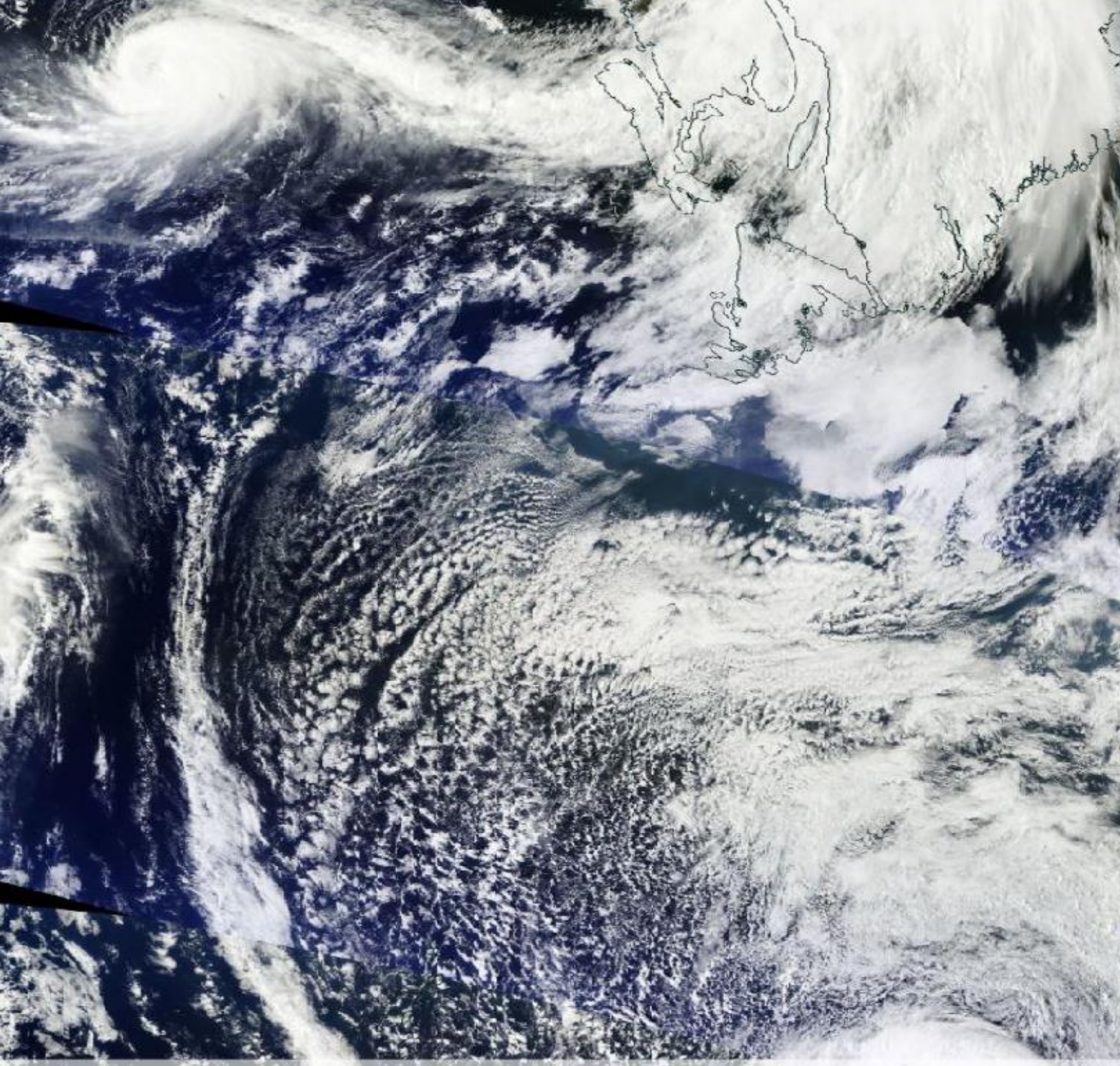

Evaluation of Relation between Rainfall and El Nino Phenomena in Iran

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ABSTRACT – In this study El Nino effects on rainfall in Iran is evaluated. Annual rainfall data of the selected rain gauging stations for the years when El Nino phenomenon has taken place (1973-2012), have been picked up. Next, annual rainfall of the years with and without El Nino phenomenon were compared and then analyzed (correlation is significant at the 0.01 level). Finally, percentage-frequency of the rainfalls influenced by warm Enso condition was obtained. Regarding that El Nino has different affect on rainfall under different regions of the world, the results approved that El Nino, increases rainfall across Iran plateau as annual rainfall is increased from south to north. While less increasing of rainfall is seen for coastal area. Results showed that El Nino causes increasing of annual rainfall in Iran.

INTRODUCTION

The term of El Nino phenomenon is used to some annual warm transoceanic current that flows southward right in prolongation of Peru and Ecuador coasts on Christmas time. This flow changes local and regional ecology because of its unusual spread heat (Trenberth & Hoar, 1990 – 1995). In La Nina conditions when adverse impacts of El Nino happen, as a result Walker's circulation and trade winds strengthens. Polar Jet stream moderately flows from 45 degree northern latitude towards Siberia and south Asia in warm phases. While in cold phases the current flows from 50 degree northern latitude towards east. Earth atmosphere is a unique system; its mechanism affects the earth surface and uppermost atmospheric layers (Alijani, 2006), so dominant land and oceans conditions affect atmospheric phenomena and elements fluctuations. Land and atmosphere relationships control climate and weather in large scales. Seas and oceans spread on most parts of the earth and because of specific heat, thermal capacity and proper conductance; they can transfer their dominant meteorological conditions and parameters to other seas or oceanic and lands. As a result they affect the climate

parameters and atmospheric fluctuations. That's why the investigation on El Nino phenomenon and its relationship to rainfall importance in aspects of meteorology and environmentalism; furthermore it has social economic impacts everywhere. Many studies has been made about the relationship between El Nino and rainfall patterns, floods, rivers etc in many parts of the world such as south Africa, Australia and the Indian subcontinent.(Markham and Mclain, 1997, Lindesay et al, 1986, Quinn and Neal, 1987,Semazzi et al1988, Famer, 1901-1984, Kiladis and Dias, 1090, Wolter 1989, Chamberlain, 1995, Halpert and Ropeleweski, 1992, Camberlin, 1997, Nicholson and Kim, 1997, Ward, 1998,Vuille et al, 2000, Mosely, 2000, Kane, 2000, Tarras et al, 2006). In continental scale La Nina impacts on rainfall in Africa had been investigated (Ropelewski and Halpert, 1989).They traced La Nina in two regions in Africa continent. They also realized that eastern tropical regions had encountered rainfall decrements and southeast anomaly had encountered rainfall increment during this phenomenon. Seasonal rainfall forecasting is important because of its role in economical productivity and managing little farmlands has been performed in Zymbaboa (Leonard et al, 2005). They realized during El Nino phenomenon corn production had been decreased. The research on El Nino and La Nina was performed in west center Texas shows rainfall increment at the early spring during El Nino and rainfall decrement during La Nina (McCullough, 2000). Rainfall fluctuations in New Mexico show an increment during El Nino and a decrement during La Nina into normalized statistical method (Liles, 2003).Cold and warm ENSO has dominant role at the beginning and intensifying seasonal rainfalls (e.g., Webster and Yange, 1992). Iran's investigations based on rainfall and drought correlation using SOI parameter shows a negative meaningful correlation during autumn in many parts of it. In this investigation autumnal droughts during La Nina and heavy rainfalls during El Nino has been reported (e.g., Nazemosadat, 1999).The study has notified branching the Jet stream in southern regions of Pacific Ocean and also has stated on adverse conditions during cold phases (Smith et al, 1986-1989).Outcomes investigations shows dominant role of sea surface temperature in controlling Atlantic and Indian oceanic rainfalls in comparison to El Nino and La Nina phenomena (Nicholson, 1997, Nickelson and Selato, 2000).Indirect El Nino impacts in changing atmospheric circulation patterns and it's teleconection to other Paramers has referred (Khoshakhlagh, 1998).ENSO warm phases during autumn happen because Jet stream moving directions changes towards southern latitudes. Its meridian circulation movements bring wet and higher average rainfalls condition (Ghayour & Khosravy, 1989).

PROCEDURE

In this study to inspect the El Nino impacts on Iran's rainfall, the relative data of Synoptic stations were provided and received from Iran's meteorological administration in statistical period (1964 – 2003). El Nino data was received from NOAA site, in the same period. Analyzing correlation performed using Pierson method. The comparison data related to warm ENSO years and normal years, also data about rainfall frequency percent were provided to be used in this investigation. Then using Arc GIS software, station locations and rainfalls frequency percent was drawn on a general distinct map. After providing diagrams and maps, analysis, discussion and conclusion were performed.

RESULTS

Warm ENSO happens when Tahiti pressure value minus Darwin pressure value makes a positive value. Adverse conditions leads to cold ENSO. During these conditions, temperature, pressure and rainfall increases or decreases in related areas. In this case depending on Iran's climate and location, El Nino caused increasing rainfall above normal line and finally brings a wet year. Based on sunspot increment, happens 1 to 3 years before El Nino and afterwards it causes drought and rainfall fluctuations .Warm and cold phenomena in tropical Pacific Ocean have a vital role in atmospheric circulations (Deser and Wallace, 1990).The wet years and drought ones in India is in accordance with ENSO phenomenon (Masoodian and Kaviani, 2008). This research shows increment in El Nino impacts proportional to higher latitude values (fig. 1). El Nino rainfall shows rainfall increases in comparison to normal years (fig. 2). Considering table (1) & figure (3), warm ENSO rainfall redundancy percent increases proportional to latitude value. But in Rasht station, because of its suitable location and high humidity and also ascent factors (convectional, mechanical, dynamical), there have been suitable geographic conditions for heavy rainfalls, so El Nino have had little impact on regional rainfalls. Also in southern coastal stations neighboring sea, a similar situation has been observed. Using Pierson correlation analyze El Nino intensity proportional to sample stations (tables 2, 3), in addition to their linear correlation in (figure 4), shows a significant relationship at level (0.01), and also a direct correlation between rainfall and El Nino phenomenon.

CONCLUSION

In this study to realize the El Nino impacts on Iran's rainfall, the amount of rainfall in sample Synoptic stations during statistical period (1973-2012), was provided and compared to El Nino years during the same period.

After calculation the data related to station's rainfall redundancy percent during warm ENSO, its impact on rainfall increment and occurring normal condition was observed carefully.

Data correlation analyze using Pierson method shows a meaningful relationship at the level (0.01).Considering Iran's aridity lands subject to its dry and semi-dry climate the importance of water reservoirs has a vital role in regional ecology. So rainfall process realization and rainfall prediction in relation to ENSO cold and warm cycles is necessary to provide capability to manage water reservoirs including gathering, storage, saving and proper consuming.

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FIGURES AND TABLES

FIGURES

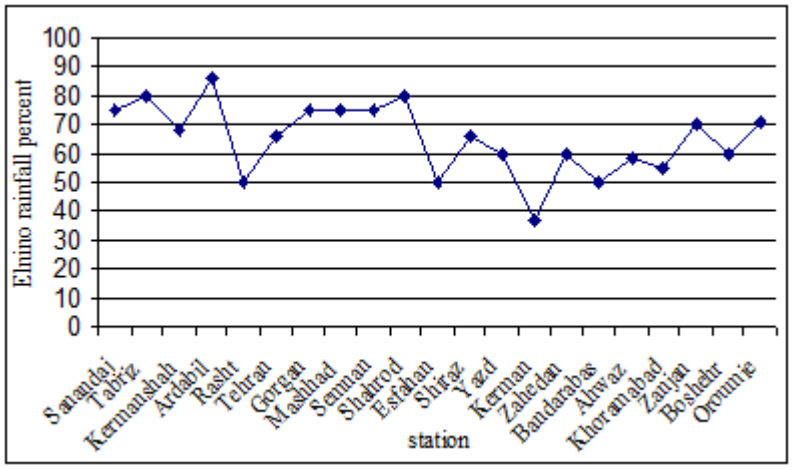

Figure 1: El Nino rainfall proportional to stations geographical latitude during statistical period (1973-2012)

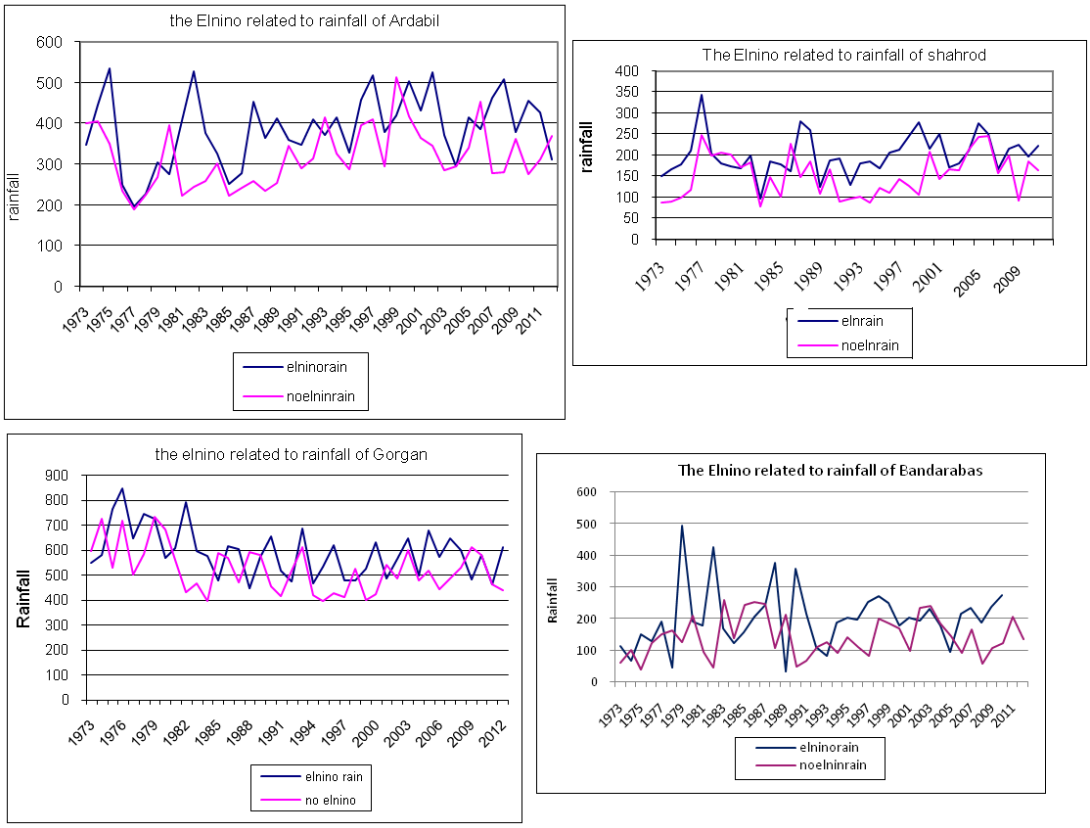

Figure 2: El Nino rainfall diagram at four sample stations during statistical period (1973-2012)

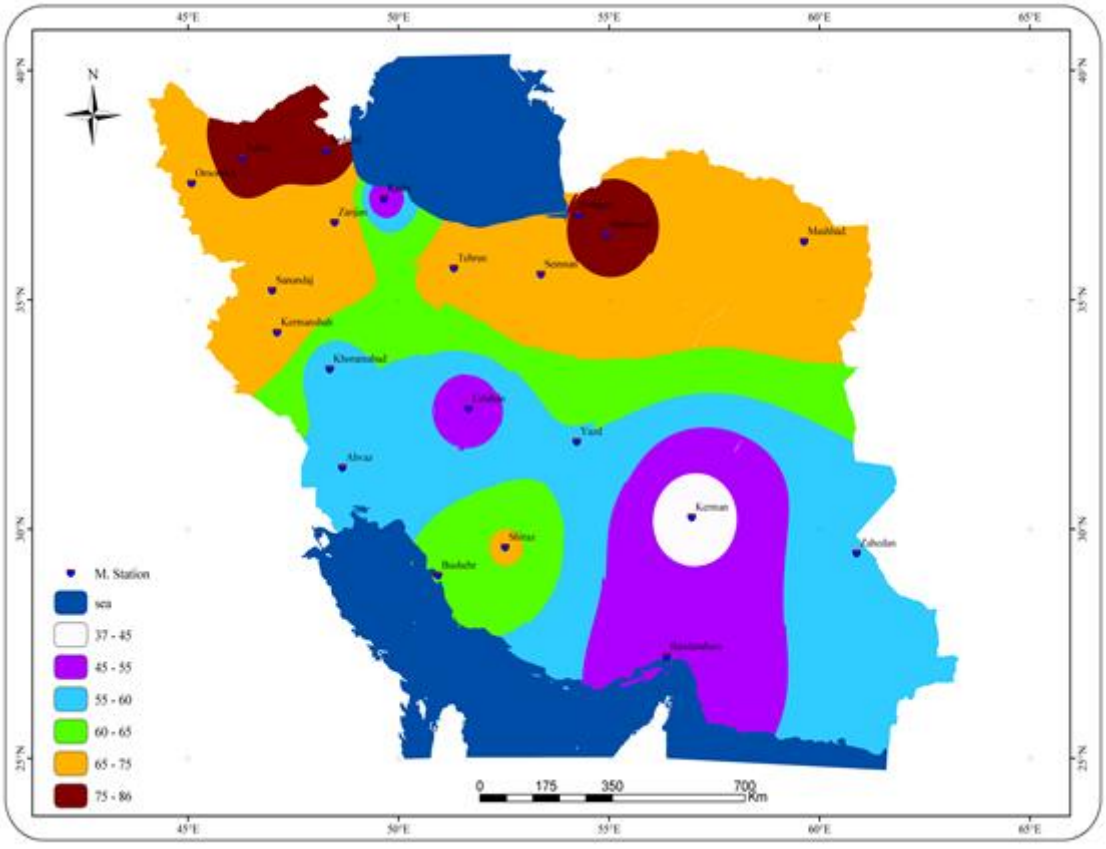

Figure 3: El Nino rainfall frequency percent map sample stations during statistical period (1973-2012)

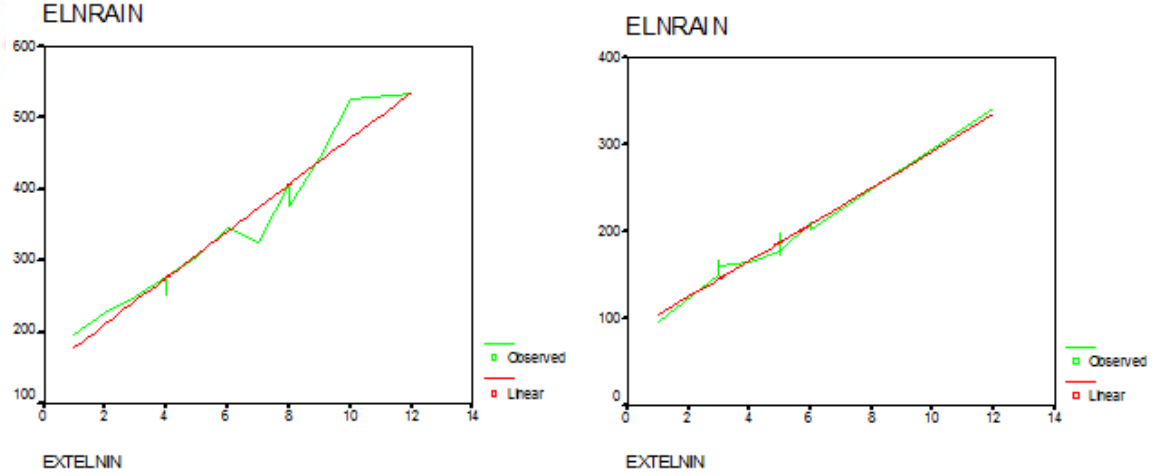

Figure 4: El Nino intensity and sample station's rainfall linear correlation during statistical period (1973-2012). A) El Nino intensity and Ardabil's rainfall linear correlation. B) El Nino intensity and Shah rood's rainfall linear correlation.

TABLES

Table 1: Sample stations El Nino rainfall frequency percent, during statistical period (1973-2012)

Station	Longitude	Latitude	Frequency Percentage
Sanandaj	47o 00'	35 o 20'	75
Tabriz	46 o 17'	38 o 5'	80
Kerman shah	47 o 74'	34 o 17'	68
Ardabil	48 o 17'	38 o 15'	86
Rasht	49 o 39'	37 o 12'	50
Tehran	51 o 19'	35 o 41'	66
Gorgan	54 o 16'	36 o 51'	75
Mashhad	59 o 38'	36 o 16'	75

Table 2: Sample stations El Nino rainfall frequency percent, during statistical period (1973-2012)

Station	Longitude	Latitude	Frequency Percentage
Semnan	53 o 23'	35 o 33'	75
Shah rood	54 o 57'	36 o 25'	80
Esfahan	51 o 40'	32 o 37'	50
Shiraz	52 o 32'	29 o 36'	66
Yazd	54 o 14'	31 o 54'	60
Kerman	56 o 58'	30 o 15'	37
Zahedan	60 o 53'	29 o 28'	60
Bandarabas	56 o 22'	27 o 13'	50
Ahwaz	48 o 40'	31 o 20'	58
Khoramabad	48 o 22'	33 o 29'	55
Zanjan	48 o 29'	36 o 41'	70
Boshehr	50 o 5'	28 o.59'	60
Oroumie	45 o 5'	37 o 32'	71

Table 3: The El Nino intensification correlation anlyze related to Ardabil rainfall

		ELNRAIN	EXTLNIN
ELNRAIN	Pearson Correlation	1	.963**
	Sig. (2-tailed)	...	.000
	N	14	14
EXTELNIN	Pearson Correlation	.963**	1
	Sig. (2-tailed)	.000	...
	N	14	14

**. Correlation is Significant at the 0.01 (2-tailed)

Table 4: El Nino intensity correlation analyze and Shah rood rainfall

		ELNRAIN	EXTLNIN
ELNRAIN	Pearson Correlation	1	.979**
	Sig. (2-tailed)	...	.000
	N	14	14
EXTELNIN	Pearson Correlation	.979**	1
	Sig. (2-tailed)	.000	...
	N	14	14

**. Correlation is Significant at the 0.01 (2-tailed)

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