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Climatology of high-impact weather events in the Ligurian Sea

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Extratropical cyclones are the main drivers of mid-latitude weather and they are the key synoptic phenomena that give rise to the areas of strong instability by the passage of their associated fronts. The importance of studying their characteristics in terms of development, trajectories and spatio-temporal distributions, has long been recognized over the last decades. Similarly, research of extreme events associated with extratropical cyclones has gained even more importance in the last years because of the increasing confidence that these weather systems are being affected by climate change. This relationship between extratropical cyclones and ongoing climate change might amplify their negative impacts on the largely populated midlatitude areas in the near future. To overcome time-consuming and subjective analyses of extratropical cyclones by manual analysis of synoptic maps, several numerical algorithms have been developed and used to identify and track cyclones. The procedures vary greatly with respect to computational details and the degree of sophistication involved. In many cases cyclonic cores are defined in terms of pressure minima at sea level, while in other cases they are alternatively defined in terms of maxima in low level vorticity. For this analysis, an algorithm originally developed for the identification and tracking of cyclones and pressure depressions in the Southern Hemisphere is applied to the Mediterranean region, which is considered as one of the major climatic hot spots in the world and one of the most prominent areas around the globe in terms of high-impact weather phenomena. The main goal of the current research is to derive a climatology of all cyclones and pressure depressions passing over the western Mediterranean that subsequently affect the Ligurian region and its surroundings. Several studies demonstrated that the specific geography of this area in the Mediterranean enhances the formation of intense cyclones associated with heavy rainfalls and windstorms. More precisely, the morphological characteristics of the area serve as a natural constraint to the air flows that blow from the southern quadrants and thereby creates convergence zones at low levels that affects the behaviour of meteorological structures at mesoscales. Our aim is to better understand the atmospheric conditions at larger scale that provide the necessary ingredients for the development of strong high-impact weather events. Moreover, we are interested in determining if these events have a trend in terms of their frequency and intensity, as well as a trend in the development of specific recurrent synoptic patterns that trigger mesoscale phenomena associated with high-impact weather in this area. In this sense, one of the goals of the present analysis will be to investigate the means by which the ongoing global warming causes variations of cyclonic properties and to what extent these variations affect the mesoscales associated with high-impact weather events in the region of interest.