The Swiss rivers in 2003

The 2003 European summer heatwave caused discharge anomalies in many Swiss rivers. Normalized deviation of the 2003 observed discharge from the long term average are shown in Figure 1. A strongly reduced discharge was observed in some large rivers in Switzerland (examples encircled in red). Glacierized basins show an equal or higher runoff during the year and summer 2003 (blue circles). Test catchment is the Landquart at Felsenbach (triangle in Fig. 1). The catchment size is 616 km² with a glacialism of 1.4 % and limited influence by hydropower management.

Model and Data

Hydrological model:
PREVAl (Precipitation-Runoff-EVApotranspiration Hydrotope) [2]

Input: Meteorological observations or weather predictions

<table>
<thead>
<tr>
<th>Meteorological input</th>
<th>Period</th>
<th>Lead time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>1975 – 2009</td>
<td>--</td>
</tr>
<tr>
<td>COSMO-LEPS¹</td>
<td>1971 – 2000</td>
<td>18 – 42 h</td>
</tr>
<tr>
<td>COSMO-LEPS¹ calibrated</td>
<td>1971 – 2000</td>
<td>18 – 42 h</td>
</tr>
</tbody>
</table>

¹ Consortium for Small-scale Modelling of limited area ensemble prediction system

Calibration Method

Quantile mapping is used to calibrate the COSMO-LEPS reforecast (Figure 2). The basic assumption is:

Quantile of forecast event based on model climatology = Quantile of observation based on observation climatology

Predictability of hydrological drought

For the period 1980 - 2000 PREVAl was driven by the three meteorological input data sets presented above. The comparison of these three runoff simulations with runoff observations at the gauging station is presented in Figure 4. It can be seen, that the simulations are more consistent with the observations for the simulations with the calibrated COSMO-LEPS and best with the observations as model input.

The drought characteristics duration, severity and magnitude are analysed with respect to the 5 % quantile as threshold in Figure 5 for PREVAl simulation with the three different meteorological inputs. Duration and severity simulations are overestimated with all three inputs. However their ratio, the magnitude, is well estimated with the calibrated COSMO-LEPS and the meteorological observations as input.

Drought Definition [3]

Daily varying quantiles between the 5 and 25 % quantile are chosen as threshold, in order to detect stream flow anomalies. Figure 3 presents the three indices drought duration, severity and magnitude investigated in this study.

Collaborations

- Comparison of runoff and soil moisture simulations with WP 4 (René Orth)
- Provide hydrological climatologies to WP 3

Conclusions

The three forcing data sets are of different quality with respect to accuracy (observation vs. prediction) and resolution. It can be seen, that the simulated runoff has the largest error when COSMO-LEPS is used as meteorological input and the smallest error with the meteorological observations used as forcing data set. A critical point is the selection of the threshold level. The compromise is to choose a threshold that is low enough to get real drought events but not to low in order to get enough independent events.

References