International workshop on seasonal to decadal prediction
Toulouse, France, 13-16 May, 2013

Self-learning fuzzy-neural seasonal predictive model for Northern Europe

Oleg POKROVSKY

Main Geophysical Observatory, Roshydromet, Russia, pokrov_06@mail.ru

A multivariate self-learning fuzzy-neural model has been developed to describe predictive relationships between evolving large-scale patterns in North Atlantic: sea surface temperature (SST), atmospheric pressure and temperature (predictors) and subsequent patterns in the Europe surface air temperature (SAT-predictand). A lead interval of varying length (from 1 to 6 months) is placed between a series of consecutive predictor periods and a single predictand period. Approach is based on two key points: (i) quantitative classification of atmospheric circulation regimes by means of fuzzy pattern determination and (ii) description of nonlinear exterior forcing and interior wave interactions by neural network technique. We used the principal fuzzy patterns (PFPs) of the SST, the surface atmospheric pressure and the SAT as the predictor and predicand fields. PFPs advantage against EOFs for field anomaly performance was demonstrated. Following teleconnection spatial areas were selected to derive PFPs for Europe model: North-Atlantic Oscillation, East Atlantic (EA), EA Jet, East-Atlantic/West Russia, Scandinavia, Polar/Eurasian. Five layers neural network utilizes fuzzy classification input and out layers and radial basis functions for PFPs as the activated units. In order to reduce the problem of artificial skill produced from over-fitting and thus receive a more representative estimate of real skill we used cross-validation method, in which forecast model is developed using only part of available data set and then applied to the independent data. Monthly time series was split in two parts: the learning and verification samples. In contrast to the GCMs our self-learning model accumulates all past observing data in so way that after 35 years of learning process it could provide very competitive prediction results for the SAT and precipitation fields. It captured both positive and negative phases of above climate indexes as well as transition periods in their relationships with predicands fields!

A series of monthly observed and forecasted grid temperature fields over Europe was considered. Deviation and other proper statistics are discussed. In particularly, achieved level for explained variance rate of predicted fields is much higher than those accessible for linear regression. Partition of Europe at the set of the homogeneous climate ranges by fuzzy regioning is discussed. Forecasted and observed temperature and precipitation time series for several climate areas are considered. Skillful magnitudes are analyzed as well.