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Vertical distribution of excess ice in icy sediments and its statistical estimation from geotechnical data (Tuktoyaktuk Coastlands, Northwest Territories)

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Excess ice can be found in the form of massive ice and within icy sediments and is an important variable to quantify as it strongly influences the geomorphic response of landscapes to permafrost thaw. The melting of excess ice in the Western Canadian Arctic has led to thaw subsidence and an increase in the number and size of thaw slumps observed across the Northwest Territories which cause issues to Northern infrastructure and affect fluvial and lacustrine watersheds. The Inuvik-Tuktoyaktuk Highway (ITH) is the first all-weather road to reach the Canadian Arctic Coast and its planning and construction has resulted in a significant cryostratigraphic dataset of 566 boreholes, which forms the basis of this contribution. Although visible ice is often recorded in boreholes, it is not a reliable measure of excess ice content on its own and there is currently no reliable method to estimate the excess ice content of boreholes based on commonly available geotechnical data. In this study, a 16-borehole subset of the ITH dataset for which samples were processed for volumetric excess ice content is used to train a beta regression model that predicts the excess ice content of stratigraphic intervals in the study area based on interval depth, visible ice content, surficial geology, and material types. The resulting predictions are compared to recorded massive ice intervals in the same boreholes and show that excess ice within icy sediments can significantly contribute to potential thaw strain and should be considered alongside massive ice when making thaw strain estimates.