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Influence of surface fluxes on polar low development: idealised simulations

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Polar lows develop during marine cold air outbreaks in regions with relative large sea surface temperature (SST) gradients. These conditions are favourable for large surface sensible and latent heat fluxes. Furthermore the differential heating resulting from SST gradients can provide a source for baroclinicity.

We utilise an idealised numerical channel model to gain insight in the role of surface turbulence fluxes on the dynamical evolution of polar lows. The initial setup consists of a baroclinic jet in thermal wind balance with a meridional temperature gradient. To mimic cold air outbreaks we prescribe SST that is higher than the low level surface air temperature, where the SST features a meridional gradient similar to the SST gradient in the Nordic Seas during winter. This setup allows for a systematic investigation of the relative contributions from surface sensible and latent heat fluxes on polar low development by varying the intensity of the initial baroclinicity, moisture, and temperature difference between the SST and low level air temperature. In addition we investigate the relative role of sensible or latent heat fluxes with sensitivity experiments where the individual fluxes are switched off.

As moisture is one of the main sources for polar low intensification, we analyse the moisture budget of the idealised simulations in greater detail. Identification of moisture sources and sinks, as well as diagnosing the moisture circulation rate shed further light on the role of surface fluxes on the intensification of polar lows.