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Conditionally dependent multiplicative cascade information integration processes in prediction of undiscovered mineral deposits

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Multiplicative cascade processes (MCP) involved in multifractal modeling are often assumed to be of independence between partitions in each consecutive generalization which yields singularities with multifractal distribution. In applications of these types of MCP it is often encountered that the partitions in each generalization may not be independent. To model the end products of these types of MCP is of general interest not only for multifractal modeling but also for applications of MCP. This paper takes logistic model for information integration processes as an example to demonstrate the idea of dependent multiplicative cascade processes (DMCP) and models for mapping the singularities of the end product of DMCP. Logistic model used in combining information layers from multiple sources for updating geo-information is commonly applied for delineating mineral exploration targeting areas and environment impact areas. This process involves identification of spatial events to be mapped such as location of mineral deposits or environment impact sites, construction of evidential layers to be used to map the distribution of the objective events, quantification of evidential layers on the basis of association between these layers and the events, and integration of these multiple layers of evidences to create a map of so-called posterior probability showing the potential locations of undiscovered mineral deposits. Several models are tested for estimating the posterior probability map with dependent evidential layers. Power-law relations are examined for modeling accumulative area and posterior probability. The case studies for methodology validation include integration of geological, geophysical and geochemical data for Au mineral resource assessments in Nova Scotia, Canada, for Sn in Yunnan and Fe in Xinqiang, China.