Multivariate evaluation rubric for assessing the reliability of Cretaceous nannofossil index taxa and bioevents

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Calcareous nannofossils (nannoplankton) are essential in biostratigraphy because of their widespread distribution, dynamic evolution, distinct morphological characteristics, and sensitivity to environmental and climatic changes. As a key tool in biostratigraphy, they offer crucial information about geologic strata by documenting the age of deposition and providing insights on past environments and ecosystems. While the reliability of an index nannofossil taxon or bioevent is a critical factor for accurate biostratigraphic interpretations, current approaches to assess reliability are primarily qualitative, highlighting the need for a more standardized framework.

Here we discuss a multivariate quantitative evaluation rubric to address the complexities associated with assessing the reliability of calcareous nannofossil bioevents. Using existing data and information sourced from published literature and our own records from the Cretaceous chalk of southern England, this rubric combines a range of criteria including (1) taxonomic clarity and consistency, (2) morphological specificity and distinction, (3) geographical and temporal distribution, (4) rarity and frequency, (5) preservation quality, (6) reliability and usefulness based on published literature, and (7) references and source validity. The development of these guidelines is based upon a thorough synthesis of biostratigraphic work done by the calcareous nannofossil community over the years, aiming to provide a standardized framework designed to strengthen consistency and accuracy in nannofossil-based biostratigraphic interpretations. Furthermore, the use of this rubric extends beyond qualitative assessments by integrating multivariate analyses using a quantitative ranking of various criteria that may be applicable to specific time scales or regions. These reliability test guidelines thus allow for the determination of robust nannofossil index species and bioevents, mitigating potential interpretative ambiguities and discrepancies inherent within a stratigraphic record. This underscores its significance for advancing biostratigraphic work within the calcareous nannofossil research community and beyond, ultimately benefiting both academic research and industrial applications.