Meteorological wind energy potential in the Alps using ERA40 and wind measurement sites in the Tyrolean Alps

The peculiarities of meteorological wind potential in alpine settings compared to flatland and offshore sites are studied. Four data sources are used: Global reanalysis ERA40 from ECMWF, long-term stations in the Tyrolean Alps, spatially dense measurements near the best site and Doppler sodar wind profiles. Due to the decrease of density with height, alpine sites suffer from a nearly linear decrease of harvestable power with altitude, which is more than offset by the increase of wind speed at altitudes above 1.5 km MSL. ERA40 data show higher potential on the northern than on the southern side of the Alps. The best locations are not isolated peaks but ridges within wide orographic channels. The best potential sites in the Tyrolean part of the Alps have median wind speeds of up to 7.1 m s⁻¹ and extractable potentials between 2900 and 1600 kWh per year and per square meter of rotor area. The profile of horizontal wind speed at ridge sites is often not logarithmic but approximately constant within the height of a wind turbine due to a (nearly) complete absence of upwind fetch. Also, the turbulence intensity is independent of height. Icing can cause considerable downtimes.

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