Background
Strain gradients are known to affect plastic deformation at small scales and in strong gradients. How gradients affect viscoplasticity is currently not well understood and constitutive models are missing.

Objective
Define a unified constitutive model and implement the model as a component of a FE code. Investigate load transients in a turbine disk. Investigate conditions at the creep crack tip.

Methods
Implement the constitutive model as a component of a FE code to analysis (1) a conceptual turbine rotor component and (2) a crack model considering transients in loads and plastic strain gradients.

Outcomes
Define a new viscoplastic constitutive model accounting for viscoplasticity, creep and hardening under the consideration of plastic strain gradients implemented in FE code

Outcomes
The KM model predicts transients not captured by a conventional Norton model
SG delays creep failure but raises stresses
SG affects local conditions, not overall response

Outcomes
The SG-KM model predicts that GND (viscoplastic strain gradients) dominate over SSD (viscoplastic strains) and that the relevance of GND increases over time
SG-KM predicts higher stresses than KM theory

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