Extreme short-duration precipitation and hydrological impacts: theory and applications

Dates: 29/9-1/10/2026 (3-day course, 9 am to 5 pm)

Organizers: Nadav Peleg, Francesco Marra

Venue: ETH, Zurich. Hönggerberg campus, HIF building, room – D 80.2

Summary

Several natural hazards are initiated and exacerbated by extreme short-duration precipitation events, including debris flows, shallow landslides, and 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 alter with climate change, is crucial for planning mitigation measures that can potentially reduce the expected damages and risks. At the same time, it is important to translate 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, you will be introduced to the concepts of extreme value analysis with a specific focus on the case of precipitation, and you will learn how to analyze short-duration precipitation extremes using both traditional and state-of-the-art statistical approaches developed in recent years. Further, students will be introduced to the concept of precipitation intensification in relation to climate change, as well as the most advanced 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 advanced statistical tools and how to incorporate them into flood inundation models.

Program

Day 1 (29/9)	**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 – 13:15	Lunch break		
13:15 – 13:45	**3** Computing frequency curves using POT and annual maxima methods	Lecture	Peleg
13:45 – 14:45	**4** Precipitation physics 101	Lecture	Marra
15:00 – 15:45	Km-scale modeling of short-duration extreme precipitation events	Seminar	Prein
16:00 – 17:00	Assessing IDF and DDF for precipitation and streamflow	Exercise	Peleg
Day 2 (30/9)	**State-of-the-art EVA methods for precipitation analysis**		
08:30 – 08:45	Coffee and open discussion on your ongoing Ph.D. work		Peleg/Marra
08:45 – 09:30	**5** Frequency curves for future climates: traditional and GWL approaches	Lecture	Peleg
09:30 – 10:45	**6** Non-asymptotic approaches	Lecture	Marra
11:00 – 11:45	**7** Stochastic approaches for simulating rainfall extremes	Lecture	Peleg
11:45 – 13:15	Lunch break		
13:15 – 14:45	Computing frequency curves using SMEV and uncertainty estimation	Exercise	Marra
14:45 – 15:30	**8** Global warming and precipitation intensification	Lecture	Peleg
15:45 – 16:30	**9** Using temperature as a physical covariate: the TENAX model	Lecture	Marra
Day 3 (1/10)	**From precipitation extremes to hydrological extremes**		
08:30 – 08:45	Coffee and open discussion on your ongoing Ph.D. work		Peleg/Marra
08:45 – 09:30	Computing future frequency curves using TENAX	Exercise	Marra
09:30 – 10:00	Estimating extreme rainfall intensification in the tropics	Seminar	Blagojevic
10:00 – 10:45	**10** Forecasting hydrological extremes: continuous vs design storm approaches	Lecture	Peleg
11:00 – 11:45	Monsoon flood hazard under climate change	Seminar	Ragettli
11:45 – 13:15	Lunch break		
13:00 – 14:30	Simulating realistic design storms: a joint return period approach	Exercise	Peleg
14:30 – 15:15	**11** Assessing rainfall intensification in space and time	Lecture	Peleg
15:30 – 16:00	**12** Projected changes in short-duration precipitation extremes along the Alps	Lecture	Peleg
16:00 – 16:30	Future challenges and conclusions		Peleg/Marra