



Areas prone to recent drought and heavy rainfall events: case studies in the Western Emilia-Romagna Apennines, Italy.

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The provinces of Piacenza and Parma make up the western sector of the Emilia-Romagna region (Italy). In the last four years, this area has been interested by heavy rainfall events and a severe drought :

1. October, 13th, 2014, Parma province. Heavy rainfall, lasting 6 hours and moving from mountain to plain areas, occurred; peak recorded intensity of 82 mm/h. Among the effects: crisis of small catchment basins in mountain areas; debris flow and erosive phenomena affecting streams and minor river courses. Main river courses were interested by floods, among them the Po River which receives the tributaries within Parma province. The city of Parma had some districts submerged itself.

2. September 13th-14th, 2015, Piacenza province. Heavy rainfall, lasting 6-7 hours, affected highly elevated catchment basins in mountain areas. Among the effects: crisis of small, steep-slope catchment basins; widespread development of more than 300 debris flow accumulations, affecting river courses (1st to 3rd order, according to Strahler's classification); floods with debris loading in hilly and plain areas. Intensity exceeding 100mm/h, the threshold of 30mm/h, considered as a benchmark for intense precipitations was overcome 47 times.

3. In June 2017 drought emergency was officially declared in the Piacenza and Parma provinces, due to the scarcity of precipitations since October 2016, coupled with high temperatures in Spring and early Summer. In hilly and mountain areas of Piacenza and Parma provinces, precipitation loss was estimated in 300-400 mm with respect to mean values referred to the period 1991-2015. Drought affected the whole region, as the scarcity of rainfall lasted nearly until the end of 2017, before the first snowfalls, but had peak effects in Piacenza and Parma provinces.

To study the climate setting and effects of these hydrological extremes, interdisciplinary collaboration based on Climate and Earth Sciences was carried out by ARPAE- Servizio Idro Meteo Clima and Servizio Geologico, Sismico e dei Suoli of Emilia-Romagna Region. The results aim at matching applicative purposes, among them early warning, prevention and mitigation.

Events were analysed in terms of geographic extent, classification of damages, monetary value of interventions. Studies on small mountain catchment basins were carried out for case 2, with highlights on case 1, evidencing both precipitation and geological-morphological preparing factors to mass transport of alluvial deposits. As far as the case 3, attention is focused on the role of springs as early warning check-points, due to discharge variations recorded in the first stages of the 2017 drought, 3-4 months earlier than the emergency was declared.