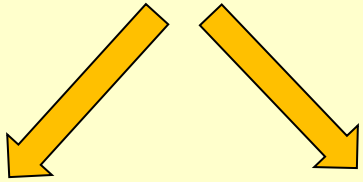
Simulation of Caspian Sea level fluctuation effects on Northern Coast of Iran



Recent Sea Level

Paleo Sea Level

Razieh Lak, Alireza Salehipoor and Ali Shakiba Azad

Geological Survey of Iran

Aim

This research has been carried out to assist the government in generating local and national plans throughout the northern shores of Iran

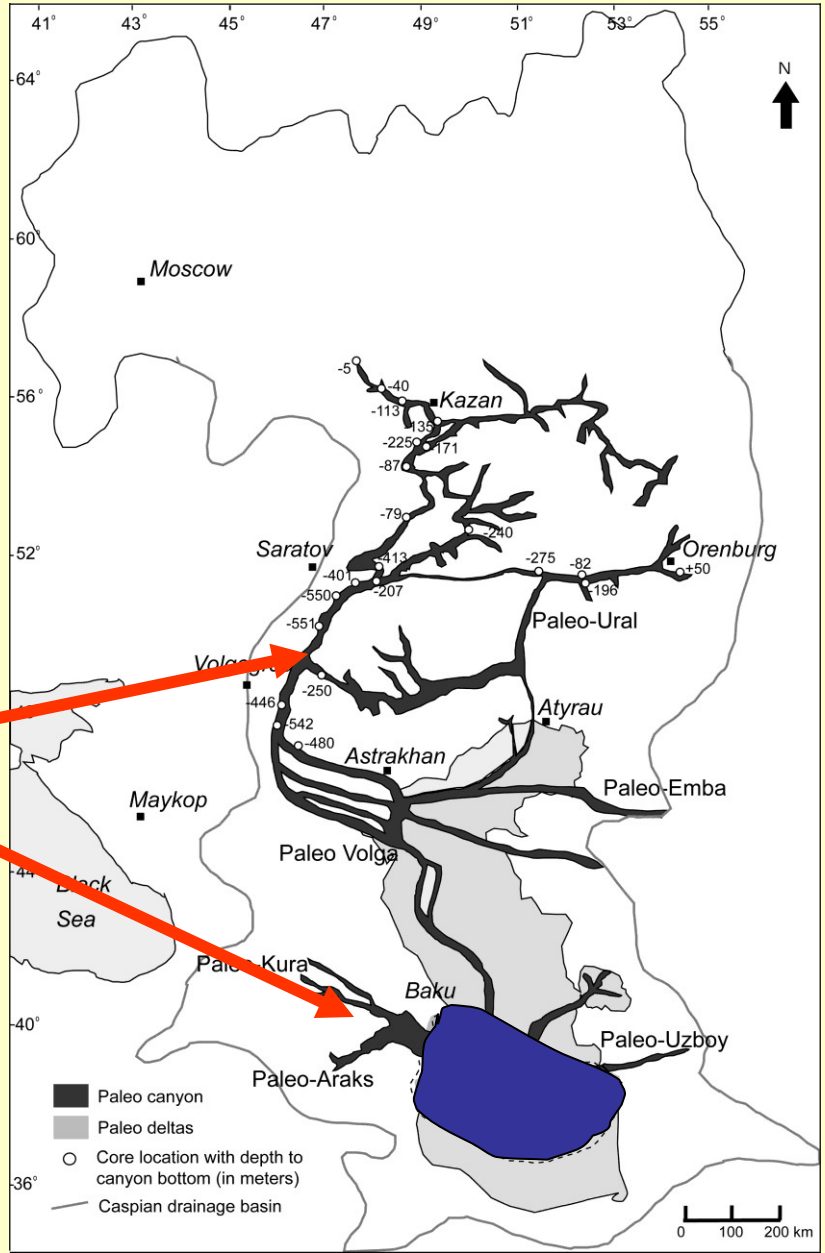
introduction

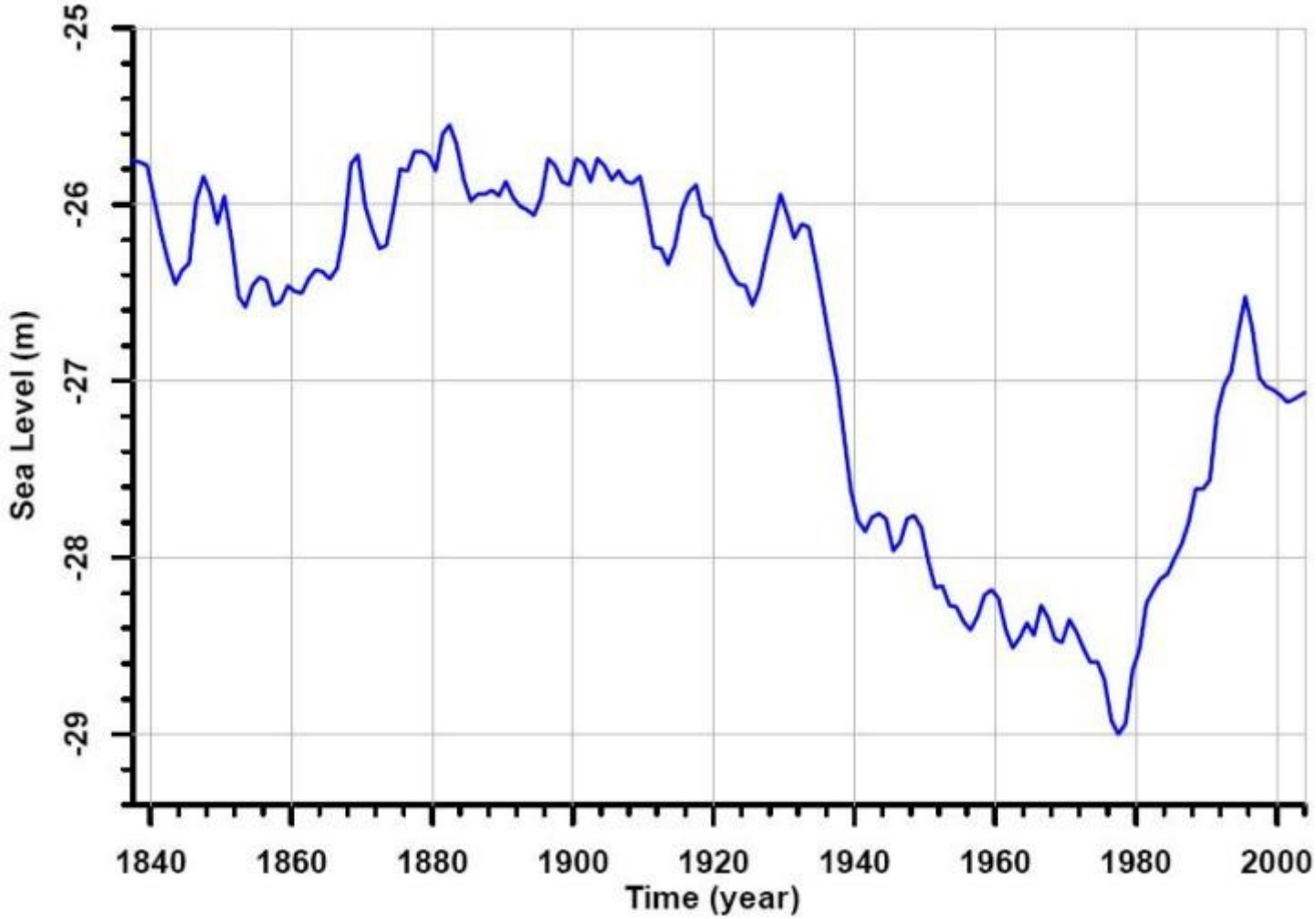
- *Changes in the Caspian Sea level are fast and occur in short periods of time, ranging between -25 and -29 meters between the year 1880 and 2000. the recent years these changes have lead to severe damages to industrial organizations, agriculture, port establishments, marine structures etc.*
- *Any short-term or long-term plan made by the surrounding countries must carefully take these factors into account in order to succeed.*

Time scales of Caspian Sea level change

- *Historic sea-level cycle (1853-2000 AD, 3 m amplitude)*
- *Late Holocene cycle (2600 - 300 BP) (>25 m amplitude)*
- *Last Glacial- Early Holocene cycle (>150 m amplitude)*
- *Pliocene lowstand 5.5-3.4 Ma.*

(Kroonenberg and Leroy, 2007)





Interannual variations of the Caspian Sea level measured by sea level gauges (1837–2004)

In about 170 years ago, the Caspian sea level has more than 3 meters fluctuation

In 450 years ago, the Caspian sea level has more than 6 meters fluctuation

National Iranian Oil Company
Khazar Exploration & Production

FLACTUATION OFCASPIAN SEA
(WATER SURFACE FROM 500 YEARS AGO)

Projection: Date: M.M.FARIDAN 26,4,1378	Scale:
Compiled by: Date:	Datum: VASSEGH
Approved by: Date:	Map No. KE-58

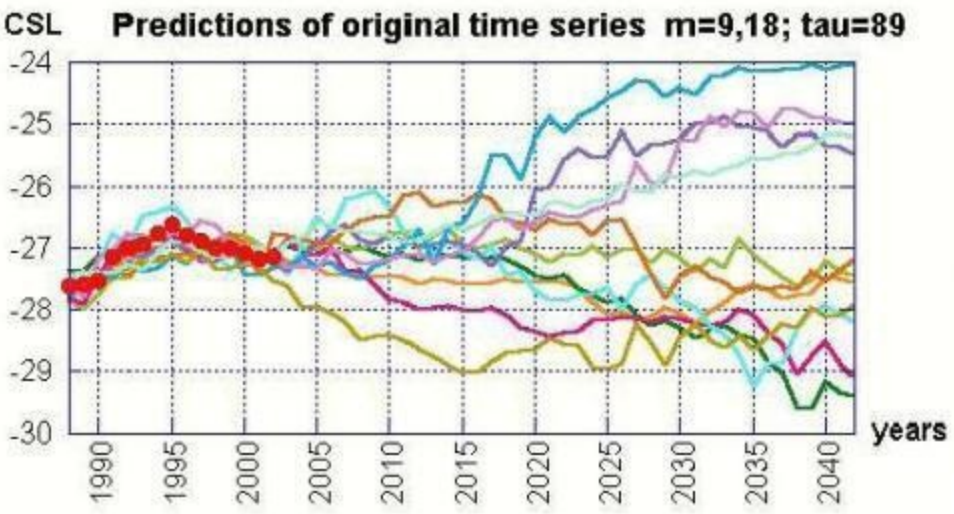
Predicting changes of the Caspian Sea level

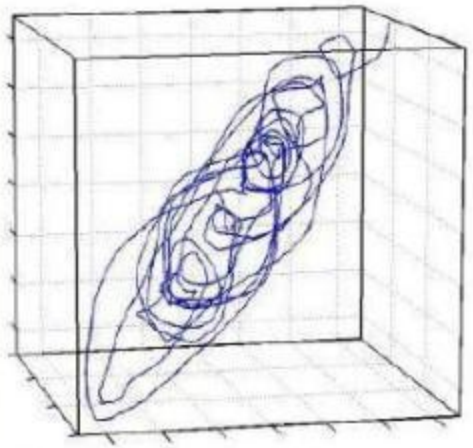
Over the recent years different methods have been discovered for predicting these changes. These methods can be classified into three different levels:

- *Predictions based on physical and mathematical models*
- *Predictions based on the relation between water level and some physical and meteorological parameters.*
- *Methods based on distinction of improvised unknown methods.*

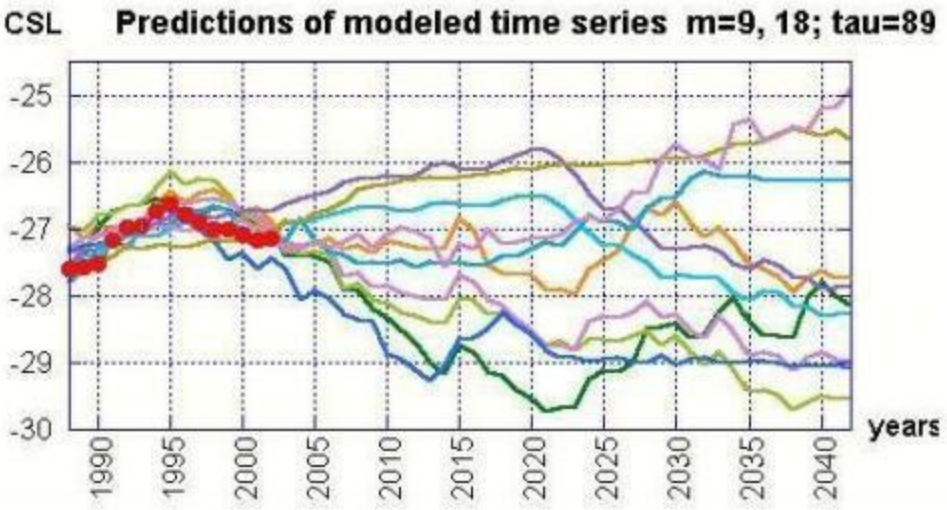
Although causes of Caspian Sea changes have been clearly identified, but using such information to predict future changes has proved impossible.

Predicting changes of the Caspian Sea level





Phase Portrait Of Original Data



Prediction Of Caspian Sea Level Change With Non-Linear Techniques Makarenko et al 2000

Other Predicting

- *The arise and fall in he sea water level has been recognized as a periodic phenomena (every about 40 years) . (Ahmadi Mirkhalegh, 1991)*
- *By the end of the 21st century , the ensemble average of the model-based estimated suggest about 9 metes drop in CSL (global climate change simulation with seven atmosphere ocean general circulation models to assess possible changes in Caspian Sea basin hydrologic budget and corresponding changes in the CSL (Egmindi and Giorgi, 2006)*
- *Cazecave et al. (1997) reported on the usage of TOPEX/POSEIDON imagery for assessing the Caspian Sea level. They reported that the Caspian Sea level was decreasing by mid-1995 and continuing to decrease in 1996 at a rate of 25 cm/year, whereas it had been increasing during the previous periods at rate of 19 cm/year. Use of the synoptic observations allowed Cazecave et al. to show that the Caspian Sea level fluctuations were not spatially uniform. The rate of the Caspian Sea level rise in the north was 3 cm/year greater than it was in the south.*

Method of study

According to the prediction of CSL, 3 major levels selected for simulation

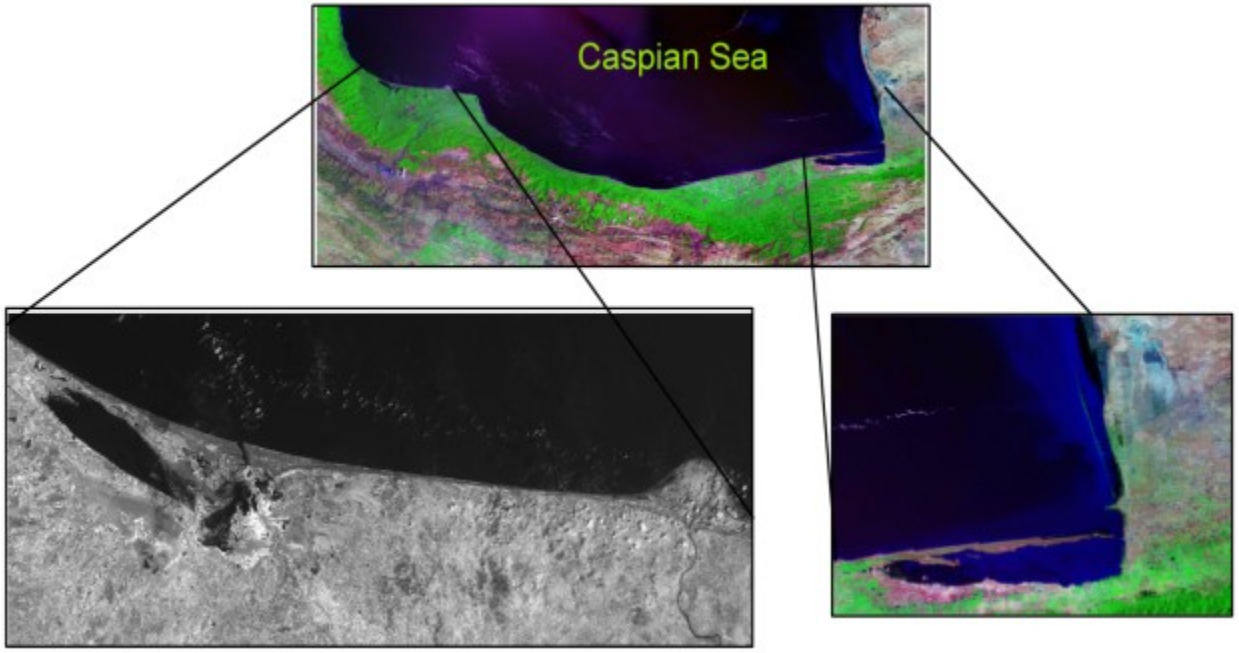
- *Using Satellite data such as ASTER (2000), IRS LISS III (2006), MSS 1975 and 1977, TM 1987, ETM, 1998-2001 and Quickbird (2007)*
- *Preparation of DEM by:*

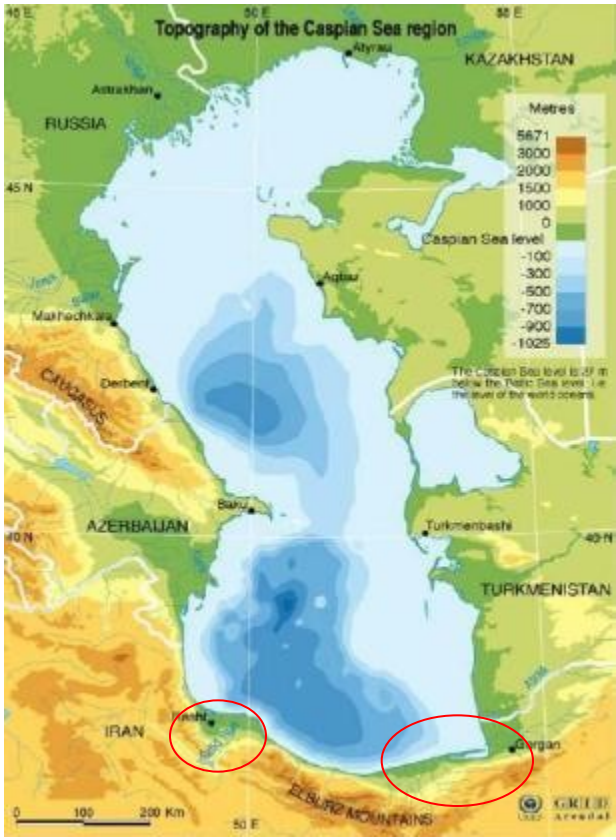
  Radar SRTM 90M

  Topographic map (1:25000 and 1:2000)
- *Modeling with GEOMATICA 8 , ARC GIS 9 ،Envi software*

Studied regions

- *Bandar-e-Turkaman and Khalij-e-Gorgan in south east and Anzali lagoon and Bandar-e-Kianshahr in south west of the Caspian Sea have been chosen as superlatives. These regions have special strategic importance. Their mild slope makes them subject to even the slightest changes in the sea level.*





Turkaman port and Gorgan gulf region

This region has great importance due to sharing borders with Turkmenistan, and containing the north railway and ports of Turkaman, Gaz and Amir Abad. The average slope of this region is Very low, therefore any minor changes in the Caspian Sea have considerable negative effect on this region

Bandar-e-Anzali region

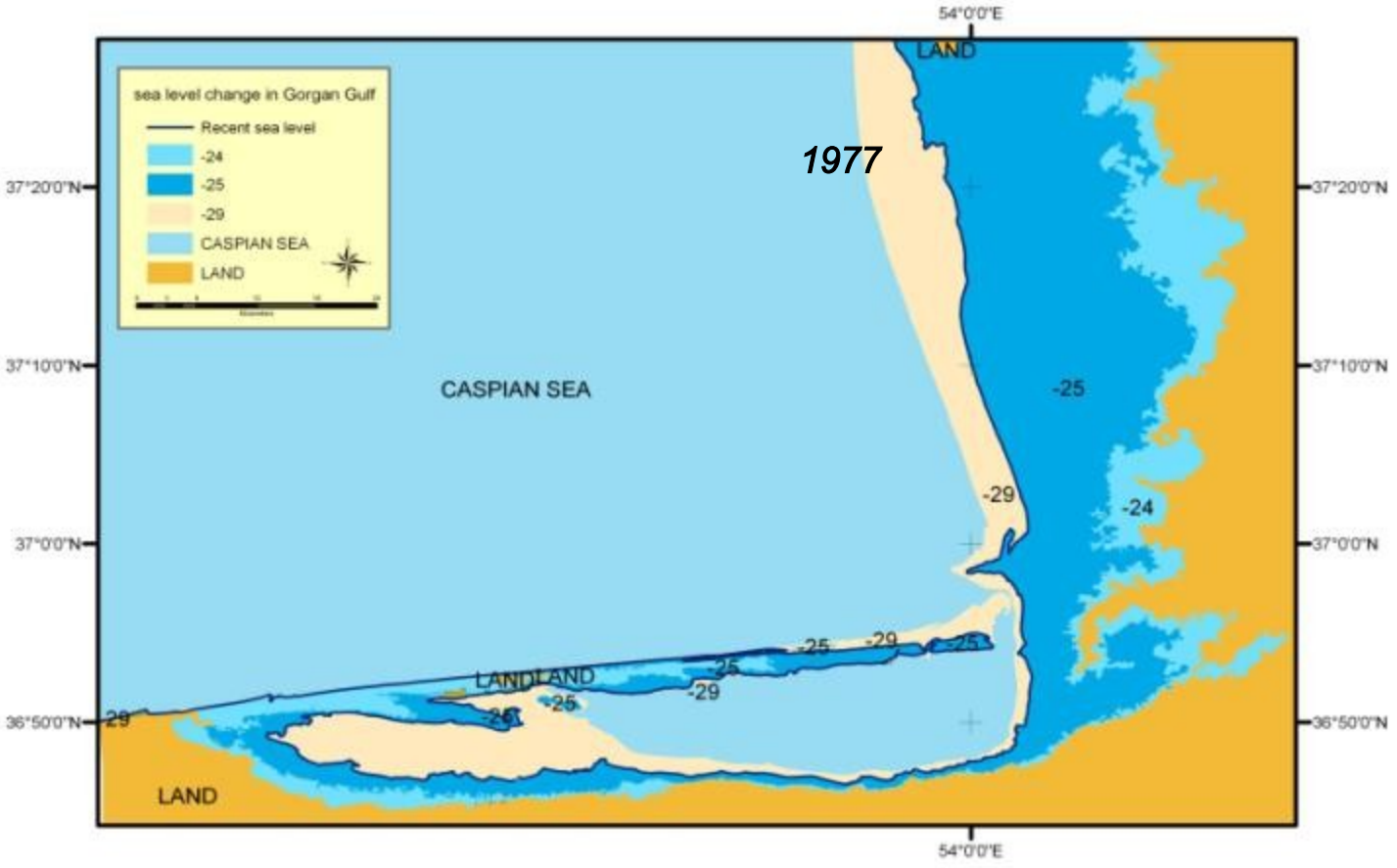
physical and chemical characteristics are essential for the survival of aquatic creatures in this region. CSL fluctuation makes an unbalanced eco-system and environmental changes in this area. In addition, residential areas and important industrial establishments around this lagoon are definitely affected by these atmospheric and environmental changes.

Examining effects of Caspian Sea changes upon the investigated regions

At a rise of -25meters, main parts of important cities and ports including Bandar-e-Turkaman, Gomishan, Amir Abad, Esmailsai and Ashurade peninsulas will drown.

Industrial organization in ports of Turkaman and Amir Abad and a major part of Gorgan railway will be demolished. The area of Miankale barrier spit will be reduced from 197km² to 94km²

water will reach as far as 18.7 kilometers into the northern parts of Turkaman port. Gorgan lagoon will lose its natural status and connect to the sea from many major channels



At a rise of -24, the northern parts of Turkaman port will be affected the most, with water reaching as far as 22.7 kilometers into the land. Major parts of Miankale barrier spit will drown and Gorgan lagoon will change dramatically. Amir Abad port and a huge part of the city of Gaz will drown and the region will lose its railway connection with the rest of the country.

Sea level fall effects

in 1977 reaching a level of -29. Water will retreat by 6.7 kilometers. The area of Gorgan lagoon will be reduced by 207km² reaching 325km². In this case Khosini channel will be blocked entirely and the lagoon will be connected to the sea through a very thin channel resulting in changes in its eco-system. With Gorgan lagoon restricted, ports of Turkaman and Gaz will lose connection with the sea and lose their use and efficiency, the newly established port of Amir Abad will be affected as well.

Bandar-e-Anzali region

At -25m, Anzali lagoon will increase in area from 177km² to 341km² affecting the entire surrounding region. About 30 rural areas will drown. the lagoon will become connected to the sea.

4km of land in Kia shahr (Sefid rood delta) will go under water. The city itself will remain safe but the surrounding rural areas will be damaged severely.

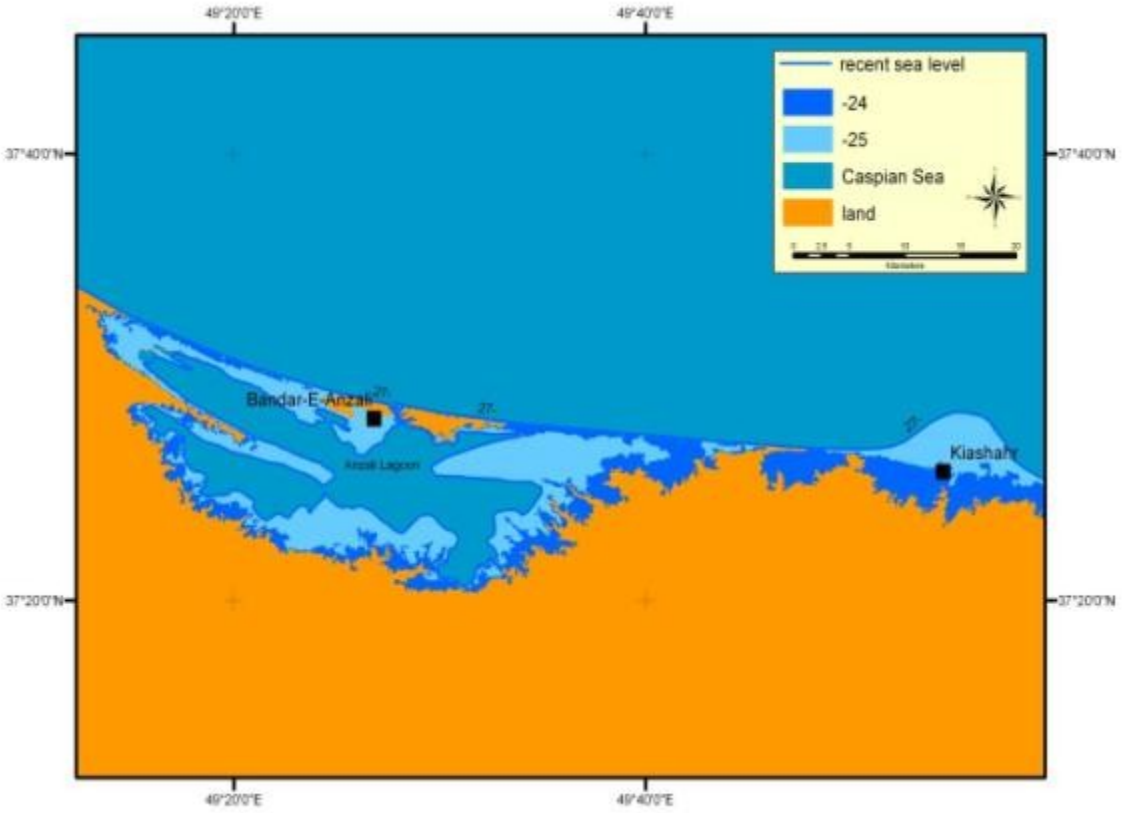
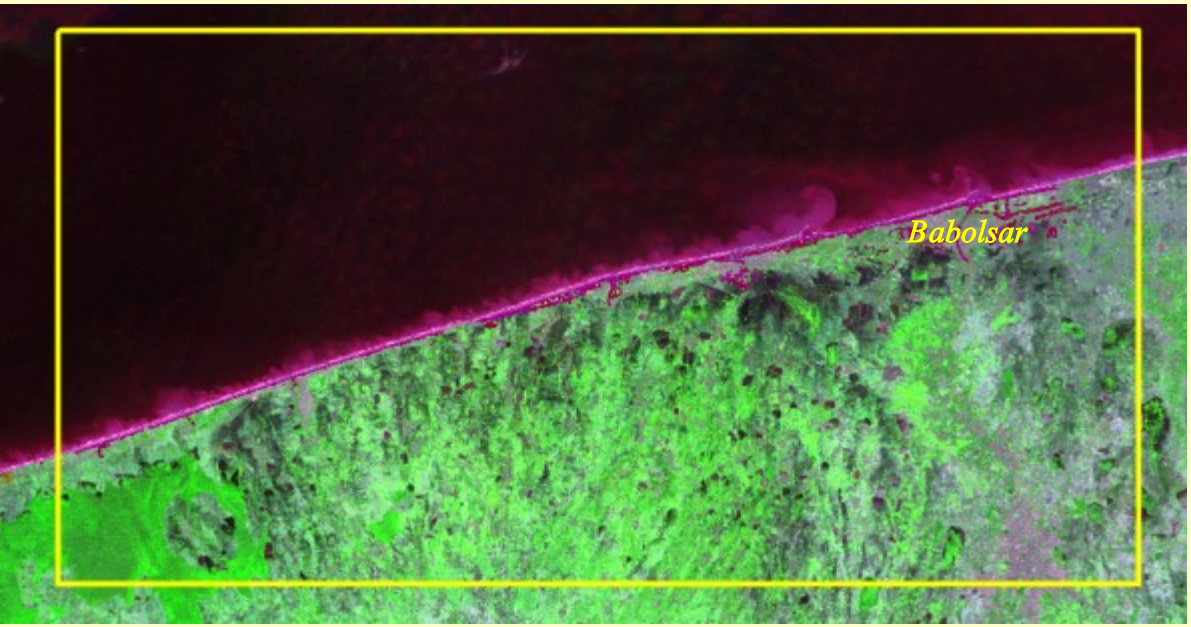


Figure 5 : sea level fluctuation in Anzali Lagoon

At -24, Anzali lagoon will become a part of the sea and its ecosystem will change noticeably. Only the city of Anzali will be safe and remain in the form of two peninsulas. Nevertheless, all the roads and railways of this region will be demolished and the region will become isolated from the surrounding districts and provinces. Industrial establishments or Anzali port will be exposed to strong waved and will become out of order.

Sea level fall effects

In case of a sea level-fall,reaching -29m substantial changes will be made in Anzali lagoon; in a way that it will be dried up and maintain connection with a sea through a very small river. Its area will be reduced by 140 kilometers and reach 37km² resulting in an unbalanced eco-system.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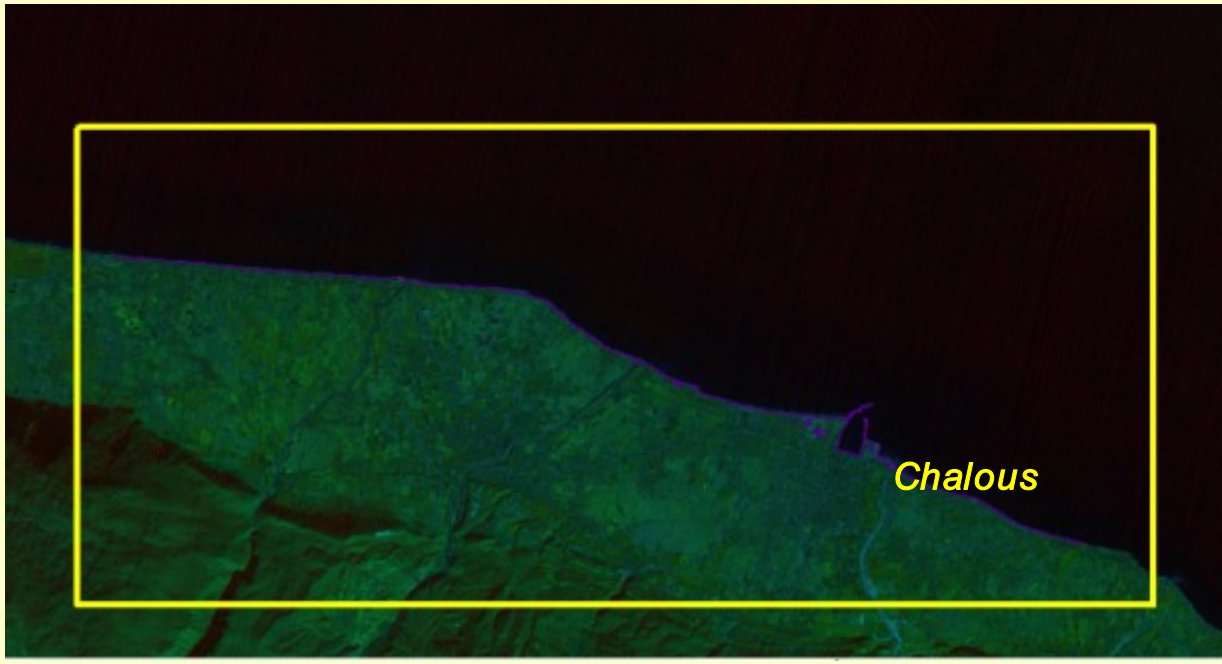
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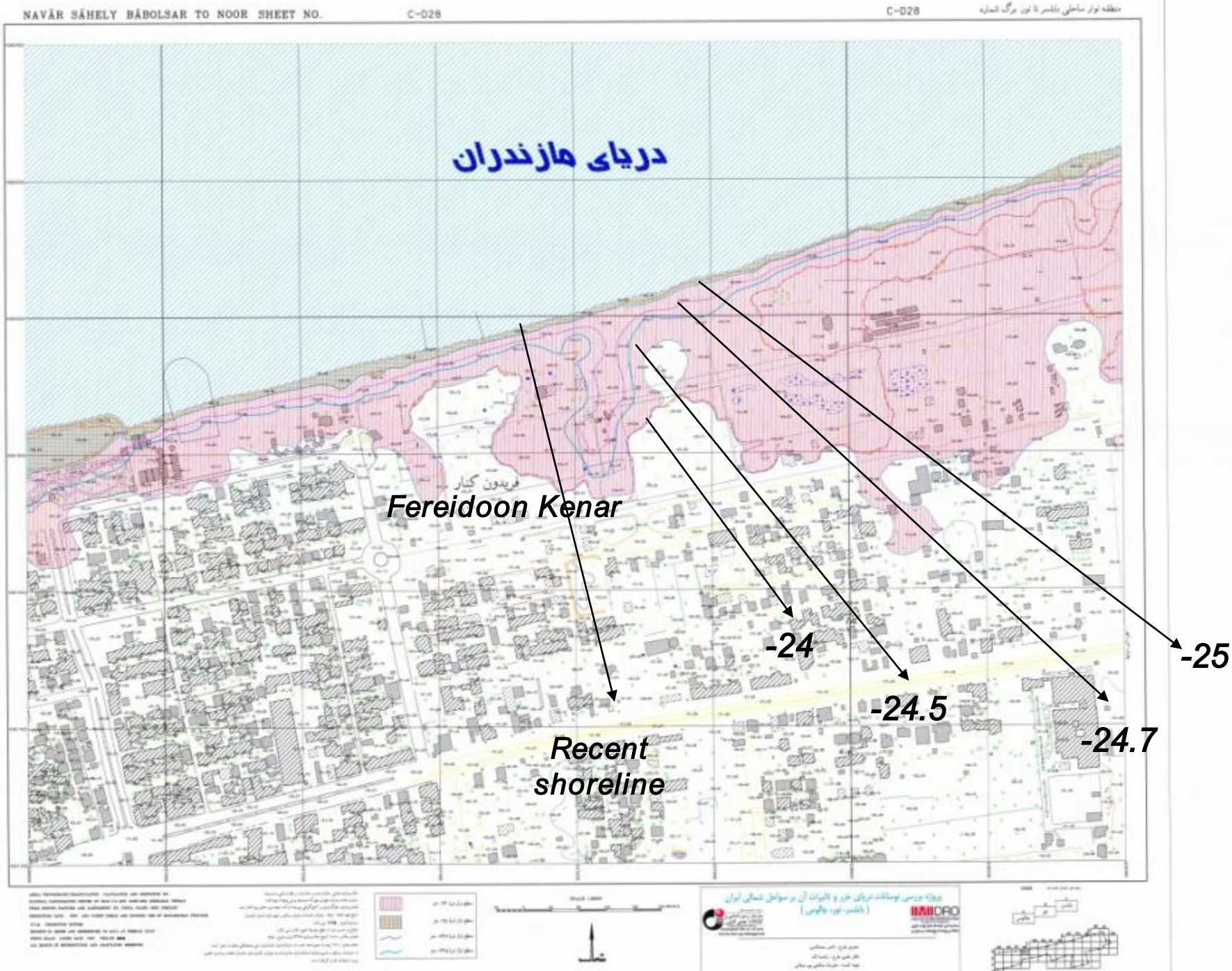
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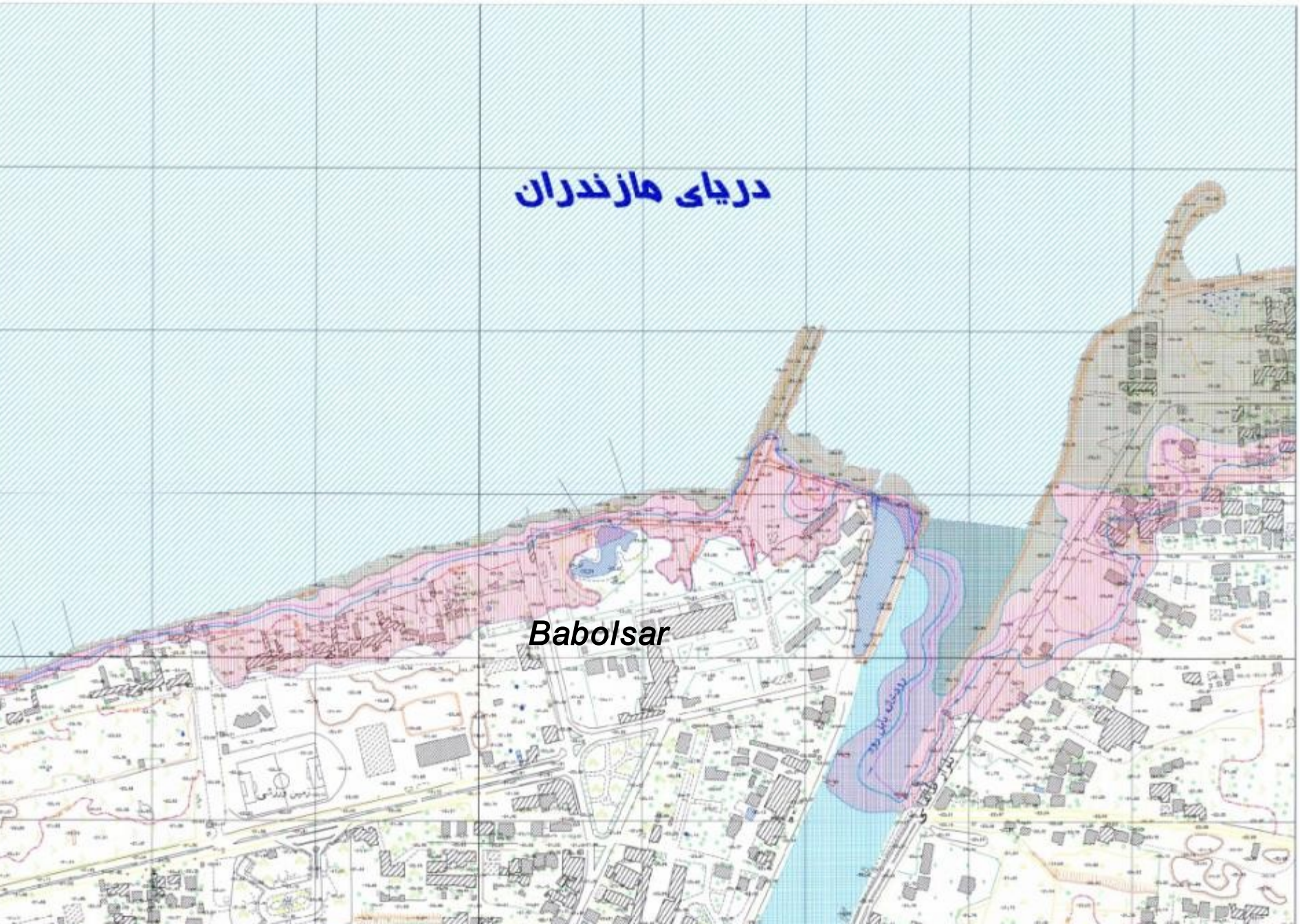
دریای مازندران
Babolsar

Quickbird satellite data with 60 Cm. resolution (2007)

Nowshahr city

Conclusion

At -25 water table:

- *The area of Miankale barrier spit will be reduced from 197km² to 94km².*
- *water will reach as far as 18.7 kilometers into the northern parts of Turkaman port.*
- *Anzali lagoon will increase in area from 177km² to 341km²*
- *4km of land in Kia shahr (Sefid rood delta) will go under water*

At -25 water table:

- *In the northern parts of Bandar-e-Turkaman water will reach maximum 22.7 km into the land*
- *Major parts of Miankale barrier spit will drown*
- *Anzali lagoon will become a part of the sea. The city of Anzali will remain in the form of two peninsulas.*

Sugestions

- *detect the Caspian Sea Shoreline in difference time by satellite data and air photo*
- *preparation of hazard map for coastal zone*
- *produce large scale topography map (1:2000) for Caspian Sea Coastal zone*
- *Produce a warming system for sea level fluctuation in the GIS base according to Sea level gauges*


از توجه شما سپاسگزاریم