

Aeolian Environments of Iceland

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Iceland has the largest area of volcanoclastic sandy desert on Earth or 22,000 km². The sand has been mostly produced by glacio-fluvial processes, leaving behind fine-grained unstable sediments which are later re-distributed by repeated aeolian events. Volcanic eruptions add to this pool of unstable sediments, often from subglacial eruptions. Icelandic desert surfaces are divided into sand fields, sandy lavas and sandy lag gravel, each with separate aeolian surface characteristics such as threshold velocities. Storms are frequent due to Iceland's location on the North Atlantic Storm track. Dry winds occur on the leeward sides of mountains and glaciers, in spite of the high moisture content of the Atlantic cyclones. Surface winds often move hundreds to more than 1000 kg m⁻¹ per annum, and more than 10,000 kg m⁻¹ have been measured in a single storm. Desertification occurs when aeolian processes push sand fronts and have thus destroyed many previously fully vegetated ecosystems since the time of the settlement of Iceland in the late ninth century. There are about 135 dust events per annum, ranging from minor storms to >300,000 t of dust emitted in single storms.

Dust can be generated from all the major sandy areas of Iceland; however the amount of finer particles that become dust varies with the surfaces. There are areas that produce more dust by far compared to the general sandy deserts; they have therefore been termed "dust plume areas" or "dust hot-spots". They are characterized by repeated charging of fine sediments with a relatively high proportion of finer (silty) materials which, upon repeated wind erosion become sorted downwind from the sources with loss of silt (dust) and an increasing saltation component (sand). Dust production is on the order of 30-40 million tons annually, some travelling over 1000 km and deposited on land and sea. Dust deposited on deserts tends to be re-suspended during subsequent storms. High PM₁₀ concentrations occur during major dust storms. They are more frequent in the wake of volcanic eruptions, such as after the Eyjafjallajökull 2010 eruption. Airborne dust affects human health, with negative effects enhanced by the tubular morphology of the grains, and the basaltic composition with its high metal content. Dust deposition on snow and glaciers intensifies melting. Moreover, the dust production probably also influences atmospheric conditions and parameters that affect climate change.