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Energy and ozone fluxes over sea ice in Hudson Bay, Canada

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Energy and ozone fluxes were measured in the surface layer over Hudson Bay sea ice during February & March 2008 as part of the COBRA (Impact of combined iodine and bromine release on the Arctic atmosphere) experiment which was part of the International OASIS (Ocean-Atmosphere-Sea Ice-Snowpack) IPY programme. All components of the local surface energy balance were measured and it was defined by net radiative cooling throughout most of the day, mainly balanced by the conductive heat flux from the warmer sea water to the cooler sea ice at the surface, and a small net radiative warming for a few hours after midday. Timeseries and typical diurnal cycles of the energy fluxes will be presented.

Unique ground-level ozone fluxes were measured by eddy covariance and deposition velocities ranged from + 0.5 mm s^{-1} (deposition) to -1.5 mm s^{-1} (emission). Ozone profile measurements suggested ozone flux divergence within the surface layer. The observed bi-directional fluxes, flux divergence with height and possibly decoupled layers with no vertical flux reveal the complexity of surface ozone fluxes in the Arctic spring time surface layer, and show that ozone exchange with the sea ice surface is best probed using the eddy covariance method alongside frequent or continuous profile measurements. The latter are required to correctly interpret the measured fluxes at some height above the surface and allow the inference of the actual exchange of ozone with the surface itself. In this study, the local in-situ ozone-halogen photochemistry was identified as weakly controlling the measured ozone flux, whereas horizontal advection and vertical mixing were considered important in influencing fluxes. Under these conditions, several measurement sites would be desirable in order to quantify the contribution of advection to the local surface exchange. A difference in behaviour of ozone exchange over sea ice compared with snow pack is suggested but cannot be unequivocally identified with this dataset alone.