EGU2020-5863
https://doi.org/10.5194/egusphere-egu2020-5863
EGU General Assembly 2020

Permeability of growing sea ice - observations, modelling and some implications for thinning Arctic sea ice

Sönke Maus
Norwegian University for Science and Technology, Department for Civil and Environmental Engineering, Trondheim, Norway (sonke.maus@ntnu.no)

The permeability of sea ice is an important property with regard to the role of sea ice in the earth system. It controls fluid flow within sea ice, and thus processes like melt pond drainage, desalination and to some degree heat fluxes between the ocean and the atmosphere. It also impacts the role of sea ice in hosting sea ice algae and organisms, and the uptake and release of nutrients and pollutants from Arctic surface waters. However, as it is difficult to measure in the field, observations of sea ice permeability are sparse and vary, even for similar porosity, over orders of magnitude. Here I present progress on this topic in three directions. First, I present results from numerical simulations of the permeability of young sea ice based on 3-d X-ray microtomographic images (XRT). These results provide a relationship between permeability and brine porosity of young columnar sea ice for the porosity range 2 to 25 %. The simulations also show that this ice type is permeable and electrically conducting down to a porosity of 2 %, considerably lower than what has been proposed in previous work. Second, the XRT-based simulations are compared to predictions based on a novel crystal growth modelling approach, finding good agreement. Third, the permeability model provides a relationship between sea ice growth velocity and permeability. Based on this relationshiop interesting aspects of the growth of permeable sea ice can be deduced: The predictions consistently explain observations of the onset of convection from growing sea ice. They also allow for an evaluation of expected permeability changes for a thinning sea ice cover in a warmer climate. As the model is strictly valid for growing and cooling sea ice, the results are mostly relevant for sea ice desalination processes during winter. Modelling permeability of summer ice (and melt pond drainage) will require more observations of the pore space evolution in warming sea ice, for which the present results can be considered as a resonable starting point.