4–8 November 2019, Kraków, Poland
ECSS2019-87

Probabilistic Hail Hazard Assessment

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Hail is one of the largest single-event natural hazards and can cause extensive damage to assets of residential and commercial infrastructure, agriculture and vehicles. The study presents a versatile methodology for the estimation of parameters in probabilistic hail hazard assessment while taking into account aleatory and epistemic uncertainties. Three area-characteristic recurrence parameters are defined by combining a Poisson process with a frequency–event-size power law. These parameters are the rate of occurrence, the power law exponent and the maximum possible event size. The methodology accounts for aleatory and epistemic uncertainty associated with the observed event sizes and the applied distributions. This is done by means of developing likelihood functions from convolution and mixture distributions. The likelihood functions allow for the application of either maximum likelihood estimation or Bayesian estimation. The applicability of the methodology is tested on hail size estimates derived from ensemble HAILCAST modelling run on ERA-ITERIM re-analysis data for South Africa. The three recurrence parameters were used to determine return periods, probabilities of exceendance and the estimated worst-case scenarios. It was determined that the type of uncertainty included have a notable effect on the hail hazard estimates. These estimates could be used as prior information for Bayesian hail risk assessment.