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Fast regional-scale technical shallow geothermal energy potential calculation with a steady-state solution of the finite line source

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The heating and cooling sector needs a large-scale transformation to achieve the climate neutrality goals by 2050 as outlined in the European Green Deal. Heat pumps coupled with a borehole heat exchanger (BHE) are a frequently discussed option for reducing greenhouse gas emissions from the heating and cooling of residential buildings. The thermal interference between BHEs makes the calculation of the technical potential on a regional scale computing intensive. Here, we use a steady-state solution of the finite line source to rapidly calculate the technical geothermal energy potential for a study area of ~35.000 km² and for up to 8.6 million BHEs. The results show that the proposed methodology can be used to calculate the potential of ground source heat pumps for heating on a regional scale with a high accuracy. Limitations of the study include the random placement of BHEs within parcels (with regulatory restrictions applying), and the non-consideration of ground water flow.