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A first Event-tree for the Bárðarbunga volcanic system (Iceland): from the volcanic crisis in 2014 towards a tool for hazard assessment

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Bárdarbunga volcano is part of a large volcanic system that had its last confirmed eruption before the present unrest in 1910. This system is partially covered by ice within the Vatnajökull glacier and it extends further to the NNE as well as to SW. Based on historical data, its eruptive activity has been predominantly characterized by explosive eruptions, originating beneath the glacier, and important effusive eruptions in the ice-free part of the system itself. The largest explosive eruptions took place on the southern side of the fissure system in AD 1477 producing about 10 km3 of tephra.
Due to the extension and location of this volcanic system, the range of potential eruptive scenarios and associated hazards is quite wide. Indeed, it includes: inundation, due to glacial outburst; tephra fallout, due to ash-rich plume generated by magma-water interaction; abundant volcanic gas release; and lava flows. Most importantly these phenomena are not mutually exclusive and might happen simultaneously, creating the premise for a wide spatial and temporal impact.
During the ongoing volcanic crisis at Bárdarbunga, which started on 16 August, 2014, the Icelandic Meteorological Office, together with the University of Iceland and Icelandic Civil Protection started a common effort of drawing, day-by-day, the potential evolution of the ongoing rifting event and, based on the newest data from the monitoring networks, updated and more refined scenarios have been identified. Indeed, this volcanic crisis created the occasion for pushing forward the creation of the first Event-tree for the Bárðarbunga volcanic system.
We adopted the approach suggested by Newhall and Pallister (2014) and a preliminary ET made of nine nodes has been constructed. After the two initial nodes (restless and genesis) the ET continues with the identification of the location of aperture of future eruptive vents. Due to the complex structure of the system and historical eruptions, this third node (location) is split into four sub-ETs corresponding to: caldera, ice-covered fissure, ice-free fissure toward the North and ice-free fissure toward the South. This subdivision is needed because different hazards will impact different parts of the country, e.g. eruption sources located in parts of the system belonging to different water catchments will trigger glacial outbursts that will inundate different areas in the lowland. Once the source location has been identified, defining outcome, phenomena, size, duration and sectors are then the following steps. The outcomes include effusive lava flows, pure sub-glacial eruptions (with no aerial component), phreatomagmatic basaltic explosive eruptions, to mixed eruptions. Once the phenomena are listed, the sizes are identified as functions of the hazards themselves, for example the sizes may refer to the extrusion rate in case of lava flow and to the volume in case of flood. This way to proceed is mostly due to the need to include a wide range of phenomena that might occur at the same time and that need to be treated separately.
A tentative estimation of likelihoods at each branch has been done mostly based on past eruptive events and historical evidence. This is the first step towards the setup of a long-range hazard assessment tool.