SEA ICE – MODEL

Description

Elasto-plastic law under compression and visco-elasto-plastic law under tension for sea ice.

A detailed description is given in.

Zyryanov D., J. Haarpaintner and R. Korsnes. 2003. Storfjorden (Svalbard): Modeling of the polynya development and sea ice ridging process, Modeling, Identification and Control J. (MIC), Lars Imsland, Ed. (Trondheim), Vol. 24, N 1: 37-48;

Zyranov, D.V., Korsues and R. Korsnes. 2002. A numerical model for simulation of the sea ice destruction due to external stress in gegoscale areas. In: Konietzky, H. (Ed.), „Numerical Modeling in Micromechanics via Particle Methods“, p 29 – 35.

Mathematical Background

$$e = \frac{s}{E} + c\left(\frac{d_0}{d}\right)\left(\frac{s}{E}\right)^s \left[1 - e^{-(a_T t)^b}\right] + \dot{e}_{n_0} t \left(\frac{s}{s_0}\right)^n \tag{1}$$

$$\frac{s_f}{s_0} = P\left(\frac{\dot{e}}{\dot{e}_0}\right)^p \tag{2}$$

$$\Delta U_n^{vis} = Sign(F_n) \cdot e\_dot\_v0 \cdot \left|\frac{f_n}{f_0}\right|^{ns} \cdot g.tdel \tag{3}$$

$$\Delta F_n^t = \frac{k_n^t}{1 + c\frac{d_0}{d}\left[1 - e^{-(a_T \cdot t)^b}\right]} \cdot \left(\Delta U_n + \Delta U_n^{vis}\right) \tag{4}$$

$$\frac{f_n}{f_0} < -P\left(\frac{\dot{U}_n}{U_n}\right)^p \tag{5}$$

Input parameters

Property name	Description	Name in literature and mathematical description	Typical value (examplary)
Kncs	normal stiffness in compression	knc	5e9
Knts	normal stiffness in tension	knt	5e9
Kss	shear stiffness	ks	5e9
Cs	material constant according to (1)	c	9e-3
d0s	average grain diameter according to (1)	d0	1.0

Ds	stress exponent grain sliding according to (1)	s	1.0
aTs	material parameter according to (1), (4) respectively	aT	2.5e-4
bs	time exponent for delayed elastic strain according to (1)	b	0.34
e_dot_v0	viscous strain rate according to (3), (1) respectively	e°v0	1.76e-17
f0	calibration parameter fro viscous strain according to (3)	f0	1.0
ns	force exponent for viscous strain according to (3)	n	3.0
PP	material constant from failure law (2), (5) respectively	P	212.0
ps	exponent in failure law (2), (5) respectively	p	0.345
e_dot_0	unit strain rate according to (2)	ε°0	1.0
Fsmaxs	shear strength		1e8

Included documents / files

Name	Type	Description
Test_ice.dat	PFC^{2D} – Inputfile	Simple example under tension

Contact address

Denis Zyryanov
Institute of Water Problems of RAS,
Moscow, Gubkina st., 3. GSP-1
119991, Moscow, Russia

Phone (work): +7 – (0)95 – 135 4735
Phone (home): +7 – (0)95 – 336 5024
Phone (mob): +7 – (9)16 – 773 2499
Fax: +7 – (0)95 – 135 5415
email: denis@npolar.no

Itasca Consultants GmbH
Leithestrasse 111
45886 Gelsenkirchen
Germany
Tel: +49-(0)209-147-5630
Fax: +49-(0)209-147-5632
email: cppudm@itasca.de