High-Wind Snow Collector

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ABSTRACT

Pure snow samples that are free from local contaminants can best be collected on mountaintops, but the extremely high winds that typically occur there make sample collection difficult. During the winters of 1989–90 and 1990–91, snow samples were collected at the summit of Mt. Washington, New Hampshire, using a specially designed high-wind snow collector that allowed snow collection in winds as high as 80 mph (129 km/h) and temperatures as low as 0°F (–18°C). The collector consists of a Lexan "bucket" and an adjustable framework that allows the bucket to be rotated directly into the wind for increased collection efficiency.

INTRODUCTION

Chemical signatures of snow, together with storm trajectories, can be used to trace sources of pollutants in the atmosphere. Chemical analysis of snow samples also gives an indication of the pH signature of the snow and forecasts the acid pulse that can be expected during spring runoff in a watershed.

Regionally representative snow samples are best collected on mountaintops, where minimal contamination from local conditions exists. However, most mountain summits, especially in the northeastern United States, are known for having extremely high winds during snowstorms, making snow collection very difficult. Traditional snow collectors are not very efficient in high winds. Snow tends to blow by above the openings of the collector, which are usually oriented horizontally, rather than falling inside (Hall et al. 1988, Bates et al. 1987 and O'Brien and Bowen 1984). A high-wind snow collector was recently developed at the Cold Regions Research and Engineering Laboratory (CRREL) with the objective of allowing efficient collection of clean snow in high winds. It was successfully tested and used on the summit of Mt. Washington (elevation 6288 ft or 1917 m), located in the White Mountains of New Hampshire.

COLLECTOR DESIGN

The snow collector (Fig. 1) consists of a Lexan collection bucket, an aluminum collar that holds the bucket, an adjustable aluminum framework, and a mounting bracket. The bucket (Fig. 2) was fabricated out of Lexan because of this material's chemical inertness and strength in cold conditions. The bucket is 7.5 in. (19 cm) in diameter and 12 in. (30.5 cm) deep. A Lexan panel covers the lower third of its opening. This partial cover was found to be effective in holding the snow in the bucket during windy conditions. Holes 0.5 in. (1.3 cm) in diameter were drilled through the sides of the bucket to hold a chemically clean bag inside by induction during windy conditions.

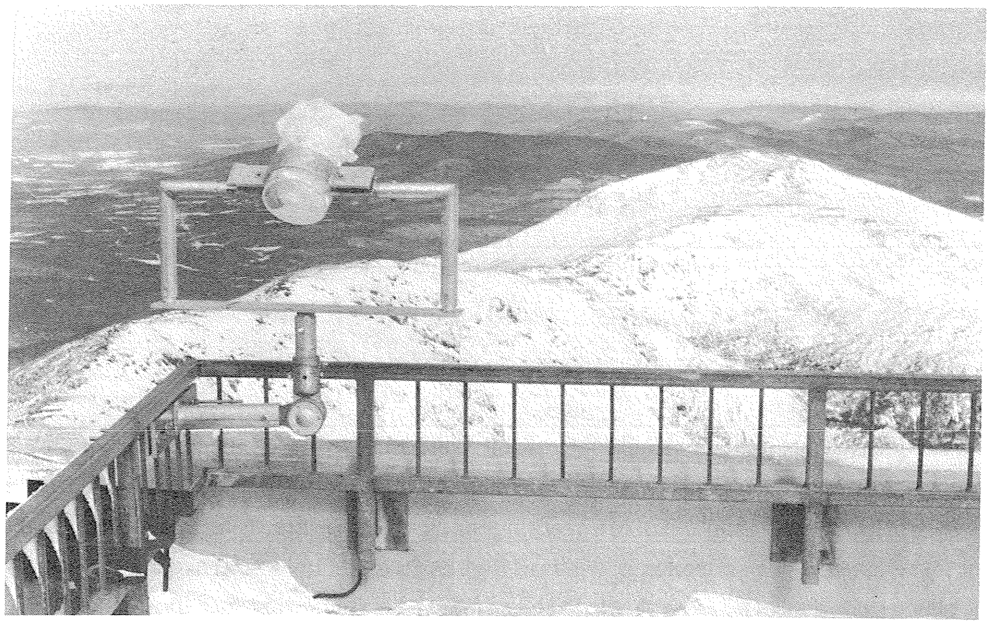

Figure 1. Snow collector mounted on the roof railing of the Mt. Washington Observatory.

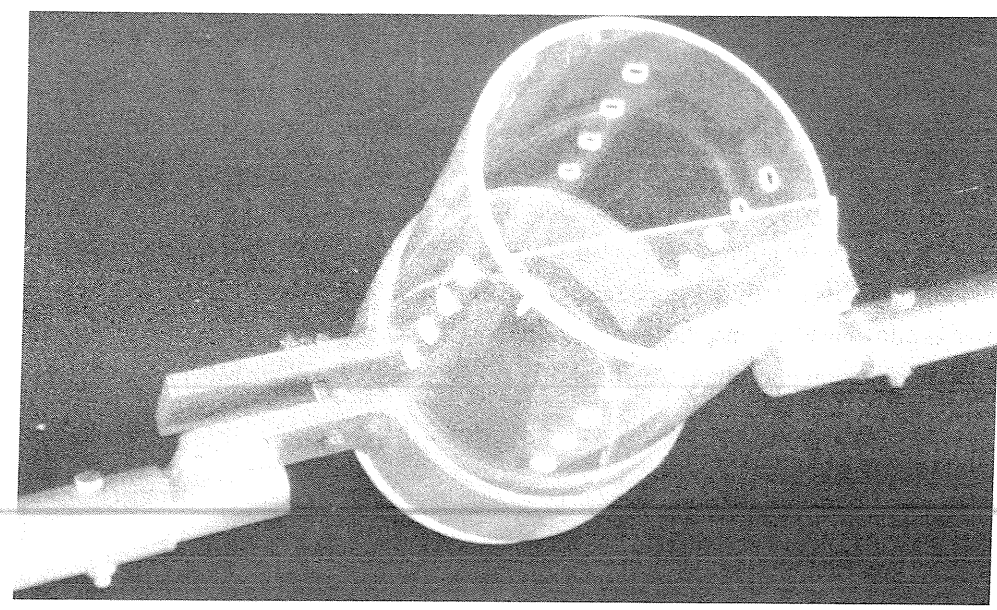

Figure 2. Lexan collection bucket and adjustable collar.

Aluminum pipe, 2 in. (5 cm) in diameter, and flat stock, 3–4 in. (7.6–10.2 cm) wide, form the collector's framework and mounting bracket. An adjustable collar holds the bucket to the framework (Fig. 3). Located between the framework and the mounting bracket (Fig. 4) is an adjustable elbow that allows complete rotation of the collector so that the bucket can be easily oriented into the wind for sampling. In winds over 40 mph (65 km/h), the bucket's collection angle of 45° to the wind is most effective for sampling. However, in lighter winds, the bucket should be facing directly into the wind for most effective collection.

Once the collector is installed, a polyethylene bag is placed inside the bucket and secured with rubber bands (Fig. 1). The bucket and bag should be installed using clean techniques; personnel should use clean gloves and stay downwind of the device.

The device can either be used as a bulk sampler in remote regions or as a wet sampler if personnel are available to install it at the beginning of a storm. In the latter case, the bag can be changed several times during the storm to monitor chemical fractionation changes that occur during ongoing precipitation.

SNOW COLLECTION TRIALS

The high-wind snow collector was successfully used to collect samples at the summit of Mt. Washington during the winter field seasons of 1989–1991. The device was mounted on the railing of the roof at the Mt. Washington Observatory. This location, approximately 45 ft (15 m) off the ground, was high enough that the possibility of contamination from previously fallen windblown snow, dirt and dust was minimal. The observatory is permanently staffed so the collector could be placed in the mounting bracket at the beginning of a snow event.

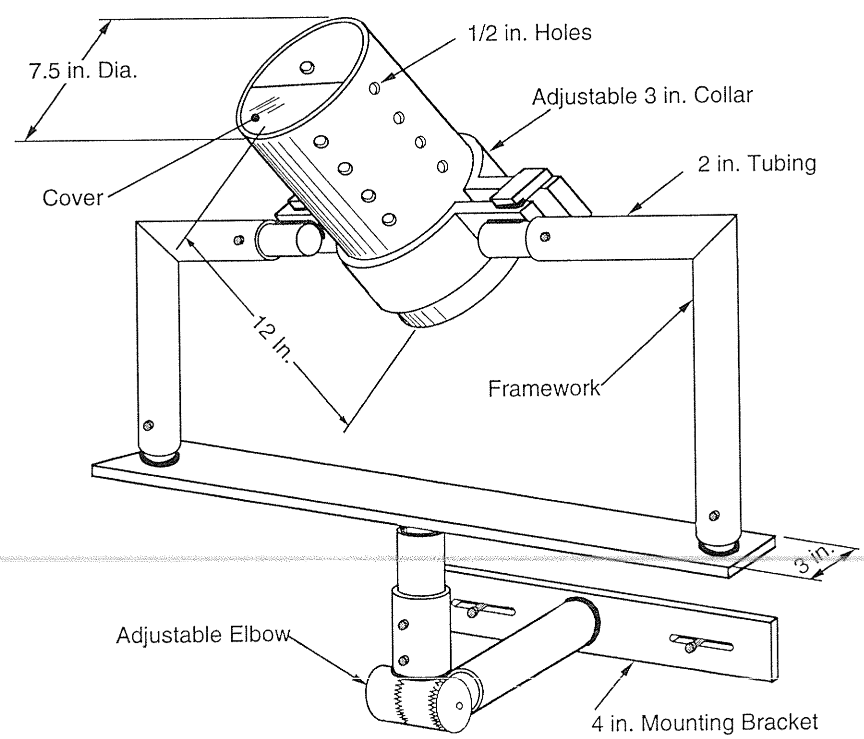

Figure 3. Complete snow collector (1 in. = 2.54 cm).

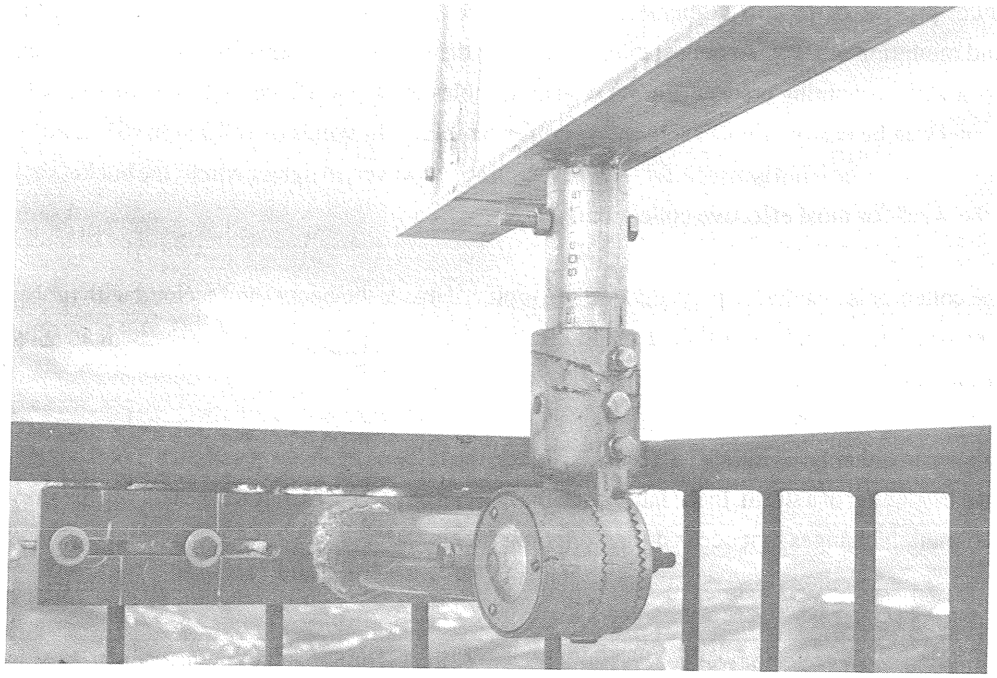

Figure 4. Adjustable elbow and mounting bracket.

Samples were collected in winds as high as 80 mph (129 km/h) and at temperatures as low as 0°F (–18°C). To test its strength, the unit was successfully exposed to winds as high as 130 mph (209 km/h) during atmospheric icing conditions.

ACKNOWLEDGMENT

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