

Using a Monte Carlo approach to recreate the yearly oscillation in $\delta^{18}O$ of an ice core

H. C. Steen-Larsen* [†], and S. J. Johnsen*

* Ice and Climate Research, University of Copenhagen, Copenhagen, Denmark.

[†] Department of Earth and Space Sciences, University of Washington, Seattle, Washington, USA.

CONTACT: H.C. Steen-Larsen, (hanschr@gfy.ku.dk)

In precise dating of an ice core it is essential to be able to count the years back in time. One way this has been done is by looking at the summer/winter oscillation in the $\delta^{18}O$. However, since the $\delta^{18}O$ values have diffused recognizing an oscillation might be difficult. Instead of looking at the measured $\delta^{18}O$ profile in order to estimate how many yearly oscillations a given ice core includes, we try to recreate the $\delta^{18}O$ profile as it was before diffusive processes altered the values. This recreation, also known as back-diffusion, can be performed in two steps. First, we need to estimate the diffusion length. Second, we take the fourier-transform of the $\delta^{18}O$ profile. Since diffusion is equal to the convolution of the original profile with a Gaussian-curve, back-diffusion is in the fourier-space especially simple. To transform the back-diffused $\delta^{18}O$ from the fourier-space we will have to estimate a cut-off value in the frequency domain so the white noise is not transformed back into the results.

The Monte Carlo method presented here will bypass any subjective estimation. By using a Monte Carlo simulation it is possible to sample solutions from the posteriori probability density. The sampling is done using a Metropolis algorithm. In this way one is able to recreate the original signal in an almost completely objective way. Hence the results from the Monte Carlo simulation are more trustworthy and return more information than the spectral method.

This method has numerous other applications. For example, extracting information from Continuous Flow Analysis data, or other data where the original profile has been smoothed by any of various known processes.