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Cell volumes of marine phytoplankton from globally distributed coastal data sets

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ABSTRACT

Globally there are numerous long-term time series measuring phytoplanton abundance. With appropriate conversion factors, numerical species abundance can be expressed as biovolume and then converted to phytoplankton carbon. To-date there has been no attempt to analyze globally distributed phytoplankton data sets to determine the most appropriate species-specific mean cell volume. We have determined phytoplankton cell volumes for 214 of the most common species found in globally distributed coastal time series. The cell volume, carbon/cell and cell density of large diatoms is 200,000, 20,000 and 0.1 times respectively, compared to small diatoms. The cell volume, carbon/cell and cell density of large dinoflagellates is 1500, 1000 and 0.7 times respectively, compared to small dinoflagellates. The range in diatom biovolumes is 100 times greater than across dinoflagellates (i.e. >200,000 vs. 1500 times) and within any diatom species, the range in biovolume is up to 10-fold. Variation in diatom cell volumes are the single largest source of uncertainty in community phytoplankton carbon estimates and greatly exceeds the uncertainty associated with the different volume to carbon estimates. Small diatoms have 10 times more carbon density than large diatoms and small dinoflagellates have 1.5 times more carbon density than large cells. However, carbon density varies relatively little compared to biovolume. We recommend that monthly biovolumes should be determined on field samples, at least for the most important species in each study area, since these measurements will incorporate the effects of variations in light, temperature, nutrients and life cycles. Since biovolumes of diatoms are particularly variable, the use of size classes will help to capture the percentage of large and small cells for each species at certain times of the year. This summary of global datasets of phytoplankton biovolumes is useful in order to evaluate where locally determined biovolumes lie within the global spectrum of spatial and temporal variations and may be used as a species cell volume reference where no locally determined volume estimates are available. There is a need to adopt standard protocols for measuring biovolumes and documenting the accompanying metadata which would improve inter-comparability among time series data sets.

1. Introduction

There is considerable concern about the long-term changes that are occurring in coastal ecosystems, leading to the development of

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