

Extreme precipitation and hydrological impacts: theory and applications

Dates: 10-12/6/2025 (3-day course, 9 am to 5 pm)

Organizers: Nadav Peleg, Francesco Marra

Venue: Eawag, Dübendorf. Room - FX B01

Summary

Several natural hazards are initiated and exacerbated by extreme precipitation events, including flash floods that occur in mountainous catchments and urban areas. Identifying the probability of occurrence and magnitude of extreme precipitation events, as well as how they are expected to change with climate change, is crucial for planning mitigation measures that can potentially mitigate the expected damages and risks. Furthermore, it is important to translate right the impact of these precipitation events into hydrological hazards. This can be obtained by analyzing extreme precipitation values, computing precipitation frequency curves, and then strategically selecting extreme precipitation events to simulate the precipitation-flood response. In this three-day course, students will be introduced to the concepts of extreme value analysis and will learn how to analyze precipitation extremes using both traditional and state-of-the-art methods that were developed in recent years. Further, students will be introduced to the concept of precipitation intensification in relation to climate change, as well as novel methods for quantifying the effects of climate change. As a final step, we will demonstrate how to transition from extreme precipitation predictions to flood assessments by utilizing novel statistical tools and incorporating them into flood inundation models.

Program

Day 1 (10/6)	General introduction to precipitation extreme value analysis		
08:30 – 08:50	Coffee and gathering		
08:50 – 09:00	Course introduction: from extreme precipitation to hydrological impacts		Peleg
09:00 – 10:15	1 Introduction to extreme value theory	Lecture	Marra
10:30 – 11:45	2 Parameter estimation methods	Lecture	Marra
11:45 – 13:00	Lunch break		
13:00 – 14:45	Computing frequency curves using peaks over threshold and annual maxima	Exercise	Peleg
15:00 – 15:45	3 Precipitation physics 101	Lecture	Marra
16:00 – 17:00	4 Frequency curves for future climates: traditional and GWL approaches	Lecture	Peleg
Day 2 (11/6)	State-of-the-art EVA methods for precipitation analysis		
08:30 – 09:00	Coffee and open discussion on your ongoing Ph.D. work		Peleg/Marra
09:00 – 10:15	5 Non-asymptotic approaches	Lecture	Marra
10:30 – 11:45	Computing frequency curves using SMEV and uncertainty estimation	Exercise	Marra
11:45 – 13:00	Lunch break		
13:00 – 13:30	Computing frequency curves using SMEV and uncertainty estimation - continue	Exercise	Marra
13:30 – 14:15	6 Global warming and precipitation intensification	Lecture	Peleg
14:30 – 15:30	7 The TENAX model	Lecture	Marra
15:45 – 17:00	Computing future frequency curves using TENAX	Exercise	Peleg
Day 3 (12/6)	From precipitation extremes to hydrological extremes		
08:30 – 09:00	Coffee and open discussion on your ongoing Ph.D. work		Peleg/Marra
09:00 – 09:45	8 The effect of modeling choices on updating IDF curves for climate change	Lecture	Cook
10:00 – 10:45	9 Introducing climate uncertainties into extreme precipitation analysis	Lecture	Peleg
11:00 – 11:45	10 Forecasting hydrological extremes: WG, TENAX-CDS, and Copula-based models	Lecture	Peleg
11:45 – 13:00	Lunch break		
13:00 – 14:15	Simulating realistic design storms: a joint return period approach	Exercise	Cache
14:30 – 15:15	10 Novel tools for flood modelling and assessment	Lecture	Leitão
15:30 – 16:15	11 Projected changes in short-duration precipitation extremes along the Alps	Lecture	Peleg
16:15 – 16:30	Conclusions		