EGU2020-498
https://doi.org/10.5194/egusphere-egu2020-498
EGU General Assembly 2020

Characterization of extreme meteo-hydrological events in the Alpine Region: historical picture and future scenarios

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In the European Alps, climate change has determined changes in extreme precipitation and river flood events, which impact the population living downstream with increasing frequency. The objectives of our work are:

- to determine what types of precipitation extremes and river flood events occur in the Alpine Region, based on their generating mechanisms (e.g., frontal convergence storms, convective storms, snow-melt floods, rain-on-snow floods, short and long rain floods, flash floods, ...)
- to determine the spatial and seasonal distribution of these event types (e.g., their dependence on elevation, geographical location, catchment size, ...) and how precipitation extremes relate to the floods they produce (e.g., the role of snow precipitation and accumulation)
- to determine whether the event type distribution is changing and will change in the future (e.g., due to climate change).

To these aims, we will compile and analyze historical time series of precipitation and discharge in order to identify events in terms of intensity, duration, and spatial extent. We will use the ETCCDI indices as a measure of the precipitation distribution and hydrograph separation techniques for flow events, following the methodology of Tarasova et al. (2018). We will then characterize each event in terms of generation mechanisms. Furthermore, we will analyze the frequency and magnitude of the different event types in different locations and time of the year and determine whether clusters exist by applying automatic techniques (e.g. K-means clustering algorithm). Finally, we will correlate statistics of precipitation and flood event types with climate indices related to large scale atmospheric circulation, such as Atmospheric Blocking, NAO, etc. (Ciccarelli et al. 2008). Results will be then used for the projection of future storm and flood scenarios.

We will first apply the methodology in Piedmont by comparing the station-based time series with the NWIOI dataset (ARPA Piemonte) and reanalysis datasets by ECMWF (ERA5, ERA5-Land). We will use a rainfall-runoï¬€ model at the daily and sub-daily timescale, through calibration at the regional scale, useful for the simulation of soil saturation and snowpack. We expect to find a statistical correlation between the different datasets, but with changing statistical features over space and time within the single datasets. We aim to provide a detailed picture of the different types of events according to the spatial location and season. The results will be useful, from a

scientific perspective, to better understand storm and flood regimes and their change in the Alpine Region, and, from a practical perspective, to better mitigate the risk associated with the occurrence of extreme events.

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