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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Spatio-temporal trends in the hydroclimate of Turkey for the last decades based on two reanalysis datasets" *by* Mustafa Gokmen

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The author would like to thank Referee #4 for his/her valuable and constructive comments. We have considered the comments of Referee #4, and hereby try to correspond to them within our knowledge. Based on the comments, we will make the necessary revisions, which will contribute improving the quality of the manuscript. We hope that our replies will satisfy the Referee.

Anonymous Referee #4 Received and published: 23 March 2016 In this manuscript the author studied a regional assessment of the spatiotemporal trends in hydro-climate variables in Turkey by using two sets of reanalysis data. This study is important since it could be useful for impact studies. However, I think the paper requires major revision.

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There are several points that need to be further addressed. My comments are the following: 1. As the other 3 referees mentioned that, the seasonal and even monthly averages should be investigated by the author to treat also seasonal shift that was indicated by Yucel et al. 2014 (page 12, line 4).

Reply of the Author (1): As suggested by the Referee #4 (and the other Reviewers), the spatio-temporal trends in precipitation were analyzed at seasonal scale and the results will be included in the revised manuscript.

Figure1. The presence and the direction of Total Precipitation trends by ERA-Interim for a) Winter, b) Spring, c) Summer and d) Autumn.

Figure2. The magnitudes of the Total Precipitation trends (32-years total) by ERA-Interim for a) Winter, b) Spring, c) Summer and d) Autumn.

Figure3. The presence and the direction of Total Precipitation trends by Interim/Land for a) Winter, b) Spring, c) Summer and d) Autumn.

Figure4. The magnitudes of the Total Precipitation trends by Interim/Land for a) Winter, b) Spring, c) Summer and d) Autumn.

On the other hand, to be selective on including the seasonal analyses of the variables, I assessed the correlations between the variables for both datasets. As the below results reveal, all the hydrological variables (Runoff, SWE and ET over land) are positively correlated with Precipitation for the majority of the study area. Such high correlations also confirm the fact that, land surface models included in Reanalysis datasets (in this case ECMWF) are mainly driven by the atmospheric variables (i.e. Precipitation) rather than land use dynamics (e.g. irrigation). Therefore, I would rather limit the seasonal trend analysis to the Precipitation, as its seasonal trends would also be expressed especially in seasonal trends of Runoff and ET. With respect to Snow Water Equivalent, as the snow accumulation and melting is mostly taking place in Winter and Spring, a separate seasonal analysis of SWE was considered unnecessary.

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Figure5. The correlation between (a) total Precipitation and Runoff, (b) total Precipitation and SWE, (c) total Precipitation and ET for Interim/Land dataset.

2. Author should provide the map of 249 meteorological stations distributed over the country. The difference between observational and reanalysis data should be investigated in a more systematic manner. For example, author could have explained the main reason behind the statement that the overall increase of air temperature was relatively higher in the lowlands compared to the high mountainous regions.

Reply of the Author (2): Thanks to the temperature data provided by Dr. Faize Saris from Canakkale 18 Mart University, the comparison could be extended to around 100 stations distributed over the country. The revised Figure (attached Fig.6) presents an overlaid comparison of the significance and magnitude of the temperature trends by the ERA-Interim and meteo-stations. With the availability of more stations data, Figure 3 (in the manuscript) was also revised to compare the observational and reanalysis data in a more systematic manner. In the revised Fig. 3a (attached Fig.7a), the average yearly temperature of all stations was compared to the yearly average reanalysis data at the same station locations for the study period. While in the revised Figure 3b (attached Fig.7b), the total 32-years increase of temperatures indicated by meteo-stations and Reanalysis were compared for different elevations. While the attached Fig.6 reveals a general confirmation of the increasing temperature trends in terms of significance and magnitude in the overall country (except the very eastern part), the revised Figure 3 (attached Fig.7a) generally reveals a systematically higher average temperatures and total increasing trends by the meteo-stations compared to Reanalysis data. The systematically higher yearly average temperature by the stations can generally be attributed to the intrinsic problems of point-based vs. grid comparisons: the meteo-station measurements not only represent the local environment (compared to the 80 km resolution original Reanalysis data), they are also usually located in the lower altitudes around the cities due to ease of maintenance. Therefore, for a particular grid, it can be expected that the point measurement of temperature by the station is

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systematically higher than the overall average of the grid represented by the Reanalysis data. In addition, the growth of urban areas and the related urban heating effect possibly explains the higher increasing trend of temperature indicated by the meteo-stations compared to the Reanalysis data.

Figure6. The comparison of the (a) presence of the significant Air Temperature trends and (b) the magnitudes of 32-years total Air Temperature trends between the ERA-Interim dataset and the meteo-stations. In Figure (a) upward triangles/circles indicate the presence/absence of increasing trends, while the colors indicate the degree of the significance.

Figure7 a) The comparison of the average yearly temperature between the (all) stations and the corresponding grids from the ERA-Interim dataset for the study period, b) The comparison of the total 32-years increase of temperatures by meteo-stations and ERA-Interim with respect to elevation.

3. I suggest that author discuss the result presented in Figure 2a properly, especially for minor region at the very Eastern border of the country. What could be the reason of this result?

Reply of the Author (3): That is the non-significant increase of temperature area in the very Eastern border of the country. Several reasons could be contributing for such a result: The average height corresponding to this area is about 1850 m.a.s.l. (the average of whole country is 1140 m), which is relatively high altitude region of the country with complex topography. Therefore, the region has relatively intense terrestrial climate with shorter summers and longer & harsher winters. As shown in the satellite image (attached Fig.8), the snow also stays longer on the land. Considering that there has not been considerable change in the snow dynamics for the region during the study period (Figures 6a and 6b in the manuscript), albedo effect could play a role for relatively less amount of increase in the temperature.

Figure8. True color Terra-Modis satellite image on a clear-sky day (April 1, 2016;

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source: worldview.earthdata.nasa.gov)

Besides, the region has also significantly less population density in the country, with even considerable population migration to the other regions. So direct urban/land use change contribution to the temperature increase can be less effective. Lastly, the differences in the regional climate system due to the different controlling factors (e.g. the differences in the effective pressure systems, topography, etc) can play a role.

Figure9. Population density map of Turkey based on 2011 data (source. www.eba.gov.tr)

4. I think there are problems in figure captions. b) and c) should be interchanged in Figure 4, Figure 6, Figure 7 and Figure 8.

Reply of the Author (4): The Figure captions will be checked and corrected in the revised manuscript.

5. Unit of variable (mm) should be indicated in Figure 5.

Reply of the Author (5): The unit of variables will be indicated in the revised manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-23, 2016.

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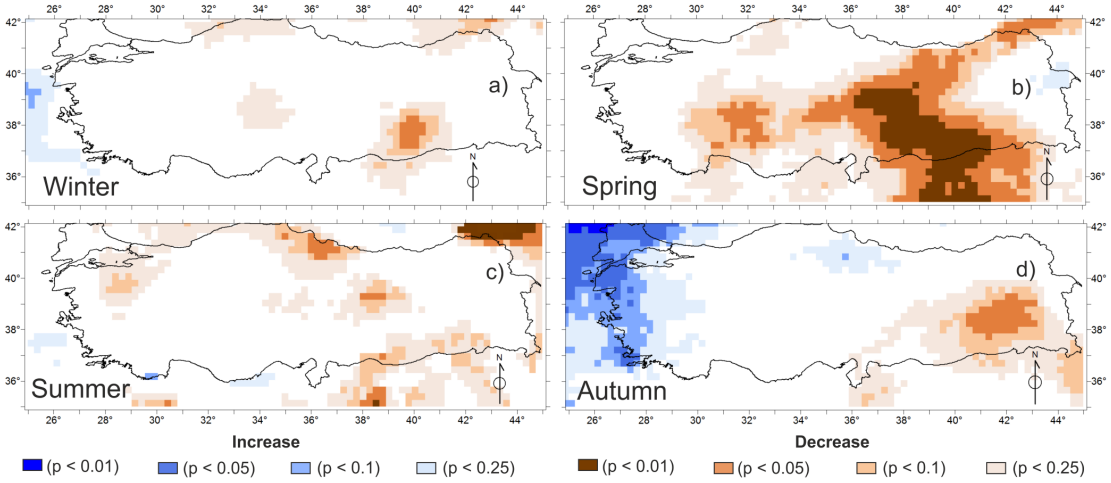

Fig. 1. The presence and the direction of Total Precipitation trends by ERA-Interim for a) Winter, b) Spring, c) Summer and d) Autumn

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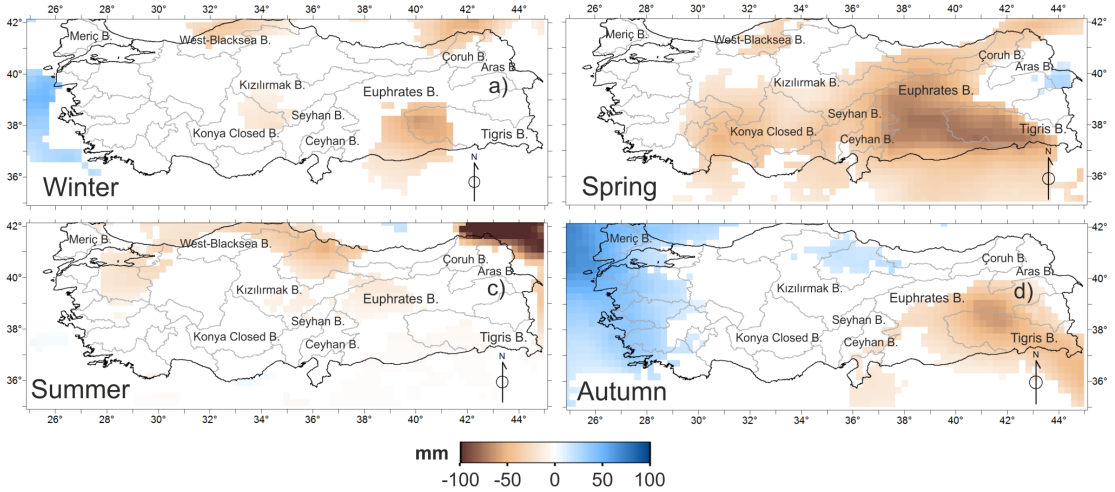

Fig. 2. The magnitudes of the Total Precipitation trends (32-years total) by ERA-Interim for a) Winter, b) Spring, c) Summer and d) Autumn

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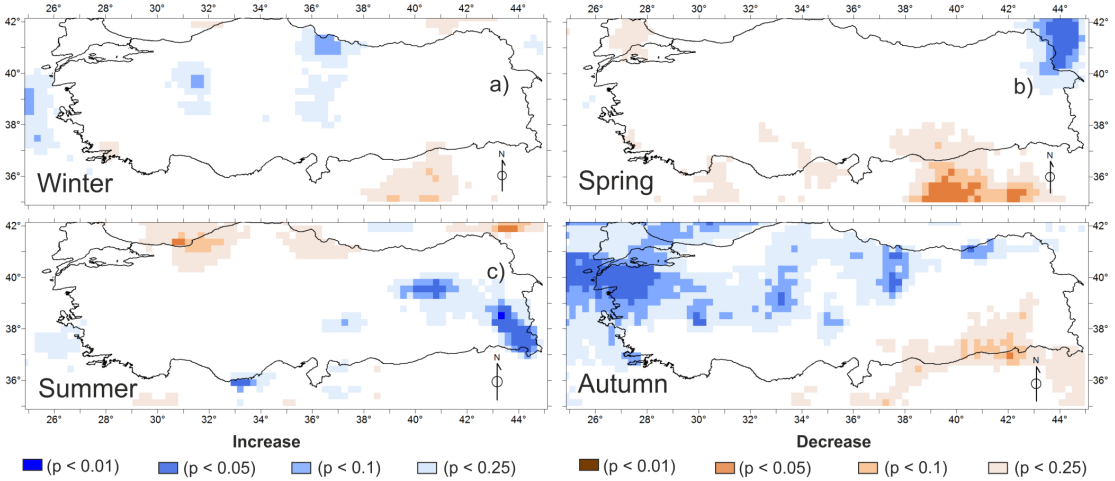

Fig. 3. The presence and the direction of Total Precipitation trends by InterimLand for a) Winter, b) Spring, c) Summer and d) Autumn

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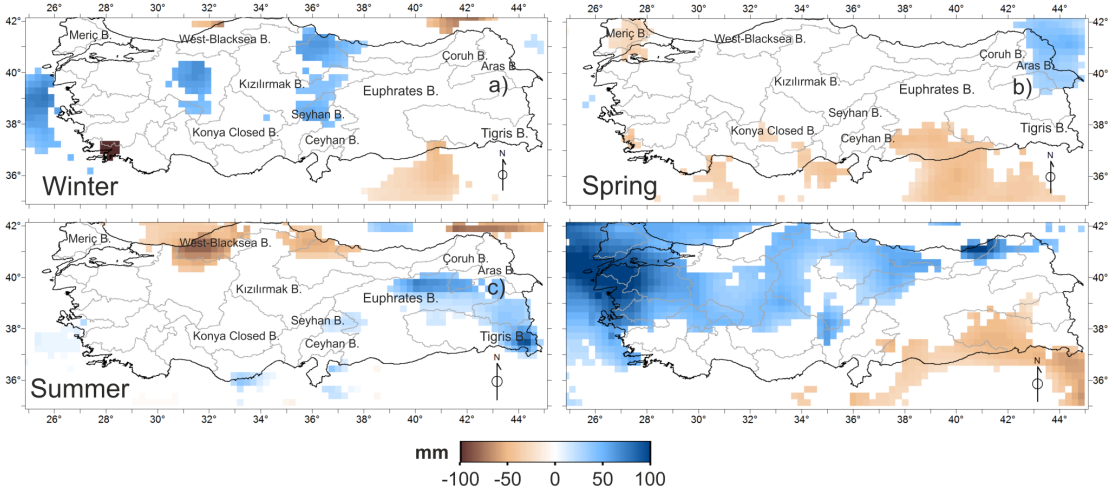

Fig. 4. The magnitudes of the Total Precipitation trends (32-years total) by InterimLand for a) Winter, b) Spring, c) Summer and d) Autumn)

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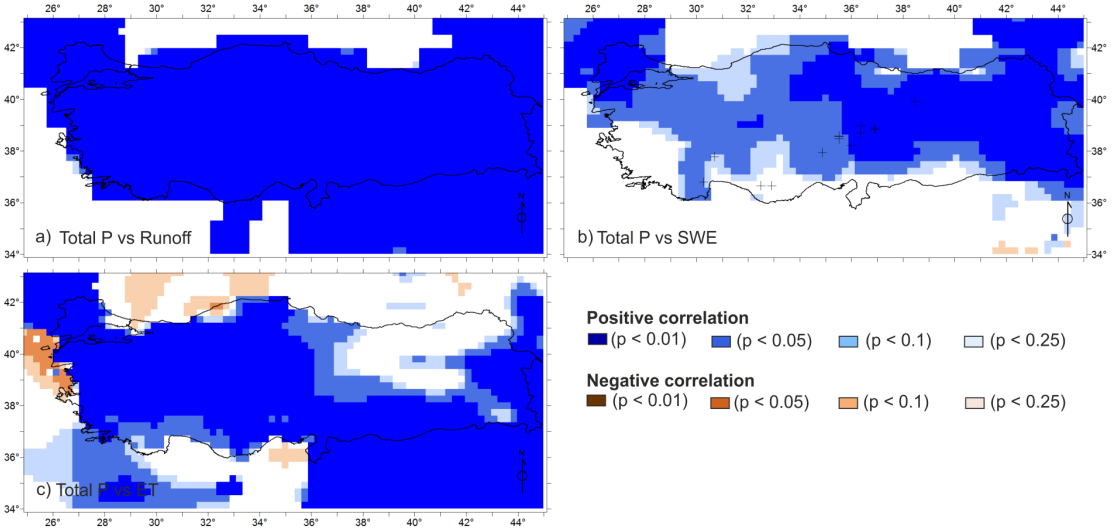

Fig. 5. The correlation between (a) total Precipitation and Runoff, (b) total Precipitation and SWE, (c) total Precipitation and ET for InterimLand dataset

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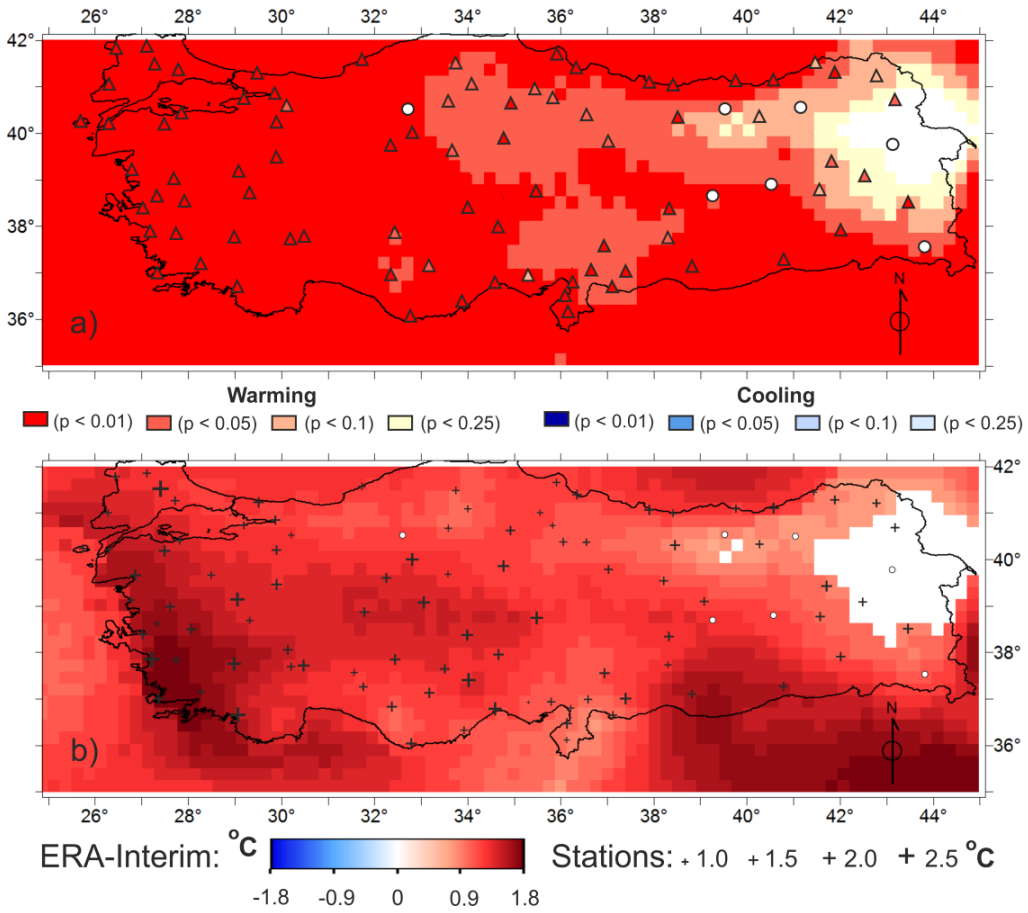

Fig. 6. The comparison of the (a) presence of the significant Air Temperature trends and (b) the magnitudes of 32-years total Air Temperature trends between the ERA-I dataset and the meteo-stations

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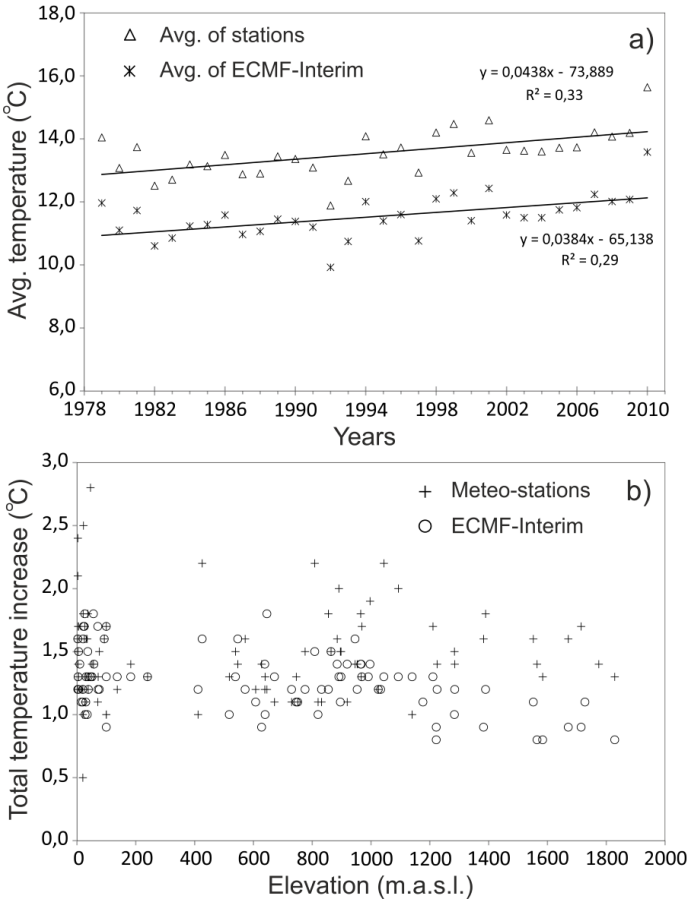

Fig. 7. Comparison of avg yearly T between the (all) stations and the corresponding grids from ERA-I for the study period b) The comparison of the total 32-years increase of T by stations and ERA-I

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Fig. 8. True color Terra-Modis satellite image on a clear-sky day (April 1, 2016 source world-view.earthdata.nasa.gov)

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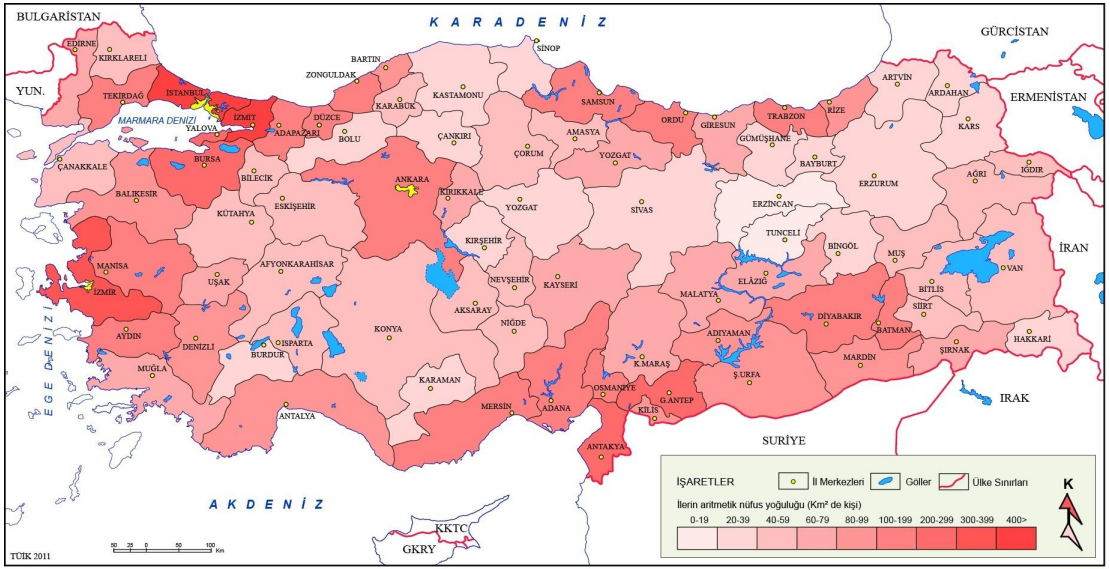

TÜRKİYE'NİN NÜFUS YOĞUNLUĞU HARİTASI

Fig. 9. Population density map of Turkey based on 2011 data (source. www.eba.gov.tr)

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