Climate change modeling on Rhine discharge

Extremely low water levels in the Rhine, occurring more often, cause problems for water supply and navigation.

Climate scenarios suggest that Rhine river discharges in winter and spring may have increased by about 30% by the end of the century, whereas in summer and autumn they can decrease by about 30%. In addition, the snow melt season starts up to 2 months earlier in the year, and snow storage in the Alps is reduced dramatically.

To adapt water management in the Rhine basin to climate change, it is important to understand how the hydrological regime and river discharge will be affected. To investigate this, a hydrological model, the Variable Infiltration Capacity (VIC) model, is forced by three high-resolution (10km) climate scenarios, each corresponding to a different IPCC storyline describing societal and technological developments. The high model resolution enables a better representation of convective (small-scale) precipitation events and orographic features, especially in the Alps.

After correcting for structural errors in the global and regional climate models, the VIC-model, previously optimized for the Rhine basin[1], was forced by the climate scenarios and a reference model run for the 20th century. All three climate scenarios indicate a decrease in summer discharge and an increase in winter and spring discharge for the end of this century, as well as an increase in magnitude and frequency of streamflow droughts in summer and peak flows in spring[2].

It should be noted that only one global, regional and hydrological model was used. Seasonal changes in temperature and precipitation, are however, broadly consistent between models. Whereas increasing frequency and magnitude of peak flows has been acknowledged in previous studies, the increase in summer droughts may have consequences for many sectors and perhaps pose an even larger challenge for adaptive management in the Rhine basin.

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