



Influence of volcanic tephra on photovoltaic (PV)-modules: An experimental study with application to the 2010 Eyjafjallajökull eruption, Iceland

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Large volcanic eruptions may lead to significant tephra dispersion, crossing borders and affecting distant and industrial societies in various ways. While the effects of volcanic ash clouds on the aviation industry have been recognized, damaging effects on the photovoltaic energy sector are poorly investigated. Here we describe the influence of volcanic tephra deposition on photovoltaic (PV) modules that we experimentally analyzed and evaluated. A systematic set of experiments was conducted under controlled conditions using an artificial light source and measuring the electrical power generated from the PV-modules with the aim to determine the dependency of the amount of tephra covering a module and its subsequent loss in power production (measured in voltage and current) as well as the influence of the tephra grain size. We find that a mass of fine tephra has a stronger influence on the PV-modules power generation than the same mass of coarser particles. An application to the fine-grained 2010 Eyjafjallajökull eruption in Iceland and the resulting ash-cloud reveals that the power produced by PV-modules in continental Europe might have been affected significantly. Deposits were thick enough to cause complete failures of PV-modules up to a distance of about 300 km downwind. Although this distance is largely over the ocean in this particular case, our results imply that similar and larger eruptions of other volcanoes elsewhere might harm commercial or private energy production at distances of hundreds to thousands of kilometers from the volcano. Given that volcanic eruptions are frequent and the fact that the PV-industry is growing rapidly, negative impacts are expected in the future, requiring close tephra dispersion monitoring and PV-maintenance strategies.