Responses of the Iranian Regional Water Authorities to Drought

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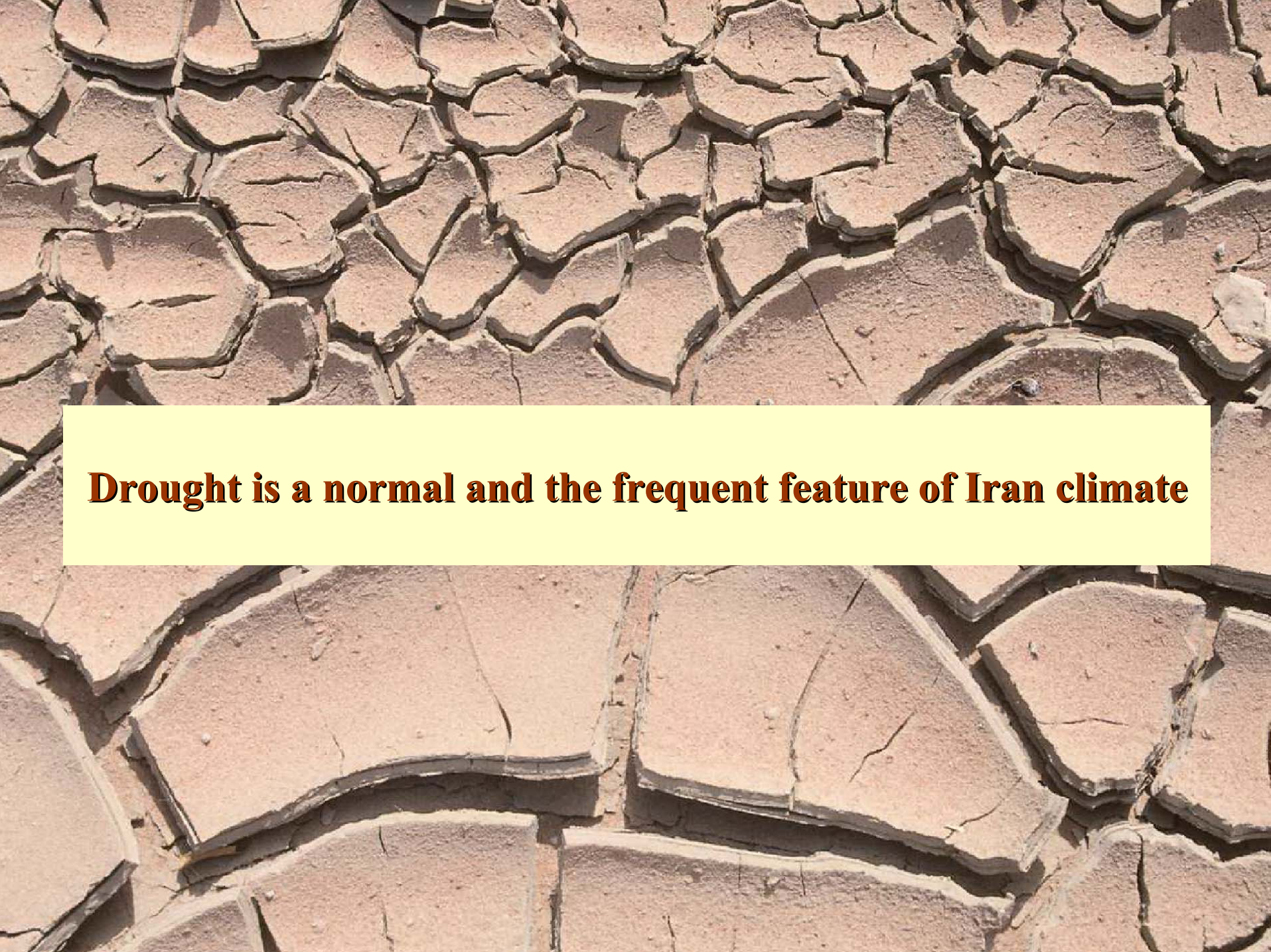
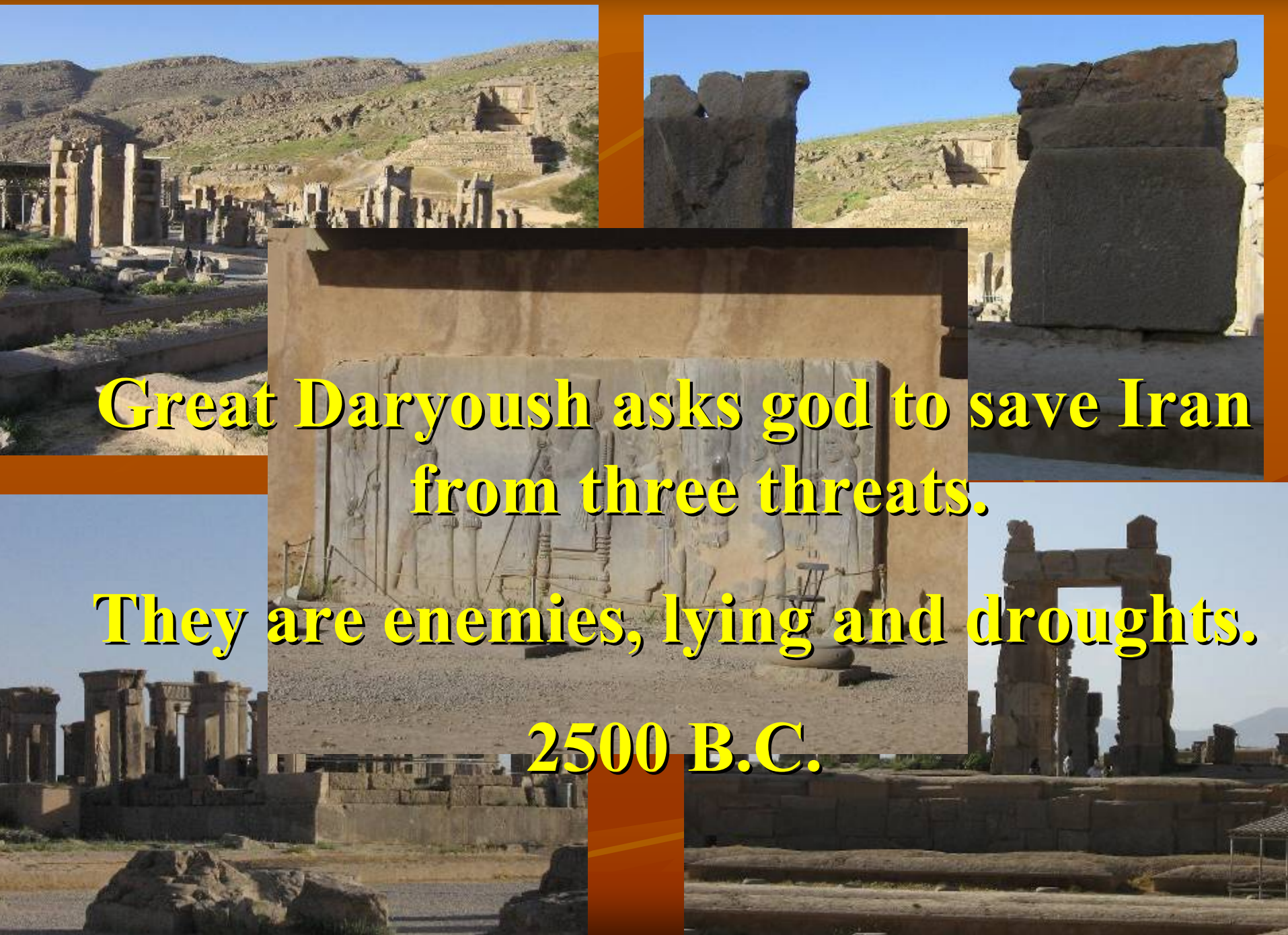


Drought is a normal and the frequent feature of Iran climate


Great Daryoush asks god to save Iran
from three threats.
They are enemies, lying and droughts.
2500 B.C.

The 1998-2001 drought

-The most recent country wide drought happened during 1998-2001,

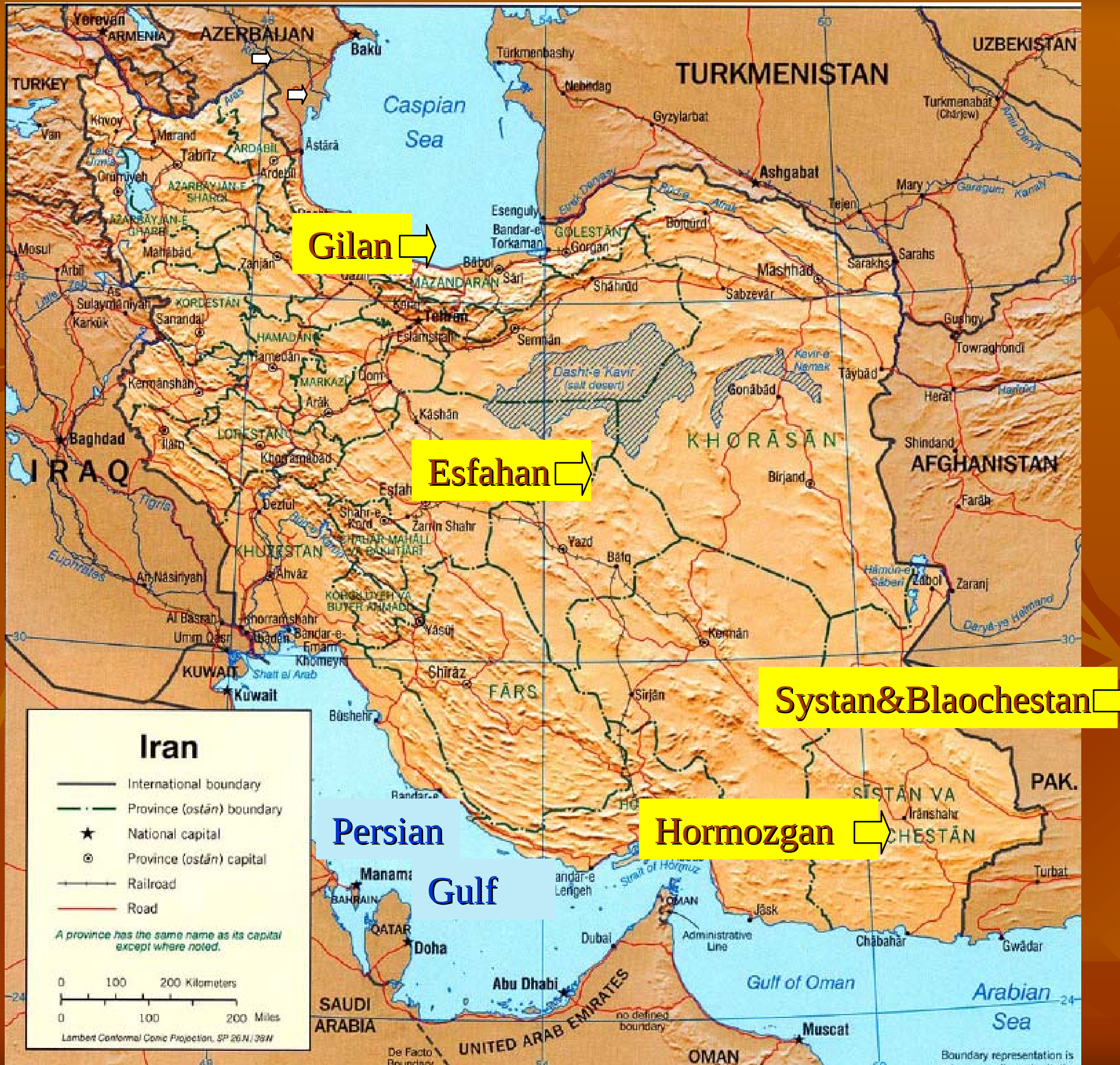
-Rainfall deficits consistently exceeding 60% of the mean annual rainfall.

-Storages of its main dams reduced up to 100% of its long term average

-18 out of the 28 provinces of the country were affected.

-The crops from a rainfed area of 4 million hectares as well as from an irrigated area of 2.7 million hectares were completely destroyed.

- The total agricultural and livestock losses by the year 2001 were estimated to be US$ 2.6 billion.



Gilan
Esfahan
Systan&Blaochestan
Hormozgan
Persian
Gulf
Iran
International boundary
Province (ostān) boundary
National capital
Province (ostān) capital
Railroad
Road
A province has the same name as its capital except where noted.
0 100 200 Kilometers
0 100 200 Miles
Lambert Conformal Conic Projection, SP 26N/39N
AZERBAIJAN
ARMENIA
Yerevan
Baku
TURKEY
TURKMENISTAN
UZBEKISTAN
Caspian Sea
Türkmenbashy
Ashgabat
Tehran
Mashhad
Tabriz
IRAQ
Baghdad
KHORĀSĀN
AFGHANISTAN
Dasht-e Kavir (salt desert)
Yazd
Kermān
Shīrāz
FĀRS
KUWAIT
Kuwait
SAUDI ARABIA
Manama
BAHRAIN
QATAR
Doha
Abu Dhabi
UNITED ARAB EMIRATES
Dubai
OMAN
Muscat
Gulf of Oman
Arabian Sea
PAK.
Strait of Hormuz
SĪSTĀN VA BALUCHESTĀN
Boundary representation is not necessarily authoritative

Regional water authorities

- In response to this drought spell, the regional water authorities (RWAs) implemented a number of measures to mitigate drought impacts. However, there were some necessary measures that were not applied, too. Documentation and evaluation of these implemented actions can provide a catalog of options that can be applicable for future droughts with appropriate modifications.

Gilan Province

Rice and tea are the main crops in this province….

August 1999

May 2001

May 2003

Hormozgan Province


خطر مرگ
FARS

Questionnaire

For our survey a questionnaire was prepared

Tayeb Ameziane,

Food and Agriculture Organization

Donald Wilhite ,

National Drought Mitigation Center

Questionnaire

The final version came up with 10 main topics which included more than 100 questions. The topics are as follows:

- **Drought monitoring and early warning systems**
- **Policies, mandates and guidelines**
- **Exploitation from special and new resources**
- **Public awareness, training programs, research and capacity building**
- **Compulsory and incentive actions for reducing water consumption**
- **Emergency programs**
- **Financial issues**
- **Legislation and law related issues**
- **Institutional framework**
- **Drought contingency plans**

The questionnaire was sent for all of the RWAs and here are our

Findings and Recommendations as well as some of the Research Works

that were performed based on these recommendations

Drought monitoring and early warning systems

- The RWAs apply the Iranian Meteorological Organization rainfall and temperature forecasts ➡

and for river flows, use their own stochastic models. The forecasts are in dry, normal and wet categories.

Drought monitoring and early warning systems

- Developing a national wide drought monitoring system ➡
- Monitoring drought severity as well as drought impacts ➡
- Working on multi-indicator indices ➡
- More attention to mid-term and long-term forecasts of rainfalls and river flows, considering uncertainty and risk ➡ ➡

Policies, mandates, guidelines

- Organizing an emergency committee to conduct drought management and drought polices within the RWAs
- Preparation a guideline that indicated how irrigation depth should be reduced based on available water. It is based on equitable water reduction method so called “Vonesh”

Policies, mandates, guidelines

- Establish permanent drought mitigation committee in the RWA to support the provincial drought plan
- Support (financially and technically) of the Ministry of Energy is required for achievement of long term drought plans. Otherwise, the RWA can not start it without such supports.
- The equitable water reduction method or "Vonesh" was applied in a number of the RWAs and performed well, with less social tension. But, more attention are required to apply and evaluate optimization based methods to reduce drought losses.

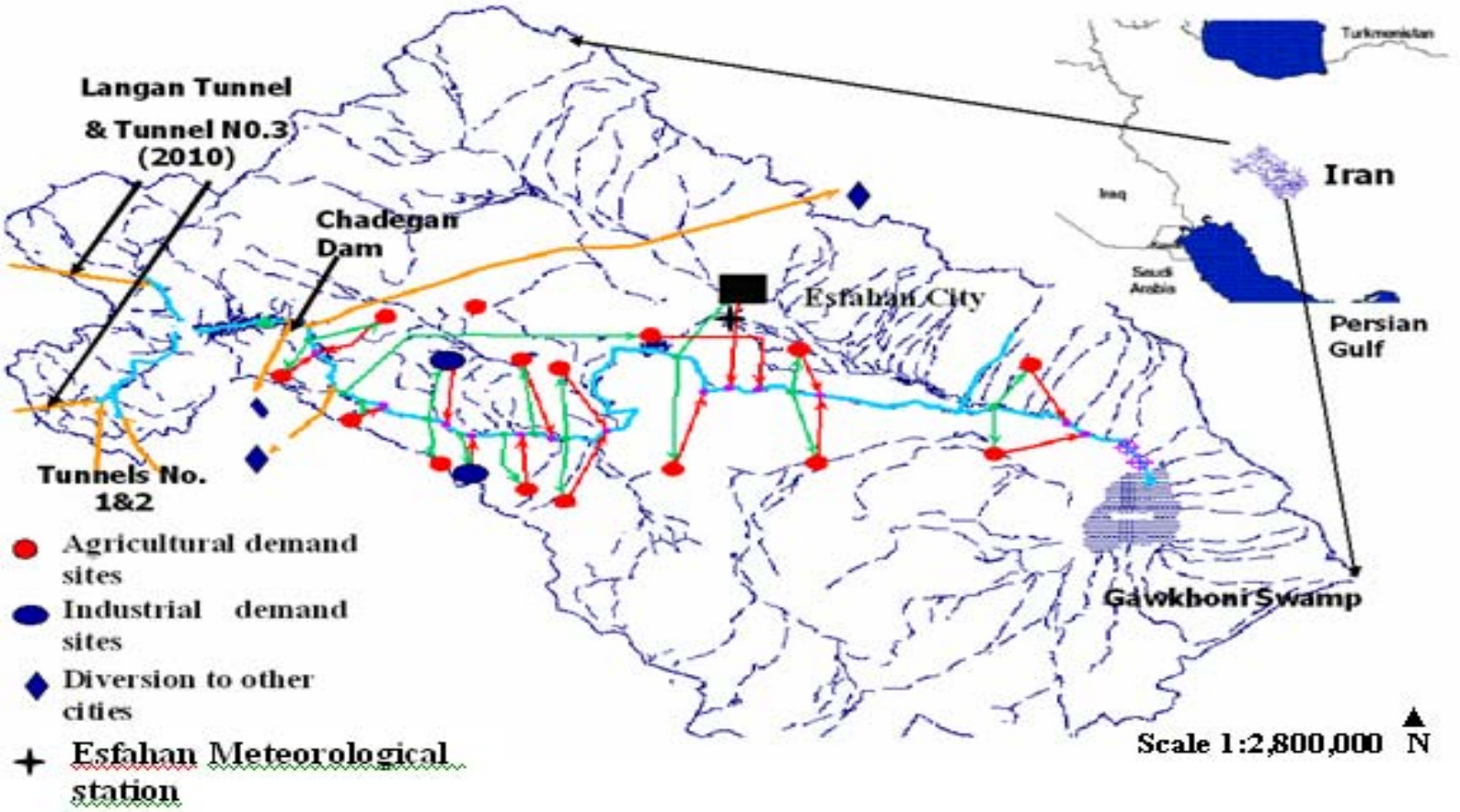


Figure 1. The Zayandeh Rud Irrigation system and related infrastructures

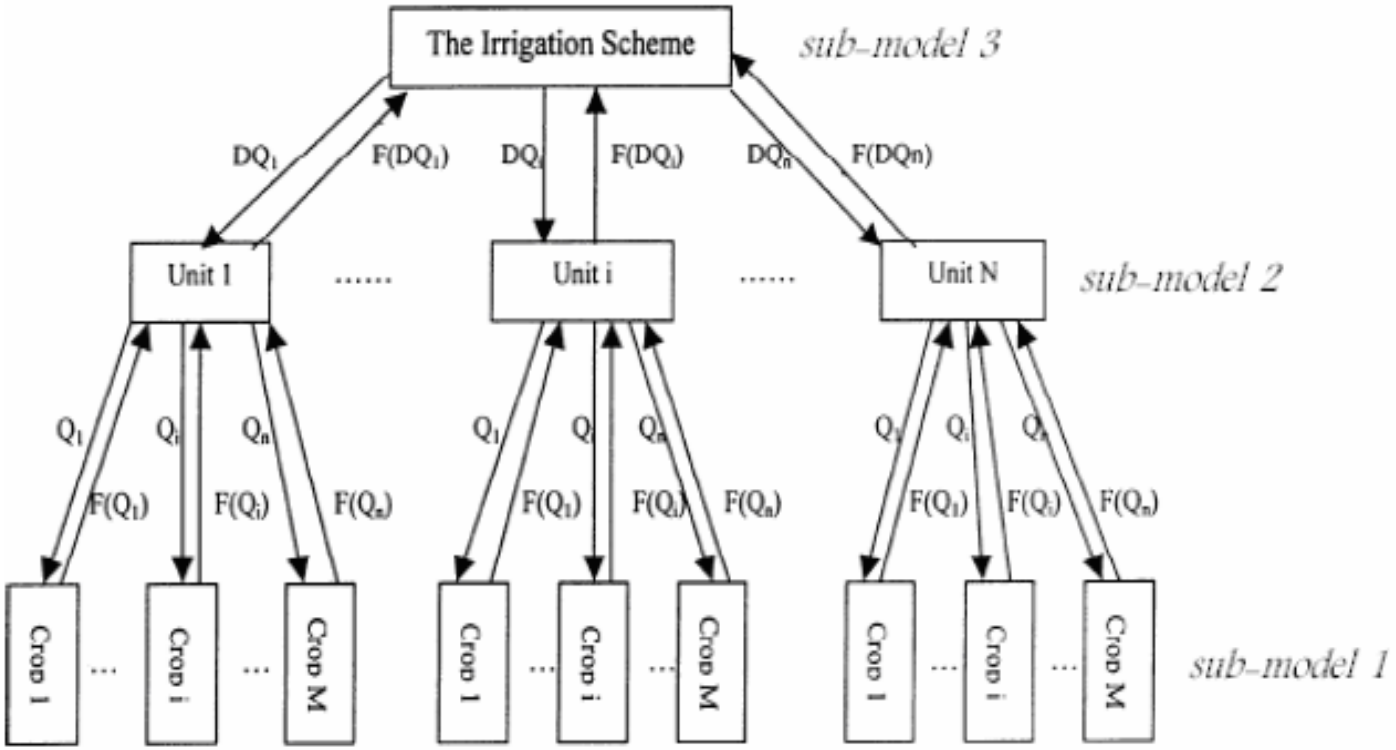


Figure 1: The frame work of the optimization model for water allocation

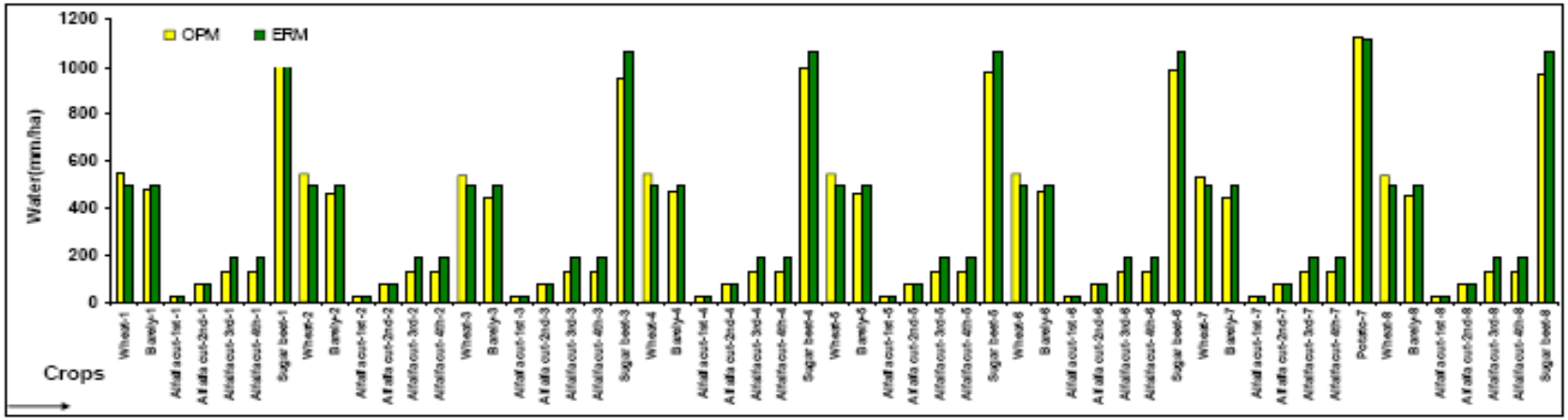


Fig. 2: Water distribution among crops in the irrigation units (1) Nekouabad LB, 2) Nekouabad LR, 3) Mahyar, 4) Borkhar, 5) Abshar LB, 6) Abshar LR, 7) Rudasht, 8) Small-Scale systems)

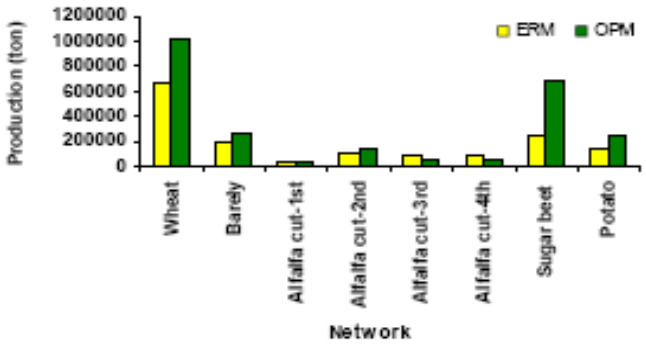


Fig. 3: The total production in the Zayandeh Rud irrigation system

Table 1: Estimated income and using OPM and ERM methods

Irrigation Units	ERM	OPM	ERM	OPM
	Cropped Area (ha)		*Income (US$) *10^8*	
Nekouabad LB	36608	38596	0.856	1.35
Nekouabad LR	14081	14779	0.347	0.518
Mahyar	27796	28385	0.993	1.53
Borkhar	25032	26036	0.733	1.2
Abshar LB	31122	32372	0.912	1.52
Abshar LR	17985	18819	0.506	0.815
Rudasht	57806	59468	2.04	3.13
Small-scale Systems	49727	51223	1.43	2.17
Area Total	*260157*	*269678*	*7.82*	*12.2*

Exploitation from special and new resources

- Construction of pumping station to use dead storage of dams ➡
- Digging new wells ➡
- Construction of new pipe lines to divert water to villages ➡

Exploitation from special and new resources

- To cope with the water scarcity of the 1999-2001 droughts, it was permitted to dig a number of wells in the critical plains. Unfortunately, some of these wells are now being exploited as usual water resources while they should be kept as emergency resources.
- Construction of the drinking water network of Sistan and Balochestan villages is one of the unique examples as long term plan measure. Due to this plan, no migration from villages are reported during the drought spell.

Public awareness, training programs, research and capacity building

- Publication and distribution of pamphlets to individuals, businesses and farmers
- Presenting lectures in schools and masques of cities and villages
- Producing specific programs and shows for the provincial radio and TV networks
- Support from drought-related research works in universities
- Organization of drought-related workshops and conferences
- Holding a number of tours for the province directors, NGO representatives and headman of villages to visit water resources status (e.g. empty dams, dried rivers, etc)

Public awareness, training programs, research and capacity building

- More efforts are needed to improve public awareness to water crisis. During the 1999-2001 the people didn't much suffer from water shortage and this was done by overdrafting. "Living with drought" should become part of the people believes.
- To improve drought risk management rather than crisis management in the RWA, capacity building and special training programs are recommended.
- The drought related research works during and after this drought spell are concentrated on "drought monitoring" while more attentions are required for "mitigating drought impacts" .

Emergency programs

- Distributing drinking water with trucks
- Compiled list of locations for livestock and wild animals watering
- Buying wells where the water tables are at critical elevation

Compulsory and incentive actions for reducing water consumption

- Drinking water rationing
- Elimination of summer crops

Financial issues

- Distributing drought fund relief to drought affected farmers
- Clemency of farmers' loan interests

Financial issues

- The provided relief funds for this drought were mainly allocated to combat the crisis rather than allocating funds for long term mitigation plans.
- Improving drought insurance
- Developing more scientific methodology to distribute drought relief funds among the provinces. It is presently more on bargaining.

Institutional framework

- Organizing an emergency committee in the governors' offices to coordinate drought emergency plans within the provinces.
- The committee were usually formed by the heads of agriculture, industry, radio and TV, environment, drinking water and sewerage organizations.

Institutional framework

- Establish permanent drought mitigation council
- The national ability to cope with drought mainly depends on integration of the provincial organizations. It was shown this coordination was highly significant to reduce economical and social impact of the 1999-2001 drought spells.
- Role of governors was very important to achieve this coordination.

Legislation and law related issues

- Holding specific meeting for judiciary organization
- A special branch in the provincial judiciary organization for water

Drought planning programs

- Developing specific drought plans for operation of dams

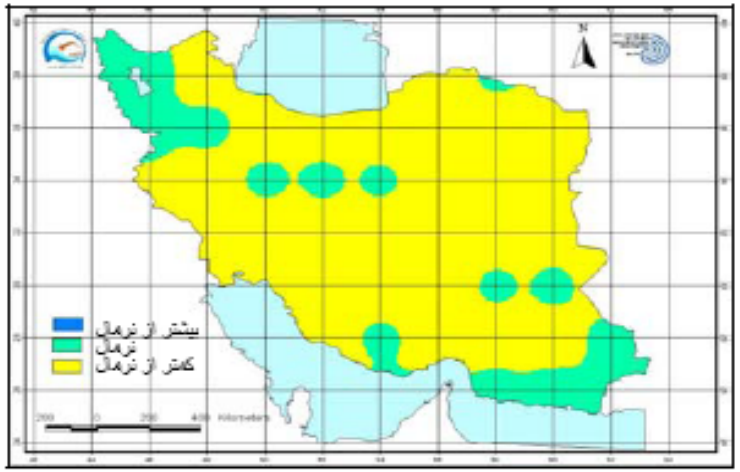
Drought planning programs

- Establish provincial contingency plans ➡
- Considering risk-based decision making in plans due to serious uncertainty in climate and hydrological forecasts
- Virtual drought exercise

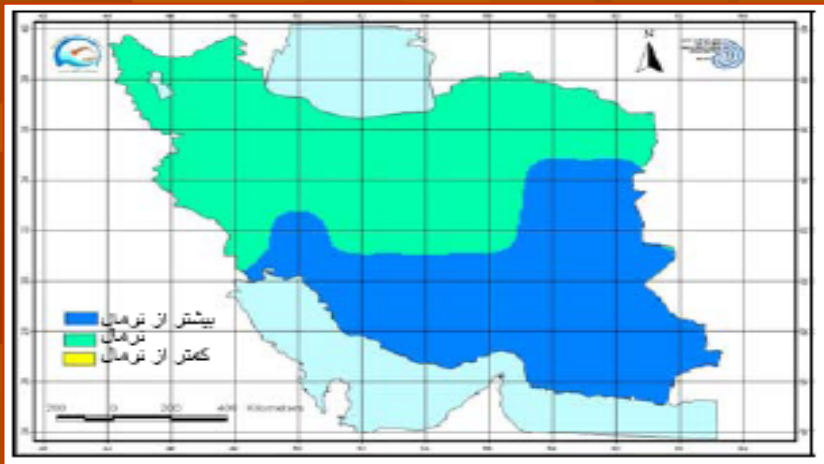
Climate Change

- In addition to the internal changes and activities that are presently going on in Iran and increasing the country vulnerability to drought, there is an important external driver which is CLIMATE CHANGE.

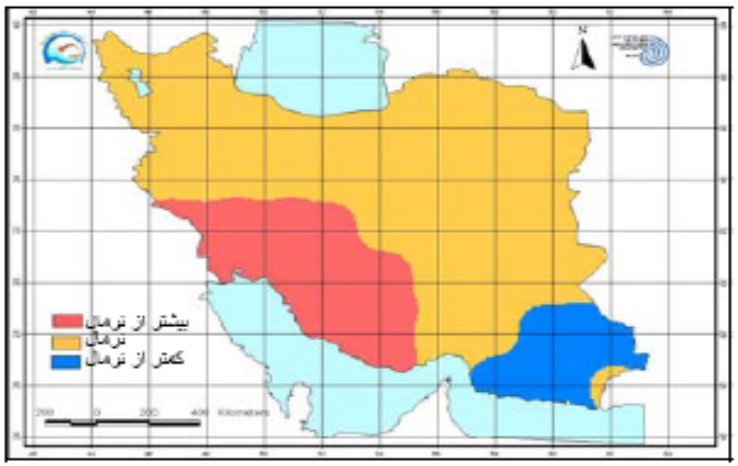
Rainfall and Temperature Seasonal forecast



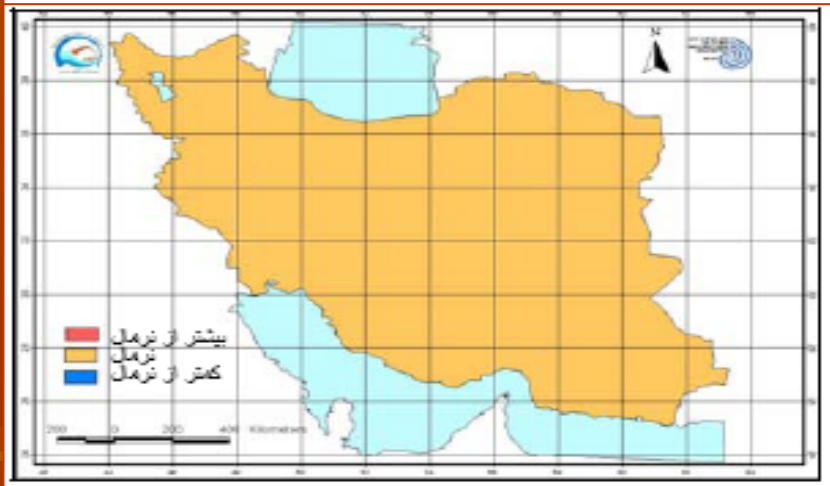
شکل ۶- پیش بینی بارش نیمه دوم شهریور تا نیمه اول آذر ماه ۱۳۸۶



شکل ۴- پیش بینی بارش ایران برای نیمه دوم تیر تا نیمه اول مهر ماه ۱۳۸۶



شکل ۵- پیش بینی دمای ایران برای نیمه دوم تیر تا نیمه اول مهر ماه ۱۳۸۶



شکل ۷- پیش بینی دمای نیمه دوم شهریور تا نیمه اول آذر ماه ۱۳۸۶

Hormozgan Emergency pumping station to exploit death storage of the Minab Dam

Digging wells and feeding irrigation canals

The Sistan Emergency pipeline from Chanimeh reservoir to 600 villages

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- providing access to international scientific information database.
- Database construction process implementation and consultation.
- Indexing training course.
- Training course on " utilizing union list of Latin periodicals "
- International Document supply.

Before 1999 it was about 5 per year and after this drought it is increased up to 20 per year.

DIP

File Data Run View Graph Help

Show Data File Ctrl+S

Add Data ... Ctrl+A

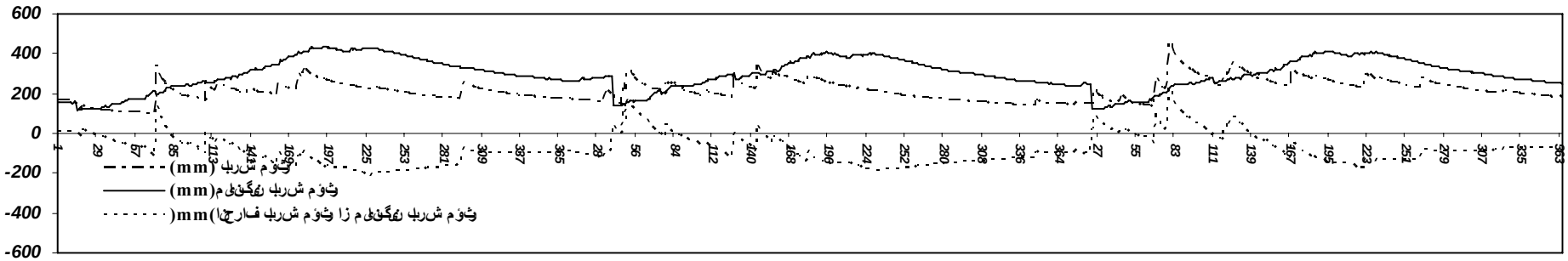
DIP

(*Drought Indices Package*)

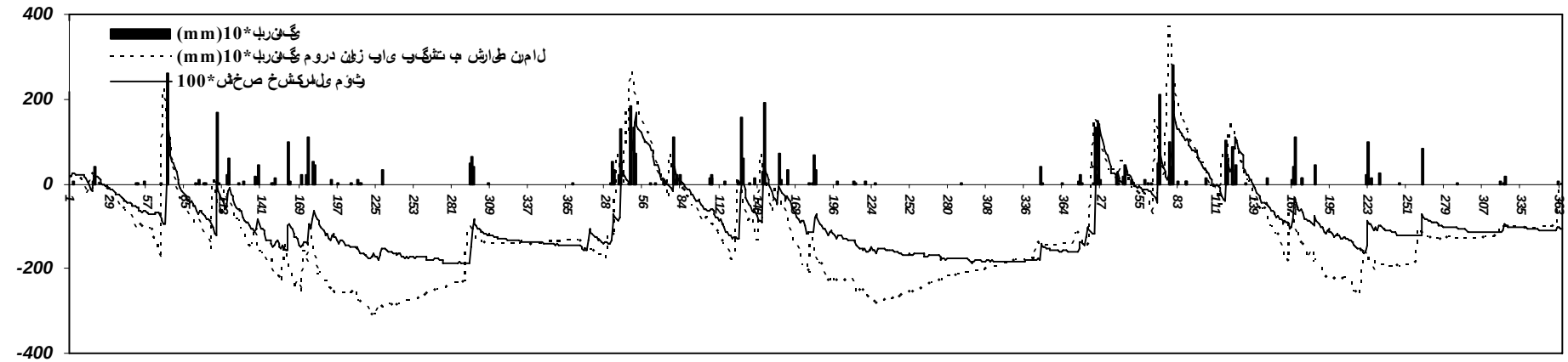
PNI : Present of Normal Index
DI : Deciles Index
SPI : Standardized Precipitation Index
CZI : China Z Index
MCZI : Modified CZI Index
ZSI : Z-Score Index
EDI : Effective Drought Index

2. Daily to 24 months time scale

ایستگاه مهرآباد



1380 لغایت آخر شهریور 1377شماره روز از اول مهرماه



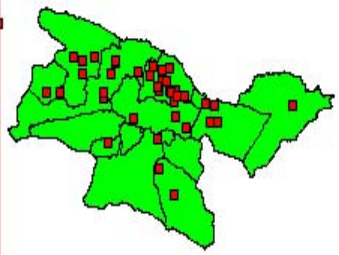
1380 لغایت آخر شهریور 1377شماره روز از اول مهرماه

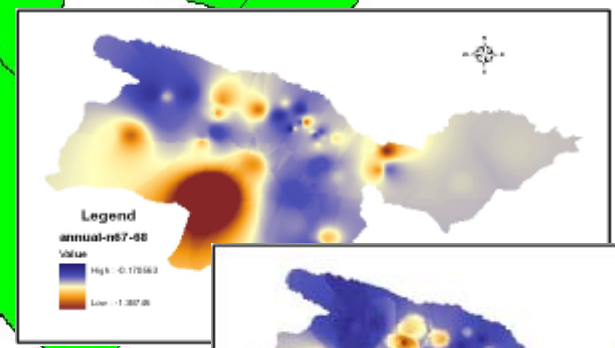
DIP Map

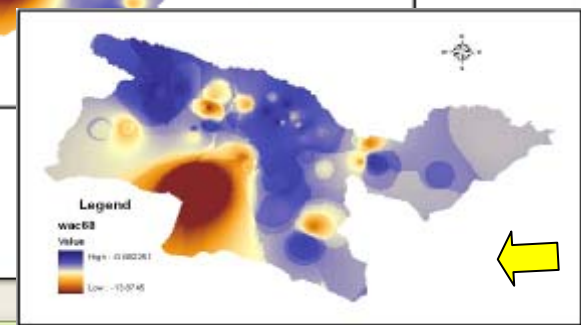
Project Layer Station Help

STATION

CITY

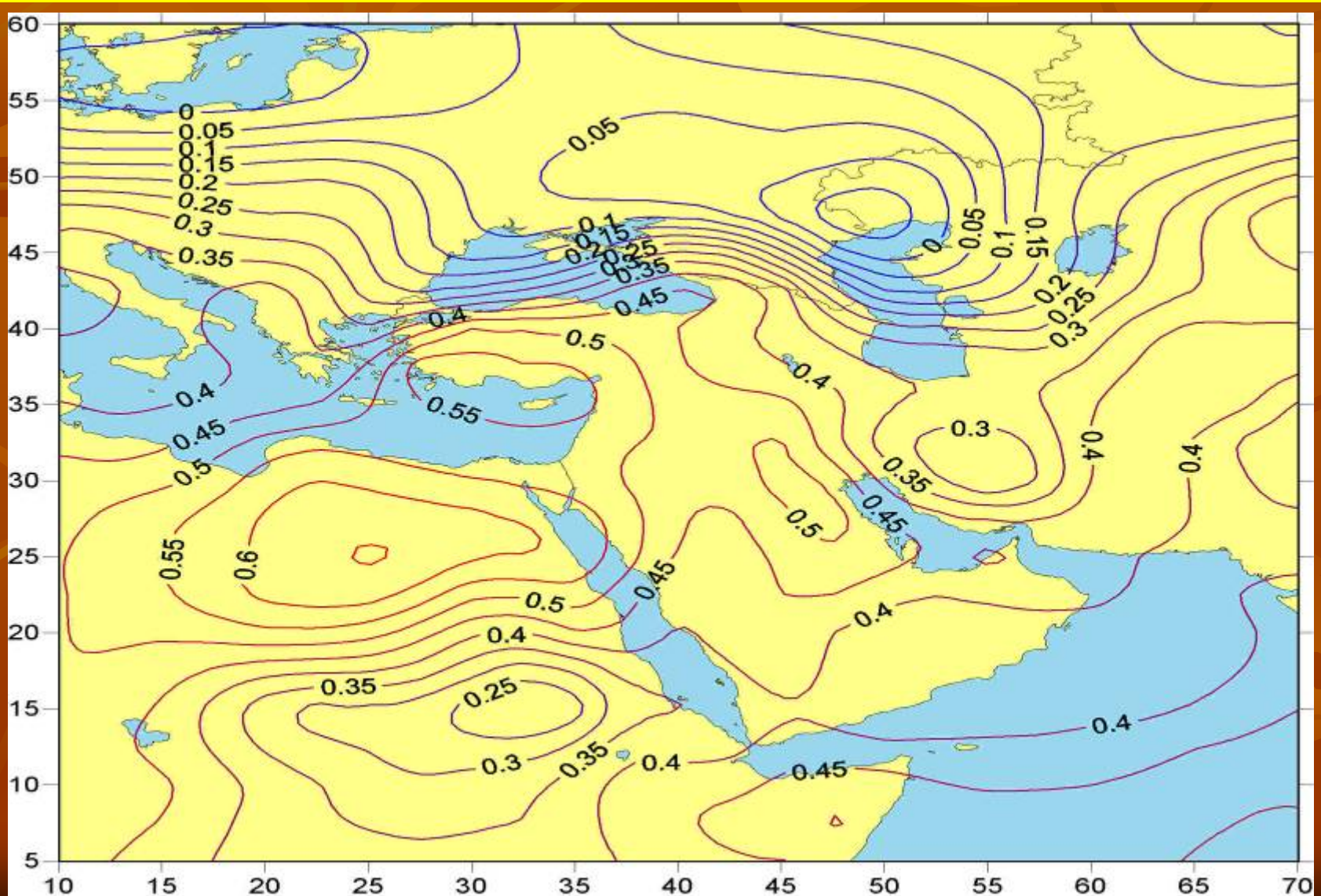




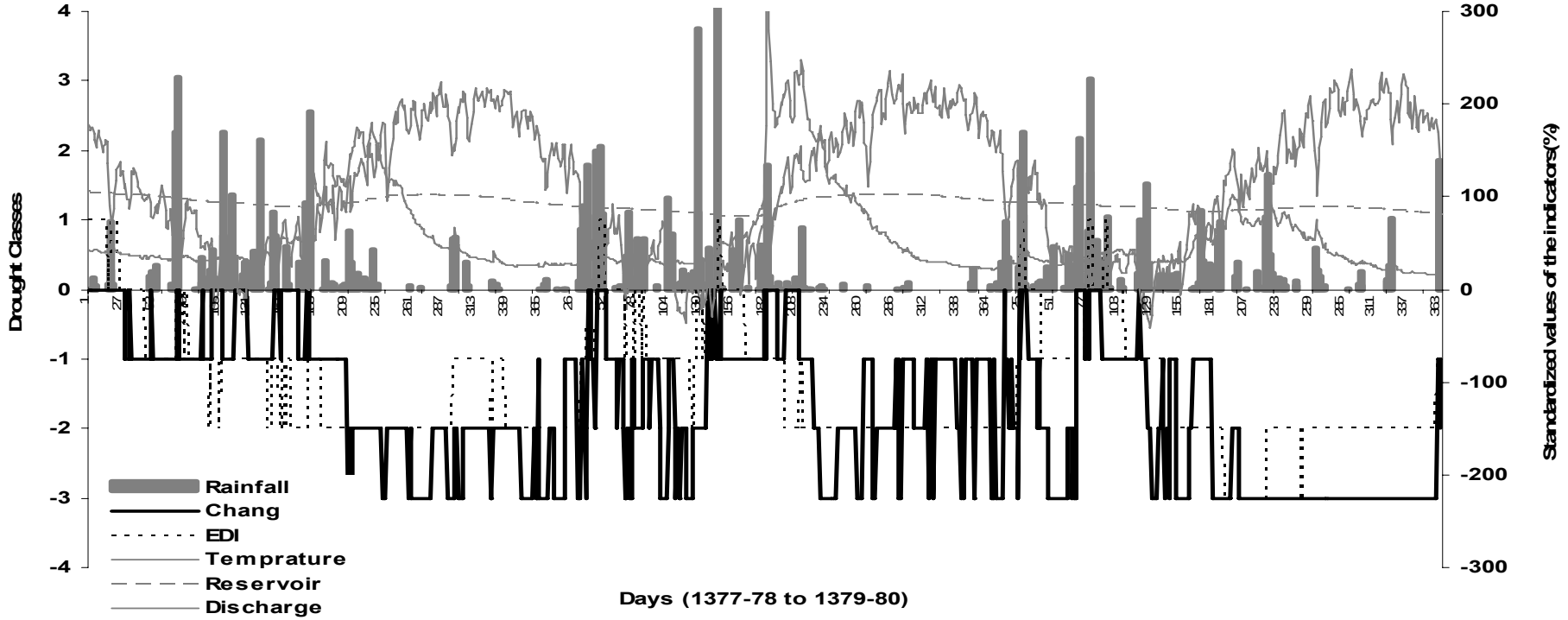


X: 620311.5456872 Y: 3949370.46371453

Data mining to locate effective SST and SLP nodes on the Tehran province drought

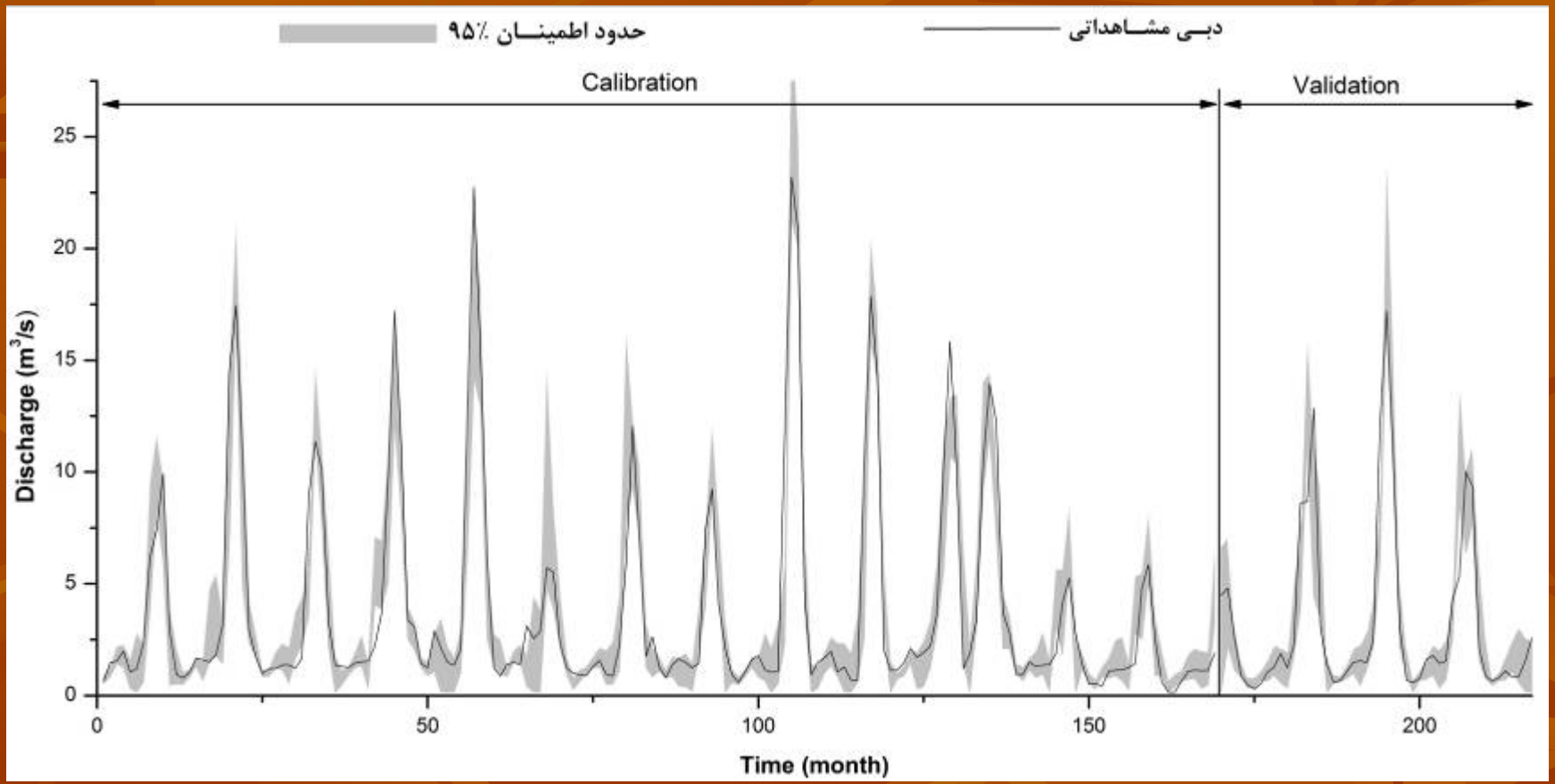


Multi-indicator indices

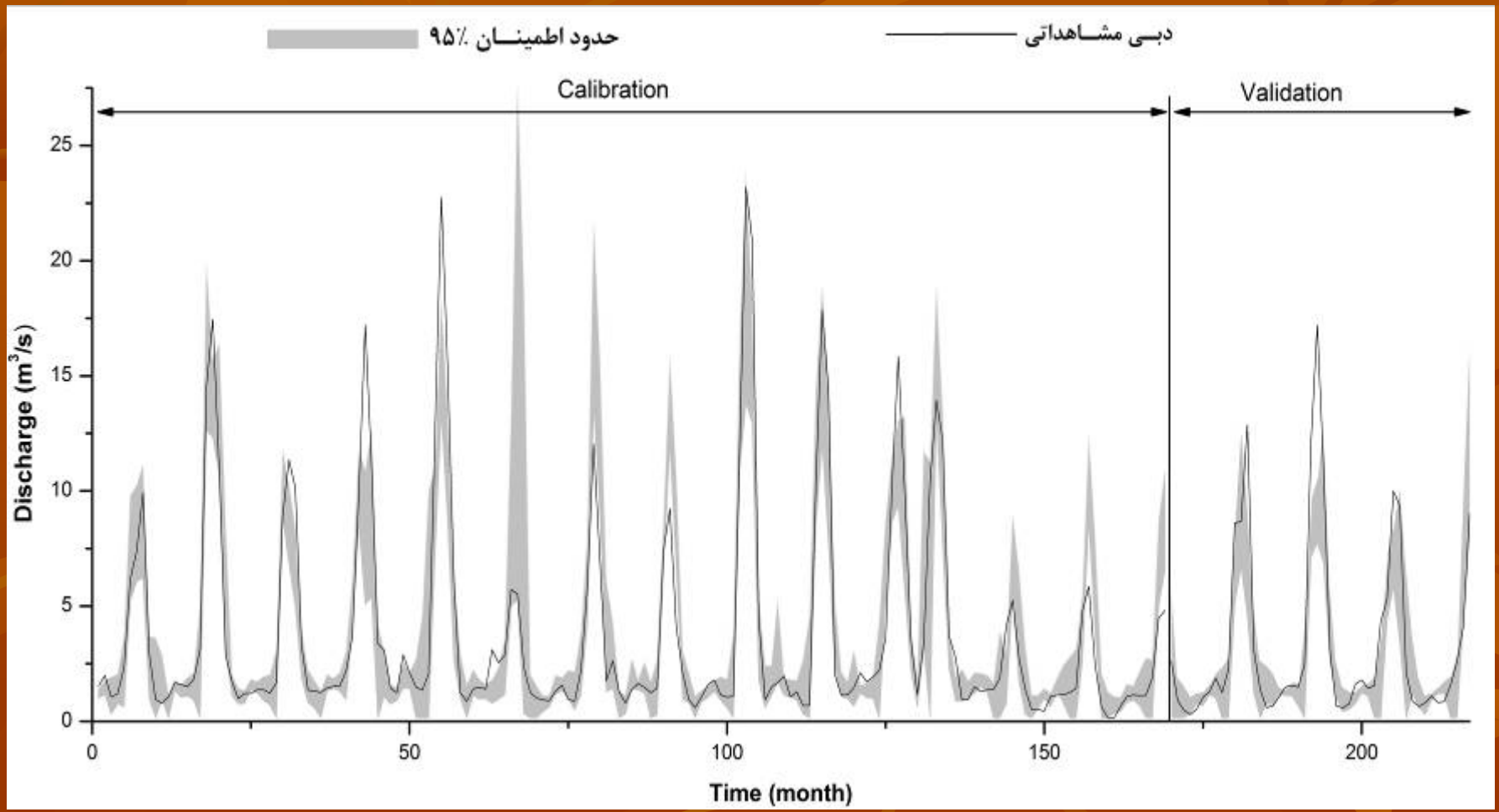


Drought category	Normal and wet	Mild drought	Sever drought	Very sever drought
EDI	80.7	15.3	4.0	0
Chang	57.8	31.5	5.8	4.9

ANFIS & Uncertainty 1month

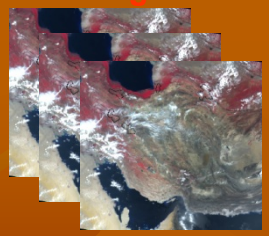


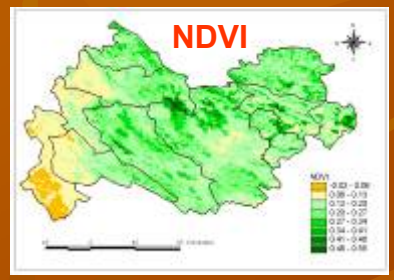
ANFIS & Uncertainty 3months

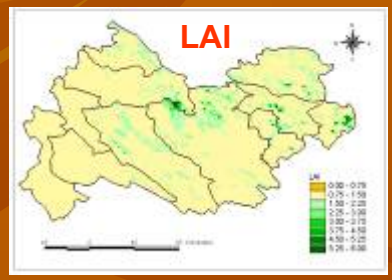


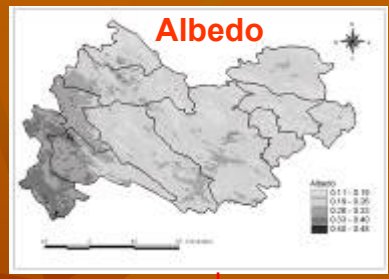
SEBAL Procedure

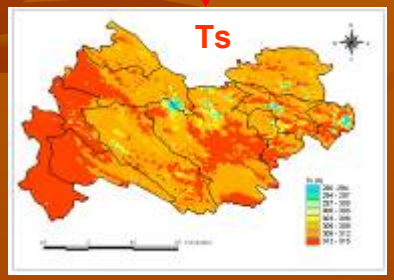
Image

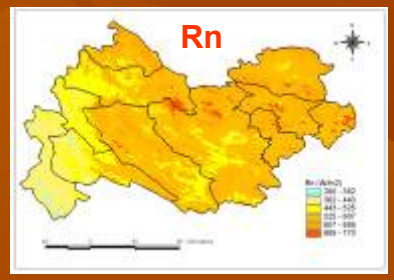


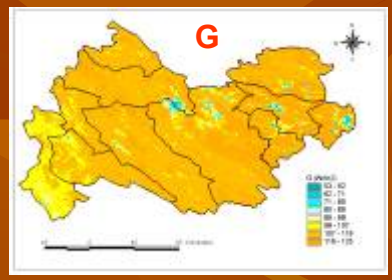




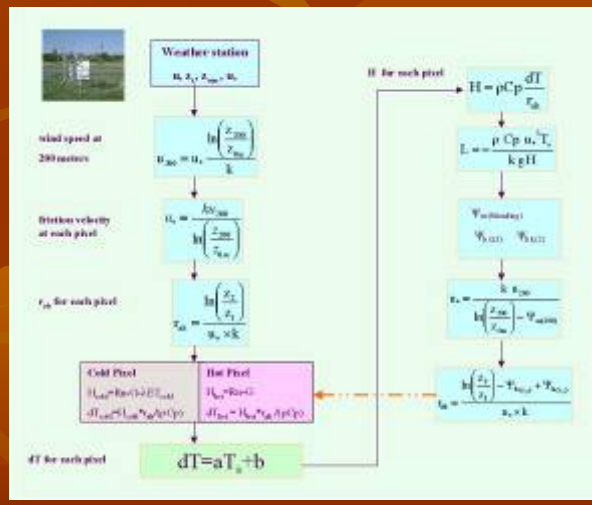


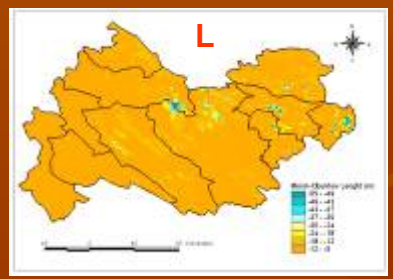


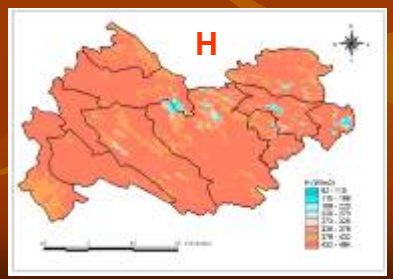


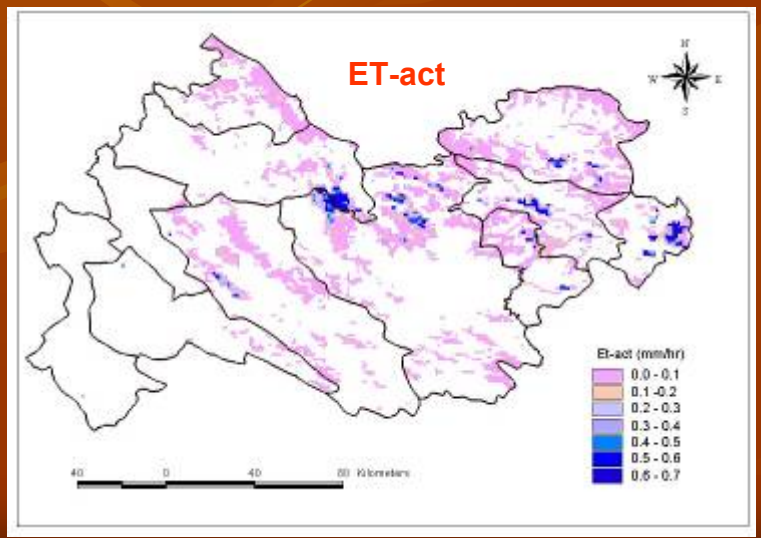


Cold & hot pixel selection

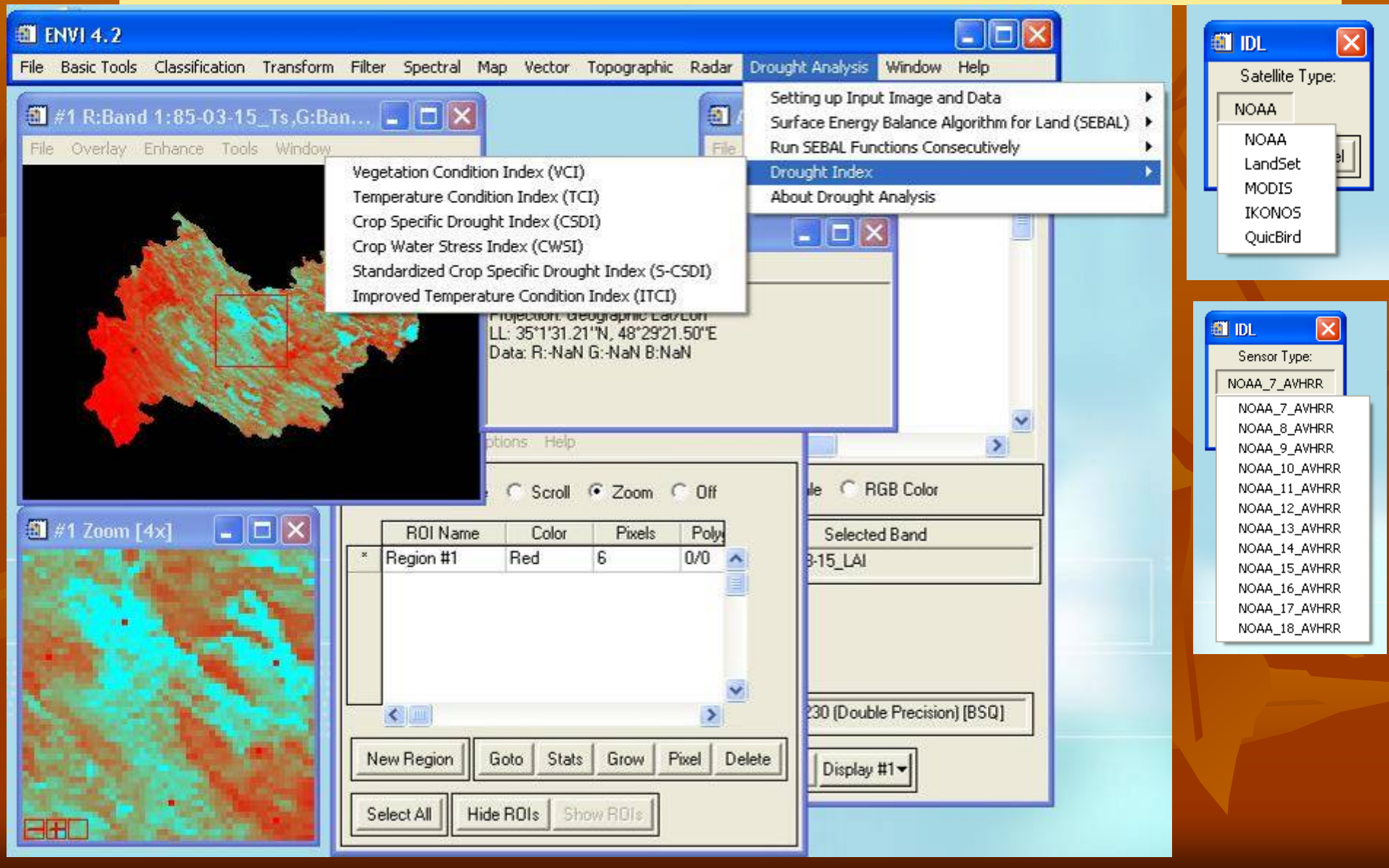






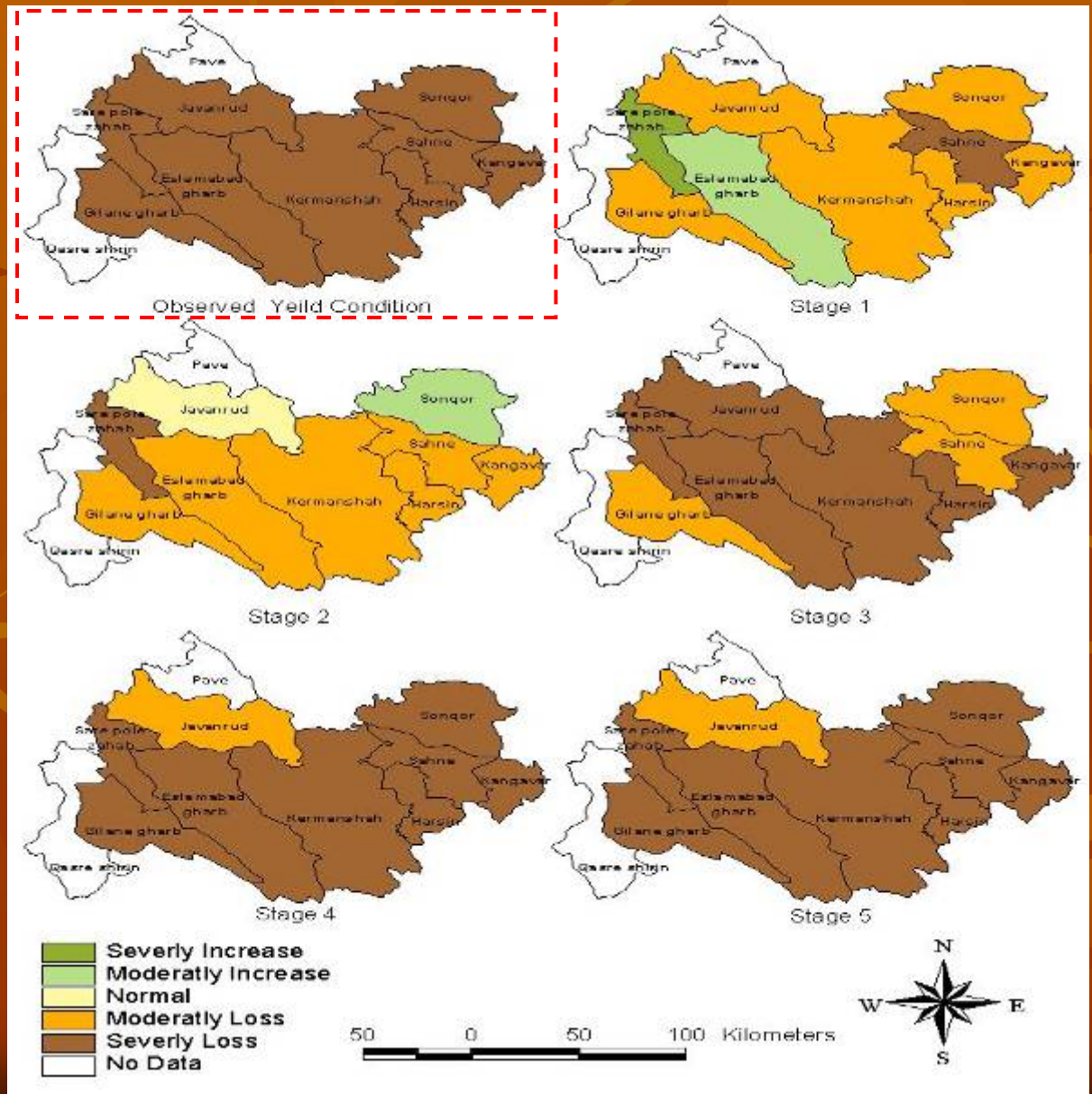


The Developed Software for Calculation of VCI, TCI, ET_act, CSDI, S_CSDI



Results of the Risk-assessment Model

Model with information of satellite image



The installed billboard to encourage farmers to use water more efficiently

Conclusion

- To cope with this creeping natural disaster, there have been many dedicated efforts and initiatives by the RWAs to response more effective and timeliness. But, these measures are more categorized as emergency and reactive (i.e. crises management) responses rather than proactive (i.e. risk management). There is a strong need to think and work on programs that could be implemented in advance of the next drought to reduce society vulnerability. This goal can be achieved by improving provincial drought plans with leadership of the governors and supervision of the central government.

Conclusion

- In spit of the difficulties to achieve “drought risk management”, this paradigm has been more considered by the decision makers. Nowadays, expressions like "shifting from crisis management to risk management", "proactive mitigation measures", "preparedness", "drought insurance", “reducing government-sponsorship" are common in the dialog of the water sector of Iran.
- Impressive progresses are achieved in drought researches in Iran that can be a backbone for efficient drought management


Hope to have
water,
fun
and peace
for the world people.
Thanks for your attention
FARS

Applied GCM models for climate change impacts on Zayandh Rud River

	ECHAM4	HadCM2	CSIRO	CGCM1	GFDL	NCAR	CCSR
AGCM	2.8°x2.8° L19	2.5°x 3.75° L19	3.2°x5.6° L9	3.7°x3.7° L10	4.5°x7.5° L9	4.5°x7.5° L9	5.6°x5.6° L20
OGCM	2.8°x2.8° L11	2.5°x 3.75° L20	3.2°x5.6° L21	1.8°x1.8° L29	4.5°x 3.75° L12	1°x1° L20	2.8°x2.8° L17
Features	prognostic CLW*, geostrophic ocean	prognostic CLW, isopycnal ocean diffusion			no diurnal cycle, isopycnal ocean diffusion	no diurnal cycle	prognostic CLW, explicit sulfate scattering
Flux correction	monthly mean heat, fresh water, stress	monthly mean heat, fresh water	heat, fresh water, momentum	heat, fresh water	monthly mean heat, fresh water	none	monthly mean heat, fresh water
Control CO_2	354 ppmv	323 ppmv	330 ppmv	295 ppmv	300 ppmv	330 ppmv	345 ppmv
Transient CO_2	1.0% yr^{-1} (compound)	1% yr^{-1} (compound)	0.9% yr^{-1}	1% yr^{-1}	1% yr^{-1} (compound)	1% yr^{-1} (linear)	1% yr^{-1} (compound)

Risk of streamflows reduction due to climate change

	2020							
	Winter		Spring.		Summer		Autumn.	
	A2	B2	A2	B2	A2	B2	A2	B2
-10%	40.9	47.4	43.8	67.9	43.1	79	40.8	75.8
-20%	21.5	17.3	24.8	39.4	24.3	56.1	22.3	53.9
-30%	6.2	4.6	9.5	15.9	12.7	29.5	11.1	24.7

	2050							
	Winter		Spring.		Summer		Autumn.	
	A2	B2	A2	B2	A2	B2	A2	B2
-10%	52.9	67	52.4	63	54	67.2	52.6	67.2
-20%	35.4	39.9	36.2	39.9	37.1	46.1	35.4	45.2
-30%	18.6	14.6	21.5	16.9	22	21.9	20.8	20.6

	2080							
	Wint.		Sprin.		Sum.		Autu.	
	A2	B2	A2	B2	A2	B2	A2	B2
-10%	75.2	58.9	75.1	70.3	71.4	77.7	70.9	77.3
-20%	63.3	37.9	65.1	50	69.4	64.2	67.3	63.4
-30%	46.9	21	53.4	28.8	61.6	49	60.4	46.2

Value Engineering workshop in Kerman to indicate the best management practices to cope the recent drought

The Sistan drought plan emphasizing risk management

- Customizing the NDMC 10 steps approach for the region
- Considering IWRM and the system dynamic approach for the proposed drought contingency plan
- Developing drought monitoring system based on the single water resource – Chahnimeh
- Defining mid and long term measures to mitigate drought impacts
- Develop a framework to define role and relationship between the province's organizations before, during and after drought