using ERA Interim dataset	-4,43



Results:

Table 3. Precipitation over Gavkhouni basin for 2004

Month/Dataset	Precipitation (mm per month)			
	OBS	CRU	ERA5	ERA Interim
Jan	62,57	23,84	40,41	38,77
Feb	13,67	19,71	6,50	8,68
Mar	26,89	24,28	29,98	24,64
Apr	26,75	23,34	35,15	28,44
May	7,13	12,45	8,45	9,43
Jun	5,31	1,06	0,31	0,68
Jul	0,91	0,94	3,65	5,05
Aug	0,40	0,05	0,13	0,23
Sep	0,00	0,09	0,53	0,74
Oct	0,00	2,97	1,59	1,23
Nov	8,51	9,19	12,79	13,60
Dec	34,73	21,61	41,54	47,15
Total	186,87	139,52	181,03	178,65

Conclusion:

- Changes in soil moisture storage calculated by model estimations for the year 2004 are negative which shows extremely water withdrawals in this basin. However, positive observed changes in soil moisture storage indicate water recharge in the Gavkhouni basin (Table 2).

- In general, calculated soil moisture storage by extracted precipitation and reference evaporation from the ERA5 dataset has the least difference with the observed one. This is due to the fact that the ERA5 dataset has closest total precipitation to total observed precipitation over the Gavkhouni basin (Table 3).

Conclusion:

- We should consider that one year of calculation could not represent the water management practice in the basin and further years for study are required. In our future work, we will apply this study for a long term period.

- In this study we choose the year 2004 as the average crop calendar is available for this year. Besides, as GlobWat model developers know the best set up for the model, we wanted to compare our results with their results and theirs are on average for this year.

Thanks for your attention!

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Reference:

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