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Advanced ice sheet modeling: A temperature dependent creep damage model for polycrystalline ice

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We present a continuum damage model for the temperature dependent creep response of polycrystalline ice under a multiaxial state of stress. The proposed model is based on a viscoelastic constitutive law for the creep of ice and an orthotropic damage accumulation law for the different damage development in tension, compression and shear. Orthotropic damage is represented by a symmetric second-order damage tensor and its effect on creep is incorporated through the effective stress concept. The unknown model parameters are calibrated using published experimental data from constant uniaxial stress tests. The model predictions are then compared with published experimental data from constant strain rate and multiaxial stress tests. The predicted results are in good agreement with experimental data illustrating the viability of the proposed model.