Geophysical Research Abstracts,
Vol. 10, EGU2008-A-03763, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-03763
EGU General Assembly 2008

Reconstruction of global monthly upper-level temperature and GPH back to 1880

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The study of upper-level fields is an important tool in climate research and is particularly important for understanding the mechanisms leading to long-range teleconnections. However, global 3-dimensional datasets are only available for the second half of the 20^{th} century. For the investigation of climate anomalies in the first half of the 20^{th} century, like the 1930s "Dust Bowl" droughts in the US or the arctic warming, it is of interest to have upper-level data prior to 1948. A better understanding of climate anomalies helps to assess the natural climate variability. On the other hand, the validation of climate models can be improved by extending upper-level timeseries.

In this paper we present statistical reconstructions of global monthly mean fields of temperature and geopotential height back to 1880 for the 850 to 100 hPa levels. The reconstructions are based on new available upper-air data and additional surface measurements. The predictors consist of several thousand variables of wind, temperature and pressure in the upper levels and temperature and sea level pressure measurements on the ground. As predictand the ERA40 reanalysis is used. Between predictors and predictand a principal component regression model is fitted in a recent calibration period (1957-2002). The derived coefficients are applied in the reconstruction period (1880-1957). Only a few predictor variables are available for the whole reconstruction period. Therefore, for each month in the reconstruction period a separate regression model is adjusted. The skill of each model is estimated with a split-sample validation in the recent calibration period. Good reconstructions are found for GPH up to 100 hPa and for the northern hemisphere and the tropics. Only average reconstructions are achieved for temperature in the higher levels and for GPH and temperature in the southern hemisphere. The reconstructed fields are presented for selected strong

climate extremes.