Geophysical Research Abstracts
Vol. 14, EGU2012-12032, 2012
EGU General Assembly 2012

Climate variability in China during the last millennium based on reconstructions and simulations

E. García-Bustamante (1), J. Luterbacher (1), E. Xoplaki (1), J. P. Werner (1), J. Jungclaus (2), E. Zorita (3), J.F. González-Rouco (4), L. Fernández-Donado (4), G. Hegerl (5), Q. Ge (6), Z. Hao (6), and S. Wagner (3)

(1) 1.Department of Geography, University of Giessen, Germany (Elena.Garcia-Bustamante@geogr.uni-giessen.de), (2) Max-Planck Institute für Meteorologie, Hamburg, Germany, (3) Helmholtz-Zentrum-Geestacht, Germany, (4) Dpto. Física de la Atmósfera, Universidad Complutense de Madrid, Spain, (5) School of Geosciences, University of Edinburgh, U.K., (6) 1.Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), Beijing 100101, China

Multi-decadal to centennial climate variability in China during the last millennium is analysed. We compare the low frequency temperature and precipitation variations from proxy-based reconstructions and palaeo-simulations from climate models. Focusing on the regional responses to the global climate evolution is of high relevance due to the complexity of the interactions between physical mechanisms at different spatio-temporal scales and the potential severity of the derived multiple socio-economic impacts. China stands out as a particularly interesting region, not only due to its complex climatic features, ranging from the semiarid northwestern Tibetan Plateau to the tropical monsoon southeastern climates, but also because of its wealth of proxy data. However, comprehensive assessments of proxy- and model-based information about palaeo-climatic variations in China are, to our knowledge, still lacking. In addition, existing studies depict a general lack of agreement between reconstructions and model simulations with respect to the amplitude and/or occurrence of warmer/colder and wetter/drier periods during the last millennium and the magnitude of the 20th century warming trend. Furthermore, these works are mainly focused on eastern China regions that show a denser proxy data coverage. We investigate how last millennium palaeo-runs compare to independent evidences from an unusual large number of proxy reconstructions over the study area by employing state-of-the-art palaeo-simulations with multi-member ensembles from the CMIP5/PMIP3 project. This shapes an ideal frame for the evaluation of the uncertainties associated to internal and intermodel model variability.

Preliminary results indicate that despite the strong regional and seasonal dependencies, temperature reconstructions in China evidence coherent variations among all regions at centennial scale, especially during the last 500 years. The spatial consistency of low frequency temperature changes is an interesting aspect and of relevance for the assessment of forced climatic responses in China. The comparison between reconstructions and simulations from climate models show that, apart from the 20th century warming trend, the variance of the reconstructed mean China temperature lies in the envelope (uncertainty range) spanned by the temperature simulations. The uncertainty arises from the internal (multi-member ensembles) and the inter-model variability. Centennial variations tend to be broadly synchronous in the reconstructions and the simulations. However, the simulations show a delay of the warm period 1000-1300 AD. This warm medieval period both in the simulations and the reconstructions is followed by cooling till 1800 AD. Based on the simulations, the recent warming is not unprecedented and is comparable to the medieval warming.

Further steps of this study will address the individual contribution of anthropogenic and natural forcings on climate variability and change during the last millennium in China. We will make use of of models that provide runs including single forcings (fingerprints) for the attribution of climate variations from decadal to multi-centennial time scales. With this aim, we will implement statistical techniques for the detection of optimal signal-to-noise-ratio between external forcings and internal variability of reconstructed temperatures and precipitation. To apply these approaches the uncertainties associated with both reconstructions and simulations will be estimated. The latter will shed some light into the mechanisms behind current climate evolution and will help to constrain uncertainties in the sensitivity of model simulations to increasing CO_2 scenarios of future climate change.

This work will also contribute to the overall aims of the PAGES 2k initiative in Asia (http://www.pages.unibe.ch/workinggroups/2k-network)