(82-240423-B) **Good BUDS (Boulder Utrecht Deuterium System): Hydrogen Isotope Measurements of Atmospheric Methane Through International Collaboration**

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For over fifteen years, methane abundance has increased and the carbon isotope ratio of atmospheric methane has decreased, and these changes are accelerating at record pace: from 2020 to 2022 methane abundance has increased by an average of 15.4 ppb yr^{-1}, and $d^{13}C_{CH4}$ has decreased at a rate of 0.09 ‰ yr^{-1}. The hydrogen isotope of methane, expressed as $d^{2}H_{CH4}$, provides additional information on different source and sink processes. However, measurement of $d^{2}H_{CH4}$ is more challenging than $d^{13}C_{CH4}$, and data are very limited as a result. Here we show 2022-2024 data that have been obtained by transferring NOAA Global Greenhouse Gas Reference Network (GGGRN) flask samples to FlexFoil bags and sending them to collaborators at the university of Utrecht. The transfer process involves 3 cycles of filling the bags with pure nitrogen and pumping them out before transferring the air from the flasks into the bags. This process combined with the previous handling of the flasks for other measurements (GHG concentrations, $d^{13}C_{CO2}$, $d^{13}C_{CH4}$) introduces potential for biases. Measurement comparisons of CH_4 mole fraction and $d^{13}C_{CH4}$ between Boulder and Utrecht allow us to flag samples that show significant differences. Over 90% of the samples pass these quality tests. The data show clear latitudinal gradients and seasonal cycles in $d^{2}H_{CH4}$, highlighting the power of these isotopes to constrain changes to the methane budget. Meanwhile, INSTAAR is making progress on the revival of its $d^{2}H_{CH4}$ system. Flask measurements of many more samples from the GGGRN should soon be possible.

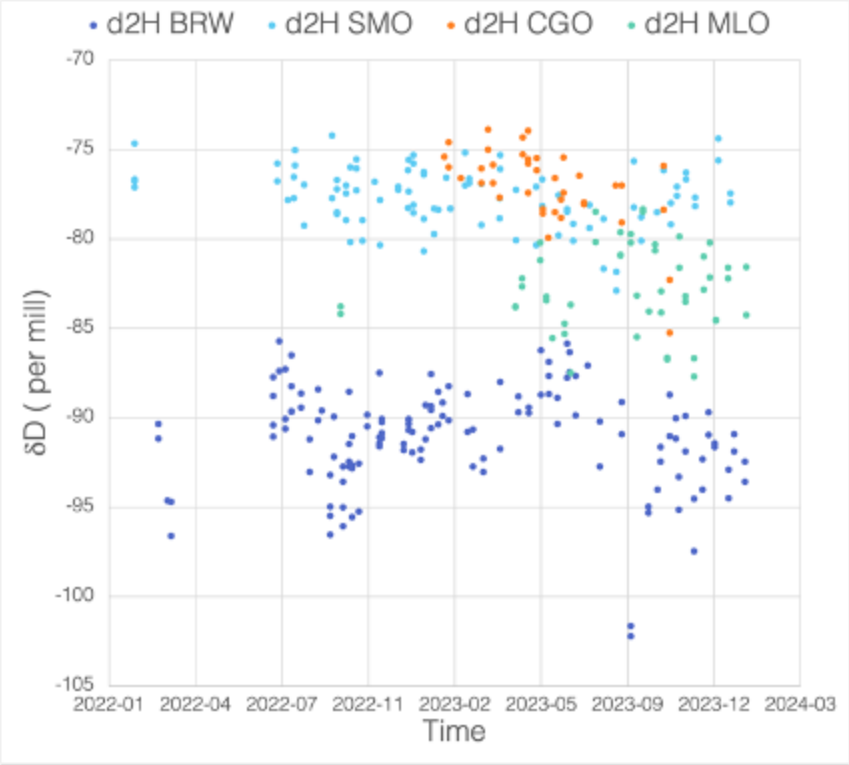

Figure 1. A time series of $d^{2}H_{CH4}$ measurements from Barrow, AK (BRW), Tutuila, American Samoa (SMO), Cape Grim, Tasmania (CGO), and Mauna Loa, Hawaii (MLO). These samples were transferred from GGGRN flasks to FlexFoil bags and measured at the University of Utrecht.