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Extreme precipitation events over Northern Italy and their link with the large-scale dynamics

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Accurate and timely prediction of high impact weather, and in particular extreme precipitation events (HPe) , is essential to limit losses of life and property. Although predictability is fundamentally limited by the chaotic nature of the atmosphere, researches in atmospheric dynamics have provided new insights into the processes that limit the accuracy of forecasts, which may be of significant use in operational practice. The aim of this Transfer project (T1), founded by the DFG in the framework of Waves to Weather (W2W), is to evaluate and review some processes based measures of predictability, and to combine them, in the attempt to formulate a new forecasting methodology, specifically thought for HPe.

Here we present results concerning the first part of the project that is dealing with identification, classification and study of HPe over Northern-Central Italy, one of the regions in Europe with the highest frequency of disaster induced by heavy precipitation.

The statistics of past HPe has been investigated using the high resolution precipitation dataset ArCIS (Climatological Archive for Central Northern Italy) that for the first time gather together a very high number of daily, quality controlled and homogenized, observation from different regional networks of 11 italian regions. Gridded precipitation is aggregated over Italian operational warning-area units (WA). HPe are defined as events in which a daily average precipitation is greater than 99° percentile (climate reference 1979-2015), at least over one of the 94 WA considered. A list of 637 independent dates, merging consecutive days and aggregating WA above 99° threshold, has been found in the period.

The seasonal distribution of HPe is bimodal, with a first moderate peak in spring and a very pronounced peak in autumn between October and November. The sharpness of the autumn peak suggest a particularly strong synergy, in this time of the year, from the large-scale forcing, induced by incoming Rossby waves, and favorable warm and moist boundary layer conditions. The strong linkage between the large scale dynamics is measured by a significant correlation of HPe and integrated water vapor transport (IVT) which, over south-facing side of the Apennines and the Alps, reach an R2 close to 0.5. The robust relation between HPe and high values of IVT sets the ground for the second part of the project which will be focus on the predictability contribution of Rossby Wave Packets in setting up the intense moisture transport associated with Hpe.