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A new coupled model to shed light on sea-ice--ocean interactions

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Sea ice is a key component of the earth's climate system as it modulates air-sea interactions in polar regions. These interactions strongly depend on openings in the sea ice cover, which are associated with fine-scale sea ice deformations. Visco-plastic sea ice rheologies used in most numerical models struggle at representing these fine-scale sea ice dynamics without going to very costly horizontal resolutions (~1km). A solution is to use damage propagation sea ice models, which were shown to reproduce well sea ice deformations with little dependency on the mesh resolution.

Here we present results from the first ocean--sea-ice coupled model using a rheology with damage propagation. The ocean component is the NEMO-OPA model. The sea ice component is neXtSIM, introducing the newly developed Brittle Bingham-Maxwell rheology. Results show that sea ice dynamics are very well represented from large scales (sea ice drift) to small-scales (sea ice deformation). Sea ice properties relevant for climate, i.e volume and area, also show a remarkable match with satellite observations. This coupled framework opens new opportunities to quantify the impact of small-scale sea ice dynamics on ice-ocean interactions.