A FOCUS ON EXTREMES IN GEWEX

Ronald Stewart
McGill University, Canada

Importance of Extremes: One of the most critical aspects of the water and energy cycle is the occurrence of extremes such as droughts and extended wet periods. Not only do they have enormous impacts when and where they occur but they are also fundamental features of the climate system.

Extremes and GEWEX: The strategy of the GEWEX Hydrometeorology Panel (GHP) has concentrated on assembling relevant data sets, addressing long-term water and energy budgets, assessing sources and sinks of moisture, and interacting with the water resource community. GHP, along with the other GEWEX components, is now ready to examine extremes in a systematic manner. The primary objectives of this effort will be to *better understand and model the occurrence, evolution and role of extremes within the climate system and to contribute to their better prediction*. These objectives will be addressed by determining the extent to which similar processes are responsible for extremes in different regions, and understanding the processes that link extremes in different regions and how they may be changing.

In part these activities will consider (1) extremes as a natural follow-on to current water and energy budget related studies; (2) the Coordinated Enhanced Observing Period (CEOP) Phase I data period as a case study; and (3) trends in the occurrence of extremes through the analysis of long-term records.

To some extent a study of extremes would build on existing initiatives. In particular, it could expand the Water and Energy Budget Study (WEBS) with a focus on droughts and extended wet periods rather than on the average conditions occurring over those regions. During Phase I of CEOP (2001-2004), numerous extremes occurred, including a long-lasting drought over western North America; a devastating heat wave in Europe; and periods of drought as well as flooding over Asia, South America, Australia and Africa. On longer time scales, multi-decade records assembled by GEWEX and other groups, including reanalysis efforts, can all be exploited to focus on trends in extremes.

Extremes are important to other climate and disaster related initiatives. Linkages will be developed with other WCRP projects and international efforts including disaster research.

USE OF INDICES IN CHARACTERIZING PRECIPITATION EXTREMES: A EUROPEAN EXAMPLE

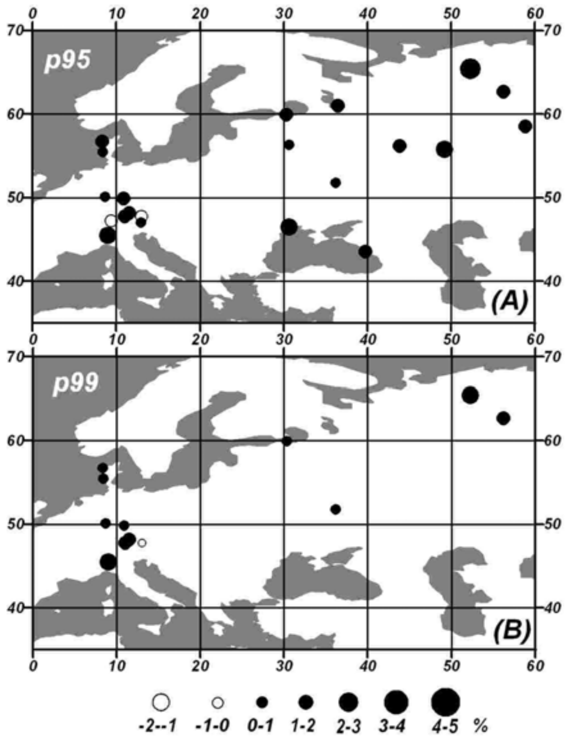
Olga Zolina[1], Clemens Simmer[1]
Alice Kapala[1], Sergey Gulev[2]

[1]Meteorologisches Institut, Universitatet Bonn, Germany, [2]P. P. Shirshov Institute of Oceanology, Moscow, Russia

Accurate estimates of the changes in extreme precipitation from station measurements are very important for validation of model experiments aimed to quantify trends in extreme precipitation under global warming. The linear trend estimates in extreme precipitation indices over Europe show increasing probability of the occurrence of heavy precipitation for both stations and models. Although these indices may be qualitatively consistent with each other, they may, however, show some disagreement in their quantitative estimates of linear trends (Frei and Schar, 2001; Groismann et al., 2005; Klein Tank and Koennen, 2003). Moreover, when missing values of daily precipitation are inhomogeneously distributed they contribute additional uncertainty in the trend estimates.

In this study, we used daily rainfall data from the Royal Netherlands Meteorological Institute European Climate Assessment data set along with the collections of the Russian National Climate Data Center and the German Weather Service (Zolina et al., 2004). These data consist of 295 stations for 1804-2003 with 96 station records longer than 100 years and characterized by the homogeneity of the observational practices. Using 22 stations with records without gaps we derived the distributions of the number of missing values and of the durations of continuous gaps, and developed sampling models which were used for the homogenization of centennial daily records for all 96 stations with complete records. From the homogenized time series we derived different precipitation indices and further analyzed linear centennial trends in these indices. The three indices used were the exceedance of 95% threshold (*G95*) (Groismann et al., 2005), the percentage of seasonal total during very wet (>95%) days (R95) (Klein Tank and Koenen, 2003) and the 95% percentile (p_{95}) of precipitation from the estimated Gamma distribution for the daily precipitation (Zolina et al., 2004).

Trend estimates (in percentage per decade) for R95 may exhibit locally significant differences with



Estimates of linear trends in annual values of (A) p_{95} *and* (B) p_{99} *in the locations where all three indices (*p_{95}, R95, G95*) computed from the homogenized time series are significant according to the chosen criteria.*

those for p_{95}, while trends in G95 are very close to p_{95}. During winter, trends in p_{95} and R95 are primarily positive in Central and Eastern Europe (2-7% and 3-10% per decade respectively). In 43 locations the indices demonstrated significant changes. However, the trends in all three indices are significant and show the same sign at only 19 locations. In Western Europe in summer all three indices show negative trends in the northern part and positive changes in the Alps. Summer trends of these indices in the Eastern Europe are less consistent. Significant linear trends with the same sign exist only for 12 of 34 locations where either index demonstrated significant changes. Considerable disagreement is also observed in Northern Europe where R95 indicates stronger negative changes.

In the figure above the estimates of linear trends in annual values of p_{95} are shown for the 22 locations where all three indices (p_{95}, R95, G95) computed from the homogenized time series are significant according to the different statistical criteria, such as Student t-test, Hayashi criterion and Wilcoxon test and are simultaneously unaffected by the sampling density. In other words, these maps show the locations where trends in heavy European precipitation can be accepted with confidence. These trends are positive in most of Eastern Europe, where the strongest changes range from 3 to 5% per decade, and are somewhat weaker in the Central Western Europe. The trends in p_{99} (see Panel B of the figure) are significant in 12 locations only, with primarily positive tendency and maxima of 3-4% per decade in the Northern European Russia. A general conclusion can be made that the use of more objective indices based on estimated PDFs for daily precipitation, appears to be the best strategy for estimating long-term tendencies in extreme precipitation.

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GEWEX SSG Chair Receives Highest NASA Honor

On April 27, 2005, Prof. Soroosh Sorooshian, chair of the GEWEX Scientific Steering Group, received the Distinguished Public Service Medal, the highest honor that the National Aeronautics and Space Administration (NASA) awards to someone who is not a government employee. The award is granted only to individuals whose distinguished accomplishments contributed substantially to the NASA mission. Prof. Sorooshian received this award for his distinguished record in providing scientific leadership for global water cycle research and assuring that NASA science is well integrated into international programs.