Geophysical Research Abstracts
Vol. 18, EGU2016-16267, 2016
EGU General Assembly 2016


# Constraining the parameters of the EAP sea ice rheology from satellite observations and discrete element model

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The new elastic-plastic anisotropic (EAP) rheology that explicitly accounts for the sub-continuum anisotropy of the sea ice cover has been implemented into the latest version of the Los Alamos sea ice model CICE. The EAP rheology is widely used in the climate modeling scientific community (i.e. CPOM stand alone, RASM high resolution regional ice-ocean model, MetOffice fully coupled model). Early results from sensitivity studies (Tsamados et al, 2013) have shown the potential for an improved representation of the observed main sea ice characteristics with a substantial change of the spatial distribution of ice thickness and ice drift relative to model runs with the reference visco-plastic (VP) rheology.

The model contains one new prognostic variable, the local structure tensor, which quantifies the degree of anisotropy of the sea ice, and two parameters that set the time scale of the evolution of this tensor. Observations from high resolution satellite SAR imagery as well as numerical simulation results from a discrete element model (DEM, see Wilchinsky, 2010) have shown that these individual floes can organize under external wind and thermal forcing to form an emergent isotropic sea ice state (via thermodynamic healing, thermal cracking) or an anisotropic sea ice state (via Coulombic failure lines due to shear rupture). In this work we use for the first time in the context of sea ice research a mathematical metric, the Tensorial Minkowski functionals (Schroeder-Turk, 2010), to measure quantitatively the degree of anisotropy and alignment of the sea ice at different scales. We apply the methodology on the GlobICE Envisat satellite deformation product (www.globice.info), on a prototype modified version of GlobICE applied on Sentinel-1 Synthetic Aperture Radar (SAR) imagery and on the DEM ice floe aggregates.

By comparing these independent measurements of the sea ice anisotropy as well as its temporal evolution against the EAP model we are able to constrain the uncertain model parameters and functions in the EAP model.