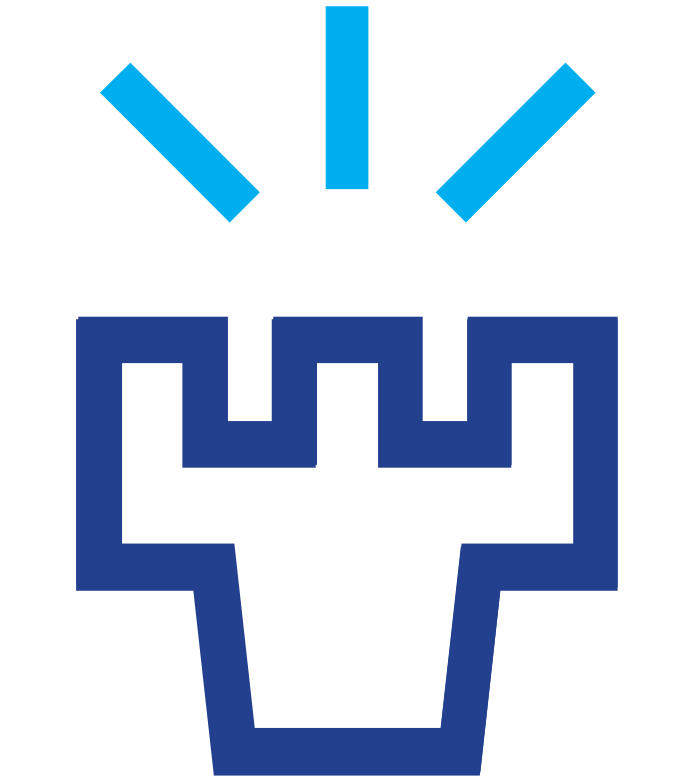

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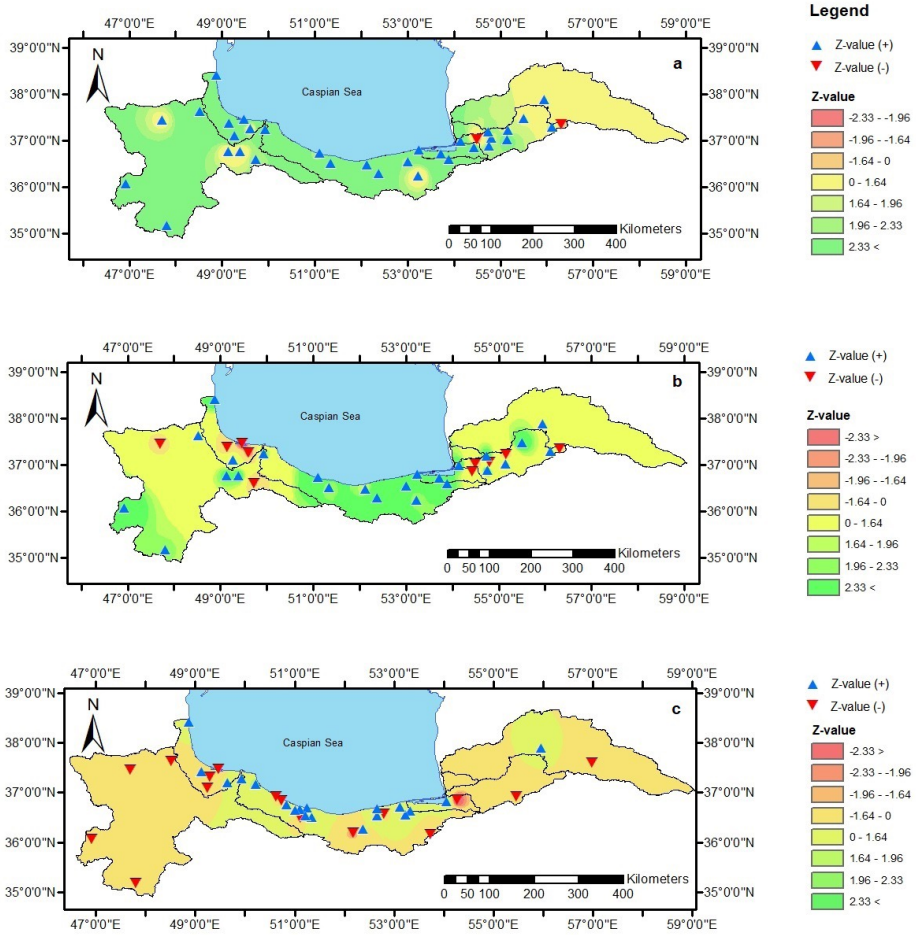
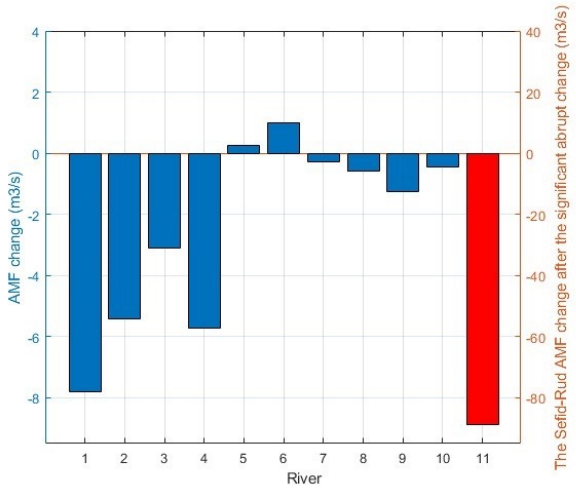
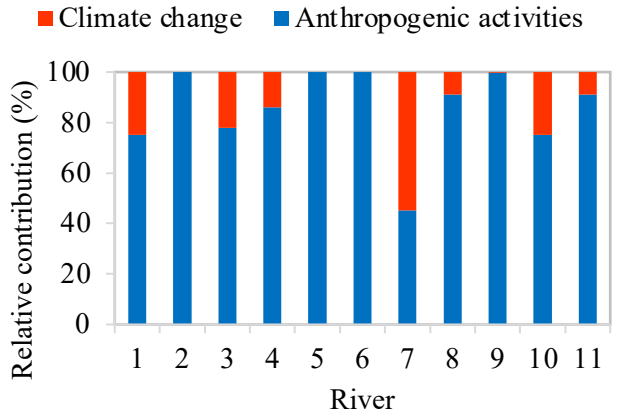
What is the impact of human activities and climate change on river flow alteration?





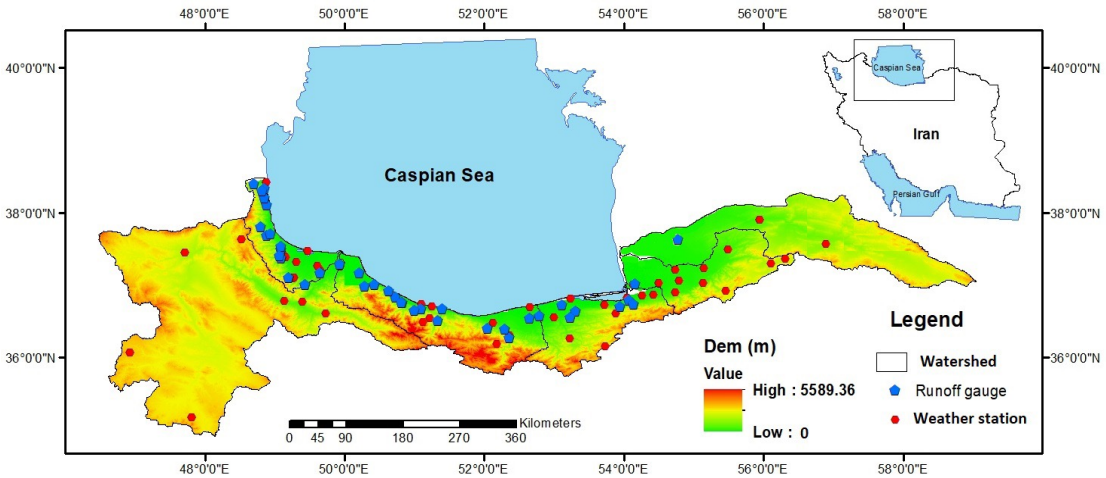


- 11 significant change in river flow from 40 rivers.
- Anthropogenic activities played a dominant role in river flow alteration almost in all rivers (10 of 11 rivers)
- Human activities contribution: 83.3 %, on average, led to the inflow to the Caspian Sea decline by about 2,412 MCM annually.
- Climate change contribution: 16.7 %, on average, decreasing inflow by about 551 MCM every year.

Hydrological response to anthropogenic activities and climate change in the southern Caspian Sea, Iran

Alireza Sharifi, Ali Torabi Haghighi, Ritesh Patro

Water, Energy and Environmnetal Engineering, University of Oulu, Finland



Southern Caspian Sea

- Area: 159,000 km2
- North of Iran
- Relatively compact vegetation and mild weather

Impact of human activities and climate change on river flow alteration

$$\Delta\bar{Q} = \Delta\bar{Q}_{ha} + \Delta\bar{Q}_{cc} = \bar{Q}_{var} - \bar{Q}_{bl}$$

$\Delta\bar{Q}_{ha}$: changes in AMF due to anthropogenic activities

$\Delta\bar{Q}_{cc}$: changes in AMF due to climate change

$\bar{Q}_{var}$: AMF in the variation period

$\bar{Q}_{bl}$: AMF in the baseline period

By applying the Pettitt test (Pettitt, 1979), we can find a significant abrupt change point in the rivers' time series and divide it into two-time series, including baseline and variation periods(before and after the change point, respectively).

Impact of human activities and climate change on river flow alteration

ΔQ in a basin can be expressed as follow:

$$\Delta Q = \frac{\partial Q}{\partial P}\Delta P + \frac{\partial Q}{\partial ET_p}\Delta ET_p + \frac{\partial Q}{\partial V}\Delta V$$

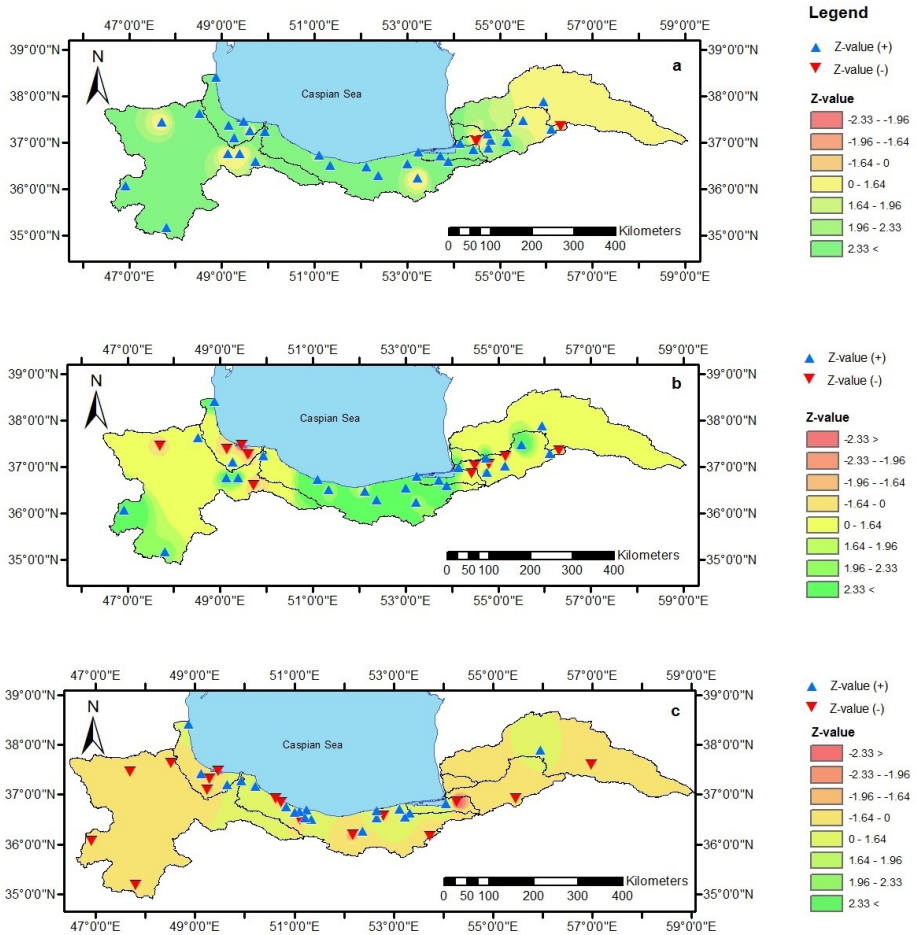
ΔP: change in annual mean precipitation

ΔET_p: change in potential evapotranspiration

ΔV: change in basin characteristics

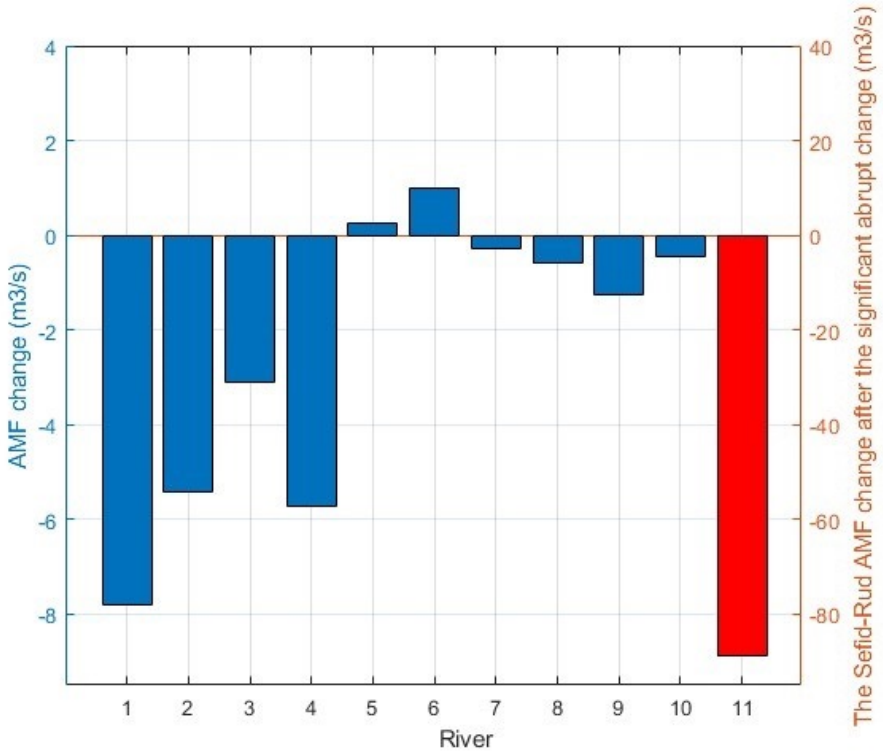
Any change in P and ET_p back to climate change. Therefore, the contribution of climate change in river flow alteration can be estimated by calculation of change in P and ET_p .

Trend results



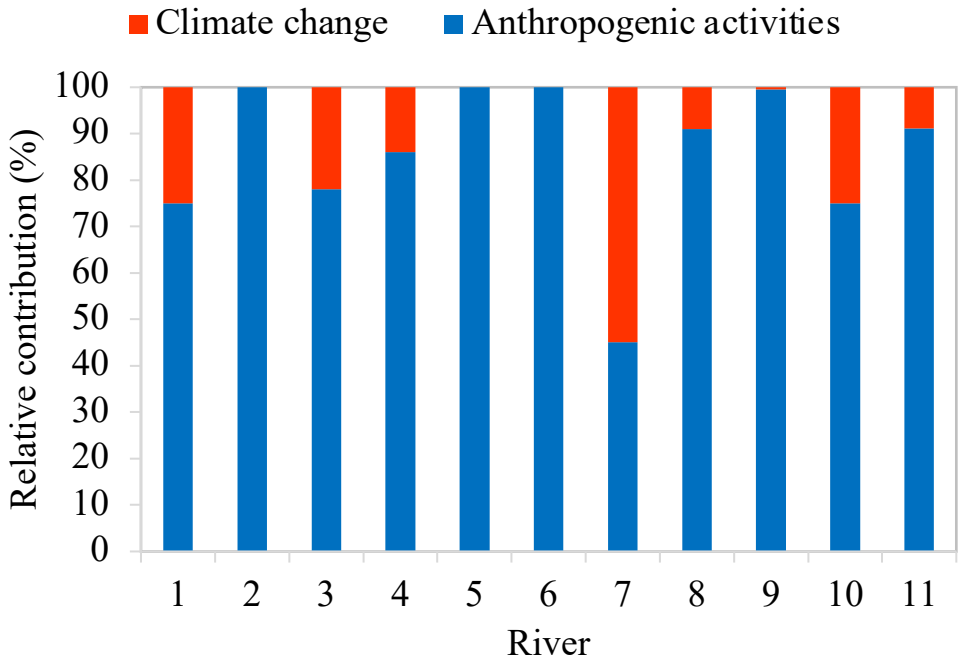
Change point results

- AMF has declined in 9 (of 11) rivers after the significant abrupt change point that caused inflow to the Caspian Sea to decrease by about 3,580 MCM annually.
- The most decline has occurred at the Astaneh gauge in the Sefid-Rud River, by about 90 m^3/s after the change point in 1996.



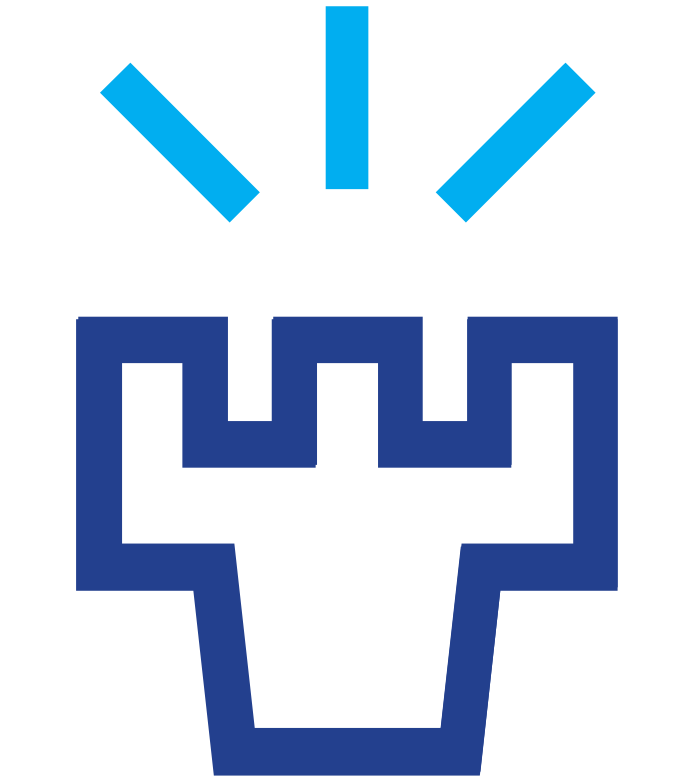
Imapct of climate change and human activities

- Anthropogenic activities played a dominant role in river flow alteration almost in all rivers (10 of 11 rivers),
- Human activities ratio: 83.3 %, on average led to the inflow to the Caspian Sea decline by about 2,412 MCM annually.
- Climate change contribution: 16.7 %, on average, decreasing inflow by about 551 MCM every year.



Conclusion

- There is an alarming trend of increasing T and ET_p in the SCS.
- This is evident in a decreasing nonmonotonic trend in most of the river flow in the region.
- In general, inflow to the Caspian Sea has declined by about 3 BCM after the significant abrupt change point in 11 rivers.
- Anthropogenic activities played a dominant role in river flow alteration in the SCS.
- Decreasing inflow to the Caspian Sea can accelerate the declining trend of the Sea level, which can boost eutrophication conditions in the Sea.



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