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Assessing the hydropower potential of ungauged watersheds in Iceland using hydrological modeling and satellite retrieved snow cover images

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About 80% of the domestic energy production in Iceland comes from renewable energies. Hydropower accounts for about 20% this production, representing about 75% of the total electricity production in Iceland. In 2008 total electricity production from hydropower was about 12.5 TWh a-1, making Iceland a worldwide leader in hydropower production per capita. Furthermore, the total potential of hydroelectricity in Iceland is estimated to amount up to 220 TWh a-1. In this regard, hydrological modelling is an essential tool to adapt a sustainable management of water resources and estimate the potential of possible new sites for hydropower production. We used the conceptual lumped Hydrologiska Byråns Vattenbalansavdelning model (HBV) to estimate the potential of hydropower production in two remote areas in north-eastern Iceland (Leirdalshraun, a 274 km2 area above 595 m asl and Hafralónsá, a 946 km2 area above 235 m asl). The model parameters were determined by calibrating the model with discharge data from gauged sub catchments. Satellite snow cover images were used to constrain melt parameters of the model and assure adequate modelling of snow melt in the ungauged areas. This was particularly valuable to adequately estimate the contribution of snow melt, rainfall runoff and groundwater intrusion from glaciers outside the topographic boundaries of the selected watersheds. Runoff from the entire area potentially used for hydropower exploitation was estimated using the parameter sets of the gauged sub-catchments. Additionally, snow melt from the ungauged areas was validated with satellite based snow cover images, revealing a robust simulation of snow melt in the entire area. Based on the hydrological modelling the total amount of snow melt and rainfall runoff available in Leirdalshraun and Hafralónsá amounts up to 700 M m3 a-1 and 1000 M m3 a-1, respectively. These results reveal that the total hydropower potential of the two sites amounts up to 1.2 TWh a-1 hydroelectricity, accounting for about 10% of the current production in Iceland. These result are of eminent importance to embed sustainable and resilient based water management in discussions concerning future plans of national energy production.