**Joint Russian-German Project** "European and Russian Extreme Events: Mechanisms, Variability and Future Climate Change"

**Partners**
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**Abstract**
Over the last century, a considerable increase in global, hemispheric and regional average surface temperatures has been observed, along with trends in temperature and precipitation extremes. The first decade of the 21st century was globally the warmest in the instrumental temperature record and has brought a number of remarkable weather and climate extremes to European countries and Russia which had considerable impacts on society and ecosystems. Among the most recent of these extreme events are the cold winter of 2009/2010, the Russian heat wave of 2010 and the flooding in Central Europe in 2010. Further extreme events affecting Europe and Russia are extreme air pollution, strong marine storms and wind waves and fast permafrost thawing.
In this project, we shall investigate if these extremes are already affected by and in which way they will change in the future in response to global warming. First, we aim to understand individual events such as the Russian heat wave 2010, the cold winter 2009/2010 or the flooding in Central Europe 2010, and the mechanisms underlying extremes in cyclone activity and marine storminess. Second, we aim to determine the influence of external forcing and internal modes of decadal variability, in particular the Atlantic Multi-decadal Oscillation, on extreme events. Third, we shall assess the representation of extreme events in climate models, in particular as a function of model resolution, and on regional scales. Fourth, we shall develop future scenarios of extreme events in Europe and Russia including the associated uncertainties.
To address these questions, we shall carry out case study simulations, sensitivity integrations and future projections with global and very high-resolution regional climate models in different forcing and coupling settings. These experiments and additional millennial-long control runs will be validated against observational data by means of modern statistical methods, in particular extreme value theory, vector-generalised regression models and cyclone tracking algorithms. The regional climate model projections will be bias-corrected with a special focus on correcting the magnitudes of extreme events.
The project will extend the existing collaboration between the participating institutes on large-scale climate phenomena towards extreme events on a regional scale. By bringing together expertise in regional climate, global climate as well as statistical modelling and data analysis, a unique research team will be created capable to address a wide range of scientific questions regarding extreme events under climate change. The project will lead to a direct knowledge transfer from the IFM-GEOMAR to the Russian teams in global climate modelling and extreme value theory, and vice versa in regional climate modelling.
The anticipated results will improve the understanding of the mechanisms underlying extreme events and their variability and can be used to better predict potential future events. The improved predictability on decadal to multi-decadal time scales and the provision of bias-corrected scenarios of future climate extremes and their associated uncertainties will help end users and stake holders to implement adaptation measures to changes in the statistics of extreme events, and will help policy makers to assess the required degree of climate change mitigation.