MULTILAYERED PRECEPTRONS FOR PRECIPITATION PREDICTION IN BULGARIA BASED ON NWP MODELS

Ivan Tsonevsky, Valery Spiridonov

National Institute of Meteorology and Hydrology, 66 Tzarigradsko Chaussee, 1784 Sofia, Bulgaria

e-mail: Ivan.Tzonevski@meteo.bg

Neural networks are used for modelling of complex, non-linear dynamical phenomena. They have a wide range of applications. First of all this technique is a very powerful tool for classification problems. Neural networks have some advantages, which make them very useful in many tasks. Their great power is due to some aspects, which the standard statistical techniques do not possess. In practice, they are able to model very complex unknown functions especially non-linear ones with a large number of variables avoiding the curse of dimensionality.

On the other hand, the atmosphere has a chaotic behaviour. Its evolution depends crucially on its initial state and very small perturbations could cause a very dramatic change into it. Its initial state could not be described exactly. Very complex interconnections between different processes in the atmosphere exist and they cannot be explicitly resolved in the numerical weather prediction (NWP) models.

The prediction of precipitation is one of the most important aspects in the weather forecasting. Precipitation has a high impact over the human society. Correct prediction of the torrential rain and heavy snow is absolutely necessary for the success of the weather forecasts. In spite of the improvement of the NWP models nowadays the precipitation forecasts are far from being perfect.

Neural networks are found to be very useful for improvement of the precipitation forecasts and particularly for making decisions when heavy precipitation is expected. Their implementation in the forecasting process could lead to more confidence when warnings for severe weather are preparing by forecasters.

Neural networks have been implemented to a classification problem in the weather forecasting of precipitation. A number of neural networks have successfully been trained to classify correctly whether a given case belongs or not to one of the two classes for specified regions in Bulgaria.

In this investigation a multilayered preceptron is used as the most popular architecture for the neural networks. Actually a tree-layered preceptron is quite sufficient in this case.

The territory of Bulgaria is divided into six regions. For every region two training sets are created, one for winter and autumn seasons and another for summer and spring seasons, each of them consists of all the cases when a 12-hourly precipitation amount is measured for the period from 1998 to 2004. For the same cases a set of 27 parameters from the NWP global model of the UK MetOffice are determined which are used as input variables in the neural networks. Four three-layered preceptrons are trained for each of the six regions during the spring and summer seasons. The performance of the networks is satisfactory. The correct classification rate is between 60 and 70 %. The performance of the networks for

winter and autumn seasons is much better. Over 80 % of the cases in winter and autumn are correct classified.

The summer of 2005 is very rich in severe weather events. There were several cases with extremely large amounts of precipitation, which caused flash floods, many damages and human victims. Thousands of homes were destroyed. Most of the territory of Bulgaria was affected by those floods. All the trained networks were applied for those flood events. Table 1 shows the performance of the preceptrons for all the events with rain in summer 2005 for the three of the most affected regions.

Table 1. Performance of the trained networks for the cases in summer 2005

	Region 2		Region 3	Region 5
Total number of cases	128		157	128
MLP (4,14)	Correct	81	100	89
	Wrong	47	57	39
MLP (6,8)	Correct	74	96	87
	Wrong	54	61	41
MLP (5,7)	Correct	80	87	82
	Wrong	48	70	46
MLP (27,14)	Correct	71	87	74
	Wrong	57	70	54