Corals are ~~not~~ thermometers – How to extract a geochemical time series from a complex skeleton

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For the past ~30 years, the geochemical variations in coral skeletons have provided many multi-century long reconstructions of temperature, salinity, and other environmental variables. As this field matures, there are discussions that some coral proxies are not as reliable, reproducible, and/or difficult to interpret. Geochemical methods have improved with advances in technology but the methods used to extract samples from the coral skeleton vary from hand-held rotatry tools to advanced computer-aided micro-milling systems. Furthermore, the methods used for time assignment to coral samples has not improved. Our work reveals that sampling and time assignment can have a large impact on coral proxy calibration and reconstruction. Slabs removed from a coral core must transect the extending corallite walls so the user can extract samples along a continuous growth-time skeletal feature. Computer-aided micro-mills are preferred for sampling to control the sample location and penetration depth into the coral skeleton, which is needed to avoid non-target skeletal elements. This method allows for sampling increments smaller than the diameter of the bit since the movement is lateral whereas the up-down drilling sets increment size to drill bit diameter. For complex coral skeletons, laser ablation (LA) can be used to extract weekly samples from coral skeletons but require the coral to be cut into 1–2 cm pieces; however, advances in LA large chamber technology will help resolve this issue. Time assignment is difficult, particularly for weekly LA records, where users assigned years by-hand with guidance from x-radiographs to establish each year and/or use Analyseries software to assign years and months. We find the number of "tie points" used per year changes calibration slopes. Our recent study with gridded and interpolated SST (HadISST and ERSST) reveals non-systematic biases at the single grid level that can significantly change calibration slopes. We recommend using *in situ* SST or satellite-derived SST (AVHRR SST) for a single location. We find that the Atlantic coral, *Siderastrea siderea*, has the ~same Sr/Ca-SST calibration equation for 47 coral colonies at different sites in the Gulf of Mexico and Tropical Atlantic when using these improved sampling and calibrating methods.