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Continental scale hail frequency estimation from geostationary satellite detection

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Satellite derived datasets of cloud overshooting tops (OT) can serve as a proxy for severe convection. However, the occurrence and intensity of specific hazards associated to these severe storms, such as large hail, heavy rain, or severe wind, depend on the local and regional atmospheric conditions. A filter specific to large hail as reported in the European Severe Weather Database (ESWD) was designed using ERA-INTERIM reanalysis data and applied to a 11-year OT database for Europe from Meteosat Second Generation SEVIRI data. In particular detections with absent convectively available potential energy or particularly high freezing level are unlikely to be related to large hail on the ground - these make up for significant contributions over sea and mountainous parts of southern Europe and neighboring Northern Africa, respectively. Hail hotspots in Europe are found in foothill regions of the Alps and Medium range mountains such as Pyrenees, Massif Central, and the Carpathians. The resulting hail hazard map for Europe has been constructed and is found in good agreement with major regional and national scale climatological studies.
With the same method, a 10 year database of OTs in Australia has been obtained from Japanese MT-SAT imagery and Australian Severe Storm Archive hail reports. The filter criteria based on the two independent report databases are found to differ only slightly. Hail is found to be most frequent in the South-Eastern parts of Australia. A large majority of OTs detected in the North of Australia are unlikely to be related to hail on the ground due to very high freezing levels and low wind shear. The findings match well with existing large scale hail frequency estimates for Australia from other satellites or model data, but offer greater detail.
Analysis of seven years of 3D data fom the Bureu of Meteorology weather radar network covering most larger settlements shows a similar overall pattern, but appears to suffer from large calibration deficiencies. The radar-based findings can however be used to resolve small scale variations of hail frequency due to orography and land-sea contrast. Furher improvements compared to reported hail frequency can be obtained when undetected capped situations with lower cloud top level but still significant convective potential in sounding data are accounted for and winter time detections at higher latitudes are scaled based on the observed annual cycle of hail.