



Investigation of the relationship between Mediterranean ocean-atmospheric oscillation and drought in Isfahan province

Rabbaneh Roghani¹ and Saeid Soltani²

1- Graduate student, Department of Natural Resources, Isfahan University of Technology

2- Associate professor, Department of Natural Resources, Isfahan University of Technology

r.roghani@na.iut.ac.ir

Abstract

As drought intensity and frequency have increased over recent years in Isfahan province, improving water resources risk management is so essential. Identifying the factors that influence in Isfahan precipitation could progress the water resources risk management. This study is aimed to determine the potential impact of Mediterranean oscillation on drought events of Isfahan province. The correlations between four Mediterranean oscillation indices including: Western Mediterranean Oscillation (WeMO), Mediterranean Circulation Index (MCI), Mediterranean Oscillation-Algiers/Cairo (MOac) and Mediterranean Oscillation-Gibraltar/Israel (MOgi) versus Standard Precipitation Index (SPI) in 3, 6 and 12 months timescale in some synoptic stations in Isfahan for the period of the last 20 years (1989-2008) were analyzed separately. The results showed that Mediterranean oscillations during June are related with droughts in Isfahan non-simultaneously. In seasonal timescale, a significant correlation between WeMO index and spring (April-June) drought was found; and MCI, MOac and MOgi indices are correlated with winter (January-March) drought significantly. Correlation between 6 and 12 months SPI and Mediterranean indices were weak. It seems that the strongest impact of Mediterranean oscillation is received in west and south parts of Isfahan. Since there was a long lag time among Mediterranean oscillation indices and drought periods, Mediterranean oscillation indices could be beneficial for Isfahan drought forecasting and improving water resources risk management. Also, physical mechanism responsible for co-variability of Mediterranean oscillation and Isfahan rainfall are recommended for further study.

Keywords: Ocean-atmospheric oscillation, Mediterranean, Drought, Isfahan, Water Resources Management

1. INTRODUCTION

Water resources management in Isfahan province is so important due to arid and semi-arid climate, population growth and increasing water demand [1]. Drought has incurred the irreversible damages to human society and natural ecosystems of Isfahan [2]. As drought intensity and frequency have increased and climate has changed over recent years in Isfahan [3], drought and rainfall forecasting are so essential. Firstly, the factors that influence Isfahan rainfall must be identified for drought forecasting [4].

The previous studies showed that ocean-atmospheric oscillations are the main forcing factor controlling variability of climate variables [5, 6]; however, some changes in rainfall cannot always be explained by changes these oscillations [4, 7]. The global and regional significant relationships between rainfall and ocean-atmospheric oscillations have been implied by researchers [8-10]. El Niño Southern Oscillation (ENSO), North Atlantic Oscillation (NAO), Pacific Decadal Oscillation (PDO), Arctic oscillation (AO) and Antarctic Oscillation (AAO) were known as the major ocean-atmospheric oscillations [11-14].

Ocean-atmospheric oscillations are usually explained by the seesaw fluctuation of pressure or temperature between two oceanic poles. It means that when the pressure or temperature of one pole increases, it decreases in another pole. Standardized difference pressure between two poles is often used for the quantity of these oscillations [15]. Recently, some oscillations were found at smaller spatial scale, like Mediterranean Sea. Brunetti and et al. (2002) calculated the Mediterranean Circulation Index (MCI) based on Marseille (northwest of Mediterranean) and Jerusalem (southeast of Mediterranean) surface pressure records, and they showed that there was significant relationship between MCI and total precipitation and number of wet days in Italy [16]. Martin-Vide and Lopez-Bustins (2006) defined the Western Mediterranean Oscillation (WeMO). As WeMO was related with Iberian Peninsula rainfall, WeMO was suggested as a useful tool for forecast torrential rainfall events in the north-western zones of the Mediterranean [17].

Recent studies have confirmed the significant relationships between some ocean-atmospheric oscillation indices and rainfall in whole or part of Iran. In General, the results of previous studies showed that there is a negative correlation between the ENSO's index (Southern Oscillation Index, SOI) and rainfall data