Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02525, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02525
EGU General Assembly 2008

Sea ice dynamics in the marginal ice zone: the role of rheology

DL Feltham (1,2)

(1) Centre for Polar Observation and Modelling, UCL, UK (dlf@cpom.ucl.ac.uk), (2) British Antarctic Survey, Cambridge, UK

The region of sea ice near the edge of the sea ice pack is known as the marginal ice zone (MIZ), and its dynamics are complicated by ocean wave interaction with the ice cover, strong gradients in the atmosphere and ocean and variations in sea ice rheology. Due to its small size (10s of km), the MIZ is not resolved in climate models although its importance to determining sea ice extent and navigation is likely to increase in the Arctic due to reductions in sea ice extent. I focus on the role of sea ice rheology in determining the dynamics of the MIZ. The sea ice is treated as a granular material with a composite rheology describing collisional ice floe interaction and plastic interaction. The collisional component of sea ice rheology depends upon the granular temperature, a measure of the kinetic energy of flow fluctuations. A simplified model of the MIZ is introduced consisting of the along and across momentum balance of the sea ice and the balance equation of fluctuation kinetic energy. The constitutive assumptions and boundary conditions in the model are discussed. The steady solution of the MIZ model is found using the method of matched asymptotic expansions, and an outline of this is presented. The calculations reveal a concentrated region of rapid ice flow parallel to the ice edge, which is in accordance with field observations, and previously called the ice jet. Previous explanations of the ice jet relied upon the existence of ocean currents beneath the ice cover. We show that an ice jet results as a natural consequence of the granular nature of sea ice. Some possible generalizations of the study are mentioned.