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Jet Formation at the Sea Ice Edge

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The sea ice edge presents a region of many feedback processes between the atmosphere, ocean and sea ice, which are inadequately represented in current climate models. Here we focus on on-ice atmospheric and oceanic flows at the sea ice edge. Mesoscale jet formation due to the Coriolis effect is well understood over sharp changes in surface roughness such as coastlines. This sharp change in surface roughness is experienced by the atmosphere flowing over, and ocean flowing under, a compacted sea ice edge. We have studied a dynamic sea ice edge responding to atmospheric and oceanic jet formation. The shape and strength of atmospheric and oceanic jets during on-ice flows is calculated from existing studies of the sea ice edge and prescribed to idealised models of the sea ice edge. An idealised analytical model of sea ice drift is developed and compared to a sea ice climate model (the CICE model) run on an idealised domain. The response of the CICE model to jet formation is tested at various resolutions.

We find that the formation of atmospheric jets during on-ice winds at the sea ice edge increases the wind speed parallel to the sea ice edge and results in the formation of a sea ice edge jet. The modelled sea ice edge jet is in agreement with an observed jet although more observations are needed for validation. The increase in ice drift speed is dependent upon the angle between the ice edge and wind and can result in a 40% increase in ice transport along the sea ice edge. The possibility of oceanic jet formation during on-ice currents and the resultant effect upon the sea ice edge is less conclusive. Observations and climate model data of the polar oceans has been analysed to show areas of likely atmospheric jet formation, with the Fram Strait being of particular interest.