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Review Article

SUITABILITY OF NEURAL NETWORK FOR WEATHER FORECASTING: A COMPREHENSIVE LITERATURE REVIEW

Vertika Shrivastava., *Sanjeev Karmakar and Sunita Soni

Department Computer of Application, Bhilai Institute of Technology Durg, Chhattisgarh India

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ABSTRACT

Forecasting of Weather is a complex and challenging task for a scientist. It is almost complicated due to chaos behavior of climatic data. However, since 1986 neural network based numerical modeling for the same is suggested by the world's scientific community and shown some extent of success. In this study, a comprehensive review of various contributions from 1997 to 2017. Wherein models of various contribution is studied year wise. As a result, soft-computing i.e., neural network, deep learning technique, data mining such as associative classifier has been found to be successfully applied. Finally, it is concluded that BPN is sufficient enough to resolve this complex problem. It has shown 90% accuracy in modeling. However, obtaining optimum architecture for better performance is a pre-requisite. These evidences are broadly discussed in this review article.

INTRODUCTION

Accurate and ideal forecasting of weather data through modeling has been challenging for scientists along with engineers since decades and centuries. The mathematical modeling and computation play significant role to overcome this challenge. Different techniques have been working, with various enhancements to get accurate diagnosis. Though, the diagnosis is difficult due to presence of complex nonlinear relationships dependent and independent parameters of this data set. And also, this data set is representing chaotic in nature. From 1986, Artificial Neural Networks (ANNs) has developed as a powerful computing system for extremely complex and non-linear systems (chaos) such as climate, runoff etc. ANNs belongs to the black box time series models and offers a relatively flexible and quick means of modeling. The architecture of ANNs is utilized in non-linear system. It is found that the architecture of ANNs is dependent on the problem space. The aim of this study is to be categorized ANNs in weather forecasting and their applicability without any scientific controversy. For the objectives of this study are to identify all methods including ANNs for weather forecasting up to till date and their performances and evaluate the performance of ANNs. These objectives are considered via comprehensive review of literature from 1997-2017. It is found that, several methods are used including ANNs. Although, ANNs are found suitable without any controversy. However, detail of discussion concerning the architecture of ANN for the same is rarely visible in the literature; while various applications of ANN are available. In this study the review of these contributions is accomplished. And tried to identify that neural network is sufficiently suitable for modeling of chaotic data sets. Since weather data sets is also an illustration of chaotic nature thus various contributions was reviewed to identification of suitability of neural network for forecasting of weather. This paper has been constructed with the sections. The comprehensive review of world-wide contribution from 1997 to 2017. Neural network techniques for climatic data are unquestionably accepted and no scientific disagreements are discussed. A Table of different Modelling Techniques and finally conclusions of the study are described.

Comprehensive Literature Review

The significant and north worthy contributions in the field of weather forecasting from 1997 to 2017 are reviewed and identified fundamental with their vital methodologies. The major contributions are discussed in this section. The primary objective of this research is to develop a model for weather forecasting using Neural Network. In the initial years of 1997 Zhang *et al*, stated that ANN can be very promising tool for

Corresponding author:* **Sanjeev Karmakar
Department Computer of Application, Bhilai Institute of Technology Durg, Chhattisgarh India

understanding nonlinear and non-stationary process. In 1997 Mendel and Mouzouris analyzed that SVD-QR method is a very powerful method that allows us to design highly accurate and parsimonious FLS's. It was found that these training methods can be extended to design and train non-singleton FLS's.

In the year 1998 Albers J.D. *et al*. (1998) found that as the numbers of degrees of freedom are increased, the probability of chaos approaches unity given a system that is sufficiently nonlinear and the Result is general. In 1998 Franses H.P showed the potential usefulness of artificial neural networks for technical trading rules to forecast daily exchange-rate data. Hence, the recently documented poor performance of ANNs may be owing to the inclusion of inappropriate explanatory variables. Dawson & Wilby (1998) found that ANNs are like conventional hydrological models in that different attributes of the hydrograph are simulated to varying degrees of success (of Sorooshian, 1991). The optimization criteria used here (MSRE) is unbiased, whereas an in statistic or the RMSE would have simulated peaks better than low flows.

In the year 1999 Palmer, N.T (1999) said that ensemble forecasts as input to a simple decision-model analysis, it is shown that probability forecasts of weather and climate have greater potential economic value than corresponding single deterministic forecasts with uncertain accuracy.

In the year 2000 Maier & Dandy stated that ANNs are being used increasingly for the prediction and forecasting of a number of water resources variables, including rainfall, flow, water level and various water quality parameters. But the modelling of ANN is poorly described. Takagi.H (2000) introduces the two-new patent using NN+FS the Soft computing techniques.

In the year 2001 Sivapragasam *et al*, found that SVM has higher prediction accuracy of hydrologic variables than that of the non-linear prediction (NLP) method.SSA-SVM results in a significant improvement in the case study on Singapore rainfall prediction with a correlation coefficient of 0.70 as opposed to 0.51 obtained by NLP. Zhang, (2001) propose that the linear ARIMA model and the nonlinear ANN model are used jointly, aiming to capture different forms of relationship in the time series data. It has been proposed that the combination method can be an e5ective way to improve forecasting performance.

In the year 2002 Taylor & Buizza (2002) concluded that there is strong potential for the use of weather collective predictions in NN load forecasting. Meek *et al*, (2002) discussed the one of the most important aspect of modeling time series is handling seasonality in data. Seasonality can be handled using ART models by explicitly allowing or including relevant regressor variables in the linear regressions at the leaves.

In the year 2003 Kokkinos *et al*, concluded that nonlinear models of the speech production system have been presented, that are constructed on the reconstructed attractor of speech signals. Temeyer *et al*, (2003) stated that although the nonlinear models usually performed best, for some parameters at some times, the linear models were better.

In the year 2004 Maqsood *et al*, found that Neural-networks-based ensemble models were established and applied for hourly weather forecasting of southern Saskatchewan. The experimental results show that the ensemble networks can be trained effectively without excessively compromising the performance.

In the year 2005 Rao *et al*, concluded that by using neural network ensembles there will be considerable improvement in the classification of the remote sensed images. We can also study various methods and have an idea to ensure the error diversity among neural networks in an ensemble. Asefa. *et al*, (2005) presented the promising performances of Support Vector Machine. Onwubolu *et al*, (2005) experiments result indicate that that the proposed approach is useful for data mining technique for forecasting weather data. Lekkas.F (2005) presented that in real-time applications, like flow regulation and flood forecasting where the precision and modeling speed are crucial, black box models and signal processing techniques need to be implemented.

In the year 2006 SomvanshiK *et al*, predicted that the ANN is more appropriate ten AIRMA model in long term prediction. Leng *et al*, (2006) evident that the GA-based pruning method, as a global search tool, is superior to the OBS-based pruning method to identify the significance of the existing EBF neurons. Gooijer *et al*. (2006) Reviewed the progress on time series forecasting.

In the early 2007 Hayati & Mohebi stated that the forecasting reliability was evaluated by computing the mean absolute error between the exact and predicted value. Kumar N.D (2007) predicted that ANNs are suitable for the seasonal Rainfall Prediction. Joorabchi.A *et al* (2007) concluded that feed-forward Back-propagation learning algorithm can predict flood events very accurately. Krasnopolskya M.V (2007) established a new enhanced NN emulation approach called a compound parameterization, which integrates NN-based quality control techniques for controlling larger errors of NN emulations .Marcellino.M (2007) concluded that in general linear time series models can be hardly beaten if they are carefully specified and therefore still provide a good benchmark for theoretical models of growth and inflation .Kannan *et al*. (2007) originated that rainfall time series may be unfounded. The monsoon-rainfall data series is highly complex the role that multiple linear regressions might play in this topic is one for future research.

In the year Ni.X (2008) found that neural network is suitable for solving data mining problem and it will improve the efficiency of data mining methods. Ingsrisawang *et al*, found that machine learning techniques are suitable for prediction of rainfall in same day period. Choudhary & Garg. (2008) proposed that a hybrid GA-SVM system for predicting the future direction of stock prices. Qi & Zhang, (2008) found that the most effective way to model and forecast trend time series with NNs, a recent popular nonlinear modeling tool. Mutlu *et al*, (2008) found the comparison the ANN models to forecast daily flows at multiple gauging stations in the Eucha watershed in north-west [33].

In the year 2009 Radhika & Shashi found that Support Vector Machine perform better than Machine Learning Process for Weather Prediction. De.S (2009) found that the Artificial Neural Network has been found to produce a forecast with

small prediction error. Solaimani.K(2009) stated that predictability is possible in artificial neural network environment. Awad *et al*, (2009), proposed a new modified approach is presented to predict chaotic time series. The proposed algorithm of clustering particularly suited for function approximation problems. Mitrea *et al*, concluded that in a time series forecasting, best result is obtained using a NARX NN. In the NN approach the use of each item in order to increase forecasting accuracy gives the best results. Also, the inventory management can be improved for a better efficiency. Radhika & Shashi (2009) presented that an application of support vector regression for atmospheric temperature prediction. The performance of SVM was equated with MLP for different orders. The results obtained show that SVM performs better than MLP trained with back propagation algorithm for all orders. Hung,Q.N said that an Artificial Neural Network model was working to forecast rainfall for Bangkok, Thailand, with lead times of 1 to 6 h.

In the year 2010 Baboo & Shereef (2010) found that Back propagation neural network approach for temperature forecasting is capable of giving good results and can be considered as a substitute to traditional meteorological approaches. Vamsidhar.E *et al*, (2010) has found that back propagation neural network was acceptably accurate and can be used for predicting the rainfall. Peralta.J (2010) found that in future the use of "cross validation" into the GA for a better evaluation of each individual; using sparsely connected ANN to try to improve the forecast to obtain an accurate system. ZeLin *et al*, (2010) stated that ANNs are a useful tool for classification, modeling, and forecasting global climate change and ecological research, and their applications are growing.

In the year 2011 Baboo & Shereef found that back propagation neural network is used for predicting the temperature based on the training set provided to the neural network. Bisht & Jangid (2011) suggests that ANFIS methodology is highly successful in the simulation and forecasting of the stage-discharge process. El-Shafie *et al*, (2011) has found that ANN has a better performance than an MLR model. Again, the same year 2011 El-shafie *et al*, stated that the artificial neural network method is more suitable to predict runoff than classical regression model MLR. Tripathy *et al*, (2011) found that ANN models have the potential to be useful as a component of weather prediction like humidity, long range rainfall and temperature prediction, so it needs further development and validation. Milanovic & Stamenković (2011) presents a conceptual framework of TSDM, emphasizes the role of data preprocessing, points out to the significance of the similarity search, and reviews segmentation problem in function of dimensionality reduction of time series data. M.Khashei *et al*,(2011) presented time series forecasting is an active research area with applications in a variety of fields. Despite the numerous time series models available, the accuracy of time series forecasting is fundamental to many decision processes and hence, research into ways of improving the effectiveness of forecasting models has never been given up.

Khalili.N *et al* found that the black box model is more capable of predicting the rainfall, it is reasonable to employ the prior information in our rainfall model in the form of a gray box ANN model to improve the prediction performance. Duncan *et al*, found that the results for RAPIDS show that ANNs can provide a very significant speed enhancement over conventional hydraulic simulators without excessive degradation in performance. El-Shafie *et al*, proposed that a feed forward neural network with back propagation algorithm was implemented and tested for the purpose of yearly basis rainfall forecasting. The input data were the change in the yearly rainfall and average temperature. Kaur & Singh concluded that a feed-forward NN model using back-propagation algorithm is developed to identify the minimum temperature. The results show that an appropriate accuracy can be achieved using this network. Shereef & Baboo concluded that back propagation neural network is used for predicting the temperature based on the training set provided to the neural network. Through the implementation of this system, it is illustrated, how an intelligent system can be efficiently integrated with a neural network prediction model to predict the temperature.

In the year 2012 Patil *et al*, stated that the Rainfall Runoff modeling mainly removes the bottle necks presented by current Rainfall runoff modeling, thereby making the overall water consumption scalable. But it presents a larger cost overhead due to advance technology as compared to manual system so cost of product is also affected. Sharma *et al*, (2012) has concluded that as per as technology is developing day by day the need of Artificial Intelligence is increasing because of only parallel processing. Abhishek *et al*, (2012) found the different tools for the prediction of rainfall using ANN. Nayak *et al*, (2012) proposed an improved approach for Weather Forecasting System which is more effective than existing methods. We also designed a complete UML modeling for the Weather Forecasting System. Sumi *et al*, (2012) investigated that the use of several machine learning methods and particularly suggests to employ a hybrid multi-model method coupled with model ranking and selection for improving two rainfall forecasting problems in the Fukuoka city. Abbot & Marohasy. (2012) used the POAMA, technique for rainfall forecasting in Queensland. And in further re-search into the application of artificial neural networks to rainfall forecasting in Queensland is likely to result in a significantly improved seasonal rainfall forecast, and this likelihood has an intrinsic real value. Galavi & Shui (2012) reviewed the ANFIS model's application process in water resources and studies was organized to explain the fundamental actions taken in this technique in a straight forward and practical manner. Olaiya.F (2012) investigates the use of data mining techniques in forecasting maximum temperature, rainfall, evaporation and wind speed. This was carried out using Artificial Neural Network and Decision Tree algorithms and meteorological data collected between 2000 and 2009 from the city of Ibadan, Nigeria. Sarkar & Kumar (2012) presented that study have been able to demonstrate that the ANN models are able to provide a good representation of an event-based rainfall-runoff process. Mittal *et al*, (2012) presented that dual-ANN model to improve the performance of the model in terms of prediction of high flows. Shrivastava *et al*, (2012) concentrates on capabilities of ANN in prediction of several weather phenomenon such as rainfall, temperature, flood and tidal level etc. finally it has been concluded that the major architectures i.e. BPN, RBFN, MLP are sufficiently suitable to predict weather phenomenon. Zhu & Genton stated that information about the global overwhelming development of wind energy as

a clean, renewable resource with its unmatched benefits, as well as big challenges to current power system operations due to the wind's intermittent and unstable nature. Nogay *et al*, found that the selection of the suitable model using ANN implies a process of careful analysis that depends on the characteristics of the problem; for short term wind speed forecasting this technique responds in a satisfactory way to the necessities of precision and accuracy required to support the operators of the Electric Utility Control Centre. Abhishek *et al* implemented the algorithms in matlab. They are-Nntool - open network/data manager. Only back propagation algorithm is implemented in this matlab tool. Agrawal *et al*, concluded that Multilayered Neural Network can be an effective tool in weather prediction. Devi *et al*, showed that that neural networks are useful in forecasting the weather and the working of most powerful prediction algorithm called back propagation algorithm was explained. Olaiya.F founded that C5 decision tree classification algorithm was used to generate decision trees and rules for classifying weather parameters such as maximum temperature, minimum temperature, rainfall, evaporation and wind speed in terms of the month and year.

In the year 2013 Timothy D. Rey, stated that time series data for forecasting, there is certainly the potential for problems with big data given services like TIHS Global Insight that provide access to over 30,000,000-time series. These opportunities call for the use of data mining for forecasting approaches which leads us to using special techniques for variable. Sawale & Gupta discussed the Back Propagation Neural Network and Hopfield Network Model is used for predicting the atmospheric condition based on the training set provided to the neural network. This is the first approach of weather prediction which combines both Back Propagation Network (BPN) and Hopfield Network Model effectively. Kumari *et al*, address the problem of retail forecasting using different data mining techniques. Even though different existing techniques can be used for retail forecasting but back propagation neural network has been found most appropriate technique. In future this tool may bring major benefits in this area. Teja & Vasundra. Predicting program for uni-variant time sequence that utilizes artificial neural networks. These processing devices proved themselves to be feasible options to classic approaches. Samek & Varacha showed the case study of artificial time series prediction using various artificial neural network structures. There has been tested prediction of non-artificial data from the Santa Fe benchmark. The presented simulations showed dependencies of prediction accuracy on the number of values in input vector. Kuril *et al*, originate a new cloud classification method using wavelet transform and RBF neural network has been reported and discussed. The classification rate is relatively high. The research of future work will be Classification by PNN. They believe that the Classification rate will be improved as well as the Computational time will be low and enhanced greatly. Taksande & Mohod presented that the FP Growth Algorithm was used to generate decision trees and rules for classifying weather parameters such as maximum temperature, minimum temperature, rainfall, humidity and wind speed in terms of the month and year. Saxena *et al* presents a survey that using artificial neural network (ANN) approach for weather forecasting yields good results and can be considered as an alternative to traditional metrological approaches. The study describes the capabilities of ANN in predicting several weather phenomenon's such as temperature, thunderstorms, rainfall and concluded that major architecture like BP, MLP are suitable to predict weather phenomenon. Kumar & Jha conclude that Multilayered Neural Network can be an effective tool in weather prediction. This type of Network can correctly provide the mapping between input and the output using historical data. Jimoh *et al*, suggested that application of fuzzy logic is necessary in other domains since the two logic levels cannot solve many of such problems. Ahour *et al*. studied and illustrate that the several errors correlation coefficient, root mean square error (RMSE), normalized mean square errors (NMSE) and mean absolute percentage error (MAPE) based upon ANFIS and ANN results, ultimately the results of two models analyzed and were compared. Bisht *et al* demonstrated that ANN technique gives good results for more number of inputs while for less number of inputs fuzzy technique gives better result. Panigrahi *et al*, stated that fully connected multilayer perceptron model is considered and three methods like ANN-GD, ANN-GA and ANN-DE are used to predict the future values. It is observed that both the evolutionary methods (ANN-GE and ANN-DE) outperform the gradient based method (ANN-GD) for both the time series considered. Chaudhari *et al*, stated that data mining techniques are now the important techniques utilized in all application area related to meteorological data for the prediction and decision making by discovering interesting rules or patterns or groups that indicate the relation. Kapoor & Bedi presented the comparison of weather condition variation using sliding window approach and it has been found to be highly accurate. The results can be altered by changing the size of the window. Accuracy of the unpredictable months can be increased by increasing the window size to one month. Talwar & Kumar indicate that parameter tuning is often more important than the choice of algorithm. Quantitative support is provided to the assertion that some algorithms are more robust than others with respect to parameter configuration. Bhattacharya.M discussed a comprehensive review of applications of various Machine Learning techniques to bioclimatic modelling and broadly to ecological modelling. Charaniya & Dudu stated that rainfall prediction using ANNs has been discussed in the paper. Two different ANNs models found suitable for this task were designed and compared. Rani *et al*, predicated model of neural networks provides us the more kernel functions hybrid procedure for classification and prediction using MLP for initial classification that followed by the single SVM and SVM with SOM. Adeyemo presented the use of soft computing techniques (SOM and CANFIS) for knowledge discovery and prediction of rainfall and weather parameters [93]. Nanda *et al* presented that rainfall estimation was predicted using a complex statistical model ARIMA (1,1,1) and three different kind of Artificial Neural Network (ANNs) models, MLP, FLANN and LPE. The best statistical model for time series model was ARIMA and ARIMA (1,1,1) model was used for analysis for Rainfall Estimation data. Artificial Neural Network models viz MLP, FLANN and LPE were successfully applied for the complex time series models. Lalithamma & Puttaswamy presented an extensive literature survey is conducted for the application of neural networks in applications related to control

systems. Different models are discussed in detail and its suitability for specific application is highlighted. The importance of back propagation algorithm is emphasized. Bushara & Abraham presented an overview of using the various computational intelligence tools in weather forecasting, describing the main contributions on this field and providing taxonomy of the existing proposals according to the type of tools used. Nayak *et al* reported a detailed survey on rainfall predictions using different neural network architectures over twenty-five years. From the survey it has been found that most of the researchers used back propagation network for rainfall prediction and got significant results. Joseph & Ratheesh discussed that Rainfall prediction has been one of the most technically and technologically challenging task in the climate dynamics and climate prediction theory around the world in the last century. Mahajan &Mazumdar stated that Artificial Neural Network model based on frequency analysis approach using Fast Fourier Transform is used for rainfall prediction. This model is tested as forecasting tool for one-year rainfall prediction on regional (subdivision) scale of India. Model error is below 8%. It predicts the quantity of rainfall 1 year ahead of time which is adequate time for crop planning in agriculture country like India. Nagalakshmi *et al*, found that Radial Basis Function Network (RBFN) is performed well than MLPN, ERNN, HFM. Saxena *et al*, presents (ANN) approach for weather forecasting yields good results and can be considered as an alternative to traditional metrological approaches. The study describes the capabilities of ANN in predicting several weather phenomenon's such as temperature, thunderstorms, rainfall and concluded that major architecture like BP, MLP are suitable to predict weather phenomenon.

In the year 2014 Khan & Hayat stated that a robust computation model for weather prediction. Kumar & Sharma. (2014) discussed about the artificial neural network, working of neural networks, characteristics of ANN, its advantages, limitations and applications of ANN. Matarneh *et al*, (2014) proposed novel models for weather forecasting Artificial Neural Network and Fuzzy Logic. It has been stated these methods are accurate for forecasting. Malik *et al*, (2014) propose a new technique of weather forecasting by using Feed-forward ANN. Amanullah & Khanaa. (2014) explained the techniques of Soft computing and their ability to predict natural system's behavior at future time. The techniques were implemented, tested and trained with the existing dataset. The best method suitable to forecast weather is identified. Lu *et al*, (2014) stated that the crisp inputs of the neural network are changed into fuzzy ones; correspondingly, the structure of the neural network is also changed. Kanth *et al*, (2014) originate that over 112 years of temperature data that temperature is increasing gradually i.e. there is an indication of global warming taking place. The predictions can be done using the linear regression line equations that are found in an effective manner. Chauhan & Thakur (2014) presented a survey that using Data mining techniques for weather prediction yields good results and can be considered as an alternative to traditional metrological approaches. Pate l & Parekh. (2014) concluded that Hybrid method gives better results than Back Propagation Method for Gandhinagar station. Geetha & Nasira. (2014) concluded that artificial neural networks can be used as an aid to model a weather forecasting system for predicting maximum and minimum temperature. Dutta & Tahbilder found 63% accuracy in variation of rainfall for our proposed model for rainfall prediction. Sharma *et al*, (2014) found that accurate forecasting or prediction is a very difficult task, the purpose of our investigation is to analyze different regression based models and find out which one shows higher percentage of accuracy. Mangai *et al*, (2014) founded that to predict a very few instants of future values and it is equivalent to other models. Mishra *et al*. (2014) examined that various approaches of artificial neural network for hydrological forecast with their potential as well as limitation and proposed an approach for artificial neural network model building for hydrological forecast. Mishra *et al*, (2014) examined the state of modern predictive approaches. The discussion follows well known criteria for prediction based approaches: RMSE, AME, R. Experiments demonstrate that for different type's datasets different approaches may be more successful. Thawkar *et al*, (2014) found that the result of proposed algorithm an Adaptive Markov chain Algorithm is able to detect patterns and their rare outlying changes. Gupta *et al*, found that using MLP with a Back propagation yield a low mean square error and mean absolute error as compare to linear regression for rainfall forecast. This result clearly indicating that artificial neural network approach is a more convincing and relatively predicting more accurate simulation results than linear regression Sharma. & Chouhan. initiate that fuzzy time series model has been analyzed along with ARIMA and neural network, as it has been found that traditional time series does not provide good results, so methods based on neural or fuzzy fictions are achieving good results in forecasting. It has been also concluded that Uses of fuzzy models are more transparent than neural networks, which make them useful in applications where transparency is required. Afanasieva *et al*, discuss the framework (algorithm) of multiple time series forecasting, based on fuzzy techniques. Khashei *et al*, proposed a model in which, using autoregressive integrated moving average (ARIMA) models, extends hybrid artificial neural networks and fuzzy (FANNs) to yield more accurate results.

Malik *et al*, proposed a new technique of weather forecasting by using Feed-forward ANN. The data is taken from Rice Research center (Kaul) Haryana. The data is trained by LM algorithm. And it is found that this is the fastest method among other weather forecasting methods. Taksande *et al*, presented a framework to develop neural network estimates of rainfall. Among the five data-mining algorithms tested in this paper, the MLP (multilayer perceptron) has performed best ANNs are being used increasingly for the prediction and forecasting of a number of water resources variables, including rainfall, flow, water level and various water quality parameters. Sharma presented how neural networks are useful in forecasting the weather and the working of most powerful prediction algorithm BPNN was explained. The trained sets are predicted by BPNN with least errors. The feature work is the trained sets or data sets are predicted by BPNN for feature weather conditions. With this research the BPNN will predict the Natural Calamities in future. Amanullah & Khanaa explain the techniques of Soft computing and their ability to predict natural system's behavior at future time. The procedures were implemented, tested and trained with the existing dataset. The best method suitable to forecast weather is identified. Soft computing techniques are easy to implement and produces desirable mapping function by training on the given data set.

Lu *et al* founded that, the crisp inputs of the neural network are changed into fuzzy ones; correspondingly, the structure of the neural network is also changed. Then, specific models based on the improved neural network are used to predict weather conditions such as precipitation and get a better result than the traditional neural network. Goswami & Gaur proposed a neural fuzzy network model for relative humidity prediction on the basis of best combination of parameters. Short term prediction is an important part of the latest control technology for operation of building systems. The work discusses found the possibility of using meteorological data with local observation data for short-term prediction. Chang.Y presented a review on forecasting of wind speed and power under different time-scales. Six categories of forecasting methods, which have their own characteristics, were discussed. Papers were selected to emphasize the diversity of forecasting methods and the time-scales of forecasting methods. Some of these methods have good performances at short-term prediction while others perform better in different time-scale prediction. Taksande *et al*, have presented a framework to develop neural network estimates of rainfall. Among the five data-mining algorithms tested in this paper, the MLP (multilayer perceptron) has performed best ANNs are being used increasingly for the prediction and forecasting of a number of water resources variables, including rainfall, flow, water level and various water quality parameters. Sharma& Bose presented that forecasting or prediction is a very difficult task, the purpose of our investigation is to analyze different regression based models and find out which one shows higher percentage of accuracy. Bakkera, *et al*, found that Simulations with six different sets of water demands, showed that a heuristic model and a transfer/-noise model out performed a Multiple Linear Regression model when forecasting the one-day lead water demand.

In the year 2015, Agarwal research and found that data mining based on neural network. Neural network solves the problem of data mining as it has parallel processing, distributed storage, high degree of fault tolerance, good robustness. Rani *et al*, (2015) founded that for prediction and visualization of large collection of data sets SOM and SVM are the best machine learning techniques. Dubey.A (2015) founded 12 different ANN models which were trained and tested using different combinations of the training algorithms, training functions and adaptive learning functions. Mesgari *et al*, use the tools and functions in the MATLAB software were adjusted and used for education and test of the model. Finally, the artificial nervous networks were applied. Results indicated that a feed forward network of multi-layer perception (MLP), sigmoid and linear functions and Marquaret- Lonberg (LM) are the most effective network that the variables used in the model of predicting the rainfall managed to determine the disparity of the annual and monthly rainfall in the region under study and can be applied as predicting variables in the models of predicting rainfall .M *et al*, proposed us that the use of neural network is very wide in data mining due to some characteristic and features like parallel performance, Self-organizing adaptive, robustness and fault tolerance. Diaconescu.E found the performance of the prediction for different time series was tested using a NARX dynamic recurrent neural network. Krishna,V.G concentrates on the various methodologies available in the area of weather forecasting. This paper presents a review on the brief study of models available based on data mining techniques and artificial neural networks. Mandale & Jadhawar used C5 decision tree classification algorithm to generate decision trees and rules for classifying weather parameters such as maximum temperature, minimum temperature, rainfall, evaporation and wind speed in terms of the month and years. Jeslet & Jeevanandham concluded that the C5 decision tree classification algorithm was used to generate decision trees and rules for classifying weather parameters such as maximum temperature, minimum temperature, rainfall, evaporation and wind speed in terms of the month and year. Bhagawati *et al*, discussed interactive plant disease forecasting system and developed model with multilayer perception architecture having two hidden layers using Artificial Neural Network. Kaur & Singh concluded that a feed-forward NN model using back-propagation algorithm is developed to identify the minimum temperature. The results show that an appropriate accuracy can be achieved using this network. Sreekumar & Badjate performed comparative analysis of various schemes indicates that the hybridization of the soft computing techniques gives optimum results in combination with fuzzy rules. The algorithm CTOA shows even better results due to the updation of variation of each particle within the system by their deviation. Nayak.R concluded that Neural Networks are capable of modeling a weather forecast system. In this paper, BPN is used for forecasting the temperature based on the training set provided to the neural network with c4.5 decision tree to convert, neural network into the form of transparent data model's *et al*, investigated that data mining algorithm we used Decision tree algorithm for classifying weather parameters such as maximum temperature, minimum temperature, rainfall, evaporation and wind speed in terms of the month and year. Rupa & Jain have used the ANFIS which has been applied for the rainfall forecasting. This provides the proficient, faster and well-organized forecasting. Sharma & Nijhawan founded these results of different networks give different results with same training functions and adaptive learning functions having same number of neurons. Back-propagation shows the best result out of the three networks. Muthulakshmi & Baghavathi. proposed methodology which aims at providing an efficient weather forecasting framework for predicting and monitoring the weather attribute datasets to predict rainfall. Mateen *et al*, inspected the data set of 1975-2004 was used with integration of statically analysis and .net frame work all these are assembled with software and hardware infrastructure with stored and predicted AI & ANN data set when the user selects its option from GUI interface these procedure are automatically invoke and climate forecasting is display with 90% of accuracy. Shukla & Karmakar found the identification of internal dynamics of chaotic motion and its prediction for future is very difficult. While BPN model is sufficient to overcome such shortcomings, with a proper selection of appropriate parameters is all most importance and challenging task. Benkachcha *et al*. founded that Demand forecasting plays a crucial role in the supply chain of today's company. Among all forecasting methods, neural networks models are capable of delivering the best results if they are properly configured. Narvekar & Fargose. founded that the Artificial Neural Network model proposed in this paper indicates all the parameters for input and output, training and

testing data set, number of hidden layers and neurons in each hidden layer, weight, bias, learning rate and activation function. The Mean Squared Error between predicted output and the actual output is used to check accuracy. Taksande & Mohod. investigated that the FP Growth Algorithm was used to generate decision trees and rules for classifying weather parameters such as maximum temperature, minimum temperature, rainfall, humidity and wind speed in terms of the month and year. Kharat & Krishna. found that data mining is a new and important area of research, and neural network itself is very suitable for solving the problems of data mining because its characteristics of good robustness, self-organizing adaptive, parallel processing, distributed storage and high degree of fault tolerance. Prasad & Nejres applied knowledge discovery process to extract knowledge from Basra city weather dataset. The dataset includes nine years period [2004-2013] of daily weather observation. We went through all knowledge discovery process and applied many data mining techniques like outlier analysis, prediction, classification, association mining and clustering. Hang *et al*, found that ANNs are widely applied in engineering solutions. When constructing ANN-based models, a considerable number of model parameters must be calibrated, and the trial-and-error method is frequently employed for calibration during ANN training. This paper presents ANN models for 1-h-ahead rainfall forecasting, in which the training model parameters are adjusted using the proposed PAC approach. Krishna.V.G stated that forecasting experiment is carried out to evaluate, the weather condition for the next 15 days by enabling the ARIMA model prediction algorithm model to predict the forecasts. Initially the ARIMA (1, 1,0), model is considered. G.Vamsi Krishna concentrates on the various methodologies available in the area of weather forecasting. This paper presents a review on the brief study of models available based on data mining techniques and artificial neural networks. Devikar & Sahu. main aim is to detect the variation in weather after some period of time or the effect on other parameters of weather with respect to any one parameter. Bhagawati, *et al*, found that major useful characteristics of the model are: i) Accuracy, 2) its site-specific nature, 3) interactive nature and 4) flexibility [160]. Sankari & Valarmathi. Found the Back propagation which reduces the level of the errors. The MATLAB is used to simulate the process using the neural network tool in MATLAB, which reduced the work load of coding and the data set are successfully trained without any errors. Nayak.R presented that that Neural Networks are capable of modeling a weather forecast system. In this paper, BPN is used for forecasting the temperature based on the training set provided to the neural network with c4.5 decision tree to convert, neural network into the form of transparent data model. Sharma & Nijhawan discussed that different networks give different results with same training functions and adaptive learning functions having same number of neurons. Back-propagation shows the best result out of the three networks. Kumar & Kaur. proposed a method of weather forecasting using the feed forward network. Back Propagation network is used to on the basis of the training set. The Number of Statistical measures are evaluated for the prediction of the weather. Back Propagation neural network presents high accuracy and efficiency to predict the weather. Narvekar.M found the different methods for weather forecasting are reviewed. ANN with back propagation is recommended for weather forecasting. ANN with backpropagation uses an iterative process of training where, it repeatedly compares the observed output with targeted output and calculates the error. Arora. & Mehta. Propose a new technique of weather forecasting by using Feed-forward ANN.

In the year 2016 new research worked emerged, Hirani & Mishra reports a detailed survey on rainfall predictions using different rainfall prediction methods extensively used over last 20 years. Liu *et al*, found the weak generalization ability for the FNN by using BP neural network, the QPSO algorithm is used to optimize the FNN in order to propose a QPSOFNN model. There show the strong performances for optimizing the FNN based on the QPSO algorithm. The QPSO-FNN algorithm is a simple algorithm, and can greatly improve the learning speed, accuracy and robustness. Narejo & Eros. concluded from the current research that the proposed approach is promising and can be further applied to the multi-step ahead prediction of a different set of weather parameters such as humidity, pressure and rain. Li *et al* proposed a novel time series prediction method, MANNP model. This model can successfully predict the time series by providing it with data of the relevant factors. It can be concluded that, prediction made by MANNP can be used as an effective time series analysis and prediction tools. Kondelwar & Hajare predicted that Radial basis neural network are used and for classification feed forward neural network with back propagation is used. The paper concentrates on the effectiveness of PSO and only the FFNN is chosen for both the problems. Subhasree. & Priya. prediction is essential for common people to recognize the price of vegetable in advance. In this research it was concluded that, vegetable prices are predicted using Back propagation neural network, Radial basis function and Genetic algorithm based neural network. Chaudhuri. & Ghosh concluded that both ANN based models and Econometric models in a multivariate framework to predict the Indian rupee US dollar exchange rate. The study is based on daily data. Li.& Liu concluded that, prediction made by MANP can be used as an effective time series analysis and prediction tools. We will keep working on the improvements of MANP such as multiple neural network prediction. In the future, the MANP method can be extended to other areas such as financial market or weather forecasts for uncertainty modeling. Ruiz *et al* provided a methodology to predict energy consumption in a set of public buildings using neural networks. In our approach, we assume that each building is equipped with an automation system containing energy consumption sensors that store consumption data in a shared database, but we also perform experimentation considering that other external data, such as temperature, are available. Feng *et al* presented the machine-learning toolbox Climate Learn for climate prediction problems, based on climate data obtained from complex network reconstruction and analysis. Papagiannopoulou *et al*, introduced a novel framework for studying Granger causality in climate-vegetation dynamics. We compiled 10 a global database of observational records spanning a thirty-year time frame, containing satellite, in situ and reanalysis-based datasets. Jain & Bhawna presented an overview of weather forecasting techniques with time series data describing the main contributions in this field. Papers were reviewed to emphasize the diversity of forecasting methods and the time-scales of forecasting methods.

Table 1 Identified methods of modelling in the literature (1972-2017).

S.NO	Year	Methods	Contributor(s)
1	1997	Artificial Neural Networks-ANN	Zhang.G *et al*
2		SVD-QR and FLS's,	Mendel and Mouzouris
3	1998	Bifurcation Theory and Chaotic Dynamics- ANN	Albers J.D. *et al*
4		Artificial Neural Networks-ANN	Franses,H.P
5		Artificial Neural Networks-ANN	Dawson & Wilby
6	1999	Decision-Model Analysis,	Palmer, N.T
7	2000	Artificial Neural Networks-ANN	Maier & Dandy
8		NN+FS- Soft Computing Technique	Takagi.H
9	2001	SSA–SVM	Sivapragasam.C *et,al.*
10		ARIMA model and Non- Liner ANN	Zhang,P.G
11	2002	Neural Network-NN	Taylor & Buizza.
12		ART models	C. Meek,*et al*
13	2003	Chaos, nonlinear systems,	Kokkinos,I. *et,al*
14		Artificial Neural Networks-ANN	Temeyer,R.B *et,al*
15	2004	Neural Network-NN	Maqsood.I *et al*
16		Neural Network-NN	Rao,G,V.K *et al*.
17	2005	Support Vector Machine	Asefa T. *et al*
18		Data Mining Technique	Onwubolu,C.G *et al*
19		Black Box Models And Signal Processing Techniques	Lekkas F.D
20		AIRMA model	Somvanshi,K.V *et al*
21	2006	GA-Based Pruning Method	Leng.G *et al*
22		Time Series Forecasting.	Gooijer.J *et al*.
23		Artificial Neural Networks-ANN,MLP	Hayati & Mohebi
24		Artificial Neural Networks-ANN	Kumar N.D
25	2007	Feed-Forward Back-Propagation	Joorabchi.A *et al*
26		Artificial Neural Networks-ANN	Krasnopolskya M.V
27		Linear Time Series Models	Marcellino.M
28		Multiple Linear Regressions	Kannan.M *et al*.
29		Data Mining Methods	Ni.X
30		Machine Learning Techniques	Ingsrisawang.L *et al*.
31	2008	GA-SVM System	Choudhary & Garg
32		Time Series With Nns	Qi & Zhang
33		Artificial Neural Networks-ANN	Mutlu.E *et al*
34		Support Vector Machine, Machine Learning Process	Radhika & Shashi
35		Artificial Neural Networks-ANN	De.S
36		Artificial Neural Networks-ANN	Solaimani.K
37	2009	Chaotic Time Series	Awad.M *et al*
38		NARX NN	C. A. Mitrea *et al*
39		SVM, MLP	Radhika & Shashi
40		Artificial Neural Networks-ANN	Hung,Q.N
41		Back Propagation Neural Network	Baboo & Shereef
42	2010	Back Propagation Neural Network	Vamsidhar.E *et al*
43		GA, Artificial Neural Networks-ANN	Peralta.J
44		Artificial Neural Networks-ANN	ZeLin.L *et al*
45		back propagation neural network	Baboo & Shereef
46		ANFIS methodology	Bisht & Jangid
47		Artificial Neural Networks-ANN, MLR	El-Shafie,H.A
48		Artificial Neural Networks-ANN, MLR	El-shafie1.A *et al*.
49		Artificial Neural Networks-ANN	Tripathy,K.A *et al*
50		TSDM	Milanovic & Stamenković
51	2011	Time Series Models	M.Khashei *et al*
52		Artificial Neural Networks-ANN	Khalili.N *et al*
53		Artificial Neural Networks-ANN	Duncan,P.A *et al*
54		Back Propagation Algorithm	El-Shafie.H, *et al*
55		Feed-Forward NN Model Using Back-Propagation Algorithm	Kaur & Singh
56		Back Propagation Algorithm	Shereef.& Baboo
57		Rainfall Runoff modeling	Patil.S *et al*.
58		Artificial Neural Networks-ANN	Sharma V. *et al*
59		Artificial Neural Networks-ANN	Abhishek.K *et al*.
60		UML modeling	Nayak.R *et al*
61		machine learning methods, hybrid multi-model method	Sumi,M.S *et al*.
62		POAMA, technique	Abbot & Marohasy.
63	2012	ANFIS models	Galavi & Shui
64		data mining techniques, Artificial Neural Network, Decision Tree algorithms	Olaiya.F
65		Artificial Neural Networks-ANN	Sarkar.& Kumar
66		Dual-ANN Model	Mittal,P *et al*
67		BPN, RBFN, MLP-ANN	Shrivastava.G *et al*.
68		Artificial Neural Networks-ANN	Zhu & Genton

69		Artificial Neural Networks –ANN	Nogay,S.H *et al*.
70		Matlab Tool	Abhishek.K *et al*
71		Multilayered Neural Network	Agrawal.A *et al*
72		Back Propagation Algorithm	Devi.J *et al*
73		C5 Decision Tree	Olaiya.F
74		Data Mining Techniques.	Timothy D. Rey,
75		Back Propagation Neural Network And Hopfield Network Model	Sawale.& Gupta.
76		Data Mining Techniques.	Kumari.A *et al*
77		Artificial Neural Networks –ANN	Teja & Vasundra.
78		Artificial Neural Networks –ANN	Samek & Varacha
79		RBF neural network	Kuril.S *et al*
80		FP Growth Algorithm	Taksande.& Mohod
81		Artificial Neural Networks –ANN	Saxena.A *et al*
82		Multilayered Neural Network	Kumar & Jha
83		fuzzy logic	Jimoh R. G *et al*.
84		RMSE, NMSE, MAPE, ANFIS, ANN	Ahour *et al*.
85		Artificial Neural Networks –ANN	Bisht.D *et al*
86		ANN-GD, ANN-GA and ANN-DE	Panigrahi.S *et al*
87	2013	Data Mining Techniques	Chaudhari *et al*
88		Artificial Neural Networks –ANN	Kapoor & Bedi
89		Quantitative Support	Talwar & Kumar
90		Machine Learning techniques	Bhattacharya.M
91		Artificial Neural Networks –ANN	Charaniya & Dudu
92		MLP, SVM with SOM	Rani.U *et al*
93		(SOM and CANFIS)	Adeyemo
94		ARIMA, Artificial Neural Network	Nanda *et al*
95		Artificial Neural Network	Lalithamma & Puttaswamy
96		computational intelligence tools	Bushara & Abraham
97		Artificial Neural Network	Nayak.D *et al*
98		Artificial Neural Network	Joseph & Ratheesh
99		Artificial Neural Network	Mahajan & Mazumdar
100		RBFN, MLPN, ERNN, HFM, Support vector Machine	Nagalakshmi.R *et al*
101		Artificial Neural Network-ANN	Saxena.A *et al*
102		Robust Computation Model	Khan & Hayat
103		Artificial Neural Network	Kumar & Sharma
104		Artificial Neural Network and Fuzzy Logic.	Matarneh.A *et al*.
105		Feed-forward ANN.	Malik.P *et al*.
106		Soft computing	Amanullah. & Khanaa.
107		Artificial Neural Network and Fuzzy Logic	Jing Lu *et al*.
108		linear regression line equations	Kanth.R,V,T. *et al*
109		Data mining techniques	Chauhan. & Thakur
110		Back Propagation Method	Patel & Parekh.
111		Artificial Neural Network-ANN	Geetha. & Nasira.
112		Artificial Neural Network-ANN	Dutta,& Tahbilder
113		regression based models	Sharma.A *et al*
114		Artificial Neural Network-ANN	Mangai.A,S *et al*
115		Artificial Neural Network-ANN	Mishra.S *et al*.(
116		RMSE, AME,	Mishra.S *et al*
117		Adaptive Markov chain Algorithm	Thawkar.K *et al*.
118		MLP with a Back propagation	Gupta.P *et al*
119		fuzzy time series, ARIMA and neural network	Sharma.& Chouhan.
120		multiple time series	Afanasieva.T *et al*
121		ARIMA models, FANNs	Khashei.M *et al*
122		Feed-forward ANN	Malik.P *et al*
123	2014	data-mining algorithms, MLP (multilayer perceptron)	Taksande.A *et al*
124		BPNN	Sharma.A
125		Soft computing Technique	Amanullah & Khanaa
126		Artificial Neural Network-ANN	Jing Lu *et al*
127		Neural Fuzzy Network Model	Goswami & Gaur
128		Short-Term Prediction	Chang.Y
129		MLP(multilayer perceptron), Artificial Neural Network-ANN	Amruta A.Taksande *et al*
130		regression based models	Sharmaa.& Boseb
131		Multiple Linear Regression model	M. Bakkera, *et al*
132		Back Propogation Algorithm,ANN, Data Mining, neuro fuzzy system	Agarwal.A
133		SOM and SVM	Rani.U.R *et al*.
134		Artificial Neural Network-ANN	Dubey.A
135	2015	MATLAB software, linear functions and Marquaret- Lonberg (LM)	Mesgari.E *et al*
138		data mining techniques and artificial neural networks.	Krishna,V.G
139		C5 decision tree classification algorithm	Mandale.& Jadhawar.
140		C5 decision tree classification algorithm	Jeslet & Jeevanandham
141		Artificial Neural Network model with multilayer perception	Bhagawati.R *et al*.
142		feed-forward NN model using back-propagation algorithm	Kaur.& Singh

143		CTOA	Sreekumar.& Badjate
144		Artificial Neural Network,BPN	Nayak.R
145		data mining algorithm we used Decision tree algorithm	Joshi.A *et al*
146		ANFIS	Rupa & Jain
147		Back-propagation	Sharma & Nijhawan
148			Muthulakshmi & Baghavathi.
149		AI & ANN	Mateen.A *et al*.
150		BPN	Shukla & Karmakar
151		Artificial Neural Network	Benkachcha.S *et al*
152		Artificial Neural Network model	Narvekar & Fargose
153		FP Growth Algorithm	Taksande & Mohod.
154		Artificial Neural Network	Kharat & Krishna.
155		data mining techniques like outlier analysis, prediction, classification, association mining and clustering	Prasad & Nejres
156		Artificial Neural Network	Chang Lo.D *et al*
157		ARIMA model	Krishna.V.G
158		Artificial Neural Network	Arif.M *et al*
159		Artificial Neural Network	G.Vamsi Krishna
160		Artificial Neural Network	Devikar & Sahu.
161		Artificial Neural Network	R. Bhagawati, *et al*
162		Back propagation	Sankari & Valarmathi.
163		BPN	Nayak.R
164		Back-propagation	Sharma.& Nijhawan
165		Back Propagation network	Kumar.& Kaur
166		Back Propagation network, ANN	Narvekar.M
167		Levenberg-Marquardt algorithm, Feed-forward ANN	Arora.& Mehta.
168		MLP, BPN, RBFN, SOM and SVM	Hirani & Mishra
169		FNN, BP neural network, QPSO FNN model.	Liu.M, *et al*
170		Artificial Neural Network	Narejo.& Eros
171		MANNP model.	Li.F *et al*
172		FFNN	Kondelwar & Hajare.
173		Back propagation neural network,	Subhasree.& Priya.
174		Artificial Neural Network	Chaudhuri.& Ghosh
175		MANP	Li.& Liu
176		Artificial Neural Network	Ruiz.L *et al*
177		Machine-Learning	Feng.Y.Q *et al*
178		Artificial Neural Network	Papagiannopoulou.C *et al*
179	2016	Artificial Neural Network	Jain & Bhawna
180		linear regression	Gupta.S *et al*
181		Artificial Neural Network	Maqaleh.A *et al*
182		IMD	Gouda & Chandrika
183		Artificial Neural Network	Rusia & Pathak
184		ANFIS	Pallavi & Singh
185		Artificial Neural Network	Tyagi.H *et al*
186		LSTM network	Zaytar & Amrani
187		Machine Learning Algorithms	Shivaranjani & Karthikeyan.
188		Support Vector Machine	Narayanan & Govindarajan
189		Artificial Neural Network	Pallavi & Singh
190		Artificial Neural Network	Taohidul Islam *et al*..
191		Multiple Linear Regression Analysis, Artificial Neural Network	T. Soares dos Santos *et al*
192	2017	Artificial Neural Network	Bojja & Sanam

Gupta *et al*, suggests and proposes an efficient and accurate weather prediction and forecasting model using linear regression concepts and normal equation model. Maqaleh *et al*, founded two forecasting methods are presented: one is based on statistical models and the other is developed using ANN. The first method employed Box-Jenkins model which is usually used to predict time series. In the second method, a modified artificial neural network model in which adaptive slope and momentum parameter are used to update the weights in back propagation neural network. Gouda & Chandrika founded that, As the monsoon rainfall information is very useful for the users across all the sectors so in this study the detailed classification of rainfall categories using IMD observed data is carried out. Using this algorithm (which can analyze very large climate data) the 53-year climate aspect of Indian monsoon is studied. Rusia & Pathak. concluded the following of this study:1) Artificial Neural Network (ANN) is a very powerful tool for stress analysis of triangular plates with concentric.cut-outs.2) Artificial Neural Network approach is easy and fast whereas traditional techniques are tedious and time consuming and require greater skills. 3) The differences between the maximum equivalent von Mises stress, strain and directional deformation calculated by ANN and ANSYS Workbench 15.0 are low. 4) Using ANN, dependency upon costly analysis and design packages can be avoided. Pallavi & Singh presented a survey that uses several approaches for weather forecasting. The conclusion was the ANFIS approach is the best and can be considered as an alternative to traditional metrological approaches. Tyagi *et al*, discussed experimental results, it is concluded that the proposed system is able to resolve some of the issues discussed earlier. The performance of the proposed system is equivalent, if not better than other systems currently being used. Zaytar & Amrani shows that a deep LSTM network can forecast general weather variables with a good accuracy. The success of the model suggests that it

could be used on other weather-related problems, and while Theano provides excellent environment to compile and train models, it also gives the ability to carry any model into a production server and integrate them in pre-existing applications (as an example, one could perform. Shivaranjani & Karthikeyan. Found that supervised and unsupervised machine learning algorithms can be used to perform the weather prediction and yield of crop can be increased by using different data mining techniques can used for prediction of rainfall for daily ,monthly and yearly with various parameter and thus it provides better result .Narayanan & Govindarajan found that the two existing techniques Support Vector Machine and Naive Bayes are used for the time series analysis for rainfall prediction is carried out. It was concluded from the results that there is good amount of increase in the accuracy of prediction and substantial decrease in the percentage of classification error in both the proposed techniques. Pallavi & Singh describes that major advantage of neural networks is their flexible nonlinear modeling capacity and concluded that due to the nonlinear nature of weather, prediction accuracy obtained by above techniques is still below the satisfactory level. Therefore, use of hybrid combination of ANN and Fuzzy Logic could improve the result considerably. Islam *et al*, discusses the implementation of ANN model for monthly basis reliable weather monitoring with seasonal disaster prediction. The result of given model used for monthly rainfall prediction shows that a good performance and reasonable prediction accuracy was achieved for Barisal city in Bangladesh through this model. Santos *et al*, investigated the applicability of artificial neural networks and multiple linear regression analysis by principal components, as temporal downscaling methods for the generation of monthly precipitation over South America (for current years and future scenarios).

In the year 2017 Bojja & Sanam found the simulation results of neural network shows the training algorithm performs well in the process of convergence characteristics, and improve the convergence rate, a satisfactory approximation.

RESULTS AND DISCUSSIONS

It is found that suitability of ANN for Weather Forecasting has greatly improved the performance and the result accuracy. It is also found that the different type of Neural Networks package supports different types of training and learning algorithms like Artificial Neural Network (ANN), Back Propagation Neural Network, (BPN). Since weather forecasting is a dynamic and non-linear process so ANN can be used for prediction of weather. From the research it is also found that ANN is the best approach than Numerical and traditional methods. On the contrary BPN is the best algorithm to use the neural network for weather forecasting.

Recently, Khalili *et al*., in 2011 have presented ANN modeling for daily rainfall forecasting in Mashhad synoptic station. The ANN model is used as a black box model, and it was found that the hidden dynamics of rainfall through the past information of the system. The obtained results of validation phase are shown in Table 2 that include Correlation Coefficient (R), Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) for daily prediction using GS531 and GS651.

Table 2 Results of used superior ANNs structures (Khalili *et al*., 2011)

ANN structures	R	RMSE (mm)	MAE
GS531 (March)	0.83	0.17	1.20
GS651(March)	0.89	0.14	1.15
GS521(May)	0.82	0.19	1.22
GS681(May)	0.85	0.14	1.16
GS571(December)	0.82	0.20	1.24
GS631(December)	0.86	0.15	1.17

The above prediction values proved that ANN model gave satisfactory prediction performance. And also, Devi *et al*, 2012 have shown that those neural networks are useful in forecasting the weather and the working of most powerful prediction algorithm called back propagation algorithm was explained in detail stating that neural network can predict the future temperature with less error. Sharma., 2014 has presented how neural network are useful in forecasting the weather and the working of most powerful prediction algorithm BPN was explained. The trained sets are predicted by BPNN with least errors.

Karmakar *et al*, 2014, have identified impact of learning rate and momentum factor in prediction of chaotic motion through BPN system and clearly declared that the optimum value of learning rate and momentum factor is dynamic and always depending on input parameters and targeted parameter in BPN system. In general, BPN contributors randomly selected the learning rate (α) closer to 0 and momentum factor (μ) closer to 1 in the close interval [0 1] i.e.,$0<\alpha<1$ and $0<\mu<1$ for most favorable performance. However no contributions have been found to identify optimum value of α and μ for most favorable performance of BPN. It is pre-requisite to identify have been observed. Similarly the optimum architecture of BPN is equally pre-requisite in terms of number neurons in hidden layer, number of input vectors, number of output neurons etc. It is observed that weather forecasting modeling through BPN has sufficiently suitable to explain chaotic nature of weather data time series and significant for prediction of future.

Recently Bojja & Sanam (2017) found the simulation results of neural network shows the training algorithm performs well in the process of convergence characteristics, and improve the convergence rate, a satisfactory approximation. The major finding of this paper was that fuzzy logic system we can predict the temperature more accurately than the other methods including B.P neural networks.

CONCLUSIONS

Weather forecasting has become a challenging and important field of research in the last few decades. It well known that the weather data is nonlinear and follows a very irregular trend, artificial Neural Network (ANN) is a better technique to bring out the structural relationship between the various entities. In the survey the different architecture of ANN and BPN found to the most appropriate method for the weather forecasting. The study also describes that the capabilities of ANN in predicting several weather phenomenon's such as temperature, thunderstorms, rainfall yields good results and can be considered as an alternative to traditional meteorological approaches. And concluded that the Neural Network are the most suitable to predict Weather Forecasting.

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