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Risk assessment for tephra dispersal and sedimentation: the example of four Icelandic volcanoes

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In order to assist the elaboration of proactive measures for the management of future Icelandic volcanic eruptions, we developed a new approach to assess the impact associated with tephra dispersal and sedimentation at various scales and for multiple sources. Target volcanoes are Hekla, Katla, Eyjafjallajökull and Askja, selected for their high probabilities of eruption and/or their high potential impact. We combined stratigraphic studies, probabilistic strategies and numerical modelling to develop comprehensive eruption scenarios and compile hazard maps for local ground deposition and regional atmospheric concentration using both TEPHRA2 and FALL3D models. New algorithms for the identification of comprehensive probability density functions of eruptive source parameters were developed for both short and long-lasting activity scenarios. A vulnerability assessment of socioeconomic and territorial aspects was also performed at both national and continental scales. The identification of relevant vulnerability indicators allowed for the identification of the most critical areas and territorial nodes. At a national scale, the vulnerability of economic activities and the accessibility to critical infrastructures was assessed. At a continental scale, we assessed the vulnerability of the main airline routes and airports. Resulting impact and risk were finally assessed by combining hazard and vulnerability analysis.