Título: ANALYSIS OF STRUCTURAL CHARACTERISTICS AND EXTREMAL BEHAVIOUR OF TRANSFORMED SPATIOTEMPORAL PROCESSES

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Resumen: Summary

With the reference goal of bringing together the theory of risk measures and the analysis of structural characteristics of random field excursion sets, this thesis work addresses two general objectives: (i) to develop methodologies for risk assessment in spatial and spatiotemporal scenarios in relation to threshold exceedances; (ii) to analyze the effect of transformations, with reference to the spatial domain and the state space, on structural characteristics of threshold exceedance sets, as well as the consideration of related generalizations.

Regarding the first objective, a general and flexible methodology for spatial and spatiotemporal risk assessment is proposed based on a conditional approach. More specifically, for a given random field model and available observations, empirical distributions of different threshold exceedance indicators are obtained from conditional simulation, as a basis for evaluation of measures of risk. In particular, the study is focused on the global and local assessment of exceedance area and excess volume indicators, from which different risk maps are derived.

For these first-order indicators, the compound cumulative distribution function plays a key role, both formally and regarding the practical threshold specification. Illustrations based on simulation and applications to real data (Hydrology and Environmental Health) of this methodology are performed in spatial and spatiotemporal scenarios.

Relationships between widely used risk measures such as Value-at-Risk and Average Valueat-Risk, and structural characteristics of excursion sets of the underlying random field such as exceedance area and excess volume, for varying thresholds, are established. The asymptotics of these relationships are interpreted in relation to the shape parameter of the Generalized Pareto Distribution. Formal extensions are developed in scenarios of special interest (`level¿ and `flow¿ type deformation effects and population covariate effect), and finally, a generalized formulation in terms of non-constant thresholds and non-Lebesgue measures is also established.

In addition with respect to the second objective, in this thesis work two approaches are proposed to address the asymptotic behaviour for threshold exceedance probabilities for random fields without some restrictive conditions of regularity, stationarity or isotropy. A first approach is based on regularizing sequences and a second approach on adequate spatial deformation and blurring transformations.