Hydrological climate-impact projections for the Rhine river: GCM-RCM uncertainty and separate temperature and precipitation effects.

Journal of Hydrometeorology

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1 Introduction

This electronic supplementary material contains in section 2 additional figures of the seasonal spatial patterns of changes in the variables temperature $T$, precipitation $P$, evapotranspiration $E$ and runoff $R$ for all the GCM-RCM chains and the two scenario (SCE) periods 2021-2050 and 2070-2099, both relative to the control (CTL) period 1980-2009. Further, section 3 shows the mean annual cycle of the water balance components in the CTL period as well as their relative changes for the two SCE periods at additional gauges.
2 Spatial pattern of changes of atmospheric variables

2.1 SCE period 2021-2050

2.1.1 Temperature

Figure ESM1: Change of winter temperature ($T$) in the sub-basins for the SCE-period 2021-2050 vs. CTL-period 1979-2008 [°C]. Each panel shows the values for a specific GCM-RCM chain (indicated in the panel’s title).

Figure ESM2: Same as in Fig. ESM1 but for spring.
Figure ESM3: Same as in Fig. ESM1 but for summer.

Figure ESM4: Same as in Fig. ESM1 but for autumn.
2.1.2 Precipitation

Figure ESM5: Change of winter precipitation ($P$) in the sub-basins for the SCE-period 2021-2050 vs. CTL-period 1979-2008 [%]. Each panel shows the values for a specific GCM-RCM chain (indicated in the panel’s title).

Figure ESM6: Same as in Fig. ESM5 but for spring.
Figure ESM7: Same as in Fig. ESM5 but for summer.

Figure ESM8: Same as in Fig. ESM5 but for autumn.
2.1.3 Evapotranspiration

Figure ESM9: Change of winter evapotranspiration ($E$) in the sub-basins for the SCE-period 2021-2050 vs. CTL-period 1979-2008 [%]. Each panel shows the values for a specific GCM-RCM chain (indicated in the panel’s title).

Figure ESM10: Same as in Fig. ESM9 but for spring.
Figure ESM11: Same as in Fig. ESM9 but for summer.

Figure ESM12: Same as in Fig. ESM9 but for autumn.
2.2 SCE period 2070-2099

2.2.1 Temperature

Figure ESM13: Change of spring temperature ($T$) in the sub-basins for the SCE-period 2070-2099 vs. CTL-period 1979-2008 [°C]. Each panel shows the values for a specific GCM-RCM chain (indicated in the panel’s title).

Figure ESM14: Same as in Fig. ESM13 but for autumn.
2.2.2 Precipitation

Figure ESM15: Change of spring precipitation ($P$) in the sub-basins for the SCE-period 2070-2099 vs. CTL-period 1979-2008 [%]. Each panel shows the values for a specific GCM-RCM chain (indicated in the panel’s title).

Figure ESM16: Same as in Fig. ESM15 but for autumn.
2.2.3 Evapotranspiration

Figure ESM17: Change of spring evapotranspiration ($E$) in the sub-basins for the SCE-period 2070-2099 vs. CTL-period 1979-2008 [%]. Each panel shows the values for a specific GCM-RCM chain (indicated in the panel’s title).

Figure ESM18: Same as in Fig. ESM17 but for autumn.
3 Changes in the annual cycle

Figure ESM19: Mean annual cycle of the water balance quantities precipitation, evapotranspiration and runoff in the CTL period 1979-2008 for additional gauges along the Rhine river. The depicted precipitation includes a water balance correction as derived by the hydrological model PREVAH. Evapotranspiration and runoff are estimated by PREVAH. Scales are identical.
Figure ESM20: Relative changes in the mean annual cycle of precipitation ($P$), evapotranspiration ($E$) and runoff ($R$) at nine gauges along the Rhine river. Each panel pair shows the changes relative to the CTL period 1979-2008 for the SCE period 2021-2050 on the left side and for the SCE period 2070-2099 on the right side. The gauge name is indicated in the top left corner of each panel pair. The scales are identical except for the gauge Diepoldsau.