A multi-scale risk assessment for tephra fallout and airborne concentration from multiple Icelandic volcanoes - Part II: vulnerability and impact assessment

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The aim of this project is to perform a multi-scale risk assessment of tephra dispersal and fallout from explosive activity in Iceland. The vulnerability and impact assessment presented here, together with the probabilistic hazard assessment presented in Part I, provide the necessary information for long-term risk management of explosive eruptions at local and European scales.

Results of part I show that explosive activity at Iceland may produce consequences at local and regional scale, and a vulnerability assessment for both tephra dispersal and deposition is necessary. A multi-scale vulnerability assessment is presented for both for Iceland and for the European cities, airports and airspace, with a special focus on systemic and socio-economic vulnerability.

The analysis of socio-economic background of Iceland at local scale allows to identify the most of the relevant vulnerability themes. The themes considered for the estimation of systemic vulnerability are: presence of primary road network, redundancy of road network, presence of critical facilities and accessibility from main cities to critical facilities. From the socio-economic point of view, we take into account the presence of agricultural activities, and the productivity of milk and wool, which are relevant for the economy of aisled towns and rural areas. Thematic vulnerability indicators are defined and estimated for each municipality with a common vulnerability rating system in order to produce thematic maps. A cumulative vulnerability map is produced by combining all thematic maps, with the assumption that vulnerability themes have all same weight. Expected impacts are estimated for selected eruptive scenarios, identifying critical areas for intervention.

European air traffic network is highly vulnerable to the failure of main transportation hubs, and this analysis allows for the identification of the critical airports and routes that might be the most affected by an Icelandic eruption. The socio-economic vulnerability is estimated for Nuts-2 regions, depending on the population and the multi-modal accessibility of the region. Expected impacts on European air traffic system are estimated for selected eruptive scenarios.

Results are vulnerability maps for Iceland and European air traffic, and expected impact maps for selected eruptive scenarios. This is the first attempt of performing a multi-scale vulnerability assessment for both tephra dispersal and sedimentation. The concepts of systemic and socio-economic vulnerability are applied here to local and regional domain, to produce a comprehensive multi-scale vulnerability assessment. The presented methodology could significantly improve current risk-management practices both at local and regional scale. Moreover, results are useful for risk mitigation at local scale and long-term planning at regional scale.