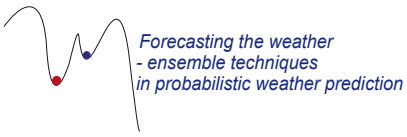
EMS Annual Meeting Abstracts
Vol. 8, EMS2011-45, 2011
11th EMS / 10th ECAM



Evaluation of GCM-based climatic projections for Northern Eurasia: implication for environmental modeling

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Mathematical models have been used extensively to access the impacts of meteorological factors and climate change on the environment. Examples of such studies for the Northern Eurasia include but are not limited to the evaluation of agroclimatic parameters, distribution of vegetation, river runoff, state and distribution of permafrost. Results differ substantially due to uncertainties in the forcing data particularly under the projected for the future climate. This study is targeted at the evaluation of the quality of GCM-based climatic projections in the specific context of predictive environmental modelling in Northern Eurasia. To accomplish this task, we used the output from 21 GCMs from the IPCC AR-4 data base for the control period 1960-1999 and calculated several climatic characteristics and indexes that are most often used in the impact models, i.e. the summer warmth index, duration of the vegetation growth period, precipitation sums, dryness index, thawing degree-day sums, and the annual temperature amplitude. Results were compared with observations at Russian weather stations to evaluate the skills of individual models and to rank them in the specific context of predictive regional environmental modeling. Ultimately, we identified top-end models that "better than average" reproduce the behavior of the selected meteorological parameters and climatic indexes and eliminated the outliers.

Selected climatic models with "better than average" skills were used to compose several ensembles, each combining results from the different number of GCMs. Ensembles were ranked using the same algorithm and outliers eliminated. We then used data from top-end ensembles for the 2000-2100 period to construct the climatic projections that are likely to be "better than average" in predicting climatic parameters that govern the state of environment in Northern Eurasia. These projections were used as input to several impact models for predicting the shifts in bioclimatic zones and changes in the distribution, temperature, and seasonal thaw depth of permafrost.

The ultimate conclusions of our study are the following.
· High-end GCMs that demonstrate excellent skills in conventional atmospheric model intercomparison experiments are not necessarily the best in replicating climatic characteristics that govern the state of environment in Northern Eurasia, and independent model evaluation based on the specific criteria is necessary to identify "better than average" GCMs.
· Each of the ensembles combining results from several "better than average" models replicate selected meteorological parameters and climatic indexes better than any single GCM. The ensemble skills are parameter-specific and depend on models it consists of. The best results are not necessarily those based on the ensemble comprised by all "better than average" models.
· Comprehensive evaluation of climatic scenarios using specific criteria narrows the range of uncertainties in environmental projections.