Title: Understanding tree root anchorage strength with finite element method including root architecture and soil strength measurements

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Advances in wind risk require progress in understanding the uprooting process as a function of tree characteristics and soil material properties. Modelling tree anchorage mechanism has progressed with progresses in plant architecture modelling, but the estimation of anchorage strength is still limited. It depends on root architecture, root strength and soil condition (soil texture, water content, etc.). The present study reports developments in anchorage modelling with finite element method allowing incorporating failure behaviour of individual roots. During simulated tree overturning process, roots fail successively and cause global rupture in the tree mechanical response. The tree anchorage strength is thus identified and estimated. This model allows us to conduct numerical experiments to investigate the key factors involved in anchorage strength. This study is based on measurements of 3D root architecture and soil mechanical strength of Maritime pine cultivated in sandy soil. A sensitivity analysis was conducted on a simplified typical root system of Maritime pine representative of observed root systems. It aims to quantify the contribution related to morphological and material properties of roots and soil. Thus a picture of major elements influencing tree anchorage strength is proposed.

Key words: tree anchorage, sensitivity analysis, finite element model, 3D simplified root system of Maritime pine

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