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Weather circulation patterns associated with extreme precipitation events in Italy

Wazita Scott, Marco Gaetani, and Giorgia Fossier

IUSS Pavia, Department of Science Technology and Society, Italy (wazita.scott@iusspavia.it)

In the last years, many countries in Europe have been experiencing an increased frequency of extreme precipitation leading to natural disasters like floods and landslides. In Italy, the majority of the country's natural disasters have been related to extreme precipitation. Floods and landslides have led to the country experiencing great loss in its social and economic structure. Early warning systems are important to stakeholders such as Disaster Risk Managers to make informed decisions in relation to a forecasted disaster.

Extreme precipitation is often associated with specific circulation patterns. Precursor information about atmospheric circulation patterns can therefore act as an indicator of an oncoming extreme precipitation event. The objective of this work is to identify the weather circulation patterns associated with extreme precipitation events over Italy.

E-OBS precipitation datasets were used to identify the most intense extreme precipitation events for each season for the period 1990-2020 across Italy. Mean sea level pressure and 500 hPa geopotential height from the ERA5 dataset were used to identify circulation anomalies associated with the extreme events. The analysis is performed by clustering extreme precipitation events into three homogeneous climatic zones in Italy defined following the Köppen-Geiger classification.

Results show that extreme precipitation events are always associated with an intense low pressure system located within the Euro-Mediterranean region. Depending on the location of precipitation extremes across different climatic zones, low pressure location changes, also modifying the atmospheric circulation and the associated moisture transport. Namely, for precipitation extremes occurring in the Italian peninsula, the low pressure is located in central-western Europe, while for extremes in Sardinia and Sicily, low pressure is in the Mediterranean.