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Isotope calibrated temperature estimates – Potential, Limitations and implications for hydrology and biogeochemical cycles

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Greenland temperature variations on millennial time scales were characteristic for the last ice age. Abrupt warmings, known as Dansgaard-Oeschger (DO) events, can be traced in the $\delta^{18}O_{ice}$ record of Greenland ice cores. However, it has been shown that $\delta^{18}O_{ice}$ is not a direct temperature proxy. Measurements of the isotopic composition of gases trapped in the ice, namely, $\delta^{15}N$ and $\delta^{40}Ar$ can be used to calibrate the paleothermometer. This new and powerful tool will be discussed in detail based on different published examples. Particularly, the influence of the measurement uncertainty onto the temperature estimate will be discussed. Conclusions based on obtained temperature estimates during rapid climate change events involving hydrology and biogeochemical cycles are drawn.