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Screening for suitable areas for Aquifer Thermal Energy Storage within the Brussels Capital Region, Belgium using coupled groundwater flow and heat transport modelling tools

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Urban areas have a great potential for shallow geothermal systems. Their energy demand is high, but currently they have only a limited potential to cover their own energy demand. The transition towards a low-carbon energy regime offers alternative sources of energy an increasing potential. Urban areas however pose special challenges for the successful exploitation of shallow geothermal energy. High building densities limit the available space for drillings and underground investigations. Urban heat island effects and underground structures influence the thermal field, groundwater pollution and competing water uses limit the available subsurface. To tackle these challenges in the Brussels Capital Region, Belgium two projects 'BruGeo' and the recently finished 'Prospective Research of Brussels project 2015-PRFB-228' address the investigation in urban geothermal systems. They aim to identify the key factors of the underground with respect to Aquifer Thermal Energy Storage (ATES) installations like thermal properties, aquifer thicknesses, groundwater flow velocities and their heterogeneity. Combined numerical groundwater and heat transport models are applied for the assessment of both open and closed loop shallow geothermal systems. The Brussels Capital Region comprises of the Belgian Capital, the City of Brussels and 18 other municipalities covering 161 km^2 with almost 1.2 million inhabitants. Beside the high population density the Brussels Capital Region has a pronounced topography and a relative complex geology. This is both a challenge and an opportunity for the exploitation of shallow geothermal energy. The most important shallow hydrogeological formation in the Brussels-Capital Region are the Brussels Sands with the Brussels Sands Aquifer. Scenarios where developed using criteria for the hydrogeological feasibility of ATES installations such as saturated aquifer thickness, groundwater flow velocity and the groundwater head below surface. The Brussels Sands Formation is covering almost 8000 ha, roughly the half of the Brussels Capital Region. In an optimistic scenario (i.e. all criteria show acceptable or favorable conditions) around 80% of the 8000 ha is suitable for ATES. This is an indication for the considerable potential for ATES installations in the Brussels Capital Region. Results of the research will lead to quantitative spatial output about the potential of shallow geothermal energy use in the Region.