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Validation of ERA-Interim Dataset of European Center for Medium-Range Weather Forecasts (ECMWF) in Iran

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INTRODUCTION

Availability of reliable precipitation data with dense and long-term spatial coverage is important in climate change studies, water resource management and drought monitoring. However, observational data are often short-lived, with inappropriate spatial distribution, inadequate data and low density relative to the area under study. Reanalysis products (e.g. ERA-40 and NCEP-NCAR) as surrogate data are increasing applied in the past years. Although they are improving forward, previous studies showed that these products should be objectively evaluated due to their various uncertainties (Gao et al 2013).

In this study, we evaluated the precipitation data from ERA-Interim, the monthly ERA-Interim precipitation data at 0.75°× 0.75° grids as an advanced generation of The European Center for Medium-Range Weather Forecasts (ECMWF) was compared with observational data of 119 stations in the 1991-2010 period over Iran.

DATA AND METHOD

Study Area:

Iran is located between 25° and 40°N and 45° and 60°E and is a mountainous country bordering the Gulf of Oman, the Persian Gulf, and the Caspian Sea (Figure 1). The total area of Iran is 1.648 × 10^6 km2. Overall, sixty percent of Iran is covered by mountains, with the central part of the country consisting of two dry deserts: the Dasht-e-Kavir and the Dasht-e-Lut.

The Alborz range in the north, close to the Caspian Sea, extends in an east–west direction with a maximum elevation of approximately 5000 m. The Zagros Mountains are aligned in a northwest-to-southeast direction and reach a maximum elevation of approximately 3500 m. These two ranges play a significant role in determining the no uniform spatial and temporal distribution of precipitation across the entire country (Javanmard et al., 2010). For instance, the high ranges of the Alborz Mountains in the north and Zagros Mountains in the west inhibit much of the moisture available from adjacent water bodies from reaching the interior of the country. Thus, the interior parts of the country receive much less precipitation.

Most of the interior slopes of the Zagros Mountains experience a rain shadow effect with annual rainfall much less than their western counterparts. More than half of the country receives less than 200mmof precipitation, with some regions That get less than 50mm annually (Alijani et al., 2008).

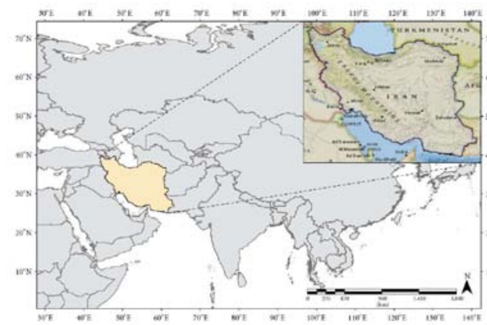

FIG1: The Study area , (Balling Jr., et al 2016)

Observational Data: Monthly precipitation data from 119 stations operated by the Meteorological Organization of Iran are used to compare to the monthly ERA-Interim precipitation throughout the study area. The stations are located within a large range of altitude from -15 m to 2500 m.

ERA-Interim precipitation data : ERA-Interim represents a third generation reanalysis dataset of The European Centre for Medium-Range Weather Forecasts (ECMWF) . The ERA-Interim is built upon a consistent assimilation of an extensive set of observations (typically tens of millions daily) distributed worldwide (from satellite remote sensing, in situ, radio sounding, profilers, etc.). In this study monthly ERA-Interim precipitation data at 0.75°× 0.75° grids is used.

Methods: Because the ERA-Interim precipitation dataset is derived at 0.75°× 0.75° grids, in order to conformity and comparison of observation data with ERA-Interim precipitation in each grid, observation data is also averaged at 0.75°× 0.75° grids. In this way, the average rainfall of stations in each grid is considered as representative of the network.

Figure 2 shows the ERA-Interim network on Iran. The number of stations for the period 1991-2010 in each network is between zero and four mate stations.

-Evaluation Criteria: The root mean square error (RMSE) and the mean absolute error (MAE) and correlation (R) are used for the assessment of precipitation amount, and bias is applied for the evaluation of dry/wet simulation accuracy .

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum_{t=1}^{N}(P_o - P_m)^2},$$

$$\mathrm{MAE} = \frac{1}{N}\sum_{t=1}^{N}|P_o - P_m|,$$

Fig.2. ERA-Interim at 0.75°× 0.75° and station location

Result

Verification scores over period of years 1991-2010 is shown in table 1. Results show The correlations between that the mean yearly precipitation observed and ERA-Interim for more than 57% of grids network in the period of 1991-2010 are (90%-70%) as well as, RMSE and MAE are are high in 20 % of grids network . Positive biases shows the large value of precipitation is predicate by ERA-Interim and near 30% of the model predicts are underestimating.

Table.1. Result of verification

Correlation	>90%	70-90%	50-70%	<50%	Total
	11.86	57.63	25.42	5.08	100.00
RMSE	<5	5-10	10-20	>20	Total
	8.42	42.10	29.47	20	100.00
MAE	<5	5-10	10-20	>20	Total
	8.42	42.10	29.47	20	100.00
Bias	Negative Bias		Positive Bias		Total
	30.39		69.61		100.00

Validation of the precipitation patterns:

In (Fig. 3), The differences between observation data in the winter (DJF) and ERA-Interim precipitation are shown. The ERA-Interim precipitation is generally larger than observation in the most years and positive biases in ERA-Interim are clearly reduced. Slightly overestimating of ERA-Interim occur in spring time (Fig .4). Largest differences between ERA40 and ERA15 occur of course in the tropics where there are also the largest. in ERA-Interim shows large increases of precipitation compared to observation data in summer (Fig .5).During the autumn (SON) shown in(Fig. 6) the dry bias is increased in ERA-Interim. Also, In (Fig. 7) and (Fig. 8), long term seasonal and monthly precipitation are compare together.

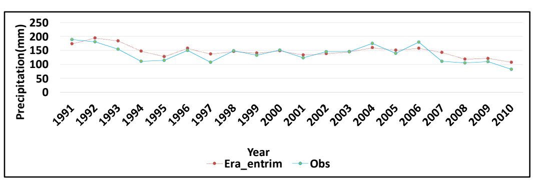

Fig. 3. Time series of Winter precipitation

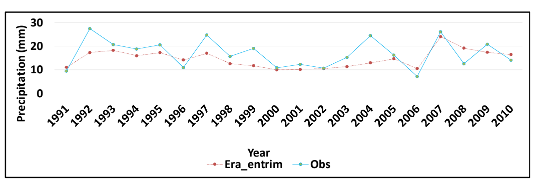

Fig. 5. Time series of Summer precipitation

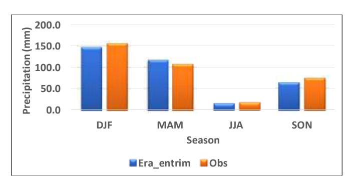

Fig. 7. Long term seasonal precipitation

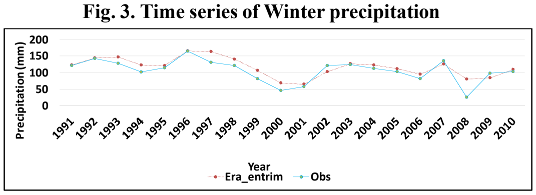

Fig. 4. Time series of Spring precipitation

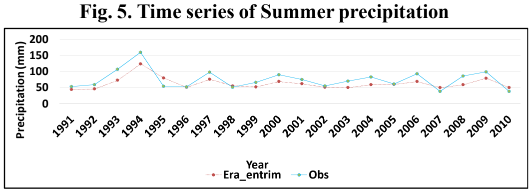

Fig. 6. Time series of Autumn precipitation

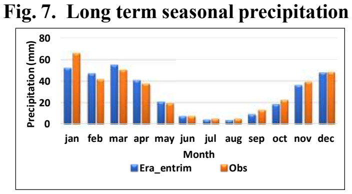

Fig. 8. Long term monthly precipitation

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