

(33-220415-B) Working Towards Replacing the NOAA FPH Cryogen (R23) with Dry Ice and Alcohol (DIA)

E. Hall^{1,2}, A.F. Jordan^{1,2}, D.F. Hurst^{1,2}, P. Cullis^{1,2}, K. Xiong^{1,2}, and G.A. Morris³

¹Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309; 303-497-4288, E-mail: emrys.hall@noaa.gov

²NOAA Global Monitoring Laboratory (GML), Boulder, CO 80305

³St. Edward's University, Austin, TX 78704

The Boulder NOAA Frost Point Hygrometer (FPH) record is the longest continuous upper atmospheric water vapor time series in the world. The NOAA Global Monitoring Laboratory launches balloons from four sites: Boulder, Colorado, Lauder, New Zealand, Hilo, Hawaii, and most recently La Reunion, France. The records from these international sites are important for detecting interannual variability and longer-term net changes in stratospheric water vapor.

Over the past 42 years the instrument has used two different liquid cryogens as coolant; chlorotrifluoromethane (R13) and trifluoromethane (R23). The switch from R13 to R23 happened in the mid 1990's. Currently, R23 will be phased-down over the next 25 years as part of the Kigali Amendment to the Montreal Protocol. While R23 is not an ozone depleting substance, it is a greenhouse gas with a high global warming potential (GWP).

Early in 2020 the first replacement cryogen balloon flight took place using 200 proof ethanol combined with dry ice pellets. Initial experimental profiles from Boulder have shown promising results that this new coolant will be a viable alternative to R23. The new coolant is warmer than R23 throughout the profile by 5 to 20 C with the difference in cooling power becoming larger as the balloon ascends. Work still remains along with future test flights at the other GML sites to optimize the instrument.

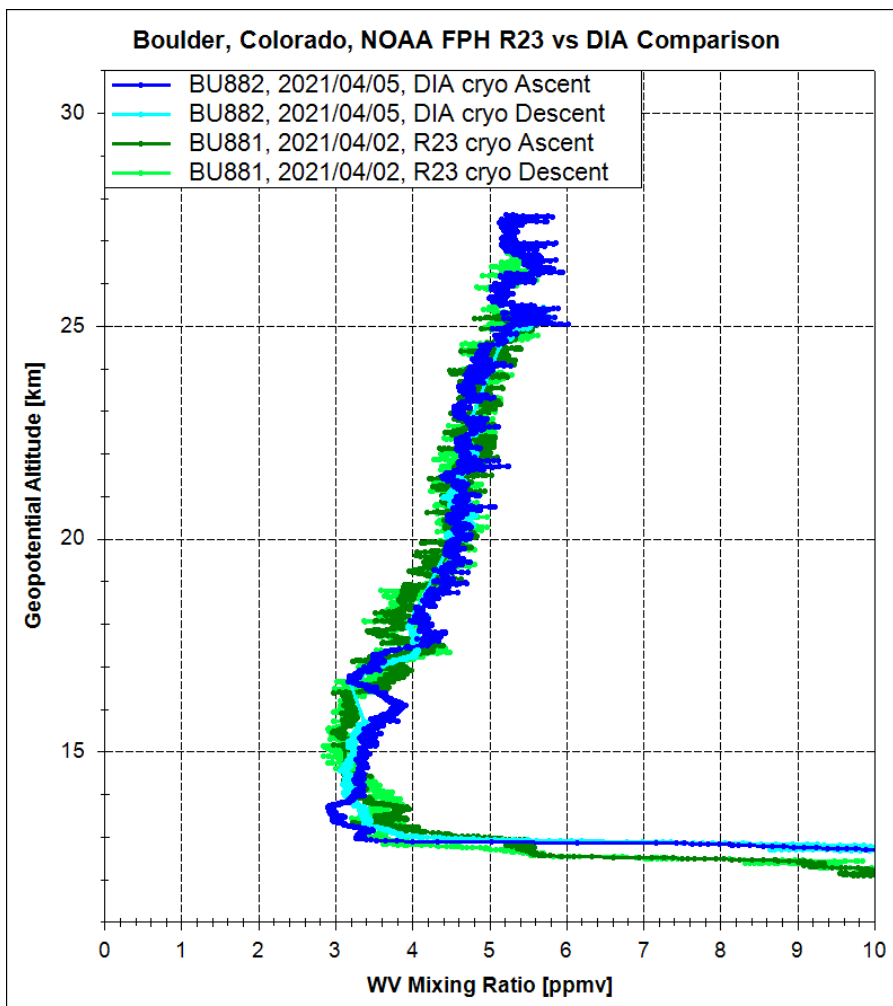


Figure 1. The second DIA FPH profile over Boulder, Colorado was performed on 05 April, 2021. The DIA FPH profile shows good agreement between the ascent (blue) and descent profile (cyan), along with the R23 FPH flight taken 3 days prior.