Assignment 10

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Simulation period:
- Spin up: 1/1/1999 - 1/1/2004
- Simulation period: 1/1/2004 - 31/12/2008

Gauging station coordinates:
- 6.25 51.75

Parameters modified:
- Precipitation
- Temperature
- Temperature of rain/snow (the temperature at which the rain becomes snow
A summary of the detailed changes will be available in the Findings summary section

All sensitivity analysis was conducted on daily discharge data at the gauging station

1 Discharge plots

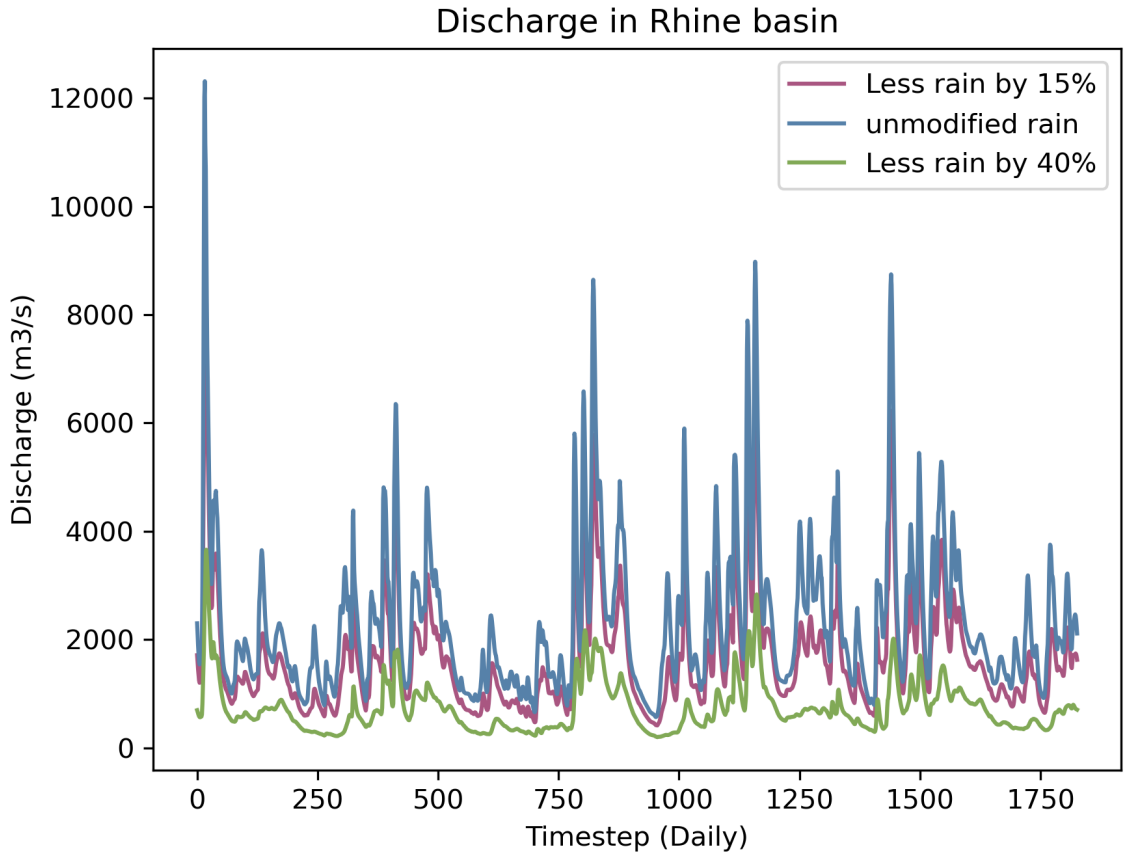

Figure 1: Discharge plots showing the original model output alongside model outputs when rain is decreased by 15% and 40%

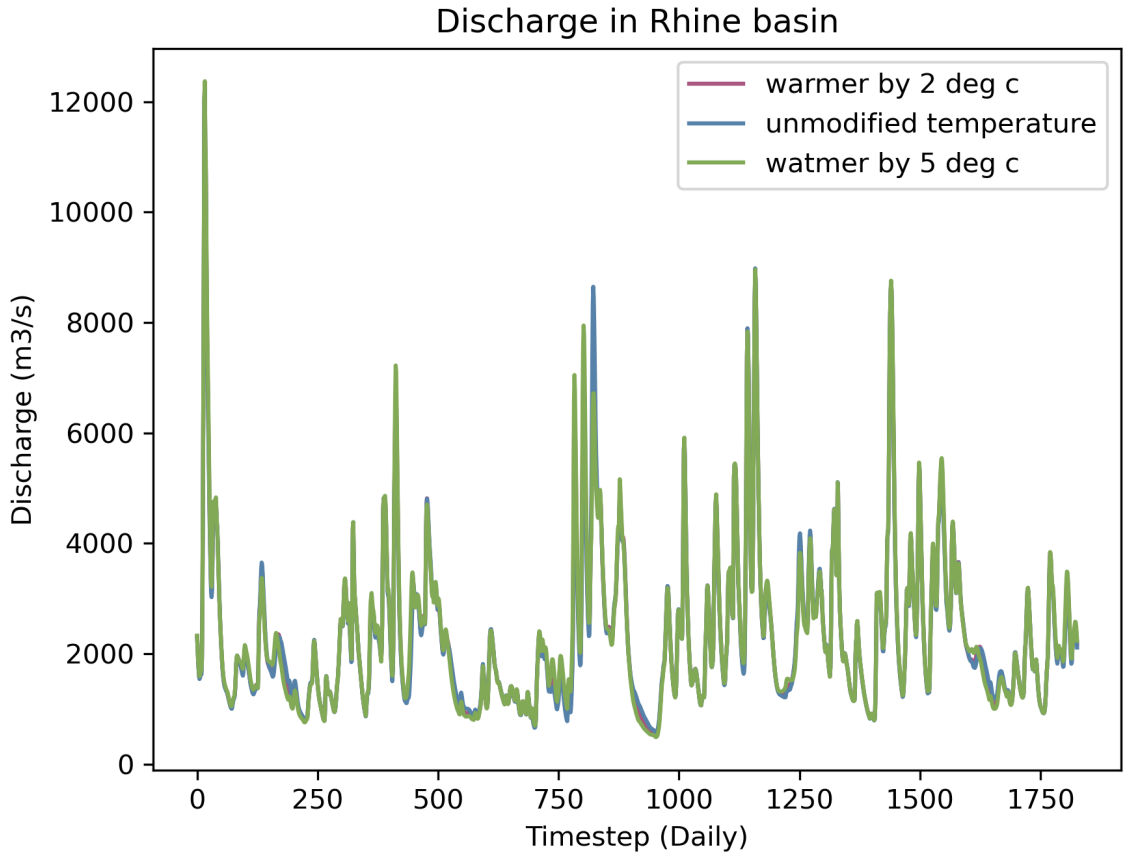

Figure 2: Discharge plots showing the original model output alongside model outputs when the temperature is warmer by 2 deg c and 5 deg c

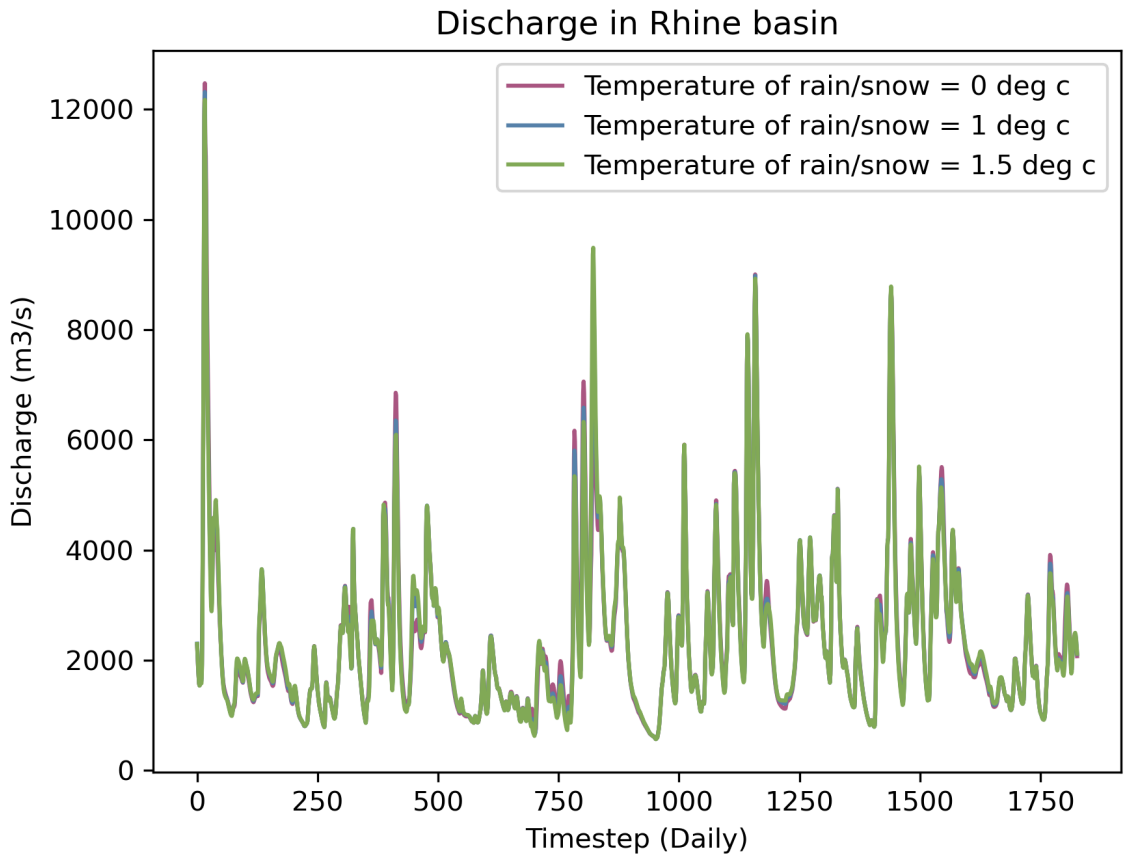

Figure 3: Discharge plots showing the original model output of default temperature at which rain becomes snow (1 deg c) alongside model outputs when the temperature is at 0 deg c and 1.5 deg c

2 Findings summary

Parameter	average discharge	change of discharge from original	x sensitivity
-15% in rain	1667.2	-28.6%	1.9x
-40% in rain	729	-68.8%	1.7x
+16% in temperature (+2 deg c)	2343.8	+0.38%	0.02x
+40% in temperature (+5 deg c)	2355.2	+0.88%	0.02x
Temp/snow = 0	2341.9	0.3%	
Temp/snow= 1.5	2330.6	-0.2%	

Table 1: Summary of the findings of paramters change in (%) and how the modeled discharge reacted accordingly

3 Reflection

The model seems to be highly sensitive to precipitation values and not so much to temperature values. We suspect that the high sensitivity is due to the nature of the physical effects of the temperature and rain on discharge. Rain has a direct and fast impact on discharge, and increasing/decreasing this parameter has a effect on discharge data. However, when the temperature is (a little bit) warmer, the effect is directly related to evapotranspiration which will decrease discharge, but the process of evaporation is not as fast as discharge and perhaps analysing the varying temperature parameter would have been best to be done on ET data rather than discharge. Nevertheless, I tried to use the same output for comparison thinking that it was the correct way to have the same basis. Perhaps further analysis is needed to fully understand model sensitivity.
For the temperature at which the snow is becoming rain: The results are pretty much expected; when more rain is becoming snow, it will lead to less water discharging through the gauge because snow doesn't flow, rather it sits where it falls.
Providing rationale for the numbers I chose, I imagine a future where climate change is taking place; warmer temperature above the Rhine basin, and less rainfall (mainly due to air parcels holding more water), and the numbers are average of low-end expected number to high-end expected numbers taken from various sources listed at the "Additional info" section

4 Additional info

Sources:
- Pace of shifts in climate regions increases with global temperature
- Changes in precipitation with climate change
- Spatial variation of the rain–snow temperature threshold across the Northern Hemisphere

Additional information and the code provided can be found on my Github account.

Github