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BINGHAM RESEARCH CENTER

Laboratory investigation of Air-Snow interface influxes of organic compounds.

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Introduction

- Snow acts as a reservoir of chemical constituents and as a photochemical reactor.
- Physical and chemical processes occurring in snowpacks have a significant impact on the chemistry of the atmosphere (Grannas et al., 2007).
- In past field studies our group has found that carbonyls can be emitted from the snowpack in the presence of sunlight more readily than in the absence of sunlight.

Methods

- We modified a chest freezer with UV transparent sheeting for the lid and liquid N_2 as a coolant.
- We added natural snow to a Teflon bag within the freezer for 6-hour incubation periods to determine its ability to take up or release organic compounds.
- We took several gas samples in the presence and absence of sunlight, and with and without the introduction of a mixture of gas-phase organic compounds (mixture designed to mimic Uinta Basin ambient air).
- We sampled air within the bag using whole-air canisters and DNPH cartridges, and analyzed the samples for a suite of hydrocarbons, alcohols, and carbonyls using GCMS, GCFID, and HPLC.

Air Quality

Take picture to visit our team's webpage.

Natural snow emits acetaldehyde and formaldehyde when exposed to sunlight, with implications for **wintertime ozone formation.**

Figure 3: Photograph of modified freezer and liquid nitrogen apparatus that maintained temperature within freezer in the presence of natural sunlight.

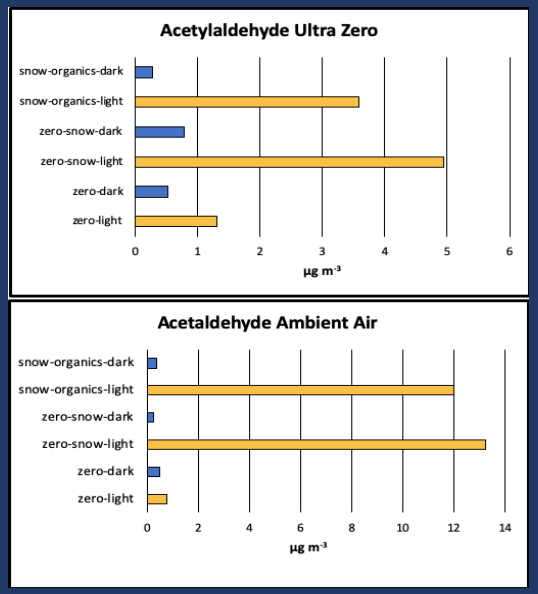

Figure 1: Comparisons between samples taken in the presence vs the absence of light reveal that light greatly increases the formation of acetaldehyde, an important precursor to wintertime ozone production.

The top panel shows final acetaldehyde concentrations when compressed ultra-zero air was used to fill the bag, and the bottom panel shows results when ambient air was used. In the descriptions at left, "snow" indicates snow was added to the Teflon bag in the freezer, "organics" indicates a mixture of gas-phase organic compounds was added, "Zero" indicates no organics were added, and "dark" and "light" show whether the bag was exposed to sunlight.

Results

- Both snow and sunlight appear to be required to drive chemical reactions that result in the formation of carbonyls.
- Addition of gas-phase organics did not increase carbonyl formation.
- Emissions of carbonyls occurred even in ultra-zero air, which can be presumed to be free of oxidants (though oxidants can be expected to have existed in the snow)

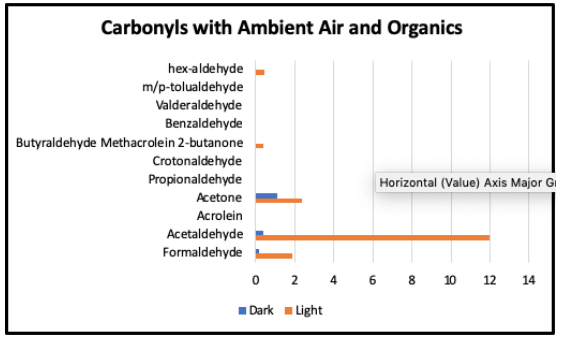

Figure 2: *In ambient air, acetaldehyde, formaldehyde, and other carbonyls are higher when snow is exposed to sunlight.*

Implications

- Carbonyls are extremely important for winter ozone production.
- These results show that carbonyls, especially acetaldehyde, are emitted from snow in the presence of sunlight, which means the snowpack is a source of ozone precursors.
- Emissions of these compounds from snow is not currently parameterized in photochemical models or inventories.
- Additional field and lab studies are needed to understand the importance of this phenomenon in natural conditions.

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