Evaluation of WRF Model for Temperature Forecasting and frosting Occurrence in Zayandeh Rud Basin

Mehrdad Nasr Esfahani
PhD Candidate of Climatology, Faculty of Geography and Planning, University of Isfahan, Isfahan, Iran

Hojjatollah Yazdanpanah*
Associate Professor of Natural Geography, Faculty of Geography and Planning, University of Isfahan, Isfahan, Iran

Mohmmad Ali Nasr Esfahani
Assistant Professor of Water Engineering, University of Shahrekord, Iran

Received: 15/06/2018 Accepted: 06/12/2018

Extended abstract

Introduction

Occurrence of weather hazards such as freezing, annually late spring frost can create much damage in agricultural section. Programming and decision making with suitable action can decrease damages resulted from weather hazards. Therefore, it is necessary to consider comprehensive and precision of this phenomenon. Nowadays, use of numerical weather prediction (NWP) models and recognition of weather hazards can prevent such damages.

In the recent years, direct numerical weather prediction models can forecast near surface parameters suffering from systematic errors mainly due to the low resolution of the model topography and inaccuracies in the physical parameterization schemes incorporated in the model. On the other hand, verification is a critical component of the development and use of forecasting systems. The verification should play a major role in monitoring the quality of forecasts, providing feedback to developers and forecasters to help improve forecasts, and provide meaningful information to forecast users to apply in their decision-making processes. The purpose of this study is to evaluate the performance of the WRF model for Temperature Forecast and frosting occurrence in Zayandeh Rud Basin.

Materials and methods

The study area of this research is Zayandeh Rud Basin. This Basin geographical coordinates are at 50° 20´ to 52° 24´ eastern longitude and 31° 12´ to 33° 42´ northern latitude.

In this study, for temperature forecasting, we used weather data from 11 meteorological stations near Zayandeh Rud Basin with 1 Km horizontal resolution via the WRF model for late spring frost. We also used schemes model (KFMYJ and GDMYJ) for simulation. Then, simulated temperatures and the corresponding observed values were evaluated by two methods of point prediction of of 24 and 48 hours of surface temperature (2m). For evaluation of forecast

∗E-mail: h.yazdanpanah@geo.ui.ac.ir Tel: +98 9133638107

models, we employed different indicator functions including Determination coefficient (R^2), Root Mean Square Error (RMSE), Mean Square Error (MSE), Mean Absolute Deviation (MAD), Relative Error (Error), correlation coefficient (R), Mean Bias Error (MBE), Mean Absolute Percentage Error (MAPE), and Mean Square Skill Score(MSSS).

$$RMSE = \sqrt{\frac{\sum_{t=1}^{n}(A_t - F_t)^2}{n}} \quad MSE = \frac{\sum_{t=1}^{n}(A_t - F_t)^2}{n} \quad MBE = \frac{1}{n}\left(\sum_{i=1}^{n} F_i - \sum_{i=1}^{n} A_i\right)$$

$$RE = \frac{\frac{1}{n}\left(\sum_{i=1}^{n} F_i - \sum_{i=1}^{n} A_i\right)}{\sum_{i=1}^{n} A_i} \quad MAD = \frac{\sum_{t=1}^{n}\left|A_t - F_t\right|}{n} \quad MAPE = \frac{\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|}{n} \times 100$$

$$MSSS = 1 - \frac{RMSE_F}{RMSE_A}$$

For the forecasting, A_t ، F_t and n are observed values, forecast values and number of data, respectively.

Results and discussion

According to the results, Root Mean Square Error, Adjusted Rsquare and Mean Bias Error for 24-hours temperature simulation are better than 48 and were about 2.8 , 0.88 and 0.48 respectively. The results of output data for 24 with 48 hours indicated that error of 48 hours forecast data is higher than 24 hours. Acceptable relations from the viewpoint of statistical tests (correlation coefficients and coefficient of determination) are between independent variables (WRF model values) and dependent variable (observed values) that is significant in 5% level.

Substantially, the maps of 850mb in the dates of late spring frost occurrence can find out nature of late spring frost that is in radiation or advection. For instance, existence of cold advection on the maps of 850mb is obvious well. Contour lines and isotherm have almost intersected vertically and has created a strong cold advection. It is worth mentioning that whatever condition of Baroclinic (intersection isotherm by contour with good angle) get better and angle of intersection approach the vertical angle, advection is stronger. The existence of cold advection is obvious. We conclude that occurrence of late spring frost in this paper is mostly advectional motions.

Zoning maps of the used indicators show predictions of 24 and 48 hours. The stations have low level rate of model error. The output of the model is nearly proportional to the stations. This indicates that forecast of surface parameters can imply the topography.

Conclusion

Daily temperature was suitable for forecasting in time scale of 24 and 48 hours. Although 24 hours forecast have high accuracy, the verification scores of model in estimation of quantitative temperature in 24 forecasts are better than 48h forecasts. In addition to accuracy forecast of 2 meters temperature is intense relation in zone topography of the study area. The accuracy of the model can estimate plain areas in mountainous areas. The results of this paper indicate that the WRF model forecasts can be used well for Temperature Forecast and frosting occurrences.

Keywords: Verification, WRF model, horizontal resolution, Temperature Forecast.