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# AN INTEGRATED CONSTITUTIVE THEORY FOR THE MECHANICAL BEHAVIOR OF SEA ICE: EXPERIMENTAL VERIFICATION

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## Abstract

A rate-sensitive constitutive theory is developed for describing the mechanical behavior of sea ice. The theory is characterized by its ability to:

(a) Decompose the various recoverable (instantaneous elastic and delayed elastic or primary creep) and irrecoverable (secondary creep and strain-softening or tertiary creep) components of strain.

(b) Describe materially anoisotropic material behavior with a pressure-insensitive but rate-dependent potential function.

(c) Represent continuously damaging or strain-softening material behavior during ductile-to-brittle transition in compression with a linear incremental damage accumulation model.

(d) Predict first crack occurrence or nucleation with a rate-dependent limiting tensile strain criterion.

(e) Describe ultimate failure by macrocracking representing either yielding of the material or fracture with a rate and pressure sensitive Drucker-Prager surface.

This paper compares the model predictions with several independent sets of experimental data, particularly those for first-year sea ice. Data for the uniaxial "strength" of sea ice is augmented with the extensive experimental data base available for pure polycrystalline ice through a normalization to account for the presence of brine.