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Climatology of hail in Portugal and consistency with atmospheric circulation

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An analysis of hail climatology in mainland Portugal is carried out. For that purpose, a network of 15 meteorological stations, maintained by the Portuguese weather service and for the period 1971–2009 (39 years), are used. Three hail sub-classes, defined taking into consideration the SYNOP codes, are targeted: small hail, hail without thunder and hail with thunder. Additionally, hail occurrences are compared with thunderstorm, convection and precipitation days for a consistency analysis. The results showed that hail events are more frequent in northern Portugal, particularly during winter and spring (peaking in April), whereas convection and thunderstorm events depict a maximum in April–May and a weaker peak in October. The latter maximum is typically linked to convective storms without hail fall at the ground, since no clear autumnal maximum is recorded in hail, which is clearly apparent for small hail and hail without thunder. In effect, the warmer temperatures in October than in February to April tend to render excessively high freezing level heights that may impede hail fall at the surface. Furthermore, the atmospheric mechanisms underlying hail occurrences are analysed using eight three-dimensional weather types. The results showed that the so-called Western European Trough, Blocking and Scandinavian Trough weather types are responsible for approximately 75% of all hail events in mainland Portugal. In general, hail events are favoured either by extra-tropical depressions, with cold front passages over Portugal, or by upper-level troughs/lows over western Iberia. They also tend to occur from December to May. These dynamical large-scale drivers promote mesoscale instability conditions that are herein assessed by both CAPE and the total-totals index.