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Weather circulation patterns as precursor of heavy rainfall events: an application to Sicily, Italy

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Since the impacts of climate change on the environment have been constantly rising over the last decades, scientists have paid much attention to understanding the effects of this phenomenon. Climate change leads to different kinds of extremes, such as heavy rainfall events, characterized by short duration and high intensity, and drought, which can cause the problem of water scarcity over a certain area. These types of extreme events cause several damages for the affected areas since they can result in loss of human lives and economic damages. In particular, heavy rainfall events, which are often associated with convective precipitation because of their characteristics, may result in flash floods, especially when they hit small catchments with low times of concentration, thus causing economic damages and, more relevantly, human lives losses.

The increasing occurrence of heavy rainfall events in many areas of Europe, also in Italy, over the last few years, has contributed to raising the importance of understanding which factors could be recognized as drivers of these events. In this perspective, it is possible to identify in atmospheric circulation one of the causes of severe rainfall events occurrence since some air fluxes, generated from certain schemes of atmospheric circulation, could lead to the accumulation of moisture within a certain volume of the atmosphere, hence to the occurrence of rainfall.

Since even the Sicily (Italy) has been experimenting heavy rainfall events and consequent flash floods and urban floods in the last years, this work aims to find out a relationship between some weather circulation patterns, developed by the UK Met Office, and the rainfall Annual MAXima (AMAX) for the Sicily, recorded by the rain gauge network of Autorità di Bacino - Regione Siciliana. The possible connection between AMAX and WPs has been investigated in order to define some specific schemes of atmospheric circulation that are responsible for leading to the occurrence of AMAX in Sicily. In order to do this, a database containing the AMAX of all the available gauges for the Sicily has been used. A distinction between AMAX occurred in summer and winter season and their related WPs has been performed as well, with the goal to understand the possible influence of WPs on the summer and winter AMAX. Furthermore, in order to distinguish convective from stratiform AMAX, some analyses on reanalysis data, namely the CAPE and the Vertical Integral of Divergence of Moisture Flux (VIDMF), have been done.