HYDROEUROPE
Flood Risks Management and Resilience in Europe

Uncertainties in advanced hydrological and hydraulic modeling

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Team 8
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Hydroeurope project (February 13th - February 25th)

The Task

- “Uncertainties in Advanced Hydrological and Hydraulic Modelling”
- Focus on the effect of different **temporal and spatial precipitation intensities** towards catchment runoff for flash flood situations
- The team task deals with two European catchments – the river Ahr catchment in Germany and the river Var(Vésubie) catchment in France.

Objectives

- Identify & compare the characteristics of the Var(Vésubie) and Ahr catchments
- Analysis of the precipitation timeseries for the 2021 Ahr event
- Analysis of the impact of different temporal and spatial rainfall intensities to catchment runoff
- Draw conclusions from the results

Recap of the Var(Vésubie) and Ahr Floods

Var(Vésubie) Catchment - October 2020

Duration of flash flood: few hours

Time period of the storm: 2nd-3rd(night) October

Low-pressure conditions, high wind, heavy and stormy rainfall

High intensity rainfall, short duration storm

October 2nd: storm happens

Estimated discharge: river Vesubie 700 m3/s

Ahr Catchment - July 2021

Duration of flood: 14 hours

Time period of the storm: 13th-15th July

Recurrent, persistent and heavy rainfall caused by low-pressure

Extreme precipitation in wet soil - Duration

July 14th: maximum rainfall recorded

Estimated discharge at gauge: 400-700 m3/s

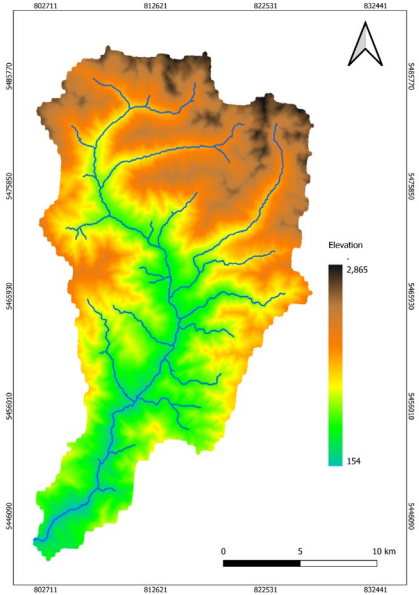
Recap of the Var(Vésubie) and Ahr Floods

Var(Vésubie) Catchment - October 2020

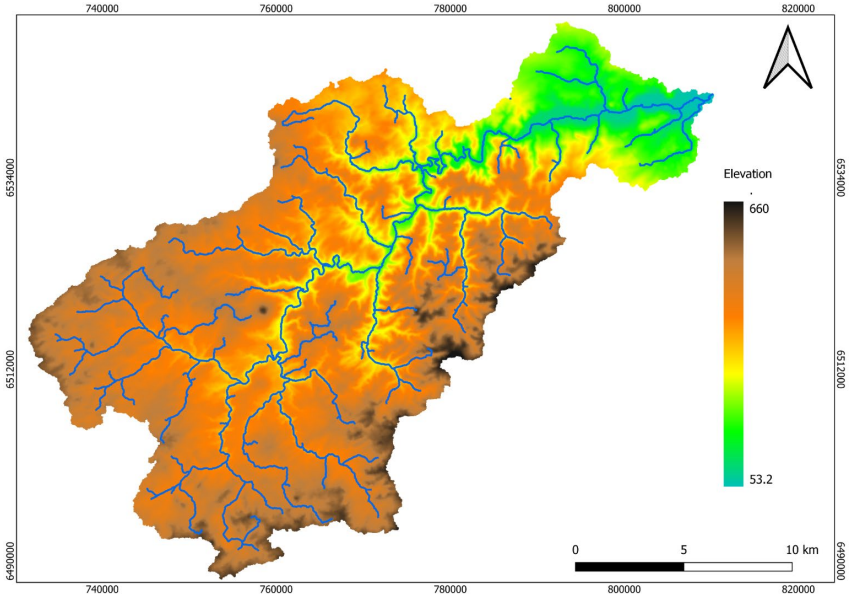
Ahr Catchment - July 2021

Catchment Comparison - Elevation

Var(Vésubie)

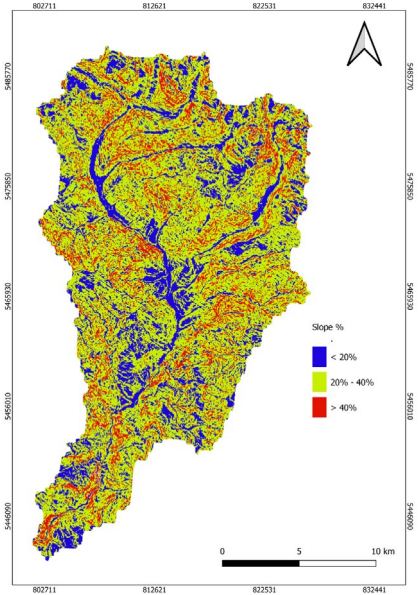


Ahr

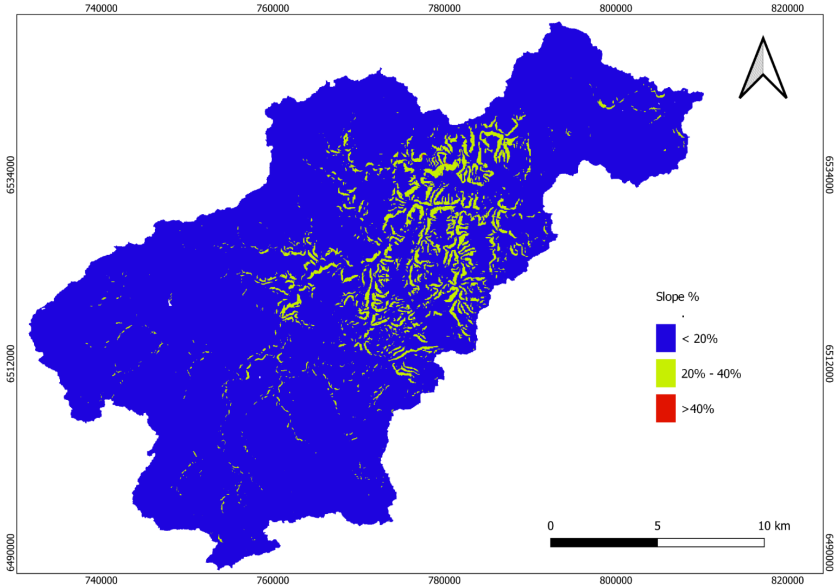


Catchment Comparison - Slope

Var(Vésubie)

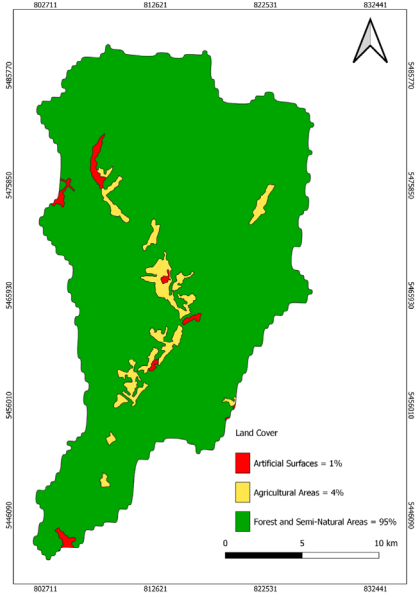


Ahr

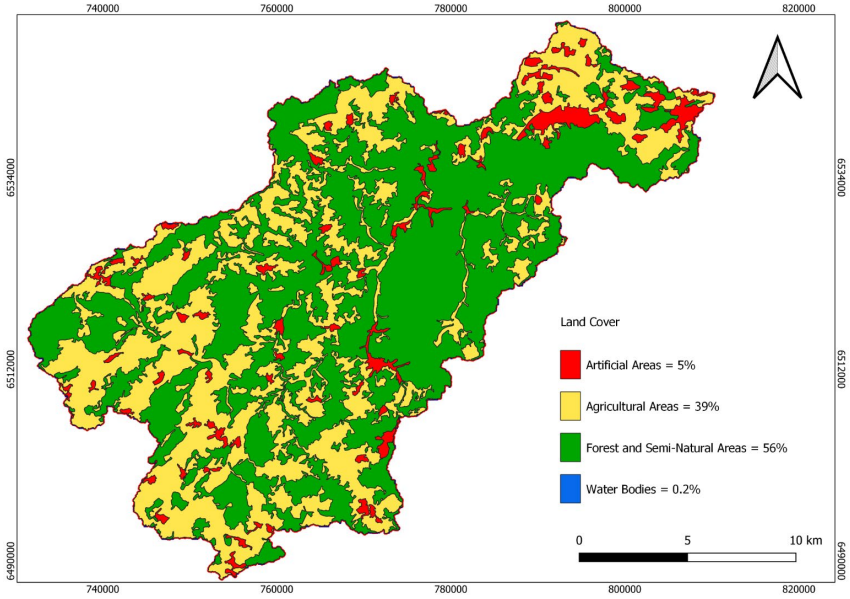


Catchment Comparison - Land Use

Var(Vésubie)

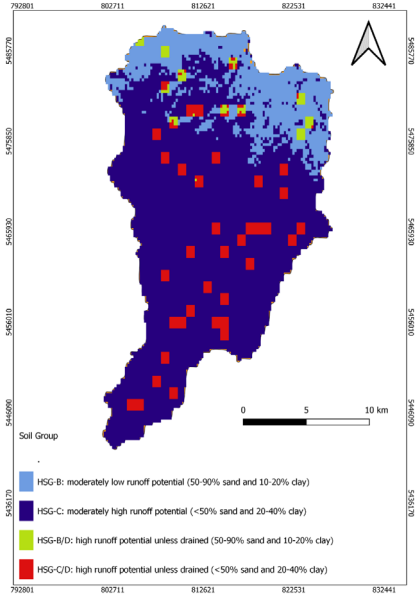


Ahr

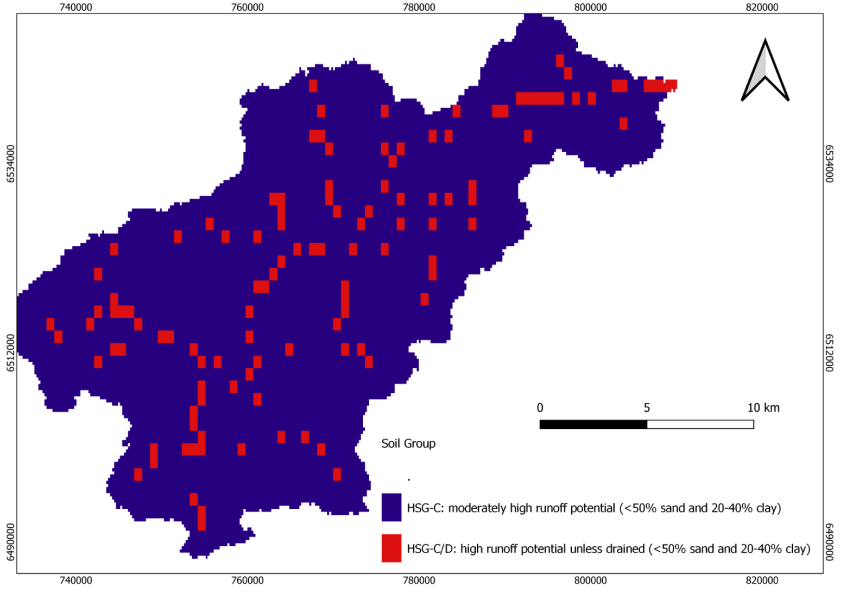


Catchment Comparison - Soil Type

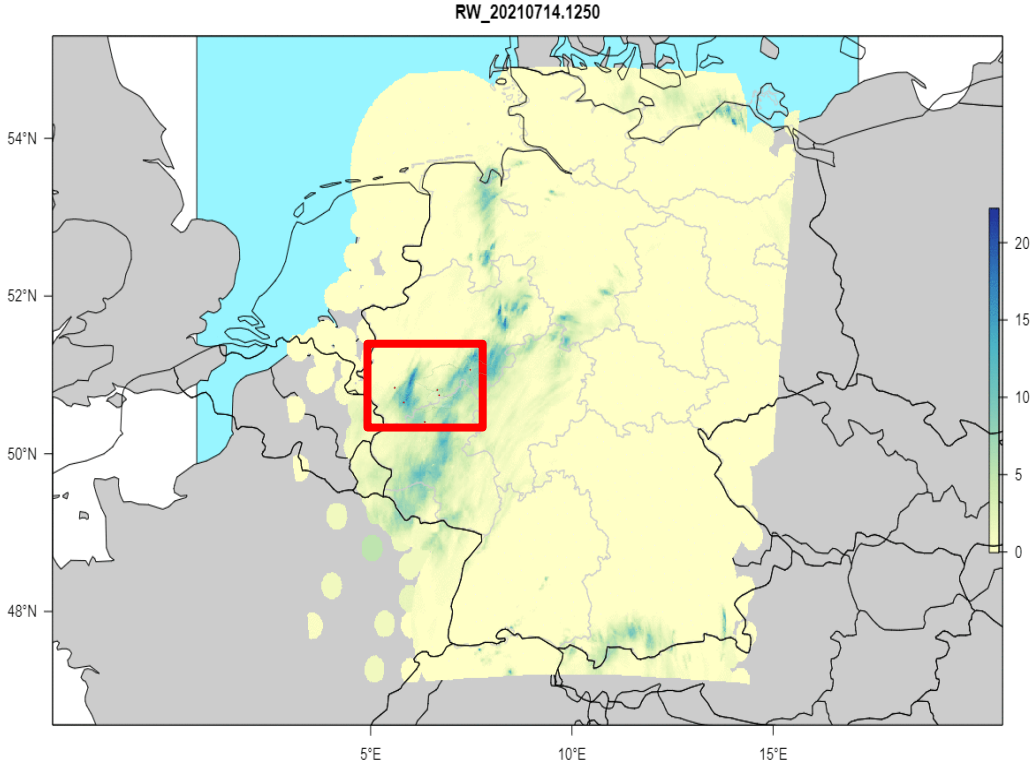
Var(Vésubie)

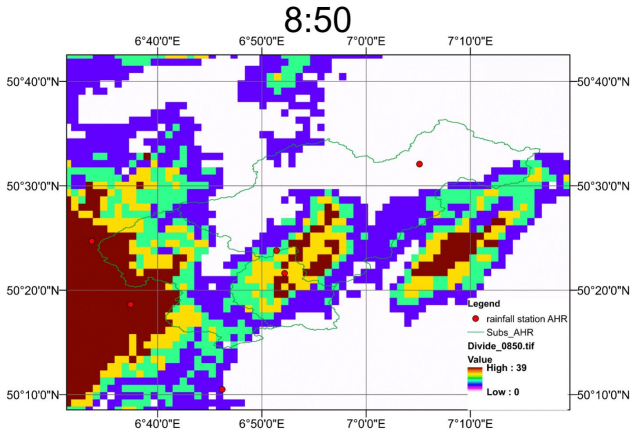


Ahr



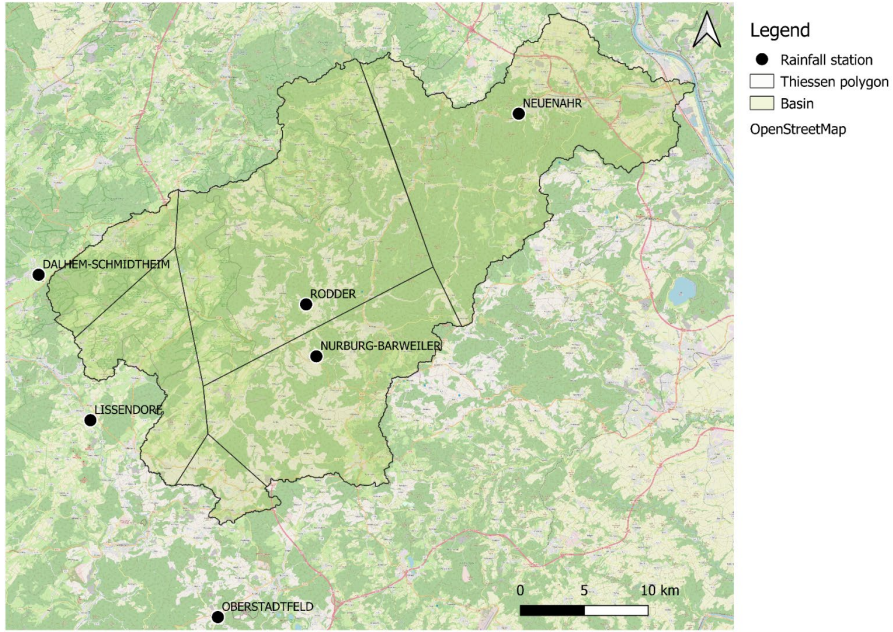
Precipitation analysis





14 July 2021

Precipitation analysis



Ahr catchment

Var catchment

Precipitation analysis *Arh catchment*

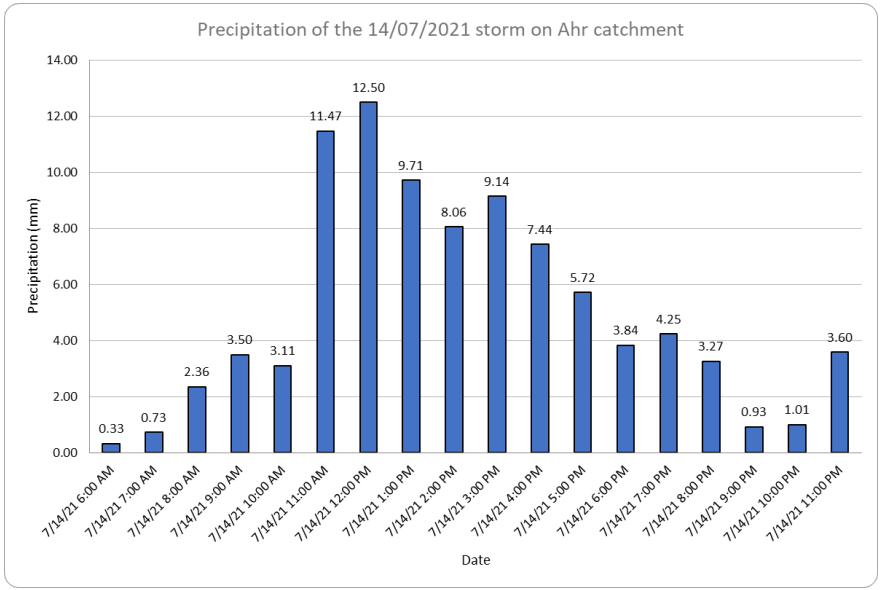
Station	Area (km2)	Area %	Volume (m3)	Return period (years)	Rainfall 14/07/2021			
					Total precipitation (mm)	Average (mm/h)	Maximum in 1h (mm)	Duration (h)
Dahlem - Schmidtheim	51	6	7 109 774	Between 100 & 200	138.3	2.56	23.1	54
Lissendorf	88	10	11 909 429	100	135.2	2.5	20.3	54
Neuenahr	265	29	23 982 062	50	90.5	1.93	14.5	47
Oberstadtfeld	25	3	2 839 868	87	112.3	2.44	15.6	46
Nurburg - Barweiler	182	20	18 404 545	135	101.4	2.36	18.9	43
Rodder	288	32	32 177 994	200	111.8	2.43	18.9	46

IDF curve

Gumbel (standard normal law)

Precipitation analysis

Precipitation comparison

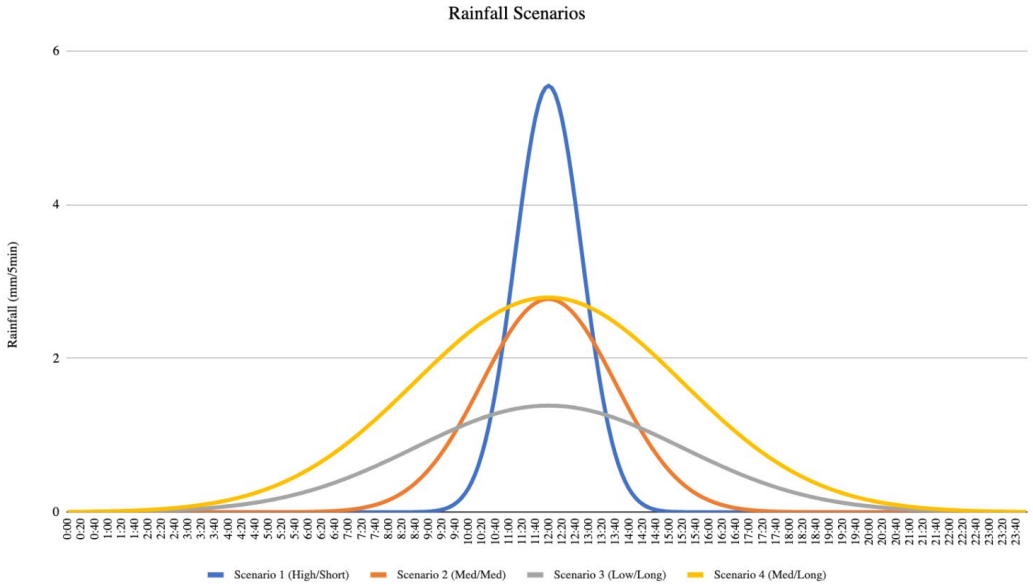


Ahr catchment

- Precipitations : 63 at 90 mm/h (max)
- Total precipitations : 250 at 500 mm
- Return period : 500 years

Var catchment

Temporal Variations



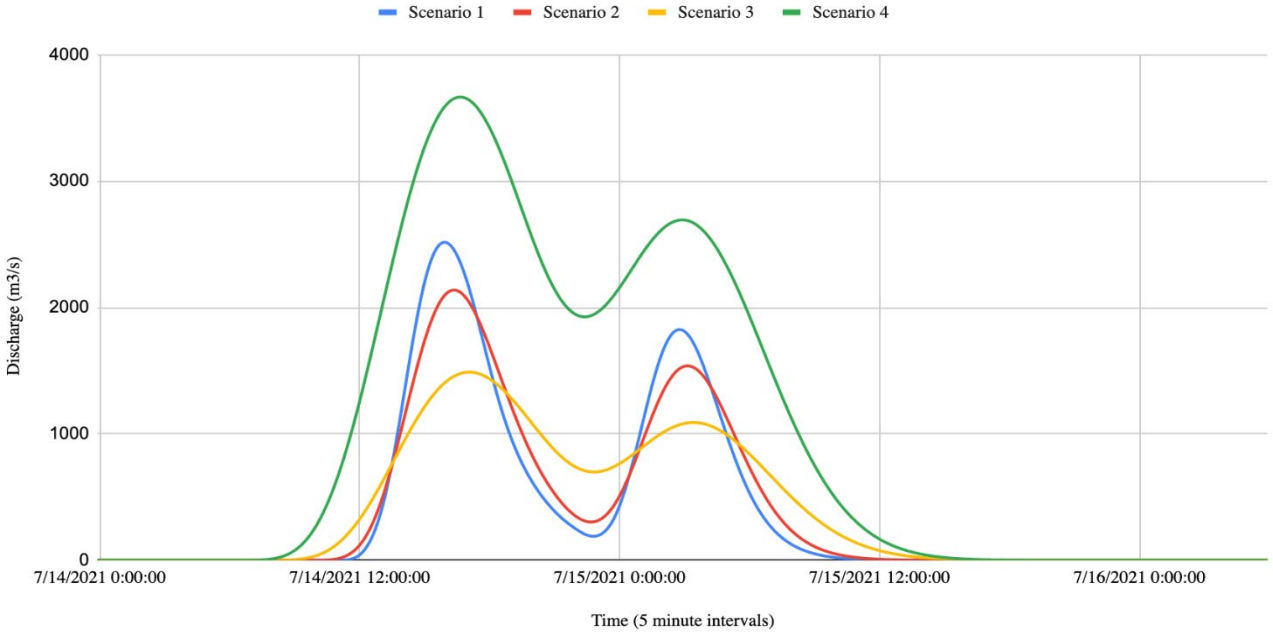
- High intensity - Short duration
- Medium intensity - Medium duration
- Low intensity - Long duration
- Medium intensity - Long duration *

*Higher total rainfall

Results

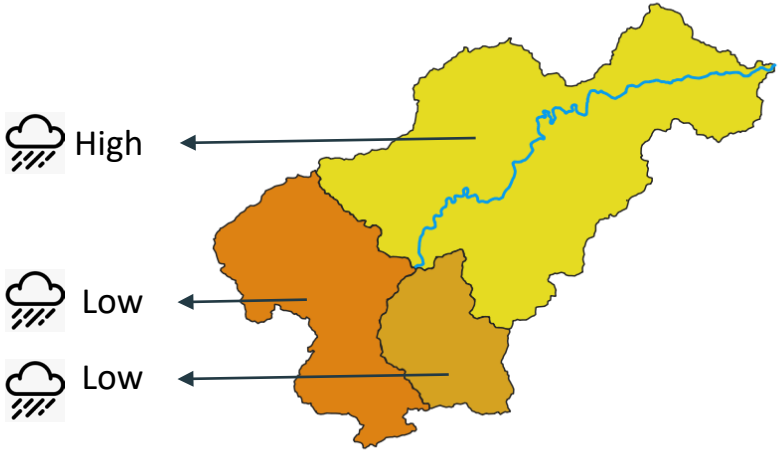
	Intensity Change	Peak Discharge Change
Scenario 2	-36.00%	-15.00%
Scenario 3	-52.00%	-40.00%
Scenario 4	40.00%	45.00%

Discharge for Temporal variation Scenarios

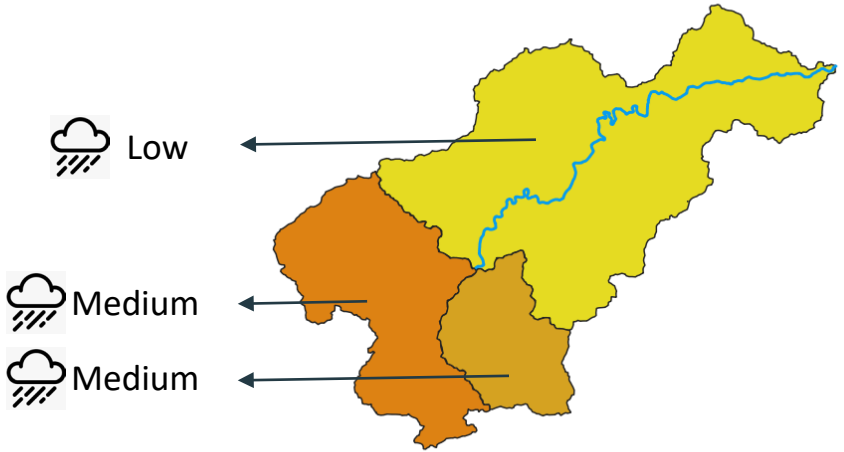


Spatial Variation

- Three hypothetical precipitation measurements applied to sub-catchments



Scenario 1

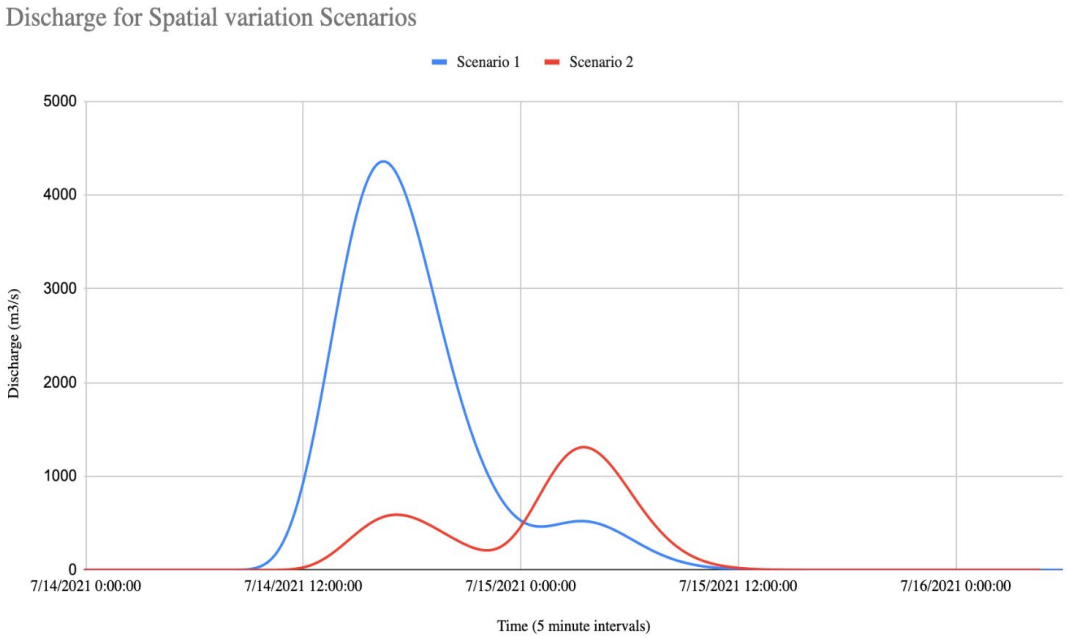


Scenario 2

Results

- Significant difference between discharge peaks of the two scenarios
- Higher peak discharge for the scenario with lower measurements upstream due to:

1. Sub-catchment Area
2. Time lag
3. Routing effect



Conclusions

- During a storm there may be much variation in the spatial distribution of rainfall within a catchment
- Rain gauges may not pick up some isolated extreme downpours captured by radar
- Intensity has a significant impact on peak flood discharge
- The spatial distribution appears to impact the peak discharge

Limitations

- The design storm simulations do not account for antecedent conditions
- The hydrological model only has 3 sub-catchments incorporated, more sub-catchments could increase accuracy
- The hydrological model was not calibrated and therefore results cannot be used to estimate actual discharges