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A statistical analysis of compound drought-landslide events in Italy

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Compound hazards represent a major challenge in hydrogeological risk analysis, as the co-occurrence of extreme conditions can generate complex and non-intuitive impacts, sometimes exceeding those produced by isolated extreme events. This preliminary study investigates the statistical relationship between droughts and landslides in Italy, with the aim to quantify the marginal and conditional probabilities associated with their co-occurrence and, thus, assess the relevance of drought–landslide compound events. The proposed analysis uses the historical series of Standardized Precipitation Evapotranspiration Index (SPEI), provided by the European Drought Observatory at multiple temporal scales, and the historical landslide occurrences provided by the ITALICA national catalogue. Specifically, for the analyzed period 1996–2021, a landslide–SPEI database is constructed by associating each grid cell in which at least one landslide occurred in the corresponding SPEI time series. As expected, a decrease in landslide frequency is observed during drought conditions. However such a frequency remains non-negligible, highlighting the need for multiple risk management strategies.