



## **IPCC climate models do not capture Arctic sea ice drift acceleration: Consequences in terms of sea ice thinning and decline**

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IPCC climate models underestimate the shrinking of the Arctic sea ice extent, and unforeseen its recent acceleration. Arctic sea ice decline is also expressed by a spectacular thinning as well as an acceleration of sea ice drift and deformation, both aspects being coupled together through positive feedbacks. We show that IPCC models underestimate the observed thinning trend by more than a factor of 4 in average, and do not capture the associated drift's acceleration. An unexpectedly weak coupling between the ice state (thickness and concentration) and kinematics is also obtained: for most models, ice drifts faster during the months it is thicker, in contradiction with observations, and models that show a stronger long-term thinning trend do not necessarily accelerate more. This can be interpreted as a nearly free-drift behaviour of modelled sea ice, i.e. a negligible influence of the internal stress term on ice motion, whatever the sophistication of the sea ice rheological model. This absence of coupling between the ice state and kinematics might explain partly why climate models underestimate both the increasing kinematics and the cover's shrinking, as the associated positive feedbacks are necessarily ignored. As an example, negligible long-term trend is obtained on ice velocities at export gates (essentially, Fram Strait). The consequence is a remarkably constant relative percentage of sea ice of the Arctic basin exported outwards each year, meaning that export plays no role on Arctic sea ice negative mass balance in models. These models limitations as well as simple estimations of negative sea ice mass balance in case of an accelerated export suggest a nearly ice-free Arctic in summer around 2050, well ahead former IPCC projections.