Uptake of Ozone-Depleting Halogenated Gases to the Snow-Covered Surface at Niwot Ridge, CO

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Whole air samples were drawn from four heights within the deep winter snowpack at Niwot Ridge, Colorado, during a one-week experiment in March, 2005, and subsequently analyzed by gas chromatography. Two adjacent plots with similar snow cover were sampled, one over natural, vegetated soil, and a second one where the ground was covered with a Tedlar/Teflon film isolating the snowpack from the soil. Samples were also collected from an ambient air inlet above the snow surface. This comparison allowed for studying chemical and physical effects occurring inside the snowpack itself versus effects of soil processes on concentrations and fluxes within and through the snowpack. Here, we focus on findings for a series of halogenated compounds which are of interest for the stratospheric halogen burden and its ozone-depleting potential, i.e. CFC-11, CFC-12, CFC-113, HCFC-22, HCFC-141b, HCFC-142b, methylchloride, tetrachloromethane, methylchloroform, 1,2-dichloroethane, methylbromide, dibromomethane, and bromoform. All of these species were found at lower, i.e. depleted concentrations in the snow, indicating that the snow and/or soil constitute a sink for these gases. A series of other species, including chloroform and dichlorobromomethane, displayed contrasting, i.e. higher concentrations inside the snow, indicating a formation of these gases and release into the atmosphere from this snow-covered environment. Microbial activities below this deep, winter snowpack were determined to be the driving mechanism behind these gas sources and sinks. A snowpack gas diffusion model was applied to develop preliminary gas flux estimates at the snow-atmosphere interface. These flux results were then incorporated into a simple box model to assess the potential contribution of the sink strength of the determined snowpack uptake rates to budgets and atmospheric lifetime estimates of these halogenated gases.

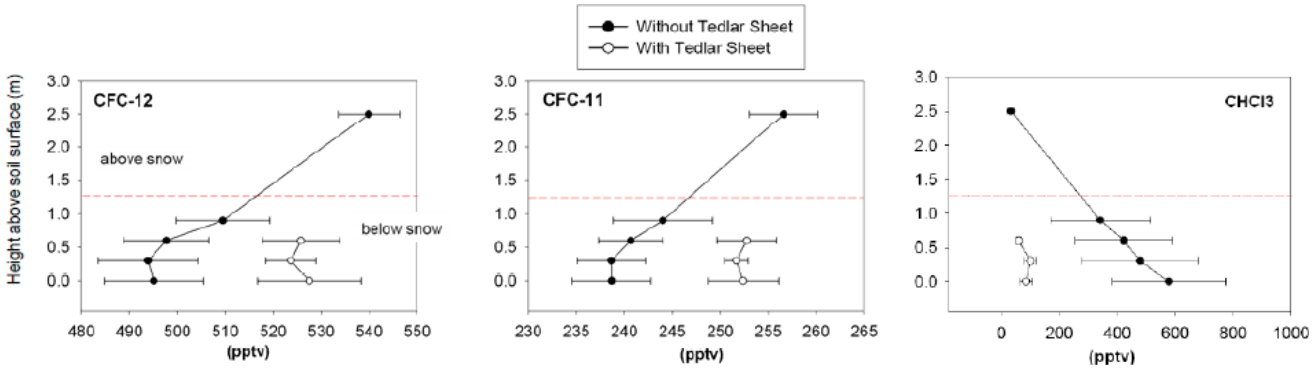

Figure 1. Concentration profiles of CFC-12, CFC-11, and $CHCl_3$ in air samples withdrawn from inlets above and within the snow. The red, staggered line depicts the top of the snowpack surface, which was at 1.3 m above ground. Data are mean values from ~ 3-5 samples collected from each inlet, with horizontal error bars indicating the variability (standard deviation) of each subset of data.