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# A Drought Outlook and Early-warning System over I. R. of Iran (DOES)


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## Abstract


In this research, post processed amounts of precipitation GPVs from MRI-CGCM3/JMA-Tokyo Climate Center model has been used to compute the future three months SPI drought index to develop Drought Outlook and Early warning System (DOES) over Iran. Recent study has three main results including: 1-post processing of the model outputs is a substantial need to improve the skill of numerical models in station scale. 2-Implementation of post processing can significantly increase the accuracy of station scale precipitation forecasts. 3- post processing method used in this research can highly improve the accuracy of drought prediction and early warning. Results showed that capability of model to predict the drought indices has been increased from 66.7% (non-post processed)up to 78.5% when using post processing.


## Introduction

In the recent years, because of the increasing of the climatic extreme events, demands for reliable seasonal precipitation forecasts, drought early warning and predictions have been increased, especially in water resources and agricultural sectors. There are many researches on precipitation and other meteorological forecast in seasonal scale, but the number of researches involving drought prediction using dynamical model outputs is low. As the drought situation in the future months can help in agriculture water management and water resources over Iran, therefore, most of researches use the statistical approaches including regression, time series, fuzzy, fuzzy-logic, neural network and genetic algorithm to predict the drought conditions of Iran for 3 months to one year in ahead. In Mashad Climate Center, located in the Northeast of Iran, we have examined some different methods to predict the drought situations over Iran. In this regard, the method using statistical post processing of a dynamical seasonal forecast model has presented in this poster.

## Data and Methodology

Two kinds of data are used in this research: 1-observation data of precipitation over 71 weather stations of Iran in the period of 1980-2007 (28 years) and 2-MRI-CGCM3 reforecast Grid Point Values(GPV) in the same period to the observation years.
Table 1 shows the name and description of GPVs data which are used in this research. Six station scale MRI-CGCM GPVs are not shown in the figure. They are model outputs of precipitation, T850, T2m, H500, SST and MSLP.

Table 1. Name and definition of the MRI-CGCM3 variables used for post processing of precipitation over 71 stations of Iran. Six GPVs added to these variables.

| Indices | Variables | Areas |
|---|---|---|
| NINO3 SST | SST | (150W-90W, 5S-5N) |
| NINOWEST SST | SST | (130E-150E, EQ-15N) |
| IOBW SST | SST | (40E-100E, 20S-20N) |
| WIO SST | SST | (40E-70E, EQ-20N) |
| EIO SST | SST | (70E-100E, EQ-20N) |
| IOBW RAIN | RAIN | (40E-100E, 20S-20N) |
| WIO RAIN | RAIN | (40E-70E, EQ-20N) |
| EIO RAIN | RAIN | (70E-100E, EQ-20N) |
| SAMOI RAIN | RAIN | (80E-140E, 5N-25N) |
| WNP RAIN | RAIN | (110E-160E, 10N-20N) |
| SEAsia RAIN | RAIN | (115E-140E, 10N-20N) |
| MC RAIN | RAIN | (110E-135E, 5S-5N) |
| DL RAIN | RAIN | (170E-170W, 5S-5N) |
| Z2030 | 500hPa Height | (0-360, 20N-30N) |
| Z3040 | 500hPa Height | (0-360, 30N-40N) |
| Z4050 | 500hPa Height | (0-360, 40N-50N) |
| Z5060 | 500hPa Height | (0-360, 50N-60N) |
| THMD | Thickness Middle | (0-360, 30N-50N, 300hPa-850hPa) |
| THEX | Thickness extratropic | (0-360, 30N-90N, 300hPa-850hPa) |
| THTR | Thickness tropic | (0-360, 25S-25N, 100hPa-850hPa) |

For improving the accuracy of seasonal precipitation forecasts and drought early warnings, the outputs of MRI-CGCM3 seasonal forecast model including gridded precipitation and 20 parameter and climate indices has been used to station scale post processing of the model precipitation over 71 synoptic weather stations of Iran over the period of 2001-2007. *The outputs of MRI-CGCM3 are available to registered National Meteorological and Hydrological Services (NMHSs) on the website of the Tokyo Climate Center of the Japan Meteorological Agency (JMA/TCC).* Model variables and indices which were used in the post-processing were WIO rain, Z2030, Z5060, WIO SST, T850, T2m, SST, NINOWEST SST, WNP RAIN, NINO3 SST, Z3040, H500, MSLP, SAMOI RAIN, MC RAIN, DL RAIN, THMD, THTR and total precipitation (Table 1).

JMP4 software are used to investigate the regression between observed station precipitation and 26 outputs of MRI-CGCM3 in calibration period of 1980-2000 (calibration period is changed for small number of stations those had little period of observation). All of MRI-CGCMs GPVs which had statistically significant regression with observed precipitation are fed to a regression model to find multiple linear regression model coefficient in calibration period for each months in all selected stations. Figure 1 shows the feature of JMP4 in computing regression values.

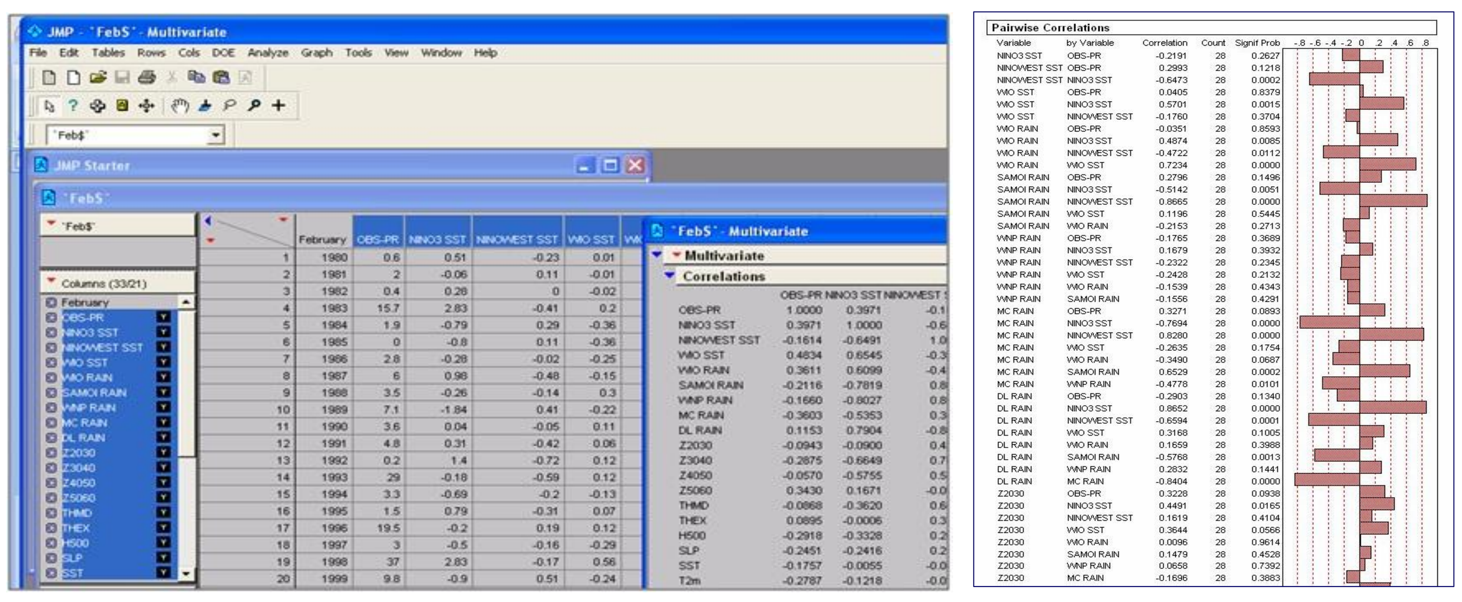

Figure 1. Using JMP4 to calculate regression between MRI-CGCMs outputs and observed precipitations over 71 weather stations of Iran.

The skill of multivariate post-processing was evaluated using Mean Square Skill Score, Mean Bias Error, relative error and categorical skill score over the training and evaluation periods. Categorical skill score is determined by computing the skill of post processed and raw model data in forecasting five precipitation category of above normal, above normal to normal, normal, normal to below normal and below normal. Post-processed precipitation outputs were entered to the SPI software to calculate SPI drought index over 71 weather stations of Iran. Post processed precipitations and SPI drought indices are compared with observed precipitations and drought indices for checking the capability of statistical post processing method used on the model outputs. Then the accuracy of the post processing method is computed over all stations for precipitation and drought indices.

## Results

Skill of DOES in modeling drought outlook using SPI index by post processed precipitation for two case of dry and wet months (August and February 2001)are shown in figure 2. Left panels shows the observed SPI using actual station precipitation. Middle panels shows the SPI drought index using non post processed precipitation data retrieved from MRI-CGCM3. In the right panels results of SPI index using post processed precipitation data are shown.

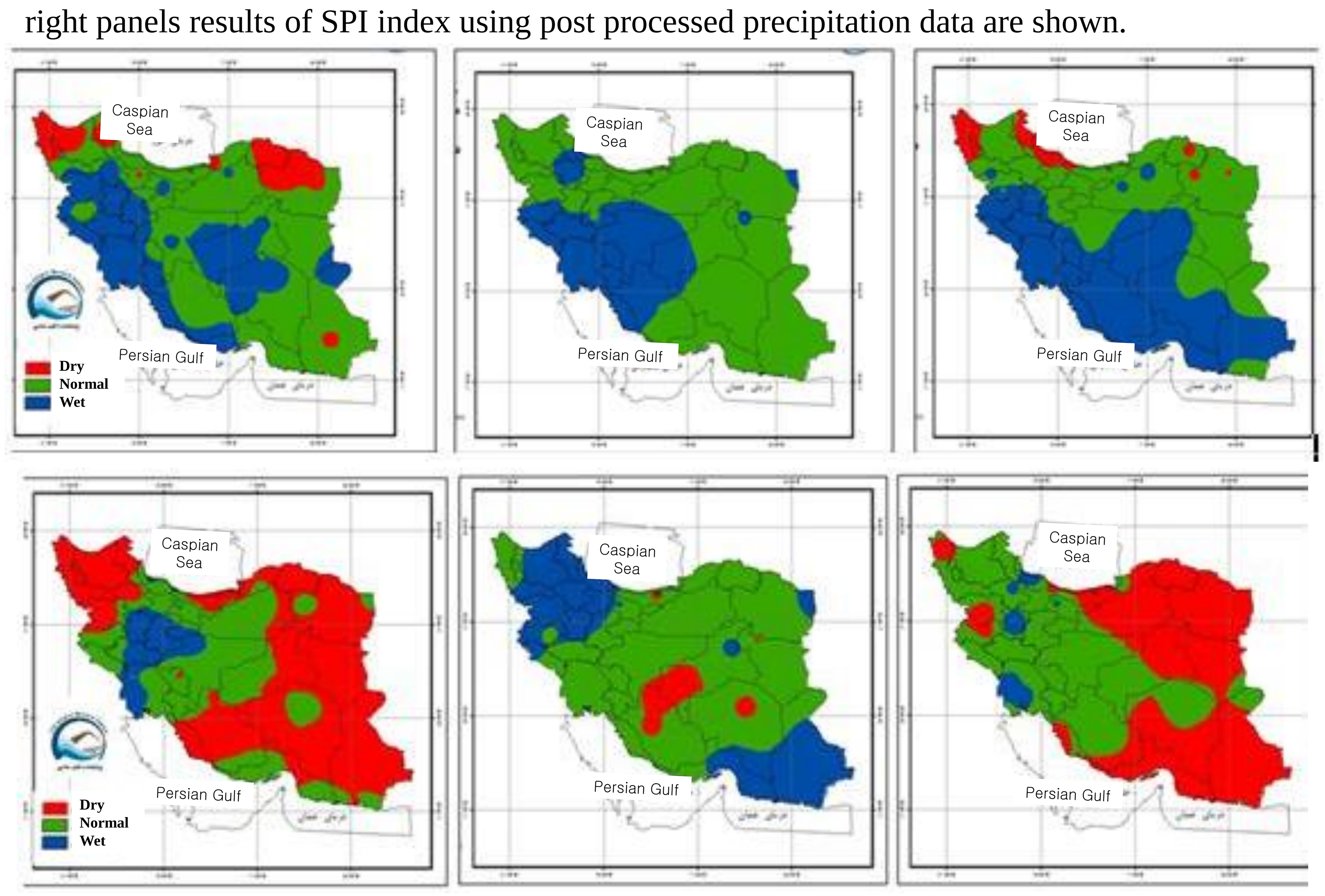


Figure 2. Drought Outlook and Early-earning System(DOES) results for two dry and wet months of August (up) and February(bellow) using post processing of MRI-CGCM3 outputs. Left panel: observed SPI, Middle panel: non-post processed SPI and right panel: post processed SPI.

## Summary

Post processing of the model outputs is a substantial need for improving skill of numerical seasonal forecast models. Post processing method used in this research can highly improve the accuracy of drought prediction and early warning. Results showed that capability of model to predict the drought indices has been increased from 66.7% up to 78.5% when using post processing. According to the goals of the GFCS, development of a method for drought early warning system is useful for agriculture and water resource management. This method can be improved by utilizing other GPVs from different dynamical seasonal forecast models.

## Acknowledgement


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## References


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