**Methane isotopes – clues to the budget changes: and the need for independent isotopic measurement programs.**

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Methane is rising, but the causes behind the rise are not clear. One possibility is that methane sources have increased; the other hypothesis is that sinks have decreased. The actual explanation may be between these two end-members. Isotopic measurements provide further constraints: $\delta^{13}C_{CH4}$ is becoming more negative from pole to pole, and the start of this trend coincided with the start of the rise in methane mole fraction. The trend towards lighter $\delta^{13}C_{CH4}$ has been observed by several independent groups.

Had the data all come from one source (i.e. NOAA), it could be argued that the isotopic trend was simply a calibration drift, affecting both standard and trap or target tanks. But on both Ascension and Alert, parallel isotopic time series are being measured by both NOAA and Royal Holloway. The two sets of data are independent, but closely comparable. This gives confidence that the measurements are indeed accurate, and do not hide unrecognised system drift.

Plotted together, the two high-precision (1 s.d ~ 0.05‰) isotopic records are useful in a different way: changes in methane sources can quickly shift regional $\delta^{13}C_{CH4}$ values (e.g. in the remote Arctic or S. Atlantic marine air). In contrast, changes in methane sinks only have a slow impact on $\delta^{13}C_{CH4}$ of remote air masses. The 'bumpiness' and rapid steps in the Alert and Ascension $\delta^{13}C_{CH4}$ data sets thus indicate that increased sources are driving the growth in methane, rather than declining sinks.

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