(31-240329-B) **A New Approach for an Aerosol Humidity Conditioning System to Study f(RH) Measurements**

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Studying the dynamics of hygroscopic aerosols and their correlation with relative humidity (RH) is pivotal in advancing climate modeling, particularly in understanding direct aerosol radiative forcing. A key parameter, the scattering enhancement factor, f(RH), becomes crucial for accurate modeling and is defined as the ratio between the scattering coefficient under enhanced RH conditions and a reference (dry) scattering coefficient. To study the effects of hygroscopic growth on atmospheric aerosols, the collocated NOAA FAN, NASA AERONET, and NASA MPLNET sites at Appalachian State University named AppalAIR (Atmospheric Interdisciplinary Research site), utilizes a RH ramp every hour (40-90%).

A common approach that is used by organizations such as NOAA, is to inject water vapor into the sample stream through a water jacketed ePTFE sleeve. Heating the surrounding water proportionally transfers water molecules into the sampling stream, increasing the RH and size of hydrophilic particles. One of the chief downsides to this approach is the latency of heat in the water jacket, even after the heating element is off. This makes it difficult to have precise control over the RH ramp. The maintenance and cost associated with the present system is of quite concern. The membranes are expensive, hard to obtain, prone to leaking, and require difficult preventative maintenance.

We offer an updated solution to humidifying aerosols by injecting water vapor directly into the sample stream using an ultrasonic atomizer. These cheap and simple devices can raise the RH of a system to over 90%. Utilizing an ultrasonic atomizer, a distilled water pump, and a PID controlled electronic valve to control the level of vapor entering the sample stream, RH from ambient to 95% (+/- 2%) has been achieved in short term tests of the prototype. Other advantages include reduction of the sample tube length by up to 83% and humidity control response times within seconds rather than tens or hundreds of seconds using present technologies.

In the absence of any sample air dryer, our system turns off the humidifying element at the top of the ramp and waits for the sample to return to ambient. Heat stored in the stainless steel wrapped ePTFE sleeve cools and makes the drop extremely slow. With this new setup a PID tuned dryer will be added by Summer '24 and we expect to see 90 %RH at the inlet to drop to 40-50%, and 40 %RH to drop to the 20's at maximum drying. Due to the fast response of the humidifier and dryer, there will be no issue maintaining precise control of humidity at each stage of the sample line.

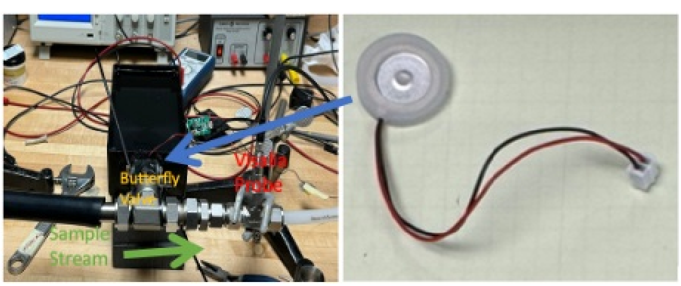

Figure 1. Prototype design of new humidifier system using an ultrasonic atomizer

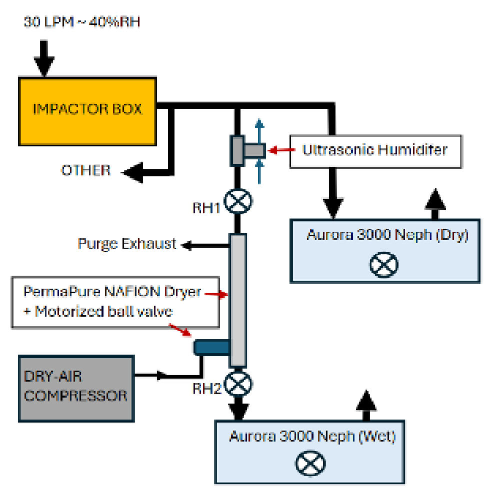

Figure 2. Simplified system schematic.