Vol. 48: 3–4, 2011
doi: 10.3354/cr01016

CLIMATE RESEARCH
Clim Res

Published July 19

Contribution to CR Special 26 'Environmental change and socio-economic response in the Baltic region'

OPEN ACCESS

INTRODUCTION

Environmental change and socio-economic response in the Baltic region

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ABSTRACT: Mitigation of the negative effects of climate change on the environment and society requires planning and decision-making at regional and local levels. This necessitates the downscaling of global climate models to regional levels. The contributions to this CR Special investigate the effects of changing climate on the natural and socio-economic environment of the Baltic region, under the following broad topics: (1) variations in paleo-climate reconstructed through measurements, and the interpretation of climate proxies; (2) modeling of past climate change and future projection; (3) climate–anthroposphere interactions; and (4) climate variability and change and its effects on Baltic Sea coasts.

KEY WORDS: Baltic Sea · Climate change · Hindcast · Future projection · Modeling · Natural environment · Anthroposphere

This Climate Special is devoted to the results of the conference 'Climate change: the environmental and socio-economic response in the southern Baltic region' co-organized by the BALTEX international office and the University of Szczecin, 25–28 May 2009, in Szczecin, Poland. The conference concentrated on the latest research on climate change and its effects on the environment and society in the southern Baltic region. Although remarkable progress has been achieved in understanding the climate system at a global scale, deeper insights into climage-change phenomena are needed at a regional scale. Planning agencies and local authorities have expressed the need for climate projections to be used for management and decision making at a regional and local level, to mitigate negative effects of climate change on the environment and society. As the questions posed by society to the scientific community are very complex and require complex answers, one of the goals of the conference was to foster an interdisciplinary discussion. This CR Special contains selected papers on 4 topics from this interdisciplinary discussion.

1. Variations in paleoclimate reconstructed through measurements and the interpretation of climate proxies

Björck discusses current global warming as an anomalous period in relation to the climate of the last 20 000 yr. Other climate events, even if they correlate temporally, do not occur in a globally consistent way, but are rather the expression of the regional complexities of the climate system.

Grigoriev et al. reconstructed the paleoenvironment in the Baltic Sea during the last 13 000 yr based on sediment core data from the Gdansk Basin. The high resolution proxy data correlates with marine transgression phases and near-bottom current dynamics from basins in the Baltic, and confirms assumptions about basin-wide exchange of water masses.

Świątek reports about detailed changes in precipitation measured at weather stations along the Polish coast related to variations in the intensity of westerly winds over Europe between 1954 and 2003. More intense western advection causes more frequent precipitation, especially in the east of Poland.

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2. Modeling of past climate change, and future projections

Meier et al. investigated the effect of climate and environmental changes on marine ecosystems of the Baltic Sea, simulated with a high-resolution 3-dimensional coupled biogeochemical-physical model. They conclude that the effect of changing climate on the Baltic biogeochemistry may be significant, in particular due to a reduced winter ice cover and an increase in wind speed and river runoff. Nevertheless, the sensitivity of the partly highly non-linear response to climate change depends on key processes that are not well understood and additional studies are still required.

Apsīte et al. projected river runoff in the southeast of the Baltic Sea basin to the end of this century, using the hydrological model METQ2007BDOPT. This model was applied to eight river basins and sub-basins in Latvia. Climate change was projected by regional climate modelling (RCAO-HCCTL) and further statistical downscaling for the control period HCCTL (1961–1990) and two scenarios HCA2 and HCB2 (2071–2100). Compared with the control period, both scenarios show the increase in mean annual air temperature and precipitation while the annual river flow is projected to decrease, except for the Berze river. The seasonal pattern is expected to change with significantly higher runoff during winter.

Demchenko et al. use geostatitical models for the investigation of seasonal structural thermally-induced fronts in the Baltic Sea and their specific features after winters of different severity. The analysis of long-term spring monthly mean SST data reveals that surface water temperatures in the southern Baltic Sea exceed the (salinity-dependent) temperature of maximum density (Tmd). Thermal front advancement is correlated with biological parameters. Pronounced frontal gradients and an extended area of elevated chlorophyll *a* (about 200 km in width) associated with the Tmd was observed after the severe winters, with a significantly longer characteristic life-time than that occurring after mild winter.

3. Climate–anthroposphere interactions

Batóg & Batóg introduced the concept of absolute and marginal convergence of relative environmental pollution to compare relative emissions of basic pollutions in the different countries of the Baltic area. The measure of relative pollutions accounts for the ecological effectiveness of the national economies. The application of the method reveals clear differences between the countries under investigation.

4. Climate variability and change: effects on Baltic Sea Coasts

Łabuz et al. focused on storm-induced surges and the erosional processes on the southern Baltic coast. They showed that during the surge of November 2004 (max. sea level 3.0 m above mean sea level), dunes retreated by 2 to 6 m on average, and 22 m^3 per 1 m coastline was eroded. These data provide a potential basis for the development of coastal protection concepts.

Acknowledgements. Each contribution to this CR Special was reviewed by at least 2 referees. The Guest Editors thank them for their valuable comments and suggestions that greatly improved the manuscripts. We also thank the Managing Editor, Matthias Seaman, and the Editorial Board, who provided invaluable advice and guidance through all production stages of this CR Special.