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The Evolution of Strontium, Lithium, and Osmium Isotopes Over the Cenozoic

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$^{87/86}Sr$, $\delta^{7}Li$, and $^{187}Os/^{188}Os$ are influenced by similar biogeochemical processes – such as weathering, hydrothermal fluxes, and organic carbon weathering and burial. Often, we want to use a combination of these signals to deconvolve particular palaeoclimate drivers. Each has been reconstructed over the Cenozoic, but interestingly they all have very different data density, uncertainty levels, and potential rates of change. Comparing or combining them on such long timescales requires that we turn the individual data constraints into continuous reconstructions, propagating uncertainty in each. We discuss the statistical challenges in producing long term records of Cenozoic isotope ratios – and demonstrate an approach based on Gaussian Processes which has useful properties for geochemical time series. After applying this technique to the Cenozoic strontium, lithium, and osmium isotope signals, we have an improved ability to compare and contrast them, and to deconvolve the climatological processes responsible for the changes.