

INFLUENCE OF NAO, SCA, EA/WR, POL CIRCULATION PATTERNS ON MONTHLY MEAN MAXIMUM TEMPERATURE IN POLAND

Mariusz Zieliński

Department of Meteorology and Climatology, University of Lodz (contact: mariusz.r.zielinski@gmail.com)

1. Introduction

An increasing interest in climate and its contemporary changes has been seen recently. As the atmospheric circulation and its influence on climate in different regions of the Earth play a vital role in climate system, the connections between different elements of climate belong to one of the most intensively studied problem.

The aim of this study is to investigate how strong is the connection between four circulation patterns of Northern Hemisphere and the monthly mean maximum temperature (hereafter TMAX) in Poland.

2. Data and methods

Data used in this study are the 56-year (1951-2006) time series of TMAX from 18 meteorological stations located in Poland (Fig.1). The second data set include values of four indices: North Atlantic Oscillation (NAO), Scandinavia Pattern (SCA), East Atlantic/Western Russia (EA/WR) and Polar Eurasian Pattern (POL).

Following methods are used:

- The simple and multiple regression coefficients between the monthly values of TMAX and each of mentioned above teleconnection patterns were calculated for each month.
- Correlation coefficients (R) and their square determination coefficients (R^2) were calculated for both simple and multiple regression models.
- The statistical significance (at $\alpha=0.05$) of regression models was investigated with the F statistic.
- Moreover a few different measures were calculated: root mean square error (RMSE) as well as "index of agreement" (d) proposed by Willmot (1981).



Fig. 1 Location of analyzed meteorological stations in Poland.

3. Results

- During the winter NAO (Fig. 2a) significantly affects TMAX - positive correlation as well as SCA (Fig. 2b) - negative correlation.
- In the summer the greatest influence on TMAX has POL (Fig. 2d) and the NAO.
- The SCA significantly correlates with spring TMAX while the POL with temperature in November.

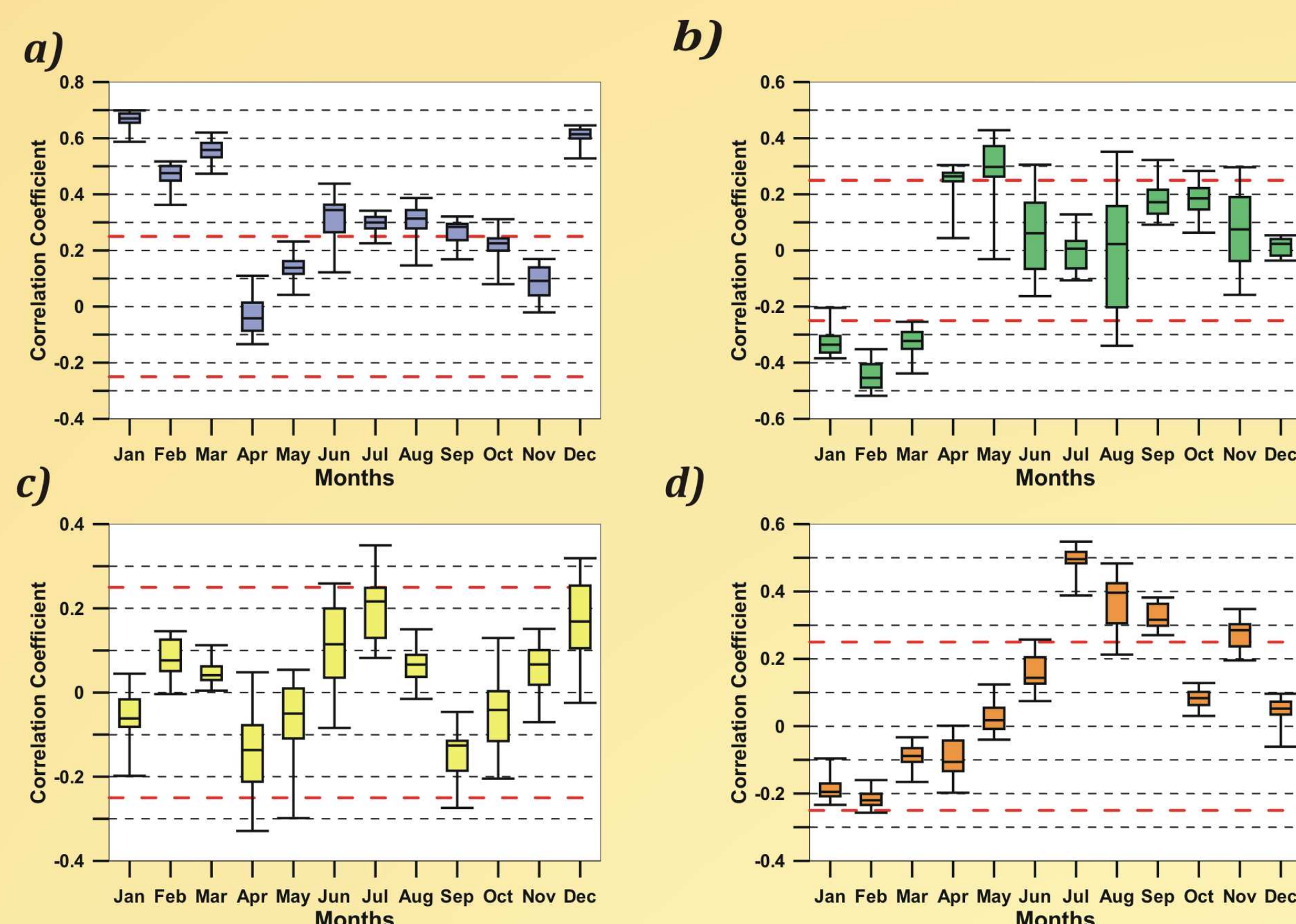


Fig. 2 Correlation coefficients of TMAX and a) NAO, b) SCA, c) EA/WR, d) POL patterns. Red dotted lines indicate the statistical significance of correlations at $\alpha=0.05$.

- The least importance to TMAX variation has EA/WR (Fig. 2c) since significant correlations occur only in certain locations in a few months.
- Determination coefficient of the multiple regression models and index of agreement (d) (Fig. 3) highlight that the influence of the investigated circulation patterns on TMAX is not uniform across Poland.
- Northeastern Poland is the most susceptible to circulatory impacts.
- In the southeast only in winter strong influence of considered teleconnection patterns can be seen.
- During the transitional seasons R^2 and d reach the lowest values what is consistent with other studies suggesting, that meridional circulation is more vital to temperature in Poland in those parts of the year (Degirmendžić et al., 2004).
- Standard deviation (Fig. 4a) of the observed TMAX values indicates that the temperature variation in winter is greater than in the other seasons.
- The comparison of RMSE of the simple regression models (Fig. 4c-f) and multiple regression model (Fig. 4b) with standard deviation shows that RMSE reaches the highest values in winter when the TMAX variation is the greatest.
- The RMSE of the multiple regression as well as the simple regression confirms

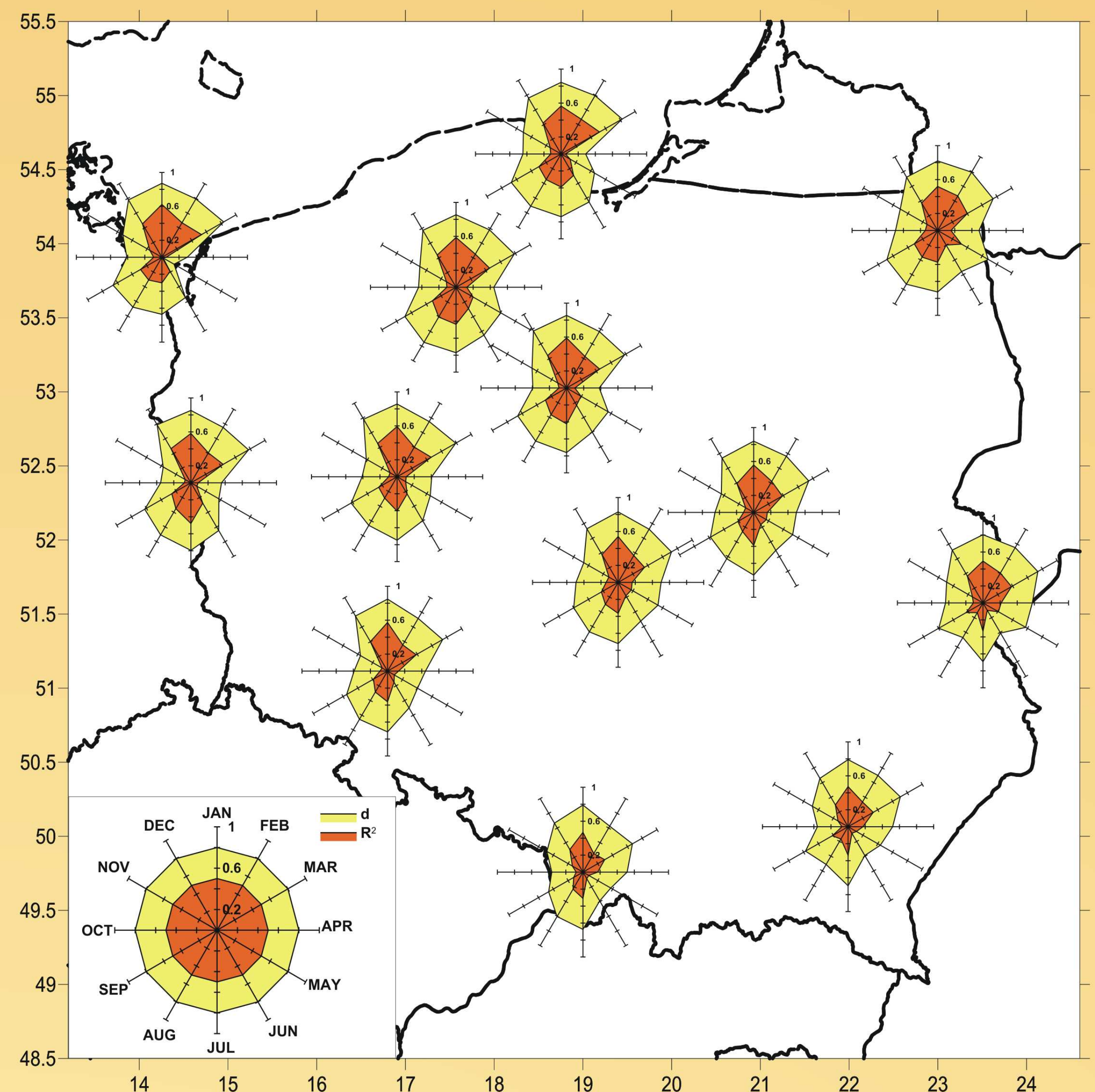


Fig. 3 The determination coefficient (R^2) and index of agreement (d) for multiple regression on chosen stations.

results mentioned before.

- In case of the EA/WR the RMSE distinctly follows the course of the standard deviation what indicates that this pattern has no significant influence on TMAX in Poland.

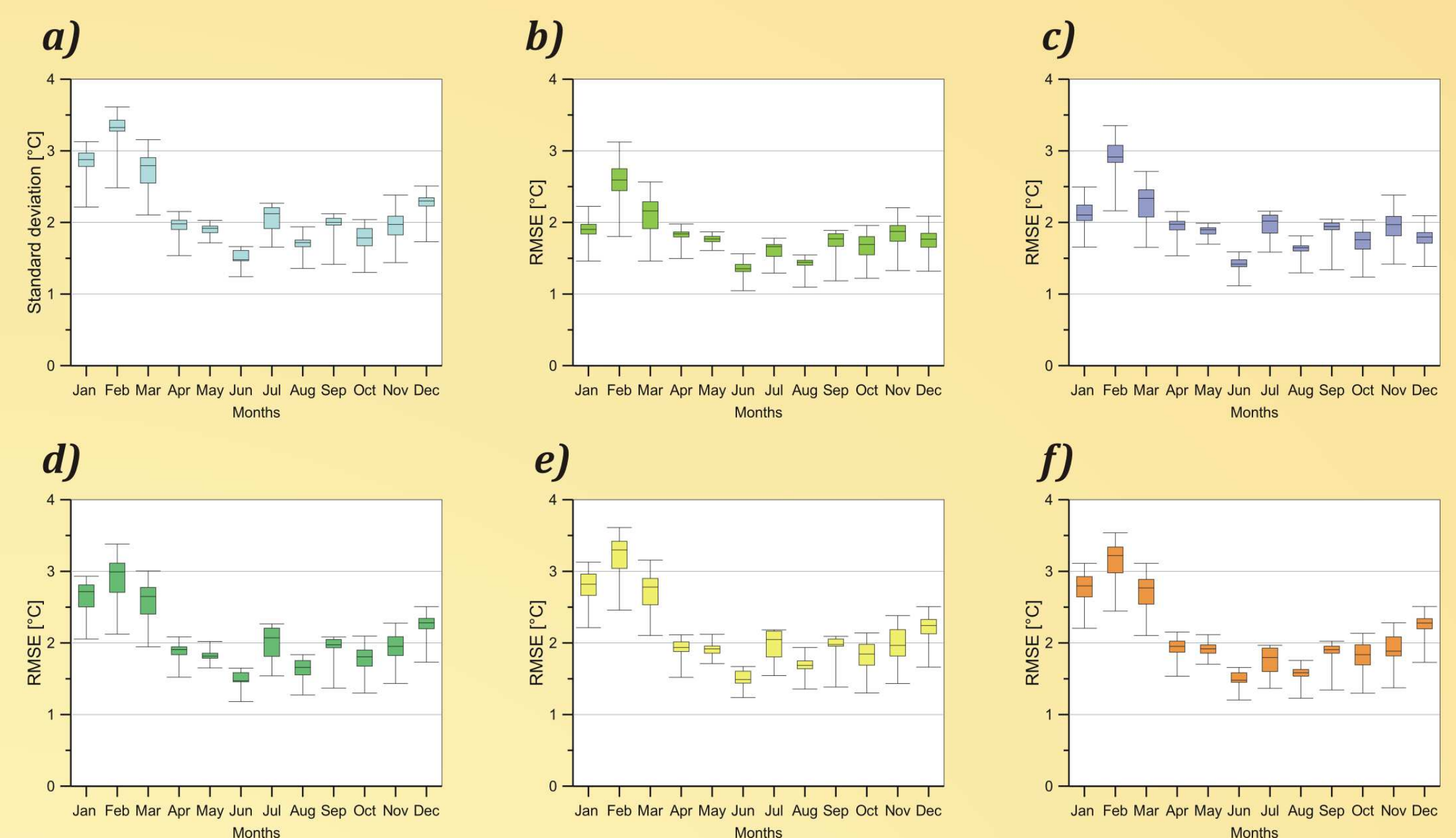


Fig. 4. The standard deviation of observed values of maximum temperature (a), the RMSE of multiple (b) and simple linear regression model with NAO (c), EA/WR (d), SCA (e), POL (f).

4. Conclusions

- This study shows that not only the NAO vitally determine monthly average maximum temperature in Poland. The SCA and the POL are also important factors of observed TMAX variation.
- In the winter especially in January the circulatory impacts are the strongest during the year. The enhance of zonal circulation influence on temperature (Kozuchowski, 2003) is visible in the summer (significant correlations of TMAX with NAO and POL).
- The western and northwestern part of Poland is more vulnerable to circulatory impacts than the rest of the country.

References

- Degirmendžić J., Kozuchowski K., Żmudzka E., 2004: Changes of air temperature and precipitation in Poland in the period 1951-2000 and their relationship to atmospheric circulation. *Int. J. Climatol.*, 24: 291-310.
- Kozuchowski K., 2003: Circulatory factors of climate of Poland. *Czas. Geogr.*, 74(1-2): 93-105, (In Polish).
- Willmott, C.J., 1981: On the validation of models. *Phys. Geogr.*, 2: 184-194.