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Comparative study of sea ice dynamics simulations with a Maxwell elasto-brittle rheology and the elastic-viscous-plastic rheology in NEMO-LIM3

Jonathan Raulier (1), Véronique Dansereau (2), Thierry Fichefet (1), Vincent Legat (3), and Jérôme Weiss (2)

(1) Georges Lemaître Centre for Earth and Climate Research, Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium, (2) Institut des Sciences de la Terre, CNRS/Université Grenoble-Alpes, Grenoble, France, (3) Institute of Mechanics, Materials and Civil Engineering, Université catholique de Louvain, Louvain-la-Neuve, Belgium

Sea ice is a highly dynamical environment characterized by a dense mesh of fractures or leads, constantly opening and closing over short time scales. This characteristic geomorphology is linked to the existence of linear kinematic features, which consist of quasi-linear patterns emerging from the observed strain rate field of sea ice. Standard rheologies used in most state-of-the-art sea ice models, like the well-known elastic-viscous-plastic rheology, are thought to misrepresent those linear kinematic features and the observed statistical distribution of deformation rates. Dedicated rheologies built to catch the processes known to be at the origin of the formation of leads are developed but still need evaluations on the global scale. One of them, based on a Maxwell elasto-brittle formulation, is being integrated in the NEMO-LIM3 global ocean-sea ice model (www.nemo-ocean.eu ; www.elic.ucl.ac.be/lim). In the present study, we compare the results of the sea ice model LIM3 obtained with two different rheologies: the elastic-viscous-plastic rheology commonly used in LIM3 and a Maxwell elasto-brittle rheology. This comparison is focused on the statistical characteristics of the simulated deformation rate and on the ability of the model to reproduce the existence of leads within the ice pack. The impact of the lead representation on fluxes between ice, atmosphere and ocean is also assessed.