Authors Names :

Doitrand Nicolas
Astier Kévin
Djatit Maël
Sanabria Jorge
Llerena Erika
Ezzidouni-elmimouni Marwane
Cunningham Daniel
Maldonado Pamela
Belaube Chloé
Berthier Constant
Molines Lucas
(Ayadi Oussama)

Team 03 Presentation 3

HYDROEUROPE

Presentation 3: Results of the 2nd week

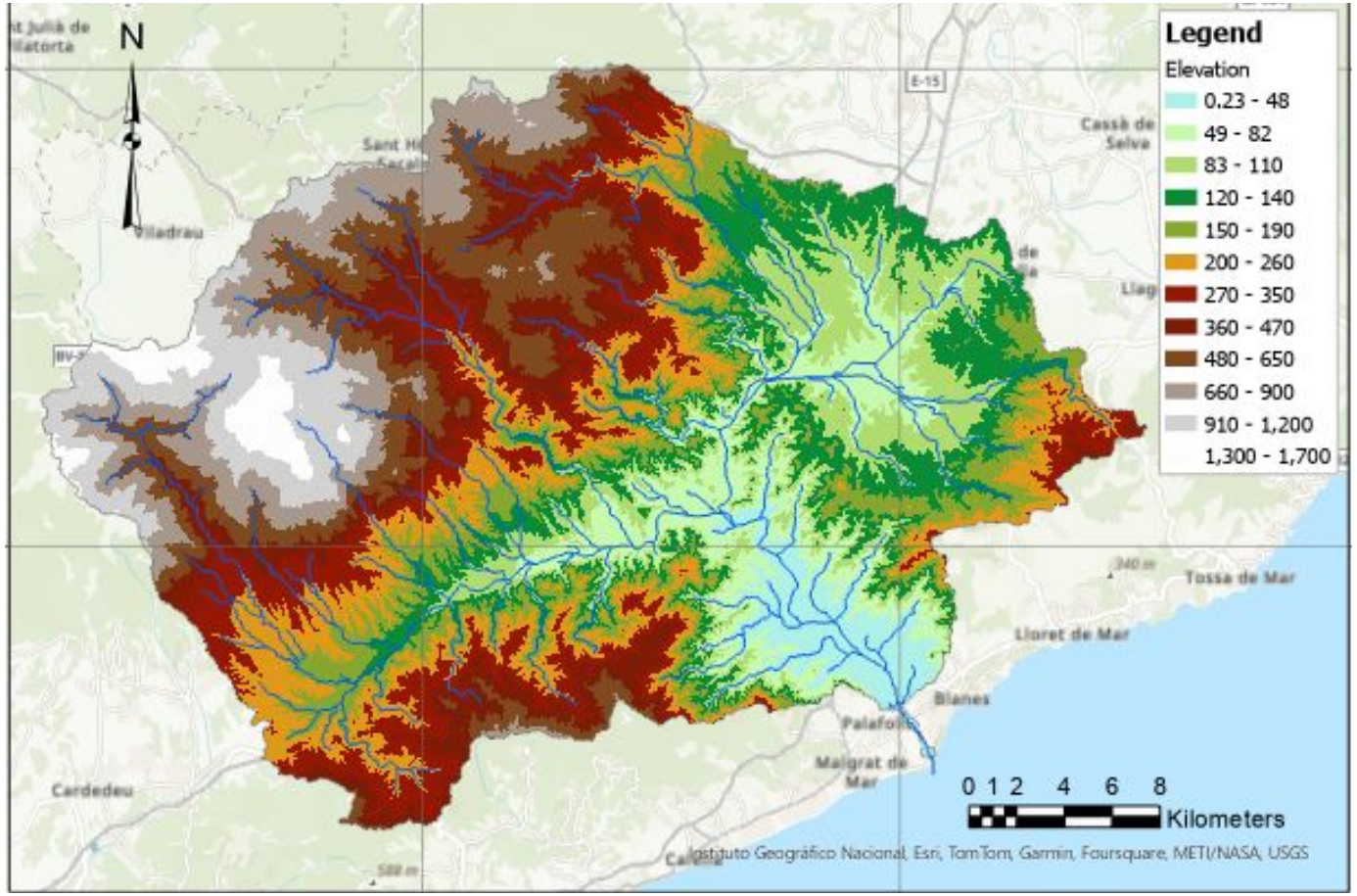
Erasmus+
UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH
VUB VRIJE UNIVERSITEIT BRUSSEL
WARSAW UNIVERSITY OF TECHNOLOGY
Newcastle University
b-tu Brandenburgische Technische Universität Cottbus - Senftenberg
UNIVERSITÉ CÔTE D'AZUR

Catchment Tordera - Team 03 Presentation

Summary :

- Located in Catalonia - Spain.
- Area: 870 km²

Climate change impacts on flash floods



Methodology

Historical data

Variables evolution assessment

Climate change projections

Frequency analysis (1984-2008):
- Historical P24h (limitations)!
- Historical Q's (limitations)!

IDF
Flooded Areas (Telemac)

Frequency analysis (2015-2100):
- P24h
- Modeled Q's (100y)
  Long-term

IDF
Flooded Areas (Telemac)

Objectives

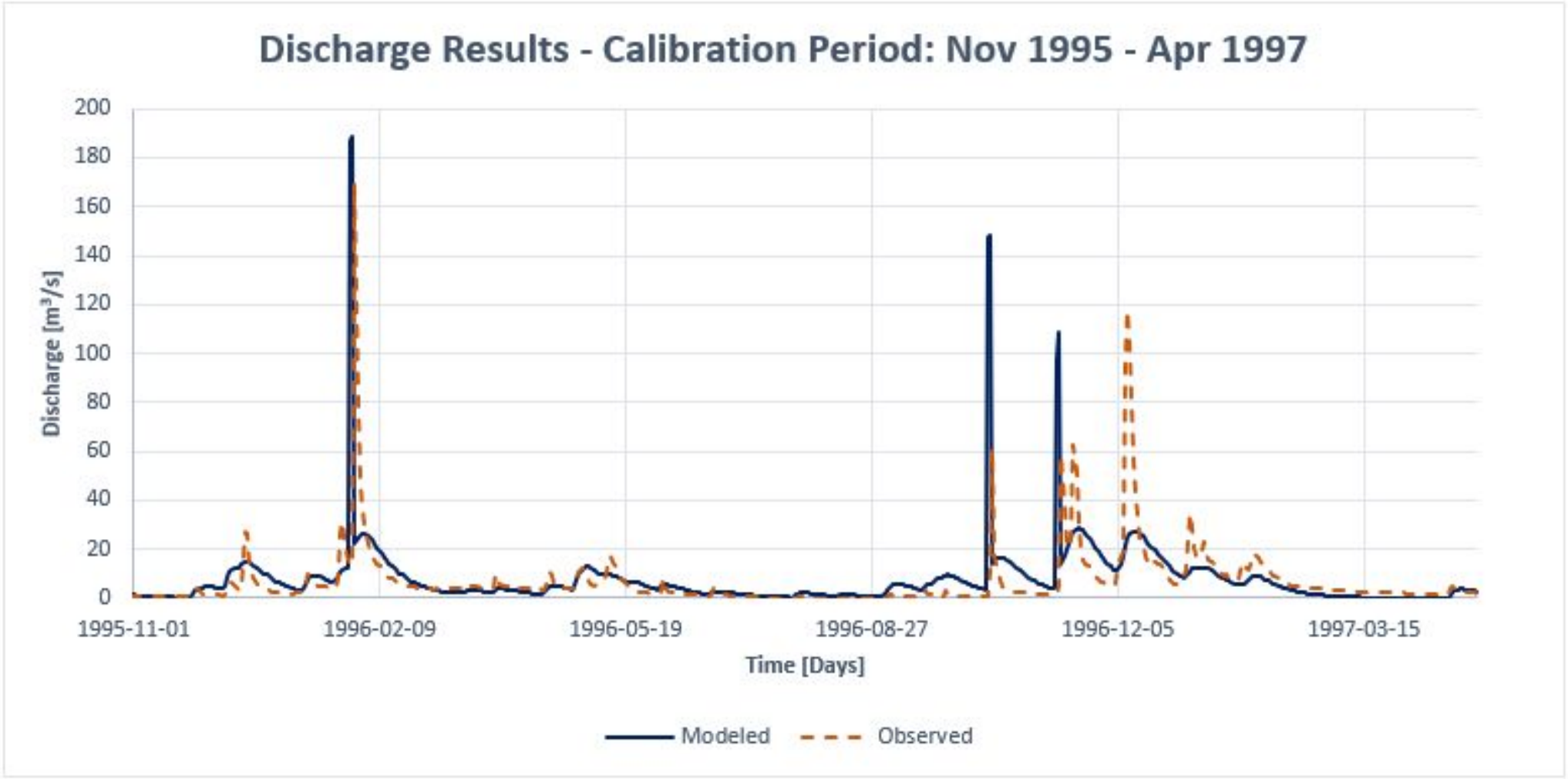
Tasks of the week :

1. Validation and calibration of Hydrological model.
2. Analyse frequency of the historical vs future projections.
3. Construction of Hydraulic model.
4. Creation of historic and projected flood risk maps.

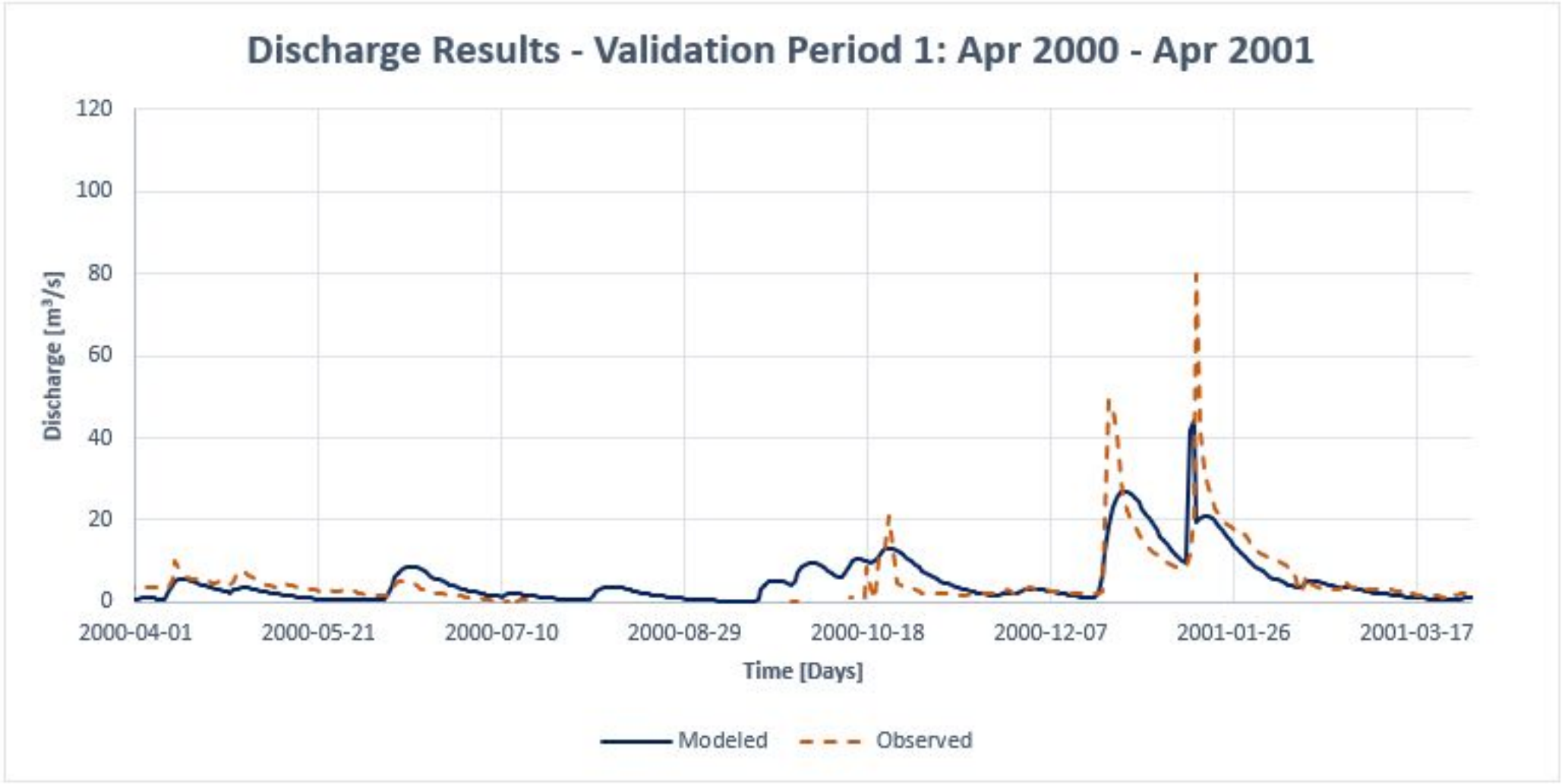
See the impact of global warming on the Tordera catchment area

“Human need to predict”

Hydrologic Model - HEC-HMS



Hydrologic Model - HEC-HMS



Hydrologic Model - HEC-HMS

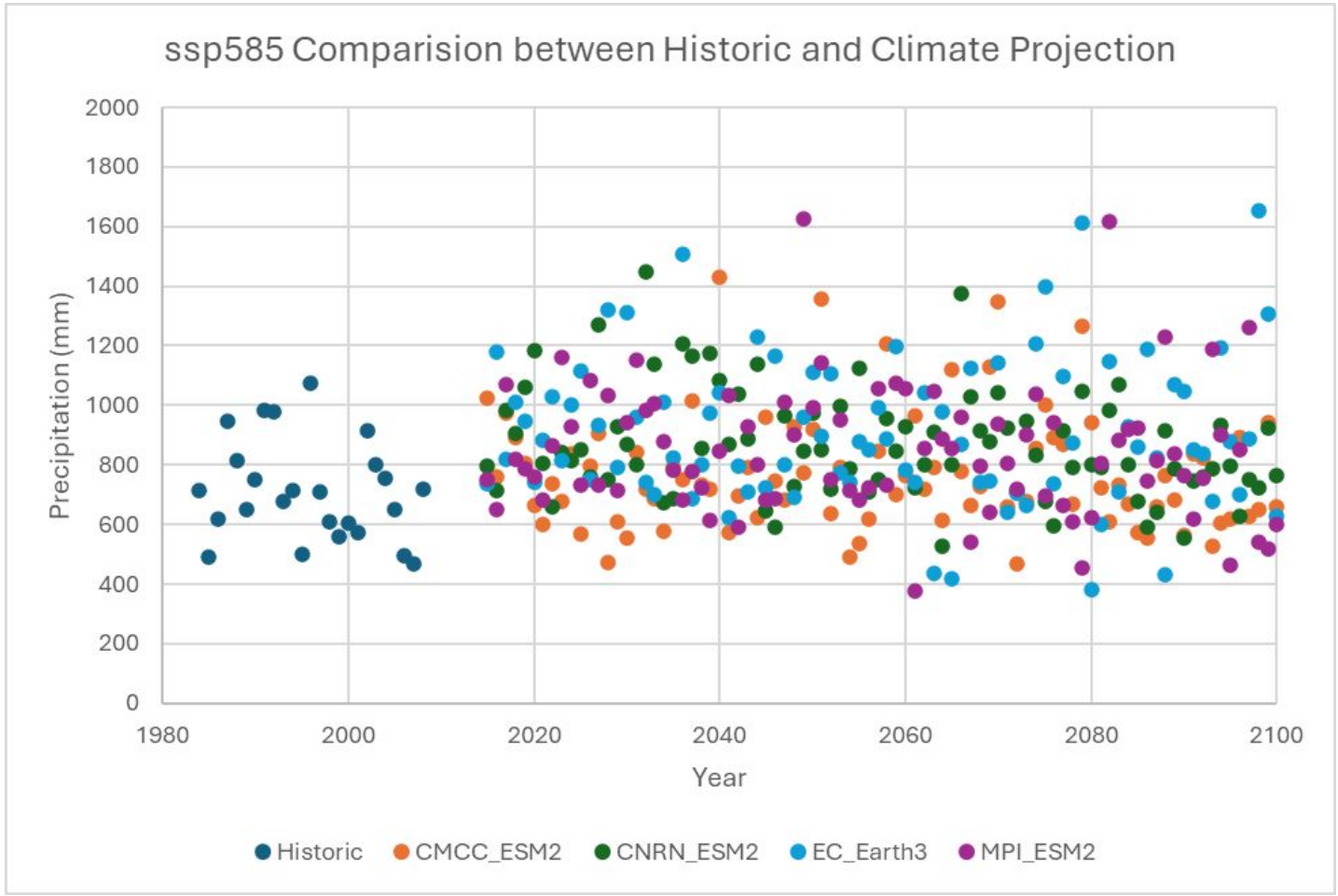
Performance Criteria

	From	To	NSE	RMSE
Calibration	1-Nov-95	30-Apr-97	-0.73	18.38
Validation 1	1-Apr-00	1-Apr-01	0.55	6.03
Validation 2	1-Mar-02	1-Jun-03	0.23	9.64
Validation 3	1-Jun-03	1-Jun-04	0.22	10.5

$$\text{NSE} = 1 - \frac{\sum_{i=1}^{n}(P_i - O_i)^2}{\sum_{i=1}^{n}(O_i - \bar{O})^2}$$

$$RMSE = \sqrt{\sum_{i=1}^{n} \frac{(\hat{y}_i - y_i)^2}{n}}$$

Climate Change - Selection of a Model (CMCC_ESM2)

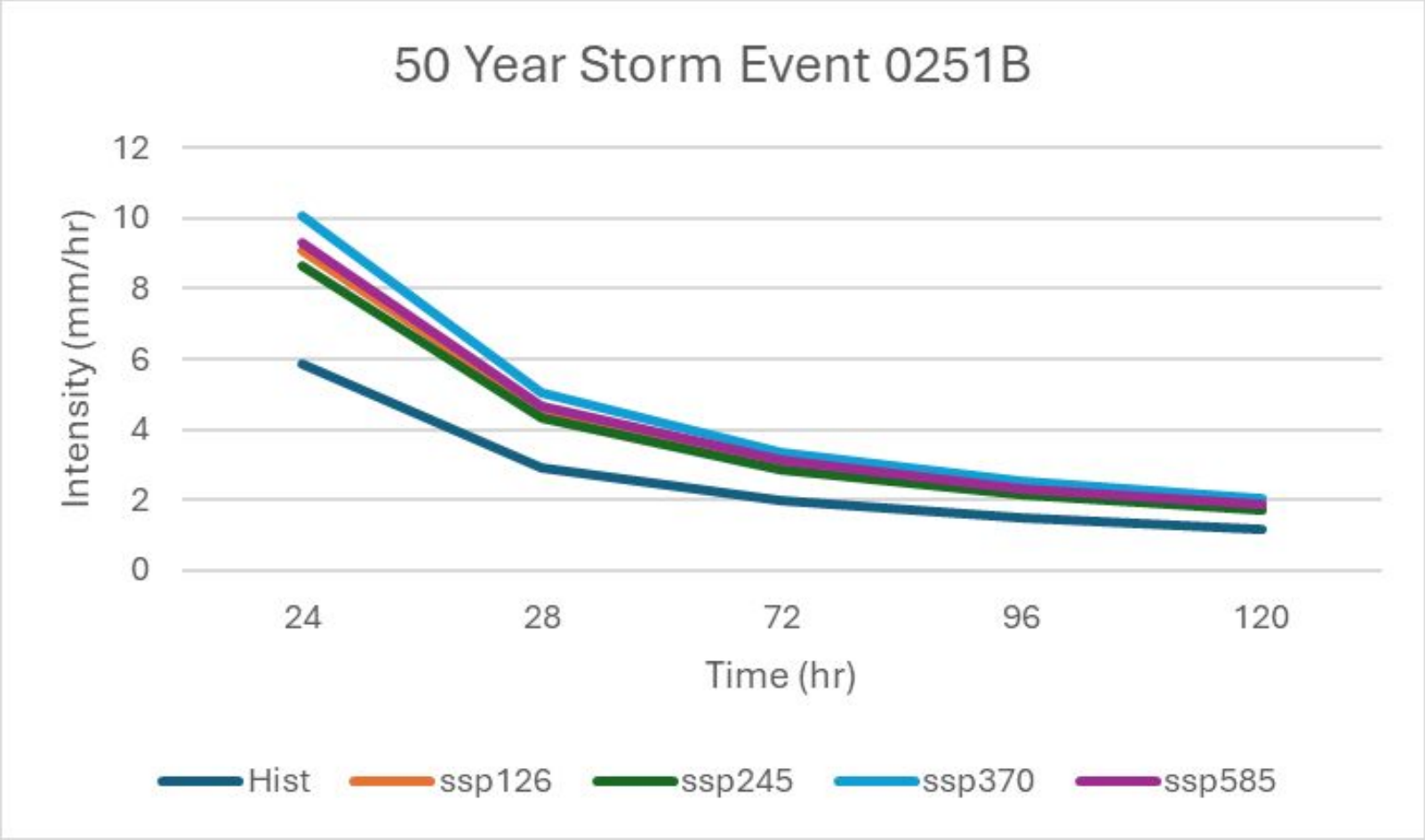


Climate Change Comparison between Historic and Climate Projection

Model	Pathway	Bias	MAE
CMCC_ESM2	ssp370	13.44	1.06
	ssp585	6.55	1.04
CNRN_ESM2	ssp370	19.68	1.09
	ssp585	33.81	1.16
EC_Earth3	ssp370	17.23	1.07
	ssp585	34.49	1.18
MPI_ESM2	ssp370	20.80	1.09
	ssp585	23.48	1.13

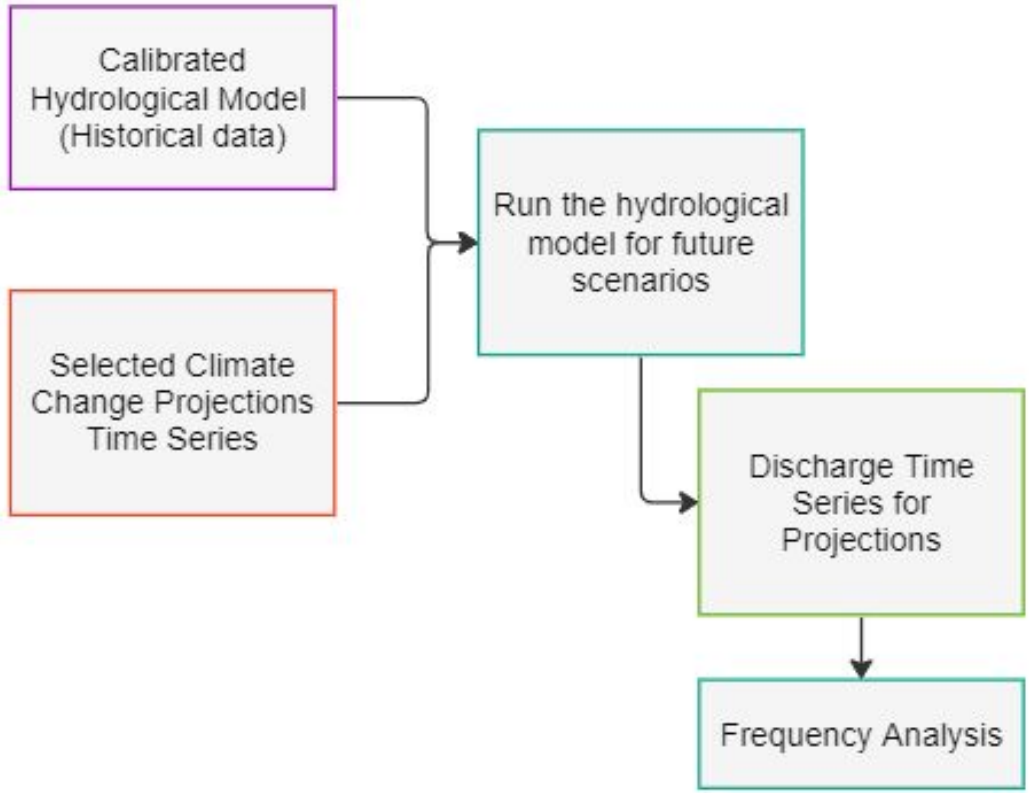
Extract of Results from Statistical Analysis

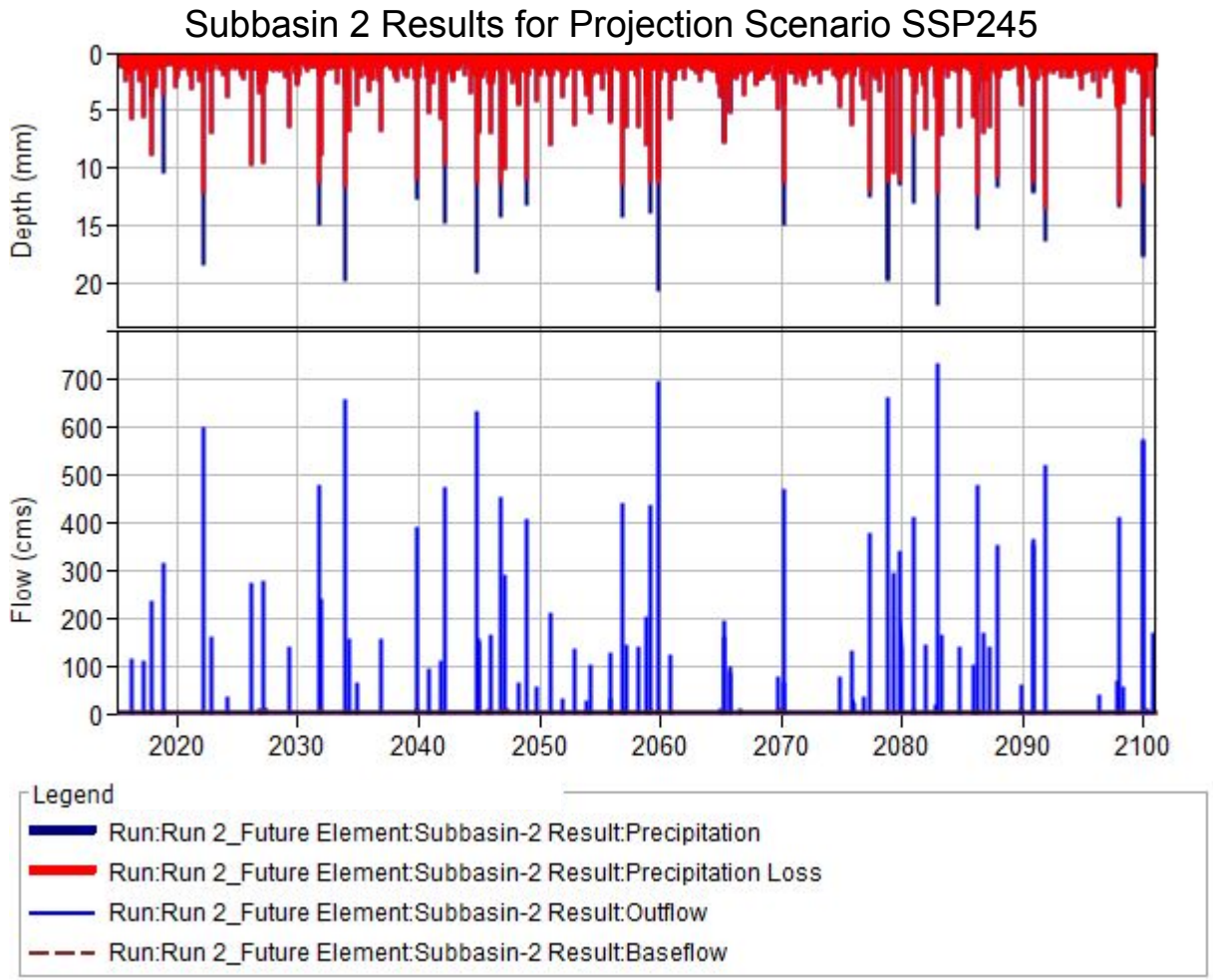
IDF Curves



IDF Curve of a 50 Year Storm Event at Station 0251B

Discharge Results for Projected Scenarios

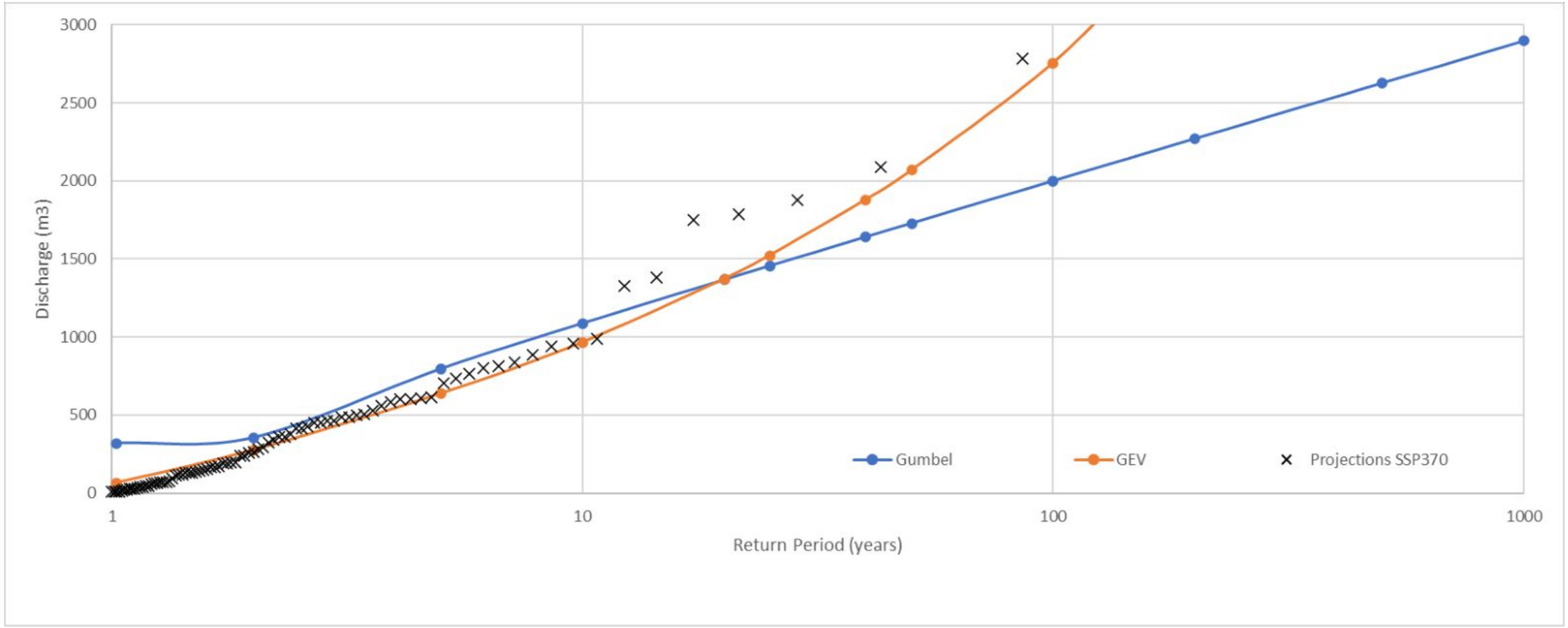




Frequency analysis Q (Historical vs CC Projections)

Historical vs Scenario ssp370

Goodness-of-Fit test Kolmogorov–Smirnov



Frequency analysis Q (Historical vs CC Projections)

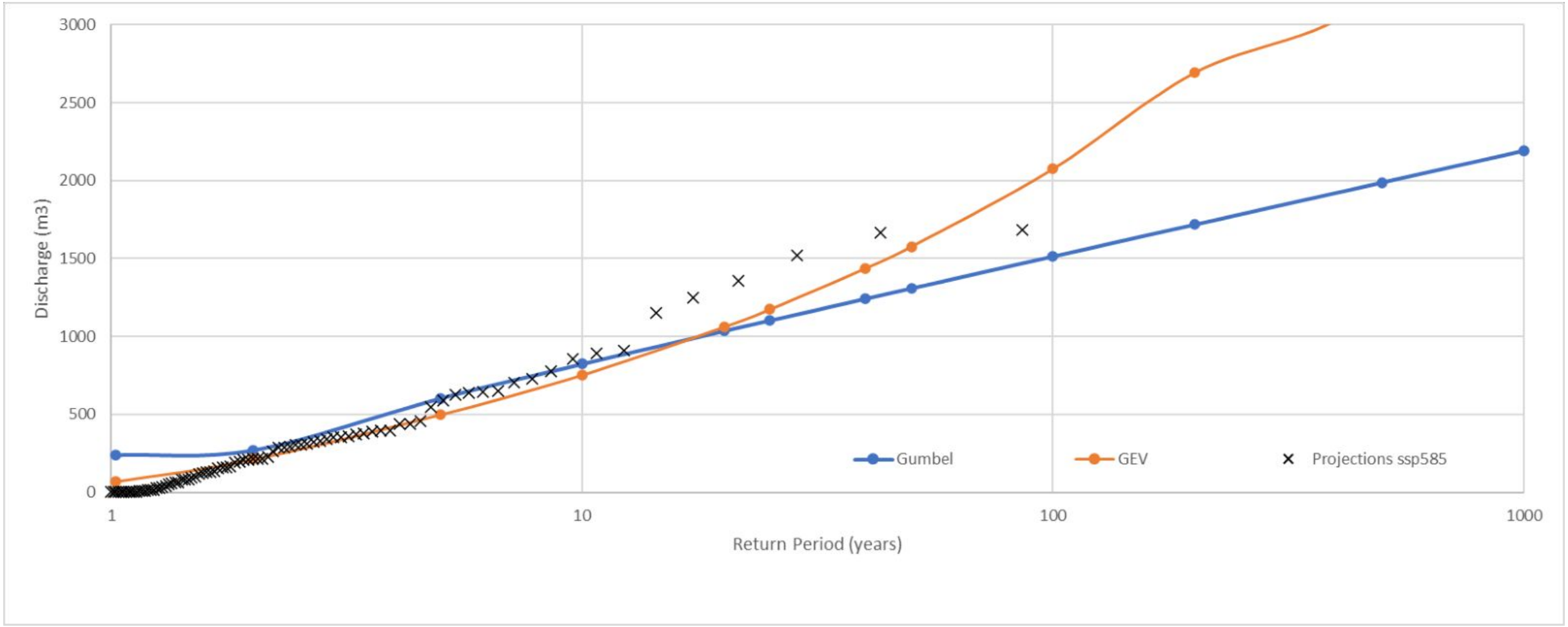
Historical vs Scenario ssp370

SSP370		
Return Period	**Gumbel**	**GEV**
2	355.04	276.6
5	795.43	638
10	1087.01	966.8
20	1366.70	1372.5
25	1455.42	1523.5
40	1641.04	1880.3
50	1728.73	2067.9
100	2000.02	2755.4
200	2270.32	3624.1
500	2626.93	4408.7

Return Period	Historical
2	69.3
5	117.5
10	144.7
20	167.8
25	174.5
40	187.8
50	193.7
100	210.7
200	255.7
500	312.5

Frequency analysis Q (Historical vs CC Projections)

Historical vs Scenario ssp585



Frequency analysis Q (Historical vs CC Projections)

Historical vs Scenario ssp585

SSP 585		
Return Period	Gumbel	GEV
2	270.42	212.5
5	603.42	499.6
10	823.90	754.2
20	1035.38	1061.6
25	1102.47	1174.4
40	1242.82	1438.4
50	1309.13	1577.5
100	1514.26	2075.7
200	1718.65	2693.1
500	1988.30	3233.1

Return Period	Historical
2	69.3
5	117.5
10	144.7
20	167.8
25	174.5
40	187.8
50	193.7
100	210.7
200	255.7
500	312.5

Hydraulic Model

Definition of the study area

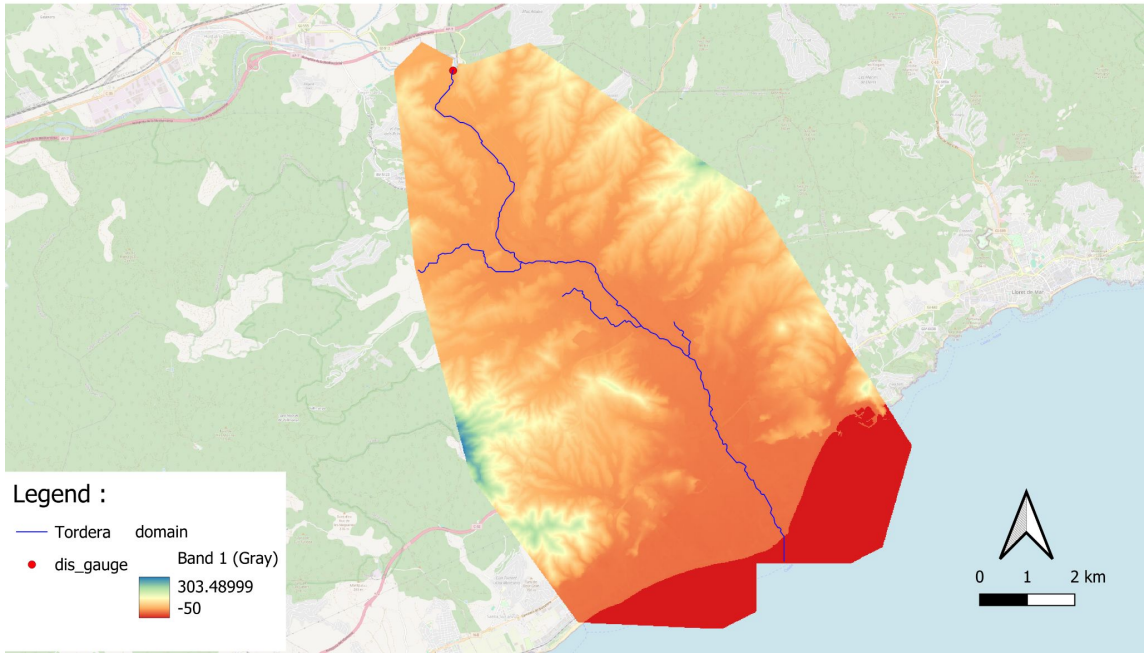
- Model the entire watershed or just the downstream section?

⇒ Downstream section

- Downstream of the catchment : business and housing areas (12 x 8 km).

- Impact of a flood of return period : 10, 20, 40, 100, 200, and 500 (historical data and climate change analysis)

Study area for the hydraulic model



Hydraulic Model

Mesh and Boundaries Conditions

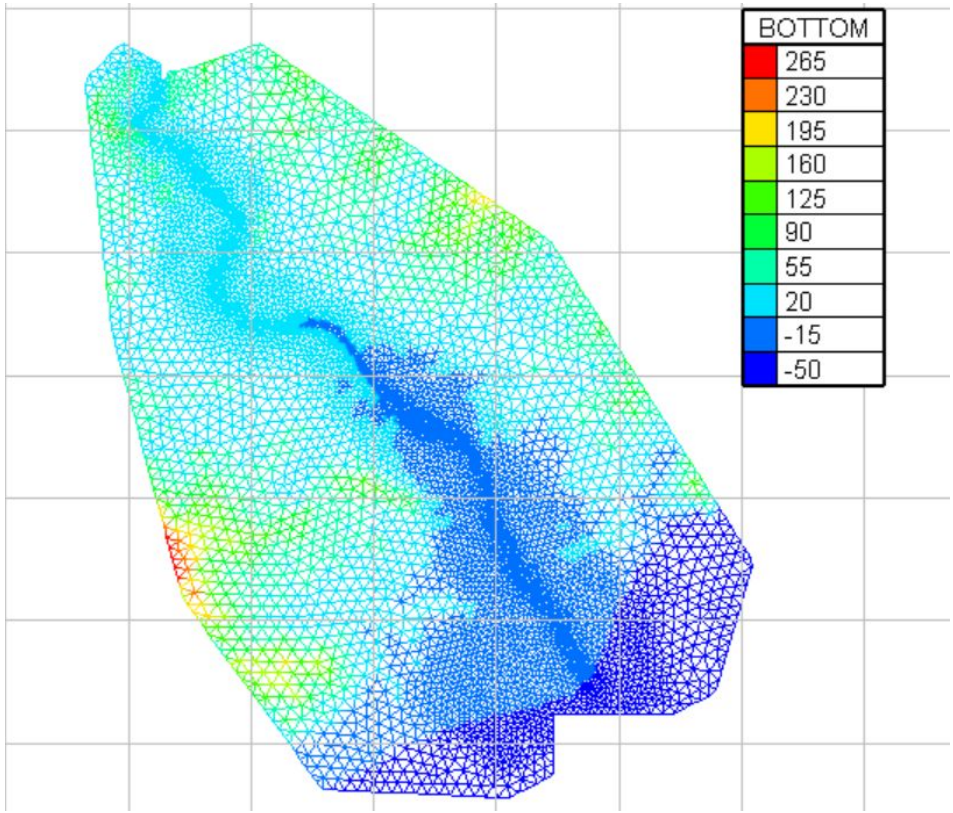


Figure : Mesh of the domaine (BlueKenue)

Boundaries Conditions :

- Upstream hydrograph
  - Steady
  - Unsteady
- Downstream sea level

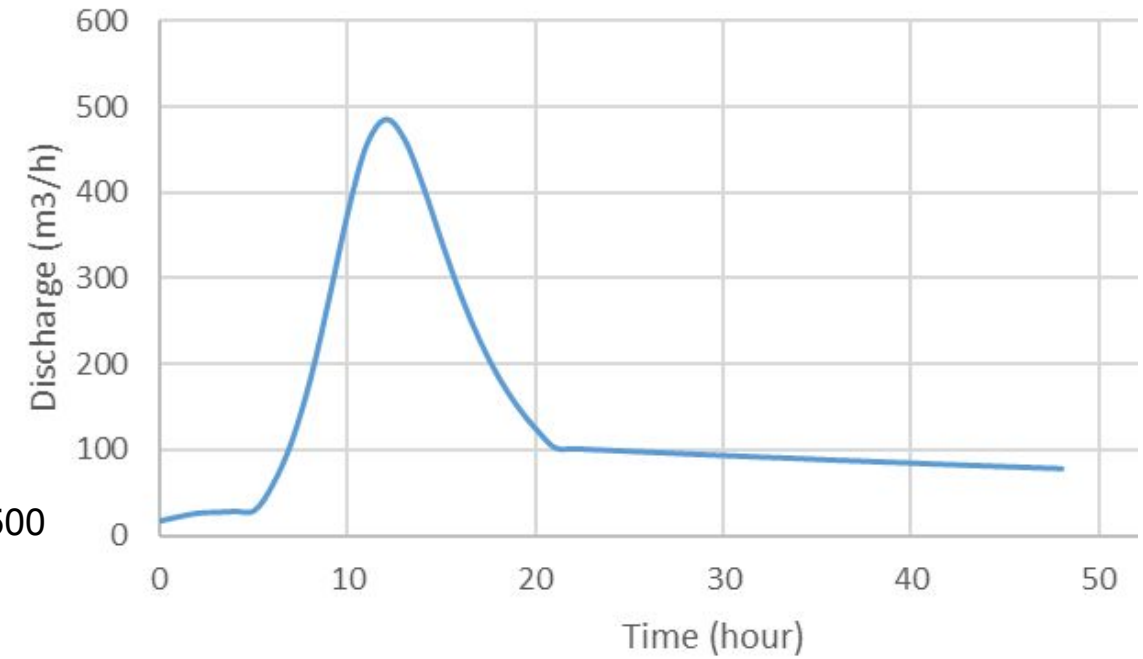
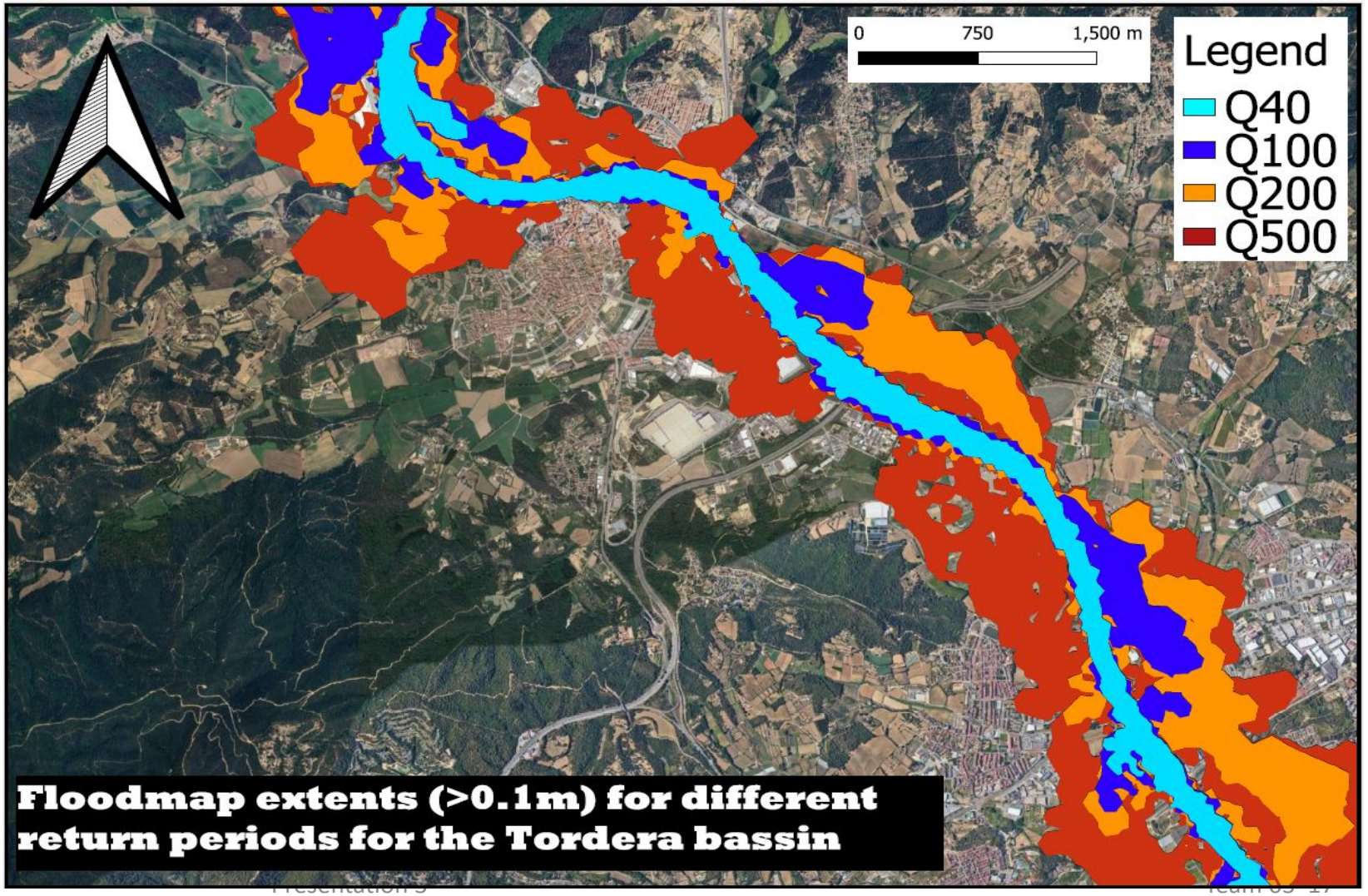


Figure : Flood hydrograph for Tr = 500 (historical values)

Hydraulic Model (historical data)

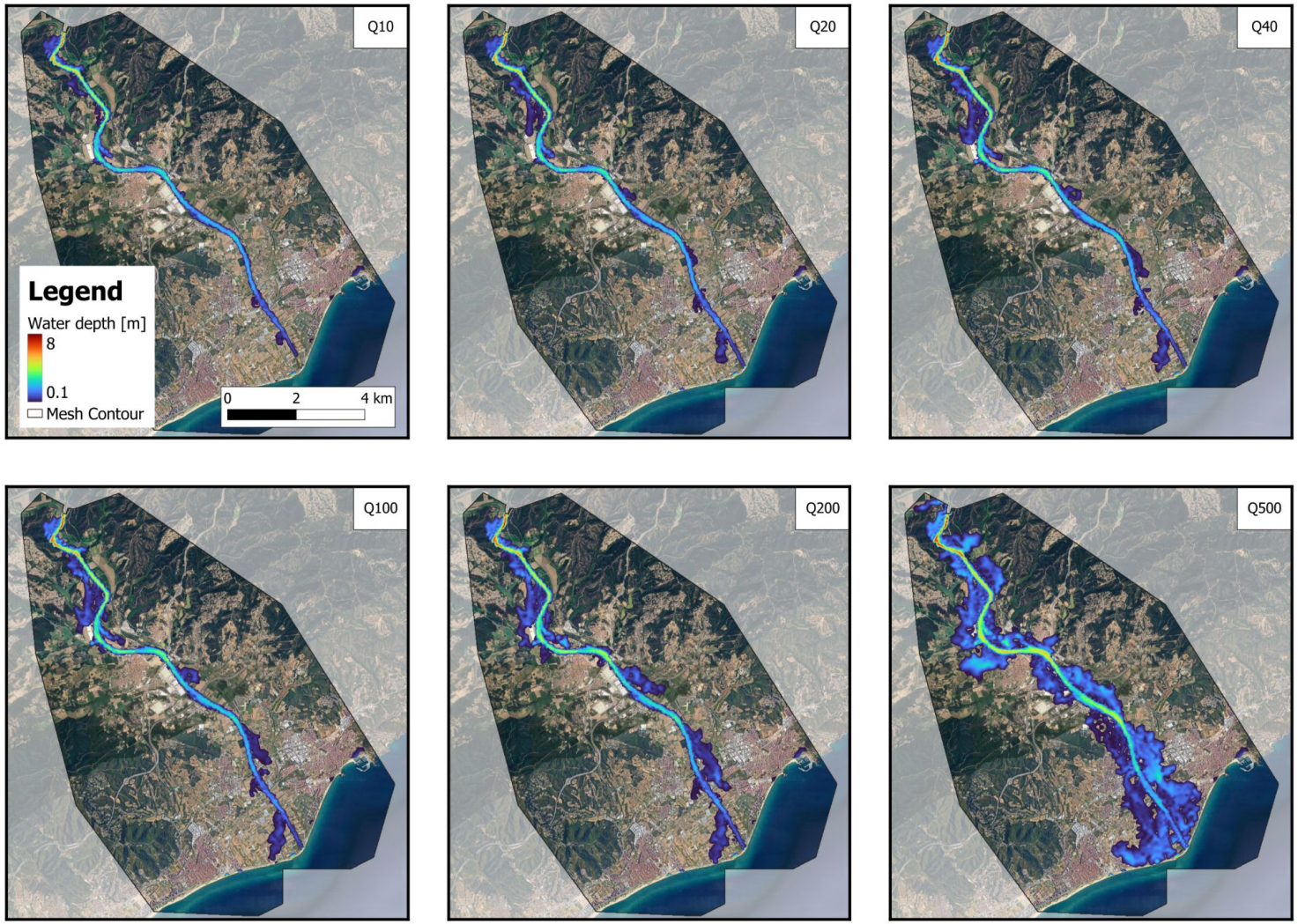
Flooded area:

- Different return periods
- Enables damage analysis
- Enables the creation of risk management plans



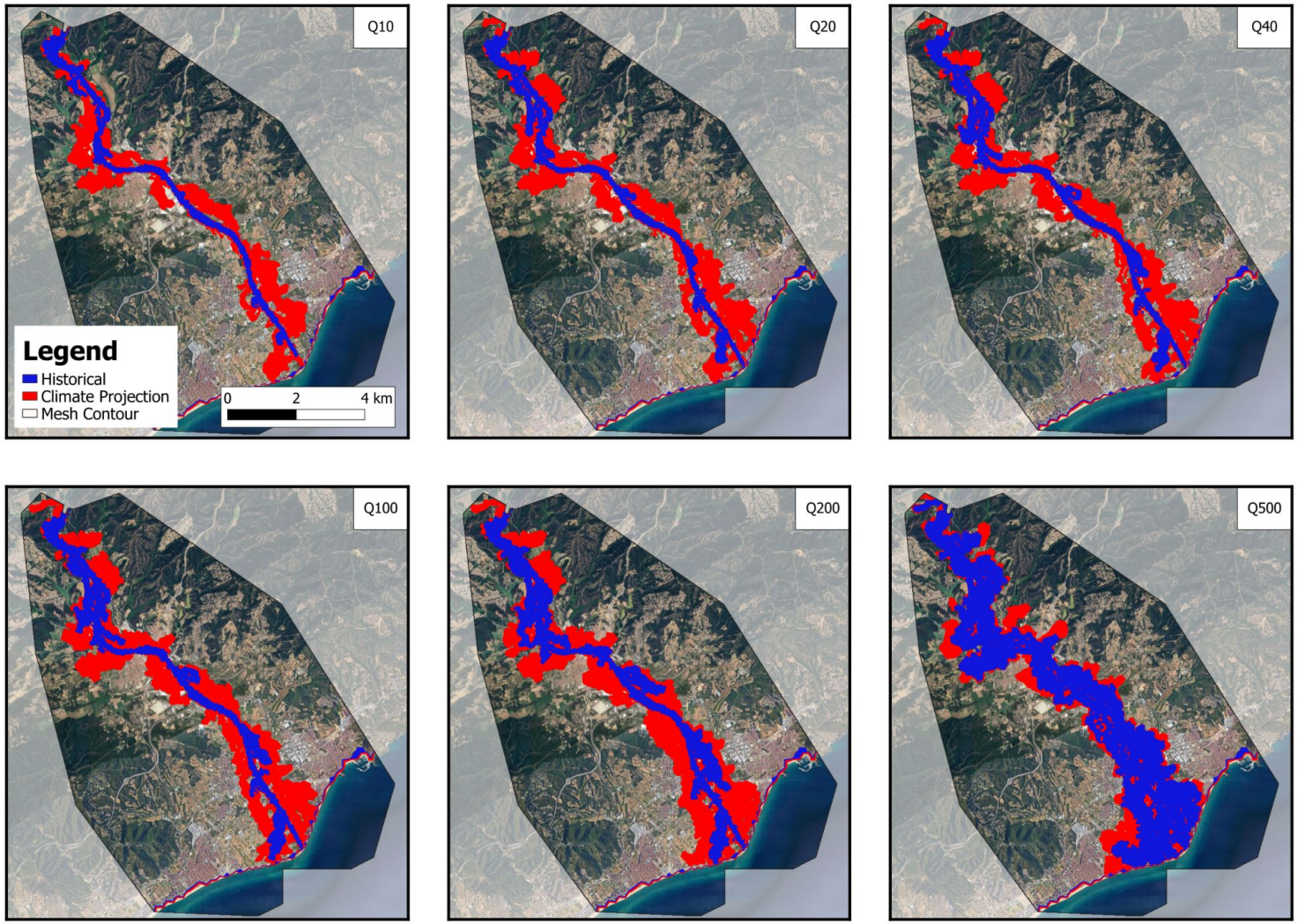
Hydraulic Model (historical data - water depths)

T (years)	Qp (m3/s)
10	287.40
20	348.14
40	407.71
100	485.66
200	544.35
500	621.80



Hydraulic Model (historical data - water depths)

T (years)	Qp (m3/s)	Qp ssp245
10	287.40	955.05
20	348.14	1179.01
40	407.71	1400.28
100	485.66	1688.77
200	544.35	1905.99
500	621.80	2192.57



Conclusions

⚠ We have to limit climate change. ⚠

- Projection of increase in P, Q, Flooded area.
- Significant (>>) difference in extreme events frequency between historical (limited amount of data) and projected scenarios (climate and hydrological models uncertainty).

Further work can be done:

- Improvement of mesh resolution for the Hydraulic Model.
- Estimation of material damages based on Catalan Administration hazard criteria and land use.

Thank you !