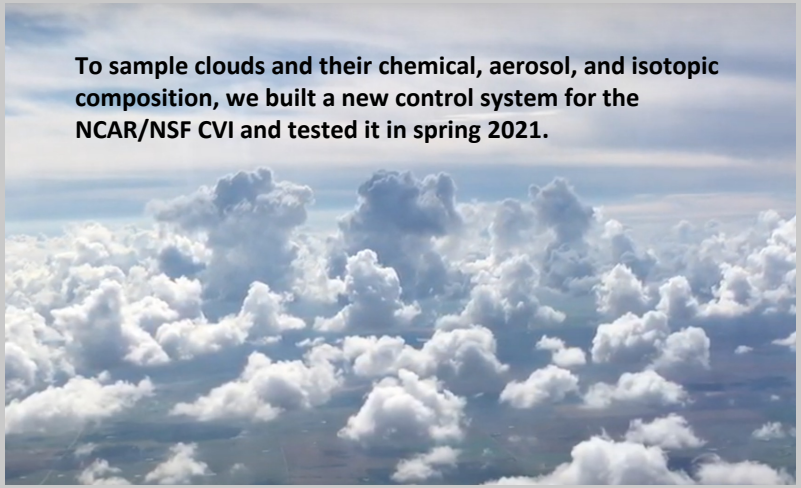
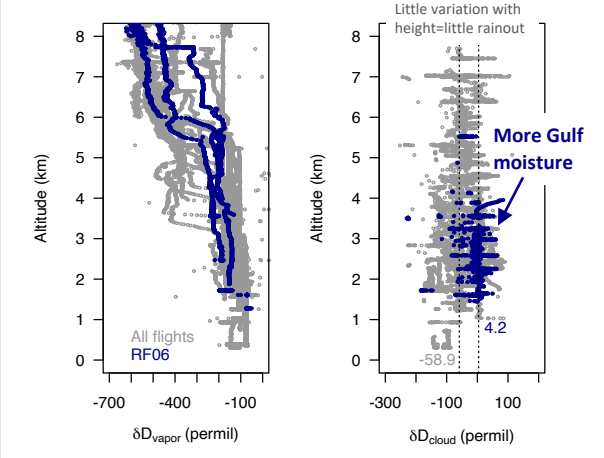
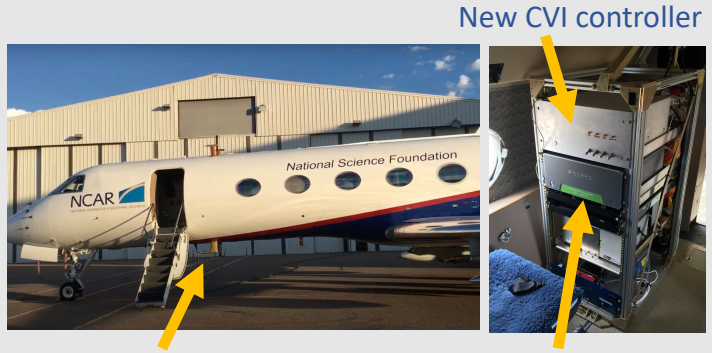
Measuring cloud isotope ratios behind a Counterflow Virtual Impactor (CVI)

Adriana Bailey[1], Darin Toohey[2], David Noone[3]
[1]National Center for Atmospheric Research, [2]University of Colorado, [3]University of Auckland

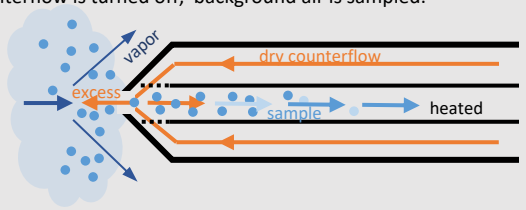


Water vapor and cloud isotopic profiles and cloud median values from ~ 50 flight hours over the US South-Central Great Plains

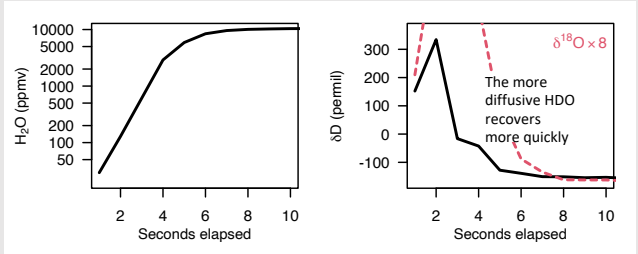




How the CVI works. The dry counterflow pushes gas molecules away, allowing only cloud particles (and precipitation) into the heated inlet. When the counterflow is turned off, background air is sampled.

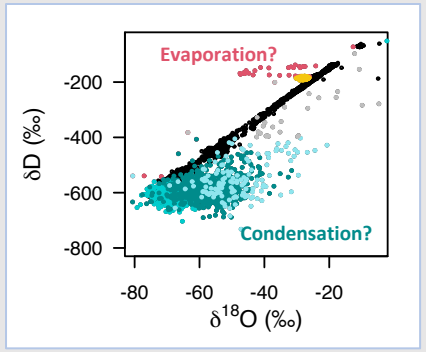


Turning counterflow off creates a perfect signal step-change in flight. Here is the composite response of the isotopic analyzer.

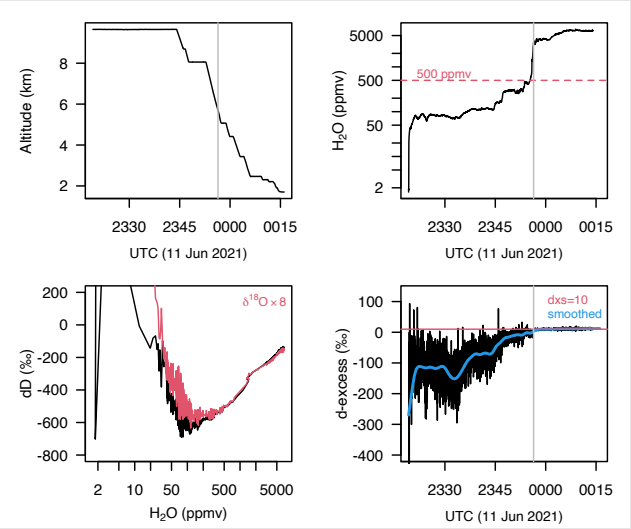


H$_a$: Are the isotopic differences the effect of time offsets in Picarro averaging?

Isotopic sleuthing. High d-excess (δD – 8×δ^{18}O > 25 permil) during RF06 shows evaporation (or desorption) off the inlet (e.g. when the heaters are turned on, yellow). The bigger problem appears to be condensation (or adsorption) at low humidity (H$_2$O < 150 ppmv) when the counterflow is turned off (blues-greens).



Condensation issues. Turning off the counterflow at altitude reveals the extent of possible condensation problems: d-excess takes minutes to reset.



Contributions. A. Bailey operated and tested the new CVI system, which was designed and built by D. Toohey. D. Noone contributed to the design and developed the software and user interface.