ICELANDIC RHYTHMS: ANNUAL MODULATION OF LAND ELEVATION AND PLATE SPREADING BY SNOW LOAD (AGU – G33B-0055)

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We find strong correlation between seasonal variation in continuous GPS (CGPS) time series and predicted response to annual snow load in Iceland. The load is modeled using Green's functions for an elastic halfspace and a simple sinusoidal load history on Iceland's four largest ice caps. We derive $E = 40 \pm 15$ GPa as a minimum value for the effective Young's modulus in Iceland, increasing with distance from the Eastern Volcanic Zone. We calculate the elastic response over all of Iceland to maximum snow load at the ice caps using $E = 40$ GPa. Predicted annual vertical displacements are largest under the Vatnajökull ice cap with a peak-to-peak seasonal displacement of $-37$ mm. CGPS stations closest to the ice cap experience a peak-to-peak displacement of $-16$ mm, consistent with our model. East and north of Vatnajökull we find the maximum of annual horizontal displacements of $-6$ mm resulting in apparent modulation of plate spreading rates in this area.

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Results from our simple load model correspond to observations of earlier studies and match the data of CGPS stations in Iceland. Future models should consider the different lengths of loading and unloading cycles. An inhomogeneous load distribution needs to be included as well as other sources of seasonal load, i.e. ocean load. Evaluation of modeled amplitudes suggests a sensitivity to $E$ depending on location. Phase offsets in the vertical component (Fig. 5) might be due to recharge of the groundwater table, or caused by irregular melting of the ice caps. The impact of other load sources needs future studies. Despite the limitations, our simple approach explains a large part of the observed annual variations, suggesting glacier load variation provides a major contribution to the annual ground displacements. The value of $40 \pm 15$ GPa is inferred to be a minimum value for $E$ depending on the location.

An expanded ISSGP network combined with this work might reveal information about yet too poorly constrained snow loads outside of the ice caps. Furthermore, future additional CGPS data could be used to infer the onset of the melting season for the individual ice caps. The simulator this work was carried out with will be expanded to allow for application of more complex loading behavior to a more realistic Earth model.