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Reconstructing past changes in cloud cover from foraminifera population geochemistry – A testable hypothesis

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One of the most important paleoclimate model parameters remaining to be quantified by sedimentary proxies is cloud cover in Earth's past. Because elevated regional cloudiness decreases surface irradiance levels, geochemical proxies sensitive to water column light levels should be sensitive to cloud cover change. Laboratory experiments have demonstrated that the carbon isotope ($d^{13}C$) composition of the symbiont-bearing species, *Orbulina universa,* varies with irradiance such that ambient light levels above symbiont photosynthetic maximum (P_{max}) yields shells that are considerably enriched in ^{13}C relative to individuals growing at reduced, sub P_{max} levels. In open ocean tropical regions, P_{max} light levels are found shallower then ~30m. The *O. universa* $d^{13}C$ range observed in laboratory experiments, ~2-2.5‰, agrees well with the $d^{13}C$ range recorded among *O. universa* individuals in fossil populations. Because *O. universa* inhabits the full photic zone in the ocean, the distribution of $d^{13}C$ values among individuals should reflect the habitat depth distribution of a population. Furthermore, the % of individuals living at shallow depths with irradiance $>P_{max}$ levels will yield the highest grouping of $d^{13}C$ values. As cloudiness increases, the P_{max} irradiance depth range will shoal such that fewer individuals will record high $d^{13}C$ values. This change in $d^{13}C$ distribution is quantifiable and can be modeled. I will discuss how to test this hypothesis and present population geochemical data from fossil assemblages that suggests glacial equatorial Indian Ocean cloud cover during some MIS 6 intervals were higher than later interglacial and glacial periods.