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The effect of climate change on agro climate zoning of wheat in Iran

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This study presented first results on a regional climate downscaling exercise which will be used for studying the effects of climate change on wheat phenology and yield in Iran. Local temperature variability which is the important factor for phenology is very well represented in the ERA-40 data set. Coherent large scale structures can be used as predictors to related large scale information from a global climate model to local climate in a statistical sense. The climatic stations with long term data (45 years) in Iran were selected. These stations covered the whole Iran. Quality of the data was assessed visually by plotting all available data and registering obviously erroneous data or change points. Erroneous data were removed from the data set while no data in homogeneities could be identified. Overall the data quality was exceptional good. To fill up the gaps we developed a multivariate regression method for each station and each month based on the three-hourly values. The training data set was that part of the observed record which was complete. For each specific time of the day a multivariate regression was estimated using the remaining 7, 6 or 5 subdaily observations as predictors for the missing datum/data in case those 1 to 3 gaps of the three-hourly data were present. If more than three observations per day were missing, the complete day was considered as missing. This rather strict constraint could be relaxed in future e.g. if only daily averages are to be analysed. Then We turned to ERA-40 reanalyses at 806 grid points covering Iran and parts of the neighbouring countries. Due to the complex orographic structure within Iran and the possible influence of two rather large water bodies (the Persian Gulf to the south and the Caspian Sea to the north) we performed a univariate linear regression between each ERA-40 grid point temperature as predictor and each single station as predictand.

$$T_{obs} = a + bT_{era} + E_i$$

Then the estimated regression coefficient b and the respective squared correlation coefficient are functions of the grid point coordinates and can be presented as maps. They are estimated from the data by minimizing the residual errors E_i. To avoid a contamination from the annual cycle monthly anomalies from the 42 year monthly means for the whole year were considered first. Additionally month specific regressions for February as the coldest month and August as the warmest month were estimated to document the seasonality in the regression based on daily dataset. To estimate the sampling uncertainty of the regression results we used bootstrapping. The sampling uncertainty of the regression results is assessed by analysing the regression coefficients and correlation from the bootstrap sample which has in our case a sample size of 1000. In this research some prediction crop models will be used to predict wheat yield for next 50 years.