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Evaluation of GCMs in the context of regional predictive climate impact studies.

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Significant improvements in the structure, complexity, and general performance of earth system models (ESMs) have been made in the recent decade. Despite these efforts, the range of uncertainty in predicting regional climate impacts remains large. The problem is two-fold. Firstly, there is an intrinsic conflict between the local and regional scales of climate impacts and adaptation strategies, on one hand, and larger scales, at which ESMs demonstrate better performance, on the other. Secondly, there is a growing understanding that majority of the impacts involve thresholds, and are thus driven by extreme climate events, whereas accent in climate projections is conventionally made on gradual changes in means. In this study we assess the uncertainty in projecting extreme climatic events within a region-specific and process-oriented context by examining the skills and ranking of ESMs.

We developed a synthetic regionalization of Northern Eurasia that accounts for the spatial features of modern climatic changes and major environmental and socio-economical impacts. Elements of such fragmentation could be considered as natural focus regions that bridge the gap between the spatial scales adopted in climate-impacts studies and patterns of climate change simulated by ESMs. In each focus region we selected several target meteorological variables that govern the key regional impacts, and examined the ability of the models to replicate their seasonal and annual means and trends by testing them against observations. We performed a similar evaluation with regard to extremes and statistics of the target variables. And lastly, we used the results of these analyses to select sets of models that demonstrate the best performance at selected focus regions with regard to selected sets of target meteorological parameters.

Ultimately, we ranked the models according to their skills, identified top-end models that "better than average" reproduce the behavior of climatic parameters, and eliminated the outliers. Since the criteria of selecting the "best" models are somewhat loose, we constructed several regional ensembles consisting of different number of high-ranked models and compared results from these optimized ensembles with observations and with the ensemble of all models.

We tested our approach in specific regional application of the terrestrial Russian Arctic, considering permafrost and Artic biomes as key regional climate-dependent systems, and temperature and precipitation characteristics governing their state as target meteorological parameters. Results of this case study are deposited on the web portal www.permafrost.su/gcms