

Streszczenie w języku angielskim

Time series of meteorological elements that have been recorded for a couple of decades, are used in a variety of human activities. Such data are used, between others, for the physical description and modeling of processes taking place in the atmosphere. They are likewise applied to creating forecast of analyzed variables. The time series analysis is based on the exploration of the nature of phenomenon represented by the sequence of observations and enables forecasting of still unregistered values of time series. Furthermore, the models of dynamics for specific weather quantities are developed on the basis of such an analysis. Thanks to the development of the methodology, time series prediction tools and due to the onward progress of computing capabilities, in a large number of science centers the research on creating the most detailed model, enabling time series forecast, is conducted with various weather quantities. As the developed models are using historical data, thus it is crucial to specify spatial dynamics of meteorological processes with the use of all available sources of data including time series coming from ground-based stations as well as those derived from the reanalysis.

In the herein thesis, the usefulness of the model created by the author, combining the TBATS method of exponential smoothing with the SVM method of machine learning, has been showed. The developed model has been applied to circumscribe the forecast of the minimum and the maximum values of the temperature. In the research several combinations of parameters of this model and several dozens of meteorological quantities sets, comprising the input data for the SVM model, have been tested in order to find the mixed model SVM/TBATS with the highest predictive power score. Due to the high achieved predictive power it can be applied to fulfill the gaps in time series of the studied meteorological elements. In order to assess the possibility of applying the results of the created model into practice, six-year time series of the forecasted minimum and maximum values of the temperature, obtained with the SVM/TBATS mixed model, have been used to forecast yields. It has been decided to apply two models for the plant growth and yield: DNDC and WOFOST that are well-circumscribed in several literature reports and tested in varied climatic conditions. The results of yield modeling for four locations out of various climatic zones, received for generated series, have been compared with those calculated on the basis of time series of measured temperatures. The obtained magnitudes have not differed significantly and the differences of the calculated yields have not been greater than 10 per cent, regardless of the applied model.

Furthermore, in the thesis the comparative analysis of time series of meteorological elements from retrospective data and ground data has been conducted. The comparison has aimed at researching if ground data, sometimes barely accessible and dispersed, can be substituted in various applications with data derived from database that integrates measurements from different sources, including ground and satellite ones. Integrated data of this type are much more easily accessible and are usually generated for a regular grid. For the comparison, two databases have been selected – a database from the ground synoptic stations of the Institute of Meteorology and Water Management (IMGW-PIB) and the retrospective data coming from the MERRA-2 system. The comparative analysis of the meteorological time series values of the retrospective data from MERRA-2 and the ground-based IMGW-PIB data for the territory of Poland was not limited only to the use of standard methods of statistical analysis, such as correlation analysis. Additionally, a comparative analysis of meteorological time series was performed using the Multifractal Detrended Fluctuation Analysis (MF-DFA) method, which allowed to determine the dynamics of weather processes. Changes in the values of multifractal parameters may reflect sudden drops or increases in temperature not previously encountered in some climatic zones. Moreover, information upon which areas of Poland are exposed to extreme weather events and in which areas strongly correlated processes prevail, has been obtained. The obtained maps of multifractal parameters comprise a valuable source of knowledge about the climate dynamics in certain regions of Poland. Spatial variability of the analyzed parameters has been verified by geostatistical analyzes. The abovementioned analyzes provide information about the spatial structure of variability in tested quantities. The conducted comparison implies that time series of basic meteorological quantities coming from the MERRA-2 system can be effectively applied, since not only their values approach those recorded in ground measurements, but also their dynamics and the inherent structure of the long-range correlations are really similar.

keywords: modeling of agrophysical processes, forecasting, meteorological parameters, time series, MERRA-2, IMGW-PIB.