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Correcting for the effect of smoothing

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Many data series have been subject to smoothing prior to measurement, either due to diffusion or due to mixing in measurement equipment. Some of the details lost in the smoothing may be restored using deconvolution techniques. However, detailed and accurate information on the nature and strength of the smoothing must be known, and the presence of measurement noise complicates the restoration process and may lead to restoration-induced artefacts in the restored data. We here present a Monte Carlo based method for resolution enhancement, that only requires detailed information on the nature, and not on the strength, of the smoothing process.

The method is applied to Continuous Flow Analysis (CFA) measurements of the impurities in the NGRIP ice core. CFA has become a popular measuring technique for obtaining high-resolution chemical ice core records due to an attractive combination of measuring speed and resolution. However, resolution enhancement by post-measurement smoothing correction can improve the quality of the data for analysis. A recent study [Rasmussen et al., 2005, *Journ. Geophys. Res.*, 110, D17304] demonstrates that the resolution of ice core CFA data can be significantly improved using deconvolution techniques, but the information needed to apply the method is not always readily available, and the crucial assessment of the noise level can be difficult.

In this work, the basis of both the spectral and the Monte Carlo methods are presented, and the results are compared. Special emphasis is put on required input needed by the methods and the issues that make each of the methods suitable for certain tasks. Although the method is only applied to CFA ice core data here, the method can in principle be used to correct for any type of smoothing, as long as the effect of the smoothing process can be parameterized.