

Time series monitoring of Bakhtegan Lake changes and factors affecting it using satellite images on Google Earth Engine

Mina Mohammadi 1, Reza Shah-Hosseini 2

1 MinaMohammadi@ut.ac.ir

2 rshahosseini@ut.ac.ir

INTRODUCTION & AIM

Monitoring changes in the water levels of lakes and wetlands and providing timely information for their protection is essential. This study uses Landsat-5 and Landsat-8 satellite images and the NDWI index to monitor changes in Lake Bakhtegan over the past two decades.

Objective: To examine the changes in the water level of Lake Bakhtegan and the factors contributing to its desiccation.

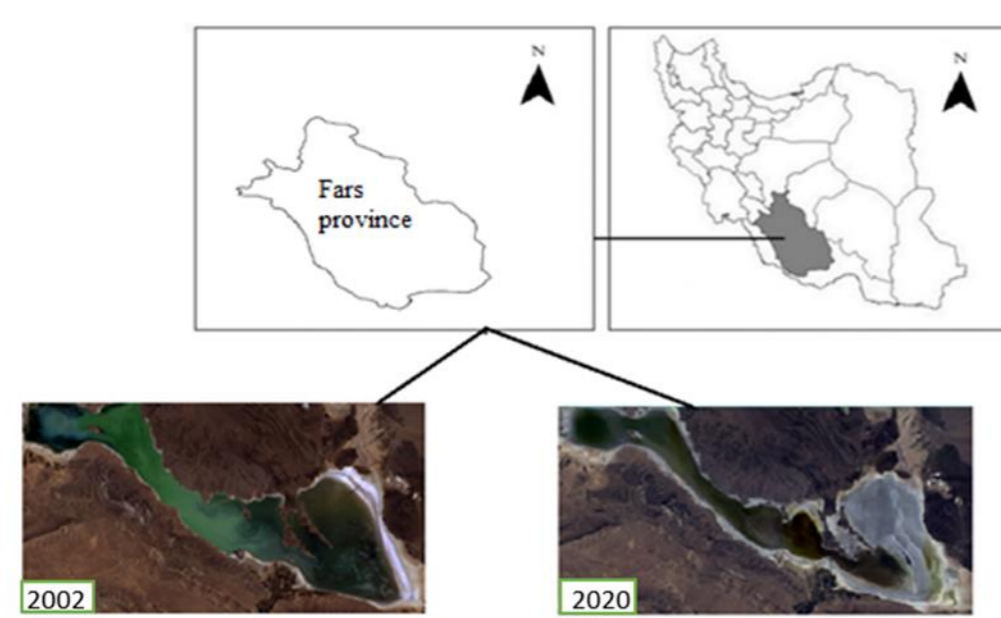


Figure 1. The location of Bakhtegan Lake.

METHOD

- Use of Landsat 5 and 8 satellite images (2000-2022)
- NDWI index to extract water surface
- Analysis of temperature, rainfall, evapotranspiration, groundwater level, and drought data

Table 1. Specifications of the data used.

Monitoring Parameter	Data Type	Time Range
Lake Water Surface Area	Landsat-5 and Landsat-8	2000-2017, 2020-2022
Evapotranspiration	MODIS	2000-2022
Precipitation	GPM	2000-2022
Groundwater	GRACE	2000-2017
Drought	Landsat-7, Landsat-8 and Landsat-9	2000-2022
Temperature	FLDAS	2000-2022

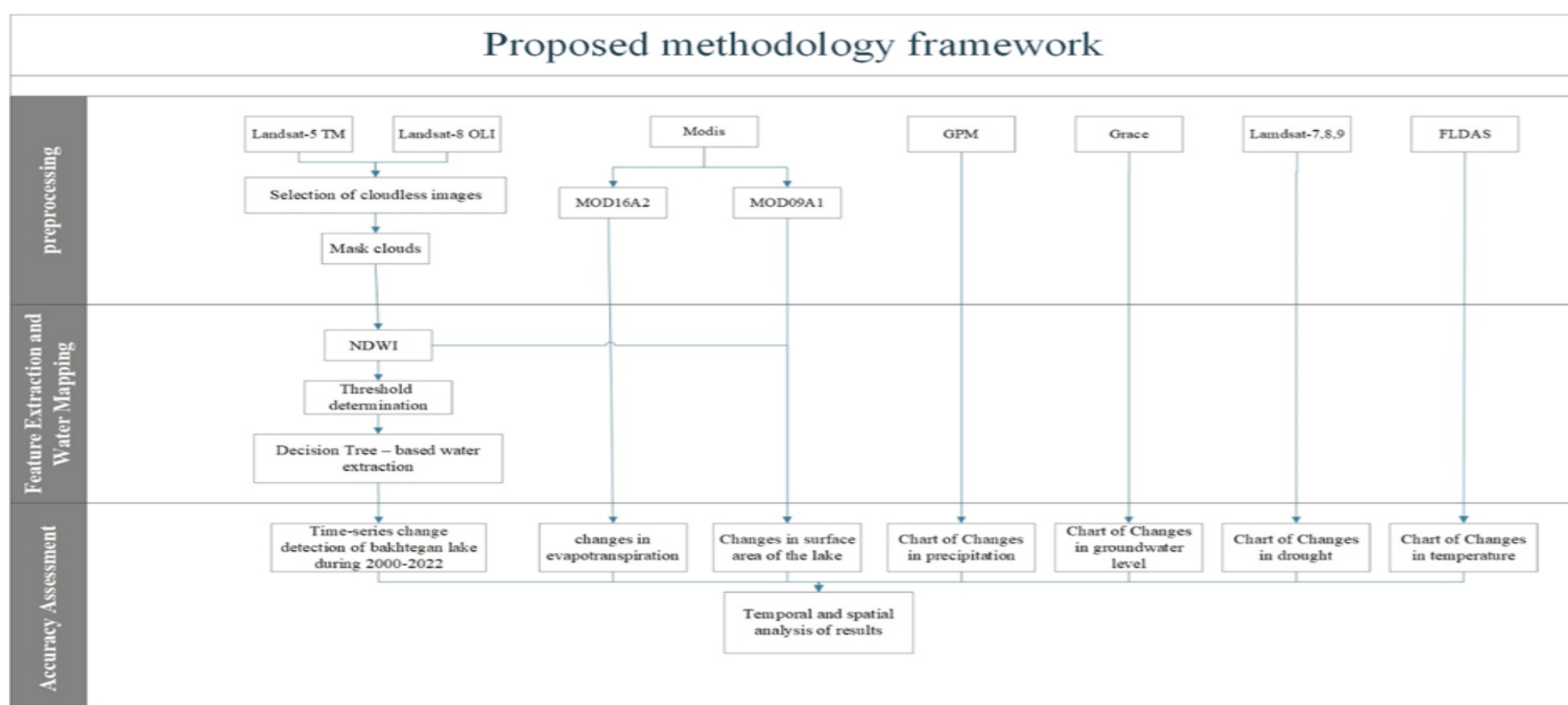


Figure 2. Research flowchart.

RESULTS & DISCUSSION

- Significant decrease in the lake's surface area from 505 square kilometers in 2000 to nearly zero in 2022.
- Main factors of water level decline: reduction in groundwater levels due to deep well drilling.
- Temperature and evapotranspiration had a minor impact, but rainfall had a significant short-term effect

Table 2. Comparison of the water surface area calculated by MODIS and Landsat satellites.

year	Water Surface Area Calculated by MODIS Satellite (km ²)	Water Surface Area Calculated by Landsat Satellite (km ²)
2000	490	505
2017	390	350
2020	260	220
2022	25	0

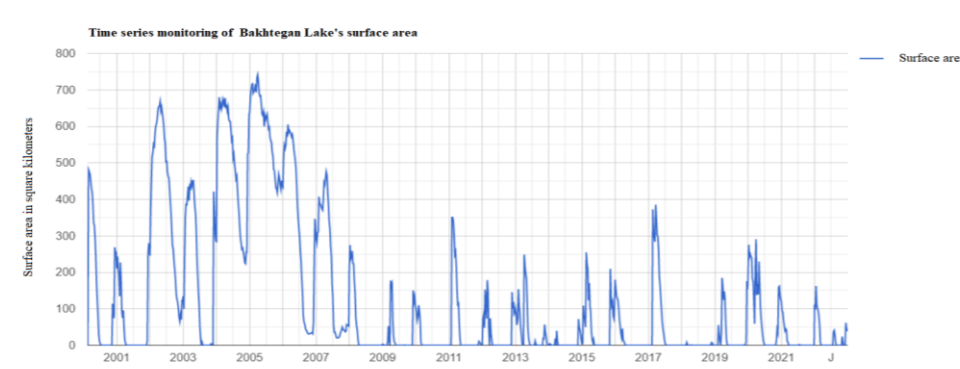


Figure 3. Chart of lake surface changes over 22 years.

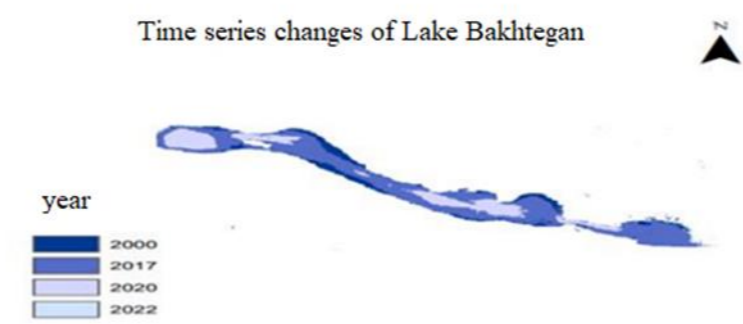


Figure 4. Multi-temporal map of Bakhtegan Lake.

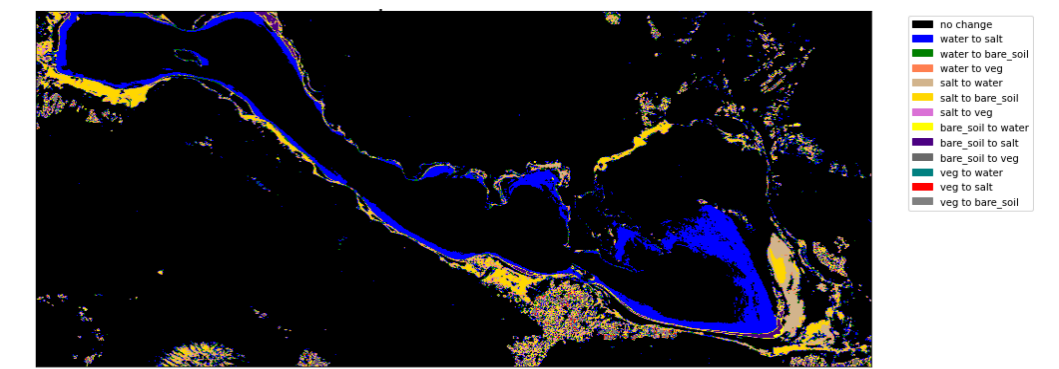


Figure 5. "from-to" maps for the years 2000 and 2020.

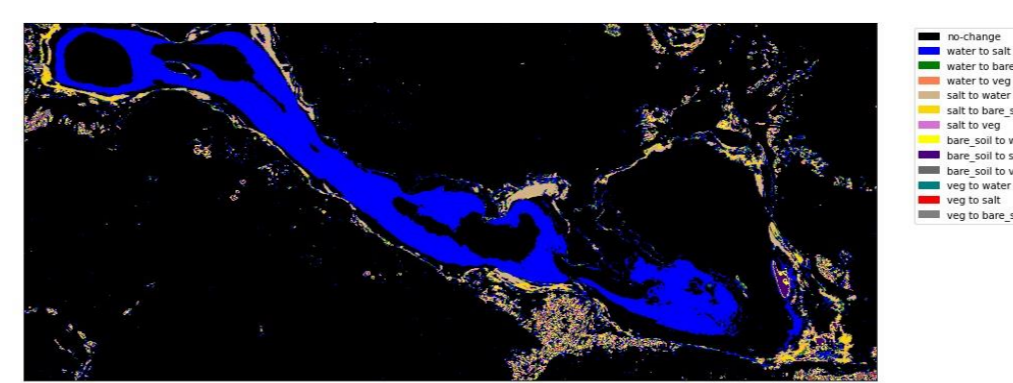


Figure 6. "from-to" maps for the years 2017 and 2020.

Table 3. Accuracy assessment of SVM classification.

year	Kappa coefficient	overall accuracy
2000	0.97	99.45%
2017	0.98	99.32%
2020	0.97	99.15%

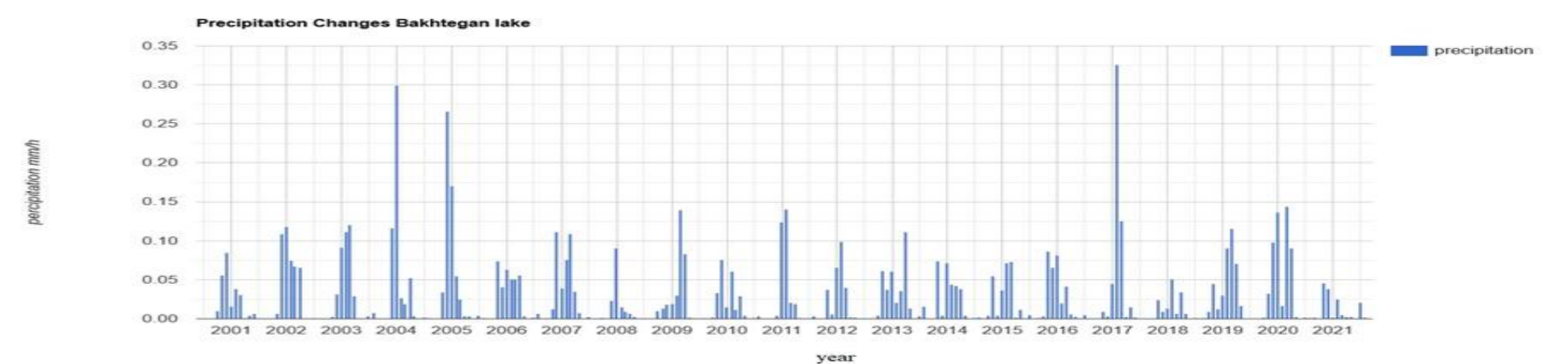


Figure 7. Time series chart of precipitation changes in the Bakhtegan Lake.

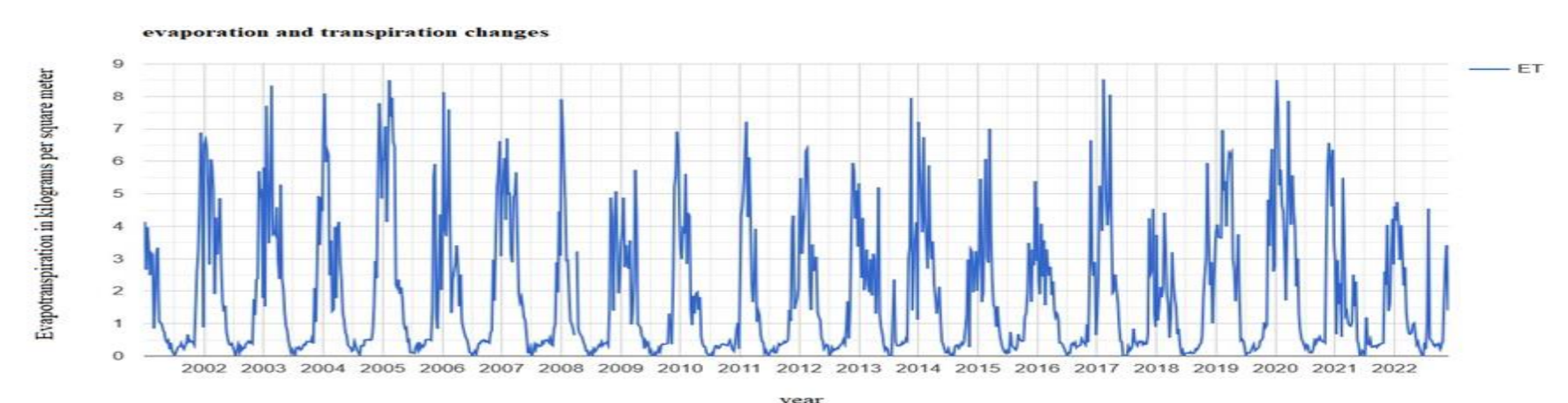


Figure 8. Time series chart of evaporation and transpiration changes in the Bakhtegan Lake.

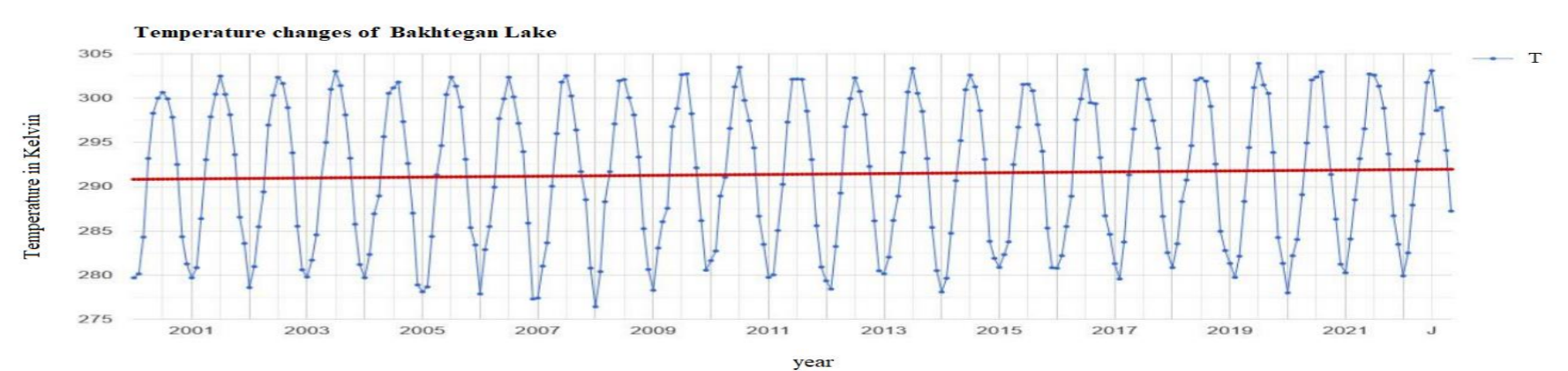


Figure 9. Time series chart of temperature changes in the Bakhtegan Lake.

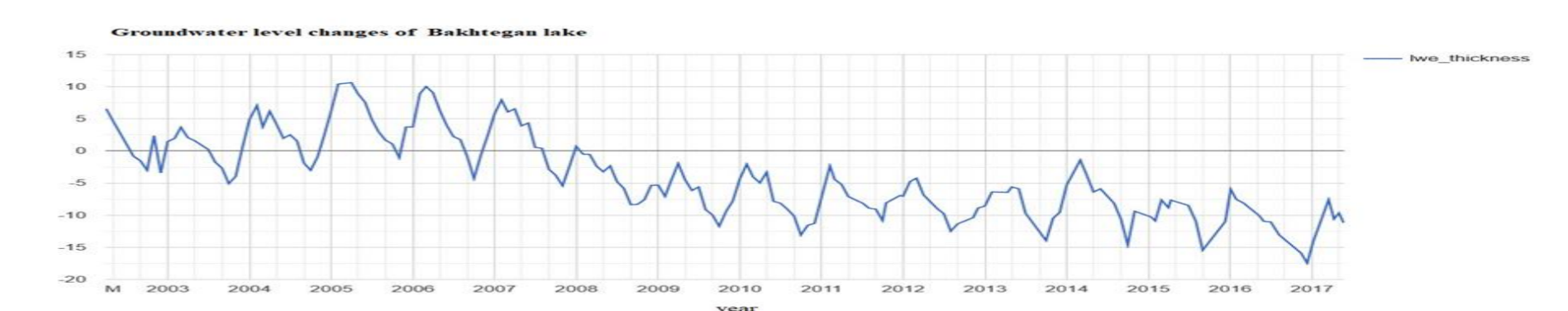


Figure 10. Time series chart of groundwater level changes in the Bakhtegan Lake.



Figure 11. Time series chart of drought conditions in the Bakhtegan Lake.

CONCLUSION

- Accurate and timely monitoring of water resources using satellite images and environmental analysis is essential.
- The decrease in Lake Bakhtegan's water level is primarily due to the reduction in groundwater levels, with rainfall playing an important role in short-term changes.
- To prevent salt turning into dust and harming agriculture, water extraction from wells in the lake's catchment should be avoided.

FUTURE WORK / REFERENCES