Aalto University
School of Engineering

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Geoid and gravity in a deforming world

Title of the dissertation	Geoid and postglacial rebound related gravity change in Finland.
Contents of the dissertation	Positioning using global navigation satellite systems (GNSS) is widely used and is getting more and more accurate. In this thesis, M.Sc. Mirjam Bilker-Koivula looks at two things that contribute to the uncertainty of coordinates, especially heights, measured with GNSS in Finland: Geoid models and the Fennoscandian postglacial rebound. Geoid models are needed to convert heights, measured with GNSS in the national 3D-coordinate system, to heights in the national height system, which is related to the sea level. The first part of the thesis deals with geoid models. The official geoid model for Finland, FIN2005N00, was developed. Additionally, high resolution global gravity field models were analyzed, and it was proven that they can be used in national geoid modelling. In anticipation of the introduction of the Baltic Sea Chart Datum 2000, a common height reference for the whole Baltic Sea, a successful method was developed to validate geoid models at sea using marine GNSS observations. The Fennoscandian rebound is the phenomenon of the ongoing rising of the Earth's crust since the disappearance of the ice load of the past ice age. This land uplift not only changes coordinates and heights, but also the gravity values of which geoid models are calculated. When the land goes up, gravity, measured at the surface, gets smaller as the gravimeter moves away from the masses. In the second part of the thesis, the land uplift induced gravity changes in Finland were studied using absolute gravity measurements made with free-fall instruments between 1976 and 2019. Reliable gravity trends could be determined at seven stations. New parameters describing the relationship between gravity change and vertical velocities were derived. The knowledge obtained in the geoid studies will be beneficial for the determination of the next generation geoid models for Finland. The absolute gravity studies pave the path for further studies of the postglacial rebound in Finland and its surrounding areas.
Field of the dissertation	Built Environment, Geodesy
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