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Global calibration of the alkenone unsaturation index using suspended particles from surface waters and comparison with coretop data

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We have compiled the current global database of surface seawater C_{37} alkenone unsaturation ($U_{37}^{K'}$) measurements (n= 606, -1 to 30^{o}C temperature range) to derive a global, field-based calibration of $U_{37}^{K'}$ with alkenone production temperature. A single, universal "global" surface water calibration of $U_{37}^{K'}$ adequately predicts alkenone production temperatures over the diversity of modern-day oceanic environments and alkenone synthesizing populations. The alkenone surface water production temperature calibration for the global data set is nonlinear yet tightly constrained, with a mean standard estimation error of 1.1^{o}C. Regional bias in estimated temperature is small or insignificant except where the alkenone signal appears to have been affected by lateral advection (e.g. the Brazil-Malvinas Confluence, Nordic Seas). In contrast with the surface water data, the updated empirical global calibration of coretop $U_{37}^{K'}$ (Müller et al., 1998) with overlying annual mean sea surface temperature (Ann0) is statistically linear. The standard estimation error (1.2^{o}C) is similar, but there is a higher degree of regional bias in the Ann0 estimates. We applied the global alkenone produc-

tion temperature calibration to the coretop sediment $U_{37}^{K'}$ data (n=686) to estimate the alkenone "integrated production temperature" (IPT), and its relationship to Levitus *et al.* (2001) estimates of Ann0. The coretop alkenone IPT recorded by $U_{37}^{K'}$ is systematically warmer than Ann0 by 2-3 ^{o}C in temperate and subpolar regions and converges to Ann0 in subtropical and tropic waters. Simple model calculations indicate that this offset between coretop alkenone IPT and Ann0 results from the combined influences of seasonality and depth of alkenone production. Our analyses also provide additional evidence that the linkage between the coretop alkenone temperature signal and the overlying surface waters is not straightforward, and can be significantly compromised by lateral advection in areas of strong currents and large temperature and productivity gradients.